Commitment to Equity Handbook
(click on title to access dropbox folder with contents)

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Online Edition October 2016

Working Version Under Peer Review

Note to the reader:


The Handbook has four Parts. The first three are below. Part IV is accessible online only and can be downloaded by clicking on the title above.

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The print version of this Handbook will be published by Brookings Institution Press and CEQ Institute, Tulane University in 2017.

The CEQ Institute works to reduce inequality and poverty through comprehensive and rigorous tax and benefit incidence analysis, and active engagement with the policy community.
Acknowledgments

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Brookings Institution and CEQ Institute (2017)
Lustig, Nora, editor

ACKNOWLEDGMENTS
(New edition. To be completed)

This Handbook has been possible thanks to the generous support of the Bill & Melinda Gates Foundation.

We are also very grateful to Tulane University’s Center for Inter-American Policy and Research, the Department of Economics, the Roger Thayer Stone Center for Latin American Studies, the School of Liberal Arts, the Vice-presidency of Research, and all the university’s staff who have helped along the way.

ACKNOWLEDGEMENTS TO 2013 EDITION OF CEQ HANDBOOK

Launched in 2008, the Commitment to Equity (CEQ) framework was designed to analyze the impact of taxation and social spending on inequality and poverty in individual countries and to provide a roadmap for governments, multilateral institutions, and nongovernmental organizations in their efforts to build more equitable societies. Led by Nora Lustig, the CEQ is a project of the Center for Inter-American Policy and the Department of Economics, Tulane University and the Inter-American Dialogue, with Peter Hakim as co-director. In 2013, the CEQ partnered with the World Bank to launch the project CEQ and World Bank: The Distributional Impact of Fiscal Policy in Armenia, Ethiopia, Indonesia, Jordan, South Africa and Sri Lanka.

This handbook was written with invaluable inputs and suggestions from a large number of people. Jim Alm, Carola Pessino, and John Scott provided essential contributions and guidance from the project’s inception. We are also greatly indebted to the members of the CEQ-Latin America Advisory Board. In particular, we wish to thank Jere Behrman, Nancy Birdsall, Otaviano Canuto, Mauricio Cárdenas, Fernando Carrera Castro, Luis Castilla, Louise Cord, Rolando Cordera, Augusto de la Torre,
Ludovico Feoli, Francisco Ferreira, Ariel Fiszbein, Juan Alberto Fuentes Knight, Juan Carlos Gómez Sabaíní, Carol Graham, Rebeca Grynspan, Martin Hopenhayn, Santiago Levy, Luis F. Lopez-Calva, Mario Marcel, Jonathan Menkos, Carmelo Mesa-Lago, Judith Morrison, Hugo Noé Pino, José Antonio Ocampo, Daniel Ortega, Tamara Ortega Goodspeed, Guillermo Perry, Jeffrey Puryear, David Roodman, Ana María Sanjuan, Michael Shifter, Vito Tanzi, and Andras Uthoff.

Important recent revisions have been largely guided by the feedback received from the World Bank team and the Advisory Committee of the CEQ and World Bank project *The Distributional Impact of Fiscal Policy*. In particular, we are very grateful to Jaime Saavedra as well as to Gabriela Inchauste and her collaborator Catherine Lee, and peer reviewers Shubham Chaudhuri, Andrew Dabalen, Luis F. Lopez-Calva and Luis Serven from the World Bank; and, advisors Francois Bourguignon, Gary Burtless, David Coady, Robert Gillingham, Jorge Martinez-Vasquez, Cormac O’Dea, David Phillips, Ian Preston, Sally Wallace, and Stephen Younger. We are also highly indebted to Jean-Yves Duclos.

The Handbook has also benefited enormously from the country teams’ important contributions to the methodological discussions and revisions. For that, we are grateful to Shamma Alam, Rythia Afkar, Florencia Amáible, Nisha Arunatilake, Marisa Bucheli, Margarita Beneke de Sanfeliu, Maynor Cabrera, Eliana Carranza, Andres Castañeda, Dante Contreras, Camilo Gomez Osorio, George Gray Molina, Carlos Hurtado, Verónica Paz Arauco, Miguel Jaramillo, Jon Jellema, Wilson Jiménez, Cristina Llerena, Mashekwa Maboshe, Yusuf Mansur, Marcela Melendez, Hilcias Estuardo Morán, José Andrés Oliva, Claudiney Pereira, Julio Ramirez, Máximo Rossi, Jaime Ruiz-Tagle, Pablo Sauma, Nistha Sinha, Barbara Sparrow, William Swanson, Juan Diego Trejos, Eysu Tsehaye, Paolo Verme, Matthew Grant Wai-Poi, Tassew Woldehanna, Ingrid Woolard, Ernesto Yáñez, and Precious Zikhali.

We are indebted to Shaohua Chen for answering our incessant questions about the methodologies used by the World Bank's PovcalNet, to Guillermo Cruces, Leonardo Gasparini, Leonardo Lucchetti, and Leonardo Tornaroli for answering similar questions about CEDLAS and the World Bank's Socio-Economic Database for Latin America and the Caribbean (SEDLAC), to David Phillips for answering these questions about the Institute for Fiscal Studies' research, to Abdelkrim Araar and Jean-Yves Duclos for answering our questions about their Distributional Analysis Stata Package (DASP) and providing us with additional ado files, to Rafael Osorio, Sergei Soares, and Pedro Souza at the Instituto de Pesquisa Econômica Aplicada for providing us with the Stata code to implement their methodology to correct for underestimation of the number of cash transfer beneficiaries, and to the Fiscal Affairs department at the International Monetary Fund for providing us with the Stata code to estimate the indirect effects of price increases using input-output tables.

Specific sections of this handbook relied substantially on inputs and feedback from others. We are very grateful to Gary Burtless, David Phillips, and Paolo Verme for authoring boxes. The section on Inequality of Opportunity is based on a write-up sent to the authors by Norbert Fiess. The section on Fiscal Mobility Matrices is based on a paper written by the authors (Higgins and Lustig, 2013) which benefitted greatly from conversations with and comments from François Bourguignon, Satya Chakravarty, Nachiketa Chattopadhyay, Jean-Yves Duclos, Francisco Ferreira, Gary Fields, James Foster, Peter Lambert, Darryl McLeod, John Roemer, Jon Rothbaum, Shlomo Yitzhaki, and participants of the Symposium on Ultra-Poverty hosted by the Institute for International Economic Policy at George Washington University, Washington, D.C., March 2012; “Well-being and inequality in the long run: measurement, history and ideas” hosted by Universidad Carlos III de Madrid and the World Bank, Madrid, May-June 2012; the annual meeting of the Latin American and Caribbean Economic Association (LACEA), Lima, November 2012; the XX Meetings of the Research Network on Inequality and Poverty (NIP), Washington, D.C., May 2013; and the annual meetings of the Society for the Study of Economic Inequality (ECINEQ), Bari, Italy, July 2013.

Last but not least, the preparation of this handbook would not have been possible without the research assistance provided by Mariellen Jewers and Emily Travis.

Since its inception, the CEQ has received financial support from Tulane University's Center for Inter-American Policy and Research, the School of Liberal Arts and the Stone Center for Latin American Studies as well as the Canadian International Development Agency (CIDA), the Development Bank of Latin America (CAF), the General Electric Foundation, the Inter-American Development Bank (IADB), the International Fund for Agricultural Development (IFAD), the Norwegian Ministry of Foreign Affairs, the United Nations Development Programme's Regional Bureau for Latin America and the Caribbean (UNDP/RBLAC), and the World Bank.

Of course, the authors remain fully responsible for any remaining errors or omissions.
Abstracts

This handbook is a unique manual detailing the theory and practical methods developed by the Commitment to Equity (CEQ) Institute for determining the impact of fiscal policy on inequality and poverty. Policymakers, social planners, and economists are presented with a step-by-step guide to applying fiscal incidence analysis as well as country studies --CEQ Assessments--to illustrate. The handbook has four parts. Part I, Methodology, describes what a CEQ Assessment is and presents the theoretical underpinnings of fiscal incidence analysis and the indicators used to assess the distributive impact and effectiveness of fiscal policy. Part II, Implementation, presents how taxes, subsidies, and social spending should be allocated to households. It includes a step-by-step guide to completing the CEQ Master Workbook of Results, a multi-sheet excel file that houses both detailed information on the country’s fiscal system and the results used as inputs for policy discussions, academic papers, and policy reports. Part III, Applications, presents applications of the CEQ framework to low and middle income countries, including simulations of policy reforms. Part IV, Tools, contains the CEQ Master Workbook of Results and the CEQ Stata Package with user-written software to complete it. It also contains guidelines for the implementation of CEQ Assessments, including a thorough protocol of quality control.

Part I – The Commitment to Equity (CEQ) Assessment, Methodology

Nora Lustig and Sean Higgins

This chapter presents key analytical insights in fiscal redistribution theory. The chapter also discusses the basics of fiscal incidence analysis used in CEQ Assessments. The chapter describes the set of indicators used to answer the following four key questions: How much income redistribution and poverty reduction is being accomplished through fiscal policy? How equalizing and pro-poor are specific taxes and government spending? How effective are taxes and government spending in reducing inequality and poverty? What is the impact of fiscal reforms that change the size and/or progressivity of a particular tax or benefit? Finally, the chapter illustrates how these questions may be answered with examples from existing CEQ Assessments.

JEL Codes: H22, D31, D63, I32, I38
Keywords: handbook, taxes and transfers, fiscal incidence, poverty, inequality
Ali Enami, Nora Lustig, and Rodrigo Aranda

This chapter provides a theoretical foundation for analyzing the redistributive effect of taxes and transfers for the case in which the ranking of individuals by pre-fiscal income remains unchanged. Typically, the redistributive effect is measured by the so-called concentration curve or the Kakwani coefficient. We show that in a world with more than a single fiscal instrument, however, the simple rule that progressive taxes or transfers are always equalizing does not necessarily hold, and offer alternative rules that survive a theoretical scrutiny. In particular, we show that the sign of the marginal contribution unambiguously predicts whether a tax or a transfer is equalizing or not.

JEL Codes: H22, D31, A23
Keywords: marginal contribution, progressivity, inequality, multiple taxes and transfers

Ali Enami

This chapter provides a theoretical foundation for analyzing the redistributive effect of taxes and transfers for the case in which the ranking of individuals by pre-fiscal income changes as a result of fiscal redistribution. Through various examples, this chapter shows how reranking—a common feature in all actual fiscal systems—reduces the predictive power of simple measures of progressivity in assessing the actual effect of taxes and transfers on inequality.

JEL Codes: H22, D31, A23.
Keywords: marginal contribution, vertical equity, reranking

Chapter 4. Can a Poverty-reducing and Progressive Tax and Transfer System Hurt the Poor?
Sean Higgins and Nora Lustig

To analyze anti-poverty policies in tandem with the taxes used to pay for them, comparisons of poverty before and after taxes and transfers are often used. We show that these comparisons, as well as measures of horizontal equity and progressivity, can fail to capture an important aspect: that a substantial proportion of the poor are made poorer (or non-poor made poor) by the tax and transfer system. We illustrate with data from seventeen developing countries: in fifteen, the fiscal system is poverty-reducing and progressive, but in ten of these at least one-quarter of the poor pay more in taxes than they receive in transfers. We call this fiscal impoverishment, and axiomatically derive a measure of its extent. An analogous measure of fiscal gains of the poor is also derived, and we show that changes in the poverty gap can be decomposed into our axiomatic measures of fiscal impoverishment and gains.

JEL Codes:
Keywords: poverty, horizontal equity, progressivity, fiscal impoverishment
Part II - The Commitment to Equity (CEQ) Assessment, Implementation

Sean Higgins and Nora Lustig

This chapter presents a step-by-step guide to applying the incidence analysis used to prepare CEQ Assessments. We define income concepts before and after taxes, transfers, and subsidies, discuss the methodological assumptions used to construct them, explain how taxes, transfers, and subsidies should be allocated at the household level, and suggest what to do when information on who paid or received certain taxes and/or transfers, or how much they paid or received, is not included in the household survey. This chapter is the basis for completing sections B and C of the CEQ Master Workbook.

JEL Codes: H22, D31, D63, I32, I38
Keywords: handbook, taxes and transfers, fiscal incidence, poverty, inequality

Chapter 6. Constructing Consumable Income: Including the Direct and Indirect Effects of Indirect Taxes and Subsidies.
Jon Jellema and Gabriela Inchauste

This chapter presents a step-by-step guide to applying the incidence analysis of indirect taxes and subsidies used in CEQ Assessments. We define the “consumable income” concept as disposable income plus the benefits received when subsidized items are purchased minus the taxes paid when taxed items are purchased. We discuss how the direct effects of indirect taxes and subsidies on either welfare or purchasing power can be estimated. We review a “price-shifting” model for estimating the magnitude of the indirect effects of indirect taxes and subsidies and demonstrate how to use an input/output matrix together with a household expenditure survey to allocate the indirect burden across households. The methods in this chapter form the basis for constructing the CEQ Assessment’s consumable income concept.

JEL Codes: H22, H24, H26, D31, D63, I32, I38
Keywords: handbook, indirect taxes, subsidies, fiscal incidence, poverty, inequality

Chapter 7. Producing Indicators and Results, and Completing Sections D and E of CEQ Master Workbook using the CEQ Stata Package.
Sean Higgins

This chapter describes the indicators and results used in a CEQ Assessment, describes sections D and E of the CEQ Master Workbook, and describes how the indicators and results can be produced and exported to the CEQ Master Workbook using the CEQ Stata Package.

JEL Codes: H22, D31, D63, I32, I38
Keywords: handbook, taxes and transfers, fiscal incidence, poverty, inequality
Rodrigo Aranda and Adam Ratzlaff

An important element of inequality in nearly every country comes from characteristics that are outside an individual's control. These include their gender, place of birth, and, particularly important in many countries, their race or ethnicity. This chapter expands on the CEQ analysis by examining how to measure fiscal incidence across ethno-racial lines in an effort to determine if governments effectively reduce ethno-racial inequalities. The chapter examines how to measure ethno-racial inequality and what indicators are useful determining the impact of fiscal interventions across groups. Additionally, this chapter provides information on Section F of the CEQ Master Workbook and instructions on how to use the ceqrace.ado Stata command to complete the CEQ analysis across ethno-racial lines.

JEL Codes: H22, D31, D63, I32, I38  
Keywords: handbook, taxes and transfers, fiscal incidence, poverty, inequality, ethnic and racial inequality

Part III - The Commitment to Equity Assessment. Applications

Nora Lustig

Using comparable fiscal incidence analysis, this paper examines the impact of fiscal policy on inequality and poverty in twenty-nine countries for around 2010. Success in fiscal redistribution is driven primarily by redistributive efforts (share of social spending to GDP in each country) and the extent to which transfers are targeted to the poor and direct taxes targeted to the rich. While fiscal policy always reduces inequality, this is not the case with poverty. While spending on pre-school and primary school is pro-poor (the per capita transfer declines with income) in almost all countries, pro-poor secondary school spending is less prevalent, and tertiary education spending tends to be progressive only in relative terms (equalizing, but not pro-poor). Health spending is always equalizing except for in Jordan.

JEL Codes: H22, H5, D31, I3  
Keywords: fiscal incidence, social spending, inequality, poverty, developing countries

Chapter 10. The Impact of Reforming Energy Subsidies, Cash Transfers, and Taxes on Inequality and Poverty in Ghana and Tanzania.  
Stephen Younger

The chapter explains methods developed by the CEQ Institute to simulate policy changes and uses them to assess the distributional consequences of three types of policy reform in Ghana and Tanzania: removal of energy subsidies, expansion of
conditional cash transfer programs, and shifts in the balance between indirect and direct taxation. The methods are simple to implement and provide a first-order approximation to the true distributional effects. In both countries energy subsidies are substantial and popular, but regressive despite the use of lifeline tariffs for electricity consumption. Their removal would reduce inequality but also increase poverty by a non-trivial amount because the poor do garner some benefit from the subsidies. A simultaneous expansion of cash transfer programs could offset the poverty consequences at significantly lower fiscal cost than that of the energy subsidies. In both countries, direct taxes are more progressive than indirect taxes, yet shifting taxation from indirect to direct taxes has relatively little effect on inequality and poverty because the incidence of the two is not so different as, for instance, the difference between taxes and a strongly progressive expenditure like conditional cash transfers.

JEL Codes: D31, H22, I14
Keywords: fiscal incidence, poverty, inequality, subsidy reform, Ghana, Tanzania

Dario Rossignolo

Using standard fiscal incidence analysis, this chapter estimates the impact of tax and expenditure policies on income distribution and poverty in Argentina with data from the National Household Survey on Incomes and Expenditures 2012-2013. The results show that fiscal policy has been a powerful tool in reducing inequality and poverty, but that the unusually high levels of public spending may make the programs unsustainable.

JEL Codes: H2; I3; D3
Keywords: taxes, public expenditures, inequality, poverty

Chapter 12. Inequality and Poverty in Brazil by Race: A Fiscal Incidence Analysis.
Claudiney Pereira

Fiscal policy played an important role in reducing poverty and inequality in Brazil (Higgins and Pereira, 2014) over the last fifteen years, but how much redistribution and poverty reduction is being accomplished across ethnic groups? How was the ethno-racial divide affected by fiscal policy? We estimate the effects of taxes and social spending on inequality and poverty among ethnic groups using a household survey. We find that direct transfers have similar effects on inequality across ethnic groups, but the reduction is larger for pardos after adding monetized in-kind benefits (health and education). However, the income ratio between whites and non-whites is virtually unchanged. Poverty is reduced after direct transfers, but the reduction is higher for whites despite the prevalence of poverty being at least twice as high among pardos, blacks, and indigenous. The positive effects on poverty are tempered by a deleterious effect from indirect taxes. In addition, per capita transfers are on average higher for whites and benefits can be twice as large as those for non-whites. Fiscal interventions did not have a significant impact in reducing the divide between whites and non-whites in Brazil.
Chapter 13. The Impact of Taxes and Social Spending on Inequality and Poverty in El Salvador.
Margarita Beneke, Nora Lustig, and Jose Andres Oliva

We conducted a fiscal impact study to estimate the effect of taxes, social spending, and subsidies on inequality and poverty in El Salvador, using the CEQ’s methodology. Taxes are progressive, but given their volume, their impact is limited. Direct transfers are concentrated on poor households, but their budget is small so their effect is limited; a significant portion of the subsidies goes to households in the upper income deciles, so although their budget is greater, their impact is low. The component that has the greatest effect on inequality is spending on education and health. Therefore, the impact of fiscal policy is limited and low when compared with other countries with a similar level of per capita income. There is room for improvement using current resources.

JEL Codes: D31, H22, I14
Keywords: fiscal incidence, poverty, inequality, El Salvador

Chapter 14. Measuring the Effectiveness of Taxes and Transfers in Fighting Poverty and Reducing Inequality in Iran.
Ali Enami

This chapter introduces two new CEQ indexes to assess the effectiveness of taxes and transfers in reducing inequality and poverty: the Impact and Spending Effectiveness indicators. The Spending Effectiveness indicator has an additional interpretation as a measure of efficiency. These effectiveness indicators are used in this chapter to rank taxes and transfers in Iran. In addition, I estimate the Fiscal Impoverishment and Fiscal Gains to the Poor Effectiveness indicators, which have also been developed by the CEQ Institute. The results show that in this case study, taxes and transfers are similarly effective in achieving their inequality-reducing potential. The income tax is the most effective intervention on the revenue side, achieving 40 percent of its inequality-reducing potential. On the spending side, social assistance transfers are the most effective, achieving 45 percent of their potential. Taxes are especially effective in raising revenue without causing poverty to rise, indicating that the poor are largely spared from taxation. In contrast, transfers are not very effective because the majority of them are not targeted to the poor: the most effective transfers achieve 21 percent of their poverty reduction potential.

JEL Codes: D31, H22, I38
Keywords: inequality, poverty, fiscal incidence, marginal contribution, effectiveness indicator, policy simulation, Iran

Abebe Shimeles, Ahmed Moumni, Nizar Jouini, and Nora Lustig
Using the National Survey of Consumption and Household Living Standards for 2010, this chapter estimates the incidence of the government’s taxation and spending in Tunisia. Taking into account the impact of direct taxes and transfers, indirect taxes and subsidies, and the monetized value of in-kind transfers in education and health services, the Gini coefficient falls from 0.43 (before taxes and transfers) to 0.35 (after taxes and transfers), mainly due to taxes (30 percent of the decrease) and in-kind services (30 percent of the decrease). Most of the equalization is produced by personal income taxes and contributions to social security. Direct taxes are progressive and the VAT is regressive. Cash transfers contribute little to redistribution. Although direct transfers are strongly progressive and equalizing, their share in the budget remains very limited (only 0.2 percent). Subsidies are equalizing, though much less so than cash transfers because benefits to the non-poor are higher than their population share (that is, subsidies are progressive but only in relative terms). Primary and secondary education are strongly redistributive and equalizing whereas tertiary education is progressive only in relative terms because the poor still have limited access. Health spending is progressive.

JEL Codes: H22, I38, D31
Keywords: fiscal policy, fiscal incidence, social spending, inequality, poverty, taxes, Tunisia


This paper uses the 2012/13 Uganda National Household Survey to analyze the redistributive effectiveness and impact on poverty and inequality of Uganda’s revenue collection instruments and social spending programs. Fiscal policy – including many of its constituent tax and spending elements – is inequality-reducing in Uganda, but the impact of fiscal policy on inequality is modest. The reduction of inequality due to fiscal policy in Uganda is lower than other countries with similar levels of initial inequality, a result tied to generally low levels of spending. The impact of fiscal policy on poverty is negligible, though the combination of very sparse coverage of direct transfer programs and nearly complete coverage of indirect tax instruments means that many poor households are net payers into, rather than net recipients from, the fiscal system. As Uganda looks ahead to increased revenues from taxation and concurrent investments in productive infrastructure, it should take care to protect the poorest households from further impoverishment from the fiscal system.

JEL Codes: H22, I38, D31
Keywords: fiscal incidence, poverty, inequality, fiscal policy, Uganda

Part IV The Commitment to Equity Assessment. Tools

The CEQ Master Workbook
CEQ Team

*CEQ Stata Package*
Rodrigo Aranda and Sean Higgins (For questions, contact Sean Higgins)

*Sample Stata Code for Measuring the Indirect Effects of Indirect Taxes and Subsidies*
Jon Jellema and Gabriela Inchauste

*Checking Protocol*
Adam Ratzlaff and Sandra Martinez

*CEQ Assessment: Team & Timeline and Terms of Reference*
CEQ Team
1. About this Handbook

This Handbook is a unique manual detailing the theory and practical methods developed by the Commitment to Equity (CEQ) Institute for determining the impact of fiscal policy on inequality and poverty. Policymakers, social planners, and economists are presented with a step-by-step guide to applying fiscal incidence analysis as well as country studies to illustrate. The country studies are called CEQ Assessments.

The Handbook has four parts. Part I, Methodology, describes what a CEQ Assessment is and presents the theoretical underpinnings of fiscal incidence analysis and the indicators used to assess the distributive impact and effectiveness of fiscal policy. Part II, Implementation, presents the methodology on how taxes, subsidies, and social spending should be allocated. It includes a step-by-step guide to completing the CEQ Master Workbook of Results, a multi-sheet excel file that houses detailed information on the country’s fiscal system and the results used as inputs for policy discussions, academic papers, and policy reports. Part III, Applications, presents applications of the CEQ framework to low and middle income countries, including simulations of policy reforms. Part IV, Tools, available online only, contains the CEQ Master Workbook of Results and the CEQ Stata Package with user-written software to complete it. It also contains guidelines for the implementation of CEQ Assessments, including a thorough protocol of quality control.

To produce a CEQ Assessment, one must have access to a recent household survey, disaggregated government budget data on revenues and expenditures, and a detailed description of the characteristics of fiscal policy instruments that will be included in the analysis. To take advantage of the automatic

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1 Nora Lustig is the Samuel Z. Stone Professor of Latin American Economics and Director of the CEQ Institute at Tulane University. She is also a nonresident Senior Fellow at the Center for Global Development and the Inter-American Dialogue.
features included in the CEQ Stata Package, Stata 13 or a newer version is required. For some graphics, Stata 14.1 is required.

Although meant to be a guide to completing a CEQ Assessment, the Handbook can also be used as a stand-alone reference for those interested in methodological and practical approaches to carry out incidence analysis and assess the impact of fiscal policy on poverty and shared prosperity. In addition, the handbook can be used as a textbook for advanced undergraduate and graduate courses on public finance and income redistribution.

2. Why Fiscal Incidence Analysis?

The world is an unequal place. Income and wealth inequality among and within countries is pervasive. Unequal opportunities translate into earnings inequality. Concentration of power and wealth translates into unfair social contracts. Societies have two main ways to change this. First, by expanding poor people’s access to assets—in particular, human capital—and bargaining power to level the playing field. Second, by redistributing income through taxes and transfers. In both instances, the power of the state to redistribute assets, income, and wealth through fiscal policy plays a key role.

By adopting the Sustainable Development Goals (SDGs) in September 2015, countries worldwide have committed to make the world more fair. They have committed to eradicating poverty and hunger, reducing inequality, and achieving healthy lives, quality education, gender equality, and sustainable development. Countries have also committed to promoting full-employment growth, decent work, peaceful societies and accountable institutions, as well as strengthening global partnerships for sustainable development. One key factor to achieve these goals will be the availability of fiscal resources to deliver the social protection, social services, and infrastructure embedded in them. A significant portion of these resources is expected to come from the countries’ own fiscal systems, complemented by transfers from the countries that are better off. As is typical with these exercises, the proposals shy away from acknowledging that goals have trade-offs: for example, that devoting resources to eradicating hunger may mean that fewer resources are available for infrastructure investment (or vice versa), that raising additional revenues domestically may hurt a significant portion of the poor or abate economic growth, or that protecting the elderly may mean protecting less of the young (or vice versa).

Governments are increasingly interested in assessing how effective their current fiscal policies are in promoting growth, expanding opportunities, and accelerating poverty reduction. More generally, governments need to gauge how well they can achieve their own distributional objectives and those implicit in the SDGs. How can we know if fiscal effort and the allocation of fiscal resources are consistent with the adopted social equity goals? Who bears the costs of financing expanded social protection systems, social services and infrastructure? What are the fiscal trade-offs that governments face in the quest towards achieving these goals? Do investments in education and health truly benefit
Introduction, Lustig

the users of these services? Fiscal incidence analysis is one of the key tools that can shed light to answer questions as fundamental as these.

3. The Commitment to Equity Assessment

The CEQ Assessment is a diagnostic tool that uses fiscal incidence analysis to determine the extent to which fiscal policy reduces inequality and poverty in a particular country. The CEQ Assessment is designed to address the following four questions:

--How much income redistribution and poverty reduction is being accomplished through fiscal policy?

--How equalizing and pro-poor are specific taxes and government spending?

--How effective are taxes and government spending in reducing inequality and poverty?

--What is the impact of fiscal reforms that change the size and/or progressivity of a particular tax or benefit?

In addition, the CEQ Assessment can be used to guide policymakers in terms of what could be done to increase redistribution and poverty reduction through changes in taxation and spending in specific countries.

Until the launch of the CEQ project in 2008, work that analyzed the incidence of both government revenue and spending simultaneously—including net indirect taxes and spending on in-kind services—especially in middle and low income countries was not frequent. The CEQ project has changed this. Often in collaboration with other institutions, the CEQ Institute has completed or is the process of completing close to forty CEQ Assessments that span all regions of the world as shown in the map below (figure 1). As of November 2016, there are CEQ Assessments available for around thirty countries. The list includes: Argentina, Armenia, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Ethiopia, Georgia, Ghana, Guatemala, Honduras, Indonesia, Iran, Jordan, Mexico, Nicaragua, Peru, Russia, South Africa, Sri Lanka, Tanzania, Tunisia, Uganda, the United States, and Uruguay. There are also several multi-country studies which illustrate

2 Throughout this handbook, fiscal policy, fiscal instruments, taxes and government spending, revenue collection and government spending, taxes and transfers, taxes and benefits, and the net fiscal system are used interchangeably.

3 The project was initially launched at the Inter-American Dialogue with a focus on Latin America only.

4 Argentina (Lustig and Pessino, 2014 and Rossignolo, 2017); Armenia (Younger and Khachatryan, forthcoming); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2014; Pereira, 2017); Chile (Martinez-Aguilar, Fuchs, and Ortiz-Juarez, forthcoming); Colombia (Harker and others, forthcoming); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, forthcoming); Ecuador (Llerena and others, 2015; El Salvador (Bencze, Lustig, and Oliva, 2017); Ethiopia (Hill and others, forthcoming); Georgia (Cancho and Bondarenko, forthcoming); Ghana (Younger, Osei-Assibey, and Oppong, 2015; Younger, 2017); Guatemala (Cabrera, Lustig, and Moran, 2016); Honduras (Castañeda and Espino, 2015); Indonesia (Afkar, Jel lemma, and Wai-Poi, forthcoming); Iran (Enami, Lustig, and Taqdiri, 2016; Enami, 2017); Jordan (Alam, Inchauste, and Serajuddin, forthcoming); Mexico (Scott, 2014); Nicaragua (Cabrera and Moran,
the powerful insights one obtains when comparing the redistributive effort across countries (see, for example, chapter 9 in this Handbook).\(^5\)

**Figure 1 – CEQ Institute: Countries With CEQ Assessments**

![Map of countries with CEQ assessments](image_url)

Source: [www.commitmenttoequity.org](http://www.commitmenttoequity.org).

The CEQ framework, which aims to be as comprehensive as possible, enables one to estimate the combined impact of taxes and transfers. The analysis also includes the estimated marginal contribution of each individual intervention to the reduction in inequality and poverty. The use of a common methodology makes the results comparable across countries. This approach has been effective in providing a sound evidence base and spurring national policy dialogues. For instance, the CEQ Assessments have led to additional diagnostic work and policy changes in Armenia regarding tax policy, in Ethiopia regarding the coverage of transfers and the minimum threshold of taxable income, and in Indonesia regarding subsidy policy.\(^6\)

At the outset, it is important to describe some important caveats. First, the analysis excludes some important categories of taxes and spending, such as spending on infrastructure, corporate income taxes, defense, and other public goods because it is difficult to assign these benefits or burdens to any single individual, as the economic burden (in the case of corporate taxes) or benefit (in the case of


\(^6\) See interviews to Tassew Woldehanna and Gabriela Inchauste in the “CEQ Snapshot No. 2”, November 2016
spending on public goods) are diffuse. Existing methodologies are not fully developed to credibly incorporate the economic incidence of those categories of taxes and spending. Second, by considering only the redistributive effects of taxes and transfers, at this point the CEQ framework does not offer a full analysis of whether specific taxes or expenditures are desirable. When one type of tax or expenditure is found to be more progressive than another, the temptation is to conclude that the former is preferable. However, redistribution is only one of many criteria that matter when making public policy. Good tax policy will aim to be sufficient, efficient, and simple in addition to equitable, and public spending will aim to meet a state’s minimal functions by investing in necessary public goods in addition to improving equity. By assessing the equity of taxes and spending, the results of the approach are one input to public policy making—one that should be weighed with other evidence before deciding whether a tax or expenditure is desirable.

It is important to keep in mind that the fiscal incidence analysis used in the CEQ Assessments is point-in-time and does not incorporate behavioral or general equilibrium effects. That is, no claim is made that the original or market income equals the true counter-factual income in the absence of taxes and transfers. It is a first-order approximation that measures the average incidence of fiscal interventions. However, the analysis is not a mechanically applied accounting exercise. The incidence of taxes is the economic, rather than statutory, incidence. It is assumed that individual income taxes and contributions both by employees and employers, for instance, are borne by labor in the formal sector. Individuals who are not contributing to social security are assumed to pay neither direct taxes nor contributions. Consumption taxes are fully shifted forward to consumers. In the case of consumption taxes, the analyses take into account the lower incidence associated with own-consumption, rural markets and informality. approach offers “a picture in time.” Finally, it is important to note that the CEQ results cannot inform the trade-offs between spending on (a) current transfers to alleviate poverty in the present, and (b) investments in physical and human capital that could lead to large impacts on well-being in the future.

4. Main Messages

There are three main messages from Part I on Methodology. First, analyzing the tax and spending sides simultaneously is not only desirable but necessary. Taxes can be unequalizing, but spending so equalizing that the unequalizing effect of taxes is more than compensated (chapter 2). Taxes can be regressive, but when combined with transfers make the system more equalizing than without the regressive taxes (chapters 2 and 3). Second, to assess the impact of the fiscal system on people’s standard of living, it is crucial to measure the effect of taxation and spending not only on inequality but also on poverty: the net fiscal system can be equalizing but impoverishing (chapter 4). Transfers can be equalizing, but when combined with taxes, post-fiscal poverty can be higher than pre-fiscal poverty.

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7 This result is known as the Lambert’s conundrum (Lambert, 1985 and 2001) and will be extensively discussed below and in chapters 2 and 3.
Part III on Applications of the CEQ framework includes a summary of results for a sample of twenty-eight countries around the world (chapter 9). The results show that fiscal systems are always equalizing but the extent of redistribution is quite heterogeneous. In contrast, fiscal systems are not always poverty reducing. In fact, fiscal policy is impoverishing more frequently than one would have thought, especially if one focuses on the “cash portion” of the fiscal system (direct taxes, direct transfers, indirect taxes, and indirect subsidies). In Armenia, Bolivia, Ethiopia, Ghana, Guatemala, Honduras, Nicaragua, Tanzania, and Sri Lanka fiscal policy increases the incidence of poverty, meaning that a significant number of the market income poor (non-poor) are made poorer (poor) by taxes and transfers (chapters 4 and 9). This startling result is primarily the consequence of high consumption taxes on basic goods.

Direct taxes tend to be equalizing and direct transfers are always equalizing. The impact of indirect taxes combined with indirect subsidies is equalizing in nineteen countries out of the twenty-eight analyzed in chapter 9. Government spending on education and health is always equalizing and its contribution to the reduction in inequality is rather large. This result is not surprising given that the use of government services is monetized at a value equal to average government cost. While the results concerning the distribution of the benefits of in-kind services in education and health are encouraging from the equity point of view, it is important to note that they may be due to factors one would prefer to avoid. The more intensive use of services in education and health on the part of the poorer portions of the population, for example, may be caused by the fact that, in their quest for quality, the middle-classes (and, of course, the rich) chose to use private providers. This situation leaves the poor with access to second-rate services. In addition, if the middle-classes opt out of public services, they may be much more reluctant to pay the taxes needed to improve both the coverage and quality of services than they would be if services were used universally.

There are two main lessons for policymakers that emerge from the analysis. First, the fact that specific fiscal interventions can have countervailing effects underscores the importance of taking a coordinated view of both taxation and spending rather than pursuing a piecemeal policy reform. Efficient regressive taxes (such as the value added tax) when combined with generous well-targeted transfers can result in a net fiscal system that is equalizing and poverty-reducing. Second, governments should design their tax and transfers system so that the after taxes and transfers incomes (or consumption) of the poor are not lower than their incomes (or consumption) before fiscal interventions. If the policy community is seriously committed to eradicating income/consumption poverty, governments will need to explore ways to redesign taxation and transfers so that the poor do not end up as net payers.

5. Organization of the Handbook

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8 The countries are Argentina, Armenia, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Ethiopia, Georgia, Ghana, Guatemala, Honduras, Indonesia, Iran, Jordan, Mexico, Nicaragua, Peru, Russia, South Africa, Sri Lanka, Tanzania, Tunisia, Uganda, and Uruguay.

9 Higgins and Lustig (2016).
As stated above, this Handbook has four parts. Part I (Methodology) describes what a CEQ Assessment is and presents the theoretical underpinnings of fiscal incidence analysis and the indicators used to assess the distributive impact and effectiveness of fiscal policy. Part II (Implementation) presents the methodology on how taxes, subsidies, and social spending should be allocated. It includes a step-by-step guide to completing the CEQ Master Workbook of Results, a multi-sheet excel file that houses detailed information on the country’s fiscal system and the results used as inputs for policy discussions, academic papers and policy reports. Part III (Applications) presents applications of the CEQ framework to low and middle income countries, including simulations of policy reforms. Part IV (Tools), available online only, contains the CEQ Master Workbook of Results and the CEQ Stata Package with user-written software to complete it. It also contains guidelines for the implementation of CEQ Assessments, including a thorough protocol of quality control.

Part I-- The CEQ Assessment. Methodology-- has four chapters. Chapter 1 by Nora Lustig and Sean Higgins presents key analytical insights in fiscal redistribution theory. The chapter also discusses the basics of fiscal incidence analysis used in CEQ Assessments. The CEQ Assessments rely on the fiscal incidence method known as the “accounting approach” because it ignores behavioral responses and general equilibrium effects. Because pensions frequently tend to be a combination of deferred income and government transfer, there is a section dedicated to how contributory pensions should be considered in fiscal incidence analysis. Finally, the chapter describes the set of indicators used to answer the four key questions outlined above, and illustrates with examples from existing CEQ Assessments.

For the interested reader, the mathematical formulation of the mathematical conditions for the net fiscal system to be equalizing in the case of multiple fiscal interventions and in the absence of reranking is presented in chapter 2 by Ali Enami, Nora Lustig, and Rodrigo Aranda. Chapter 2 also derives the conditions that must prevail for a particular tax or transfer to be equalizing and see that in the world of multiple interventions, some of these conditions defy our preconceptions and intuition.

The conditions derived in chapter 2 assume no reranking. That is, individuals do not change their position in the post-fiscal income ordering. In other words, the poorest individual in the pre-fiscal income scale will continue to be the poorest individual in the post-fiscal income scale, the second poorest individual in the pre-fiscal income scale will continue to be the second poorest individual in the post-fiscal income scale, and, so on, all the way up to the richest individual. Chapter 3 by Ali Enami discusses how the conditions derived in chapter 2 change in the presence of reranking.

A fundamental question in the policy discussion is whether a particular fiscal intervention (or a particular combination of them) is equalizing or unequalizing. In a world with a single fiscal intervention (and no reranking), it is sufficient to know whether a particular intervention is progressive or regressive to give an unambiguous response using the typical indicators of progressivity such as the
Kakwani index.\textsuperscript{10} Chapter 2 demonstrates, however, that in a world with more than one fiscal intervention (even in the absence of reranking), this one-to-one relationship between the progressivity of a particular intervention and its effect on inequality breaks down. For instance, depending on certain characteristics of the fiscal system, a tax that is regressive based on any typical indicator can exert an equalizing force over and above that which would prevail in the absence of that regressive tax.

As shown in chapter 3, reranking, which is practically universal in real life fiscal systems, destroys the public finance dictum that: “...If the combined redistributive impact of tax and spending is progressive then the higher the level of tax and spending in a country the larger is the redistributive impact. Similarly, for a given level of tax and spending, the more revenue collection is concentrated in more redistributive taxes (progressive income taxes) and the more spending is concentrated in more redistributive transfers (well targeted social transfers), the greater the redistributive impact of fiscal policy.”\textsuperscript{11} If there is reranking, in order to determine whether a fiscal system, a particular tax or transfer, or a particular policy change is inequality-increasing or inequality-reducing—and by how much—one must resort to numerical calculations. In particular, one must calculate the inequality indicator that would prevail with and without the specific intervention or policy change.

Chapter 4 by Sean Higgins and Nora Lustig is a reproduction of an article published in the Journal of Development Economics. The article shows how the typical measures of poverty, horizontal equity, and progressivity can fail to capture an important characteristic that, unfortunately, a rather large number of fiscal systems have: that a substantial proportion of the poor are made poorer (or non-poor made poor) by the tax and transfer system. The chapter axiomatically derives a measure of this phenomenon which the authors call “fiscal impoverishment.” They illustrate with specific examples how in countries in which the fiscal system is poverty-reducing and equalizing, a significant number of the poor pay more in taxes than they receive in transfers. The chapter also derives an analogous measure of fiscal gains to the poor and shows that changes in the poverty gap can be decomposed in the two axiomatic measures of fiscal impoverishment and fiscal gains to the poor.

Part II -- The CEQ Assessment. Implementation—has four chapters. Chapter 5 by Sean Higgins and Nora Lustig presents a step-by-step guide to applying the incidence analysis used to prepare CEQ Assessments. The chapter defines the core income concepts before and after taxes, transfers, and subsidies, discusses the methodological assumptions used to construct them, explains how taxes, transfers, and subsidies should be allocated at the household level, and suggests what to do when information on who paid or received certain taxes and/or transfers, or how much they paid or received, is not included in the household survey.

\textsuperscript{10} The Kakwani index for taxes is defined as the difference between the concentration coefficient of the tax and the Gini for market income. For transfers, it is defined as the difference between the Gini for market income and the concentration coefficient of the transfer. See, for example, Kakwani (1977).

\textsuperscript{11} Clements and others (2015, p.57).
Chapter 6 by Jon Jellema and Gabriela Inchauste presents a step-by-step guide to constructing the consumable income concept when one takes into account not only the direct but also the indirect effect (through input prices) of indirect taxes and subsidies. The chapter reviews a “price-shifting” model for estimating the magnitude of the indirect effects of indirect taxes and subsidies and demonstrates how to use an input/output matrix together with a household expenditure survey to allocate the indirect burden across households.

Chapter 7 by Sean Higgins presents the results and indicators used in a CEQ Assessment, and describes in great detail how indicators and results can be produced and exported to the relevant sections of the CEQ Master Workbook using the CEQ Stata Package. In particular, this chapter describes how to calculate the (marginal) contribution of a particular tax or transfer (or any combination of them) to the reduction in inequality and poverty, as discussed in chapters 1, 2, and 3. It also describes how to calculate the suite of CEQ effectiveness and efficiency indicators proposed by Ali Enami in chapter 14. The ensemble of CEQ indicators are calculated by the commands of the CEQ Stata Package and automatically exported to the results sections (sections E and D) of the CEQ Master Workbook, described below.

The CEQ analysis provides researchers with a comprehensive and comparable set of indicators to determine the impacts of fiscal intervention on poverty and inequality. However, inequality may take many different forms beyond the income dimension. Race, gender, location, and parental characteristics can have important implications on the economic and social outcomes of individuals. In an effort to determine if government fiscal interventions are exacerbating or reducing ethno-racial inequalities in Latin America, the Inter-American Development Bank (IDB) has partnered with the CEQ Institute to finance the adoption of the CEQ analysis to explore the impacts of fiscal policies on ethno-racial inequality in the Latin America and Caribbean region (LAC). Chapter 8 by Rodrigo Aranda and Adam Ratzlaff describes what measures should be used to determine the impact of fiscal policy on indicators of ethno-racial inequality and describes how the indicators and results can be produced and exported to the CEQ Master Workbook using corresponding instructions in the CEQ Stata Package.

Part III -- The Commitment to Equity (CEQ) Assessment. Applications-- includes eight chapters with country and cross-country studies in which the CEQ methodology has been applied. In chapter 9, Nora Lustig presents comparative results for 28 low and middle income countries and one advanced economy. Stephen Younger shows how the CEQ framework can be used to simulate policy reforms with an application to Ghana and Tanzania in chapter 10. Chapters 11 through 16 present CEQ Assessments for Argentina (Dario Rossignolo), Brazil by race (Claudiney Pereira), El Salvador (Margarita Beneke, Nora Lustig, and Jose Andres Oliva), Iran (Ali Enami), Tunisia (Abebe Shimeles, Ahmed Moumni, Nizar Jouini, and Nora Lustig), and Uganda (Jon Jellema, Astrid Haas, Nora Lustig, and Sebastian Wolf). In chapter 14, Ali Enami shows new effectiveness indicators and applies them to Iran.
Part IV -- The Commitment to Equity (CEQ) Assessment. Tools-- includes five items: the CEQ Master Workbook, the CEQ Stata Package, sample software to construct the post-fiscal income concept incorporating the indirect effects of indirect taxes and subsidies, a detailed checking protocol to ensure that results are as free as possible of egregious mistakes, and prototype terms of reference to produce a CEQ Assessment.

The MWB is a multi-sheet excel file that houses detailed information on the country’s economic, political, and social context, description of microdata, the country’s fiscal system and the results of the fiscal incidence analysis used as inputs for policy discussions, academic papers and policy reports. The MWB consists of six sections: Section A. Country Context, Section B. Data, Section C. Methodology, Section D. Summary of Results, Section E. Output Tables, and Section F. Compendium of Results by Ethnicity and Race.

Sections A, B, and C are meant to be filled by the CEQ Assessment’s team with information obtained from administrative sources, the household survey, and the methodological assumptions used to estimate the incidence of taxes and public spending. Section A includes background information on the country and is straightforward. The instructions on how to complete Sections B and C are included in chapter 5. If the incidence analysis includes the indirect effects of indirect taxes and subsidies, the instructions on how to complete Section C are in chapter 6. The order of the sections has been chosen having the user of the CEQ exercise in mind. Producers of a CEQ Assessment should start with Section B, the data and information required to implement an assessment. A CEQ Assessment producer can complete section A at the end.

Section E of the MWB contains the ensemble of indicators used in CEQ Assessments, described in chapter 1 and in more detail in chapter 7. Section D presents the results in a user-friendly manner to be used both in policy dialogues and scholarly research. Section E is automatically populated by the commands in the CEQ Stata Package described below. Section D, in turn, is automatically populated with information from Section E through “linking” commands embedded in the MWB. The linking commands import information from Section E and paste it in the relevant cells in Section D. Section F of the MWB includes the indicators of the CEQ analysis by ethnicity or race and is also automatically populated by the commands in the CEQ Stata Package whenever the researcher has generated the pre-fiscal and post-fiscal income concepts by ethnicity and/or race.

The CEQ Stata Package contains user written software that automates the process of producing CEQ results in sections E and F of the MWB, and ensures the quality of these estimates. The Stata Package greatly enhances the reproducibility and scalability of CEQ Assessments because it helps produce results for additional countries or years more quickly and less expensively. In addition, it will greatly reduce the marginal cost of robustness checks testing the sensitivity of one’s results to various assumptions.

6. How to Use this Handbook
For those interested in implementing a CEQ Assessment, it is advisable to follow these steps:

**Step 1: Getting ready**
-- Read chapter 1
-- Obtain a recent household survey and prepare it for use
-- Complete B3 of CEQ Master Workbook (government revenues and spending from administrative accounts)

*Note: if you are interested in the mathematical derivations of results discussed in chapter 1, read chapters 2, 3, and 4.*

**Step 2: Constructing the income concepts and completing sections B and C of the CEQ Master Workbook**
-- Read chapter 5.
-- Open the CEQ MWB (in Part IV) and fill out the rest of section B.
-- If you are using an input-output table to estimate the indirect effects of indirect taxes and subsidies, read chapter 6 in this handbook and use the sample software in Part IV. Complete the construction of income concepts and fill out section C of MWB.
-- Use Stata 13 or a newer version.
-- Compare totals and structure (for example, the ratio of total personal income tax to total disposable income (of private consumption if you don’t have income in your survey)) from administrative accounts and those that emerge from your calculations using the Household Survey. This is done using the information that you input in sheet C1 in MWB. It will show you how your “economy” differs when you use admin versus survey-based data (see details in chapter 5).

*Note: This step is probably the most time consuming of all because obtaining budget data can be quite challenging and because constructing the income concepts requires making many thoughtful decisions on how to allocate taxes and transfers to individual households.*

**Step 3: Producing results**
-- Install the CEQ Stata Package. To install it, include the following Stata code in a .do file or enter it into Stata’s command prompt:

```
update all
ssc install ceq, replace
```

-- Read chapter 7 and fill out section E of the MWB using the Stata Package.
-- Follow the linking instructions to automatically populate section D.
-- Remember that you will need to complete at least two rounds of sections E and D: first, for a scenario in which contributory pensions are considered deferred income and, second, for a scenario in which contributory pensions are considered government transfers. A third scenario that should be completed if the pension system had a deficit in the year of the survey is the scenario in which contributory pensions are partially deferred income.
-- If you are testing the robustness of specific assumptions (see chapter 5), you will need to complete separate sets of sections E and D for each test. The ceqassump command provides a preliminary
way to check robustness on the main CEQ Assessment results without producing sections E and D in their entirety.

--If you are using an input-output table to estimate the indirect effects of indirect taxes and subsidies, use the sample software in Part IV.
--If you are planning to produce a CEQ Assessment by ethnic or racial group (or, by rural-urban or other regional breakdown), read chapter 8 and fill out section F of the MWB using the Stata Package.

**Step 4: Checking results**

--Complete section A of MWB; you will use some of the information (e.g., inequality and poverty trends from existing sources), to check the accuracy of the CEQ results.
--Using the Checking Protocol in Part IV as a Guide, do a thorough quality control.
--If possible, consult with other experts if your results appear sensible.
--You should not use results until the checking process is completed.

**Step 5: Presenting results**

--To present results, see the chapters with applications of CEQ in Part III.

**Step 6: Policy Simulations**

--To estimate the impact of policy changes, make the change “manually” in Step 2 and proceed with the rest of steps. An example of how to use the CEQ for policy simulations is in chapter 10 of Part IV (policy simulations in Ghana and Tanzania).

### 7. About the CEQ Institute

The CEQ Institute at Tulane University works to reduce inequality and poverty through comprehensive and rigorous tax and benefit incidence analysis, and active engagement with the policy community. Building on the achievements of the CEQ project, the Institute was founded in May 2015. The Institute has four main areas of work: development of research methods and policy tools, a data center, advisory and training services and bridges to policy. These goals are: to improve the methodological instruments, policy tools, and database to evaluate how consistent and effective revenue collection and spending practices are with global equity goals; to establish an information system designed to monitor progress in fiscal redistributive efforts to achieve equity goals; to mainstream the use of CEQ Assessments by reaching out to the policy community through partnerships, training programs, and policy forums; and, to disseminate findings through an active communication and advocacy program undertaken in conjunction with key partners in the research, philanthropic and social activist communities. Tax and benefit incidence studies using the CEQ methodology have been completed in a wide array of low and middle income countries in all regions of the world. Results are published in the CEQ Working Paper series available in [www.commitmenttoequity.org](http://www.commitmenttoequity.org). The Institute’s studies have been published in leading peer-reviewed journals such as Journal of Development Economics, Public Finance Review, the Review of Income and Wealth, and World Development. In October 2015, the Bill & Melinda Gates Foundation awarded $4.9 million dollars to support the Institute achieve its goals.
Introduction, Lustig

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Introduction, Lustig


http://pfr.sagepub.com/content/early/2013/10/24/1091142113505193.full.pdf+html


Introduction, Lustig


The CEQ Assessment: Measuring the Impact of Fiscal Policy on Inequality and Poverty
Nora Lustig and Sean Higgins†

Version: October 31, 2016

Chapter 1
Lustig, Nora, editor
Commitment to Equity Handbook
Brookings Institution and CEQ Institute (2017)

Introduction

Developed by the Commitment to Equity Institute at Tulane University, the Commitment to Equity (CEQ) Assessment is a diagnostic tool that uses fiscal incidence analysis to determine the extent to which fiscal policy reduces inequality and poverty in a particular country.

The CEQ Assessment is designed to address the following four questions:

--How much income redistribution and poverty reduction is being accomplished through fiscal policy?¹
--How equalizing and pro-poor are specific taxes and government spending?
--How effective are taxes and government spending in reducing inequality and poverty?
--What is the impact of fiscal reforms that change the size and/or progressivity of a particular tax or benefit?

As stated in the introduction, the purpose of this Handbook is to present a step-by-step guide to applying the incidence analysis used in CEQ Assessments. The Handbook has been written to guide researchers in the completion of the CEQ Master Workbook (available in the Handbook’s online

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¹ Throughout this handbook, fiscal policy, fiscal instruments, taxes and government spending, revenue collection and government spending, taxes and transfers, taxes and benefits, and the net fiscal system are used interchangeably.
appendix), a spreadsheet file that contains all the information used in a CEQ Assessment. The CEQ Stata Package (which can be installed directly through Stata) includes a suite of user-written Stata commands that automatically fills out the results section of the CEQ Master Workbook. However, the handbook can also be used as a stand-alone document for those interested in methodological and practical approaches to carry out fiscal incidence analysis.

This chapter presents key analytical insights in fiscal redistribution theory (for the interested reader, their mathematical formulation is presented in detail in chapters 2 and 3 of this Handbook). The chapter also discusses the basics of fiscal incidence analysis used in CEQ Assessments. The CEQ Assessments rely on the fiscal incidence method known as the “accounting approach” because it ignores behavioral responses and general equilibrium effects. Because pensions frequently tend to be a combination of deferred income and government transfer, there is a section dedicated to discuss how contributory pensions should be considered in fiscal incidence analysis. Finally, the chapter describes the set of indicators used to answer the four key questions outlined above, and illustrates with examples from existing CEQ Assessments. Instructions for the implementation of a CEQ Assessment in practice are in the chapters in part II of this Handbook. The user written CEQ Stata Package software can be installed directly through Stata, and other tools are in the appendix, available online only. Part III includes applications of the CEQ Assessment tool to specific countries and a cross-country comparison.

1.1 The Theory of Fiscal Redistribution: Key Analytical Insights

In this Handbook, fiscal redistribution refers to the process by which the state collects revenues from individuals and households (primarily through taxes) and spends these revenues on benefits (e.g., cash transfers, price subsidies, and in-kind benefits such as education and health) intended for specific individuals and households. In so doing, the state changes the post-fiscal income distribution and poverty rates that would have prevailed in the absence of fiscal policy. Because of behavioral responses and general equilibrium effects, fiscal policy can also change the pre-fiscal income distribution and poverty rates. While at this point the CEQ Assessments do not estimate the counterfactual pre-fiscal income with these second-round effects in place, it is important to note that the analytical insights presented here and in chapters 2 (Enami, Lustig, and Aranda), 3 (Enami), and 4 (Higgins and Lustig) apply to fiscally-induced income redistribution regardless of the method used to estimate its extent. That is, whether fiscal redistribution is calculated using run-of-the-mill fiscal incidence analysis, microsimulation methods, or partial or general equilibrium modeling, the theoretical results discussed below and in the next three chapters, apply the same.

The state, of course, also spends on public goods, and collects revenues from and spends on subsidies that benefit corporations as well. While spending on public goods and taxing and subsidizing

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2 Higgins (chapter 7 of this Handbook) and Aranda and Ratzlaff (chapter 8 of this Handbook).
3 Enami, Lustig, and Aranda (2017), Enami (2017a), and Higgins and Lustig (2016).
corporations also have redistributive effects, these forms of revenue collection and spending are not considered in the CEQ Assessment tool (at least, not for the moment).

In order to measure the redistributive effect and poverty impact of taxes and benefits, the core building block of fiscal incidence analysis is the definition and construction of a pre-fiscal income—what we in CEQ call market income—and a post-fiscal income—that is, income after taxes net of transfers. The construction of post-fiscal income refers to the method of allocating the burden of taxes and the benefits of government spending to households. For example, disposable income is constructed by subtracting direct personal income taxes and adding cash transfers to a household’s market income. Although this procedure may sound very simple, allocating taxes and transfers to households is among the most—if not the most—challenging tasks of fiscal incidence analysis. Below we present a brief description of the fiscal incidence method used in CEQ Assessments. Part II of this Handbook is devoted to explaining the approaches to be followed in practice.

**The Fundamental Equation of the Redistributive Effect**

In his seminal book *The Distribution and Redistribution of Income: A Mathematical Analysis*, Lambert defined the redistributive effect as the difference between inequality for post-fiscal income and pre-fiscal income. Lambert shows that the redistributive effect of the net fiscal system is equal to the weighted sum of the redistributive effect of taxes and transfers, where the redistributive effect of the tax system is defined as the difference between inequality of post-tax and market income; the redistributive effect of the benefit system is defined as the difference between inequality of post-transfer income and market income; and, the weights are equal to the ratios of taxes and benefits divided by total pre-fiscal (market) income, respectively.

In mathematical terms:

\[
RE_N = \frac{(1-g)RE_t + (1+b)RE_B}{1-g+b}
\]

where \(RE_N\), \(RE_t\), and \(RE_B\) are the change in the Gini indices for the net fiscal system, taxes (only) and benefits (only), respectively; and \(g\) and \(b\) are the total tax and benefit ratios, that is, total taxes and total benefits divided by total pre-fiscal (original) income, respectively. Actually, Lambert’s formulation measures the redistributive effect with the Reynolds-Smolensky index which in the absence of reranking of households (i.e., when households occupy a different spot in the ranking with pre-fiscal than with post-fiscal income (i.e., when households occupy the same place in the ranking

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5 See Lambert (2001, equation 11.29, p. 277). This equation can be applied to the so-called S-Gini family of indicators of which the Gini coefficient is one particular case. For the description of S-Gini indicators see, for example, Duclos and Araar (2006). Other inequality indicators cannot necessarily be neatly decomposed into a weighted sum of the redistributive effect of taxes and transfers.

6 For a definition, see Duclos and Araar (2006) and Enami, Lustig and Aranda (chapter 2 in this Handbook).
from poorest to richest with pre-fiscal than with post-fiscal income equals the Gini coefficient.

We will call this the fundamental equation of the redistributive effect.\(^7\) It is a fundamental equation because it lies at a heart of two essential implications. The first implication is that to correctly estimate the redistributive effect of fiscal policy, it is essential to analyze taxes and benefits in tandem. Using the fundamental equation\(^8\), formalizes the key condition that must be fulfilled for a net fiscal system to be equalizing.

\[ \rightarrow RE_t > -\frac{(1 + b)}{(1 - g)}RE_B \]

This condition shows, for example, how taxes could be unequalizing \(RE_t < 0\) but that given the ratios of taxes \(g\) and transfers \(b\) and the equalizing effect of transfers \(RE_B > 0\), the unequalizing effect of taxes would be more than compensated. While many authors have already stressed the importance of analyzing the redistributive impact of taxes and transfers in tandem\(^9\), it is important to emphasize its essentiality.

**Lambert’s Conundrum**

Lambert’s fundamental equation of the redistributive effect has another implication which has been largely overlooked in the literature. The equation can be used to show that relying on the typical indicators of progressivity such as the Kakwani index (described below and in chapter 2) to predict whether a tax or a transfer will exert an equalizing effect is wrong. Taxes, for instance, can be regressive according to the Kakwani index but when combined with transfers make the system more equalizing than without the regressive taxes. This startling result, which was first identified by Lambert\(^{10}\), has been largely ignored in applied fiscal incidence analysis. We proceed to explain how such a counter-intuitive result is possible.

Suppose one observes that fiscal policy has an equalizing effect. Can one measure the influence of specific taxes (direct vs. indirect, for example) or transfers (direct transfers vs. indirect subsidies or in-kind transfers, for example) on the observed result?\(^{11}\) A fundamental question in the policy discussion is whether a particular fiscal intervention (or a particular combination of them) is equalizing or unequalizing. In a world with a single fiscal intervention (and no reranking), it is sufficient to know whether a particular intervention is progressive or regressive to give an unambiguous response using

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\(^7\) In chapter 2 of this Handbook, we reproduce Lambert’s formulation and extend it to the case of multiple taxes and transfers. We show how if the redistributive effect is measured with the Gini coefficient, the fundamental equation can be expressed using the Kakwani index for taxes and transfers. In chapter 3 of this Handbook, Ali Enami shows how these conditions are affected if taxes and transfers rerank households.

\(^8\) Lambert (2001).

\(^9\) See, for example, Engel and others 1999 and Clements and others (2015, p.57).

\(^{10}\) Lambert (1985, 2001).

\(^{11}\) Note that the influence of specific interventions may not be equalizing, even if the overall effect of the net fiscal system is.
Chapter 1, Lustig & Higgins

the typical indicators of progressivity such as the Kakwani index (chapter 2 in this Handbook). In a world with more than one fiscal intervention (even in the absence of reranking), this one-to-one relationship between the progressivity of a particular intervention and its effect on inequality breaks down. As Lambert so eloquently demonstrates it, depending on certain characteristics of the fiscal system, a regressive tax can exert an equalizing force over and above that which would prevail in the absence of that regressive tax.

An example borrowed from Lambert helps illustrate this point in the case of a regressive tax (table 1-1). The table below shows that “…taxes may be regressive in their original income… and yet the net system may exhibit more progressivity” than the progressive benefits alone. The redistributive effect for taxes only in this example is equal to -0.0517, highlighting their regressivity. Yet, the redistributive effect for the net fiscal system is 0.25, higher than the redistributive effect for benefits only equal to 0.1972. If taxes are regressive vis-à-vis the original income but progressive with respect to the less unequally distributed post-transfers income, regressive taxes exert an equalizing effect over and above the effect of progressive transfers.

Table 1-1. Lambert’s Conundrum

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>Original income x</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>Tax Liability t(x)</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>42</td>
</tr>
<tr>
<td>Benefit level b(x)</td>
<td>21</td>
<td>14</td>
<td>7</td>
<td>0</td>
<td>42</td>
</tr>
<tr>
<td>Post-benefit income</td>
<td>31</td>
<td>34</td>
<td>37</td>
<td>40</td>
<td>142</td>
</tr>
<tr>
<td>Final income</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Lambert (2001, Table 11.1, p. 278)

Note that Lambert’s conundrum is not equivalent to the well-known result we mentioned above: that efficient regressive taxes can be fine as long as, when combined with transfers, the net fiscal system is

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12 The Kakwani index for taxes is defined as the difference between the concentration coefficient of the tax and the Gini for market income. For transfers, it is defined as the difference between the Gini for market income and the concentration coefficient of the transfer. See, for example, Kakwani (1977).
14 See Lambert (2001, p. 277-278). Also, for a derivation of all the mathematical conditions that can be used to determine when adding a regressive tax is equalizing or when adding a progressive transfer is unequalizing, see Enami, Lustig, and Aranda (Chapter 2 in this Handbook).
16 Since there is no reranking, the R-S equals the difference between the Ginis before and after the fiscal intervention.
17 Note that Lambert uses the term progressive and regressive differently than other authors in the theoretical and empirical incidence analysis literature. Thus, he calls “regressive” transfers that are equalizing. See definitions in earlier chapters of his book.
equalizing. The surprising aspect of Lambert’s conundrum is that a net fiscal system with a regressive tax (vis-à-vis market) is more equalizing than without it. The implications of Lambert’s conundrum in real fiscal systems are quite profound, namely that in order to determine whether a particular intervention (or, a particular policy change) is inequality increasing or inequality reducing—and by how much—one must resort to numerical calculations that include the whole system. As Lambert mentions, the conundrum is “not altogether farfetched”; two renowned studies in the 1980s found this type of result for the US and the UK. It also made its appearance in a 1990s study for Chile and in the 2015 CEQ Assessment for Chile, as discussed in chapter 9 of this Handbook.

The counter-intuitive result embedded in Lambert’s conundrum is the consequence of path dependency: a particular tax can be regressive vis-à-vis market income but progressive vis-à-vis the income that would prevail if all the other fiscal interventions were already in place. As shown in chapter 2, there are other counterintuitive results; for instance, adding a regressive transfer to a system with an existing regressive transfer, could reduce inequality by more than if one does not add the new regressive transfer.

Given path dependency, how should one calculate the sign and order of magnitude of a particular tax’s or transfer’s influence on the redistributive effect? There are several ways of calculating the contribution of a particular fiscal intervention to the change in inequality (or poverty). The most commonly used in the literature is the sequential contribution. The sequential contribution is calculated as the difference between inequality indicators with fiscal interventions ordered in a path according to their institutional design. For example, if direct transfers are subject to taxation, the sequential contribution of personal income taxes is the difference between market income plus transfers and market income plus transfers and minus personal income taxes. Given path dependency, however, the result obtained by the sequential method can be wrong. The path dependency of fiscal interventions is independent of whether we can identify the institutional path accurately. For example,

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18 As Higgins and Lustig (2016) mention, “efficient taxes that fall disproportionately on the poor, such as a no-exemption value added tax, are often justified with the argument that ‘spending instruments are available that are better targeted to the pursuit of equity concerns’ Keen and Lockwood (2010, p. 141). Similarly, Engel and others (1999, p. 186) assert that ‘it is quite obvious that the disadvantages of a proportional tax are moderated by adequate targeting’ of transfers, since ‘what the poor individual pays in taxes is returned to her.’ Ebrill and others (2001, p. 105) argue that ‘a regressive tax might conceivably be the best way to finance pro-poor expenditures, with the net effect being to relieve poverty.’”

19 It can also be shown that if there is reranking, a pervasive feature of net tax systems in the real world, making a tax (or a transfer) more progressive can increase post-tax and transfers inequality. In Lambert’s example, regressive taxes not only enhance the equalizing effect of transfers, but making taxes more progressive (i.e., more disproportional in the Kakwani sense) would result in higher (!) inequality; any additional change (towards more progressivity) in taxes or transfers would just cause reranking and an increase in inequality.

20 Quotes are from Lambert, (2001, p. 278).
22 Engel and others (1999). Although the authors did not acknowledge this characteristic of the Chilean system in their article, in a recent interaction with the lead author, it was concluded that the Chilean system featured regressive albeit equalizing indirect taxes.
23 Martinez-Aguilar and Ortiz-Juarez (2016).
24 See the discussion on path dependency in chapter 7 of Duclos and Araar (2006, p. 387-406).
25 OECD (2011) used this method, for example.
whether direct transfers are subject to taxation or not, the contribution of direct taxes to the redistributive effect can be equalizing or unequalizing (this is precisely the implication of Lambert’s conundrum).

In theory, path dependency would require to measure the total average contribution by considering all the possible paths and taking, for example, the so-called Shapley value (used in game theory). Interpreting the meaning of a Shapley value for policy purposes is, however, intractable. A sensible alternative is to use what in the statistical literature is known as the marginal contribution. In our context, the marginal contribution of a tax (or transfer) is calculated by taking the difference between the inequality (or poverty) indicator without the tax (or transfer) and with it. For example, the marginal contribution of direct taxes is the difference between the Gini for gross income (market income plus transfers) and the Gini for disposable income (market income plus transfers minus direct taxes).

The marginal contribution has a straightforward policy interpretation because it is equivalent to asking the question: what would inequality be if the system did not have a particular tax (or transfer) or if a tax (or transfer) was modified? Would inequality be higher, the same or lower with the tax (or transfer) than without it? It is important to note as well that the notion of marginal contribution is general. That is, it can be applied not only to any inequality indicator but to poverty indicators as well. The basic question is always the same: one must compare the size of the indicator without the fiscal instrument in place with the indicator that does include the latter.

The Wildcard: Reranking of Households

In chapter 2, Enami, Lustig, and Aranda reproduce Lambert’s formulation and extends it to the case of multiple taxes and transfers; and, in chapter 3, Enami shows how the conditions are affected if taxes and transfers rerank households (i.e., when households occupy a different spot in the ranking with pre-fiscal than with post-fiscal income). It is important to note that, if there is reranking, the fundamental equation can no longer be interpreted as a measure of the fiscally-induced change in inequality. To illustrate, let’s think of the hypothetical case in which taxes and transfers cause extreme reranking: i.e., that households switch places in such a way that the pre-fiscal richest becomes the post-fiscal poorest, the second pre-fiscal richest becomes the second post-fiscal poorest, and so on. In such a situation, the change in inequality will be zero. However, the redistributive effect will be positive and equal to the weighted sum described above, but where $RE_N$, $RE_t$, and $RE_B$ are the Reynolds-Smolensky indices for the net fiscal system, taxes (only) and benefits (only), respectively.

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26 For an analysis of the Shapley value and its properties see, for example, Shorrocks (2013).
27 The term “marginal” here is not to be confused with the term marginal used in defining a derivative in calculus.
28 The marginal contribution should not be confused with the marginal incidence, the latter being the incidence of a small change in spending. The marginal contribution is not a derivative. Note that, because of path dependency, adding up the marginal contributions of each intervention will not be equal to the total change in inequality. Clearly, adding up the sequential contributions will not equal the total change in inequality either. An approach that has been suggested to calculate the contribution of each intervention in a way that they add up to the total change in inequality, is to use the Shapley value. The studies analyzed here do not have estimates for the latter.
29 Note that if certain fiscal interventions come in bundles (e.g., a tax that only kicks in if a certain transfer is in place), the marginal contribution can be calculated for the net tax (or the net benefit) in question.
In other words, reranking introduces the equivalent of a “wildcard;” the only way to know if the net fiscal system is equalizing or not is by empirical estimation. One cannot predict whether a net fiscal system is equalizing by relying on the size and progressivity of taxes and transfers. Most if not all fiscal systems in real life feature some degree of reranking of households. The order of magnitude can vary; below we present an indicator to measure reranking and illustrate with examples from existing CEQ Assessments. Reranking is interpreted as a measure of fiscally-induced horizontal inequality.\(^{30}\) The more reranking there is, the more horizontal inequity.

It can also be shown that if there is reranking, which as we say is a pervasive feature of net fiscal systems in the real world, making a tax more progressive (vis-à-vis market income) can result in an increase in post-fiscal inequality. Let’s go back to Lambert’s table 1-1 to illustrate. Make the tax more progressive and see what happens. In Lambert’s example, regressive taxes not only enhance the equalizing effect of transfers, but making taxes more progressive (in other words, more disproportional in the Kakwani sense) would result in higher(!) inequality; any additional change (towards more progressivity) in taxes or transfers would just cause reranking and an increase in inequality.

In other words, reranking destroys the public finance dictum that: “…If the combined redistributive impact of tax and spending is progressive then the higher the level of tax and spending in a country the larger is the redistributive impact. Similarly, for a given level of tax and spending, the more revenue collection is concentrated in more redistributive taxes (progressive income taxes) and the more spending is concentrated in more redistributive transfers (well targeted social transfers), the greater the redistributive impact of fiscal policy.”\(^{31}\)

If there is reranking, in order to determine whether a particular intervention (or a particular policy change) is inequality-increasing or inequality-reducing--and by how much-- one must resort to numerical calculations. In particular, one must calculate the inequality indicator that would prevail with and without the specific intervention (or policy change).\(^{32,33}\)

### 1.2 Fiscal incidence analysis at a glance

As stated above, the CEQ Assessment relies on state-of-the art fiscal incidence analysis to address the following four questions:

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\(^{30}\) Duclos and Araar (2006).

\(^{31}\) Clements and others (2015, p.57).

\(^{32}\) The same applies to poverty indicators or any other indicator of interest.

\(^{33}\) The difficulties are compounded when one wants to compare the impact of net fiscal systems across countries because the original distributions (i.e., the income distribution before taxes and transfers) differ. For a discussion of comparing systems when the original distribution must be taken into account, see Lambert, op. cit., and Duclos and Araar, op. cit.
Chapter 1, Lustig & Higgins

--How much income redistribution and poverty reduction is being accomplished through fiscal policy? 34
--How equalizing and pro-poor are specific taxes and government spending?
--How effective are taxes and government spending in reducing inequality and poverty?
--What is the impact of fiscal reforms that change the size and/or progressivity of a particular tax or benefit?

Fiscal incidence analysis is used to assess the distributional impact of a country’s taxes, transfers and subsidies. 35 Essentially, fiscal incidence analysis consists of allocating taxes (for example, personal income tax, payroll taxes, other direct taxes such as property taxes, VAT, sales taxes and excise taxes) and public spending (for example, cash transfers, education, health, and housing spending, and consumption subsidies) to households so that one can compare incomes before taxes and transfers (pre-fiscal income) with incomes after taxes, transfers and subsidies (post-fiscal income). 36 Transfers in CEQ language refer to both cash transfers and near cash transfers such as school breakfasts and uniforms as well as benefits in kind such as free government services in education and healthcare. 37 In addition to assessing the impact of fiscal policy on the personal distribution of income, one may be interested in how taxes and transfers affect the welfare of different morally or institutionally relevant social groups such as groups of individuals differentiated by gender, ethnicity, or location.

Usually, fiscal incidence analysis just looks at what is paid and what is received without assessing the behavioral responses that taxes and public spending may trigger on individuals or households. This is often referred to as the “accounting” approach. Put simply, the accounting approach consists of starting from an income concept and, depending on the fiscal intervention under study, allocating the proper amount of a tax or a transfer to each household or individual. If the fiscal intervention is a direct tax (transfer) and one starts the analysis from pre-tax (pre-transfer) income, the post-tax (post-transfer) income is calculated by subtracting (adding) the tax paid (transfer received).

More formally, define the before taxes and transfers income of household \( h \) as \( I_h \) and taxes as \( T_i \) (where \( i \) refers to the range of taxes whose incidence is being analyzed) and transfers or benefits \( B_j \) (where \( j \) refers to the range of transfers whose incidence is being analyzed). Define the “allocator” of tax \( i \) to household \( h \) as \( S_{ih} \) (or the share of net tax \( i \) borne by unit \( h \)). Then, post-tax income of household \( b \) can be defined as \( Y_h \):

34 Throughout this handbook, fiscal policy, fiscal instruments, taxes and government spending, revenue collection and government spending, taxes and transfers, and taxes and benefits are used interchangeably.
35 For a description, applications and limitations of standard incidence analysis see, for example, Adema and Ladaique (2005); Alleyne and others (2004); Atkinson (1983); Bergh (2005); Bourguignon and Pereira da Silva (2003); Barr (2004); Barros and others (2009); Birdsall and others (2008); Breceda and others (2008); Dilnot and others (1990); Ferreira and Robalino (2010); Fiszbein and others (2009); Goï and others (2008); Goï and others (2011); Kakwani (1977); Lambert (2001); Lora (2006); Morra and others (2009); Lustig (2000); O’Donnell and others (2008); Shah (2003); Suits (1977); Van de Walle and Nead (1995); World Bank (2000/2001, 2006, 2009b, 2011).
36 In addition to the studies cited here and other studies in www.commitmentationequity.org, see, for example, Förster and Whiteford (2009); Immervoll and Richards (2011); OECD (2011).
37 Transfers in this Handbook are also called benefits and government spending interchangeably.
\[ Y_h = I_h - \sum_i T_i S_{ih} + \sum_j B_j S_{jh} \]

Although the theory is quite straightforward, its application can be fraught with complications. Most of the complications arise because actual incidence can be quite different from statutory incidence (for example, due to tax evasion) and the data to calculate the actual incidence is usually incomplete or absent. Part II of this Handbook is dedicated to explaining how to carry out incidence analysis in practice and complete a CEQ Assessment using the CEQ Master Workbook as the repository of “input” data and results. The chapters also provide detailed recommendations on how to address a wide range of challenges stemming from lack of information and measurement error.

Fiscal incidence analysis can be partial or comprehensive. Partial fiscal incidence analysis assesses the impact of one or several fiscal policy interventions: for example, income taxes or use of public education and health services. Comprehensive fiscal incidence analysis assesses the impact of the revenue and spending sides simultaneously: namely, the impact of direct and indirect taxes, cash and in-kind transfers, and indirect subsidies. Incidence analysis can use income or consumption (per capita or equivalized) to measure household welfare. Additionally, there is point-in-time versus lifetime fiscal incidence analysis. The analysis can assess a current system or estimate the potential or actual effects of particular reforms. It can use the statutory incidence or the actual one (include tax evasion or less than full take-up of a cash transfer, for example). It can make different tax shifting assumptions and about the value of in-kind benefits. The analysis can assess the average incidence of a tax or benefit or it can assess the incidence on the margin, the distribution of an increase in the spending of public education to increase primary enrollment.

In terms of data, incidence studies use micro-data from household surveys combined with budget data from fiscal accounts and other administrative registries. Since in practice surveys will not include information on every tax paid or transfer received (or, if the information exists, it may be inaccurate), that information must be generated in a consistent and methodologically sound way. Frequently, the information will have to be generated using a variety of assumptions to check the sensitivity of the results to assumptions that cannot be externally validated.

**Allocating Taxes and Transfers to Individuals: the Art of Fiscal Incidence Analysis**

As stated above, fiscal incidence analysis consists of allocating taxes (personal income tax and consumption taxes, in particular) and public spending (social spending and consumption subsidies, in particular) to households or individuals so that one can compare incomes before taxes and transfers with incomes after taxes and transfers. Transfers include both cash transfers and benefits in kind such as free government services in education and healthcare. Transfers also include consumption

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38 In addition to the studies cited here and other studies in [www.commitmenttoequity.org](http://www.commitmenttoequity.org), see, for example, Förster and Whiteford (2009); Immervoll and Richards (2011); OECD (2011).
subsidies such as food, electricity and fuel subsidies. The building block of fiscal incidence analysis is the construction of income concepts. That is starting from pre-fiscal income, *market income* (mainly, income from labour and capital and private transfers), each new income concept is constructed by adding another element of the fiscal system to the previous one. For example, *disposable income* subtracts direct personal income taxes and adds cash transfers to market income, *consumable income* subtracts indirect taxes and adds subsidies to disposable income and *final income* adds government spending on education and health to consumable income. See figure 1-1. The particular issue of including public contributory pensions with market income or cash transfers is discussed below.
Figure 1-1 Basic Income Concepts

**Market Income**
Wages and salaries, income from capital, private transfers (remittances, private pensions, etc.) before taxes, social security contributions and government transfers AND contributory social insurance old-age pensions ONLY in the case in which pensions are treated as deferred

**TAXES**
Personal income taxes AND employee contributions to social security ONLY in the case that contributory pensions are treated as transfers

**Direct cash and near cash transfers:** conditional and unconditional cash transfers, school feeding programs, free food transfers, etc.

**Indirect subsidies:** energy, food and other general targeted price subsidies

**In-kind transfers:** free or subsidized government services in education and health

**Consumable Income**
Indirect taxes: VAT, excise taxes and other indirect taxes

**Co-payments, user fees**

**Disposable Income**

**Final Income**
The basic incidence analysis used in CEQ Assessments is point-in-time rather than lifecycle and does not incorporate behavioral or general equilibrium modeling. That is, we do not claim that the pre-fiscal income obtained from this exercise equals the true counter-factual income in the absence of taxes and transfers. It is a first-order approximation. Despite being a standard incidence analysis that does not incorporate second-round or general equilibrium effects, the analysis is not a mechanically applied accounting exercise. We analyze the incidence of taxes by their (assumed) economic rather than statutory incidence. For instance, we assume that individual income taxes and contributions (both by employee and employer) are borne by labor in the formal sector and consumption taxes (on both final goods and inputs, using input-output tables for the latter) are fully shifted forward to consumers. This is equivalent to assuming that the supply of labor and demand for goods and services are perfectly inelastic. In the case of consumption taxes, furthermore, we take into account the lower incidence associated with own-consumption and tax evasion due to informality. Old-age contributory pensions are not automatically assumed to be a government transfer, a subject that is discussed in more detail below.

Despite the fact that the CEQ Assessments do not model behavioral, lifecycle, or general equilibrium effects, the method and resulting studies are among the most comprehensive and comparable tax-benefit incidence analyses available for middle income and low income countries to date.

We attempt to cover a very broad spectrum of taxes and government spending. Taxes include personal income and payroll taxes, other direct taxes such as property taxes, and consumption taxes. Spending on public goods such as defense and corporate taxes and subsidies are not included in CEQ Assessments (at least, not at this point).

Spending covers direct cash and near-cash direct transfers, indirect subsidies (especially on food, housing, energy and agricultural inputs), and benefits from public spending on education and health. Throughout the handbook, we refer to transfers, benefits and social spending interchangeably; “transfers” is intended to include indirect subsidies (which includes housing subsidies) and in-kind benefits from public spending on education and health.

As a rule, if taxes and transfers are explicitly available in the surveys, one should use this information unless there are reasons to believe that it is not reliable. However, the information on direct and indirect taxes, transfers in cash and in-kind, and subsidies is often not collected in household surveys. In order to allocate the benefits of transfers and burden of taxation to individuals included in the household surveys, the CEQ Assessments make use of administrative data on revenues and government expenditures as well as knowledge about how the tax and transfer programs work, and allocates them following methods that are described below. Thus, one of the most important aspects of CEQ is a detailed description of how each component of income is calculated (for example, directly identified in the survey or simulated) and the methodological assumptions that are made while calculating them. In many cases, the authors must choose a method based on the institutional structure of the country and the data available. CEQ relies on local experts as a crucial part of the research team for precisely this reason. In many cases, the researcher must exercise judgment based on their knowledge of the country’s institutions, spending, and revenue collection, and on the availability and
quality of the data. It is of the utmost importance to always describe what method was used for a particular tax or transfer, the reasoning for using this method, and—whenever possible—the sensitivity of the results to using alternative methods.

When taxes and transfers can be obtained directly from the household survey, we call this the *Direct Identification Method*. When the direct identification method is not feasible, there are several options which we have called *Inference, Imputation, Simulation, and Prediction*, and which are described in detail in chapter 5. If the primary survey being used for the CEQ Assessment does not have the necessary information, these methods can be used in an alternate survey, then benefits or taxes matched back into the main survey. As a last resort, one can use secondary sources: e.g., incidence or concentration shares by quintiles or deciles that have been calculated by other authors. Finally, if none of these options can be used for a specific category, the analysis for that category will have to be left blank.

One of the biggest challenges for the CEQ Assessments has to do with how to treat the differences in scale and structure between survey-based values and administrative registries. The causes for these differences are multiple including differences in definitions, but most prominently measurement errors due to under-reporting of certain income categories (for example, income from capital) and under-sampling of the rich in the surveys and measurement errors in national accounts. Whatever the cause, the overriding principle followed in the CEQ is that—unless there are good reasons not to—the information in the surveys is taken as valid and given precedence over and above the information from administrative registries. However, whenever the team has sufficient evidence to believe that totals in the survey are less credible than those in administrative registries, the latter should be used and the rationale properly documented (more on this in chapter 5).

CEQ is not the only methodological framework for applying fiscal incidence analysis. EUROMOD, based in the University of Essex, and LATAAX—a multi-country flexible tax micro-simulation model—, housed in the Institute of Fiscal Studies, are two alternatives. Their characteristics are described in the appendix to chapter 5.

Because the process of allocating taxes and transfers relies on assumptions that one cannot truly test or uses definitions for which there is no overriding consensus, it is recommended to carry out robustness checks to assess the reliability of results. For example, use consumption instead of income, use equivalized income instead of per capita income, change assumptions about tax evasion or program take-up, assume ratios of taxes and transfers to disposable income are the same in the surveys as in national accounts, and so on.
Old-age Social Insurance Contributory Pensions: A Government Transfer or Deferred Income? 39

The treatment of pensions from government-sponsored social insurance compulsory pension schemes (henceforth, contributory pensions) poses a particular challenge. Should contributions be treated as a tax or a form of “forced saving”? Should income from contributory pensions be treated as a government transfer or deferred income (consumption)? This decision will have a significant impact on assessing the redistributive power of a fiscal system especially in countries with a high proportion of retirees and large spending on social security.

In the incidence analysis literature, one can find both approaches: in some cases contributory pensions are considered deferred income40 while in others—especially in systems with a large subsidized component—they are considered a pure government transfer.41 We believe that treating income from contributory pensions as a pure transfer is misleading. In populations with a large proportion of retirees, market income will be zero or close to zero for a large number of individuals. The fiscally-induced inequality and poverty reduction will be overestimated because the system will feature many “false poor.”

To make the point clearer, let’s assume a pensioner had been earning a high wage during her working years and that, privately, she could have saved enough so that at the time of retirement, her pension would have been at a 100 percent replacement ratio. Let’s assume that instead she receives a pension from the social security system and that this is her only income. If her pension is treated as a pure government transfer, she will have been ranked among high wage-earners during her working years and fall to the destitute poor during retirement. This does not make sense. Although any government tax or transfer might generate behavioral changes42, social security is special in the sense that it is a lifelong contract between a working individual and society. Although a CCT or other cash transfer will likely induce some behavioral changes, not having a government-sponsored retirement plan would generate major behavioral changes in a significant part of the population commanding an even larger share of income.

Some may argue that, in the absence of a government-sponsored program, individuals would not save enough for their old-age and could become much poorer so treating pensions as a transfer makes sense. However, the government’s role could be just that of a “piggy bank”43 forcing individuals to save during their working years to ensure an income stream during retirement. Reflecting this role, many countries place Social Security in a separate budget, protected from the politics governing other public expenditures.

39 The authors are very grateful to Francois Bourguignon, Francisco Ferreira, Carlos Grushka, Santiago Levy, Angel Melguizo, Rafael Rofman, Sergei Soares, and Sergio Urzua for their invaluable insights.
40 Alvaredo and others (2015); Breceda and others (2008); Immervoll and others (2009).
41 Goñi and others (2011); Immervoll and others (2009); Lindert and others (2006); Silveira and others (2011)
43 Barr (2001).
Thus, as long as there is a government-sponsored old-age pension system with a mandatory savings component during individuals’ working years, pensions should not be treated as a transfer (at least, not in full). Independently of whether a system is fully-funded or pay-as-you-go, or whether it is a defined benefit or defined contributions system,\(^4^4\) the redistribution and transfer components of a pension from a government-sponsored system have to be calculated against what would have happened if the contributions would have been placed in an interest-bearing individual account whose accrued assets would be used to finance consumption during retirement years through an annuity or in some other way. In addition, to be consistent, contributions have to be treated as “forced savings” and not a tax, to avoid double counting of this income (when it is earned as labor income and then later as retirement income).

If there is within-system redistribution, people are implicitly taxed, or receive a transfer, at the time of retirement: if their pension is below what they would have received had the contributions been privately saved at the market expected return, the difference is the tax; in contrast, for the retirees whose pension is above what they would have received in the private savings counterfactual, the difference is a transfer. In a system that is actuarially fair as a system, this tax and transfer process occurs implicitly within the system. In a system that is actuarially fair at the system level as well as at the level of each individual, there is neither redistribution within the system nor from other revenue sources. This would be, in the social security systems’ jargon, equivalent to a fully-funded defined contribution system. However, if the system is not actuarially fair, in addition to within-system redistribution there is a redistribution process that takes place when government revenues (for example, taxes) are used to finance the deficit of the social security system.

Let us illustrate with a simple set of formulas. Let us assume that there are only two types of individuals: working and retired. Given that we need to develop a framework that can be applied to cross-section household surveys, in the following the individual during working years and the individual during retirement are not the same.

Let us define:

\[
Y_f = \text{factor income during working years (grossed up for employer contributions to pensions)}
\]

\[
Y_m = Y_f(1 - s) + Y_o = \text{market income during working years, where } Y_o = \text{other income during working years (e.g., private transfers, remittances, and alimony)}
\]

\[
s = \text{rate of contributions to contributory pensions (as a proportion of factor income) during working period made by worker and employer (we assume that employer shifts his/her contributions to the worker in the form of lower wages)}\(^4^5\)
\]

\(^4^4\) See, for example, Barr (2012) for a description of pension systems.

\(^4^5\) See, for example, Melguizo and Gonzalez-Paramo (2013).
Chapter 1, Lustig & Higgins

\[ Y = \text{disposable income during working years} \]

\[ Y' = \text{disposable income during retirement} = Y'_p + Y'_o, \text{ where } Y'_p = \text{income from contributory pensions (net of any taxes paid on income from contributory pensions different from the implicit taxes that occur if there is within-system redistribution)}, \text{ and } Y'_o = \text{other income during retirement}. \text{ If contributory pensions are the only source of income during retirement, then we have } Y' = Y'_p. \]

\[ C = \text{consumption during working years} \]

\[ C' = \text{consumption during retirement} \]

\[ R = (1+r)sY_f \text{ the annuity (or some other payment form) that would have been generated by the contributions } sY_f \text{ made by the retirees over their lifetime and the returns } rsY_f \text{ (with “r” equal to the interest rate) on those contributions in a purely private system} \]

\[ t = \text{the within-system tax for individuals whose pension is below } R \text{ (implicit tax paid by individuals at the time of retirement to other pensioners in the system due to within-system redistribution)} \]

\[ b = \text{the within-system transfer for individuals whose pension is above } R \text{ (implicit transfer received by individuals at the time of retirement from other pensioners in the system due to within-system redistribution)} \]

\[ \omega = \text{proportion of deficit in the pension system allocated to each pensioner} \]

\[ d = \omega Y'_p = \text{absolute pension amount received by each pensioner that is funded by deficit spending or general revenues; that is, transfer.} \]

\[ B, B' = \text{direct transfers during working years, direct transfers during retirement (these are other direct transfers during retirement, different from the transfers due to within-system redistribution or that emanate from the deficit of the social security system)} \]

\[ T, T' = \text{direct taxes during working years (these taxes do not include contributions to the old-age pensions of the social security system), direct taxes during retirement (these are taxes unrelated to the within-system redistribution of the social security system)} \]

The following table summarizes the general formulation from theory.

Table 1-2. General formulation from theory
Ideally, one would like to be able to estimate the within-system redistribution: i.e., the tax-cum-transfer (the t and b). In practice, however, it is quite problematic to calculate R—i.e., the annualized income that would correspond to the accumulated contributions and their respective return in the private saving counterfactual—from cross-section household surveys since one does not know the history of contributions of individuals who are receiving a pension at the time of the survey.

Thus, in CEQ Assessments we have decided to do the following. In household surveys, we usually construct disposable income (in income-based surveys) or private consumption (in consumption-based surveys). In systems that do not have a deficit in the year of the survey, during working years, we assume that contributions are a form of “forced saving” and all income concepts—should be net of contributions to the contributory pension systems; in income-based surveys, this implies subtracting these contributions from all income concepts from market to final income, while in consumption-based surveys it implies not adding these contributions into any “income” concept, since observed consumption is already net of these contributions.46 This way one avoids double counting since this saving is treated as income/consumption during retirement. Note that in the income-based scenario, the “double-counting” problem does not occur with other forms of savings since we do not include dissaving (either through selling of assets, withdrawing from savings or borrowing) as part of income. In the consumption-based scenario, although dissaving is implicit in observed consumption, so is saving; thus, there is no double-counting issue either. This is so because observed consumption by definition will be equal to the portion of income consumed during the period plus dissaving (amounts borrowed or withdrawn from bank accounts, or revenues from selling of assets) minus saving.

During retirement, income from contributory pensions are assumed to be equal to the private saving counterfactual and thus in a fully-funded system, contributory pensions are considered part of market income (independently of whether contributory pensions are subject to taxation or not). If the only income a retiree receives is income from contributory pensions, then Y’ (disposable income) is

---

46 In the previous version of the Handbook (Lustig and Higgins, 2013), we did not make this important point.
implicitly assumed to be equal to \( R \) minus any taxes paid on contributory pensions (different from the implicit taxes that arise from within-system redistribution) plus any other transfers. In other words, market income is disposable income plus any taxes paid on contributory pensions, if such taxation exists, minus government transfers. This scenario is equivalent to assuming a fully-funded defined contributions system.

The following table summarizes CEQ practice in the case in which contributory pensions are considered deferred income and there is no deficit in the social security system in the year of the survey. We call this Scenario 1.\(^{47}\) For simplicity, here and in all the scenarios below, we assume that there are no retirees in the household during working years and that there are no working members in the households during retirement. However, in practice, we take into account the fact that—especially in developing countries—households will be frequently composed of both working members and retirees.

Table 1-3. Scenario 1

| Scenario 1 in CEQ Assessments: Pensions are treated as deferred income and contributions as forced saving. \( R \) is unknown and social security system has no deficit during year of survey. |
|---|---|---|---|---|
| | Contributions to Old-Age Social Security System | Market Income | Tax | Transfer |
| **Working** | \( Y_f \) | \( s Y_f \) | \( Y_m = Y_f (1 - s) + Y_o \) | \( T \) | \( B \) |
| **Income-based Scenario** | | | | | | \( Y = Y_m - T + B \) |
| **Retirement** | 0 | 0 | \( R + Y_o' \) | \( T' \) | \( B' \) | \( Y' = R + Y_o' - T' + B' \) |

| **Consumption-based scenario** |
|---|---|---|---|
| **Working** | \( Y_f \) | \( s Y_f \) | \( C + T - B \) | \( T \) | \( B \) | \( C \) |
| **Retirement** | 0 | 0 | \( C' + T' - B' \) | \( T' \) | \( B' \) | \( C' \) |

In systems with a deficit, as with the case without a deficit, we assume that contributions are a form of “forced saving” during working years. Hence, all income concepts—included market income—are net of the contribution. During retirement, income from contributory pensions are assumed to be equal to the private saving counterfactual plus a transfer that allocates the deficit proportionately to people’s pensions. The pension minus this transfer is considered to be market income (independently of whether pensions are subject to taxation or not). In other words, for an individual during retirement, market income equals disposable income plus any taxes paid on pensions, if such taxation exists, minus the transfer to the pension system (that is, the deficit corresponding to old-age pensions in the social security system during the year of the survey) that is allocated to that individual and minus other government transfers received by the same individual.

\(^{47}\) In the previous version of the Handbook (Lustig and Higgins, 2013), Scenario 1 was called the “benchmark case.”
Since one does not have any additional information, in CEQ we assume that the portion of the deficit allocated to each individual receiving a contributory pension during retirement is proportional to their pension income. That is, \( d = \omega Y_p' \), where \( \omega = \text{the ratio} \ D/\text{total spending on social security old-age pensions in the year of the survey when} \ D > 0 \) and \( D = \text{deficit of old age pensions system = total spending on social security old-age pensions less total revenues in the year of the survey.} \) Since in most consumption-only surveys we don’t know how much of the income comes from pensions, and since many households are made up in practice of some retired individuals and some non-retired ones (so we can’t just set \( d = \omega C' \)), we attempt to estimate \( Y_p' \). For example, in the CEQ Assessment for Indonesia, \( Y_p' \) (and \( sY_p \) which was similarly not available in the consumption-only survey) was estimated as follows. Individuals potentially making contributions to (as well as those potentially receiving income from) the pension system were identified using individual characteristics such as relationship to household head, age, education, sector of work, and most importantly participation in other benefit schemes for civil servants. Contribution and benefit amounts were estimated using parameters from an imputed wage regression carried out in a secondary labor force survey.\(^{49}\)

The following table summarizes CEQ practice in the case in which pensions are considered deferred income and there is a deficit in the social security system in the year of the survey. We call this Scenario 2.

### Table 1-4. Scenario 2

<table>
<thead>
<tr>
<th>Income-based Scenario</th>
<th>Consumption-based scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contributions to Old-Age Social Security System</strong></td>
<td><strong>Contributions to Old-Age Social Security System</strong></td>
</tr>
<tr>
<td>Working ( Y_f )</td>
<td>Working ( Y_f )</td>
</tr>
<tr>
<td>Retirement 0</td>
<td>Retirement 0</td>
</tr>
<tr>
<td><strong>Market Income</strong></td>
<td><strong>Market Income</strong></td>
</tr>
<tr>
<td>( Y_m = Y_f (1 - s) + Y_o )</td>
<td>( C + T\cdot B )</td>
</tr>
<tr>
<td><strong>Tax</strong></td>
<td><strong>Tax</strong></td>
</tr>
<tr>
<td>( T )</td>
<td>( T' )</td>
</tr>
<tr>
<td><strong>Transfer</strong></td>
<td><strong>Transfer</strong></td>
</tr>
<tr>
<td>( B )</td>
<td>( B' + \omega Y_p' )</td>
</tr>
<tr>
<td><strong>Disposable Income</strong></td>
<td><strong>Disposable Income</strong></td>
</tr>
<tr>
<td>( Y = Y_m - T + B )</td>
<td>( Y' = R + Y_o - T' + B' + \omega Y_p' )</td>
</tr>
</tbody>
</table>

In order to compare with exercises in which people assumed that contributions are a tax and pensions are a pure transfer, we suggest to calculate such a scenario in the CEQ Assessment as well. In this extreme case, market income for pensioners equals zero or other income if there is one, and the transfer equals the entire pension.\(^{50}\) Contributions paid during the year of the survey are equal to \( sY_f \) and are treated as a pure tax.\(^{51}\)

\(^{48}\) Note that one might also want to use the actuarial deficit rather than the actual one if an estimate was available.\(^{49}\) Afkar, Jellema, and Wai-Poi (forthcoming).\(^{50}\) In the previous version of the Handbook (Lustig and Higgins, 2013), Scenario 1 was called the sensitivity analysis scenario.\(^{51}\) This scenario should not be viewed as a special case of the general framework developed above but rather a scenario we construct to compare with the typical assumptions made in other exercises (e.g., EUROMOD). As such, it is
The following table summarizes the CEQ practice when contributory pensions are considered a pure government transfer and contributions a pure tax. We call this Scenario 3.

**Table 1-5. Scenario 3**

<table>
<thead>
<tr>
<th>Income-based Scenario</th>
<th>SCENARIO 3 IN CEQ ASSESSMENTS: PENSIONS ARE TREATED AS A GOVERNMENT TRANSFER AND CONTRIBUTIONS AS A TAX</th>
<th>Consumption-based scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Contributions to Old-Age Social Security System</strong></td>
<td><strong>Market Income</strong></td>
</tr>
</tbody>
</table>
| Working                | $Y_1$ | 0 | $Y_m = Y_f + Y_o$ | $T + sY_f$ | $B$ | $Y = Y_m - T - sY_f + B$ | $C + T + sY_f - B$ | $T + sY_f$ | $B$ | $C$
| Retirement            | 0 | 0 | $R + Y_o$ | $T$ | $B + Y_o'$ | $Y' = R + Y_o - T + B + Y_o'$ | 0 | 0 | $C' + T' - B' - Y'$ | $T'$ | $B' + Y'$ | $C'$

It is important to note that the above formulation does not incorporate the case in which the social security deficit is financed through debt, which would have implications for the tax burden on future generations.

Another clarification worth making is that if pensions of public servants have a component that is a transfer (whether partial or in full), this does not immediately mean that they should be treated as a pure transfer. That depends on whether pension income is part of the labor contract of public servants. If their remuneration in the private sector during the working years would have been higher but their pension benefits lower, this would be the case in which pensions—although in the government’s bookkeeping might appear as a transfer—are actually a component of wages of public employees.

**Policy simulations**

The CEQ Handbook describes how to estimate the distributional impact of a system of taxes, cash transfers and in-kind services using micro-data. Once this is done for the existing public finance system, one might want to explore further issues to get a fuller understanding of the impacts of tax and spending policy, and the opportunities and risks of policy change. What is the impact of a particular set of reforms to the system on the incomes and spending power of different types of households, and the government’s revenue or spending? What about the potential behavioral impacts of the existing system or reforms to it? These are the kinds of issues that are typically examined using tax-and-transfer microsimulation models. There are several different types of model, that vary in the types of impact they can be used to assess.\(^5\) Policy simulations in CEQ are done “manually.” See the

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\(^5\) Two salient examples are EUROMOD and LATAX, a description of which are presented in Chapter 5. Also, see Bourguignon and Pereira da Silva (2003), Bourguignon and Spadaro (2006), and Urzua (2012). For further information on the different types of model that can be developed, and the data requirements for each of these, see Chapters 1–9 of the Handbook of Microsimulation, O’Donoghue (2014).
Chapter 1, Lustig & Higgins

chapter by Stephen Younger on how one can use CEQ to simulate the elimination of energy subsidies in Ghana and Tanzania, and the impact of compensatory cash transfers.

Caveats

Behavioral Responses

At this point, CEQ only considers first-order effects (also known as partial equilibrium analysis). We do not account for behavioral or general equilibrium effects, although it is worth noting that our economic incidence assumptions (for example, on who bears the burden of payroll or consumption taxes) are based on general equilibrium theory. In essence, one assumes zero demand price and labor supply elasticities and zero elasticities of substitution among inputs, which may not be far-fetched assumptions for analyzing effects in the short-run. “The first order estimate is much easier to calculate, provides a bound on the real-income effect, and is likely to closely approximate a more sophisticated estimate. Finally, since one expects that short-run substitution elasticities are smaller than long-run elasticities, the first-order estimate will be a better approximation of the short-run welfare impact.”

Box 1-1 provides more detail on the accuracy of these first-order approximations. In some context, behavioral responses can be quite significant so results based on first-order approximation must be taken with great caution.

Box 1-1

**Ignoring Behavioral Responses to Tax and Expenditure Policies**

Stephen Younger, CEQ Institute

Many incidence analyses, including standard CEQ analyses, ignore households’ behavioral responses to taxes and expenditures. This greatly simplifies the analysis as it obviates the need for demand estimation, but it may also prove to be misleading. As it turns out, the estimate of a tax’s cost or an expenditure’s benefit used in the simple approach of a standard incidence analysis is usually a first-order approximation to the true cost or benefit. The question of how misleading this analysis is then boils down to asking: how good is a first-order approximation?

Consider an *ad valorem* indirect tax of t percent. In competitive markets, this will raise the price of the good(s) taxed by t percent. A standard measure of the cost of such a tax to consumers is the compensating variation: the amount of additional expenditure a consumer would need to keep her utility constant in the face of the price increase:

\[
CV = e(p^1, u^0) - e(p^0, u^0) = \int_{p_0}^{p_1} x^c(p, u^0) dp
\]

---

53 Coady and others (2006, p. 9)
54 Ravallion and Chen (2015)
where e() is the expenditure function; p¹ is a vector of prices inclusive of the tax, which is what we usually observe; p⁰ is a vector of prices without the tax; u is utility; and xᶜ is the compensated demand function. The second equality shows that the compensating variation is equal to the area under the compensated demand curve. If we take a Taylor expansion of this function around p¹ and allow all prices to vary with the tax, we have:

\[
CV \approx \sum_i x_i^c (p^1, u^0) \Delta p_i + \frac{1}{2} \sum_i \sum_j \frac{\partial x_i^c (p^1, u^0)}{\partial p_j} \Delta p_i \Delta p_j + \ldots
\]

If we limit our interest to the change in one price only, this reduces to:

\[
CV \approx x_i^c (p^1, u^0) \Delta p_i + \frac{1}{2} \frac{\partial x_i^c (p^1, u^0)}{\partial p_i} \Delta p_i^2 + \ldots
\]

The first term of the expansion is what a standard incidence analysis uses to estimate the cost of a tax to consumers: the ex post quantity consumed times the difference in prices, which is the tax rate. The second term is a linear approximation of the behavioral response – the change in (compensated) demand induced by the price change. Higher order terms approximate any non-linearity in the demand function. The accuracy of standard incidence methods thus depend on the size of the higher-order terms.

A figure can help assess this accuracy. Figure 1-2 shows the compensating variation for a single tax on good i, which is the area to the left of the demand curve from P₀ to P₁. The first-order approximation is area ABEF. The second-order term is BDE. And higher-order terms capture the eye-shaped area between the demand curve and the line BD segment.

Figure 1-2. Variation for a single tax on good i
The first-order approximation captures the largest share of the compensating variation, as it should. It is straightforward to show that the ratio of the second-order term to the first-order increases in the size of the price change and the demand elasticity. That is, the first-order approximation is more accurate for smaller price changes and for more inelastic demands.

It is worth noting that many of the tax and expenditure policies that a typical incidence analysis evaluates do in fact have inelastic demands: VAT taxes all consumption; income tax falls on labor supply; excises are often levied on products with inelastic demand like petroleum or tobacco. On the expenditure side, demands for the health and education services governments provide are often inelastic. All of this suggests that the first-order approximations to the compensating variation are adequate. On the other hand, the price changes tend to be non-marginal.

It is important to note that the first-order effects do take into account both the direct effects of indirect taxes and subsidies as well as the indirect effects on final goods’ prices of indirect taxes/subsidies applied to inputs. For the latter, one uses input-output matrices, described in chapter 6 of this Handbook. Indirect effects should not be confused with general equilibrium effects because the indirect effects measured with input-output tables still do not incorporate behavioral responses to changes in relative prices.

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55 Inchauste and Jellema (chapter 6 of this Handbook).
Chapter 1, Lustig & Higgins

If a team decides to depart from partial equilibrium analysis, it should be carefully explained and done as an additional sensitivity analysis so that the main results can still be compared with those for other countries.\(^{56}\)

**Intertemporal Effects and Lifetime Incidence**

CEQ analyzes cross-sectional data and thus provides a point-in-time perspective on the incidence of taxation and social spending. While some work has focused on intertemporal effects and lifetime tax incidence, we do not due to data limitations. In particular, “the lifetime perspective requires much more data over long periods of time, because results depend critically on the whole shape of the lifetime earnings profile.”\(^{57}\) Compared to a lifetime perspective, we are therefore likely overstating the progressivity of income taxes and the regressivity of consumption taxes. We take some solace in findings that replacing annual income with a longer-term income average did not significantly reduce the measured degree of inequality in the U.S.\(^{58}\), and findings that “the lifetime incidence of the entire U.S. tax system is strikingly similar to the annual incidence.”\(^{59}\)

**Spillover Effects**

CEQ does not incorporate spillover effects due to the difficulty in estimating their magnitudes and the beneficiaries.\(^{60}\)

1.3 CEQ Assessment: Indicators

The indicators used in a CEQ Assessment can be categorized by the questions a CEQ Assessment is designed to address, described at the beginning of this section. The main indicators are overviewed here and described in more detail, including their mathematical formulas when applicable and instructions on producing the indicators using the CEQ Stata Package, in Higgins (chapter 7 of this Handbook).

--How much income redistribution and poverty reduction is being accomplished in each country through the fiscal system (taxes, social spending, and subsidies)?

We use various indicators to answer this question, further organized by the following sub-questions.

--Does the fiscal system reduce inequality?

\(^{56}\) For work on incidence analysis accounting for behavioral effects, see, for example, Coady (2006) and Ravallion and Chen (2015).


\(^{58}\) Slemrod (1992).


\(^{60}\) For estimates of the spillover effects of cash transfer programs, see Barrientos and Sabates-Wheeler (2009); Angelucci and De Giorgi (2009).
First, we compare inequality for the different income concepts described earlier in this chapter. Doing so allows us to trace out how inequality evolves as different transfers and taxes are added to and subtracted from income. For example, comparing market and disposable income inequality shows how much redistribution is achieved by direct transfers and taxes, while comparing disposable and consumable income inequality shows how much redistribution is achieved by indirect subsidies and taxes, and comparing consumable and final income inequality shows how much redistribution is achieved by in-kind transfers in the form of health, education, and other public spending. Finally, comparing market and final income inequality shows how redistributive is the fiscal system as a whole.

The inequality measures used in CEQ include the Gini, S-Gini, Theil, and 90/10 indices. In addition, we measure how ex-ante inequality of opportunity varies across income concepts, where inequality is measured using the mean log deviation. We also decompose the change in inequality between income concepts into that of vertical equity and horizontal inequity (reranking), where the latter is measured by the Atkinson-Plotnick index of reranking.

--Does the fiscal system decrease poverty?

We can again assess the impact of the fiscal system by tracing out the change in poverty across income concepts. The poverty measures we use are members of the FGT class of poverty measures, and include the headcount index, which measures the proportion of the population that is poor; the poverty gap ratio, which measures the depth of poverty; and the squared poverty gap ratio, which measures the severity of poverty. We measure poverty for a number of poverty lines, including commonly used “international poverty lines”, national extreme and moderate poverty lines, and any other extreme and moderate poverty line that is relevant such as the lines estimated by the UN Economic Commission for Latin American and the Caribbean (in the case of countries in Latin America), and a relative poverty line set as a percent of median income (commonly 50 or 60%). If the 2005 International Comparison Project (ICP) is used for purchasing power parity (PPP) adjustments, these lines are commonly set at $1.25, $2.50, and $4 per person per day. If the 2011 ICP is used, an extreme poverty line of $1.90 is the official World Bank extreme poverty line, while a line of $3.10 is the median of all poverty lines, and in this sense is analogous to the $2.50 (2005 PPP) line and could be used as a moderate poverty line, although it is not an official World Bank poverty line. Note that in some regions, other poverty lines are commonly used, such as a $5 (2005 PPP) per person per day line for Europe and Central Asia.

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61 For more detail about these concepts, see Higgins and Lustig (chapter 5 of this Handbook).
62 For a comprehensive discussion of inequality indexes and their properties see, for example, Duclos and Araar (2006).
63 See Ferreira and Gignoux (2011).
64 See Duclos and Araar (2006).
65 Foster and others (1984).
66 Chen and Ravallion (2010); Ferreira and others (2013).
67 Ferreira and others (2016).
We also use dominance tests to assess whether poverty is unambiguously lower in one income distribution than another for a range of poverty lines and broad class of poverty measures.\(^{68}\)

In addition to directly measuring the change in poverty caused by taxes and transfers, we assess whether various groups (e.g., income deciles) are net payers to the fiscal system or net receivers of transfers on average. These averages provide an overall picture of who tends to benefit more from or pay more to the fiscal system across the income distribution, but could overlook substantial variation within each decile.

---Does the fiscal system make the poor poorer, or the non-poor poor?

Even if a tax and transfer system unambiguously reduces poverty and inequality, and is progressive, it can make a substantial portion of the poor poorer, or non-poor poor.\(^{69}\) This startling result occurs because poverty indicator are anonymous in the sense that we do not know whether a particular individual with a set post-fiscal income had a lower or higher pre-fiscal income. Figure 1-3 illustrates. The dark grey areas refer to poor (nonpoor) individuals who were made poorer (poor) by the prevailing combination of taxes and transfers. In contrast, the light grey areas are pre-fiscal poor individuals who were made less poor.

Figure 1-3: Fiscal Impoverishment and Fiscal Gains to the Poor

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\(^{68}\) Atkinson (1987); Foster and Shorrocks, (1988).

\(^{69}\) Higgins and Lustig (2016).
We thus use the measures of fiscal impoverishment\textsuperscript{70} to assess the extent to which the tax and transfer system makes some of the poor poorer and some of the non-poor poor.\textsuperscript{71} As shown, the poverty gap ratio can be exactly decomposed in the measure of fiscal impoverishment and fiscal gains to the poor. When using these measures, please cite the Higgins and Lustig article, which is reprinted as chapter 4 of this Handbook for the reader’s convenience.\textsuperscript{72}

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How equalizing and pro-poor are specific taxes and government spending?

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Is a particular tax or transfer equalizing (unequalizing)?

To determine whether a particular tax or transfer is equalizing or unequalizing, we use the marginal contribution of that tax or transfer to inequality. In essence, the marginal contribution equals the difference between the inequality indicator measured without the tax or transfer of interest but with all the other components of fiscal policy in place MINUS the same indicator with all the components including the one whose effect we are interested. If this difference is positive (negative), then the tax or transfer is equalizing (unequalizing): i.e., inequality is higher (lower) without the tax or transfer of interest than with it. If the difference equals zero, the tax or transfer is “neutral” (in other words, it does not affect inequality or poverty). So, for example, let’s say one would like to know whether the value added tax (VAT) is unequalizing. One would calculate, for instance, the Gini coefficient with a new income concept defined as consumable income (see figure 1-1) less VAT and would subtract the Gini coefficient for consumable income. If the difference is positive (negative), the VAT is equalizing (unequalizing). Box 1-2 by Ali Enami defines the marginal contribution in more formal terms.

\textbf{Box 1-2. Marginal Contribution}

\textit{Ali Enami, Tulane University}

We use \( T \) and \( B \) to refer to Taxes and Benefits, where \( T \) can refer to any combination of direct and indirect taxes, and \( B \) can refer to any combination of direct transfers, indirect subsidies, and in-kind transfers from public spending on health and education. The indicators can also be defined for combinations of taxes and transfers, which is why we write “\( T \) (and/or \( B \))” throughout. We calculate the Marginal Contribution (MC) of any combination of taxes or benefits as follows:

\[
MC_{T (and/or B)} = \text{Index}_{\text{End income}} \setminus T (and/or B) - \text{Index}_{\text{End income}}
\]

\textit{Index} refers to any inequality or poverty indices that one may use in the calculation of the marginal contribution. For example, we use the Gini index as a measure of inequality. The subscript of the \textit{Index}, i.e. \textit{End income}, refers to the income concept with respect to which we calculate the marginal contribution to the index of a tax or benefit. For example, \textit{Gini}_{Disposable Income} means the Gini coefficient of disposable income and if we use it for \textit{Gini}_{End Income} it implies that we are interested

\textsuperscript{70} Derived in Higgins and Lustig (2016).

\textsuperscript{71} Higgins and Lustig (2016).
in calculating the marginal contribution of a tax or benefit to the disposable income Gini. “End income \((and/or B)\)” refers to the income concept that is equivalent to the End income prior to the tax or benefit of interest. For example “Disposable Income\(\backslash\)Direct Taxes” equals disposable income plus direct taxes (to have the income concept prior to subtracting out direct taxes). Intuitively, \(MC_{End income}^{T (and/or B)}\) is how much the value of \(Index_{End income}\) would have changed if \(T (and/or B)\) are removed from the fiscal system. It should be noted that the End income does not have to be one of the CEQ core income concepts. An example is that if we want to calculate the marginal effect of indirect taxes with respect to disposable income, since indirect taxes have not yet been subtracted out of disposable income, the end income concept would be “Disposable Income minus Indirect Taxes”. The MC in this case would be calculated as follows:

<table>
<thead>
<tr>
<th>(MC_{Indirect Taxes}^{Disposable Income minus Indirect Taxes})</th>
<th>(Index_{Disposable Income} - Index_{Disposable Income minus Indirect Taxes})</th>
</tr>
</thead>
</table>

On the other hand, if we were calculating the MC of direct taxes with respect to disposable income, since disposable income is already net of direct taxes, the end income would be disposable income, while the end income without the fiscal intervention would require taking disposable income and adding back in direct taxes, so we would have:

<table>
<thead>
<tr>
<th>(MC_{Direct Taxes}^{Disposable Income})</th>
<th>(Index_{Disposable Income plus Direct taxes} - Index_{Disposable Income})</th>
</tr>
</thead>
</table>

In calculating MC, what matters is that we have two income concepts that are only different from each other because of one component or a bundle of taxes and/or transfers. In other words, one can use components of a fiscal system separately and also in different combinations (i.e. bundles) to perform a marginal contribution analysis. An example would be to evaluate the inequality reducing effect of different taxes in a system separately and then the whole taxation system together as one entity. Regardless of how a component or bundle is set up, we consider the difference for a particular inequality index between these two income concepts (i.e. the End Income with and without that specific component or bundle) as the MC of that fiscal intervention.

While the above examples are all about the Gini index, the concept of marginal contribution is applicable to any inequality or poverty index.

Source: Chapter 2 in this Handbook.

In addition to the marginal contribution, we measure progressivity using concentration coefficients and Kakwani coefficients, but the chapter 2 of this Handbook\(^73\) shows why a progressive tax or transfer is not necessarily equalizing (as explained earlier in this chapter).

By comparing the sign of the marginal contribution with the Kakwani coefficient, we can determine if a tax or transfer is equalizing despite being regressive, or unequalizing despite being progressive.

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\(^73\) Enami, Lustig, and Aranda, chapter 2 in this Handbook.
Chapter 1, Lustig & Higgins

Note that this can happen for two reasons: due to Lambert’s conundrum, which can occur even in the absence of reranking, or due to reranking. 74

--What is the contribution of a tax or a transfer to the fiscally-induced change in inequality and poverty?

We once again use the marginal contribution for this, comparing the size of the marginal contribution of a particular tax or transfer to the overall inequality or poverty reduction caused by the fiscal system. Note, however, that this does not provide a direct decomposition of the total effect into a sum of its parts from each tax or transfer. Attempting to do such a decomposition encounters path dependency issues. 75 While using something like a Shapley value would ensure that the sum of the individual contributions adds up to the total redistributive effect, a Shapley value does not lend itself to a clear policy interpretation while the marginal contribution does: it tells us what would be the influence of a particular tax or transfer or a change in that tax or transfer on inequality.

--Is a particular spending item pro-poor?

Once it has been established that the marginal contribution of a fiscal intervention to inequality is positive (i.e., the fiscal intervention is equalizing), we can determine whether it is pro-poor by comparing its concentration curve to the original income Lorenz curve. (The concentration coefficient also serves as a summary indicator of whether the concentration curve is above [coefficient less than Gini] or below [coefficient greater than Gini] the original income Lorenz, and above [coefficient less than 0] or below [coefficient greater than 0] the 45-degree line of perfect equality. Concentration curves provide a better assessment, however, as they could cross the Lorenz curve or 45-degree line, which is not revealed by the concentration coefficient.)

The pro-poorness of public spending here is defined using concentration coefficients (also called quasi-Ginis). 76 In keeping with conventions, spending is defined as regressive whenever the concentration coefficient is higher than the Gini for market income. When this occurs, it means that the benefits from that spending as a share of market income tend to rise with market income. Spending is progressive whenever the concentration coefficient is lower than the Gini for market income. This means that the benefits from that spending as a share of market income tend to fall with market income. Within progressive spending, spending is neutral in absolute terms -- spending per

74 The implications of reranking are explained in more detail in Enami (chapter 3 of this Handbook).
75 Shorrocks (2013)
76 A concentration coefficient is calculated in a way analogous to the Gini coefficient. Let \( p \) be the cumulative proportion of the total population when individuals are ordered in increasing income values using market income, and let \( C(p) \) be the concentration curve, i.e., the cumulative proportion of total program benefits (of a particular program or aggregate category) received by the poorest \( p \) percent of the population. Then, the concentration coefficient of that program or category is defined as \( 2 \int_0^1 \left( p - C(p) \right) dp \).
77 For global regressivity/progressivity to occur it is not a necessary condition for the share of the benefit to rise/fall at each and every income level. When the latter occurs, the benefit is regressive/progressive everywhere. Whenever a benefit is everywhere regressive/progressive, it will be globally regressive/progressive, but the converse is not true.
capita is the same across the income distribution—whenever the concentration coefficient is equal to zero. Spending is defined as pro-poor whenever the concentration coefficient is not only lower than the Gini but also its value is negative. Pro-poor spending implies that the per capita government spending on the transfer tends to fall with market income. Any time spending is pro-poor or neutral in absolute terms, by definition it is progressive. The converse, of course, is not true. The taxonomy of transfers is synthesized in Figure 1-4.

Here households are ranked by per capita market income, and no adjustments are made to their size because of differences in the composition by age and gender. In some analyses, the pro-poorness of education spending, for example, is determined using children—not all members of the household—as the unit of analysis. Since poorer families typically have more children, they would naturally benefit more from spending per child. As a result, pro-poor concentration curves may simply reflect this, rather than imply that poorer families receive more resources per child.

Figure 1-4: Progressivity of Transfers: A Diagrammatic Representation

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78 This case is also sometimes called progressive in absolute terms.
79 As mentioned above, care must be taken not to infer that any spending that is progressive (regressive) will automatically be equalizing (unequalizing).
Chapter 1, Lustig & Higgins

--How effective are taxes and government spending in reducing inequality and poverty?

Impact and Spending Effectiveness Indicators

The spending effectiveness indicator introduced in the previous CEQ handbook was defined as follows:

\[
CEQ \text{ Old Effectiveness Indicator} = \frac{\text{Change in Gini As a Result of Transfers}}{\text{Transfers/GDP}}
\]

As shown by Enami (Chapter 14 in this Handbook), however, this indicator suffers from some shortcomings. The most important being that the indicator would fail to rank transfers (and taxes) properly. If, for example, a transfer is scaled up proportionally, one would expect—everything else equal—the effectiveness indicator to remain constant. The reduction in Gini, however, is a non-linear function of the transfer so if the transfer is multiplied by 2, the reduction in Gini would not necessarily be multiplied by 2. As a result, bigger programs could be ranked worse because of this non-linearity and not because they are less effective at reducing inequality.

Enami (chapter 14 in this Handbook) derived new effective indicators whose main goal is to provide policymakers with meaningful but easy to interpret indices: the CEQ Impact Effectiveness and Spending Effectiveness Indicators. Policy analysts and policymakers are interested in what is called a tax’s or a transfer’s “bang for the buck:” that is, how much inequality or poverty reduction is obtained given the amount collected and spent. In developing these indicators, Enami ensured that these indicators fulfill the mathematical requirements of producing proper ranking of taxes and transfers. Specifically, the new indicators ensure that, everything else equal, an intervention with a higher marginal contribution (MC) to the reduction of inequality (or poverty) has a higher ranking and that an intervention with higher potential to reduce inequality (or poverty) yet a lower realized effect gets a lower ranking.

Impact Effectiveness (IE)

As discussed in chapter 14, IE is defined as the ratio of the observed marginal contribution of a tax (transfer) to the optimum marginal contribution of that tax (transfer) if the tax (transfer) was distributed in a way that maximizes its inequality- or poverty-reducing impact. In the case of a tax, to maximize the inequality reducing-impact of a tax of a given size, we would need to tax the richest person until her pre-tax income equals the pre-tax income of the second richest person; then, both would be taxed until their pre-tax income equals the pre-tax income of the third richest person, and so on until there is no more of the tax to be allocated. In the case of a transfer, the procedure would

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80 Enami (2017b).
81 Enami (chapter 14 in this Handbook).
be analogous but moving from the poorest person and give him enough of a transfer until his income equals that of the second poorest, and so on. If the indicator of interest is a Gini or S-Gini index, the IE indicator is identical to what is proposed by Fellman, Jäntti and Lambert.  

The IE indicator shows the relative realized power of a tax and/or transfer in reducing inequality, or of a transfer (or combined tax-transfer system) in reducing poverty. (Since taxes can only increase poverty, the poverty reduction indicator is only defined for benefits, or combined tax-transfer systems that have a positive marginal contribution.) An example shows how to interpret this indicator: if the IE of a transfer is equal to 0.7, it means the transfer has realized 70% of its potential power in reducing inequality. Therefore, the higher the value of this indicator, the more effective a transfer is in fulfilling its potential to reduce inequality. An advantage of the IE is that its value does not depend on whether one uses change in Gini or percentage change in Gini.

For poverty, one calculates the IE only for benefits or combined tax-benefit systems which reduce poverty. For taxes, which can only increase poverty, the denominator would always be zero because taxes can only increase poverty (so the optimal effect of a tax on poverty is zero).

**Spending Effectiveness (SE)**

As discussed in chapter 14 of this Handbook, the SE indicator is defined as the ratio of the minimum amount of a tax (transfer) that is required to be collected (spent) in order to create the observed marginal contribution of the tax (transfer), if the tax (transfer) is instead redistributed optimally. This indicator shows how much less tax (transfer) is required to achieve the same observed outcome (in terms of inequality reduction) if the tax (transfer) is collected (spent) in an optimal way. For example, a value of 70% for SE of a transfer means that the same MC can be achieved by only spending 70% of the current resources if the resources are spent optimally (if the objective function is to maximize equality). We only calculate this indicator for the taxes and transfers with a positive MC (as a result, the SE of taxes on poverty reduction is undefined).

We also measure effectiveness of achieving fiscal gains to the poor and avoiding fiscal impoverishment using the fiscal impoverishment and gains effectiveness indicators described in Box 1-3 by Ali Enami, Sean Higgins, and Stephen Younger.

**Box 1-3. Fiscal Impoverishment and Gains Effectiveness Indicators**

*Ali Enami, Tulane University; Sean Higgins, UC Berkeley; Stephen Younger, Ithaca College*

In this section, we introduce effectiveness indicators that are specific to the effect of taxes and transfers on fiscal impoverishment (FI) and fiscal gains to the poor (FGP). Axiomatic indicators for FI and FGP are derived in Higgins and Lustig (2016) and described earlier in this chapter. Consider a

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83 Enami (chapter 14 in this Handbook).
84 See Higgins and Lustig (2016) on these concepts.
set of policies that may include both benefits and taxes. We measure the effectiveness of these policies at reducing poverty as:

\[
\text{Effectiveness}_{FI/FGP} = \left[ \frac{B}{T + B} \left( \frac{\text{FGP}_B \text{MC}_B^{\text{End income}}}{B} \right) \right] + \left[ \frac{T}{(T + B)} \left( 1 - \frac{\text{FI}_T \text{MC}_T^{\text{End income}}}{T} \right) \right]
\]

Where \( T \) and \( B \) are the size of total taxes and transfers (both positive values), \( \text{FGP}_B \text{MC}_B^{\text{End income}} \) is the marginal contribution of transfer \( B \) to \( \text{FGP} \) (always a non-negative value) and \( \text{FI}_T \text{MC}_T^{\text{End income}} \) is the marginal contribution of tax \( T \) to \( \text{FI} \) (always a non-negative value).

This indicator is a weighted average of the income reductions for some poor and income increases for other poor as a result of the tax and transfer system. For analyzing bundles that include only taxes, including a single tax, the indicator reduces to:

\[
\text{Tax Effectiveness}_{FI} = \frac{T - \text{FI}_T \text{MC}_T^{\text{End income}}}{T}
\]

For policies that include only benefits, it reduces to:

\[
\text{Transfer Effectiveness}_{FGP} = \frac{\text{FGP}_B \text{MC}_B^{\text{End income}}}{B}
\]

Note that taxes can only hurt and transfers can only help the poor and even though both above indicators have positive values, one should not compare the effectiveness of a tax to a transfer in reducing poverty.

These indicators vary between zero and one and the higher the value of the indicator, the better. In addition, the \( \text{Effectiveness}_{FI/FGP} \) indicator (and its special cases for tax effectiveness and transfer effectiveness) satisfies the following axioms:

1) FI Monotonicity. (If a person experiencing FI has a larger decrease in post-fiscal income, the measure must decrease.)

2) FGP Monotonicity (If a person experiencing FGP has a larger increase in post-fiscal income, the measure must not decrease, and must increase if that person's post-fiscal income was still below the poverty line prior to this additional increase.)

3) Weak Monotonicity in \( B \). If \( B \) increases and all else equal, the measure must not increase.

4) Weak Monotonicity in \( T \). If \( T \) increases and all else equal, the measure must not decrease.

5) Focus: if the pre and post incomes of all individuals experiencing FI and FGP are the same in two scenarios, and \( T \) and \( B \) are the same, the measure is the same.

\[^{85}\text{FGP and FI are defined before in this handbook and introduced first in Higgins and Lustig (2016).}\]
6) Normalization. If the government performs as well as possible, so \( F_{GP} = B \) and \( F_{I} = 0 \), then the measure equals 1. If the government performs as poorly as possible, so \( F_{GP} = 0 \) and \( F_{I} = T \), then the measure equals 0.

7) Continuity in individual pre-fiscal incomes, post-fiscal incomes, and the poverty line, as well as continuity in \( F_{I}, F_{GP}, T, B \).

8) Permutability

9) Subgroup consistency

10) Scale Invariance in \( F_{I}, F_{GP}, T \) and \( B \)

Transfers: Indicators of Coverage, Errors of Exclusion, and Errors of Inclusion, and Errors of Social Programs: Definitions

To conceptualize the concepts of coverage, errors of inclusion or leakages, and errors of exclusion, we can think of separating the population into two groups based on poverty status and two groups based on whether they receive benefits. This results in four total groups, which we call group A, B, C, and D and represent with the following 2x2 matrix (table 1-6):

[Table 1-6 here]

We can then define the indicators of coverage, leakages, and errors of exclusion as follows. Each of these definitions can be measured among *households*, which is how we define them here for illustration. Alternatively, they can be measured among *direct beneficiaries* (the individuals within the household that directly receive benefits), and among *individuals* or equivalently among *direct and indirect beneficiaries*, where “direct and indirect beneficiaries” are defined as all individuals within a beneficiary household.

For example, a household may have five total members and two members who report directly receiving benefits from a particular program. For the household-level calculations, it counts as one household; for the direct beneficiaries calculation, it has two direct beneficiaries; and for the individual-level calculation, it has five individuals (or “direct and indirect beneficiaries”).

**Coverage** is defined as the total number of households that receive benefits\(^\text{86}\) divided by the total number of households in the country, or \( (A+C)/(A+B+C+D) \).

**Coverage of the poor** is defined as the total number of *poor* households that receive benefits divided by the total number of *poor* households in the country, or \( A/(A+B) \).

\(^{86}\) For the indicators at the household level, a beneficiary household will be a household that receives a benefit whether one can or cannot identify who within the household is the recipient of the benefit.
Errors of exclusion is defined as the total number of poor households that do not receive benefits divided by the total number of poor households in the country, or \( \frac{B}{A+B} \).

Leakages (also known as errors of inclusion) is defined as the total number of non-poor households that nevertheless receive benefits divided by the total number of households that receive benefits, or \( \frac{C}{A+C} \).

Proportion of beneficiary households that are poor is defined as the total number of poor households receiving benefits divided by the total number of households receiving benefits, or \( \frac{A}{A+C} \).

The above definitions can then be modified in any combination of the following ways to generate additional indicators of coverage, leakages, and errors of exclusion:

--Replacing total number of households with “total number of direct beneficiaries” or “total number of individuals (i.e., direct and indirect beneficiaries)”

--Replacing “total number of” with “benefits received by,” where benefits can be defined at either the household or per capita (dividing by the number of members in the household) levels

--Computing the mean benefits accruing to households in each group A, B, C, and D.

--Further disaggregating from poor and non-poor to various income groups

--Replacing poor and non-poor with eligible for the program (also called “target”) and not eligible for the program if clear eligibility criteria are available, and potentially further disaggregating eligible and non-eligible by income group

In Sections D and E of the CEQ Master Workbook, we compute all of the measures discussed here; for more detail, see Chapter 7.\(^87\)

Finally, we estimate additional poverty reduction EI.\(^88\)

--What is the impact of fiscal reforms that change the size and progressivity of a particular tax or spending program?

The indicator used to answer this question is the derivative of the MC of a tax or transfer with respect to its size and progressivity.\(^89\)

\(^87\) Higgins (2017).
\(^88\) From Beckerman (1979); Immervoll and others (2009).
\(^89\) Mathematical expressions of these in the absence and presence of reranking are described in Enami and others (chapter 2 in this Handbook) and Enami (chapter 3 in this Handbook), respectively.
References


Martínez-Aguilar, S. and E. Ortiz-Juarez. 2016. CEQ Master Workbook: Chile, in progress (CEQ Institute, Tulane University and World Bank).


Introduction

Suppose we observe that income inequality after taxes and transfers is lower than pre-fiscal income inequality. Can this finding be related to the characteristics of the tax and transfer system in terms of the usual indicators of progressivity and size? As shown below, once one leaves the world of a single fiscal intervention, the relationship between inequality outcomes and the size and progressivity of fiscal interventions is complex and at times counter-intuitive. In particular, in a system of multiple taxes and transfers, the simple relationship between the size of a tax (or transfer) and its progressivity, on the one hand, and its impact on inequality, on the other, no longer holds.

We start this chapter with a review of the simplest case: a single fiscal intervention. The first section shows the conditions for a tax or a transfer to be equalizing. We draw, primarily, on

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1 Ali Enami and Rodrigo Aranda are doctoral students of the PhD in Economics at Tulane University and Research Associates of the CEQ Institute. Nora Lustig is the Director of the CEQ Institute at Tulane University. For questions, please contact aenami@tulane.edu.
Lambert and Duclos and Araar. The second section presents the conditions for the net fiscal system to be equalizing in the case of multiple fiscal interventions. We also derive the conditions that must prevail for a particular tax or transfer to be equalizing and see that in the world of multiple interventions, some of these conditions defy our preconceptions and intuition.

Both sections of this chapter assume no reranking, that is, individuals do not change their position in the post-fiscal income ordering. In other words, the poorest individual in the pre-fiscal income scale will continue to be the poorest individual in the post-fiscal income scale, the second poorest individual in the pre-fiscal income scale will continue to be the second poorest individual in the post-fiscal income scale, and, so on, all the way up to the richest individual. These sections also assume that there is dominance: that is, the pre-fiscal and post-fiscal Lorenz curves do not cross. They also assume that, when comparing systems with different taxes and transfers, the respective post-fiscal Lorenz curves do not cross either. Finally, these sections assume a constant pre-fiscal income distribution, that is, that the conditions apply to a particular country at a particular point in time. Comparisons across countries and over time will usually feature different pre-fiscal income distributions and are not the subject of this chapter.

Chapter 3 of this handbook discusses how the conditions derived in sections below change in the presence of reranking. The implications of relaxing the assumption of dominance or having different pre-fiscal income distributions will be the subject of future work. Throughout this chapter, the traditional Gini coefficient is used as our measure of inequality but the ideas presented here can be easily extended to all members of the S-Gini family. However, while the idea of “marginal” analysis (introduced in this chapter) can be applied to other measures of inequality, the type of decomposition that we rely on in this chapter and the next one may not be applicable for other measures of inequality, such as the Theil index.

2.1 The Fiscal System and Income Redistribution: The Case of a Single Tax or a Single Transfer

In this section, we focus on a fiscal system with a single tax or transfer. Here we define concepts that we use throughout this chapter to analyze the effect of a tax or a transfer on the income distribution. We should first clarify that the word “single” does not mean that a system has only one tax but rather that the same conditions apply when all taxes are combined into a single category.

A Single Tax

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2 Lambert (2001); Duclos and Araar (2007).
3 This section draws from Lambert (2001) and Duclos and Araar (2007).
We start by presenting some notations and definitions that will be used throughout the chapter:

\( x = \text{pre-tax income} \)

\( f(x) = \text{pre-tax income distribution} \)

\( T(x) = \text{tax liability at income } x \)

\( x - T(x) = \text{post-tax income} \)

\( t(x) = T(x)/x = \text{tax rate at income } x \)

\( t'(x) = \text{marginal tax rate at income } x \)

Let’s assume that the tax schedule adheres to a typical pattern of starting at a zero rate and that it follows a sequence of fixed and increasing marginal tax rates.\(^4\) Let’s also assume that both the tax liability and post-tax income increase with pre-tax income:

\[
\begin{align*}
(2-1) & \quad 0 \leq T(x) < x \\
(2-2) & \quad 0 \leq t'(x) < 1
\end{align*}
\]

Condition 2-2 rules out reranking; that is, no pair of individuals switch places after the tax has been imposed.

Now, let’s define the following terms:

\( T = \text{total taxes paid} = \sum_{i} T(x_i) \)

\( X = \text{total pre-tax (and pre-transfers) income} = \sum_{i} x_i \)

\( g = \text{total tax ratio} = T / X; \text{thus, } (1 - g) = (X - T) / X \text{ and } g / (1 - g) = T / (X - T) = \text{Total tax as a share of pre-tax income} \)

\(^4\) Lambert (2001).
Chapter 2, Enami, Lustig, Aranda,

\[ g = \int \frac{T(x)f(x)dx}{\int x f(x)dx} \] = total tax ratio (continuous version)

\[ L_X(p), \ L_{X,T}(p) \] = Lorenz curve of pre-tax income and post-tax income, respectively (ranked by original income)

\[ C_{X,T}(p), \ C_T(p) \] = Concentration curve of post-tax income and taxes, respectively (ranked by original income)

In all preceding formulas \( p \) has a value between zero and one and represents quantile \( p \) of income distribution in which \( 100p\% \) of individuals are below it.

It can be shown that the Lorenz curve of pre-tax income is the weighted average of the concentration curve of taxes and the concentration curve of post-tax income:

\[ (2-3) \quad L_X(p) = g \ C_T(p) + (1-g) \ C_{X,T}(p). \]

Because of conditions 2-1 and 2-2, the ranking of people by pre-tax and post-tax income is exactly the same. Thus, condition 2-3 can be re-written simply as the weighted average of the concentration curve of taxes and the Lorenz curve of post-tax income:

\[ (2-3)' \quad L_X(p) = g \ C_T(p) + (1-g) \ L_{X,T}(p). \]

**Equalizing, Neutral, and Unequalizing Net Fiscal Systems: Conditions for the One Tax Case**

In this section, we review conditions that allow us to determine whether a fiscal system with only a single tax is equalizing, neutral, or unequaulizing.

**Concentration and Lorenz Curves**

When the post-tax income Lorenz curve lies everywhere above the pre-tax income Lorenz curve, that is \( L_{X,T}(p) \geq L_X(p) \), the tax is equalizing (and vice versa).

---

5 Recall that concentration curves plot the cumulative shares of post-tax income and taxes by positions in pre-tax income distribution (in notational terms, if there is no superscript, they are ranked by pre-tax income). The reader should recall that a concentration coefficient is calculated in the same manner as the Gini coefficient. The difference is the same as that between the Lorenz and concentration curves: the cumulative distribution of the tax (in this case) is plotted against the cumulative distribution of the population ranked by original income and not the tax.
Chapter 2, Enami, Lustig, Aranda,

Equation 2-3 implies that the post-tax income Lorenz curve lies completely above the pre-tax income Lorenz curve if and only if the concentration curve of taxes lies completely below the pre-tax income Lorenz curve.

\[ L_{X,T}(p) \geq L_X(p) \iff C_T(p) \leq L_X(p) \quad \text{for all } p, \text{ and with strict inequality for some } p \]

In other words, the distribution of post-tax income is less unequal than the pre-tax income distribution if and only if the tax is distributed more unequally than the income to which it applies, or put another way, if and only if the concentration curve of taxes lies completely below the pre-tax income Lorenz curve. This condition is shown on figure 2-1, which features the Lorenz curves for pre-tax and post-tax income and the concentration curve for taxes.

Figure 2-1. Lorenz Curve of Pre-Tax Income and Post-Tax Income and Concentration Curve of Tax

\[ ^6 \text{This is true because if } 0 < g < 1, \text{ the weights by definition sum to one. Hence } L_X(p) \text{ must lie between } C_T(p) \text{ and } C_{X,T}(p) \text{ by necessity.} \]
In other words, if the average tax rate \( t(x) \) is increasing with income everywhere, then taxes are distributed more unequally than pre-tax income. Thus, an everywhere progressive tax will always be equalizing.

Given equation 2-4, it is easy to see that the condition for a tax to be unequalizing is \( C_t(p) \geq L_X(p) \). This condition will occur if \( t(x) \) decreases with income, that is, if taxes are regressive everywhere. However, just like in the case of progressive taxes, it is not necessary for taxes to be regressive everywhere to be unequalizing. Finally, in the case of a proportional tax—that is, when \( T(x)/x \) is the same for all \( x \)—the distribution of post-tax and pre-tax income will be exactly the same and \( C_t(p) = L_X(p) \).

In sum, incomes are less unequal after a tax than before the tax if and only if the tax is distributed more unequally than the income to which it applies. Incomes are more unequal after a tax than before the tax if and only if the tax is distributed more equally than the income to which it applies. A proportional tax will have the same distribution as the pre-tax income and leave the distribution of income unchanged. A poll tax, which taxes all individuals by the same absolute amount, will feature a concentration curve coincidental with the diagonal, that is, it will be very unequalizing.\(^7\)

If condition 2-2 is everywhere observed, plotting the average tax rate \( T(x)/x \) against values (or quantiles) of pre-tax income will be sufficient to determine whether a tax system is everywhere progressive (tax rates rise with income), neutral (tax rates are the same for all incomes—a flat tax), or regressive (tax rates decrease with income). For example, if we are sure that condition 2-2 is strictly observed within deciles, we can determine whether a tax system is progressive, regressive, or neutral by plotting the incidence of the tax by decile as we do in figure 2-2.

Figure 2-2. Average Tax Rate by Pre-Tax Income: A Progressive, Neutral, and Regressive Tax

\(^7\) Although not impossible in principle, taxes in absolute terms (that is, per capita) rarely decline with income in the real world. If such a tax were to exist, its concentration curve would lie above the diagonal and be extremely unequalizing.
Globally Progressive Taxes and Taxes That Are Everywhere Progressive

Note, however, that taxes do not have to be progressive everywhere for the distribution of post-tax income to be less unequal than the pre-tax income distribution. A necessary and sufficient condition for a tax to be equalizing is for it to be globally progressive, that is, that $C_T(p) \leq L_X(p)$ for all $p$ and strict inequality for some $p$ and for any distribution of pre-tax income.

The following toy example in table 2-1 illustrates the difference between a tax that is progressive everywhere and one that is globally progressive only.

Table 2-1. An Everywhere Progressive Tax and a Globally Progressive Tax
Chapter 2, Enami, Lustig, Aranda,

### Everywhere Progressive Tax

<table>
<thead>
<tr>
<th>Population</th>
<th>Pre-tax Income</th>
<th>Lorenz Curve Pre-Tax</th>
<th>Average Tax Rate (Everywhere Progressive)</th>
<th>Tax paid</th>
<th>Post-tax Income</th>
<th>Lorenz Curve Post-Tax</th>
<th>Difference Between Post and Pre-tax Lorenz Curves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$10.00</td>
<td>10.0%</td>
<td>0%</td>
<td>$0.00</td>
<td>$10.00</td>
<td>13%</td>
<td>2.50%</td>
</tr>
<tr>
<td>2</td>
<td>$20.00</td>
<td>30.0%</td>
<td>10%</td>
<td>$2.00</td>
<td>$18.00</td>
<td>23%</td>
<td>5.00%</td>
</tr>
<tr>
<td>3</td>
<td>$30.00</td>
<td>60.0%</td>
<td>20%</td>
<td>$6.00</td>
<td>$24.00</td>
<td>30%</td>
<td>5.00%</td>
</tr>
<tr>
<td>4</td>
<td>$40.00</td>
<td>100.0%</td>
<td>30%</td>
<td>$12.00</td>
<td>$28.00</td>
<td>35%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Total</td>
<td>$100.00</td>
<td>20%</td>
<td>$20.00</td>
<td>$80.00</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Globally Progressive Tax

<table>
<thead>
<tr>
<th>Population</th>
<th>Pre-tax Income</th>
<th>Lorenz Curve Pre-Tax</th>
<th>Average Tax Rate (Not Everywhere Progressive)</th>
<th>Tax paid</th>
<th>Post-tax Income</th>
<th>Lorenz Curve Post-Tax</th>
<th>Difference Between Post and Pre-tax Lorenz Curves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$10.00</td>
<td>10%</td>
<td>0%</td>
<td>$0.00</td>
<td>$10.00</td>
<td>13%</td>
<td>2.50%</td>
</tr>
<tr>
<td>2</td>
<td>$20.00</td>
<td>30%</td>
<td>18%</td>
<td>$3.60</td>
<td>$16.40</td>
<td>21%</td>
<td>3.00%</td>
</tr>
<tr>
<td>3</td>
<td>$30.00</td>
<td>60%</td>
<td>12%</td>
<td>$3.60</td>
<td>$26.40</td>
<td>33%</td>
<td>6.00%</td>
</tr>
<tr>
<td>4</td>
<td>$40.00</td>
<td>100%</td>
<td>32%</td>
<td>$12.80</td>
<td>$27.20</td>
<td>34%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Total</td>
<td>$100.00</td>
<td>20%</td>
<td>$20.00</td>
<td>$80.00</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### The Kakwani Index

To assess whether a tax is equalizing or not, one can also use the Kakwani index of progressivity. Kakwani’s index of progressivity of tax $t$ is defined as the difference between the concentration coefficient ($C_t$) of the tax and the Gini coefficient of pre-tax income ($G_X$), or

$$\Pi^K_t = C_t - G_X,$$

---

8 Kakwani was among the first to propose a measure of tax progressivity based on “disproportionality,” that is, by the extent to which a tax distribution was not proportional to the distribution of pre-tax income. See Kakwani (1977).
where $C_T$ is the concentration coefficient of the tax $t$ and $G_X$ is the Gini coefficient of pre-tax income. The conditions for a tax to be equalizing, neutral, or unequalizing are $\Pi_T^K > 0$, $\Pi_T^K = 0$, and $\Pi_T^K < 0$, respectively.

Table 2-2 presents a summary of the conditions described above. Of course, if the tax meets the sufficient condition, it implies that the necessary condition is met too (but not vice versa). Since we assumed there is no reranking, the disproportionality measures such as the concentration curves and the Kakwani index translate immediately into measures of redistribution.

Table 2-2. Conditions of Equalizing, Neutral, and Unequalizing Taxes

<table>
<thead>
<tr>
<th>Tax</th>
<th>Sufficient</th>
<th>Necessary and Sufficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equalizing</td>
<td>$t(x) \geq 0$ for all $x$ with some $t(x) &gt; 0$</td>
<td>$C_T(p) \leq L_X(p)$ for all $p$ and for any distribution of pre-tax income</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\Pi_T^K &gt; 0$</td>
</tr>
<tr>
<td>Neutral</td>
<td>$t(x) = 0$ for all $x$</td>
<td>$C_T(p) = L_X(p)$ for all $p$ and for any distribution of pre-tax income</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\Pi_T^K = 0$</td>
</tr>
<tr>
<td>Unequalizing</td>
<td>$t(x) \leq 0$ for all $x$ with some $t(x) &lt; 0$</td>
<td>$C_T(p) \geq L_X(p)$ for all $p$ and for any distribution of pre-tax income</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\Pi_T^K &lt; 0$</td>
</tr>
</tbody>
</table>
If there is reranking, the link between inequality and measures of disproportionality is no longer straightforward because with reranking we need to use equation 2-3, that is, \( L_X(p) = g C_X(p) + (1-g) C_{X,T}(p) \) instead of equation 2-3’. Note that in equation 2-3, the post-tax income Lorenz curve has been replaced by the post-tax income concentration curve (the distribution of post-tax income with individuals ranked by pre-tax income). Because we are no longer comparing two income distributions with the presence of reranking, some of the “redistribution” will not be actual redistribution; instead, the tax will be reordering individuals. The consequences of reranking will be further discussed in chapter 3 of this handbook.\(^9\)

In addition, because we assume that the post-tax income Lorenz dominates the pre-tax income Lorenz curve, we can be sure that the Kakwani index will give an unambiguous ordering of different taxes in terms of progressivity (the implication of no dominance is left for future work). However, it is important not to extrapolate from progressivity to impact on inequality when comparing taxes of different sizes. We discuss this issue in the subsection on comparing taxes in section 1.1.

Measures of progressivity of a tax are presented diagrammatically in figure 2-3.

Figure 2-3. Progressive, Neutral, and Regressive Taxes

\(^9\) See also Urban (2009).
Comparing Two Taxes of Different Sizes

We have just shown how progressivity determines whether a tax in a single tax system is equalizing or not. Does this mean that the more unequally distributed a tax is (that is, the more progressive), the more equalizing it is? The following example will show that this is not necessarily the case.  

In Table 2-3, we present two hypothetical taxes taken from Duclos and Tabi, A and A’. We can see that tax A’ is more unequally distributed (that is, more progressive) than tax A, or using the terminology presented in the previous section, that the concentration curve of tax system A lies completely above the concentration curve of tax system A’ (that is, A is less disproportional than A’). Yet, the post-tax distribution is more unequal under tax system A’. How can that be? Notice that tax system A’ collects a lower share of post-tax income than system A. The higher tax ratio in A more than compensates for its lower progressivity to the point that the redistributive effect in A is higher.

Table 2-3. Redistributive Effect and the Progressivity and Size of Taxes

<table>
<thead>
<tr>
<th>Individual</th>
<th>Gross income</th>
<th>Tax A=50.5%</th>
<th>Net income under A</th>
<th>Tax A’=1%</th>
<th>Net income under A’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inco</td>
<td>Distri</td>
<td>Tax</td>
<td>Distri</td>
<td>Tax</td>
<td>Distri</td>
</tr>
<tr>
<td>Inc</td>
<td>Distribu</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10 This section draws from Lambert (2001) and Duclos and Araar (2007).

The extent of disproportionality is not sufficient to compare the redistributive effect across different taxes. What indicators can we use? There are three options: comparing the post-tax Lorenz curves, comparing the residual progression functions, or comparing the Reynolds-Smolensky (R-S) indices if one wishes to use a scalar instead of a function. In the absence of reranking and if there is Lorenz dominance, the three approaches are equivalent.

The first condition is straightforward. If the Lorenz curve of post-tax income A dominates the Lorenz curve of post-tax income A’, inequality will be reduced more greatly under the former than the latter.

Residual progression is defined as the elasticity of post-tax income with respect to pre-tax income (that is, the percentage change in post-tax income per one percent change in pre-tax income) and can be written as follows:

(2-6) \[ RP_{X,T} = \left[ \frac{\partial (X - T(X))}{\partial X} \right] \frac{X}{(X - T(X))}, \]

(2-7) \[ RP_{X,T} = \frac{(1 - T'(x))}{(1 - T(x))/x}. \]

If \( RP_{X,T} < 1 \) everywhere, the tax is progressive everywhere. To determine if tax A is more equalizing than tax A’, compare the residual progression for tax A and A’. If \( RP_{X,T} \) for tax A lies completely below the \( RP_{X,T} \) of tax A’, the former will generate a higher reduction in inequality than the latter.

Finally, the Reynolds-Smolensky (R-S) index is defined as

(2-8) \[ \Pi^{R_S}_{T} = G_X - C_{X,T} = g / (1 - g) (C_T - G_X) = \left[ \frac{g}{(1 - g)} \right] \Pi^{K}_{T} \]

where \( C_{X,T} \) is the concentration coefficient of post-tax income, \( G_X \) is the Gini coefficient of pre-tax income, \( C_T \) is the concentration coefficient of tax T, and \( \Pi^{K}_{T} \) is the Kakwani index of progressivity of tax T defined as \( C_T - G_X \) (see the subsection on progressive taxes in section 1.1).

To see this equality, note the following. Lerman and Yitzhaki prove that
\( C_Q = \frac{2 \text{cov}(Q, F_X)}{\mu_Q} \)

where \( \text{cov}(Q, F_X) \) is the covariance between income concept or component \( Q \) and ranking of individuals with respect to the original income (that is, \( X \)).\(^{12}\) Moreover, \( \mu_Q \) is the average value of income concept or component \( Q \) among all individuals. Similarly,

\[ G_X = \frac{2 \text{cov}(X, F_X)}{\mu} \]

Therefore, we have the following:

\[ G_X - C_{X-T} = G_X - \frac{2 \text{cov}(X - T, F_X)}{\mu(1 - g)} = G_X - \frac{2 \text{cov}(X, F_X)}{\mu(1 - g)} + \frac{2 \text{cov}(T, F_X)}{\mu(1 - g)} \]

\[ = G_X - \left( \frac{1}{1 - g} \right) \frac{2 \text{cov}(X, F_X)}{\mu} + \left( \frac{g}{1 - g} \right) \frac{2 \text{cov}(T, F_X)}{\mu g} \]

\[ = G_X - \left( \frac{1}{1 - g} \right) G_X + \left( \frac{g}{1 - g} \right) C_T \]

\[ = \left( \frac{g}{1 - g} \right) (C_T - G_X) \]

Under no re-ranking, it turns out that the R-S index is identical to the redistributive effect (RE), that is, the change in inequality between pre-tax and post-tax income distribution measured in Gini points.\(^{13}\)

With no re-ranking,

\[ C_{X,T} = G_{X,T} \]

\( (2.8)' \quad \text{RE} = G_X - G_{X,T} = \frac{g}{1 - g} (C_T - G_X) = \Pi_T^{RS} = \left[ \frac{g}{1 - g} \right] \Pi_T^R \)

The R-S Index, \( \Pi_T^{RS} \), is greater than, equal to, or less than 0, depending on whether the tax is equalizing, neutral, or unequalizing, respectively. The larger the R-S index, the more equalizing the tax. Thus, we can use \( \Pi_T^{RS} \) to order different taxes individually based on their redistributive effects.

\(^{12}\) Lerman And Yitzhaki (1989).

\(^{13}\) This result can be generalized to a wide range of inequality measures of the S-Gini family. See also Lambert (2001) and Duclos and Araar (2007).
The R-S index \( \Pi^{RS} \) shows exactly how the redistributive effect does not depend \textit{only} on the extent of progressivity. It is an increasing function of the latter \textit{and} the tax ratio \( g \).\(^{14}\) Therefore, either making a given tax more progressive or raising the tax ratio of a progressive tax can increase the redistributive effect. In the case of a regressive tax, either making the tax less regressive or lowering the tax ratio will make its effect less unequalizing.

We summarize these conditions in Table 2-4.

### Table 2-4. Conditions for the Redistributive Effect and Progressivity and Size of Taxes

<table>
<thead>
<tr>
<th>Condition</th>
<th>Necessary and sufficient conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax A is more equalizing than Tax A'</td>
<td>( L^A_{\text{X-T}} (\phi) \geq L^{A'}<em>{\text{X-T}} (\phi) ) for all ( \phi ), with strict inequality for some ( \phi ), and for any distribution of pre-tax income, \textit{or} ( \text{OR} ) ( \text{RP}^A</em>{\text{X-T}} (\phi) \leq \text{RP}^{A'}_{\text{X-T}} (\phi) ) for all ( \phi ), with strict inequality for some ( \phi ), and for any distribution of pre-tax income.</td>
</tr>
<tr>
<td>Tax A is more unequalizing than Tax A'</td>
<td>( L^A_{\text{X-T}} (\phi) \leq L^{A'}<em>{\text{X-T}} (\phi) ) for all ( \phi ), with strict inequality for some ( \phi ), and for any distribution of pre-tax income, \textit{or} ( \text{OR} ) ( \text{RP}^A</em>{\text{X-T}} (\phi) \geq \text{RP}^{A'}_{\text{X-T}} (\phi) ) for all ( \phi ), with strict inequality for some ( \phi ), and for any distribution of pre-tax income.</td>
</tr>
</tbody>
</table>

We have developed Table 2-4 assuming there is no reranking. If there is reranking, the link between the progressivity and size of a tax and its redistributive effect is no longer straightforward, and thus comparisons are no longer straightforward either. (We will return to the consequences of reranking in chapter 3.) In addition, the three conditions in Table 2-4 are equivalent under the assumption that the post-tax Lorenz curve under a specific tax dominates the post-tax Lorenz curve under another tax. We have left the discussion of the implications of no dominance for future work.

\(^{14}\) See Lambert (2001).
Note also that the conditions for comparing the redistributive effect between different taxes characterized by different degrees of progressivity and size were defined for the case in which the pre-tax income distribution is always the same. The comparison of the redistributive effect of taxes (and transfers) in cases when the original income distributions are not the same is left for future work.\footnote{Interested readers can refer to Dardanoni and Lambert (2000).}

More important, even without reranking, with dominance and keeping the original distribution constant, in the case of more than one intervention the neat relationship between the size and progressivity of a fiscal intervention and its redistributive effect no longer holds. As we will see in section 2 of this chapter, a tax can be regressive using any of the necessary or sufficient conditions spelled out in table 2-2 and still exert an equalizing influence on the post-tax and transfer income distribution, by which we mean that, in the absence of such a tax, the reduction in inequality would be smaller than with the tax in place. Before we turn to this topic, however, we will present the analogous conditions for a single transfer.

**A Single Transfer**

The word “single” here does not mean that the conditions derived in this section apply to a system with only one transfer. In the case of multiple transfers, however, they need to be aggregated into one category in order for the conditions to apply.

Transfers here encompass a wide spectrum of benefits provided by the government such as cash transfers, school food programs, consumption subsidies, and access to free public services. We will use the words transfer and benefit interchangeably and use the abbreviation $B$ for both.

We will also use the following definitions:

\[
\begin{align*}
\pre = & \text{pre-tax income} \\
B(\pre) = & \text{transfer at income } \pre \\
\pre + B(\pre) = & \text{post-transfer income} \\
\frac{B(\pre)}{\pre} = b(\pre) = & \text{average benefit rate at income } \pre \\
\frac{B(\pre)}{\pre} = & \text{marginal benefit rate}
\end{align*}
\]
Chapter 2, Enami, Lustig, Aranda,

\[ B = \text{total transfers} = \sum_{i=1} B(x_i) \]

\[ b = \text{total transfers ratio} = \frac{B}{X} \]

\[ \Rightarrow (1 + b) = \frac{X + B}{X} \]

\[ \Rightarrow \frac{b}{1 + b} = \frac{B}{X + B} \]

\[ L_X(p), L_{X+B}(p) = \text{Lorenz curve of pre-transfer income and post-transfer income, respectively (ranked by original income)} \]

\[ C_{X+B}(p), C_B(p) = \text{Concentration curve of post-transfer income and transfer, respectively (ranked by original income)} \]

It can be shown that

\[ (2-9) \quad L_X(p) = (1 + b) \ C_{X+B}(p) - b \ C_B(p) \]

which implies that

\[ (2-10) \quad L_X(p) \geq C_{X+B}(p) \Leftrightarrow C_{X+B}(p) \geq C_B(p). \]

If we assume no re-ranking, that is,

\[ (2-11) \quad -1 \leq b'(x) \]

where \( b'(x) \) is the increase in benefits that occurs as pre-transfer income \( X \) rises, the ranking of people by pre-transfer and post-transfer income does not change. Thus, equation 2-10 can be re-written as

\[ (2-10)' \quad L_X(p) \geq L_{X+B}(p) \Leftrightarrow L_{X+B}(p) \geq C_B(p). \]

Under no reranking, incomes are less unequal after transfers than before if and only if transfers are distributed more equally than the income to which they apply. If the average transfer rate \( b(x) \) decreases with income everywhere, then transfers are distributed more equally than pre-transfer income. This scenario is shown in figure 2-4.
For instance, although cash transfers are very unlikely to be regressive, this is not the case with subsidies, contributory pensions, and spending on tertiary education, which are sometimes regressive in the real world. An everywhere regressive transfer will fulfill the following condition:

\[(2-10)'' \quad L_X(p) \leq L_{X+b}(p) \iff L_{X+b}(p) \leq C_b(p)\]

When \(2-10''\) occurs, benefits will be unequalizing.

However, equalizing transfers may not be pro-poor. As long as the relative size of the transfer declines with income, a transfer will be equalizing. In order to be pro-poor, however, the absolute size of the transfer also needs to decline with income (although not so much that the marginal benefit is less than \(-1\)). That is, the share of a transfer going to the rich can be higher than the share going to the poor even if a transfer is equalizing (or progressive).

Figure 2-5 shows the concentration curve for a transfer that is both equalizing and pro-poor.
Fiscal Systems: Comparing Two Single-Transfer Systems of Different Sizes

So far, we have shown that in a system with only one transfer and no reranking, a progressive transfer is equalizing. Does this mean that the more progressive a transfer is (that is, the more progressive or disproportional), the more equalizing it is? Table 2-5 shows that this need not be the case: transfer A is not only more progressive but also more pro-poor than A' yet the post-transfer distribution is considerably more equal with transfer A than with transfer A'.

<table>
<thead>
<tr>
<th>Population</th>
<th>Gross Income Distribution</th>
<th>Transfer A Distribution</th>
<th>Net Income under A Distribution</th>
<th>Transfer A' Distribution</th>
<th>Net Income under A' Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21 21%</td>
<td>50 98%</td>
<td>71 0.47 1 100%</td>
<td>22 22%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>80 79%</td>
<td>1 2%</td>
<td>81 0.53 0 0%</td>
<td>80 78%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>101 100%</td>
<td>51 100%</td>
<td>152 1 1 100%</td>
<td>102 100%</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 2, Enami, Lustig, Aranda,

As with taxes, the redistributive effect of a transfer depends not only on its progressivity but also on its relative size. That is, under no reranking,

\[(2-11) \quad RE = G_X - G_{X+B} = b / (1 + b) \quad [G_X - C_B] = \rho^R_S = \left[ b / (1 + b) \right] \rho^K_B \]

where \( \rho^R_S \) and \( \rho^K_B \) are the R-S index and Kakwani index of the benefit \( B \), respectively.\(^{16}\) This equation highlights the fact that the redistributive effect does not depend on the extent of progressivity (disproportionality) of the transfer only. Rather, the redistributive effect depends on both the extent of progressivity and the relative size of the transfer, \( b / (1 + b) \), which equals the total transfer divided by the post-transfer total income. Therefore, either making a given transfer more progressive or raising the relative size of a progressive transfer can increase the redistributive effect. The R-S index can also be used to compare the redistributive effect across transfers.

As in the case of taxes, the R-S is a summary index and thus will not alert us to cases in which a transfer is more redistributive in some parts of the distribution and less in others. Additionally, as with taxes, one can use the residual progression to compare the redistributive effect of transfers across the entire distribution.

We summarize these results and present the conditions under which a transfer exerts an equalizing force on the pre-transfer distribution of income in table 2-6.

Table 2-6. Conditions of Equalizing, Neutral, and Unequalizing Transfers

<table>
<thead>
<tr>
<th>A transfer is</th>
<th>Sufficient</th>
<th>Necessary and Sufficient</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equalizing</strong>, if</td>
<td>(-1 &lt; b'(x) \leq 0 ) for all ( x ) and ( b'(x) &lt; 0 ) for some ( x )</td>
<td>( C_B(p) \geq L_X(p) ) for all ( p ), with strict inequality for some ( p ), and for any distribution of pre-tax income</td>
</tr>
<tr>
<td><strong>Neutral</strong>, if</td>
<td>( b'(x) = 0 ) for all ( x )</td>
<td>( C_B(p) = L_X(p) ) for all ( p ) and for any distribution of pre-tax income</td>
</tr>
</tbody>
</table>

\(^{16}\) The proof of this formula is similar to equation 2-8 explained earlier.
Chapter 2, Enami, Lustig, Aranda,

| Unequalizing, if | \( b'(x) \geq 0 \) for all \( x \) and \( b'(x) > 0 \) for some \( x \) | \( C_B(p) \leq L_X(p) \) for all \( p \), with strict inequality for some \( p \), and for any distribution of pre-tax income |

In the case of transfers, the literature tends to distinguish between a relatively progressive transfer and a transfer that is progressive in absolute terms.\(^{17}\) The former is defined by the following condition \( b'(x) \leq 0 \) for all \( x \) and \( b'(x) < 0 \) for some \( x \). This condition is sufficient for a transfer to be equalizing. However, this condition does not need to be fulfilled in order for a transfer to be equalizing. As mentioned previously, the necessary and sufficient condition is \( C_B(p) \geq L_X(p) \) for all \( p \), with strict inequality for some \( p \), and for any distribution of pre-tax income or for \( \rho^k_B > 0 \).

In the case of a transfer that is progressive in absolute terms, the concentration curve \( C_B(p) \) is not compared to the \( L_X(p) \) but rather to the population shares or the diagonal. When the transfer tends to decline with income in per capita terms, that is \( B'(x) \), transfers are called progressive in absolute terms. They are also sometimes called “pro-poor.”

In figure 2-6, we present hypothetical concentration curves for progressive, neutral (proportional), and regressive transfers. Among the progressive transfers, we distinguish between the transfers that are progressive in relative and in absolute terms. A simple way to identify a transfer that is progressive in absolute terms is by the sign of its concentration coefficient, which will be negative.

Figure 2-6. A Diagrammatic Representation of Progressivity of Transfers

\(^{17}\) Such a distinction is not made in the case of taxes because no one expects per capita taxes to increase with income.
2.2 The Fiscal System and Income Redistribution: Multiple Taxes and Transfers

This section derives the conditions for fiscal redistribution in a world of multiple fiscal interventions.\(^\text{18}\) We first derive the conditions for the simple one tax-one transfer case and, subsequently, for the case with multiple taxes and transfers. Suppose we observe that post-fiscal income inequality is lower than pre-fiscal income inequality. Can we relate this finding to the characteristics of specific taxes and transfers in terms of indicators of progressivity and size? As demonstrated in the following section, once we leave the world of a single fiscal intervention, the relationship between inequality outcomes and the size and progressivity\(^\text{19}\) of fiscal interventions is complex and at times counter-intuitive. In particular, the relative size and progressivity of a fiscal intervention by itself can no longer tell us if inequality would be higher or lower without it. We will show that, under certain conditions, a fiscal system that includes a regressive tax can be more equalizing than a system that excludes it.\(^\text{20}\) In the same

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\(^{18}\) The word “multiple” is used as opposed to the word “single.” In the case of a “single” tax or transfer, we either deal with only one tax or transfer or a group of taxes or transfers that are combined and treated as one incident.

\(^{19}\) Using, for example, the Kakwani index of progressivity.

\(^{20}\) See also Lambert (2001, p. 278), for the same conclusion.
vein, a fiscal system that includes a progressive transfer can be less equalizing than a system that excludes it.

The so-called “Lambert’s Conundrum” helps to illustrate this point in the case of a regressive tax.\(^{21}\) Table 2-7 below shows that “taxes may be regressive in their effect on original income…and yet the net system may exhibit more progressivity” than the progressive benefits alone.\(^{22}\) The R-S index for taxes in this example is equal to \(-0.0517\), highlighting their regressivity.\(^{23}\) Yet, the R-S index for the net fiscal system is 0.25, higher than the R-S index for benefits equal to 0.1972. If taxes are regressive in relation to the original income\(^{24}\) but progressive with respect to the less unequally distributed post-transfers (and subsidies) income, regressive taxes exert an equalizing effect over and above the effect of progressive transfers.\(^{25}\)

\(^{21}\) Lambert (2001, p.278).

\(^{22}\) Lambert (2001, p.278).

\(^{23}\) Since there is no reranking, the R-S index equals the difference between the Ginis before and after the fiscal intervention.

\(^{24}\) Note that original income is in fact the “tax base” in this example.

\(^{25}\) Note that Lambert uses the terms “progressive” and “regressive” differently than other authors in the theoretical and empirical incidence analysis literature. Thus, he calls transfers that are equalizing “regressive.” See definitions in earlier chapters of his book.
Table 2-7. Lambert’s Conundrum

<table>
<thead>
<tr>
<th>Individual</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original income</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax liability (T)</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>42</td>
</tr>
<tr>
<td>Benefit level (B)</td>
<td>21</td>
<td>14</td>
<td>7</td>
<td>0</td>
<td>42</td>
</tr>
<tr>
<td>Post-benefit income</td>
<td>31</td>
<td>34</td>
<td>37</td>
<td>40</td>
<td>142</td>
</tr>
<tr>
<td>Final income</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>


Note that Lambert’s conundrum is not equivalent to the well-known (and frequently repeated) result that efficient regressive taxes can be fine as long as the net fiscal system is equalizing when combined with transfers. The surprising aspect of Lambert’s conundrum is that a net fiscal system with a regressive tax (in relation to pre-fiscal income) can be more equalizing than without the tax.

The implications of Lambert’s “conundrum” for real fiscal systems are quite profound. In order to determine whether a particular intervention (or a particular policy change) is inequality-increasing or inequality-reducing—and by how much—one must resort to numerical calculations that include the whole system. As Lambert mentions, his example is “not altogether farfetched.” For example, two renowned studies in the 1980s found this type of result for the United States and the United Kingdom. Moreover, two recent studies for Chile found that although the value-added tax (VAT) is regressive, it is equalizing. The conundrum, however, can occur with transfers as well: a transfer may be progressive but unequalizing, as was the case for contributory pensions in the CEQ Assessment for 26 As Higgins and Lustig (2016) mention, “efficient taxes that fall disproportionately on the poor, such as a no-exemption value added tax, are often justified with the argument that “spending instruments are available that are better targeted to the pursuit of equity concerns” (quoted in Keen and Lockwood, 2010, p. 141). Similarly, Engel and others (1999, p. 186) assert that “it is quite obvious that the disadvantages of a proportional tax are moderated by adequate targeting” of transfers, because “what the poor individual pays in taxes is returned to her.” Ebrill and others (2001, p. 105) argue that “a regressive tax might conceivably be the best way to finance pro-poor expenditures, with the net effect being to relieve poverty.” For the interested reader, the paper appears as chapter 4 of this Handbook as well.

27 It can also be shown that if there is reranking (a pervasive feature of net tax systems in the real world), making a tax (or a transfer) more progressive can increase post-tax and transfer inequality. In Lambert’s example, regressive taxes not only enhance the equalizing effect of transfers, but making taxes more progressive (that is, more disproportional in the Kakwani sense) would result in higher inequality. Any additional change (towards more progressivity) in taxes or transfers would just cause reranking and an increase in inequality.


30 See Martinez, Fuchs, and Ortiz-Juarez (2016) and Engel and others (1999). Although Engel and his coauthors were not aware of this characteristic of the Chilean system when they published their article, in a recent interaction with Engel, he concluded that the Chilean system featured regressive albeit equalizing indirect taxes.
In this analysis, the Kakwani index for contributory pensions was positive but unequalizing in the sense that the reduction in inequality would have been higher without the contributory pensions (and the rest of the fiscal interventions) in place.

Estimating the sign and order of magnitude of the contribution of a particular intervention to the change in inequality will depend on the particular question one is interested in. For example, if one is interested in answering the question “what if we remove or introduce a particular intervention,” one should estimate the “marginal” contribution by taking the difference in the indicators of interest (for example, the Gini coefficient) that would prevail with and without the specific intervention.

Note, however, that the sum of all the marginal contributions will not equal the total redistributive effect (except by a fluke) because there is path dependency in how interventions affect the net fiscal system and the marginal effect. Essentially, the path in which the fiscal intervention of interest is introduced last is just one of the possible paths. To obtain the average contribution of a specific intervention, one would need to consider all the possible (and institutionally valid) paths and use an appropriate formula to average them. One commonly used approach is to calculate the Shapley value. The Shapley value fulfills the efficiency property: that is, the sum of all the individual contributions is equal to the total effect. Moreover, if some particular paths are irrelevant, the Shapley formula can be modified to exclude them (without losing the efficiency property introduced earlier). We shall return to the Shapley value and its use in appendix 2A.

In the next section, we first turn to deriving the conditions that ensure that a net fiscal system is equalizing. Next, we derive the conditions that must prevail in order for the marginal contribution of a tax or a transfer to be equalizing. As mentioned earlier, we first derive the conditions for the simple one tax-one transfer case and, subsequently, for the case with multiple taxes and transfers.

2.1 Equalizing, Neutral, and Unequalizing Net Fiscal Systems

The next two sub-sections discuss the conditions for a net system to have an equalizing marginal effect. We begin with the simple case of one tax and one transfer and then we extend it to the case of a system with multiple taxes and transfers.

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31 Lustig and Melendez (2016).
32 The same applies to poverty indicators or any other indicator of interest.
33 This is also the case for the vertical equity and reranking components of redistributive effect.
34 Note that here we use the terms marginal contribution and marginal effect interchangeably.
35 See the discussion on path dependency in chapter 7 of Duclos and Araar (2007). See also Bibi and Duclos (2010).
36 For a review of the decomposition techniques in economics, see Fortin and others (2011). For a review of the Shapley decomposition, see also Shorrocks (2013).
Conditions for the One Tax-One Transfer Case

As shown by Lambert, the redistributive effect (measured by the change in Gini coefficients) is equal to the weighted sum of the redistributive effect of taxes and transfers

\[ \Pi^R_N = \frac{(1-g)\Pi^R_T + (1+b)\rho^R_B}{1-g+b} \]

where \( \Pi^R_N \), \( \Pi^R_T \), and \( \rho^R_B \) are the Reynolds-Smolensky indices for the net fiscal system, taxes and benefits, respectively; and \( g \) and \( b \) are the total tax and benefit ratios, that is, total taxes and total benefits divided by total pre-fiscal (original) income, respectively. There are two features to note. First, the weights sum to more than unity so the redistributive effect is not a weighted average. This fact is not innocuous: it lies at the heart of Lambert’s conundrum. Second, recall that in the absence of reranking, the Reynolds-Smolensky index is identical to the redistributive effect measured as the difference between the Gini coefficients. As we will see later in chapter 3 of this handbook, if there is reranking, equation 2-12 will no longer be equal to the redistributive effect.

Using equation 2-12, we can derive the general condition for the case in which the combination of one tax and one transfer (that is, the net fiscal system) is equalizing, neutral, or unequalizing. As noted, when there is no reranking, \( \Pi^R_N \) is equal to the change in the Gini coefficient (that is, \( G_X - G_{X,T+b} \)). If \( G_X - G_{X,T+b} > 0 \), the net fiscal system is equalizing, which simply means that equation 2-12 must be positive. Since the denominator is positive by definition, the condition implies that the numerator has to be positive. In other words,

\[ \Pi^R_N = \frac{(1-g)\Pi^R_T + (1+b)\rho^R_B}{1-g+b} > 0 \iff (1 - g)\Pi^R_T + (1 + b)\rho^R_B > 0 \]

(2-13)

\[ \iff \Pi^R_T > -\frac{(1+b)}{(1-g)}\rho^R_B \]

(2-14)

\[ \iff \Pi^K_T > -\frac{b}{(g)}\rho^K_B \]

(2-15)

where \( \Pi^K_T \) and \( \rho^K_B \) are the Kakwani index of the tax and transfer, respectively, and \( 1 - g \) is positive.

Therefore, we can state the following conditions.

\[ ^{37} \text{Lambert (2001, p. 277, equation 11.29).} \]

\[ ^{38} \text{It is important to note that the tax relative sizes or ratios have to be those that are calculated in the actual data of the fiscal incidence analysis, which are not necessarily equal to the ratios of taxes or transfers to GDP obtained from administrative accounts.} \]
Condition 2-16:
If and only if \( \Pi_T^{RS} > -\frac{1+b}{1-g} \rho_B^{RS} (\rho_B^{RS} > -\frac{1-g}{1+b} \Pi_T^{RS}) \) or \( \Pi_T^K > -\frac{(b)}{(g)} \rho_B^K (\rho_B^K > -\frac{(g)}{(b)} \Pi_T^K) \),
the net fiscal system reduces inequality.

Condition 2-17:
If and only if \( \Pi_T^{RS} = -\frac{1+b}{1-g} \rho_B^{RS} (\rho_B^{RS} = -\frac{1-g}{1+b} \Pi_T^{RS}) \) or \( \Pi_T^K = -\frac{(b)}{(g)} \rho_B^K (\rho_B^K = -\frac{(g)}{(b)} \Pi_T^K) \),
the net fiscal system leaves inequality unchanged.

Condition 2-18:
If and only if \( \Pi_T^{RS} < -\frac{1+b}{1-g} \rho_B^{RS} (\rho_B^{RS} < -\frac{1-g}{1+b} \Pi_T^{RS}) \) or \( \Pi_T^K < -\frac{(b)}{(g)} \rho_B^K (\rho_B^K < -\frac{(g)}{(b)} \Pi_T^K) \),
the net fiscal system increases inequality.

As shown in table 2-8, a system that combines a regressive tax with a regressive or neutral transfer or a neutral tax with a regressive transfer can never be equalizing. A system that combines a progressive tax with a neutral or progressive transfer or a neutral tax with a progressive transfer is always equalizing. Combining a neutral tax and a neutral transfer leaves inequality unchanged. A regressive tax combined with a progressive transfer or a progressive tax combined with a regressive transfer can be equalizing if and only if Condition 2-16 holds.

Table 2-8. Net Fiscal System: Conditions for the One Tax-One Transfer Case

<table>
<thead>
<tr>
<th>Transfer</th>
<th>Regressive ( \rho_B^K &lt; 0 )</th>
<th>Neutral ( \rho_B^K = 0 )</th>
<th>Progressive ( \rho_B^K &gt; 0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regressive ( \Pi_T^K &lt; 0 )</td>
<td>Always unequalizing</td>
<td>Always unequalizing</td>
<td>Equalizing if and only if Condition 2-16 holds</td>
</tr>
<tr>
<td>Neutral ( \Pi_T^K = 0 )</td>
<td>Always unequalizing</td>
<td>No change in equality</td>
<td>Always equalizing</td>
</tr>
<tr>
<td>Progressive ( \Pi_T^K &gt; 0 )</td>
<td>Equalizing if an only if Condition 2-16 holds</td>
<td>Always equalizing</td>
<td>Always equalizing</td>
</tr>
</tbody>
</table>
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[H3] Conditions for the Multiple Taxes and Transfers Case

Let’s assume there are $n$ taxes and $m$ transfers in a fiscal system. Equation 2-12 can be written as

$$
\Pi^R_N = \frac{\sum_{i=1}^{n} (1-g_i) \Pi_{Ti}^R + \sum_{j=1}^{m} (1+b_j) \rho_{Bj}^R}{1 - \sum_{i=1}^{m} g_i + \sum_{j=1}^{m} b_j}
$$

The condition for the net system to be equalizing is that the Reynolds-Smolensky index for the net fiscal system should be higher than zero, that is,

$$
\Pi^R_N > 0
$$

that is,

$$
\frac{\sum_{i=1}^{n} (1-g_i) \Pi_{Ti}^R + \sum_{j=1}^{m} (1+b_j) \rho_{Bj}^R}{1 - \sum_{i=1}^{m} g_i + \sum_{j=1}^{m} b_j} > 0
$$

Assuming, of course, that the denominator is positive,

$$
\iff \sum_{i=1}^{n} (1-g_i) \Pi_{Ti}^R > -\sum_{j=1}^{m} (1+b_j) \rho_{Bj}^R
$$

or equivalently,

$$
\iff \sum_{i=1}^{n} g_i \Pi_{Ti}^K > -\sum_{j=1}^{m} b_j \rho_{Bj}^K
$$

Therefore, we can state the following conditions.

Condition 2-23:
If and only if $\sum_{i=1}^{n} (1-g_i) \Pi_{Ti}^R > -\sum_{j=1}^{m} (1+b_j) \rho_{Bj}^R$ or $\sum_{i=1}^{n} g_i \Pi_{Ti}^K > -\sum_{j=1}^{m} b_j \rho_{Bj}^K$, the net fiscal system reduces inequality.

Condition 2-24:
If and only if $\sum_{i=1}^{n} (1-g_i) \Pi_{Ti}^R = -\sum_{j=1}^{m} (1+b_j) \rho_{Bj}^R$ or $\sum_{i=1}^{n} g_i \Pi_{Ti}^K = -\sum_{j=1}^{m} b_j \rho_{Bj}^K$, the net fiscal system leaves inequality unchanged.

Condition 2-25:
If and only if $\sum_{i=1}^{n} (1-g_i) \Pi_{Ti}^R < -\sum_{j=1}^{m} (1+b_j) \rho_{Bj}^R$ or $\sum_{i=1}^{n} g_i \Pi_{Ti}^K < -\sum_{j=1}^{m} b_j \rho_{Bj}^K$, the net fiscal system increases inequality.

Equalizing, Neutral, and Unequalizing Taxes or Transfers
The previous section looked at the net system and provided conditions for the whole system to be equalizing, whereas this section focuses on only one tax or only one transfer in the system. The question is whether that specific component leads to a more equalizing total system. The first case is a simple system with only one transfer (or one tax) in place and determines the conditions for the addition of a tax (or a transfer) to make the system more equal. In the following sub-section, a more general case with multiple taxes and transfer is analyzed.

**Conditions for the One Tax-One Transfer Case**

In a scenario where there is one tax and one transfer, conditions to assess whether adding a regressive (or progressive) transfer or tax exerts an unequalizing (or equalizing) effect do not necessarily hold as described in the section “The Fiscal System and Income Redistribution: The Case of A Single Tax or A Single Transfer,” and introducing these interventions could even derive unintuitive results. For example, adding a regressive transfer to a regressive tax could result in a more equal system or adding a progressive transfer to a progressive tax could decrease equality. The following toy examples illustrate the two unintuitive cases just mentioned. The main factor in these unintuitive examples is that progressivity is (usually) calculated with respect to the original income and it is perfectly possible for a transfer (for example) to be progressive with respect to the original income yet regressive with respect to the “original income plus tax.” Such a transfer, therefore, would decrease equality if it were added to this system.

Table 2-9. Toy Example: Adding a Regressive Transfer to a Regressive Tax Can Exert an Equalizing Effect

<table>
<thead>
<tr>
<th>Individual</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
<th>Gini</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original income</td>
<td>10.00</td>
<td>20.00</td>
<td>30.00</td>
<td>40.00</td>
<td>100.00</td>
<td>0.2500</td>
</tr>
<tr>
<td>Tax (regressive)</td>
<td>9.00</td>
<td>10.00</td>
<td>2.00</td>
<td>0.00</td>
<td>21.00</td>
<td>n.c.</td>
</tr>
<tr>
<td>Original income minus tax</td>
<td>1.00</td>
<td>10.00</td>
<td>28.00</td>
<td>40.00</td>
<td>79.00</td>
<td>0.4272</td>
</tr>
<tr>
<td>Benefit (regressive)</td>
<td>0.00</td>
<td>3.50</td>
<td>7.00</td>
<td>10.50</td>
<td>21.00</td>
<td>n.c.</td>
</tr>
<tr>
<td>Original income plus benefit</td>
<td>10.00</td>
<td>23.50</td>
<td>37.00</td>
<td>50.50</td>
<td>121.00</td>
<td>0.2789</td>
</tr>
<tr>
<td>Original income minus tax plus benefit</td>
<td>1.00</td>
<td>13.50</td>
<td>35.00</td>
<td>50.50</td>
<td>100.00</td>
<td>0.4250</td>
</tr>
</tbody>
</table>

39 In the toy examples, we assume that the tax and transfer ratios are equal (it would be very easy to show that the results occur when the ratios are not equal so we chose the “most difficult” assumption).
Chapter 2, Enami, Lustig, Aranda,

n.c. Not calculated.

Table 2-10. Toy Example: Adding a Progressive Transfer to a Progressive Tax Can Exert an Unequalizing Effect

<table>
<thead>
<tr>
<th>Individual</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
<th>Gini</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original income</td>
<td>10.00</td>
<td>20.00</td>
<td>30.00</td>
<td>40.00</td>
<td>100.00</td>
<td>0.2500</td>
</tr>
<tr>
<td>Tax (progressive)</td>
<td>0.00</td>
<td>1.55</td>
<td>3.10</td>
<td>4.65</td>
<td>9.30</td>
<td>n.c.</td>
</tr>
<tr>
<td>Original income minus Tax</td>
<td>10.00</td>
<td>18.45</td>
<td>26.90</td>
<td>35.35</td>
<td>90.70</td>
<td>0.2329</td>
</tr>
<tr>
<td>Benefit (progressive)</td>
<td>1.00</td>
<td>1.80</td>
<td>2.80</td>
<td>3.70</td>
<td>9.30</td>
<td>n.c.</td>
</tr>
<tr>
<td>Original income plus benefit</td>
<td>11.00</td>
<td>21.80</td>
<td>32.80</td>
<td>43.70</td>
<td>109.30</td>
<td>0.2495</td>
</tr>
<tr>
<td>Original income minus tax plus benefit</td>
<td>11.00</td>
<td>20.25</td>
<td>29.70</td>
<td>39.05</td>
<td>100.00</td>
<td>0.2340</td>
</tr>
</tbody>
</table>

Given these results, we derive the conditions under which the marginal contribution of a single tax or benefit can be unequalizing, neutral, or equalizing.

**Is the Marginal Contribution of a Single Tax Equalizing?**

This section addresses the question of whether a tax is equalizing, unequalizing, or neutral, and if it is equalizing or unequalizing, by how much. To answer the question of whether the tax exerts an equalizing or unequalizing force over and above the one prevailing in the system without the tax, we must assess whether the marginal contribution of the tax is positive or negative.

Before continuing, it should be noted that there are three instances in which the word “marginal” is used in incidence analysis.40

1. *The marginal contribution or effect* of a fiscal intervention (or of a change in a particular intervention); this is the subject of this section of the chapter. It is calculated as the difference between the indicator of choice (for example, the Gini) without the intervention of interest (or the change in the intervention of interest) and with the intervention. So, for example, if we are interested in the marginal contribution of direct taxes when going from

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40 For an extensive review of the literature on analyzing the concept of tax incidence, see Fullerton and Metcalf (2002).
market income to disposable income, we take the difference of, for example, the Gini without direct taxes and the Gini of disposable income (which includes the effect of direct taxes).

2. The derivative of the marginal contribution with respect to progressivity or size of the intervention. This is, so to speak, the marginal effect of progressivity or size on the marginal contribution. In the case of the derivative with respect to the relative size, this is also known as the marginal incidence for the intensive margin.

Both definitions one and two assume that the behavior of individuals is unchanged and unaffected by changes in the taxes or transfers.

3. The extensive margin is the last instance for the application of the phrase “margin.” To calculate the extensive margin, one needs to estimate the predicted expansion in, for example, users of a service or beneficiaries of a cash transfer or payers of a tax, when the size of the intervention is increased. Researchers have followed different approaches in calculating this type of marginal effect. One way to estimate the effect of an expansion on the extensive margin is by comparing results of average incidence analyses over time. For example, in Mexico Lopez-Calva and others found that concentration curves for tertiary education moved conspicuously towards the diagonal from 1992 to 2010, that is, the extensive margin was progressive. Because of identification problems, care must be taken not to ascribe a causal effect from the expansion of tertiary education to the fact that the extensive margin is progressive. However, one can argue that more spending has probably had something to do with the progressive extensive margin.

As shown by Lambert, the general condition for the tax to be equalizing (when it is added to a system with a benefit in place) is derived from the following inequality:

\[ \Pi_N^{RS} > \rho_B^{RS} \]  

Substituting the expression in equation 2-12 for the left-hand side gives

\[ \frac{(1-g)\Pi_T^{RS} + (1+b)\rho_B^{RS}}{1-g+b} > \rho_B^{RS} \]

\[ \Leftrightarrow \Pi_T^{RS} > -\frac{g}{1-g} \rho_B^{RS} \]

\[ \Leftrightarrow \Pi_T^K > -\frac{b}{1+b} \rho_B^K \]

\[ 41 \] Lopez-Calva and others (forthcoming).

Therefore, we can state Condition 2-30.

Condition 2-30:
If and only if \( \Pi_{T}^{RS} > -\frac{g}{1-g} \psi_B^{RS} \left( \frac{1-g}{g} \Pi_{T}^{RS} \right) \) or \( \Pi_T^K > -\frac{b}{1+b} \psi_B^K \left( \frac{1+b}{b} \Pi_T^K \right) \), adding the tax reduces inequality. This is exactly the condition derived by Lambert.\(^{43}\)

Condition 2-31:
If and only if \( \Pi_{T}^{RS} = -\frac{g}{1-g} \psi_B^{RS} \left( \frac{1-g}{g} \Pi_{T}^{RS} \right) \) or \( \Pi_T^K = -\frac{b}{1+b} \psi_B^K \left( \frac{1+b}{b} \Pi_T^K \right) \), adding the tax leaves inequality unchanged.

Condition 2-32:
If and only if \( \Pi_{T}^{RS} < -\frac{(1-g)}{(1-g)} \psi_B^{RS} \left( \frac{1-g}{g} \Pi_{T}^{RS} \right) \) or \( \Pi_T^K < -\frac{(b)}{(1+b)} \psi_B^K \left( \frac{1+b}{b} \Pi_T^K \right) \), adding the tax increases inequality.

From Conditions 2-30, 2-31, and 2-32, we can immediately derive some conclusions, summarized in table 2-11. As expected, adding a regressive tax to a system with a regressive transfer can never be less unequalizing. Similarly, adding a progressive tax to a progressive transfer is always more equalizing. However, the unexpected result—which goes back to Lambert’s conundrum—is that adding a regressive tax to a system with a progressive transfer can be more equalizing if and only if Condition 2-30 holds. Note that all of the inequality comparisons are made with respect to a system without the tax (that is, a system that only has a transfer in place). The other example of an unintuitive result is that a neutral tax is unequalizing when it is added to a progressive tax. To understand the logic behind these cases, note that the progressivity is calculated with respect to the original income (without any tax or transfer), whereas for a tax to be equalizing when it is added to a system that has a transfer in place, it has to be progressive with respect to the “original income plus transfer.”

**Table 2-11. Marginal Contribution of a Tax**

<table>
<thead>
<tr>
<th>System with a Transfer that is</th>
<th>Regressive ( \psi_B^K &lt; 0 )</th>
<th>Neutral ( \psi_B^K = 0 )</th>
<th>Progressive ( \psi_B^K &gt; 0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adding a Tax that is</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regressive ( \Pi_T^K &lt; 0 )</td>
<td>Always more unequalizing</td>
<td>Always unequalizing</td>
<td>More equalizing only if Condition 2-30 holds</td>
</tr>
<tr>
<td>Neutral</td>
<td>Always more</td>
<td>No change in</td>
<td>Always more</td>
</tr>
</tbody>
</table>

\(^{43}\) Lambert (2001, p. 278, equation 11.30).
Chapter 2, Enami, Lustig, Aranda,

<table>
<thead>
<tr>
<th>( \Pi_T^K = 0 )</th>
<th>unequalizing</th>
<th>inequality</th>
<th>equalizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{Progressive} )</td>
<td>More equalizing only if Condition 2-30 holds</td>
<td>Always equalizing</td>
<td>Always more equalizing</td>
</tr>
</tbody>
</table>

Is the Marginal Contribution of a Single Transfer Equalizing?

Adding a transfer to a system that has a tax in place is equalizing if

\[
(2-33) \quad \Pi_N^{RS} > \Pi_T^{RS}.
\]

Substituting for the left-hand side and rearranging the preceding inequality we have

\[
(2-34) \quad \Leftrightarrow \Pi_T^{RS} < \frac{(1+b)}{b} \rho_B^{RS}
\]

\[
(2-35) \quad \Leftrightarrow \Pi_T^K < \frac{(1-g)}{g} \rho_B^K.
\]

Therefore, we can state the following conditions.

Condition 2-36:
If and only if \( \Pi_T^{RS} < \frac{1+b}{b} \rho_B^{RS} \) \( \rho_B^{RS} \) \( \frac{b}{1+b} \Pi_T^{RS} \) or \( \Pi_T^K < \frac{1-g}{g} \rho_B^K \) \( \rho_B^K \) \( \frac{g}{1-g} \Pi_T^K \) does adding the transfer reduce inequality.

Condition 2-37:
If and only if \( \Pi_T^{RS} = \frac{1+b}{b} \rho_B^{RS} \) \( \rho_B^{RS} = \frac{b}{1+b} \Pi_T^{RS} \) or \( \Pi_T^K = \frac{1-g}{g} \rho_B^K \) \( \rho_B^K = \frac{g}{1-g} \Pi_T^K \) does adding the transfer leave inequality unchanged.

Condition 2-38:
If and only if \( \Pi_T^{RS} > \frac{1+b}{b} \rho_B^{RS} \) \( \rho_B^{RS} < \frac{b}{1+b} \Pi_T^{RS} \) or \( \Pi_T^K > \frac{1-g}{g} \rho_B^K \) \( \rho_B^K < \frac{g}{1-g} \Pi_T^K \) does adding the transfer increase inequality.

Some conclusions can be immediately derived from conditions 2-36 through 2-38. Adding a progressive transfer to a system with a regressive tax always results in a less inequality. Similarly, adding a regressive transfer to a system with a progressive tax increases inequality. However, somewhat counterintuitively, adding a regressive transfer to a system with a regressive tax does not always increase inequality (see the toy example in table 2-9). Similarly, adding a progressive transfer to a system with a progressive tax does not always increase equality (see the toy example in table 2-10). These two results (as shown in table 2-12) are
essentially similar to Lambert’s conundrum discussed earlier. Note that when comparing the change in equality, the reference point is the system with only a tax and without any transfer and not the original distribution of income.

Table 2-12. Marginal Contribution of a Transfer

<table>
<thead>
<tr>
<th>Adding a Transfer that is</th>
<th>Regressive $\rho^T_B &lt; 0$</th>
<th>Neutral $\rho^T_B = 0$</th>
<th>Progressive $\rho^T_B &gt; 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A system with a Tax that is</td>
<td>Less unequalizing if and only if Condition 2-36 holds</td>
<td>Always less unequalizing</td>
<td>Always less unequalizing</td>
</tr>
<tr>
<td>Regressive $\Pi^T_T &lt; 0$</td>
<td>Neutral $\Pi^T_T = 0$</td>
<td>Always unequalizing</td>
<td>No change in equality</td>
</tr>
<tr>
<td>Neutral $\Pi^T_T = 0$</td>
<td>Progressive $\Pi^T_T &gt; 0$</td>
<td>Always less equalizing</td>
<td>Always less equalizing</td>
</tr>
<tr>
<td>Progressive $\Pi^T_T &gt; 0$</td>
<td>More equalizing if and only if Condition 2-36 holds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conditions for the Multiple Taxes and Transfers Case

This section generalizes the preceding discussion for a system with only one tax and one transfer. In the following sub-sections, we focus on the conditions for a tax or transfer to have an equalizing marginal contribution in a system with multiple other taxes and transfers.

Is the Marginal Contribution of a Tax Equalizing?

Assuming no-reranking, for a tax to be equalizing (if it is added to a system with other taxes and transfers in place), the following inequality has to hold:

$$\Pi^{RS}_N > \Pi^{RS}_{N\setminus T_k}.$$  

In other words, the redistributive effect is larger with the tax of interest than without it.

The element on the right-hand side shows the change in the Gini coefficient (from pre-fiscal to post-fiscal income) when all taxes and transfers other than tax $T_k$ are in place. Without loss of generality and for simplicity, we will set $k = 1$. Using equation 2-13, we have

$$\frac{\sum_{i=1}^n(1-g_i)\Pi^{RS}_{T_i} + \sum_{j=1}^m(1+b_j)\rho^{RS}_{b_j}}{1-\sum_{i=1}^ng_i + \sum_{j=1}^mb_j} > \frac{\sum_{i=2}^n(1-g_i)\Pi^{RS}_{T_i} + \sum_{j=1}^m(1+b_j)\rho^{RS}_{b_j}}{1-\sum_{i=2}^ng_i + \sum_{j=1}^mb_j}.$$  

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The analysis goes similarly. After some rearranging, we have

\[
\Pi_{T_1}^{RS} > \left( \frac{-g_1}{1-g_1} \right) \left( \frac{\sum_{i=2}^{n} (1-g_i)\Pi_i^{RS} + \sum_{j=1}^{m} (1+b_j)\rho_i^{RS}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right)
\]

or equivalently,

\[
\Pi_{T_1}^{K} > - \left( \frac{\sum_{i=2}^{n} g_i \Pi_i^{K} + \sum_{j=1}^{m} b_j \rho_i^{K}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right).
\]

Therefore, for \( T_1 \) to be equalizing when \((n - 1) \) taxes and \( m \) benefits are already in place, the following conditions apply.

**Condition 2-41:**

If and only if \( \Pi_{T_1}^{RS} > \left( \frac{-g_1}{1-g_1} \right) \left( \frac{\sum_{i=2}^{n} (1-g_i)\Pi_i^{RS} + \sum_{j=1}^{m} (1+b_j)\rho_i^{RS}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \) (or \( \Pi_{T_1}^{K} > - \left( \frac{\sum_{i=2}^{n} g_i \Pi_i^{K} + \sum_{j=1}^{m} b_j \rho_i^{K}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \)), then adding \( T_1 \) reduces the inequality.

**Condition 2-42:**

If and only if \( \Pi_{T_1}^{RS} < \left( \frac{-g_1}{1-g_1} \right) \left( \frac{\sum_{i=2}^{n} (1-g_i)\Pi_i^{RS} + \sum_{j=1}^{m} (1+b_j)\rho_i^{RS}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \) (or \( \Pi_{T_1}^{K} = - \left( \frac{\sum_{i=2}^{n} g_i \Pi_i^{K} + \sum_{j=1}^{m} b_j \rho_i^{K}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \)), then adding \( T_1 \) increases the inequality.

**Condition 2-43:**

If and only if \( \Pi_{T_1}^{RS} = \left( \frac{-g_1}{1-g_1} \right) \left( \frac{\sum_{i=2}^{n} (1-g_i)\Pi_i^{RS} + \sum_{j=1}^{m} (1+b_j)\rho_i^{RS}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \) (or \( \Pi_{T_1}^{K} < - \left( \frac{\sum_{i=2}^{n} g_i \Pi_i^{K} + \sum_{j=1}^{m} b_j \rho_i^{K}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \)), then adding \( T_1 \) does not change the inequality.

**Is the Marginal Contribution of a Transfer Equalizing?**

Assuming no-reranking, the following inequality should hold:

\[
\Pi_N^{RS} > \Pi_{N \setminus B_k}^{RS}.
\]
Chapter 2, Enami, Lustig, Aranda,

Assuming \( k = 1 \) and substituting for both sides of the inequality, we have

\[
\frac{\sum_{i=1}^{n_i} (1 - g_i) \Pi_{T_i}^{RS} + \sum_{j=1}^{m} (1 + b_j) \rho_{RS}^{B_j}}{1 - \Sigma_{i=1}^{n_i} g_i + \sum_{j=1}^{m} b_j} > \frac{\sum_{i=1}^{n_i} (1 - g_i) \Pi_{T_i}^{RS} + \sum_{j=2}^{m} (1 + b_j) \rho_{RS}^{B_j}}{1 - \Sigma_{i=1}^{n_i} g_i + \sum_{j=2}^{m} b_j}.
\]

After some rearranging, we have

(2-45) \[ \rho_{RS}^{B_1} > \left( \frac{b_1}{1+b_1} \right) \left( \frac{\sum_{i=1}^{n_i} (1 - g_i) \Pi_{T_i}^{RS} + \sum_{j=2}^{m} (1 + b_j) \rho_{RS}^{B_j}}{1 - \Sigma_{i=1}^{n_i} g_i + \sum_{j=2}^{m} b_j} \right) \]

or equivalently,

(2-45b) \[ \rho_{RS}^{B_1} > \left( \frac{\sum_{i=1}^{n_i} g_i \Pi_{T_i}^{K} + \sum_{j=2}^{m} b_j \rho_{RS}^{B_j}}{1 - \Sigma_{i=1}^{n_i} g_i + \sum_{j=2}^{m} b_j} \right). \]

Therefore for \( B_1 \) to be equalizing when \( n \) taxes and \( (m - 1) \) benefits are already in place, the following conditions apply.

Condition 2-46:

If and only if

\[ \rho_{RS}^{B_1} > \left( \frac{b_1}{1+b_1} \right) \left( \frac{\sum_{i=1}^{n_i} (1 - g_i) \Pi_{T_i}^{RS} + \sum_{j=2}^{m} (1 + b_j) \rho_{RS}^{B_j}}{1 - \Sigma_{i=1}^{n_i} g_i + \sum_{j=2}^{m} b_j} \right) \]

then adding \( B_1 \) reduces inequality.

Condition 2-47:

If and only if

\[ \rho_{RS}^{B_1} = \left( \frac{b_1}{1+b_1} \right) \left( \frac{\sum_{i=1}^{n_i} (1 - g_i) \Pi_{T_i}^{RS} + \sum_{j=2}^{m} (1 + b_j) \rho_{RS}^{B_j}}{1 - \Sigma_{i=1}^{n_i} g_i + \sum_{j=2}^{m} b_j} \right) \]

then adding \( B_1 \) does not change inequality.

Condition 2-48:

If and only if
\[ \rho_{RS}^{B_1} < \left( \frac{b_1}{1+b_1} \right) \left( \frac{\sum_{i=1}^{n} (1-g_i) \beta_{RS}^i + \sum_{j=2}^{m} (1+b_j) \rho_{RS}^j}{1 - \sum_{i=1}^{n} g_i + \sum_{j=2}^{m} b_j} \right) \] (or \( \rho_{RS}^K < \left( \frac{\sum_{i=1}^{n} g_i \beta_{RS}^i + \sum_{j=2}^{m} b_j \rho_{RS}^j}{1 - \sum_{i=1}^{n} g_i + \sum_{j=2}^{m} b_j} \right) \)),

then adding \( B_1 \) increases inequality.

Table 2-13 presents the marginal contributions for broad categories of fiscal interventions for eight countries for which CEQ assessments were performed. The redistributive effect shown here is from market income to final income, which includes the monetized value of transfers in kind in the form of public spending on education and health.\(^{44}\) The main results can be summarized as follows. Direct taxes and transfers as well as indirect subsidies are equalizing in all countries. Indirect taxes are equalizing in four countries: Brazil, Chile, Sri Lanka, and South Africa. Given that indirect taxes are regressive in all countries, these four countries are displaying a (Lambert) conundrum in which a regressive tax is equalizing and the fiscal system would be more unequal in the absence of it. Lambert’s conundrum, thus, is much more common than one might anticipate. Education and health spending are always equalizing except for health spending in Jordan. In Jordan, health spending is progressive but unequalizing, demonstrating another example of the conundrum.

\(^{44}\) For the definitions of income concepts and how they are calculated, see chapter 1 by Higgins and Lustig in this handbook.
Table 2-13. Marginal Contributions: Results from CEQ Assessments

<table>
<thead>
<tr>
<th></th>
<th>Lower-middle-income economies</th>
<th>Upper-middle-income economies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redistributive effect (from Gini market income plus pensions) to final income</td>
<td>0.1244</td>
<td>0.0238</td>
</tr>
<tr>
<td>Marginal contribution</td>
<td>Direct taxes</td>
<td>0.0221</td>
</tr>
<tr>
<td></td>
<td>Direct transfers</td>
<td>0.1002</td>
</tr>
<tr>
<td></td>
<td>Indirect taxes</td>
<td>-0.0141</td>
</tr>
<tr>
<td></td>
<td>Indirect subsidies</td>
<td>0.0004</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>0.0199</td>
</tr>
<tr>
<td></td>
<td>Health</td>
<td>0.0077</td>
</tr>
<tr>
<td>Kakwani</td>
<td>Direct taxes</td>
<td>0.1819</td>
</tr>
<tr>
<td></td>
<td>Direct transfers</td>
<td>0.7063</td>
</tr>
<tr>
<td></td>
<td>Indirect taxes</td>
<td>-0.2298</td>
</tr>
<tr>
<td></td>
<td>Indirect subsidies</td>
<td>0.3716</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>0.5414</td>
</tr>
<tr>
<td></td>
<td>Health</td>
<td>0.6360</td>
</tr>
<tr>
<td>Relative size</td>
<td>Direct taxes</td>
<td>9.8%</td>
</tr>
<tr>
<td></td>
<td>Direct transfers</td>
<td>19.4%</td>
</tr>
<tr>
<td></td>
<td>Indirect taxes</td>
<td>12.8%</td>
</tr>
<tr>
<td></td>
<td>Indirect subsidies</td>
<td>0.4%</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>4.3%</td>
</tr>
<tr>
<td></td>
<td>Health</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

Sources: Higgins and Pereira (2014); Martinez-Aguilar et al., (2016); Alam et al. (forthcoming); Afkar et al., (forthcoming); Arunatilake et al., (forthcoming); Cancho and Bondarenko, (forthcoming); Inchauste et al., (forthcoming); Lopez-Calva, (forthcoming).
2.3 The Derivative of Marginal Contribution with Respect to Progressivity and Size

Section 2.2 showed the conditions that must prevail for the marginal contribution of a tax or a transfer to be equalizing, neutral, or unequalizing. How will the marginal contribution of a particular tax or transfer be affected if its progressivity or size is changed? This is a relevant question in terms of policymaking, especially in the realistic context where leaders want to adjust the progressivity or relative size of an existing intervention given a pre-existing fiscal system—for example, making cash transfers more progressive or increasing the level of collection of a VAT, or more generally, expanding any pilot program.

This question can be answered by taking the derivative of the particular tax or transfer of interest with respect to progressivity and size. The reader should bear in mind that while the derivative yields the marginal effect of changing the progressivity or size of a particular intervention, the word *marginal* in this context does not have the same meaning or interpretation as the word *marginal* when one is talking about marginal contributions in a joint distribution. The marginal contribution or effect in the latter sense was discussed previously throughout this chapter. This section presents the conditions for the marginal effect in the “partial derivative sense.”

The Derivatives for the Case of a Marginal Change in Taxes

We will define $M_{T_i}$ as the marginal contribution of tax $T_i$. The marginal contribution of a tax ($T_i = T_i$ is chosen without loss of generality) in the case of multiple taxes and benefits is defined as follows:

$$M_{T_1} = G_{N \setminus T_1} - G_N$$

or

$$(2-49a) \quad M_{T_1} = G_{X - \sum_{i=2}^{n} t_i + \sum_{j=1}^{m} b_j} - G_{X - \sum_{i=1}^{n} t_i + \sum_{j=1}^{m} b_j}$$

$$= \left( G_{X - \sum_{i=1}^{n} t_i + \sum_{j=1}^{m} b_j} \right) - \left( G_{X - \sum_{i=2}^{n} t_i + \sum_{j=1}^{m} b_j} \right)$$

$$\equiv \prod_{X - \sum_{i=1}^{n} t_i + \sum_{j=1}^{m} b_j}^{RS} - \prod_{X - \sum_{i=2}^{n} t_i + \sum_{j=1}^{m} b_j}^{RS} \quad Assuming \ no-reranking$$
Chapter 2, Enami, Lustig, Aranda,

\[
\frac{\sum_{i=1}^{n} (1 - g_i) \prod_{T_i}^{RS} + \sum_{j=1}^{m} (1 + b_j) \rho_{B_j}^{RS}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} - \frac{\sum_{i=2}^{n} (1 - g_i) \prod_{T_i}^{RS} + \sum_{j=1}^{m} (1 + b_j) \rho_{B_j}^{RS}}{1 - \sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j}
\]

or

\[
\frac{\sum_{i=1}^{m} g_i \prod_{T_i}^{K} + \sum_{j=1}^{m} b_j \rho_{B_j}^{K}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} - \frac{\sum_{i=2}^{m} g_i \prod_{T_i}^{K} + \sum_{j=1}^{m} b_j \rho_{B_j}^{K}}{1 - \sum_{i=2}^{m} g_i + \sum_{j=1}^{m} b_j}
\]

What are the derivatives of the marginal contribution of a tax with respect to its progressivity and size? Manipulating equation 2-49b, we obtain

\[
(2-49b) \quad \frac{\partial M_{T_1}}{\partial \prod_{T_i}^{K}} = \frac{g_i}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j}.
\]

Note that the derivative 2-50 is always positive given the usual assumption about the total size of taxes and transfers, that is \(1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j > 0\).

\[
\frac{\partial M_{T_1}}{\partial g_i} = \frac{[\prod_{T_i}^{K} (1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j)] - [(-1)(\sum_{i=1}^{n} g_i \prod_{T_i}^{K} + \sum_{j=1}^{m} b_j \rho_{B_j}^{K})]}{(1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j)^2}
\]

\[
(2-51) \quad \frac{\prod_{T_i}^{K} (1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j)}{(1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j)^2}
\]

To sign derivative 2-51, please note that it is equal to

\[
\frac{\prod_{T_i}^{K} + \prod_{T_i}^{RS} \prod_{X-T_i}^{RS} + \sum_{j=1}^{m} b_j}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j}.
\]

\[\text{45} \text{ Here we hold the relative size of } T_1 \text{ and everything else constant.}\]

\[\text{46} \text{ Here we hold the progressivity of } T_1 \text{ and everything else constant.}\]
Since the denominator is always positive, the sign depends only on the numerator, which is the Kakwani index of Tax ($\Pi^K_{T_1}$) and the R-S index of the net system with $T_1$ ($\Pi^RS_{X-\sum_{i=1}^{n}T_i+\sum_{j=1}^{m}B_j}$), that is, the following condition assures the derivative is positive.

Condition MT1:

$$\Pi^K_{T_1} > -\Pi^RS_{X-\sum_{i=1}^{n}T_i+\sum_{j=1}^{m}B_j}$$

The following table shows what the ultimate sign will be. Here the assumption is that there is no reranking, so the R-S index being positive is equivalent to the fiscal system being equalizing.

Table 2-14. The Sign of the Derivative of a Tax’s Marginal Contribution with Respect to Its Relative Size

<table>
<thead>
<tr>
<th>The Tax of Interest: $T_1$</th>
<th>Regressive</th>
<th>Neutral</th>
<th>Progressive</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Pi^K_{T_1} &lt; 0$</td>
<td>Negative (more unequalizing)</td>
<td>Negative (more unequalizing)</td>
<td>Positive (less unequalizing), if and only if condition MT1 holds</td>
</tr>
<tr>
<td>$\Pi^K_{T_1} = 0$</td>
<td>Zero</td>
<td>Positive (more equalizing)</td>
<td></td>
</tr>
<tr>
<td>$\Pi^K_{T_1} &gt; 0$</td>
<td>Positive (more equalizing), if and only if condition MT1 holds</td>
<td>Positive (more equalizing)</td>
<td></td>
</tr>
</tbody>
</table>

The following expression shows that when the marginal effect of progressivity on the marginal contribution of a tax is more than its relative size,

$$\frac{\partial M_{T_1}}{\partial \Pi^K_{T_1}} > \frac{\partial M_{T_1}}{\partial g_1}$$

$(2-52)$
Chapter 2, Enami, Lustig, Aranda,

\[
\frac{g_1}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j} > \frac{\Pi^K_{T_1}(1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j) + \left(\sum_{i=1}^n g_i \Pi^K_{T_1} + \sum_{j=1}^m b_j \rho^K_{B_j}\right)}{(1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j)^2}
\]

\[
\iff g_1 > \Pi^K_{T_1} + \frac{\sum_{i=1}^n g_i \Pi^K_{T_1} + \sum_{j=1}^m b_j \rho^K_{B_j}}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}
\]

(2-53)

\[
\iff g_1 > \Pi^K_{T_1} + \Pi^{RS}_{X-T+B} - \rho^{RS}_{B_j}
\]

The derivatives with respect to progressivity and size are shown as follows:

\[
\frac{\partial M_T}{\partial \Pi^K_{T_1}} = \frac{g}{1 - g + b}
\]

and

\[
\frac{\partial M_T}{\partial g} = \frac{\Pi^K_{T_1}(1 - g + b) + [g \Pi^K_{T_1} + b \rho^K_{B_j}]}{1 - g + b} = \frac{\Pi^K_{T_1} + \Pi^{RS}_{X-T+B}}{1 - g + b}
\]

Equation 2-53a shows the condition under which the derivative of the marginal contribution of a tax with respect to its progressivity would be greater than the derivative with respect to its size:

\[
\frac{\partial M_T}{\partial \Pi^K_{T_1}} > \frac{\partial M_T}{\partial g}
\]

\[
\iff \frac{g}{1 - g + b} > \frac{\Pi^K_{T_1}(1 - g + b) + [g \Pi^K_{T_1} + b \rho^K_{B_j}]}{1 - g + b}
\]

(2-53a)

\[
\iff g > \Pi^K_{T_1} + \Pi^{RS}_{X-T+B}
\]
The Derivatives for the Case of a Marginal Change in Transfers

The marginal contribution $M_{B_1}$ of a transfer $B_i$ ($B_i = B_i$ is chosen without the loss of generality) in the case of multiple taxes and benefits can be similarly written in this format as

$$M_{B_1} = G_{N\setminus B_1} - G_N$$

or

$$M_{B_1} = G_X - \sum_{l=1}^{n} T_l + \sum_{j=2}^{m} B_j - G_X - \sum_{l=1}^{n} T_l + \sum_{j=1}^{m} B_j$$

$$= \left( G_X - G_X - \sum_{l=1}^{n} T_l + \sum_{j=1}^{m} B_j \right) - \left( G_X - G_X - \sum_{l=1}^{n} T_l + \sum_{j=2}^{m} B_j \right)$$

$$\equiv \left[ \prod_{X=1}^{S} \frac{\sum_{i=1}^{n} (1 - g_i) \prod_{T_i}^{RS} + \sum_{j=1}^{m} (1 + b_j) \rho_{B_j}^{RS}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} \right] - \left[ \prod_{X=1}^{S} \frac{\sum_{i=1}^{n} g_i \prod_{T_i}^{RS} + \sum_{j=2}^{m} (1 + b_j) \rho_{B_j}^{RS}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} \right]$$

Assuming no reranking

$$= \left[ \frac{\sum_{i=1}^{n} g_i \prod_{T_i}^{K} + \sum_{j=1}^{m} b_j \rho_{B_j}^{K}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} \right] - \left[ \frac{\sum_{i=1}^{n} g_i \prod_{T_i}^{K} + \sum_{j=2}^{m} b_j \rho_{B_j}^{K}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=2}^{m} b_j} \right]$$

or

$$(2.54)$$

$$= \frac{b_1 \left[ (1 - \sum_{j=1}^{m} g_i + \sum_{j=2}^{m} b_j) \rho_{B_1}^{K} - \left( \sum_{i=1}^{n} g_i \prod_{T_i}^{K} + \sum_{j=2}^{m} b_j \rho_{B_j}^{K} \right) \right]}{\left( 1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j \right) \left( 1 - \sum_{i=1}^{n} g_i + \sum_{j=2}^{m} b_j \right)}.$$ 

The derivatives with respect to progressivity and size are expressed in equations 2-55 and 2-56 respectively:

$$(2.55)$$

$$\frac{\partial M_{B_1}}{\partial \rho_{B_1}^{K}} = \frac{b_1}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j}.$$
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Note that the derivative 2.36 is always positive given the usual assumption about the total size of taxes and transfers, that is, 

$$1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j > 0$$

Let us consider the following expression for the marginal contribution of a transfer with respect to the relative size of the transfer:

$$\frac{\partial M_{B_1}}{\partial b_1} = \frac{\rho_{B_1}^{K} \left(1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j \right) - \left(1 + 1 \left(\sum_{i=1}^{n} g_i + \sum_{i=1}^{n} b_i \rho_{B_1}^{K} \right)\right)}{\left(1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j \right)^2}$$

(2.56)

To sign the preceding derivative, please note that it is equal to

$$\frac{\rho_{B_1}^{K} - \Pi_{X=1}^{n} t_i + \sum_{j=1}^{m} B_j}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j}.$$

Because the denominator is always positive, the sign depends only on the numerator, which is the Kakwani index of transfer ($\rho_{B_1}^{K}$) and R-S index of the net system with $B_1$ ($\Pi_{X=1}^{n} t_i + \sum_{j=1}^{m} B_j$). The following condition assures the derivative is positive.

**Condition MB1:**

$$\rho_{B_1}^{K} > \Pi_{X=1}^{n} t_i + \sum_{j=1}^{m} B_j$$

Table 2-15 shows what the ultimate sign will be. Here, we assume that there is no reranking, so the R-S index being positive is equivalent to the fiscal system being equalizing.

Table 2-15. The Sign of the Derivative of the Marginal Contribution of a Transfer with Respect to its Relative Size

<table>
<thead>
<tr>
<th>The Transfer of Interest: $B_1$</th>
<th>Regressive</th>
<th>Neutral</th>
<th>Progressive</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho_{B_1}^{K} &lt; 0$</td>
<td>$\rho_{B_1}^{K} = 0$</td>
<td>$\rho_{B_1}^{K} &gt; 0$</td>
<td></td>
</tr>
<tr>
<td><strong>The Whole System (including $B_1$)</strong></td>
<td><strong>Unequalizing</strong></td>
<td><strong>Neutral</strong></td>
<td><strong>Progressive</strong></td>
</tr>
<tr>
<td>$\Pi_{X=1}^{n} t_i + \sum_{j=1}^{m} B_j &lt; 0$</td>
<td>Positive (more equalizing), if and only if condition MB1 holds</td>
<td>Positive (more equalizing)</td>
<td>Positive (more equalizing)</td>
</tr>
</tbody>
</table>
Expression 2.57 shows the scenario in which the effect of progressivity on the marginal effect of a benefit is more than its relative size:

\[
(2-57) \quad \frac{\partial M_{B_1}}{\partial b_1} > \frac{\partial M_{B_1}}{\partial b_1}
\]

\[
\Leftrightarrow b_1 > \rho_{B_1}^K - \frac{\sum_{i=1}^n g_i \Pi_{T_i}^K + \sum_{j=1}^m b_j \rho_{B_j}^K}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}
\]

\[
(2-58) \quad \Leftrightarrow b_1 > \rho_{B_1}^K - \frac{\Pi_{X=T+B}^K}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}.
\]

In order to have an equivalent condition for the simple case of one tax and one transfer similar to equation 2.58, note the following equations introduced earlier:

\[
\frac{\partial M_B}{\partial b} = \frac{b}{1 - g + b}
\]

and

\[
\frac{\partial M_B}{\partial b} = \frac{\rho_{B}^K(1-g+b)}{(1-g+b)^2} = \frac{\rho_{B}^K - \Pi_{X=T+B}^K}{1 - g + b}.
\]
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Equation 2.59 shows the condition under which the derivative of marginal contribution with respect to a transfer’s progressivity would be greater than the derivative with respect to its size:

\[
\frac{\partial M_B}{\partial \Pi^K_B} > \frac{\partial M_B}{\partial b}
\]

(2-59)

\[
\iff b > \rho^K_B - \Pi^K_{X-T+B}
\]

2.4 The Sensitivity of Marginal Contribution Analysis to the Use of the Conventional Gini Index

Thus far, we have focused on the conventional Gini coefficient to determine whether a specific tax or transfer is equalizing. The application of this index implies a normative choice with regard to how individuals from different parts of an income distribution are weighted (Gini puts more weights on the middle of the income distribution). One may prefer to weight more heavily the gains that accrue to lower deciles (or the higher ones) and, therefore, can opt for the family of S-Gini indexes (or Extended Gini) to calculate the marginal contribution of the components of a fiscal system. The final conclusion about a tax (or transfer) having a positive marginal contribution (that is, an equalizing effect) could change if the concentration curve of that tax (or transfer) crosses the Lorenz curve of the total system without that tax (or transfer). In other words, in the case of no dominance, one would expect the results to depend on the normative choice of how to weight individuals. In the following explanation, we clarify this issue further.

In section 1, we discussed the application of the concentration and Lorenz curves in determining whether a tax or transfer is (everywhere) progressive or not. A similar analysis can be applied to the concept of the marginal contribution. Suppose we define the Lorenz curve of “the final income without a specific tax (\(T_i\))” as \(L(p)_{X-\sum_{i=2}^{m} T_i + \sum_{j=1}^{n} B_j}\). Then the specific tax that is being analyzed has an equalizing effect (in the marginal contribution sense), regardless of the normative choice of how to weigh individuals if and only if

\[
\begin{align*}
L(p)_{X-\sum_{i=2}^{m} T_i + \sum_{j=1}^{n} B_j} &\geq C(p)_{T_1}^{X-\sum_{i=2}^{m} T_i + \sum_{j=1}^{n} B_j} \quad \forall p \text{ and,} \\
L(p)_{X-\sum_{i=2}^{m} T_i + \sum_{j=1}^{n} B_j} &> C(p)_{T_1}^{X-\sum_{i=2}^{m} T_i + \sum_{j=1}^{n} B_j} \text{ for some } p
\end{align*}
\]

(2-60)

where \(C(p)_{T_1}^{X-\sum_{i=2}^{m} T_i + \sum_{j=1}^{n} B_j}\) is the concentration curve of \(T_i\) when individuals are ranked with respect to their final income without \(T_i\).

Similarly, for the case of a transfer \((B_j)\), we have the following condition:

\[47\] See Yitzhaki and Schechtman (2005) for a mathematical review of these indicators.
If these conditions do not hold for some \( p \), that is, if there is at least one crossing of the two curves, then the conclusion about whether a specific tax or transfer is equalizing depends on how one weights individuals in different parts of an income distribution. Therefore, it is important to use graphical representations and the sensitivity analysis (that is, using S-Gini indexes with different values for the normative parameter of weighting instead of the conventional Gini) in the context of the inequality (and poverty) analysis. These tools help to determine how much the results of an analysis using a specific index hinges on the underlying normative choice of using that specific indicator.
References


Chapter 2, Enami, Lustig, Aranda,


Higgins, Sean and Nora Lustig. 2016. “Can a poverty-reducing and progressive tax and transfer system hurt the poor?” Journal of Development Economics 122, 63-75


Chapter 2, Enami, Lustig, Aranda,


Appendix 2A: The Shapley Value

Introduction to the Shapley Value

Despite its seeming simplicity, the question “how much does inequality increase (or decrease) due to a particular source of income?” does not have a straightforward answer. In fact, the answer will be different depending on 1) what other sources of income are available to the society, 2) whether any particular meaningful order of allocating different sources of income exists, and 3) whether any theoretical basis for aggregating income sources exists.

To better understand why information about “the other sources of income” (regarding the first point) is important, imagine the following simple example. There are two individuals, $I$ and $J$, who need to get a taxi. They live on the same street but at different distances from the place that they need to get in the taxi. If each of them gets a taxi separately, they will need to pay $10 and $15, respectively. But if they share the ride, they have to pay $15 together. How should they divide the cost? Now, assume a third person joins them, who lives between the two initial passengers and who would have to pay $12 if he were to get a taxi on his own. If they all three go together, their fare remains $15 and unchanged from the previous case when only $I$ and $J$ shared the ride. Going from the first case to the second case, individuals $I$ and $J$’s share of the taxi fare should change because a third person has joined them. This example makes it clear that it is perfectly possible that based on a particular circumstance or depending on how an inequality index is defined, individual shares of each income source in creating or reducing inequality can depend on information about all other sources of income. This situation is why the Shapley value was initially formulated by Lloyd Shapley.48

Now, focusing on the second and third points of our original question, if there is no particular order for how the income sources are assigned and all income sources are perceived in the most disaggregated way (no aggregation hierarchy), then the “simple Shapley value” is the way to calculate the effect of each individual source. This formula is discussed later in this appendix in the section on the simple Shapley value.

If there is a particular order for how some sources of income will be allocated (for example, if taxes cannot be first), then the problem can be easily reduced to the case of simple Shapley. Imagine we have five sources of income and source numbers 1 and 2 are always first and the other sources (3, 4, and 5) are always last. The inequality will change in two steps. First, when sources 1 and 2 are added, the amount of change in inequality can be decomposed between these two sources using the simple Shapley formula. Then, in the second step, inequality will change due to the remaining sources. This change can be decomposed again between only the remaining sources using the simple Shapley formula. The total change will be then equal to the individual shares.

48 See Shapley (1952).
Finally, if there is no particular order but there is an aggregation scheme (for example, taxes, benefits, and so on), then a two-stage, or hierarchy-Shapley value should be used, which is discussed in the next section. The general idea of this two-stage methodology is to determine the contribution of different groups (such as a group of taxes versus a group of transfers) in the first step and then to determine the share of each individual fiscal incidence from the total contribution of its group.

**Simple Shapley Value**

There are two ways to calculate simple Shapley values that result in different outcomes and therefore have different theoretical implications. Sastre and Trannoy call these methods “zero income decomposition” (ZID) and “equalized income decomposition” (EID). The difference between the two formulas is the way that they answer a simple but fundamental question: What should be considered the reference point? In ZID (as the word “zero” implies), we always calculate changes in inequality by using zero allocation of a particular source of income as the reference point. In EID, the reference point is a hypothetical state in which a particular source is divided evenly among all people, so here change in inequality occurs because we deviate from this (hypothetical) equalized distribution of income. To see this point more clearly, assume we have three individuals and their income from a specific source is $10, $20, and $30, respectively. In order to determine the contribution of this source of income to inequality, ZID compares the Gini after this source of income is added to the scenario when this source is not added. EID, on the other hand, compares the Gini after this source of income is added to the scenario when everybody would receive $20 from this source.

Sastre and Trannoy prefer EID over ZID due to a major theoretical difference. To better understand the difference, discussing a simple question is enlightening: If there were a source of income that was distributed evenly among members of a society, what should be the share of this source in creating inequality? Sastre and Trannoy argue that the answer is zero because this particular source does not create any inequality. Only EID produces zero value for such a source and ZID would result in a non-zero value.

The preceding justification for preferring EID over ZID is, however, not as tenable if one deals with taxes and transfers as other types of income (using a broad definition of income to include negative sources as a type of income). An evenly distributed tax (that is, a lump-sum tax) is regressive or pro-rich (poor people pay the same tax as rich people so their tax rate is much higher given their lower income) and an evenly distributed transfer (that is, a lump-sum transfer) is progressive or pro-poor (because poor people get the same amount of money as rich people but relative to their lower income, they are receiving higher benefits). A regressive tax is considered a cause of increasing inequality and a progressive transfer is

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50 Sastre and Trannoy (2002).
considered a cause of reducing inequality, so accordingly one would expect to see a negative Shapley value for a lump-sum tax and a positive Shapley value for a lump-sum transfer, which is only possible through the ZID approach. The EID method would give zero shares to these taxes and transfers.

The other problem with the EID approach is that it cannot be used to decompose changes in the inequality index if the starting value of the index is not zero and the sum of the total sources of income is not zero (for example, if taxes are not equal to transfers due to inefficiency in the fiscal system). This problem is explained in more detail when the EID formula is introduced.

The following example shows the simple Shapley value calculated using the ZID and EID approaches for a specific example of three sources of income: a market income \( M \), an equalized tax \( T \), and a (non-equalized) transfer \( R \). We assume that market income is always first, so we are only interested in the share of the tax and transfer in changing the Gini index (as a measure of inequality) between market income and total income.

Table 2A-1. Comparison of ZID and EID Approaches in Calculating the Shapley Value When an Equalized (Regressive) Tax Is Involved

<table>
<thead>
<tr>
<th>Individual</th>
<th>Market income</th>
<th>Tax (equalized)</th>
<th>Transfer</th>
<th>Final income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>−5</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>−5</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>−5</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>−5</td>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
<td>−5</td>
<td>1</td>
<td>46</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>141</strong></td>
<td><strong>−25</strong></td>
<td><strong>25</strong></td>
<td><strong>141</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>28.2</strong></td>
<td><strong>−5</strong></td>
<td><strong>5</strong></td>
<td><strong>28.2</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Market Income</th>
<th>Gini</th>
<th>Final income Gini</th>
<th>Reduction in Gini</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.335</td>
<td></td>
<td>0.278</td>
<td>0.057</td>
</tr>
</tbody>
</table>

Share of Tax in reducing inequality | Share of Transfer in reducing inequality
<table>
<thead>
<tr>
<th>Shapley Value (ZID)</th>
<th>$-0.057$</th>
<th>$0.114$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shapley Value (EID)</td>
<td>$0.000$</td>
<td>$0.057$</td>
</tr>
</tbody>
</table>

ZID. Zero income decomposition.

EID. Equalized income decomposition.
As is clear from table 2A-1, the ZID approach produces a negative share (that is, inequality increases) for a regressive (pro-rich) tax, which is in line with the literature. It seems reasonable to use these two different approaches in their appropriate contexts. When the sources of income do not include any form of income redistribution (taxes or transfers), using EID has more theoretical justification. On the other hand, if one is only performing an incidence analysis (that is, if only taxes and transfers are included in the analysis), then ZID is the better approach. In cases where both income and redistribution sources are involved, using a two-step approach in ordering different sources can solve the problem. If one can argue that all sources of earned income come first, after which taxes and transfers are added, then a two-step decomposition (as explained earlier) can be employed with the EID approach for the first step (when only earned incomes are considered), followed by the ZID approach for the second step (when only taxes and transfers are considered).

Because both approaches have merits depending on the circumstances, they are both introduced mathematically in the following sections.

**Simple Shapley Value: ZID Approach**

Define a value function \( V \) that uses different income sources as input and produces one value as output. The Gini coefficient is an example of such value function. If there are \( n \) sources of income and \( m \) individuals in the society, then \( V \) can be defined as \( V : R^{m \times n} \rightarrow R \). The set of sources of income is \( N = \{ l_1, l_2, ..., l_n \} \) where each \( l_i \) is itself a \((m \times 1)\) vector of values for all individuals in the society. Therefore, \( V(l_1, l_2, ..., l_n) \) is, for example, the Gini coefficient when all sources of income are distributed in the society and \( V(l_1, 0, ..., 0) \) is the Gini coefficient when only source \( l_1 \) (and none of the other sources) is distributed. The Shapley value is a weighted average of all possible cases in which we can demonstrate the effect of adding one source to the value function. For example, \( V(l_1, l_2, ..., l_n) - V(0, l_2, ..., l_n) \) and \( V(l_1, 0, ..., 0) - V(0, 0, ..., 0) \) are two of many ways to measure the effect of adding \( l_1 \) to the value function. If all of these different ways result in the same value, there is no need to use a complicated weighted average. But for many indexes, including the Gini, this is not the case. While it is easy to list all of the possible ways of calculating the effect of adding a particular source to the value function, determining the weights requires more attention. Before introducing the formula for the weights, let’s start with an intuitive example.

Assume we are interested in determining the weight of path \( V(l_1, l_2, l_3, l_4, l_5, 0, ..., 0) - V(0, l_2, l_3, l_4, l_5, 0, ..., 0) \). This path determines how much \( V \) changes when we add \( l_1 \) given that \( l_2, l_3, l_4, l_5 \) and \( l_6 \) through \( l_n \) will not be added. The Shapley value is determined based on the permutation of sources, or put another way, order matters. In other words, we need to ask how many times we can permute sources \( l_2 \)
through $I_5$ (which is $4! = 24$) and then add $I_1$ and permute sources $I_6 = \emptyset$ through $I_n = \emptyset$ (which is $(n - (4 + 1))!$). We have to multiply all these numbers to get the total number of permutations, that is, $(4!) \times [(n - (4 + 1))!]$. Two important points should be noted. First, even though none of the sources from 6 through $n$ would be added for this path, the number of their permutations matters. Second, for any path, we always calculate the permutation of previously-added sources (sources other than the one that we are interested in) together and then multiply it by the number of permutations of sources that are not added. For example, if we were calculating the weight of path $V(I_1, 0, 0, I_4, I_5, I_6, I_7, 0, \ldots, 0) - V(0, 0, 0, I_4, I_5, I_6, I_7, 0, \ldots, 0)$, the number of permutations is exactly equal to the previous case, that is $(4!) \times [(n - (4 + 1))!]$. One should note that 4 is the number of income sources that are added already and $[n - (4 + 1)]$ is the number of income sources that will not be added. Therefore, what matters is the number of added sources, not which source is added. The number of permutations is the weight of each path. The total number of permutations, $n!$, is used (as the denominator) so that the weights add up to one. With this explanation, the ZID formula can now be formally introduced.

Assume we are interested in finding the Shapley value of income source $i$. Define set $S_{I_i}$ as the set of sub-sets of set $N - \{I_i\}$ (that is, a set that includes all sources of income except for source $I_i$). Note that the empty set, $\emptyset$, and $N - \{I_i\}$ itself are considered two-subsets of $N - \{I_i\}$ and therefore included in $S_{I_i}$. Each element in $S_{I_i}$ represents a different path through which the effect of adding $I_i$ to $V$ can be measured. These elements (which are themselves a set) represent income sources that are added before $I_i$ is added. Because all of the possible paths are represented by elements of $S_{I_i}$, a summation over these elements with appropriate weights would result in the Shapley value. The resulting formula is therefore

$$\text{(2A-1)} \quad Sh^{ZID}_{I_i} = \sum_{S \in S_{I_i}} \left( \frac{(s!) \times [(n-s-1)!]}{n!} \left( V^{ZID}(S \cup I_i) - V^{ZID}(S) \right) \right).$$

First, note that in this formula, $S$ represents an element of set $S_{I_i}$. Second, $s$ is the dimensionality of each element of $S$ that enters in the summation and $n$ is the dimensionality of set $N$. It should be noted that $s$ is the number of income sources that are already added and $n - s - 1$ is the number of sources that will not be added. Third, $V^{ZID}(S \cup I_i)$ means the value function $V$ allocates zero to any income source that is not included in set $S$ (and it is not $I_i$). For example, if $S = \{I_2, I_3, I_4, I_5\}$ then

$$V^{ZID} = V(0, I_2, I_3, I_4, I_5, 0, \ldots, 0)$$

---

51 Sastre and Trannoy (2002).
Simple Shapley Value: EID Approach

Using the same notation as in the previous section, the Shapley formula using the EID approach is

\[
\text{Sh}_{I_t}^{EID} = \sum_{S \in S_t} \left( \frac{(s!) \times ((n-s-1)!)}{n!} (V^{EID}(S \cup I_t) - V^{EID}(S)) \right)^{52}
\]

The only difference here is that \( V^{EID}(S) \) means the value function \( V \) allocates the average income to all individuals in the society for any income source that is not included in \( S \). For example, if \( S = \{I_2, I_3, I_4, I_5\} \), then the corresponding value function is

\[
V^{EID} = V(I_1, I_2, I_3, I_4, I_5, (\mu_{I_6} \times 1), \ldots, (\mu_{I_n} \times 1))
\]

where \( 1 \) is a \((m \times 1)\) vector of ones and \( \mu_{I_i} \) is the average value of income source \( i \).

Note how the EID formula would run into problems if one tried to use it to explain a change in a value function (for example, the Gini coefficient) between a reference point that is not zero and an end point that has a different per-capita income in comparison to the reference point (that is, the sum of taxes and transfers is not zero). Assume the same example that is shown in table A2-1. When total taxes and transfers are the same, the per-capita values are also equal and they cancel each other out, so the reference point remains the market income, that is,

\[
V(\text{Market income, } (\mu_{\text{Tax}} \times 1), (\mu_{\text{Transfer}} \times 1)) = V(\text{Market income, 0, 0})
\]

\[
\text{when } \mu_{\text{Tax}} = -\mu_{\text{Transfer}}
\]

If the sum of taxes and transfers is not zero, the reference point is no longer market income and has a different value for the Gini coefficient, which results in the decomposition differing from the value we want to explain. Table A2-2 shows this problem in a simple example. The sum of the EID Shapley values does not add up to the change in the Gini coefficient that we would like to explain.

Table A2-2. Example of EID Failing to Decompose the Change in Gini

<table>
<thead>
<tr>
<th>Individual</th>
<th>Market Income</th>
<th>Tax</th>
<th>Transfer</th>
<th>Final income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>-1</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>-2</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>-3</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>-4</td>
<td>2</td>
<td>38</td>
</tr>
</tbody>
</table>

\[^{52}\text{Sastre and Trannoy (2002).}\]
Gini value of the market income is not zero; the sum of taxes and transfers is not zero.

ZID. Zero income decomposition.

EID. Equalized income decomposition.

### Hierarchy-Shapley Value

According to Sastre and Trannoy, “Shapley value does not satisfy the principle of independence of the aggregation level.” The following example demonstrates this shortcoming. Assume in our previous example in table A2-1, the equalized tax is in fact the combination of two independent taxes and we recalculate the simple (ZID) Shapley values for two taxes and one transfer. As is clear from table A2-3, the Shapley values for these taxes would not add up to the Shapley value of the equalized tax in table A2-1. Moreover, the Shapley value of the transfer is different.

Table A2-3. New Shapley Values (ZID) When Taxes Are Divided into Two Groups

<table>
<thead>
<tr>
<th>Individual</th>
<th>Market</th>
<th>Tax1</th>
<th>Tax2</th>
<th>Transfer</th>
<th>Final income</th>
</tr>
</thead>
</table>

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<table>
<thead>
<tr>
<th>income</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market income Gini</td>
<td>0.335</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final income Gini</td>
<td>0.278</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction in Gini</td>
<td>0.057</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of Tax1 in reducing inequality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of Tax2 in reducing inequality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of Transfer in reducing inequality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shapley Value (ZID)</td>
<td>0.006</td>
<td>-0.063</td>
<td>0.114</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ZID. Zero income decomposition. Given that no new tax has been added and that the only change is that some additional information about the sources of taxes has been included in the analysis, it is inconvenient that the Shapley value for transfers has also changed. Different solutions have been suggested to solve this problem. Sastre and Trannoy in particular introduce two methods, “Nested Shapley” and “Owen Decomposition.”

Both of these solutions use a type of hierarchy, which is why they are called hierarchy-Shapley values here. In the following sections, unless otherwise specified, no distinction between ZID and EID approaches is made and the formulas can be used for both cases.

**Hierarchy-Shapley Value: Nested Shapley**

Using notations from the previous section, now assume each source of income $I_l$ is the summation of a sub-set of sources, that is, $I_l = I_{l1} + I_{l2} + \cdots + I_{lk}$. It is assumed that this hierarchy has a particular theoretical basis. Define set $N_l = \{I_{l1}, I_{l2}, \ldots, I_{lk}\}$ as the set of all

---

Chapter 2, Enami, Lustig, Aranda,

incomes that comprise income source $I_i$. We are particularly interested in one of these sub-sources, the nested Shapley value of $I_{ij}$. Define set $NSI_{ij}$ as the set of sub-sets of set $N_{il} - \{I_{ij}\}$ (analogous to set $S_{il}$, defined in previous sections). According to Sastre and Trannoy, nested Shapley can be viewed as a two-step procedure. In the first step, we assume that the second layer does not exist and we calculate the simple Shapley value for all sources $I_i$. In the second step, we decompose the Shapley value of each source $I_i$ between its sub-sources. The nested Shapley value of source $I_{ij}$ (which is an element of $I_i$) is then equal to

$$NSh_{ij} = \sum_{S \in NSI_{ij}} \left( \frac{(s!) \times ((k-s-1)!)}{k!} \left( V(S \cup I_{ij}) - V(S) \right) \right) +$$

$$\frac{1}{k} \left( Sh_{il} + V(I_i) - V(0) \right)$$

Elements of this formula are either introduced above or in the previous sections. The only remaining item is $k$, which is the dimensionality of set $N_{il}$. Equation A2-3 is different from Sastre and Trannoy\(^{55}\) because we do not assume that the value of $V(0)$ is zero, which is crucial when the inequality in the starting point is not zero (for example, the Gini value of the market income is not zero in our previous examples). The first term is exactly the same formula introduced for simple Shapley that is only applied to the set of sources that are part of $N_{il}$ to explain the change in the value function between $V(0)$ and $(I_i)$. The second term is the difference between the Shapley value of the aggregated source $I_i$ and the value of function $V$ when only aggregated source $I_i$ is added. It is clear to see that

$$\sum_{j=1}^{k} NSh_{ij} = Sh_{il}.$$

The proof is as follows:

$$\sum_{j=1}^{k} NSh_{ij} = \sum_{j=1}^{k} \left\{ \sum_{S \in NSI_{ij}} \left( \frac{(s!) \times ((k-s-1)!)}{k!} \left( V(S \cup I_{ij}) - V(S) \right) \right) \right\}$$

$$+ \sum_{j=1}^{k} \frac{1}{k} \left( Sh_{il} + V(I_i) - V(0) \right)$$

$$\rightarrow \sum_{j=1}^{k} NSh_{ij} = \sum_{j=1}^{k} \left\{ \sum_{S \in NSI_{ij}} \left( \frac{(s!) \times ((k-s-1)!)}{k!} \left( V(S \cup I_{ij}) - V(S) \right) \right) \right\} + Sh_{il} +$$

$$V(I_i) - V(0).$$

Note that in the second term, the summation over $k$ and $(1/k)$ cancel each other. Now note that the term inside the braces is equal to $Sh_{il}$ if one decomposes the change in $V$ between $V(0)$ and $V(I_i)$. The summation over the Shapley value of all $j$ income concepts that are part

\(^{55}\) Sastre and Trannoy (2002).
of \( I_i \) is simply equal to the total change in the value function between \( V(0) \) and \( V(I_i) \). This means the preceding equation could be written as follows:

\[
\sum_{j=1}^{k} NSh_{i|ij} = V(I_i) - V(0) + Sh_{l_i} + V(I_i) - V(0)
\]

and therefore,

\[
\sum_{j=1}^{k} NSh_{i|ij} = Sh_{l_i}.
\]

Note that the value of \( j \) has to be at least 1 (that is, one income inside each income group) and if all income groups have \( j = 1 \), then the nested Shapley is reduced to the simple Shapley.

This nested Shapley formula, however, suffers from a few theoretical problems. First, the choice of decomposing \( V(I_i) - V(0) \) between sub-elements of \( I_i \) (the first term in equation A2-3) is arbitrary. One can choose any element of set \( S_{l_i} \). Let’s call it \( O_j \) and then decompose \( V(I_i \cup O_j) - V(O_j) \) between elements of \( I_i \) and the decomposition also satisfies equation A2-4. Equation A2-3 can then be generalized as

\[
(A2-5) \quad NSh_{i|ij} = \sum_{S \in S_{l_i}} \left( \frac{(s)! \times ((k-s-1))}{k!} \left( V(O_j \cup S \cup I_{i|ij}) - V(O_j \cup S) \right) \right) \\
+ \left( \frac{1}{k} Sh_{l_i} - V(O_j \cup I_i) + V(O_j) \right) \quad \text{For any arbitrary chosen } O_j \in S_{l_i}.
\]

The value of \( NSh_{i|ij} \) would change with the choice of \( O_j \). The second theoretical problem with equation A2-3 is that \( Sh_{l_i} + V(I_i) - V(0) \) is divided evenly between all \( k \) sub-elements of \( I_i \). There is no particular reason to do so and any weighting scheme works as long as the weights add up to unity. In fact, one might argue that assigning similar weights is not in line with the idea of decomposition, which tries to allocate an appropriate share to each element depending on how important the element is. Using a weighting scheme that gives more weight to more important elements results in equation A2-6:

\[
(A2-6) \quad NSh_{i|ij} = \sum_{S \in S_{l_i}} \left( \frac{(s)! \times ((k-s-1))}{k!} \left( V(O_j \cup S \cup I_{i|ij}) - V(O_j \cup S) \right) \right) \\
+ \left( \frac{\sum_{S \in S_{l_i}} \left( \frac{(s)! \times ((k-s-1))}{k!} \left( V(O_j \cup S \cup I_{i|ij}) - V(O_j \cup S) \right) \right)}{V(I_i \cup O_j) - V(O_j)} \right) \left( Sh_{l_i} + V(O_j \cup I_i) - V(O_j) \right) \quad \text{For any arbitrary chosen } O_j \in S.
\]
The weighting scheme in equation 2A-6 uses the relative importance of element $I_{ij}$ in explaining the gap between $V(O_j \cup I_i)$ and $V(O_j)$, that is $V(O_j \cup I_i) - V(O_j)$. While this modified weighting scheme has a much better theoretical ground, the fact that $NH_{ij}$ depends on the choice of $O_j$ is still problematic. The following example helps to better visualize this problem. We use the same example as in Table 2A-3 but the results should be compared to Table 2A-1. Regardless of how we decompose the Shapley value of the total tax between its elements, the Shapley value of the transfer remains unchanged and equal to the value in Table 2A-1 (the ZID Shapley value). However, depending on which formula is used for the decomposition for taxes, the Shapley values of Tax 1 and Tax 2 change, though they always add up to the Shapley value of total tax. Among the four different methods, 2A-6' is preferred to 2A-3' and 2A-6'' is preferred to 2A-5' because of their modified weighting scheme, but there is no theoretical basis for any preference between 2A-6' and 2A-6''. Note that in Table 2A-4, values for 2A-5' and 2A-6' happen to be the same by pure luck and that this is not a general rule.

In the following formulas, $N_{Tax} = \{Tax1, Tax2\}$ and $NS_{Taxj}$ is the set of all sub-sets of $N_{Tax} - \{Taxj\}$. Moreover, $M$ represents the market income and $V(.)$ represents the Gini coefficient function. The following formulas are derived from the original formulas discussed in the specific example in Table 2A-4.

\[
(2A-3)' \quad NSh_{Taxj} = - \left[ \sum_{SENS_{Taxj}} \left( \frac{(V(MUS_{Taxj}) - V(MUS))}{2} \right) \right] + \frac{1}{2} (Sh_{Tax} + V(M \cup Tax) - V(M))
\]

\[
(2A-5)' \quad NSh_{Taxj} = - \left[ \sum_{SENS_{Taxj}} \left( \frac{(V(O_j \cup MUS_{Taxj}) - V(O_j MUS))}{2} \right) \right] + \frac{1}{2} (Sh_{Tax} + V(O_j \cup Tax) - V(O_j)) \quad \text{Where } O_j = \{Market \, Income \, + \, Transfer\}
\]

\[
(2A-6)' \quad NSh_{Taxj} = \sum_{SENS_{Taxj}} \left( \frac{(V(MUS_{Taxj}) - V(MUS))}{2} \right) \left( Sh_{Tax} + V(M \cup Tax) - V(M) \right)
\]

\[
+ \left( \frac{\sum_{SENS_{Taxj}} \left( \frac{(V(MUS_{Taxj}) - V(MUS))}{2} \right)}{V(M \cup Tax) - V(M)} \right) (Sh_{Tax} + V(M \cup Tax) - V(M))
\]
Chapter 2, Enami, Lustig, Aranda,

\[(2A-6)\]

\[NSh_{Taxj} = \sum_{S \in S_{Taxj}} \left( \frac{(V(O_j \cup S \cup Taxj) - V(O_j \cup S))}{2} \right)\]

\[\left( \sum_{S \in S_{Taxj}} \left( \frac{(V(O_j \cup S \cup Taxj) - V(O_j \cup S))}{2} \right) \right) \left( Sh_{Tax} + V(O_j \cup Tax) - V(O_j) \right)\]

Where \(O_j = \{\text{Market Income + Transfer}\}\)

Table 2A-4. Nested Shapley Values (ZID) Using Different Methods of Weighting and Reference Points

<table>
<thead>
<tr>
<th>Individual</th>
<th>Market Income</th>
<th>Tax1</th>
<th>Tax2</th>
<th>Transfer</th>
<th>Final income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>-5</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>-1</td>
<td>-4</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>-2</td>
<td>-3</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>-3</td>
<td>-2</td>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
<td>-4</td>
<td>-1</td>
<td>1</td>
<td>46</td>
</tr>
<tr>
<td>Total</td>
<td>141</td>
<td>-10</td>
<td>-15</td>
<td>25</td>
<td>141</td>
</tr>
<tr>
<td>Average</td>
<td>28.2</td>
<td>-2</td>
<td>-3</td>
<td>5</td>
<td>28.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Market Income</th>
<th>Gini</th>
<th>Reduction in Gini</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.335</td>
<td></td>
<td>0.057</td>
</tr>
</tbody>
</table>

Final income Gini 0.278

\[\text{Share of Tax1 in reducing inequality} = \text{Share of Tax2 in reducing inequality} = \text{Share of Transfer in reducing inequality} = 0.114\]

Nested Shapley Value: equation 2A-3' (ZID)

<table>
<thead>
<tr>
<th>Nested Shapley Value</th>
<th>0.010</th>
<th>-0.067</th>
<th>0.114</th>
</tr>
</thead>
</table>

| Nested Shapley Value | 0.002 | -0.059 | 0.114 |
### ZID. Zero income decomposition.

#### Hierarchy-Shapley Value: Owen Decomposition

In order to avoid the problem of the reference point in the nested Shapley value, one can use the Owen value.\(^\text{56}\) Intuitively, the Owen value can be viewed as a Shapley value of different nested Shapley values, that is, all possible reference points are included. Therefore, the Owen value is not subject to the theoretical shortcomings of the nested Shapley and accordingly, it has some advantages. Sastre and Trannoy disagree with this argument because they believe that reference points other than \(V(0)\) imply that income elements are combined at a different aggregation level.\(^\text{57}\) This argument loses its ground, however, as soon as we try to use the nested Shapley value to explain, for example, changes in the Gini index between market and final income. Because market income is on the same aggregation level as total tax but not Tax 1, using the nested Shapley implies the combination of two elements from two different aggregation levels. In other words, unless the reference point is “null,” the combination of different aggregation levels is inevitable and therefore the Owen method is a theoretically better way of calculating the Shapley value since it incorporates all possible reference points.\(^\text{58}\)

To better understand the Owen value, consider equation 2A-1 and particularly \(V^{ZID}(S \cup I_l) - V^{ZID}(S)\) in that formula. This argument is calculated for each element of the summation. Owen decomposes this argument (for every element of the summation) to determine the share of each sub-element. The formula for the Owen decomposition is therefore

\[
(2A.7) \quad OSH^{ZID}_{i|j} = \sum_{S \in S_{i|j}} \left( \frac{(s_1)! \times ((n-s-1))!}{n!} \right) \sum_{S' \in NS_{i|j}} \left( \frac{(s'_1)! \times ((k-s'-1))!}{k!} \right) (V^{ZID}(S \cup S' \cup I_l) - V^{ZID}(S \cup S'))
\]

\(^{56}\) Owen (1977).

\(^{57}\) Sastre and Trannoy (2002).

\(^{58}\) Sastre and Trannoy (2002) use a formula similar to equation 2-43, which suffers from a second theoretical problem (assigning equal weights to all sub-elements of one source) that is discussed in previous sections.
All elements of this formula have been introduced previously. Note that the second summation (the inside summation) determines the share of $I_j$ in filling the gap $V^{ZID}(S \cup I_j) - V^{ZID}(S)$. Because the coefficient outside the second summation can move inside, the formula can be simplified to a formula similar to what Sastre and Trannoy suggest:

$\text{(2A-7') } OSH_{ij}^{ZID} = \sum_{S \in S_{I_i}} \left( \sum_{S' \in S_{I_j}} \left( \frac{(S')^{(S)(I-I)(I-I)}}{k!} \right) \left( V^{ZID}(S \cup S' \cup I_i) - V^{ZID}(S \cup I_i) \right) \right)$

Note that one can easily use $V^{EID}$ in the preceding formula. Using the same example as in table 2A-3, the Owen values for the case of two taxes and one transfer are calculated in table 2A-5 and can be compared with the values in tables 2A-1 and 2A-4.

### Table 2A-5. Owen Values (ZID)

<table>
<thead>
<tr>
<th>Individual</th>
<th>Market Income</th>
<th>Tax1</th>
<th>Tax2</th>
<th>Transfer</th>
<th>Final income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>-5</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>-1</td>
<td>-4</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>-2</td>
<td>-3</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>-3</td>
<td>-2</td>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
<td>-4</td>
<td>-1</td>
<td>1</td>
<td>46</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>141</strong></td>
<td><strong>-10</strong></td>
<td><strong>-15</strong></td>
<td><strong>25</strong></td>
<td><strong>141</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>28.2</strong></td>
<td><strong>-2</strong></td>
<td><strong>-3</strong></td>
<td><strong>5</strong></td>
<td><strong>28.2</strong></td>
</tr>
</tbody>
</table>

Owen Value (ZID) | 0.006 | -0.063 | 0.114
ZID. Zero income decomposition.

It should be noted that the Owen value of the transfer is the same as in table 2A-1, as expected. Comparing Owen values from table 2A-5 to those in table 2A-4, the Owen value of each tax component is between its nested Shapley value for equation 2A-6’ and 2A-6”. This outcome is expected because the Owen value incorporates all possible reference points and is intuitively a type of (weighted) average value. As a result, the Owen value is a more conservative estimate than the nested Shapley values for the share of each component.

Concluding Remarks

Of the different methods for estimating the Shapley value for income sources, there are better theoretical justifications for using the ZID approach than EID and for using the Owen value instead of the nested Shapley for performing an incidence analysis (which is mainly focused on different sources of taxes and transfers). This conclusion stands in contrast to the suggestions by Sastre and Trannoy and Duclos and Araar. ZID is preferred over EID for two main reasons. First, ZID allocates a negative (or positive) value to a lump-sum tax (or transfer) that is by definition regressive (or progressive) and therefore increases (or decreases) inequality. EID will assign a zero value to such a tax (or transfer). Second, ZID decomposition is always exact; in contrast, EID will not be exact if we decompose a change in inequality between states A and B where inequality in the beginning point (that is, A) is not zero and average income in states A and B are different (that is, taxes and transfers do not add up to zero).

The Owen value is preferred over the nested Shapley value for two reasons. First, the simple nested Shapley formula (that is, equation 2A-3), which is used more often in the literature, assigns identical weights to different sub-items of a particular source of income. Second, even the modified version of nested Shapley (that is, equation 2A-6), which does not have the weighting problem, still suffers from the reference point dependency problem. This problem results in different Shapley values for sub-items depending on which reference point is chosen. The Owen value, on the other hand, solves this problem by using all reference points (and weighting them equally). The only critique made by Sastre and Trannoy for this technique (mixing items from different aggregation levels) is not unique to the Owen value. Moreover, nested Shapley is also subject to this critique if it is used to explain a change in inequality between points A and B when point A is not the null case such as, for instance, changes in the Gini coefficient between market income and total income.

60 See Sastre and Trannoy (2002).
61 The null case is where no source of income is distributed in the society.
Given these theoretical arguments, the Owen value with the ZID approach is the best option when the fiscal system under study mainly includes taxes and transfers, which is true for most cases. This method assures that the decomposition is exact and every single source of income receives its appropriate share based on how much it contributes to the reduction (or escalation) of inequality. Moreover, using the Owen value, there is no problem regarding the choice of the reference point.
Measuring the Redistributive Impact of Taxes and Transfers in the Presence of Reranking

Ali Enami¹

October 31, 2016

Chapter 3
Lustig, Nora, editor
Commitment to Equity Handbook
Brookings Institution and CEQ Institute (2017)

1 Introduction

In Chapter 2 by Enami, Lustig, and Aranda, we discussed how to measure the redistributive impact of taxes and transfers in a system where there is no reranking: i.e., the position of individuals ordered by their income remains identical in the pre-fiscal and post-fiscal situations.² This chapter introduces the possibility of reranking in a fiscal system into the analysis of a tax or transfer’s marginal contribution in reducing (increasing) inequality. As will become clear in this chapter, when a fiscal system creates reranking in individuals, it is much harder to use simple rules to determine whether a specific tax or transfer is equalizing or not. The complicated math introduced here shows that, in contrast to such measures as progressivity, the marginal contribution analysis is the only straightforward way of determining whether a tax or transfer is equalizing. It should be noted that the analysis in this chapter is focused on the traditional Gini index but can be similarly extended to the S-Gini indexes. The idea of marginal contribution analysis can be also extended to other measures of inequality but one should be cautious about the fact that the type of decomposition that we use in this chapter may not be applicable to other indexes (for example, the Theil index).

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² Enami and others (2017).
The best way to see how introducing reranking would create new problems is through a simple example. In the previous chapter where reranking was not present, a simple rule was introduced that held that if a system has only one tax and that tax is progressive, then the post-fiscal system is unambiguously more equal. Though this “progressive-means-equalizing” rule of thumb is one of the most commonly used rules, previous chapter showed that this rule is not always correct when a system is not composed of only one tax or one transfer (see for example, the so-called Lambert conundrum). This chapter shows that in the presence of reranking, this rule is not always correct even in a system with only one tax (transfer). In other words, this chapter shows that a progressive tax could create a more unequal post-fiscal system (using Gini as the measure of inequality). Table 3-1 shows an example where the Gini increases from 0.054 to 0.074 after introducing a progressive tax into the system.

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income</th>
<th>Tax</th>
<th>End Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.00</td>
<td>0.00</td>
<td>10.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>2.00</td>
<td>9.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>4.00</td>
<td>8.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>6.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Total</td>
<td>46.00</td>
<td>12.00</td>
<td>34.00</td>
</tr>
<tr>
<td>Average</td>
<td>11.50</td>
<td>3.00</td>
<td>8.50</td>
</tr>
</tbody>
</table>

Gini 0.0540 n.c. 0.0740

n.c. Not calculated for the purposes of this chapter.

Before continuing further, the following section will explain the notations that will be used throughout this chapter.

2 Notations

This section provides the definitions of notations that will be used throughout this chapter. The notations are generally similar to those in other chapters but some minor modifications have been made to meet the requirements of the topics covered here.

2.1 Gini and Concentration Coefficients

This chapter uses $G_Q$ and $C_Q$ for the “Gini coefficient of the income concept Q” and the “concentration coefficient of income concept Q with respect to the income concept G.” Note how the Gini and concentration coefficients are calculated using the covariance formula:
where, $F_Q$ is the normalized rank of individuals when they are ranked by income concept $Q$ and $\mu_Q$ is the average value of the income concept $Q$. The normalized rank is simply calculated as follows. Assume there are $n$ individuals who are ranked by income $Q$ from 1 to $n$, where $n$ is the rank of the individual with the highest income. The normalized rank of individual $j$ is simply equal to $j/n$. Therefore, the normalized rank ranges from $1/n$ to 1. Similarly, $F_G$ is the normalized rank of individuals if they are ranked by income concept $G$.

The previous chapter use a simpler notation, $C_Q$, for the concentration coefficient, which implies that the “original income ranking of households” is used in its calculation. This chapter uses the superscript $X$ to represent that individuals are ranked by their original income:

$$
C_Q = C_Q^X = \frac{2\text{cov}(Q,F_X)}{\mu_Q}.
$$

The covariance formula helps to explain why the concentration coefficient can be negative. For example, if the ranking of individuals is exactly the opposite with income concept $Q$ than with income concept $X$, then $C_Q^X$ would be negative. On the other hand, the Gini coefficient for income concept $Q$, $G_Q$ is always non-negative since it uses the same income concept to calculate the Gini index as it uses to rank individuals.

### 2.2 Reynolds-Smolensky (R-S) and Kakwani Indexes

Similarly to section 2.1, I use the following formulas for the R-S and Kakwani indexes of a tax ($T$) or transfer ($B$) when they are calculated with respect to the original income ranking of households.

For a tax,

$$
\Pi_T^{RS} = G_X - G_X^{X-T} = \frac{2\text{cov}(X,F_X)}{\mu_X} - \frac{2\text{cov}(X-T,F_X)}{\mu_X(1-g)}
$$

$$
\Pi_T^K = C_T^X - G_X = \frac{2\text{cov}(T,F_X)}{\mu_X g} - \frac{2\text{cov}(X,F_X)}{\mu_X}
$$

For a transfer,
where $g$ (b) is the total taxes (transfers) collected divided by the total amount of original income (that is, $X$). For example,

$$g = \frac{T}{X}$$

and

$$b = \frac{B}{X}.$$

In this chapter, I also use a modified version of these two indicators (the R-S and Kakwani indexes) that allows the basis for ranking to be different from the original income. Whenever I use these new indexes, the superscript shows the income concept for the ranking. For example, if I used income concept $Q$ for the ranking, I would have the following formulas.

For a tax,

$$\Pi_T^{RS} = C_X^Q - C_{X-T}^Q$$

$$\Pi_T^K = C_T^Q - C_X^Q$$

For a transfer,

$$\rho_B^{RS} = C_X^Q - C_{X+B}^Q$$

$$\rho_B^K = C_X^Q - C_B^Q$$

The relationship between the R-S and Kakwani indexes is as follows.

For a tax,

$$\Pi_T^{RS} = g \Pi_T^K.$$

And for a transfer,

$$\rho_B^{RS} = \frac{b}{1+b} \rho_B^K.$$
2.3 The Relationship Between the Redistributive Effect, Vertical Equity, and Reranking

To understand how reranking affects a fiscal system, it is helpful to decompose the redistributive effect (RE), which is the change in Gini from the original income to the end income, into the vertical equity (VE) and the reranking (RR) components. The following derivation shows explicitly that RR always reduces VE and is therefore always an unequalizing component. The presence of RR in a fiscal system implies a form of inefficiency in redistributive policy because the same level of reduction in inequality could be achieved with a lower level of income redistribution through taxes and transfers if RR were to be eliminated.

For the purpose of simplicity, I bundle all of the taxes in a system together and all of transfers (benefits) together and use just one tax (T) and one transfer (B) in the following.

The RE (that is, the change in Gini) can be decomposed into two elements, as follows:

\[
G_X - G_{X-T+B} = (G_X - C_{X-T+B}^X) + \left( C_{X-T+B}^X - G_{X-T+B} \right) \cdot \text{Vertical Equity} \]
\[
= (1-g)\Pi_T^{RS} + (1+b)\rho_B^{RS} \cdot \text{Reranking (non-positive)}
\]

These indexes are known as the Reynolds-Smolensky index of progressivity and VE\(^4\) and the Atkinson-Plotnick index of RR\(^5\). According to Lambert\(^6\), in the absence of RR, the change in Gini can be simply calculated using the following formula (assuming only one tax and one transfer or, alternatively, grouping all taxes together as well as all transfers).

\[
G_X - C_{X-T+B}^X = \frac{(1-g)\Pi_T^{RS} + (1+b)\rho_B^{RS}}{1-g+b}
\]

If reranking is allowed, the change in Gini will be equal to

\[
G_X - G_{X-T+B} = \frac{(1-g)\Pi_T^{RS} + (1+b)\rho_B^{RS}}{1-g+b} + (G_X - C_{X-T+B}^X) - \left(\frac{(1-g)\Pi_T^{RS} - (1+b)(\rho_B^{RS} - \rho_B^{X-T+B})}{1-g+b}\right).
\]

---

\(^3\) See Duclos and Araar (2007). Note that the component called VE in equation 2.3.1 is not exactly pure and could include a “horizontal inequality” component. This component captures the “negative” behavior of a fiscal system that treats differently individuals who are exactly the same (Duclos and Araar, 2007). Here it is assumed that people are not exactly the same, so the horizontal inequality does not exist. Note that the phrase “exactly the same” is not limited to the amount of original income and includes other elements such as number of children and even subjective measures. If people have exactly the same original income, the derivations here are still valid, so we assume people are not exactly the same in other dimensions but we allow them to have identical original income.

\(^4\) Reynolds and Smolensky (2013).

\(^5\) Atkinson (1979); Plotnick (1981, 1982).

The proof is as follows.

We know that the change in Gini can be decomposed into two elements:

\[
G_X - G_{X-T+B} = (G_X - C_X^{X-T+B}) + (C_{X-T+B} - G_{X-T+B}^X)
\]

As mentioned previously, Lambert proves the following inequality:\(^7\)

\[
G_X - C_X^{X-T+B} = \frac{(1-g)\mu_{RS}^B + (1+b)\rho_B^R}{1-g+b}
\]

Now, focusing on the second term in equation 3-3, that is, the RR term, we know from equation 3-4 that

\[
C_X^{X-T+B} = G_X - \frac{(1-g)\mu_{RS}^B + (1+b)\rho_B^R}{1-g+b}
\]

Now, focusing on \(G_{X-T+B}\),

\[
G_{X-T+B} = \frac{2\text{Cov}(X-T,F_{X-T+B})}{\mu_X(1-g+b)}
\]

\[
G_{X-T+B} = \frac{2\text{Cov}(X-T,F_{X-T+B})}{\mu_X(1-g+b)} + \frac{2\text{Cov}(X+B,F_{X-T+B})}{\mu_X(1-g+b)} - \frac{2\text{Cov}(X,F_{X-T+B})}{\mu_X(1-g+b)}
\]

\[
= \left( \frac{1-g}{1-g+b} \right) \frac{2\text{Cov}(X-T,F_{X-T+B})}{\mu_X(1-g)} + \left( \frac{1+b}{1-g+b} \right) \frac{2\text{Cov}(X+B,F_{X-T+B})}{\mu_X(1+b)}
\]

\[
- \frac{2\text{Cov}(X,F_{X-T+B})}{\mu_X(1-g+b)}
\]

To make it simpler to follow the next steps, I examine each one of the three terms in equation 3-6 in turn.

\[
A = \left( \frac{1-g}{1-g+b} \right) \frac{2\text{Cov}(X-T,F_{X-T+B})}{\mu_X(1-g)} - \left( \frac{1-g}{1-g+b} \right) \frac{2\text{Cov}(X,F_{X-T+B})}{\mu_X}
\]

\[
B = \left( \frac{1+b}{1-g+b} \right) \frac{2\text{Cov}(X+B,F_{X-T+B})}{\mu_X(1+b)}
\]

\[
C = \frac{2\text{Cov}(X,F_{X-T+B})}{\mu_X(1-g+b)}
\]

\(^7\) See Lambert (2001, p. 277).
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\[ + \left( \frac{(1-g)}{(1-g+b)} \right) \frac{2Cov(X, F_{X-T+B})}{\mu_X} \]

Note that I just added and subtracted the same term in the preceding equation at the end. It is important to note that the first two terms in the preceding formula would add up to

\[-\left( \frac{(1-g)}{(1-g+b)} \right) \Pi^R_{T}^{X-T+B} \text{ (see the notation section).} \]

The third term is equal to

\[ \left( \frac{(1-g)}{(1-g+b)} \right) C^X_{X-T+B}. \]

Therefore,

\[ (3-7) \quad A = -\left( \frac{(1-g)}{(1-g+b)} \right) \Pi^R_{T}^{X-T+B} + \left( \frac{(1-g)}{(1-g+b)} \right) C^X_{X-T+B}. \]

Analogously for B,

\[ (3-8) \quad B = -\left( \frac{(1+b)}{(1-g+b)} \right) \rho^R_B^{X-T+B} + \left( \frac{(1+b)}{(1-g+b)} \right) C^X_{X-T+B}. \]

And similarly for C,

\[ (3-9) \quad C = -\left( \frac{1}{(1-g+b)} \right) C^X_{X-T+B}. \]

The following formula puts the preceding parts together (that is, it uses 3-7, 3-8, and 3-9 in equation 3-6).

\[ (3-10) \quad G_{X-T+B} = A + B + C = - \left[ \frac{(1-g)\Pi^R_{T}^{X-T+B} - (1+b)\rho^R_B^{X-T+B}}{1-g+b} \right] + C^X_{X-T+B}. \]

Finally, the following formula puts all the parts together (that is, it uses 3-4, 3-5, and 3-10 in 3-3).

\[ G_X - G_{X-T+B} = \]
\[
\frac{(1 - g)\Pi_T^{RS} + (1 + b)\rho_B^{RS}}{1 - g + b} + (G_X - C_X^{x-T+B}) - \left( \frac{(1 - g)\left(\Pi_T^{RS} - \Pi_T^{RS x-T+B}\right) + (1 + b)\left(\rho_B^{RS} - \rho_B^{RS x-T+B}\right)}{1 - g + b} \right)
\]

Q.E.D.

It should be noted that since the RR term is always non-positive, the following expression is always negative:

\[
(G_X - C_X^{x-T+B}) - \left( \frac{(1 - g)\left(\Pi_T^{RS} - \Pi_T^{RS x-T+B}\right) + (1 + b)\left(\rho_B^{RS} - \rho_B^{RS x-T+B}\right)}{1 - g + b} \right) \leq 0
\]

Also, equation 3-2 can be further simplified:

\[
(3-11) \quad G_X - G_{X-T+B} = (G_X - C_X^{x-T+B}) + \left( \frac{(1-g)\Pi_T^{RS x-T+B} + (1+b)\rho_B^{RS x-T+B}}{1 - g + b} \right)
\]

2.4 Marginal Contribution

Based on equation 3-11, I can now derive the formula for the marginal contribution of a tax (or transfer).

For simplicity, I define income concepts \(Z\) and \(Z\setminus T_1\) as follows:

\[
Z = X - \sum_{i=1}^{n} T_i + \sum_{j=1}^{m} B_j
\]

\[
Z\setminus T_1 = X - \sum_{i=2}^{n} T_i + \sum_{j=1}^{m} B_j
\]

In the general case, I define the marginal contribution of Tax 1 (without the loss of generality) as follows:

\[
M_{T_1} = G _{Z\setminus T_1} - G_Z.
\]

The interpretation of this formula is straightforward: the marginal contribution of a tax is equal to the change in the Gini index when this tax is added to the rest of the taxes and transfers in the system.
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By adding and subtracting $G_X$ in the above equation, we would have

$$M_{T_1} = G_{Z \setminus T_1} - G_Z + G_X - G_X$$

which can then be rewritten as

(3-12)

$$M_{T_1} = (G_X - G_Z) - (G_X - G_{Z \setminus T_1}).$$

Using a generalized version of equation 3-11, we can rewrite equation 3-12 as follows:

(3-13)

$$M_{T_1} = \left( G_X - C_X^Z \right) + \left( \frac{\sum_{l=1}^{l} (1-g_l)I_{R_S}^Z + \sum_{l=1}^{m} (1+b_j)P_{R_S}^Z}{1-\sum_{l=1}^{n} g_l + \sum_{j=1}^{m} b_j} \right) - \left( G_X - C_{X \setminus T_1}^Z \right) +$$

$$\left( \frac{\sum_{l=1}^{n} (1-g_l)I_{R_S}^{Z,T_1} + \sum_{j=1}^{m} (1+b_j)P_{R_S}^{Z,T_1}}{1-\sum_{l=1}^{n} g_l + \sum_{j=1}^{m} b_j} \right).$$

Similarly, the marginal contribution of a benefit can be defined as follows:

(3-14)

$$M_{B_1} = \left( G_X - C_X^Z \right) + \left( \frac{\sum_{l=1}^{l} (1-g_l)I_{R_S}^Z + \sum_{l=1}^{m} (1+b_j)P_{R_S}^Z}{1-\sum_{l=1}^{n} g_l + \sum_{j=1}^{m} b_j} \right) - \left( G_X - C_{X \setminus B_1}^Z \right) +$$

$$\left( \frac{\sum_{l=1}^{n} (1-g_l)I_{R_S}^{Z,B_1} + \sum_{j=1}^{m} (1+b_j)P_{R_S}^{Z,B_1}}{1-\sum_{l=1}^{n} g_l + \sum_{j=1}^{m} b_j} \right).$$

Note that derivations 3-13 and 3-14 use a modified R-S index that ranks individuals by income concepts other than by the original income. One can suggest alternative formulas that are based on the ranking with respect to the original income. The following examples provide such derivations.

Beginning with equation 3-12,

$$M_{T_1} = (G_X - G_Z) - (G_X - G_{Z \setminus T_1})$$

$$= [(G_X - C_X^Z) + (C_Z^X - G_Z)] - [(G_X - C_{Z \setminus T_1}^X) + (C_{Z \setminus T_1}^X - G_{Z \setminus T_1})]$$
we can rearrange the above terms to have

\[
\begin{align*}
\text{Contribution of } T_1 & \text{ to vertical equity} \\
M_{T_1} & = \left[ (G_X - C_Z^X) - (G_X - C_{Z\setminus T_1}^X) \right] + \left[ (C_Z^X - G_Z) - (C_{Z\setminus T_1}^X - G_{Z\setminus T_1}) \right].
\end{align*}
\]

Using the relationship between VE and the R-S index of the taxes and transfers (calculated with respect to the original income ranking of households), we can rewrite the above equation as follows:

\[
M_{T_1} = \left[ \frac{\sum_{l=1}^{n} (1 - g_l) \Pi_{T_1}^{RS}}{1 - \sum_{l=1}^{n} g_l + \sum_{j=1}^{m} b_j} \right] + \left[ \frac{\sum_{l=2}^{n} (1 - g_l) \Pi_{T_1}^{RS} + \sum_{j=1}^{m} (1 + b_j) \rho_{B_j}^{RS}}{1 - \sum_{l=2}^{n} g_l + \sum_{j=1}^{m} b_j} \right] + \left[ (C_Z^X - G_Z) - (C_{Z\setminus T_1}^X - G_{Z\setminus T_1}) \right].
\]

Now, simplifying the above equation we have

\[
(3-15) \quad M_{T_1} = \left[ \frac{\left( (1 - \sum_{l=2}^{n} g_l + \sum_{j=1}^{m} b_j)(1 - g_1) \Pi_{T_1}^{RS} \right)}{1 - \sum_{l=1}^{n} g_l + \sum_{j=1}^{m} b_j} \right] + \left[ \frac{(g_1)(\sum_{l=2}^{n} (1 - g_l) \Pi_{T_1}^{RS} + \sum_{j=1}^{m} (1 + b_j) \rho_{B_j}^{RS})}{1 - \sum_{l=2}^{n} g_l + \sum_{j=1}^{m} b_j} \right]
\]

\[
+ \left[ (C_Z^X - G_Z) - (C_{Z\setminus T_1}^X - G_{Z\setminus T_1}) \right],
\]

which can be also written as follows:

\[
(3-16) \quad M_{T_1} = \left[ \frac{\left( 1 - g_1 \right) \Pi_{T_1}^{RS}}{1 - \sum_{l=1}^{n} g_l + \sum_{j=1}^{m} b_j} + \left( g_1 \frac{g_X - C_Z^X}{1 - \sum_{l=1}^{n} g_l + \sum_{j=1}^{m} b_j} \right) \right] + \left[ (C_Z^X - G_Z) - (C_{Z\setminus T_1}^X - G_{Z\setminus T_1}) \right].
\]

Similarly, for a transfer we have the following formulas:

\[
(3-17)
\]
In the rest of this chapter, I rely mainly on equations 3-13, 3-15, and 3-16 for the analysis related to the marginal contribution of a tax, and 3-14, 3-17, and 3-18 for the analysis related to the marginal contribution of a transfer. Equations 3-13 and 3-14 give us a rule of thumb for cases of multiple taxes and transfers and for cases when the tax or transfer of interest does not change the end income ranking of individuals (as will become clearer later in this chapter). These two equations, however, rely on the calculation of the R-S and Kakwani indexes with respect to the end income ranking of individuals, which is an inferior method to calculating them by the original income ranking because the indicators based on the end income ranking are dependent whereas the indicators based on the original income ranking are independent. In other words, any change in a tax (size, progressivity, introducing or removing a tax) can change the R-S index of a transfer if the end income ranking is used in the calculation of this index. Moreover, the previous chapter use only the original income ranking, so using equations 3-15, 3-16, 3-17, and 3-18 would provide comparable results to the previous chapters. When there is no RR (as in the previous chapter, the value of the R-S and Kakwani indexes is the same no matter which ranking is used.

1.5 Vertical Equity

As in the previous chapters, VE is defined as follows:

\[ VE_Z = G_X - C_Z^X. \]

This formula uses the original income both as the starting point and as a basis for ranking, but we can generalize it to use any other income concept for the purpose of ranking:

\[ VE_{LM}^Q = C_L^Q - C_M^Q. \]
3 In the Presence of Reranking, Is the Marginal Contribution of a Tax Equalizing?

This section examines the marginal contribution of a tax and identifies conditions that make a tax equalizing. The conditions are derived for different scenarios, beginning with a system that only has one tax, then a system that has a transfer, and finally a system with multiple taxes and transfers (besides the specific tax that is of the interest of the analysis).

3.1 The Case of Only One Tax

Although a progressive tax in a system with no-reranking is always equalizing, this is not the case when there is RR (see table 3-1 at the beginning of this chapter). Since there is only one tax, equation 3-13 can be simplified as follows:

\[(3-19)\]
\[M_T = (G_X - C^{X-T}_X) + \Pi^R S^{X-T} .\]

Using equation 3-16, we have the following:

\[(3-20)\]
\[M_T = \Pi^R S + (C^X_{X-T} - G_{X-T}).\]

Because equation 3-20 is easier to use, I will focus on it. Note that the RR term is always non-positive, that is \[C^X_{X-T} - G_{X-T} \leq 0.\]

For a tax to be equalizing, equation 3-20 has to be positive:

\[M_T = \Pi^R S + (C^X_{X-T} - G_{X-T}) > 0\]

or

\[(3-21)\]
\[\Pi^R S > (G_{X-T} - C^X_{X-T})\]

or

\[(3-22)\]
\[\Pi^R K > \left(\frac{1-g}{g}\right)(G_{X-T} - C^X_{X-T}).\]

Note that the right-hand side of equation 3-22 is always non-negative\(^8\) and reaches its minimum (that is, zero) when the ranking of individuals before and after adding the tax remains the same. Therefore, a progressive tax (which is defined as a tax where \(\Pi^R K > 0\)) is only equalizing when

\(^8\) This can be shown intuitively. For any income value, the deviation of highest and lowest income from the average and their rank from the average rank is the highest. The underlying covariance formula multiplies these deviations for each person and adds them together. Since Gini multiplies the largest deviation of income by the largest deviation of rank (for example, for a person with the highest or lowest income) and then adds these values, Gini is bigger than any other concentration coefficient that uses rankings that do no rank by the income concept of interest.
equation 3-22 holds. However, a regressive tax ($\Pi_T^K < 0$) is always unequalizing. Surprisingly, however, a neutral tax ($\Pi_T^K = 0$) can be unequalizing when it creates RR.

Table 3-2 identifies the effect of adding a tax to a system that has no other tax or transfer in place.

Table 3-2. Marginal Contribution of a Tax without Another Tax or Transfer in Place

<table>
<thead>
<tr>
<th>Adding a Tax that is</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regressive</td>
</tr>
<tr>
<td>$\Pi_T^K &lt; 0$</td>
</tr>
<tr>
<td>Neutral</td>
</tr>
<tr>
<td>$\Pi_T^K = 0$</td>
</tr>
<tr>
<td>Progressive</td>
</tr>
<tr>
<td>$\Pi_T^K &gt; 0$</td>
</tr>
<tr>
<td>Always unequalizing</td>
</tr>
<tr>
<td>Always no change in equality or unequalizing</td>
</tr>
<tr>
<td>Equalizing if and only if equation 3-22 holds</td>
</tr>
</tbody>
</table>

Table 3-3 shows that adding a neutral tax (where progressivity is calculated with respect to households ranked by the original income) could be unequalizing.

Table 3-3. Addition of a Neutral Tax with an Unequalizing Effect

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Tax (T)</th>
<th>OI−T</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>10.00</td>
<td>2.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>10.00</td>
<td>27.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>2.50</td>
<td>6.75</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.4167</td>
</tr>
<tr>
<td>$C^V$</td>
<td>n.c.</td>
<td>0.0000</td>
<td>n.c.</td>
</tr>
<tr>
<td>$\Pi_T^K$</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used. n.c. Not calculated. … Not applicable.

3.2 Adding a Tax to a System that Has a Transfer in Place
Because there is only one transfer in place and only one tax is added, equation 3.13 can be simplified as follows:

\[ M_T = \left\{ G_X - C_X^{T+B} \right\} + \left\{ \frac{(1-g)\rho_T^{RS^{T+B}}}{1-g+b} + (1+b)\rho_B^{RS^{T+B}} \right\} \left\{ G_X - C_X^{T+B} \right\} + \rho_B^{RS^{T+B}} \}

The preceding equation can be simplified one more step, as

\[ M_T = (C_X^{T+B} - C_X^{T+B}) + \left\{ \frac{(1-g)\rho_T^{RS^{T+B}}}{1-g+b} \right\} + (1+b)\rho_B^{RS^{T+B}} \]

or

\[ M_T = (C_X^{T+B} - C_X^{T+B}) + (1-g)\rho_T^{RS^{T+B}} + (1+b)\rho_B^{RS^{T+B}} \]

Recalling the notation section and the definitions of \( \rho_B^{RS^{T+B}} \) and \( \rho_B^{RS^{T+B}} \) which are equal to \( (C_X^{T+B} - C_X^{T+B}) \) and \( (C_X^{T+B} - C_X^{T+B}) \) respectively, we can rewrite the preceding equation as follows:

\[ (3.23) \]

\[ M_T = \left( \frac{(1-g)\rho_T^{RS^{T+B}}}{1-g+b} \right) + (G_X + B - C_X^{T+B}) \]

Now, notice that based on equation 3.23, if ranking of the households does not change before and after adding the tax, the last parentheses become equal to zero. As discussed previously, the last set of parentheses is generally a non-negative term and reaches its minimum when ranking of individuals before and after adding the tax remains the same.

Now, using these generally defined Kakwani indexes, equation 3.23 can be written as follows:

\[ (3.24) \]

\[ M_T = \left( \frac{(g^{T+B} + gb^{T+B})}{1-g+b} \right) + (G_X + B - C_X^{T+B}) \]

For a tax to be equalizing, equation (3.2.2) should be positive, that is,

\[ (3.25) \]

\[ M_T = \left( \frac{(g^{T+B} + gb^{T+B})}{1-g+b} \right) + (G_X + B - C_X^{T+B}) \]

> 0.
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Using the preceding condition, table 3-4 helps to determine whether adding a tax to a system with a transfer in place would reduce inequality.

Table 3-4. Marginal Contribution of a Tax with a Transfer in Place

<table>
<thead>
<tr>
<th>Adding a Tax that with respect to the end income ranking is</th>
<th>To a system with a Transfer that with respect to the end income ranking is</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regressive ( \pi_T^{x-t+B} &lt; 0 )</td>
<td>Regressive ( \rho_B^{x-t+B} &lt; 0 )</td>
</tr>
<tr>
<td>Neutral ( \pi_T^{x-t+B} = 0 )</td>
<td>Neutral ( \rho_B^{x-t+B} = 0 )</td>
</tr>
<tr>
<td>Progressive ( \pi_T^{x-t+B} &gt; 0 )</td>
<td>Progressive ( \rho_B^{x-t+B} &gt; 0 )</td>
</tr>
<tr>
<td>More equalizing if and only if condition 3-25 holds</td>
<td>More equalizing if and only if condition 3-25 holds</td>
</tr>
<tr>
<td>More equalizing if and only if condition 3-25 holds</td>
<td>More equalizing if and only if condition 3-25 holds</td>
</tr>
<tr>
<td>More equalizing if and only if condition 3-25 holds</td>
<td>More equalizing if and only if condition 3-25 holds</td>
</tr>
<tr>
<td>Always equalizing</td>
<td>Always equalizing</td>
</tr>
<tr>
<td>Always equalizing</td>
<td>Always equalizing</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

The most counterintuitive result is that adding a regressive tax to a regressive transfer, where progressivity is calculated with respect to the final income ranking of households, can reduce inequality. The following examples illustrate this case and other counterintuitive results.

Table 3-5 shows that adding a regressive tax to a fiscal system with a regressive transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-5. Addition of a Regressive Tax with an Equalizing Effect to a Fiscal System with a Regressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI - T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.00</td>
<td>0.90</td>
<td>10.90</td>
<td>1.00</td>
<td>9.00</td>
<td>9.90</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>0.20</td>
<td>10.80</td>
<td>10.80</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>1.10</td>
<td>13.10</td>
<td>2.20</td>
<td>9.80</td>
<td>10.90</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>4.10</td>
<td>8.90</td>
<td>8.90</td>
</tr>
<tr>
<td>Total</td>
<td>46.00</td>
<td>2.00</td>
<td>48.00</td>
<td>7.50</td>
<td>38.50</td>
<td>40.50</td>
</tr>
<tr>
<td>Average</td>
<td>11.50</td>
<td>0.50</td>
<td>12.00</td>
<td>1.88</td>
<td>9.63</td>
<td>10.13</td>
</tr>
<tr>
<td>Gini</td>
<td>0.0543</td>
<td>n.c.</td>
<td>0.0448</td>
<td>n.c.</td>
<td>0.0422</td>
<td>0.0426</td>
</tr>
<tr>
<td>( \pi_T^{x-t+B} )</td>
<td>−0.0109</td>
<td>0.3</td>
<td>0.0021</td>
<td>−0.2167</td>
<td>0.0292</td>
<td>n.c.</td>
</tr>
<tr>
<td>( C^{x-t+B} )</td>
<td>...</td>
<td>−0.3109</td>
<td>...</td>
<td>−0.2058</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
In calculating progressivity, households’ rank with respect to their original income is used. n.c. Not calculated. … Not applicable.

Table 3-6 shows that adding a regressive tax to a fiscal system with a neutral transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-6. Addition of a Regressive Tax with an Equalizing Effect to a Fiscal System with a Neutral Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.10</td>
<td>9.90</td>
<td>9.90</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.00</td>
<td>39.00</td>
<td>5.10</td>
<td>31.90</td>
<td>33.90</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.50</td>
<td>9.75</td>
<td>1.28</td>
<td>7.98</td>
<td>8.48</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.2657</td>
<td>0.2515</td>
</tr>
<tr>
<td>( \rho_{\text{B}}^{X-T+B} )</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2402</td>
<td>0.2516</td>
<td>n.c.</td>
</tr>
<tr>
<td>( \Pi_{\text{T}}^{X-T+B} )</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>-0.0098</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used. n.c. Not calculated. … Not applicable.

Table 3-7 shows that adding a regressive tax to a fiscal system with a progressive transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-7. Addition of a Regressive Tax with an Equalizing Effect to a Fiscal System with a Progressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.10</td>
<td>1.10</td>
<td>0.00</td>
<td>1.00</td>
<td>1.10</td>
</tr>
</tbody>
</table>
In calculating progressivity, households’ rank with respect to their original income is used.
n.c. Not calculated.
… Not applicable.

Table 3-8 shows that adding a neutral tax to a fiscal system with a regressive transfer (where
progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-8. Addition of a Neutral Tax with an Equalizing Effect to a Fiscal System with a Regressive
Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.10</td>
<td>13.10</td>
<td>1.00</td>
<td>12.00</td>
<td>12.10</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.10</td>
<td>39.10</td>
<td>5.00</td>
<td>32.00</td>
<td>34.10</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.53</td>
<td>9.78</td>
<td>1.25</td>
<td>8.00</td>
<td>8.53</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.2656</td>
<td>0.2515</td>
</tr>
<tr>
<td>$C^{X−T+B}$</td>
<td>0.2500</td>
<td>0.2738</td>
<td>0.2513</td>
<td>0.2500</td>
<td>0.2500</td>
<td>n.c.</td>
</tr>
<tr>
<td>$\Pi_T^{X−T+B}$ or $\rho_B^{X−T+B}$</td>
<td>…</td>
<td>−0.0238</td>
<td>…</td>
<td>0.0000</td>
<td>…</td>
<td>…</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.
n.c. Not calculated.
… Not applicable.
Table 3-9 shows that adding a neutral tax to a fiscal system with a neutral transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-9. Addition of a Neutral Tax with an Equalizing Effect to a Fiscal System with a Neutral Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>2.00</td>
<td>9.00</td>
<td>9.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>4.00</td>
<td>8.00</td>
<td>10.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>2.00</td>
<td>11.00</td>
<td>11.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.00</td>
<td>39.00</td>
<td>8.00</td>
<td>29.00</td>
<td>31.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.50</td>
<td>9.75</td>
<td>2.00</td>
<td>7.25</td>
<td>7.75</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.2672</td>
<td>0.2500</td>
</tr>
<tr>
<td>$C^ {X-T+B}$</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.

Table 3-10 shows that adding a neutral tax to a fiscal system with a progressive transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-10. Addition of a Neutral Tax with an Equalizing Effect to a Fiscal System with a Progressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.10</td>
<td>1.10</td>
<td>0.00</td>
<td>1.00</td>
<td>1.10</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.10</td>
<td>39.10</td>
<td>5.00</td>
<td>32.00</td>
<td>34.10</td>
</tr>
</tbody>
</table>
In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.

Table 3-11 shows that adding a progressive tax to a fiscal system with a regressive transfer (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-11. Addition of a Progressive Tax with an Unequalizing Effect to a Fiscal System with a Regressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>0.10</td>
<td>10.90</td>
<td>10.90</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>0.00</td>
<td>12.00</td>
<td>1.00</td>
<td>11.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>4.00</td>
<td>17.00</td>
<td>0.20</td>
<td>12.80</td>
<td>16.80</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>4.00</td>
<td>41.00</td>
<td>1.30</td>
<td>35.70</td>
<td>39.70</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>1.00</td>
<td>10.25</td>
<td>0.33</td>
<td>8.93</td>
<td>9.93</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2988</td>
<td>n.c.</td>
<td>0.2486</td>
<td>0.2991</td>
</tr>
<tr>
<td>( C^{X-T+B} )</td>
<td>0.2500</td>
<td>0.7500</td>
<td>0.2988</td>
<td>0.2885</td>
<td>0.2486</td>
<td>n.c.</td>
</tr>
<tr>
<td>( l_{T}^{X-T+B} ) or ( \rho_{B}^{X-T+B} )</td>
<td>…</td>
<td>−0.5000</td>
<td>…</td>
<td>0.0385</td>
<td>…</td>
<td>…</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.

Although equation 3-23 is derived using the R-S index that is calculated with respect to the end income ranking of households, one can calculate a similar derivation using the R-S index that is calculated with respect to the original income ranking, as shown in the following equation:
Chapter 3, Enami

\[ M_T = \frac{(1-g)\Pi^R_T + g\rho^R_T}{1-g+b} + \left[ \frac{(C^X_{X-T+B} - G_{X-T+B}) - (C^X_{X+B} - G_{X+B})}{\text{Reranking in the whole system}} \right] \]

Because both terms in the brackets are non-positive, the bracket could be positive, zero, or negative. For the tax to be equalizing, the following condition should hold:

\[ \left( \frac{(1-g)\Pi^R_T + g\rho^R_T}{1-g+b} \right) + \left[ (C^X_{X-T+B} - G_{X-T+B}) - (C^X_{X+B} - G_{X+B}) \right] > 0 \]

or

\[ (3-26) \left( \frac{g\Pi^R_T + gb\rho^R_T}{1-g+b} \right) + \left[ \frac{(C^X_{X-T+B} - G_{X-T+B}) - (C^X_{X+B} - G_{X+B})}{\text{Reranking after the tax is added}} \right] > 0. \]

As shown in table 3-12, using the traditional Kakwani index (that is, when the index is calculated with respect to the original income ranking of households) would not result in any certainty about whether the addition of a tax reduces inequality.

### Table 3-12. Marginal Contribution of a Tax with a Transfer in Place

<table>
<thead>
<tr>
<th>Adding a Tax that with respect to the original income ranking is</th>
<th>To a system with a Transfer that with respect to the original income ranking is</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regressive: ( \Pi^F_T &lt; 0 )</td>
<td>Equalizing if and only if condition 3-26 holds</td>
</tr>
<tr>
<td>Neutral: ( \Pi^F_T = 0 )</td>
<td>Equalizing if and only if condition 3-26 holds</td>
</tr>
<tr>
<td>Progressive: ( \Pi^F_T &gt; 0 )</td>
<td>Equalizing if and only if condition 3-26 holds</td>
</tr>
</tbody>
</table>

\[ \rho^F_T < 0 \quad \rho^T_B = 0 \quad \rho^T_B > 0 \]
In calculating progressivity, households’ rank with respect to their original income is used.

Table 3-12 contains some counterintuitive cases that the following examples will help to explain. Table 3-13, for instance, shows that adding a regressive tax to a fiscal system with a regressive transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-13. Addition of a Regressive Tax with an Equalizing Effect to a Fiscal System with a Regressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.10</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.40</td>
<td>13.40</td>
<td>1.00</td>
<td>12.00</td>
<td>12.40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37.00</strong></td>
<td><strong>2.40</strong></td>
<td><strong>39.40</strong></td>
<td><strong>5.10</strong></td>
<td><strong>31.90</strong></td>
<td><strong>34.30</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>9.25</strong></td>
<td><strong>0.60</strong></td>
<td><strong>9.85</strong></td>
<td><strong>1.28</strong></td>
<td><strong>7.98</strong></td>
<td><strong>8.58</strong></td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2627</td>
<td>n.c.</td>
<td>0.2688</td>
<td>0.2587</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.3333</td>
<td>0.2551</td>
<td>0.2304</td>
<td>0.2531</td>
<td>0.2587</td>
</tr>
<tr>
<td>$\Pi_B^g$</td>
<td>or $\rho_B^g$</td>
<td>−0.0051</td>
<td>...</td>
<td>−0.0031</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.

Table 3-14 shows that adding a regressive tax to a fiscal system with a neutral transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-14. Addition of a Regressive Tax with an Equalizing Effect to a Fiscal System with a Neutral Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.10</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
</tbody>
</table>
Table 3-15 shows that adding a regressive tax to a fiscal system with a progressive transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-15. Addition of a Regressive Tax with an Equalizing Effect to a Fiscal System with a Progressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.10</td>
<td>0.90</td>
<td>1.90</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.40</td>
<td>13.40</td>
<td>1.00</td>
<td>12.00</td>
<td>12.40</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>3.40</td>
<td>40.40</td>
<td>5.10</td>
<td>31.90</td>
<td>35.30</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.85</td>
<td>10.10</td>
<td>1.28</td>
<td>7.98</td>
<td>8.83</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2376</td>
<td>n.c.</td>
<td>0.2688</td>
<td>0.2302</td>
</tr>
<tr>
<td>( C^X )</td>
<td>0.2500</td>
<td>0.0147</td>
<td>0.2302</td>
<td>0.2304</td>
<td>0.2531</td>
<td>0.2302</td>
</tr>
<tr>
<td>( \pi^K_T ) or ( \rho^K_B )</td>
<td>…</td>
<td>0.0198</td>
<td>…</td>
<td>–0.0031</td>
<td>…</td>
<td>…</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.

Table 3-16 shows that adding a neutral tax to a fiscal system with a regressive transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-16. Addition of a Neutral Tax with an Equalizing Effect to a Fiscal System with a Regressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI+B</th>
<th>Tax (T)</th>
<th>OI–T</th>
<th>End Income</th>
</tr>
</thead>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.
Table 3-17 shows that adding a neutral tax to a fiscal system with a regressive transfer (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-17. Addition of a Neutral Tax with an Unequalizing Effect to a Fiscal System with a Regressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.10</td>
<td>13.10</td>
<td>1.00</td>
<td>12.00</td>
<td>12.10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37.00</strong></td>
<td><strong>2.10</strong></td>
<td><strong>39.10</strong></td>
<td><strong>5.00</strong></td>
<td><strong>32.00</strong></td>
<td><strong>34.10</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>9.25</strong></td>
<td><strong>0.53</strong></td>
<td><strong>9.78</strong></td>
<td><strong>1.25</strong></td>
<td><strong>8.00</strong></td>
<td><strong>8.53</strong></td>
</tr>
<tr>
<td><strong>Gini</strong></td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.2656</td>
<td>0.2515</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2738</td>
<td>0.2513</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2515</td>
</tr>
<tr>
<td>$\Pi_T^K \ or \ \rho_B^K$</td>
<td>...</td>
<td>$-0.0013$</td>
<td>...</td>
<td>$0.0000$</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.
Table 3-18 shows that adding a neutral tax to a fiscal system with a neutral transfer (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-18. Addition of a Neutral Tax with an Unequalizing Effect to a Fiscal System with a Neutral Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>5.00</td>
<td>7.00</td>
<td>9.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.00</td>
<td>39.00</td>
<td>7.00</td>
<td>30.00</td>
<td>32.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.50</td>
<td>9.75</td>
<td>1.75</td>
<td>7.50</td>
<td>8.00</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.3000</td>
<td>0.2656</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
</tr>
<tr>
<td>$\Pi^K$ or $\rho^K_B$</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.

Table 3-19 shows that adding a neutral tax to a fiscal system with a neutral transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-19. Addition of a Neutral Tax with an Equalizing Effect to a Fiscal System with a Neutral Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.00</td>
<td>39.00</td>
<td>5.00</td>
<td>32.00</td>
<td>34.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.50</td>
<td>9.75</td>
<td>1.25</td>
<td>8.00</td>
<td>8.50</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.2656</td>
<td>0.2500</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
</tr>
<tr>
<td>$\Pi^K$ or $\rho^K_B$</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
In calculating progressivity, households’ rank with respect to their original income is used. n.c. Not calculated. … Not applicable.

Table 3-20 shows that adding a neutral tax to a fiscal system with a progressive transfer (where progressivity is calculated with respect to households ranked by original income) could be equalizing, where progressivity is calculated with respect to the original income ranking of households.

Table 3-20. Addition of a Neutral Tax with an Equalizing Effect to a Fiscal System with a Progressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.10</td>
<td>11.10</td>
<td>1.00</td>
<td>10.00</td>
<td>10.10</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>12.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.10</td>
<td>39.10</td>
<td>5.00</td>
<td>32.00</td>
<td>34.10</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.53</td>
<td>9.78</td>
<td>1.25</td>
<td>8.00</td>
<td>8.53</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2615</td>
<td>n.c.</td>
<td>0.2656</td>
<td>0.2485</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2262</td>
<td>0.2487</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2485</td>
</tr>
<tr>
<td>$\Pi^K_T$ or $\Pi^K_B$</td>
<td>…</td>
<td>0.0013</td>
<td>…</td>
<td>0.0000</td>
<td>…</td>
<td>…</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used. n.c. Not calculated. … Not applicable.

Table 3-21 shows that adding a neutral tax to a fiscal system with a progressive transfer (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-21. Addition of a Neutral Tax with an Unequalizing Effect to a Fiscal System with a Progressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.10</td>
<td>11.10</td>
<td>1.00</td>
<td>10.00</td>
<td>10.10</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>5.00</td>
<td>7.00</td>
<td>9.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
</tbody>
</table>
Table 3-23 shows that adding a progressive tax to a fiscal system with a neutral transfer (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-23. Addition of a Progressive Tax with an Unequalizing Effect to a Fiscal System with a Neutral Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>5.00</td>
<td>7.00</td>
<td>9.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.10</td>
<td>13.10</td>
<td>1.10</td>
<td>11.90</td>
<td>12.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.10</td>
<td>39.10</td>
<td>7.10</td>
<td>29.90</td>
<td>32.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.53</td>
<td>9.78</td>
<td>1.78</td>
<td>7.48</td>
<td>8.00</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.2985</td>
<td>0.2656</td>
</tr>
<tr>
<td>$C^x$</td>
<td>0.2500</td>
<td>0.2738</td>
<td>0.2513</td>
<td>0.2570</td>
<td>0.2483</td>
<td>0.2500</td>
</tr>
<tr>
<td>$\Pi^x_B \text{ or } \rho_B^k$</td>
<td>...</td>
<td>-0.0013</td>
<td>...</td>
<td>0.0017</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.
Table 3-24 shows that adding a progressive tax to a fiscal system with a progressive transfer (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-24. Addition of a Progressive Tax with an Unequalizing Effect to a Fiscal System with a Progressive Transfer

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.00</td>
<td>1.00</td>
<td>11.00</td>
<td>0.00</td>
<td>1.00</td>
<td>11.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>1.10</td>
<td>12.10</td>
<td>0.00</td>
<td>1.10</td>
<td>12.10</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>1.20</td>
<td>13.20</td>
<td>0.00</td>
<td>1.20</td>
<td>13.20</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>1.30</td>
<td>14.30</td>
<td>5.00</td>
<td>8.00</td>
<td>9.30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>46.00</strong></td>
<td><strong>4.60</strong></td>
<td><strong>50.60</strong></td>
<td><strong>5.00</strong></td>
<td><strong>41.00</strong></td>
<td><strong>45.60</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>11.50</strong></td>
<td><strong>1.15</strong></td>
<td><strong>12.65</strong></td>
<td><strong>1.25</strong></td>
<td><strong>10.25</strong></td>
<td><strong>11.40</strong></td>
</tr>
<tr>
<td>Gini</td>
<td>0.0543</td>
<td>n.c.</td>
<td>0.0543</td>
<td>n.c.</td>
<td>0.0793</td>
<td>0.0702</td>
</tr>
<tr>
<td>( C^x )</td>
<td>0.0543</td>
<td>0.0543</td>
<td>0.0543</td>
<td>0.7500</td>
<td>-0.0305</td>
<td>-0.0219</td>
</tr>
<tr>
<td>( \Pi_T^K ) or ( \rho_B^K )</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>0.0848</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.

3.3 Adding a Tax to a System with Multiple Taxes and Transfers in Place
Recall from equation 3-13 that
\[
M_{T_1} = \left\{ \left( G_X - C_X^Z \right) + \left( \frac{\sum_{i=1}^{n}(1-g_i)|I_{T_i}^{RS} + \sum_{j=1}^{m}(1+b_j)\rho_{B_j}^{RS}Z}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\} - \left\{ \left( G_X - C_X^{Z\backslash T_1} \right) + \left( \frac{\sum_{i=2}^{n}(1-g_i)|I_{T_i}^{RS\backslash T_1} + \sum_{j=1}^{m}(1+b_j)\rho_{B_j}^{RS\backslash T_1}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\}.
\]

For \( T_1 \) to be equalizing, this equation has to be positive, that is,
\[
(3-27)
\left\{ \left( G_X - C_X^Z \right) + \left( \frac{\sum_{i=1}^{n}(1-g_i)|I_{T_i}^{RS} + \sum_{j=1}^{m}(1+b_j)\rho_{B_j}^{RS}Z}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\} - \left\{ \left( G_X - C_X^{Z\backslash T_1} \right) + \left( \frac{\sum_{i=2}^{n}(1-g_i)|I_{T_i}^{RS\backslash T_1} + \sum_{j=1}^{m}(1+b_j)\rho_{B_j}^{RS\backslash T_1}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\} > 0.
\]

If adding this specific tax does not change the end income ranking of households (that is, if end income rankings are the same before and after adding the tax), then ranking with respect to \( Z \) and \( Y \) is the same, which simplifies the whole equation to
\[
(1 - \sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j)(1 - g_1)\Pi_{T_1}^{RSZ} > -g_1 \left( \sum_{i=2}^{n} (1-g_i)\Pi_{T_i}^{RSZ\backslash T_1} + \sum_{j=1}^{m} (1+b_j)\rho_{B_j}^{RSZ\backslash T_1} \right)
\]
which is equal to
\[
\Pi_{T_1}^{RSZ} > -\frac{g_1}{(1-g_1)} \left( \frac{\sum_{i=2}^{n}(1-g_i)|I_{T_i}^{RSZ\backslash T_1} + \sum_{j=1}^{m}(1+b_j)\rho_{B_j}^{RSZ\backslash T_1}}{1-\sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right)
\]
or
\[
\Pi_{T_1}^{RSZ} > -\frac{g_1}{(1-g_1)} (C_X^{Z\backslash T_1} - G_{Z\backslash T_1})
\]
or
\[
(3-28) \quad \Pi_{T_1}^{RSZ} < (C_X^{Z\backslash T_1} - G_{Z\backslash T_1}).
\]

The term on the right-hand side is the modified VE term, which was introduced in the notation

---

9 Recall from the notation section that \( Z = X - \sum_{i=2}^{n} T_i + \sum_{j=1}^{m} B_j \) and \( Z\backslash T_1 = X - \sum_{i=2}^{n} T_i + \sum_{j=1}^{m} B_j \).
Thus, equation 3-28 can be written as follows:

(3-29)

$$\Pi_{T_1}^{Z} < V E_{X,Z,T_1}^{Z \setminus T_1}.$$ 

Table 3-25 shows how one can determine whether adding a tax to a system of taxes and transfers reduces inequality when the new tax does not change the end income ranking of households.

Table 3-25. Marginal Contribution of a Tax with Multiple Taxes and Transfers in Place

<table>
<thead>
<tr>
<th>Adding a Tax that with respect to the final incomes ranking (Z) is</th>
<th>To a system with multiple taxes and transfers where its vertical equity (with respect to the final income ranking) is Negative</th>
<th>Zero</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regressive</td>
<td>$$\Pi_{T}^{Z} &lt; 0$$</td>
<td>Equalizing if and only if condition 3-29 holds</td>
<td>Always equalizing</td>
</tr>
<tr>
<td>Neutral</td>
<td>$$\Pi_{T}^{Z} = 0$$</td>
<td>No change in inequality</td>
<td></td>
</tr>
<tr>
<td>Progressive</td>
<td>$$\Pi_{T}^{Z} &gt; 0$$</td>
<td>Always unequalizing</td>
<td>Always unequalizing</td>
</tr>
</tbody>
</table>

For the results in Table 3-25 to hold, the tax that we are interested in should not have any effect on the end income ranking of households. If that is not the case, then equation 3-27 cannot be simplified much further and the effect of adding such a tax cannot be determined using a simple rule of thumb from the table.

Alternatively, one can use the progressivity with respect to the original income in the analysis. For this purpose, we need to use equation 3-16:
For a tax to be equalizing when it is added to a system of taxes and transfers, the following condition should hold:

\[
M_{T_1} = \left[ \frac{(1-g_1)\rho_{T1}^{RS} + \left( g_1 \left( \frac{g_X-C_x^{T1}}{1-\sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right)}{\left(1-\sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j\right)^2} \right] + \left[ (C_Z^{T1} - G_Z) - (C_X^{T1} - G_X^{T1}) \right] > 0
\]

or

\[
M_{T_1} = \left[ \frac{(1-g_1)\rho_{T1}^{RS} + \left( g_1 \left( \frac{g_X-C_x^{T1}}{1-\sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right)}{\left(1-\sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j\right)^2} \right] + \left[ (C_Z^{T1} - G_Z) - (C_X^{T1} - G_X^{T1}) \right] > 0.
\]

4 In the Presence of Reranking, is the Marginal Contribution of a Transfer Equalizing?

This section is similar to the previous one, so I have presented only the minimum derivations except in cases of significant differences.

4.1 The Case of Only One Transfer

Similarly to section 3.1, we begin with the following equation (using equation 3-18):

\[
M_B = \rho_B^{RS} + (C_X^{T1} - G_X^{T1})
\]

For a transfer to be equalizing, equation 3-32 has to be positive, that is,

\[
M_B = \rho_B^{RS} + (C_X^{T1} - G_X^{T1}) > 0
\]

or
(3.33)
$$\rho^R_B > (G_{X+B} - C^X_{X+B})$$
or

(3.34)
$$\rho^K_B > \left(\frac{1+b}{b}\right)(G_{X+B} - C^X_{X+B}).$$

As in the previous section, the right-hand side is non-negative and reaches zero if the transfer does not change the ranking of individuals.

Table 3-26. Marginal Contribution of a Transfer with No Other Tax or Transfer in Place

<table>
<thead>
<tr>
<th>Adding a Transfer that is</th>
<th>Regressive</th>
<th>Neutral</th>
<th>Progressive</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho^K_B &lt; 0$</td>
<td>Always unequalizing</td>
<td>Always no change in equality or unequalizing</td>
<td>Equalizing if and only if equation 3-34 holds</td>
</tr>
<tr>
<td>$\rho^K_B = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho^K_B &gt; 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To see how a neutral transfer can be unequalizing in the presence of reranking, refer to table 3-27.

Table 3-27. Addition of a Neutral Transfer with Unequalizing Results

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI+B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>10.00</td>
<td>22.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>10.00</td>
<td>47.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>2.50</td>
<td>11.75</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.3457</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

… Not applicable.
4.2 Adding a Transfer to a System that has a Tax in Place

Because there is only one tax in place and only one transfer is added, equation 3-14 can be simplified as follows:

\[ M_B = \left( G_X - C_X^{T+B} \right) + \left( \frac{1-g \Pi^R_{X-T} + (1+b) \rho_B^R X^{T+B}}{1-g+b} \right) - \left( \Pi^R_{X-T} + (G_X - C_X^{T}) \right). \]

Similarly to section 3.2, this equation can be simplified as follows:

\[ (3-35) \]
\[ M_B = \left( \frac{-b \Pi^R_{X-T} + (1+b) \rho_B^R X^{T+B}}{1-g+b} \right) + \left( G_X - C_X^{T+B} \right) \]

or

\[ (3-36) \]
\[ M_B = \left( \frac{-b \Pi^R_{X-T} + (1+b) \rho_B^R X^{T+B}}{1-g+b} \right) + \left( G_X - C_X^{T+B} \right). \]

For a transfer to be equalizing, equation 3-36 should be positive, that is,

\[ (3-37) \]
\[ M_B = \left( \frac{-b \Pi^R_{X-T} + (1+b) \rho_B^R X^{T+B}}{1-g+b} \right) + \left( G_X - C_X^{T+B} \right) > 0. \]

Using the preceding condition, table 3-28 helps to determine whether adding a transfer to a system with a tax in place would increase the equality. Note that \( G_X - C_X^{T+B} \) is a non-negative term that reaches zero if adding the benefit does not change the ranking.

Table 3-28. Marginal Contribution of a Transfer with a Tax in Place

<table>
<thead>
<tr>
<th>Adding a Transfer that with respect to the end income ranking is</th>
<th>To a system with a Tax</th>
<th>Regressive ( \Pi^R_{X-T} &lt; 0 )</th>
<th>Neutral ( \rho_B^R X^{T+B} = 0 )</th>
<th>Progressive ( \rho_B^R X^{T+B} &gt; 0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regressive ( \rho_B^{X-T+B} &lt; 0 )</td>
<td>Equalizing if and only if condition 3-37 holds</td>
<td>Always equalizing</td>
<td>Always equalizing</td>
<td></td>
</tr>
</tbody>
</table>
Table 3-29. Addition of a Regressive Transfer with an Equalizing Effect to a Fiscal System with a Regressive Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.00</td>
<td>2.10</td>
<td>12.10</td>
<td>1.00</td>
<td>9.00</td>
<td>11.10</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>1.05</td>
<td>12.05</td>
<td>1.00</td>
<td>10.00</td>
<td>11.05</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>0.00</td>
<td>12.00</td>
<td>1.90</td>
<td>10.10</td>
<td>10.10</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>2.80</td>
<td>10.20</td>
<td>10.20</td>
</tr>
<tr>
<td>Total</td>
<td>46.00</td>
<td>3.15</td>
<td>49.15</td>
<td>6.70</td>
<td>39.30</td>
<td>42.45</td>
</tr>
<tr>
<td>Average</td>
<td>11.50</td>
<td>0.79</td>
<td>12.29</td>
<td>1.68</td>
<td>9.83</td>
<td>10.61</td>
</tr>
<tr>
<td>Gini</td>
<td>0.0543</td>
<td>n.c.</td>
<td>0.0155</td>
<td>n.c.</td>
<td>0.0235</td>
<td>0.0227</td>
</tr>
<tr>
<td>$C^{X−T+B}$</td>
<td>−0.0435</td>
<td>0.5833</td>
<td>−0.0033</td>
<td>−0.1679</td>
<td>−0.0223</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.
In calculating progressivity, households’ rank with respect to their original income is used.
n.c. Not calculated.
... Not applicable.

Table 3-30 shows that adding a regressive transfer to a fiscal system with a neutral tax (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-30. Addition of a Regressive Transfer with an Equalizing Effect to a Fiscal System with a Neutral Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.10</td>
<td>13.10</td>
<td>1.00</td>
<td>12.00</td>
<td>12.10</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.10</td>
<td>39.10</td>
<td>5.00</td>
<td>32.00</td>
<td>34.10</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.53</td>
<td>9.78</td>
<td>1.25</td>
<td>8.00</td>
<td>8.53</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.2656</td>
<td>0.2515</td>
</tr>
<tr>
<td>$C^{X−T+B}$</td>
<td>0.2500</td>
<td>0.2738</td>
<td>0.2513</td>
<td>0.2500</td>
<td>0.2500</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.
n.c. Not calculated.
... Not applicable.

Table 3-31 shows that adding a neutral transfer to a fiscal system with a neutral tax (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-31. Addition of a Neutral Transfer with an Equalizing Effect to a Fiscal System with a Neutral Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
</tbody>
</table>
In calculating progressivity, households’ rank with respect to their original income is used. 
n.c. Not calculated. 
... Not applicable.

Table 3-32 shows that adding a regressive transfer to a fiscal system with a progressive tax (where 
progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-32. Addition of a Regressive Transfer with an Equalizing Effect to a Fiscal System with a 
Progressive Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI - T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.10</td>
<td>13.10</td>
<td>1.10</td>
<td>11.90</td>
<td>12.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.10</td>
<td>39.10</td>
<td>5.10</td>
<td>31.90</td>
<td>34.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.53</td>
<td>9.78</td>
<td>1.28</td>
<td>7.98</td>
<td>8.50</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.2656</td>
<td>0.2500</td>
</tr>
<tr>
<td>$C_{X-T+B}^K$</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>n.c.</td>
<td></td>
</tr>
<tr>
<td>$\Pi_{T}^{X-T+B}$ or $\rho_{B}^{X-T+B}$</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used. 
n.c. Not calculated. 
... Not applicable.

Table 3-33 shows that adding a neutral transfer to a fiscal system with a progressive tax (where 
progressivity is calculated with respect to households ranked by original income) could be equalizing.
Table 3-33. Addition of a Neutral Transfer with an Equalizing Effect to a Fiscal System with a Progressive Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.00</td>
<td>11.00</td>
<td>21.00</td>
<td>1.20</td>
<td>8.80</td>
<td>19.80</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>12.10</td>
<td>23.10</td>
<td>0.00</td>
<td>11.00</td>
<td>23.10</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>13.20</td>
<td>25.20</td>
<td>0.00</td>
<td>12.00</td>
<td>25.20</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>14.30</td>
<td>27.30</td>
<td>1.90</td>
<td>11.10</td>
<td>25.40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>46.00</strong></td>
<td><strong>50.60</strong></td>
<td><strong>96.60</strong></td>
<td><strong>3.10</strong></td>
<td><strong>42.90</strong></td>
<td><strong>93.50</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>11.50</strong></td>
<td><strong>12.65</strong></td>
<td><strong>24.15</strong></td>
<td><strong>0.78</strong></td>
<td><strong>10.73</strong></td>
<td><strong>23.38</strong></td>
</tr>
<tr>
<td><strong>Gini</strong></td>
<td>0.0543</td>
<td>n.c.</td>
<td>0.0543</td>
<td>0.1694</td>
<td>0.0460</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

$C^{X−T+B}$

$\Pi^{K−X−T+B}_{T}$

or

$\rho^{K−X−T+B}_{B}$

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.

Table 3-34 shows that adding a progressive transfer to a fiscal system with a progressive tax (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-34. Addition of a Progressive Transfer with an Unequalizing Effect to a Fiscal System with a Progressive Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.00</td>
<td>7.00</td>
<td>17.00</td>
<td>1.00</td>
<td>9.00</td>
<td>16.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>9.00</td>
<td>20.00</td>
<td>1.00</td>
<td>10.00</td>
<td>19.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>9.00</td>
<td>21.00</td>
<td>1.90</td>
<td>10.10</td>
<td>19.10</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>9.00</td>
<td>22.00</td>
<td>2.80</td>
<td>10.20</td>
<td>19.20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>46.00</strong></td>
<td><strong>34.00</strong></td>
<td><strong>80.00</strong></td>
<td><strong>6.70</strong></td>
<td><strong>39.30</strong></td>
<td><strong>73.30</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>11.50</strong></td>
<td><strong>8.50</strong></td>
<td><strong>20.00</strong></td>
<td><strong>1.68</strong></td>
<td><strong>9.83</strong></td>
<td><strong>18.33</strong></td>
</tr>
<tr>
<td><strong>Gini</strong></td>
<td>0.0543</td>
<td>n.c.</td>
<td>0.0500</td>
<td>n.c.</td>
<td>0.0235</td>
<td>0.0331</td>
</tr>
<tr>
<td>$C^{X−T+B}$</td>
<td>0.0543</td>
<td>0.0441</td>
<td>0.0500</td>
<td>0.2351</td>
<td>0.0235</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

I or

$\Pi^{K−X−T+B}_{T}$

or

$\rho^{K−X−T+B}_{B}$
In calculating progressivity, households’ rank with respect to their original income is used. n.c. Not calculated. ... Not applicable.

Although equation 3-35 is derived using the R-S index calculated with respect to the end income ranking of households, one can calculate a similar derivation using the R-S index calculated with respect to the original income ranking, as shown in the following equation:

$$M_B = \left( -b \Pi^S_T + \frac{(1 + b) \rho^K_B}{1 - g + b} \right) \left[ (C^X_{X-T+B} - G_{X-T+B}) - (C^X_{X-T} - G_{X-T}) \right].$$

Because both terms in the brackets are non-positive, the bracket could be positive, zero, or negative. For the tax to be equalizing, the following condition should hold:

$$\left( -b \Pi^S_T + \frac{(1 + b) \rho^K_B}{1 - g + b} \right) + \left[ (C^X_{X-T+B} - G_{X-T+B}) - (C^X_{X-T} - G_{X-T}) \right] > 0$$

or

$$\frac{\left( -b \Pi^S_T + \frac{(1 + b) \rho^K_B}{1 - g + b} \right) + \left[ (C^X_{X-T+B} - G_{X-T+B}) - (C^X_{X-T} - G_{X-T}) \right]}{1 - g + b} > 0.$$  (3-38)

As table 3-35 shows, using Kakwani indexes calculated with respect to the original income ranking of households cannot give a definitive answer about the marginal effect of a transfer in any of the cases.

Table 3-35. Marginal Contribution of a Transfer with a Tax in Place

<table>
<thead>
<tr>
<th>Adding a Transfer that with respect to the original income ranking is</th>
<th>Regressive $\rho^K_B &lt; 0$</th>
<th>Neutral $\rho^K_B = 0$</th>
<th>Progressive $\rho^K_B &gt; 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>To a system with a Tax</strong></td>
<td>Regressive $\Pi^K_T &lt; 0$</td>
<td>Equalizing if and only if condition 3-38 holds</td>
<td>Equalizing if and only if condition 3-38 holds</td>
</tr>
</tbody>
</table>
that with respect to the original income ranking is

<table>
<thead>
<tr>
<th></th>
<th>Neutral $\Pi_f^g = 0$</th>
<th>Equalizing if and only if condition 3-38 holds</th>
<th>Progressive $\Pi_f^g &gt; 0$</th>
<th>Equalizing if and only if condition 3-38 holds</th>
</tr>
</thead>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

Table 3-36 shows that adding a regressive transfer to a fiscal system with a regressive tax (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-36. Addition of a Regressive Transfer with an Equalizing Effect to a Fiscal System with a Regressive Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.10</td>
<td>9.90</td>
<td>9.90</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.10</td>
<td>13.10</td>
<td>1.00</td>
<td>12.00</td>
<td>12.10</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>2.10</td>
<td>39.10</td>
<td>5.10</td>
<td>31.90</td>
<td>34.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.53</td>
<td>9.78</td>
<td>1.28</td>
<td>7.98</td>
<td>8.50</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2628</td>
<td>n.c.</td>
<td>0.2657</td>
<td>0.2529</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2738</td>
<td>0.2513</td>
<td>0.2402</td>
<td>0.2516</td>
<td>0.2529</td>
</tr>
<tr>
<td>$\Pi_f^g$ or $\rho_f^g$</td>
<td>...</td>
<td>$-0.0013$</td>
<td>...</td>
<td>$-0.0016$</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.
... Not applicable.

Table 3-37 shows that adding a neutral transfer to a fiscal system with a regressive tax (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-37. Addition of a Neutral Transfer with an Equalizing Effect to a Fiscal System with a Regressive Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.
... Not applicable.

Table 3-39 shows that adding a progressive transfer to a fiscal system with a regressive tax (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.
Table 3-39. Addition of a Progressive Transfer with an Unequalizing Effect to a Fiscal System with a Regressive Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.10</td>
<td>1.10</td>
<td>0.00</td>
<td>1.00</td>
<td>1.10</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.10</td>
<td>9.90</td>
<td>9.90</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>5.00</td>
<td>17.00</td>
<td>3.00</td>
<td>9.00</td>
<td>14.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37.00</strong></td>
<td><strong>5.10</strong></td>
<td><strong>42.10</strong></td>
<td><strong>5.10</strong></td>
<td><strong>31.90</strong></td>
<td><strong>37.00</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>9.25</strong></td>
<td><strong>1.28</strong></td>
<td><strong>10.53</strong></td>
<td><strong>1.28</strong></td>
<td><strong>7.98</strong></td>
<td><strong>9.25</strong></td>
</tr>
<tr>
<td><strong>Gini</strong></td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2951</td>
<td>n.c.</td>
<td>0.2657</td>
<td>0.2757</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2304</td>
<td>0.2476</td>
<td>0.2402</td>
<td>0.2516</td>
<td>0.2486</td>
</tr>
<tr>
<td>$\Pi^K_{f_B} \Theta^K_B$</td>
<td>...</td>
<td>0.0024</td>
<td>...</td>
<td>-0.0016</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.

Table 3-40 shows that adding a regressive transfer to a fiscal system with a neutral tax (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-40. Addition of a Regressive Transfer with an Equalizing Effect to a Fiscal System with a Neutral Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>3.00</td>
<td>15.00</td>
<td>3.00</td>
<td>9.00</td>
<td>12.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.10</td>
<td>13.10</td>
<td>1.00</td>
<td>12.00</td>
<td>12.10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37.00</strong></td>
<td><strong>3.10</strong></td>
<td><strong>40.10</strong></td>
<td><strong>5.00</strong></td>
<td><strong>32.00</strong></td>
<td><strong>35.10</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>9.25</strong></td>
<td><strong>0.78</strong></td>
<td><strong>10.03</strong></td>
<td><strong>1.25</strong></td>
<td><strong>8.00</strong></td>
<td><strong>8.78</strong></td>
</tr>
<tr>
<td><strong>Gini</strong></td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2749</td>
<td>n.c.</td>
<td>0.2656</td>
<td>0.2514</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2661</td>
<td>0.2512</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2514</td>
</tr>
<tr>
<td>$\Pi^K_{f_B} \Theta^K_B$</td>
<td>...</td>
<td>-0.0012</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.
Table 3-41 shows that adding a neutral transfer to a fiscal system with a neutral tax (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-41. Addition of a Neutral Transfer with an Equalizing Effect to a Fiscal System with a Neutral Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37.00</strong></td>
<td><strong>2.00</strong></td>
<td><strong>39.00</strong></td>
<td><strong>5.00</strong></td>
<td><strong>32.00</strong></td>
<td><strong>34.00</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>9.25</strong></td>
<td><strong>0.50</strong></td>
<td><strong>9.75</strong></td>
<td><strong>1.25</strong></td>
<td><strong>8.00</strong></td>
<td><strong>8.50</strong></td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.

Table 3-42 shows that adding a neutral transfer to a fiscal system with a neutral tax (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-42. Addition of a Neutral Transfer with an Unequalizing Effect to a Fiscal System with a Neutral Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI – T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>5.00</td>
<td>17.00</td>
<td>3.00</td>
<td>9.00</td>
<td>14.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37.00</strong></td>
<td><strong>5.00</strong></td>
<td><strong>42.00</strong></td>
<td><strong>5.00</strong></td>
<td><strong>32.00</strong></td>
<td><strong>37.00</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>9.25</strong></td>
<td><strong>1.25</strong></td>
<td><strong>10.50</strong></td>
<td><strong>1.25</strong></td>
<td><strong>8.00</strong></td>
<td><strong>9.25</strong></td>
</tr>
</tbody>
</table>

n.c. Not calculated.

... Not applicable.
In calculating progressivity, households’ rank with respect to their original income is used.
n.c. Not calculated.
... Not applicable.

Table 3-43 shows that adding a progressive transfer to a fiscal system with a neutral tax (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-43. Addition of a Progressive Transfer with an Unequalizing Effect to a Fiscal System with a Neutral Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.10</td>
<td>1.10</td>
<td>0.00</td>
<td>1.00</td>
<td>1.10</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>5.00</td>
<td>17.00</td>
<td>3.00</td>
<td>9.00</td>
<td>14.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37.00</strong></td>
<td><strong>5.10</strong></td>
<td><strong>42.10</strong></td>
<td><strong>5.00</strong></td>
<td><strong>32.00</strong></td>
<td><strong>37.10</strong></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>9.25</strong></td>
<td><strong>1.28</strong></td>
<td><strong>10.53</strong></td>
<td><strong>1.25</strong></td>
<td><strong>8.00</strong></td>
<td><strong>9.28</strong></td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2951</td>
<td>n.c.</td>
<td>0.2656</td>
<td>0.2743</td>
</tr>
<tr>
<td>$C^x$</td>
<td>0.2500</td>
<td>0.2304</td>
<td>0.2476</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2473</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.
n.c. Not calculated.
... Not applicable.

Table 3-44 shows that adding a regressive transfer to a fiscal system with a progressive tax (where progressivity is calculated with respect to households ranked by original income) could be equalizing.

Table 3-44. Addition of a Regressive Transfer with an Equalizing Effect to a Fiscal System with a Progressive Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>2.00</td>
<td>14.00</td>
<td>3.00</td>
<td>9.00</td>
<td>11.00</td>
</tr>
</tbody>
</table>
In calculating progressivity, households’ rank with respect to their original income is used.

... Not applicable.

Table 3-45 shows that adding a neutral transfer to a fiscal system with a progressive tax (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-45. Addition of a Neutral Transfer with an Unequalizing Effect to a Fiscal System with a Progressive Tax

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>5.00</td>
<td>17.00</td>
<td>3.00</td>
<td>9.00</td>
<td>14.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.10</td>
<td>11.90</td>
<td>11.90</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>5.00</td>
<td>42.00</td>
<td>5.10</td>
<td>31.90</td>
<td>36.90</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>1.25</td>
<td>10.50</td>
<td>1.28</td>
<td>7.98</td>
<td>9.23</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2976</td>
<td>n.c.</td>
<td>0.2641</td>
<td>0.2771</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2598</td>
<td>0.2484</td>
<td>0.2486</td>
</tr>
<tr>
<td>$\Pi^b_B$ or $\rho^K$</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>0.0016</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

... Not calculated.

Table 3-46 shows that adding a progressive transfer to a fiscal system with a progressive tax (where progressivity is calculated with respect to households ranked by original income) could be unequalizing.

Table 3-46. Addition of a Progressive Transfer with an Unequalizing Effect to a Fiscal System with a Progressive Tax
In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.

### 4.3 The Case of Adding a Transfer to a System with Multiple Taxes and Transfers in Place

Recall from equation 3-14 that

\[
M_{B_1} = \left\{ (G_X - C_X^Z) + \left( \frac{\sum_{i=1}^{n} (1 - g_i) \Pi_{i}^{RSZ} + \sum_{j=1}^{m} (1 + b_j) \rho_{B_j}^{RSZ}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\} - \left\{ (G_X - C_X^{Z\setminus B_1}) + \left( \frac{\sum_{i=1}^{n} (1 - g_i) \Pi_{i}^{RSZ, B_1} + \sum_{j=2}^{m} (1 + b_j) \rho_{B_j}^{RSZ, B_1}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=2}^{m} b_j} \right) \right\}. \]

For \( B_1 \) to be equalizing, this equation has to be positive, that is,

\[
\left\{ (G_X - C_X^Z) + \left( \frac{\sum_{i=1}^{n} (1 - g_i) \Pi_{i}^{RSZ} + \sum_{j=1}^{m} (1 + b_j) \rho_{B_j}^{RSZ}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\} - \left\{ (G_X - C_X^{Z\setminus B_1}) + \left( \frac{\sum_{i=1}^{n} (1 - g_i) \Pi_{i}^{RSZ, B_1} + \sum_{j=2}^{m} (1 + b_j) \rho_{B_j}^{RSZ, B_1}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=2}^{m} b_j} \right) \right\} > 0. \]

If adding this specific transfer does not change the end income ranking of individuals (that is, if end income rankings are the same before and after adding the tax), then ranking with respect to \( Z \) and \( Z\setminus B_1 \) is the same, which simplifies the whole equation to
\[
\left(1 - \sum_{i=1}^{n} g_i + \sum_{j=2}^{m} b_j \right) (1 + b_1) \rho_{B_1}^{R_{SZ}} > b_1 \left( \sum_{i=1}^{n} (1 - g_i) \Pi_{T_i}^{RS,Z,B_1} + \sum_{j=2}^{m} (1 + b_j) \rho_{B_j}^{RS,Z,B_1} \right)
\]

which is equal to

\[
\rho_{B_1}^{RS,Z} > \frac{b_1}{1 + b_1} \left( \frac{\sum_{i=1}^{n} (1 - g_i) \Pi_{T_i}^{RS,Z,B_1} + \sum_{j=2}^{m} (1 + b_j) \rho_{B_j}^{RS,Z,B_1}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=2}^{m} b_j} \right)
\]

or

\[
\rho_{B_1}^{RS,Z} > \frac{b_1}{1 + b_1} (C_{X,Z}^{Z,B_1} - G_{Z,B_1})
\]

or

\[
(3-40) \quad \rho_{B_1}^{K(Z)} > (C_{X}^{Z,B_1} - G_{Z,B_1}).
\]

As mentioned in section 3.3, the term on the right-hand side is

\[
VE_{X,Z\backslash B_1}^{Z,B_1} = C_{X}^{Z,B_1} - G_{Z,B_1}.
\]

Thus,

\[
(3-41) \quad \rho_{B_1}^{K(Z)} > VE_{X,Z\backslash B_1}^{Z,B_1}
\]

Therefore, we can use table 3-47 to determine the marginal effect of adding a transfer to a system with multiple taxes and transfers when the end income ranking of households does not change because of this additional transfer.

Table 3-47. Marginal Contribution of a Transfer with Multiple Taxes and Transfers in Place

<table>
<thead>
<tr>
<th>To a system with multiple taxes and transfers where its vertical equity (with respect to the final income ranking) is</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>$VE_{X,Z\backslash B_1}^{Z,B_1} &lt; 0$</td>
</tr>
</tbody>
</table>

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Adding a Transfer that with respect to the final incomes ranking \((Z)\) is Regressive \(\rho_B^Z < 0\) Equalizing if and only if condition 3-41 holds Always Unequalizing Always Unequalizing Neutral \(\rho_B^Z = 0\) Always Equalizing No Change in Inequality Always Unequalizing Progressive \(\rho_B^Z > 0\) Always Equalizing Always Equalizing Equalizing if and only if condition 3-41 holds

\[
Z = X - \sum_{i=1}^{n} T_i + \sum_{j=1}^{m} B_j \quad \text{and} \quad Z \setminus B_1 = X - \sum_{i=1}^{n} T_i + \sum_{j=2}^{m} B_j. \quad \text{Adding the new transfer does not change the end income ranking of individuals.}
\]

Crucially, for the preceding results to hold, the transfer that we are interested in should not have any effect on the end income ranking of households. If that is not the case then equation 3-39 cannot be simplified much further and the effect of adding such a transfer cannot be determined using a simple rule of thumb from table 3-47.

Alternatively, one can use the progressivity with respect to the original income in the analysis. For this purpose, we need to use equation 3-18:

\[
M_{B_1} = \left[ \begin{array}{c} \left(1 + b_1 \right) \rho^{RS}_{B_1} \left( - b_1 \right) \left( G_X - C_{X;B_1}^X \right) \right] \left[ \begin{array}{c} 1 \end{array} \right] + \left[ \begin{array}{c} \left( C_X^Z - G_Z \right) - \left( C_X^{Z \setminus B_1} - G_{Z \setminus B_1} \right) \end{array} \right].
\]

For a transfer to be equalizing when it is added to a system of taxes and transfers, the following condition should hold:

\[
3-42
\]

\[
M_{B_1} = \left[ \begin{array}{c} \left(1 + b_1 \right) \rho^{RS}_{B_1} \left( - b_1 \right) \left( G_X - C_{X;B_1}^X \right) \right] \left[ \begin{array}{c} 1 \end{array} \right] + \left[ \begin{array}{c} \left( C_X^Z - G_Z \right) - \left( C_X^{Z \setminus B_1} - G_{Z \setminus B_1} \right) \end{array} \right] > 0
\]

or
$M_{B_1} = \left[ \frac{(b_1 \rho_B^X) - (G_X - C_{X|B_1})}{(1 - \sum_{t=1}^{m} g_i + \sum_{j=1}^{m} h_j)} \right] + \left[ (C_{Z}^X - G_Z) - (C_{Z|B_1}^X - G_{Z|B_1}) \right] > 0. \tag{3-43}$

**5 Is the Total System More Equal?: Adding a Tax and a Transfer**

After examining the marginal contribution of taxes and transfers in the previous two sections, this section examines the total redistributive effect of all taxes and transfers. For simplicity, I bundle all of the taxes together and all of the transfers together and treat them as if there were only one tax and one transfer in the system. Recall that the change in the Gini is equal to

$$G_X - G_{X-T+B} = (G_X - C_{X-T+B}) + \left( \frac{(1-g)\Pi_T^{X-T+B} + (1+b)\rho_B^{RS_{X-T+B}}}{1-g+b} \right).$$

Then, for the whole system to be equalizing, we would need the following condition to hold:

$$G_X - C_{X-T+B} + \left( \frac{(1-g)\Pi_T^{X-T+B} + (1+b)\rho_B^{RS_{X-T+B}}}{1-g+b} \right) > 0 \tag{3-44}$$

or

$$G_X - C_{X-T+B} + \left( \frac{g\Pi_T^{X-T+B} + b\rho_B^{K_{X-T+B}}}{1-g+b} \right) > 0. \tag{3-45}$$

Note that the first term is non-negative. Therefore, we have the following cases. Table 3-48 shows the effect of the total system in the case of one tax and one transfer and when progressivity is calculated with respect to the end income ranking of households.

Table 3-48. Effect of the Total System with One Tax and One Transfer

<table>
<thead>
<tr>
<th>If the Transfer with respect to the end income ranking is</th>
<th>Regressive</th>
<th>Neutral</th>
<th>Progressive</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho_B^{K_{X-T+B}} &lt; 0$</td>
<td>$\rho_B^{K_{X-T+B}} = 0$</td>
<td>$\rho_B^{K_{X-T+B}} &gt; 0$</td>
<td></td>
</tr>
</tbody>
</table>

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Chapter 3, Enami

If the Tax with respect to the end income ranking is

<table>
<thead>
<tr>
<th></th>
<th>Regressive ( \Pi_T^{X-T+B} &lt; 0 )</th>
<th>Equalizing if and only if 3-45 holds</th>
<th>Equalizing if and only if equation 3-45 holds</th>
<th>Equalizing if and only if equation 3-45 holds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral ( \Pi_T^{X-T+B} = 0 )</td>
<td>Equalizing if and only if equation 3-45 holds</td>
<td>Equalizing if and only if equation 3-45 holds</td>
<td>Always equalizing</td>
<td></td>
</tr>
<tr>
<td>Progressive ( \Pi_T^{X-T+B} &gt; 0 )</td>
<td>Equalizing if and only if equation 3-45 holds</td>
<td>Always equalizing</td>
<td>Always equalizing</td>
<td></td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

The following examples display the counterintuitive cases.

Table 3-49 shows that adding a regressive tax and a regressive transfer (where progressivity is calculated with respect to households ranked by original income) to a fiscal system could be equalizing.

Table 3-49. Addition of a Regressive Tax and a Regressive Transfer with an Equalizing Effect to a Fiscal System

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>12.10</td>
<td>13.10</td>
<td>1.00</td>
<td>0.00</td>
<td>12.10</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>11.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>0.00</td>
<td>12.00</td>
<td>10.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.10</td>
<td>11.90</td>
<td>11.90</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>12.10</td>
<td>49.10</td>
<td>12.10</td>
<td>24.90</td>
<td>37.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>3.03</td>
<td>12.28</td>
<td>3.03</td>
<td>6.23</td>
<td>9.25</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.0372</td>
<td>n.c.</td>
<td>0.4488</td>
<td>0.2108</td>
</tr>
<tr>
<td>( C^{X-T+B} )</td>
<td>−0.2095</td>
<td>0.7500</td>
<td>0.0270</td>
<td>−0.5351</td>
<td>−0.0512</td>
<td>n.c.</td>
</tr>
<tr>
<td>( \Pi_T^{X-T+B} )  or ( \rho_B^{X-T+B} )</td>
<td>...</td>
<td>−0.9595</td>
<td>...</td>
<td>−0.3257</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.
Table 3-50 shows that adding a regressive tax and a neutral transfer (where progressivity is calculated with respect to households ranked by original income) to a fiscal system could be equalizing.

Table 3-50. Addition of a Regressive Tax and a Neutral Transfer with an Equalizing Effect to a Fiscal System

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.10</td>
<td>1.10</td>
<td>0.10</td>
<td>0.90</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>1.10</td>
<td>12.10</td>
<td>1.10</td>
<td>9.90</td>
<td>11.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>1.20</td>
<td>13.20</td>
<td>1.20</td>
<td>10.80</td>
<td>12.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>1.30</td>
<td>14.30</td>
<td>3.40</td>
<td>9.60</td>
<td>10.90</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>3.70</td>
<td>40.70</td>
<td>5.80</td>
<td>31.20</td>
<td>34.90</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>0.93</td>
<td>10.18</td>
<td>1.45</td>
<td>7.80</td>
<td>8.73</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2404</td>
<td>0.2371</td>
</tr>
<tr>
<td>$C_{X-T+B}^T$</td>
<td>0.2095</td>
<td>0.2095</td>
<td>0.2095</td>
<td>0.0431</td>
<td>0.2404</td>
<td>n.c.</td>
</tr>
<tr>
<td>$\Pi_{X-T+B}^{K}$ or $\rho_{B}^{K}$</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>−0.1664</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.

Table 3-51 shows that adding a neutral tax and a regressive transfer (where progressivity is calculated with respect to households ranked by original income) to a fiscal system could be equalizing.

Table 3-51. Addition of a Neutral Tax and a Regressive Transfer with an Equalizing Effect to a Fiscal System

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>10.10</td>
<td>11.10</td>
<td>0.40</td>
<td>0.60</td>
<td>10.70</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>4.40</td>
<td>6.60</td>
<td>6.60</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>0.00</td>
<td>12.00</td>
<td>4.80</td>
<td>7.20</td>
<td>7.20</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>5.20</td>
<td>7.80</td>
<td>7.80</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>10.10</td>
<td>47.10</td>
<td>14.80</td>
<td>22.20</td>
<td>32.30</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>2.53</td>
<td>11.78</td>
<td>3.70</td>
<td>5.55</td>
<td>8.08</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.0366</td>
<td>n.c.</td>
<td>0.2500</td>
<td>0.0998</td>
</tr>
<tr>
<td>$C_{X-T+B}^{K}$</td>
<td>−0.1959</td>
<td>0.7500</td>
<td>0.0069</td>
<td>−0.1959</td>
<td>−0.1959</td>
<td>n.c.</td>
</tr>
</tbody>
</table>
In calculating progressivity, households’ rank with respect to their original income is used.
n.c. Not calculated.
... Not applicable.

Table 3-52 shows that adding a neutral tax and a neutral transfer (where progressivity is calculated
with respect to households ranked by original income) to a fiscal system could be equalizing.

Table 3-52. Addition of a Neutral Tax and a Neutral Transfer with an Equalizing Effect to a Fiscal System

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0000</td>
<td>0.2000</td>
<td>1.2000</td>
<td>0.0000</td>
<td>1.0000</td>
<td>1.2000</td>
</tr>
<tr>
<td>3</td>
<td>12.0000</td>
<td>2.4000</td>
<td>14.4000</td>
<td>3.0000</td>
<td>9.0000</td>
<td>11.4000</td>
</tr>
<tr>
<td>4</td>
<td>13.0000</td>
<td>2.6000</td>
<td>15.6000</td>
<td>2.8154</td>
<td>10.1846</td>
<td>12.7850</td>
</tr>
<tr>
<td>Total</td>
<td>37.0000</td>
<td>7.4000</td>
<td>44.4000</td>
<td>6.8302</td>
<td>30.1698</td>
<td>37.5698</td>
</tr>
<tr>
<td>Average</td>
<td>9.2500</td>
<td>1.8500</td>
<td>11.1000</td>
<td>1.7076</td>
<td>7.5425</td>
<td>9.3925</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2365</td>
<td>0.2365</td>
</tr>
<tr>
<td>( \Pi_T^{KX-T+B} )</td>
<td>0.2365</td>
<td>0.2365</td>
<td>0.2365</td>
<td>0.2365</td>
<td>0.2365</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.
n.c. Not calculated.
... Not applicable.

Alternatively, we can use the formula based on the Kakwani index calculated with respect to the
original income ranking of households:

\[
G_X - G_{X-T+B} = (G_X - C_{X-T+B}^X) + (C_{X-T+B}^X - G_{X-T+B})
\]

which can be written as

\[
G_X - G_{X-T+B} = \left( \frac{(1-g)\Pi_T^{RS}+(1+b)p_B^{RS}}{1-g+b} \right) + (C_{X-T+B}^X - G_{X-T+B}).
\]
For the total system to be equalizing, we need to have

\[(3-46)\]

\[
\left(1 - g\right)^{l_B} \frac{\Pi_T^{rs} + (1 + b)\rho_B^{rs}}{1 - g + b} + (C_{X-T+B}^{x} - G_{X-T+B}^{x}) > 0
\]

or

\[(3-47)\]

\[
\left(1 - g\right)^{l_B} \frac{\rho_B^{K} + (1 + b)\rho_B^{K}}{1 - g + b} + (C_{X-T+B}^{x} - G_{X-T+B}^{x}) > 0.
\]

Note that the latter term is always non-positive. Therefore, we have the following cases.

Table 3-53 shows the effect of the total system in the case of one tax and one transfer and when progressivity is calculated with respect to the original income ranking of households.

Table 3-53. The Effect of the Total System with One Tax and One Transfer

<table>
<thead>
<tr>
<th>If the Transfer with respect to the original income ranking is</th>
<th>If the Tax with respect to the original income ranking is</th>
<th>Regressive</th>
<th>Neutral</th>
<th>Progressive</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\Pi_T^{K} &lt; 0)</td>
<td>Regressive</td>
<td>Always unequalizing</td>
<td>Always unequalizing</td>
<td>Equalizing if and only if equation 3-47 holds</td>
</tr>
<tr>
<td>(\Pi_T^{K} = 0)</td>
<td>Neutral</td>
<td>Always unequalizing</td>
<td>Never equalizing</td>
<td>Equalizing if and only if equation 3-47 holds</td>
</tr>
<tr>
<td>(\Pi_T^{K} &gt; 0)</td>
<td>Progressive</td>
<td>Equalizing if and only if equation 3-47 holds</td>
<td>Equalizing if and only if equation 3-47 holds</td>
<td>Equalizing if and only if equation 3-47 holds</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

The relatively counterintuitive cases in table 3-53 are presented in the following examples.

Table 3-54 shows that adding a neutral tax and a neutral transfer (where progressivity is calculated with respect to households ranked by original income) to a fiscal system could be unequalizing.

Table 3-54. Addition of a Neutral Tax and a Neutral Transfer with an Unequalizing Effect to a Fiscal System

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Table 3-55 shows that adding a neutral tax and a progressive transfer (where progressivity is calculated with respect to households ranked by original income) to a fiscal system could be unequalizing.

Table 3-55. Addition of a Neutral Tax and a Progressive Transfer with an Unequalizing Effect to a Fiscal System

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.10</td>
<td>1.10</td>
<td>0.00</td>
<td>1.00</td>
<td>1.10</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>5.00</td>
<td>17.00</td>
<td>3.00</td>
<td>9.00</td>
<td>14.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>5.10</td>
<td>42.10</td>
<td>5.00</td>
<td>32.00</td>
<td>37.10</td>
</tr>
</tbody>
</table>

Average   
Gini  

\[
\begin{array}{c|c|c|c|c|c|c}
\hline
\text{Gini} & \text{0.2500} & \text{n.c.} & \text{0.2976} & \text{n.c.} & \text{0.2656} & \text{0.2770} \\
\hline
\text{\(C^X\)} & \text{0.2500} & \text{0.2500} & \text{0.2500} & \text{0.2500} & \text{0.2500} & \text{0.2500} \\
\hline
\text{\(\Pi^T_B \text{or} \rho^K_B\)} & \text{...} & \text{0.0000} & \text{...} & \text{0.0000} & \text{...} & \text{...} \\
\hline
\end{array}
\]

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.
Table 3-56. Addition of a Progressive Tax and a Neutral Transfer with an Unequalizing Effect to a Fiscal System

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>5.00</td>
<td>17.00</td>
<td>3.00</td>
<td>9.00</td>
<td>14.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.10</td>
<td>11.90</td>
<td>11.90</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>5.00</td>
<td>42.00</td>
<td>5.10</td>
<td>31.90</td>
<td>36.90</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>1.25</td>
<td>10.50</td>
<td>1.28</td>
<td>7.98</td>
<td>9.23</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2976</td>
<td>n.c.</td>
<td>0.2641</td>
<td>0.2771</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2500</td>
<td>0.2598</td>
<td>0.2484</td>
<td>0.2486</td>
</tr>
<tr>
<td>$\Pi^K_{o\rho_B^K}$</td>
<td>...</td>
<td>0.0000</td>
<td>...</td>
<td>0.0016</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.

Table 3-57 shows that adding a progressive tax and a progressive transfer (where progressivity is calculated with respect to households ranked by original income) to a fiscal system could be unequalizing.

Table 3-57. Addition of a Progressive Tax and a Progressive Transfer with an Unequalizing Effect to a Fiscal System

<table>
<thead>
<tr>
<th>Individual</th>
<th>Original Income (OI)</th>
<th>Benefit (B)</th>
<th>OI + B</th>
<th>Tax (T)</th>
<th>OI − T</th>
<th>End Income (EI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>0.10</td>
<td>1.10</td>
<td>0.00</td>
<td>1.00</td>
<td>1.10</td>
</tr>
<tr>
<td>2</td>
<td>11.00</td>
<td>0.00</td>
<td>11.00</td>
<td>1.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>12.00</td>
<td>5.00</td>
<td>17.00</td>
<td>3.00</td>
<td>9.00</td>
<td>14.00</td>
</tr>
<tr>
<td>4</td>
<td>13.00</td>
<td>0.00</td>
<td>13.00</td>
<td>1.10</td>
<td>11.90</td>
<td>11.90</td>
</tr>
<tr>
<td>Total</td>
<td>37.00</td>
<td>5.10</td>
<td>42.10</td>
<td>5.10</td>
<td>31.90</td>
<td>37.00</td>
</tr>
<tr>
<td>Average</td>
<td>9.25</td>
<td>1.28</td>
<td>10.53</td>
<td>1.28</td>
<td>7.98</td>
<td>9.25</td>
</tr>
<tr>
<td>Gini</td>
<td>0.2500</td>
<td>n.c.</td>
<td>0.2951</td>
<td>n.c.</td>
<td>0.2641</td>
<td>0.2743</td>
</tr>
<tr>
<td>$C^X$</td>
<td>0.2500</td>
<td>0.2304</td>
<td>0.2476</td>
<td>0.2598</td>
<td>0.2484</td>
<td>0.2459</td>
</tr>
<tr>
<td>$\Pi^K_{o\rho_B^K}$</td>
<td>...</td>
<td>0.0024</td>
<td>...</td>
<td>0.0016</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

In calculating progressivity, households’ rank with respect to their original income is used.

n.c. Not calculated.

... Not applicable.
6 The Effect of a Marginal Change in One Tax or Transfer on the Equalizing (Unequalizing) Effect of a Whole System

This section focuses on the derivatives of the marginal contribution of a tax or transfer (that is, $M_{T_1}$ or $M_{B_1}$), with respect to its progressivity or relative size, to determine whether such a marginal change would increase the equalizing effect of the whole system. What differentiates this section from the previous chapter (the case of no-reranking) is that the progressivity is calculated with respect to both the end income ranking and to the original income ranking of households. In this section, therefore, I will discuss three derivatives (with respect to the relative size and two types of Kakwani indexes).

Before calculating the derivatives, I need to point out an important simplifying assumption. The derivatives represent a very minor change in a tax or transfer and therefore it is safe to assume that the end income ranking of households would not change. This is not the case, of course, if we deviate from the case of a very “marginal” change in a tax or transfer.

It should also be noted that, conceptually, the derivatives of marginal contribution with respect to either relative size or Kakwani indexes are equivalent to the derivatives of the redistributive effect or Gini of the end income with respect to these two variables, which should be easily seen in the following equation.\(^{10}\)

\[
M_{T_1} = G_{Z\setminus T_1} - G_Z = \left(\frac{G_X - G_Z}{G_X - G_{Z\setminus T_1}}\right) - \left(G_X - G_{Z\setminus T_1}\right)
\]

Note that the Gini of the final income is the only term on the right-hand side that has $T_1$ in it, that is, $G_Z$ and the rest of terms are constants in any derivative with respect to the relative size or Kakwani index of $T_1$ (and they would drop out). Also note that while the sign of the derivatives of $G_Z$ is different from $RE$ and $M_{T_1}$, they are of the same size and equivalent interpretation. To provide a more intuitive explanation, note how the following three statements in the example below are equivalent.

Example: Due to a marginal change in a tax’s relative size (or its progressivity),

---the end Gini decreased by 0.2.
---the redistributive effect of the total system increased by 0.2.
---the marginal contribution of that tax (to reducing inequality) increased by 0.2.

6.1 The Case of a Marginal Change in a Tax

\(^{10}\) Recall from the notation section that $Z = X - \sum_{i=1}^n T_i + \sum_{j=1}^n B_j$ and $Z_{\setminus T_1} = X - \sum_{i=2}^n T_i + \sum_{j=1}^n B_j$. 
This section focuses on the derivatives of the marginal contribution of a tax with respect to its relative size \((g)\), Kakwani index calculated with respect to the original income ranking of households \((\Pi^k_F)\), and Kakwani index calculated with respect to the end income ranking of households \((\Pi^{kz}_F)\).

To calculate the derivative of \(M_{T_1}\) with respect to \(g_1\), we have two formulas to work with. Using equation 3.13,

\[
M_{T_1} = \left\{ (G_X - C^x_X) + \left( \frac{\sum_{i=1}^{n} (1 - g_i) \Pi^{kz}_{T_1} + \sum_{j=1}^{m} (1 + b_j) \rho^{kz}_{B_j}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\}
-
\left\{ (G_X - C^{z \setminus T_1}_X) + \left( \frac{\sum_{i=2}^{n} (1 - g_i) \Pi^{kz \setminus T_1}_{T_i} + \sum_{j=1}^{m} (1 + b_j) \rho^{kz \setminus T_1}_{B_j}}{1 - \sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\}
\]

or

\[
M_{T_1} = \left\{ (G_X - C^z_X) + \left( \frac{\sum_{i=1}^{n} g_i \Pi^{kz}_{T_i} + \sum_{j=1}^{m} b_j \rho^{kz}_{B_j}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\}
-
\left\{ (G_X - C^{z \setminus T_1}_X) + \left( \frac{\sum_{i=2}^{n} g_i \Pi^{kz \setminus \{T_1\}}_{T_i} + \sum_{j=1}^{m} b_j \rho^{kz \setminus \{T_1\}}_{B_j}}{1 - \sum_{i=2}^{n} g_i + \sum_{j=1}^{m} b_j} \right) \right\}
\]

Therefore,

\[
\frac{\partial M_{T_1}}{\partial g_1} = \frac{\partial (-C^z_X)}{\partial g_1}
\]

\[
(1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j) \left( \Pi^{kz}_{T_1} + \frac{\partial \Pi^{kz}_{T_1}}{\partial g_1} g_1 + \sum_{i=2}^{n} g_i \frac{\partial \Pi^{kz}_{T_1}}{\partial g_1} + \sum_{j=1}^{m} b_j \frac{\partial \rho^{kz}_{B_j}}{\partial g_1} \right) + \left( \Pi^{kz}_{T_1} + \frac{\partial \Pi^{kz}_{T_1}}{\partial g_1} g_1 + \sum_{i=2}^{n} g_i \frac{\partial \Pi^{kz}_{T_1}}{\partial g_1} + \sum_{j=1}^{m} b_j \frac{\partial \rho^{kz}_{B_j}}{\partial g_1} \right)
\]

or

\[
\frac{\partial M_{T_1}}{\partial g_1} = \frac{\partial (-C^z_X)}{\partial g_1}
\]

\[
\left(1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j \right)^2
\]

Note that if a new reranking were to occur due to the marginal change in \(g_1\), then all terms ordered by \(Z\) would change, thus making it impossible to derive any general conclusion. However, our
assumption about no further reranking (with respect to the end income ranking of households) would simplify the above derivative to the following equation:

\[
\frac{\partial M_{T_1}}{\partial g_1} = \frac{\Pi_{T_1}^K + (C_{Z_T_1}^X - G_Z)}{1 - \Sigma_{i=1}^n g_i + \Sigma_{j=1}^m b_j} = \frac{c_{T_1}^Z - G_Z}{1 - \Sigma_{i=1}^n g_i + \Sigma_{j=1}^m b_j}.
\]

The sign of this derivative is ambiguous. A closer look at the numerator reveals that it follows the same idea of the traditional Kakwani index. In other words, if the concentration curve of a tax (with respect to the end income concept) happens to be below the Gini of the end income, then a marginal increase in the size of that tax would increase the value of the marginal contribution of that tax (to reducing inequality). The other obvious case is when the concentration coefficient of a tax (with respect to the end income ranking of households) is negative, it makes the derivative unambiguously negative. This happens, for example, if the poorer a household is (with respect to the end income ranking of households), the more tax dollars it pays.

An equivalent formula can be derived from equation 3-16. From this equation, we have

\[
M_{T_1} = \left[ \left( g_1 \frac{\Pi_{T_1}^K - G_X - C_{Z(T_1)}^X}{(1 - \Sigma_{i=1}^n g_i + \Sigma_{j=1}^m b_j)} \right) \right] + \left( C_Z^X - G_Z - (C_{Z(T_1)}^X - G_{Z(T_1)}) \right).
\]

The derivative therefore is equal to

\[
\frac{\partial M_{T_1}}{\partial g_1} = \left( \frac{\Pi_{T_1}^K - G_X - C_{Z(T_1)}^X}{(1 - \Sigma_{i=1}^n g_i + \Sigma_{j=1}^m b_j)} \right) + \frac{\partial (C_Z^X - G_Z)}{\partial g_1} \left( 1 - \Sigma_{i=1}^n g_i + \Sigma_{j=1}^m b_j \right)^2
\]

or

\[
\frac{\partial M_{T_1}}{\partial g_1} = \left( \frac{\Pi_{T_1}^K - G_X - C_{Z(T_1)}^X}{(1 - \Sigma_{i=1}^n g_i + \Sigma_{j=1}^m b_j)} \right) + \frac{\partial (C_Z^X - G_Z)}{\partial g_1} \left( 1 - \Sigma_{i=1}^n g_i + \Sigma_{j=1}^m b_j \right)^2
\]

Unlike the previous derivative, however, there is no reasonable simplifying assumption to take care of the last term,

\[
\frac{\partial (C_Z^X - G_Z)}{\partial g_1}.
\]

In order to calculate the derivative with respect to the Kakwani index when this index is calculated with respect to the original income ranking of households, one needs to use equation 3-16 and the transformation of the R-S index to the Kakwani index as mentioned previously.
Chapter 3, Enami

\[ M_{T_1} = \left( \frac{g_1 (\Pi_{T_1}^Z - G_x - C_{Z \setminus T_1}^x)}{(1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j)} \right) + \left[ (C_{Z}^x - G_Z) - (C_{Z \setminus T_1}^x - G_{Z \setminus T_1}) \right] \]

Therefore,

\[
\frac{\partial M_{T_1}}{\partial \Pi_{T_1}^Z} = \frac{g_1}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j} + \frac{\partial (C_{Z}^x - G_Z)}{\partial \Pi_{T_1}^Z}
\]

The sign of this derivative is ambiguous as well. The value of this derivative depends on the distribution of post-fiscal income and how the progressivity is changed (that is, the latter term in the derivative cannot be simplified any further in the general case).

Finally, the derivative with respect to the Kakwani index when this index is calculated with respect to the end income ranking of households can be calculated using equation 3.13 and transformation of the R-S index to Kakwani index, that is,

\[ M_{T_1} = \left\{ (G_X - C_{Z}^x) + \left( \frac{\sum_{i=1}^n g_i \Pi_{T_1}^Z + \sum_{j=1}^m b_j \rho_{B_j}^Z}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j} \right) \right\} - \left\{ (G_X - C_{Z \setminus T_1}^x) + \left( \frac{\sum_{i=2}^n g_i \Pi_{T_1}^{Z \setminus T_1} + \sum_{j=1}^m b_j \rho_{B_j}^{Z \setminus T_1}}{1 - \sum_{i=2}^n g_i + \sum_{j=1}^m b_j} \right) \right\}
\]

Therefore,

\[
\frac{\partial M_{T_1}}{\partial \Pi_{T_1}^Z} = \frac{\partial (-C_{Z}^x)}{\Pi_{T_1}^Z} + \frac{g_1 + \sum_{i=2}^n g_i \frac{\partial \Pi_{T_1}^Z}{\partial T_1} + \sum_{j=1}^m b_j \frac{\partial \rho_{B_j}^Z}{\partial T_1}}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}
\]

Using the simplifying assumption that increase in the progressivity is unchanged in the final ranking (Z), the preceding derivative would be simplified to

\[
\frac{\partial M_{T_1}}{\partial \Pi_{T_1}^Z} = \frac{g_1}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}.
\]

This derivative is always positive. Therefore, making a tax more progressive, when progressivity is calculated with respect to the end income ranking of households, is always equalizing (with or without reranking), assuming that no change in the end income ranking of households occurs as a result of a marginal increase in the progressivity of that tax. It is worth noting that the value of this derivative is equal to the one calculated in the previous chapter for the derivative of the marginal
effect with respect to the traditional Kakwani index. This outcome is of course expected as these two types of Kakwani indexes are the same when there is no reranking.

6.2 Case of a marginal change in a transfer

This section provides the derivatives of the marginal contribution of a transfer with respect to its relative size \((b)\), the Kakwani index calculated with respect to the original income ranking of households \((\rho_B^{K})\), and the Kakwani index calculated with respect to the end income ranking of households \((\rho_B^{Kz})\). Because there is no specific methodological difference between this section and the previous one, only the formulas for these derivatives are presented.

\[
\frac{\partial M_{B_1}}{\partial b_1} = \frac{\partial (-C_Z)}{\partial b_1} + \left( \rho_B^{Kz} + \frac{\partial \rho_B^{Kz}}{\partial b_1} b_1 + \sum_{i=1}^{n} g_i \frac{\partial K^z_i}{\partial b_1} + \sum_{j=2}^{m} b_j \frac{\partial \rho_B^{Kz}}{\partial b_1} \right) - (C_Z - G_Z) / \left( 1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j \right)
\]

With the simplifying assumption that the end income ranking of households \((Z)\) would not change as a result of a marginal change in the relative size of the transfer, we have

\[
\frac{\partial M_{B_1}}{\partial b_1} = \frac{\rho_B^{Kz} - (C_Z - G_Z)}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} = \frac{G_Z - C_B^{Z}}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j}
\]

The sign of this derivative is ambiguous, but it would be positive if, for example, the concentration curve of a benefit (with respect to the end income ranking of households) happened to be above the Gini curve of the end income. Also, a negative concentration coefficient of a benefit (with respect to the end income ranking of households) would result in a positive sign for the preceding derivative, which happens when the poorer a household is, the higher the dollar value of the transfer it receives.

Alternatively, and using the traditional Kakwani index, we would have

\[
\frac{\partial M_{B_1}}{\partial b_1} = \left( \rho_B^{RS} - G_X - C_X \right) \left( 1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j \right) / \left( 1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j \right)^2 + \frac{\partial (C_Z - G_Z)}{\partial b_1}
\]

The derivative with respect to \(\rho_B^{K}\) would be equal to

\[
\frac{\partial M_{B_1}}{\partial \rho_B^{K}} = \frac{b_1}{1 - \sum_{i=1}^{n} g_i + \sum_{j=1}^{m} b_j} + \frac{\partial (C_Z - G_Z)}{\partial \rho_B^{K}}
\]

The sign of this derivative is ambiguous since the last term cannot be simplified any further.

Finally, the derivative with respect to \(\rho_B^{Kz}\) would be equal to
Applying the simplifying assumption of no change in the final ranking (Z) results in the following formula:

\[
\frac{\partial M_{B_1}}{\partial \rho^k_B} = \frac{\partial (-C^*_k)}{\partial \rho^k_B} + \left( b_1 + \sum_{i=1}^n g_i \frac{\partial \Pi^k_{\ell_i}}{\partial \rho^k_B} + \sum_{j=1}^m b_j \frac{\partial \rho^k_{B_j}}{\partial \rho^k_B} \right) \frac{1}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}
\]

Unlike all preceding derivatives, this one has a positive sign, which means that making a transfer more progressive, when progressivity is calculated with respect to the end income ranking of households, will always reduce inequality as long as the end income ranking does not change. Similarly to the case of a tax explained in section 6.1, this derivative is equal to the one calculated in the previous chapter for the derivative of the marginal contribution with respect to the Kakwani index in the absence of reranking in the system.

The main message of this chapter is that in the presence of reranking, indicators of progressivity do not provide any insight into whether a tax or transfer reduces inequality in the marginal contribution sense. Mathematical derivations and various examples throughout this chapter intended to make this message clear. The complicated and usually inconclusive math can be entirely avoided if the marginal contribution analysis is employed. In other words, there is no shortcut to answering fiscal policy questions other than performing simulations and accounting for all components (taxes and transfers) of a fiscal system.

7 Lambert Conundrum Revisited

The previous chapter introduces the Lambert conundrum in which a regressive tax exerts an equalizing effect. Similarly, a progressive tax can increase inequality. This chapter shows that reranking can also result in a similar outcome specially for progressive taxes and transfers. Since reranking always happens in the real world, it is important to decompose the role of reranking in producing these odd outcomes from what one would describe as a pure Lambert conundrum. This section introduces a decomposition designed to achieve this goal.

To better introduce this decomposition technique, assume we are dealing with a regressive tax that has an equalizing effect. We would like to know how much change (reduction) in Gini happens before individuals are reranked and how much it happens after they are reranked.
Chapter 3, Enami

\[
MC_T = G_{X+B} - G_{X-T+B} \\
\text{Change in Gini before reranking begins}
\]

\[
= \left( G_{X+B} - G_{X-T^{NR}+B} \right) + \left( G_{X-T^{NR}+B} - G_{X-T+B} \right)
\]

Where \(MC_T\) is the marginal contribution of a tax (we assume the system has only one tax and one transfer), \(G_{X+B}\) is the Gini before tax and \(G_{X-T+B}\) is the Gini after the tax is added to the fiscal system. Finally, \(G_{X-T^{NR}+B}\) is the Gini of a simulated distribution of income in which we begin adding taxes to people but only up to the point that they are not reranked. The following example shows how this simulation works.

Table 3-58. Using an actual tax, T, to simulate a hypothetical tax, \(T^{NR}\), that does not create reranking

<table>
<thead>
<tr>
<th>Individual</th>
<th>X+B</th>
<th>T</th>
<th>X+B-T</th>
<th>(T^{NR})</th>
<th>X+B-(T^{NR})</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>0</td>
<td>12</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>2</td>
<td>11</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>4</td>
<td>10</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

In the pure Lambert conundrum, for example, the latter term of the decomposition equation above would be zero because there would be no reranking. Moreover, if the simulated tax, \(T^{NR}\), is still regressive an equalizing we can conclude that the Lambert conundrum does not depend on the reranking. However, the size of the total reduction in Gini may significantly depend on the reranking and the above decomposition would identify the relative importance of it.

Generalizing this decomposition to the case of any tax or transfer in a fiscal system with numerous other taxes and transfers, we would have the following equations:

\[
M_{T_1} = \left( G_{Z\backslash T_1} - G_{Z_{T_1}^{NR}} \right) + \left( G_{Z_{T_1}^{NR}} - G_Z \right)
\]

\[
M_{B_1} = \left( G_{Z\backslash B_1} - G_{Z_{B_1}^{NR}} \right) + \left( G_{Z_{B_1}^{NR}} - G_Z \right)
\]

where \(Z\) is the end income (market income minus all taxes plus all transfers), \(Z\backslash T_1 \quad (Z\backslash B_1)\) is the end income without including \(T_1 \quad (B_1)\). Finally, \(Z_{T_1}^{NR} \quad (Z_{B_1}^{NR})\) is the end income when the simulated \(T_1^{NR} \quad (B_1^{NR})\) is used instead of the actual \(T_1 \quad (B_1)\).

References


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October 31, 2016

https://www.dropbox.com/sh/c9v8s3hxaearhyb/AAC9hfPi83GVucieMPtM12wsa?dl=0

Chapter 4

Lustig, Nora, editor

Commitment to Equity Handbook


Brookings Institution and CEQ Institute (2017)

This chapter is a reprint of an article published in the \textit{Journal of Development Economics}, which can be accessed in its published form at \url{http://dx.doi.org/10.1016/j.jdeveco.2016.04.001}. The article is published Open Access funded by the Bill & Melinda Gates Foundation, under Creative Commons license CC BY 4.0. If you use material from this chapter, including but not limited to using the fiscal impoverishment measure, please cite the following article:


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Can a poverty-reducing and progressive tax and transfer system hurt the poor?

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\textbf{ARTICLE INFO}

\textbf{Article history:}
Received 8 April 2015
Received in revised form 25 December 2015
Accepted 1 April 2016
Available online 13 April 2016

\textbf{Keywords:}
Poverty
Horizontal equity
Progressivity
Fiscal impoverishment

\textbf{ABSTRACT}

To analyze anti-poverty policies in tandem with the taxes used to pay for them, comparisons of poverty before and after taxes and transfers are often used. We show that these comparisons, as well as measures of horizontal equity and progressivity, can fail to capture an important aspect: that a substantial proportion of the poor are made poorer (or non-poor made poor) by the tax and transfer system. We illustrate with data from seventeen developing countries: in fifteen, the fiscal system is poverty-reducing and progressive, but in ten of these at least one-quarter of the poor pay more in taxes than they receive in transfers. We call this fiscal impoverishment, and axiomatically derive a measure of its extent. An analogous measure of fiscal gains of the poor is also derived, and we show that changes in the poverty gap can be decomposed into our axiomatic measures of fiscal impoverishment and gains.

\section{1. Introduction}

Anti-poverty policies are often evaluated in isolation from the taxes used to pay for them.\textsuperscript{1} If, however, taxes cancel out the benefits of transfers for many poor households, so that some poor pay more in taxes than they receive in transfers, the objective of these policies might be compromised. This is especially important when poverty traps exist at the individual level (e.g., Ghatak, 2015, Ravallion, 2015): a tax and transfer system in which many poor pay more in taxes than they receive in transfers risks pushing the transiently poor into chronic poverty by shifting their after tax and transfer incomes below their individual-specific poverty trap thresholds.

Recently, the connection between anti-poverty policies and the taxes used to pay for them has come into the spotlight in the debates over the United Nations’ Post-2015 Sustainable Development Goals. In recognition of the resources necessary to achieve these ambitious development goals, and partly as a consequence of austerity in advanced countries (and thus lower anticipated flows of international aid to developing countries), much of the discussion has focused on how developing countries should collect the revenue necessary to achieve the goals.\textsuperscript{2} Influential organizations such as the International Monetary Fund and World Bank emphasize the importance of efficient taxes with minimal exemptions (International Monetary Fund, 2013, World Bank, 2013). When concerns are raised about these taxes—such as a no-exemption value added tax—falling disproportionately on the poor, many argue that higher tax burdens on the poor are acceptable if they are accompanied by sufficiently large targeted transfers: “spending instruments are available that are better targeted to the pursuit of equity concerns” (Keen and Lockwood, 2010, p.141). Similarly, Engel et al. (1999, p. 186) assert that “it is quite obvious that the disadvantages of a proportional tax are moderated by adequate targeting” of transfers, since “what the poor individual pays in taxes is returned to her.” These taxes “might conceivably be the best way to finance pro-poor expenditures, with the net effect being to relieve poverty” (Ebrill et al., 2001, p. 105).

How can we be sure that what the poor individual pays in taxes is returned to her? Even if the net effect of taxes and transfers is to relieve poverty, are some poor made worse off? When taxes and transfers are analyzed in tandem to determine how they affect the

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\textsuperscript{2} See, for example, the focus on domestic resource mobilization in United Nations (2015).

See, for example, the focus on domestic resource mobilization in United Nations (2015).
poor, it is common to compare poverty before taxes and transfers (“pre-fisc”) to poverty after taxes and transfers (“post-fisc”). As we show in this paper, however, a fiscal system can be unambiguously poverty-reducing for a range of poverty lines and any poverty measure, yet still make a substantial proportion of the poor worse off. This phenomenon does not only occur with regressive taxes: we show that taxes and transfers can be globally progressive, unambiguously equalizing, and unambiguously poverty-reducing and still make many poor worse off. In other words, conventional tools used to measure how the poor are affected by the tax and transfer system are inadequate to measure whether some of the poor pay more in taxes than they receive in transfers, a phenomenon we call fiscal impoverishment (FI).

We also show that in practice, there are a number of countries with poverty-reducing and progressive tax and transfer systems that nevertheless make a substantial proportion of the poor poorer (or non-poor poor), illustrating with data from seventeen developing countries. In fifteen of these countries, post-fisc poverty is unambiguously lower than pre-fisc poverty (measured with any poverty line up to $1.25 per person per day in low and lower-middle income countries and $2.50 per day in upper-middle income countries) and the tax and transfer system is globally progressive and unambiguously equalizing, i.e., we would conclude that the tax and transfer system unambiguously benefits the poor using conventional measures, potentially overlooking impoverishment. In all of these countries, some degree of FI occurs, and in ten of them we find that at least one-quarter of the poor pay more in taxes than they receive in transfers.

In light of the debate about financing anti-poverty policies and the Sustainable Development Goals, it is necessary to fill this gap in the measurement arsenal and develop a measure of this problem with conventional measures of poverty, horizontal equity, and progressivity. Of course, these measures are still quite important for assessing a tax and transfer system; we merely aim to show that they do not capture everything we are interested in. First, in Section 2.1 we show the problem with poverty measures when they are used to compare poverty before and after taxes and transfers. Although comparisons of pre-fisc and post-fisc poverty are common in empirical studies (e.g., DeFina and Thawalwa, 2004, Hoynes et al., 2006), poverty measures can overlook fiscal impoverishment because they obey the anonymity axiom (which is usually taken as an innocuous and desirable axiom): the tax and transfer system cannot reduce poverty while simultaneously making a substantial portion of the poor poorer, or making some non-poor poor. The anonymity axiom is not the only culprit for the shortcomings of existing measures, however: in Section 2.2 we show that measures designed to incorporate information about individuals’ pre-fisc positions, such as measures of horizontal equity and progressivity, can also fail to capture FI. To show that these shortcomings of conventional measures are not confined to contrived hypothetical examples, but rather occur frequently in practice, in Section 2.3 we present examples from seventeen developing countries: in ten, the tax and transfer system is poverty-reducing and progressive, but hurts a substantial portion of the poor by pushing them deeper into poverty.

1 Our illustration uses results provided to us by the authors of country studies conducted as part of the Commitment to Equity (CEQ) Institute, located at Tulane University (www.commitmenttoequity.org). The countries included are Armenia (Younger and Khachatryan, forthcoming), Bolivia (Paz Aranuco et al., 2014), Brazil (authors’ calculations), Chile (Martínez-Aguilar and Ortíz-Juarez, 2015), the Dominican Republic (Aristy-Escuder et al., forthcoming), Ecuador (Llerena Pinto et al., 2015), El Salvador (Beneke et al., 2015), Ethiopia (Hill et al., forthcoming), Ghana (Younger et al., 2015), Guatemala (Cabrera et al., 2015), Indonesia (Afkar et al., forthcoming), Mexico (Aranda and Scott, 2015), Peru (Jaramillo et al., 2015), Russia (López-Calva et al., forthcoming), South Africa (Inchauste et al., forthcoming), Sri Lanka (Arunatilake et al., forthcoming), and Tunisia (Shimeles et al., forthcoming). For an overview of the impact of taxes and social spending on inequality and poverty in many of these countries, see Lustig (2015).

2 The $1.25 per person per day poverty line (in 2005 US dollars adjusted for purchasing power parity) is approximately equal to the median income of the fifteen poorest countries for which poverty line data are available, and the $2.50 line to the median of the world’s low and middle income countries excluding the fifteen poorest (Chen and Ravallion, 2010).

3 The $1.25 per person per day poverty line is approximately equal to the median income of the fifteen poorest countries for which poverty line data are available, and the $2.50 line to the median of the world’s low and middle income countries excluding the fifteen poorest (Chen and Ravallion, 2010).

4 Other measures that are sometimes used, such as the percent of income gained or lost by each pre-fisc income decile, overlook FI for a distinct reason: they average over individuals, so for example the poorest decile could gain income on average while a substantial number of poor within the first decile lose income. We do not include these measures in this paper since the reason they overlook FI is obvious.

5 The axioms are adapted from the axiomatic poverty and mobility measurement literature (see Foster, 2006 and Zheng, 1997 for surveys of axiomatic poverty measurement and Fields, 2001 for a survey of axiomatic mobility measurement). Our resulting measure can be viewed as a censored directional version of the mobility measure derived by Fields and Ok (1996).

2. The problems with conventional measures

Suppose the change in poverty caused by the fiscal system will be evaluated over a range of poverty lines, including lines greater than 6 and less than or equal to 10. Suppose there are three individuals in society with pre-fisc incomes of 5, 8, and 20, and (retaining the order of the individuals) post-fisc incomes 9, 6, and 18. For any poverty line in the range we are considering, and for any poverty measure in a broad class of measures, poverty has either not changed or decreased. This is because the poorest individual in the pre-fisc
income distribution has an income of 5 and the second-poorest 8, while in the post-fisc distribution, the poorest has an income of 6 and the second-poorest 9. Poverty comparisons do not take into account that the poorest individual in the post-fisc distribution, with an income of 6, is not the poorest individual in the pre-fisc distribution who has an income of 5, but instead had an income of 8 in the pre-fisc distribution and paid 2 more in taxes than she received in transfers. Depending on the exact poverty line chosen within the range we are considering, this individual was either pre-fisc poor and lost income to the fiscal system, or pre-fisc non-poor and pushed into poverty by the fiscal system.

It is clear, then, that poverty measures are inadequate to measure whether some of the poor pay more in taxes than they receive in transfers. Stochastic dominance tests, which are used to determine whether poverty is unambiguously lower in one income distribution than another for any poverty line and a broad class of poverty measures (Atkinson, 1987, Foster and Shorrocks, 1988), are also inadequate. This is because poverty measures and stochastic dominance tests are anonymous with respect to pre-fisc income: they compare the pre- and post-fisc income distributions without paying attention to the specific pre-fisc to post-fisc trajectory of particular individuals’ incomes. The anonymity axiom, normally considered an innocuous and desirable property, becomes problematic when we are concerned with how the fiscal system affects the poor: in the words of Amiel and Cowell (1994, p. 448–9), “anonymity itself may be questionable as a welfare criterion when the social-welfare function is to take into account something more than the end-state distribution of incomes.” Anonymity implies that poverty measures fail to take into account individuals’ initial positions, and thus whether some are being made poorer by the tax and transfer system.\footnote{Amiel and Cowell (1994) also point out that the respect for income dominance axiom is only equivalent to the monotonicity axiom when anonymity is imposed. In the example from the previous paragraph, the post-fisc income distribution first order stochastically dominates the pre-fisc distribution on the domain from 0 to the maximum poverty line, so it would be evaluated as superior by any measure satisfying poverty focus and respect for income dominance (or, equivalently, poverty focus and both monotonicity and anonymity). It would not necessarily be evaluated as superior by a measure satisfying poverty focus and monotonicity but not anonymity, however. Other concerns with the anonymity axiom have also been pointed out: for example, it can clash with the Pigou-Dalton transfer axiom when there are households of different types (Ebert, 1997) and with the subgroup sensitivity axiom, an extension of the Pigou-Dalton transfer axiom to subgroups (Subramanian, 2006).}

To illustrate visually, Fig. 1 shows a stylistic representation of the pre- and post-fisc incomes of a population ordered by pre-fisc income. The increasing curve represents pre-fisc income, the wavy curve post-fisc income, and the dashed line the poverty line: because some individuals receive more in transfers than they pay in taxes, while others pay more in taxes than they receive in transfers, the post-fisc income curve is sometimes above and sometimes below the pre-fisc income curve. Although post-fisc poverty is lower than pre-fisc poverty because the losses of some poor are more than compensated by the gains of other poor, there is FI. The extent of FI is shown by the dark-shaded areas, while the light-shaded areas represent the extent of FGP (using the measures we axiomatically derive in Sections 3 and 4).

2.2. Horizontal equity and progressivity

Anonymity is not the only reason conventional measures overlook fiscal impoverishment: non-anonymous measures such as horizontal equity and progressivity, which are designed to incorporate information about an individual’s pre-fisc position, can fail to capture FI because they are not concerned with whether her net tax burden (taxes paid minus transfers received) is positive or negative. Denote income before taxes and transfers by $y^0_i \in \mathbb{R}_+$, and income after taxes and transfers by $y^1_i \in \mathbb{R}_+$ for each $i \in S$, where $S$ is the set of individuals in society. Consider a range of potential poverty lines $Z \subset \mathbb{R}_+$. Each individual’s income before or after taxes and transfers is arranged in the vector $y^0$ or $y^1$, both ordered in ascending order of pre-fisc income $y^0$—even if ranking occurs, the order of the $y^1$ vector reflects the pre-fisc income ranking.

Horizontal equity can be defined in two ways: the reranking definition, which requires that no pair of individuals switch ranks, and the classical definition, which requires that pre-fisc equals are treated equally by the tax and transfer system. Under either definition, the existence or absence of horizontal equity among the poor does not tell us whether FI has occurred. Even if some are impoverished by the tax and transfer system, the ranking among the poor may not change (so there is horizontal equity by the reranking definition) and pre-fisc equals may be impoverished to the same degree (so there is classical horizontal equity): e.g., $Z = (6,10)$, $y^0 = (1,1,7,13)$, $y^1 = (3,3,6,11)$. Nor does horizontal inequity among the poor necessarily imply FI, because there could be reranking among the poor or unequal treatment among pre-fisc equals when the tax and transfer system lifts incomes of some of the poor without decreasing incomes of any poor: e.g., $Z = (6,10)$, $y^0 = (5,5,6,20)$, $y^1 = (5,7,6,18)$.

A tax and transfer system is everywhere progressive when net taxes (i.e., taxes minus benefits), relative to pre-fisc income, increase with income (Duclos, 1997, Lambert, 1988). The tax and transfer system can be progressive (and unambiguously equalizing) but cause fiscal impoverishment: e.g., $Z = (6,10)$, $y^0 = (1,3,7,13)$, $y^1 = (3,4,6,11)$; net taxes relative to pre-fisc income increase with income, but the third individual whose income falls from 7 to 6 is fiscally impoverished. Thus, progressivity is not a sufficient condition to ensure that FI does not occur. Nor is progressivity a necessary condition for the absence of FI: e.g., $Z = (6,10)$, $y^0 = (1,3,7,14)$, $y^1 = (1,5,8,11)$, which involves no FI but is not everywhere progressive because net taxes first decrease with income when moving from the poorest to the second-poorest, then increase with income thereafter.

Table 1 summarizes the examples presented in Sections 2.1 and 2.2 to show that conventional tools—specifically, poverty measures (and stochastic dominance tests) and measures of or tests for horizontal equity and progressivity—can overlook FI.
2.3. Real-world examples

The problems with conventional measures are not limited to contrived hypothetical examples. In a number of countries, we observe an unambiguous reduction in poverty and a globally progressive tax and transfer system, while a significant proportion of the poor are fiscally impoverished. Using the income concepts from Higgins et al. (2015), we compare market income (before taxes and transfers) to post-fiscal income (after direct and indirect taxes, direct cash and food transfers, and indirect subsidies) in seventeen developing countries. We use post-fiscal income as the after taxes and transfers income concept even though taxes are used to fund more than just direct cash and food transfers and indirect subsidies from the government (e.g., they are used to fund public goods and services, many of which also reach the poor) because this is the income concept relevant for measuring poverty: it is “dispensable money and near-money income” that should be compared to the poverty line when the latter is based on “a poverty budget for food, clothing, shelter, and similar items” (Citro and Michael, 1995, p. 212, 237). For low and lower-middle income countries, we use a poverty line of $1.25 per person per day; for upper middle income countries, $2.50 per day. Table 2 column 1 shows the pre-fisc (market income) poverty headcount and column 2 shows the change in poverty from the pre-fisc to the post-fiscal income distribution; countries in which poverty increased due to the fiscal system are excluded.

Moving to the progressivity of the tax and transfer system and change in inequality in each country, column 3 shows the pre-fisc Gini coefficient and column 4 shows the Reynolds and Smolensky (1977) index, which is a summary indicator corresponding to tests of global progressivity; the Reynolds–Smolensky equals the pre-fisc Gini minus the concentration coefficient of post-fiscal income with respect to pre-fiscal income, and thus globally progressive systems have a positive Reynolds–Smolensky index. Column 5 shows the change in inequality, with negative numbers indicating that inequality fell as a result of the tax and transfer system.

Since we do not derive an axiomatic measure of FI until Section 3, here we use two intuitively appealing measures likely to have policy traction. Column 6 shows the percent of the population that are fiscally impoverished and column 7 the percent of the post-fisc poor that are fiscally impoverished. Although all of the countries in Table 2 experienced a reduction in poverty and inequality due to the tax and transfer system, the amount of FI varies greatly between countries. In ten countries—Armenia, Bolivia, Brazil, El Salvador, Guatemala, Indonesia, Mexico, Russia, Sri Lanka, and Tunisia—between one-quarter and two-thirds of the post-fisc poor lost income to the fiscal system. In other countries, this figure is much lower, at 13.3% of the post-fisc poor in South Africa (but, due to the high proportion of the total population that is poor, still 5.9% of the total population) and 3.2% of the post-fisc poor in Ecuador.

Even when poverty increases from pre-fiscal to post-fiscal income and hence we know that FI has occurred (as in Ghana and Ethiopia), it is impossible to tell its extent without explicit measures like the ones we propose in Section 3. A stark example of this comes from Ethiopia, where looking at poverty and progressivity numbers alone greatly masks the extent of FI: the headcount ratio at $1.25 per day increases from 31.9% to 33.2% of the population, while the squared poverty gap and Gini coefficient fall as a result of taxes and transfers (World Bank, 2015). Nevertheless, applying our measures to the same data, Hill et al. (forthcoming) find that 28.5% of Ethiopians and over 80% of the post-fisc poor experience FI.

Even if we add the value of public spending on education and health (imputed at their government cost to families who report a child attending public school or who report using public health facilities), fiscal impoverishment is still high in several countries: in Armenia, Ethiopia, Indonesia, Russia, and Tunisia, between 25 and 50% of those who are fiscally impoverished before adding in benefits from public spending on health and education are still fiscally impoverished when these benefits are included as transfers.

3. Measures of fiscal impoverishment

To assess anti-poverty policies in tandem with the taxes used to finance them, it is important to have measures of the extent of fiscal impoverishment. In the last section, we provided a glimpse of FI in several developing countries using two simple, straightforward, and intuitive measures that—given these features—can be useful for policy discussions. These two measures also have drawbacks, however. To illustrate their limitations, we begin by providing more detail about the two measures. For a particular poverty line \( z \in Z \), there is fiscal impoverishment if \( y_1^f < y_0 \) and \( y_1^f < z \) for some individual \( i \in S \). In other words, the individual could be poor before taxes and transfers and made poorer by the fiscal system, or non-poor before taxes and transfers but poor after. Both straightforward measures count the number of individuals who meet this condition (and are thus fiscally impoverished) in the numerator. The proportion of the population who are fiscally impoverished (column 6 of Table 2) divides this numerator by the number of individuals in society, while the proportion of the post-fisc poor who are fiscally impoverished (column 7) divides it by the number who are post-fisc poor (with \( y_1^f < z \)).

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8. Although the table only shows poverty for a particular poverty line and poverty measure, it is also true that the post-fisc distribution first order stochastically dominates the pre-fisc distribution from 0 to the poverty line used for each country, meaning that poverty unambiguously fell for all poverty lines up to $1.25 or $2.50 and all poverty measures in a broad class.

9. We test global progressivity by dominance of the concentration curve of post-fisc with respect to pre-fisc income over the pre-fisc Lorenz curve, and test unambiguously equalizing by comparing the post-fisc and pre-fisc Lorenz curves.

10. If we instead scale down taxes so that they equal the transfers included in our analysis, which we avoid in the main analysis for the reasons mentioned above in defense of post-fiscal income as the after taxes and transfers income concept, FI is lower; for example, in Brazil 10.8% of the post-fisc poor are fiscally impoverished using this method.
In the context of poverty measurement, Sen (1976, p. 219) proposes a monotonicity axiom requiring that, all else equal, "a reduction in income of a person below the poverty line must increase the poverty measure." We propose a similar axiom for FI measures requiring that a larger decrease in post-fisc income for an impoverished person, all else equal, must increase the FI measure. Monotonicity is violated by the straight-forward measures, which do not increase when an impoverished person becomes more impoverished because she counts as one impoverished individual in the measure's numerator regardless of how much income she loses to the fiscal system.\footnote{Another simple tool to examine FI is the $n \times n$ transition matrix $P$, whose typical element $P_{kl}$ represents the probability of being in post-fisc income group $l$ at $(1, \ldots, n)$ for an individual in pre-fisc income group $k \in (1, \ldots, q)$. Measures based on $P$ also fail to satisfy FI monotonicity and have the large drawback of not capturing FI among the poorest pre-fisc group $(k = 1)$.}

\subsection*{3.1. Axioms}

We propose eight properties desirable for a robust measure of FI; we describe these properties here and formally define them in the Appendix. Throughout, we assume that income is measured in real terms and has been converted to a common currency such as US dollars adjusted for purchasing power parity, thereby simplifying away concerns about inflation or currency conversions if comparing FI over time or across countries.

Our FI monotonicity axiom described above implies not only that the FI measure must be strictly increasing in the extent to which an impoverished individual is impoverished (ceteris paribus), but also that the measure must be strictly increasing in the number of individuals that are impoverished, holding fixed the amount of FI experienced by others. The focus axiom, analogous to Sen's (1981) focus axiom for poverty measurement, says that different income changes to the non-impoverished—provided that they remain non-impoverished—leave the FI measure unchanged. Given the focus axiom, it is natural to impose a normalization that if no one is impoverished, the FI measure equals zero. Note that this normalization axiom is not instrumental to our result: if we did not impose it, our result would be that our axioms uniquely determine a measure of FI up to a linear (rather than proportional) transformation.\footnote{It is also possible to normalize by the measure’s upper bound so that it always lies on the interval [0, 1] by specifying an axiom that if everyone loses all of their income to the fiscal system (the maximum possible FI), the measure of FI equals 1. We prefer to avoid normalizing in this way so that the class of axiomatic FI measures is more general.}

Similar to Chakravarty's (1983) continuity axiom for poverty measures, we require the FI measure to be continuous in pre-fisc income, post-fisc income, and the poverty line (since we may want to assess FI for a range of possible poverty lines). This is stronger than Foster and Shorrocks's (1991) restricted continuity axiom which only requires the measure to be continuous in incomes below the poverty line and left-continuous at the poverty line, thus allowing the measure to jump discontinuously at the poverty line; see Zheng (1997) and Permanyer (2014) for arguments in favor of using the stronger continuity axiom in the contexts of unidimensional and multidimensional poverty measures.

Because “the names of income recipients do not matter” (Zheng, 1997, p. 131), we impose a permutability axiom requiring that if we take each individual's pre- and post-fisc income pair and (keeping each pre- and post-fisc income pair as a bundle) shuffle these around the population, FI is unchanged. We use the term “permutability” rather than symmetry or anonymity because—even both have been used in the same way we use permutability above (e.g., Cowell, 1985, Fields and Fei, 1978, Plotnick, 1982)—symmetry and anonymity have also taken on different definitions. Symmetry can instead mean, for two income distributions $X$ and $Y$ and a distance measure $d$, that $d(X,Y) = d(Y,X)$; the two income distributions are treated symmetrically: losses are not distinguishable from gains (Ebert, 1984, Fields and Ok, 1999). Anonymity can instead mean that the measure compares the cumulative distribution of pre-fisc income, $F_0$, to that of post-fisc income, $F_1$,  

### Table 2

Poverty, inequality, and fiscal impoverishment in developing countries.

<table>
<thead>
<tr>
<th>Country (survey year)</th>
<th>Pre-fisc poverty headcount (%)</th>
<th>Change in poverty headcount (p.p.)</th>
<th>Pre-fisc inequality (Gini)</th>
<th>Reynolds–Smolensky (post-fisc w.r.t. pre-fisc)</th>
<th>Change in inequality (ΔGini)</th>
<th>Fiscally impoverished as % of population</th>
<th>Fiscally impoverished as % of post-fisc poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: Upper-middle income countries, using a poverty line of $2.50 per day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil (2008–2009)</td>
<td>16.8</td>
<td>−0.8</td>
<td>57.5</td>
<td>4.6</td>
<td>−3.5</td>
<td>5.6</td>
<td>34.9</td>
</tr>
<tr>
<td>Chile (2013)</td>
<td>2.8</td>
<td>−1.4</td>
<td>49.4</td>
<td>3.2</td>
<td>−3.0</td>
<td>0.3</td>
<td>19.2</td>
</tr>
<tr>
<td>Mexico (2012)</td>
<td>10.8</td>
<td>−3.8</td>
<td>47.8</td>
<td>3.5</td>
<td>−3.3</td>
<td>0.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Peru (2011)</td>
<td>13.3</td>
<td>−1.2</td>
<td>54.4</td>
<td>3.8</td>
<td>−2.5</td>
<td>4.0</td>
<td>32.7</td>
</tr>
<tr>
<td>Russia (2010)</td>
<td>13.8</td>
<td>−0.2</td>
<td>45.9</td>
<td>0.9</td>
<td>−0.8</td>
<td>3.2</td>
<td>23.8</td>
</tr>
<tr>
<td>South Africa (2010–2011)</td>
<td>49.3</td>
<td>−5.2</td>
<td>77.1</td>
<td>8.3</td>
<td>−7.7</td>
<td>5.9</td>
<td>13.3</td>
</tr>
<tr>
<td>Tunisia (2010)</td>
<td>7.8</td>
<td>−0.1</td>
<td>44.7</td>
<td>8.0</td>
<td>−6.9</td>
<td>3.0</td>
<td>38.5</td>
</tr>
<tr>
<td>Panel B: Lower-middle income countries, using a poverty line of $1.25 per day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Armenia (2011)</td>
<td>21.4</td>
<td>−8.4</td>
<td>47.4</td>
<td>12.9</td>
<td>−9.2</td>
<td>6.2</td>
<td>52.3</td>
</tr>
<tr>
<td>Bolivia (2009)</td>
<td>10.9</td>
<td>−0.5</td>
<td>50.3</td>
<td>0.6</td>
<td>−0.3</td>
<td>6.6</td>
<td>61.2</td>
</tr>
<tr>
<td>Dominican Republic (2007)</td>
<td>6.8</td>
<td>−0.9</td>
<td>50.2</td>
<td>2.2</td>
<td>−2.2</td>
<td>1.0</td>
<td>16.3</td>
</tr>
<tr>
<td>El Salvador (2011)</td>
<td>4.3</td>
<td>−0.7</td>
<td>44.0</td>
<td>2.2</td>
<td>−2.1</td>
<td>1.0</td>
<td>27.0</td>
</tr>
<tr>
<td>Guatemala (2010)</td>
<td>12.0</td>
<td>−0.8</td>
<td>49.0</td>
<td>1.4</td>
<td>−1.2</td>
<td>7.0</td>
<td>62.2</td>
</tr>
<tr>
<td>Indonesia (2012)</td>
<td>12.0</td>
<td>−1.5</td>
<td>39.8</td>
<td>1.1</td>
<td>−0.8</td>
<td>4.1</td>
<td>39.2</td>
</tr>
<tr>
<td>Sri Lanka (2009–2010)</td>
<td>5.0</td>
<td>−0.7</td>
<td>37.1</td>
<td>1.3</td>
<td>−1.1</td>
<td>1.6</td>
<td>36.4</td>
</tr>
</tbody>
</table>

Sources: For Brazil, authors' calculations. For other countries, provided to us by the authors of the studies cited in Footnote 3.

Notes: p.p.—percentage points. w.r.t.—with respect to. Ethiopia and Ghana are not included in the table because poverty with a $1.25 per day poverty line increased from pre-fisc to post-fisc income (and hence they do not illustrate shortcomings of conventional measures). Country classifications are from the World Bank for the year of the survey.
without regard to where a particular individual at position $j$ in $F_0$ ended in $F_1$ (e.g., Bourguignon, 2011a,b). In other words, an anonymous measure would compare the pre-fisc income of the $j$th poorest individual in $F_0$ to the post-fisc income of the $j$th poorest individual in $F_1$, even though “they are not necessarily the same individuals” because of reranking (Bourguignon, 2011a, p. 607).

Next, we must decide whether our measure of FI should be absolute or relative (recalling that we assume income to be in real terms of a constant currency, so arguments about inflation or currency exchange should not affect the decision). Suppose each poor individual’s pre-fisc income increases by $1$, taxes and transfers are held fixed, and the price of one essential good in the basic goods basket, normalized to have one unit in the basket, also increases by $1$ per unit. Each poor individual remains the same distance below the poverty line; that distance represents the amount of additional income she needs to afford adequate nutrition and other basic necessities. For those who experience FI, it is the absolute increase in the distance between that individual’s income and the poverty line that matters in terms of the quantity of basic goods she can buy. Hence, we assume that if all pre- and post-fisc incomes increase by $1$ and the poverty line also increases by $1$, FI should remain unchanged. We thus impose translation invariance.

Given our above argument for absolute measures, we also impose linear homogeneity: if all incomes and the poverty line are multiplied by the same factor, the measure of FI changes by that factor. Instead, specifying homogeneity of degree zero (scale invariance) would be incompatible with translation invariance for the reasons explored in Zheng (1994). Since we assume that income is expressed in real terms and a common currency, our measure is nevertheless insensitive to inflation or currency changes. The translation invariance and linear homogeneity axioms have been used together in axiomatic derivations of measures of inequality (Kolm, 1976), poverty (Blackorby and Donaldson, 1980), economic distance (Chakravarty and Dutta, 1987, Ebert, 1984), and mobility (Fields and Ok, 1996, Mitra and Ok, 1998).14

Our final axiom is based on a concept introduced to the poverty literature by Foster et al. (1984, p. 761), who argue that “at the very least, one would expect that a decrease in the poverty level of one subgroup ceteris paribus should lead to less poverty for the population as a whole.” Similarly, it would be desirable for a measure of FI if a decrease in the measured FI for one subgroup of the population and no change in the measured FI for all other subgroups results in a decrease in the measured FI of the entire population. Hence, we impose a subgroup consistency axiom analogous to the one used for poverty measurement by Foster and Shorrocks (1991). In his survey of axiomatic poverty measurement, Zheng (1997, p. 137) notes that subgroup consistency “has gained wide recognition in the literature.”

### 3.2. An axiomatic measure of fiscal impoverishment

**Proposition 1.** A measure satisfying FI monotonicity, focus, normalization, continuity, permutability, translation invariance, linear homogeneity, and subgroup consistency is uniquely determined up to a proportional transformation, and given by

\[
f(y^0, y^1; z) = \kappa \sum_{i \in S} \left( \min \left[ y^0_i, z \right] - \min \left[ y^1_i, z \right] \right).
\]

13 To avoid inflation in this thought experiment, assume that there is an offsetting fall in the price of a good not in the basic goods basket and not consumed by the poor.

14 By requiring translation invariance and linear homogeneity, we are deriving a measure of absolute FI; from there, the measure can nevertheless be modified to obtain other types of desired measures such as a scale invariant measure. This is similar to the approach taken by Fields and Ok (1996), who axiomatically derive a measure of absolute mobility from which other desired measures such as mobility proportional to income can be obtained.

The summand for individual $i$ behaves as follows. For an individual who was poor before taxes and transfers and is impoverished ($y^1_i < y^0_i < z$), it is equal to her fall in income, $y^0_i - y^1_i$. For an individual who was non-poor before taxes and transfers and is impoverished ($y^1_i < z < y^0_i$), it equals her post-fisc poverty gap, or the amount that would need to be transferred to her to move her back to the poverty line (equivalently, to prevent her from becoming impoverished), $z - y^1_i$. For a non-impoverished pre-fisc non-poor individual ($y^0_i < z$ and $y^1_i \geq z$) it equals $z - z = 0$. For a non-impoverished pre-fisc poor individual ($y^0_i < z$ and $y^1_i < y^0_i$) it equals $y^0_i - y^1_i = 0$. Hence, $f$ sums the total amount of FI, multiplied by a factor of proportionality. This constant can be chosen based on the preferences of the practitioner: for example, $\kappa = 1$ gives total FI (the dark-shaded area in Fig. 1), while $\kappa = |S|^{-1}$ gives per capita FI.15

### 3.3. Fiscal impoverishment dominance criteria

Having identified the existence of FI in a country, a useful implementation of our FI measure would be to compare the degree of FI in two situations, e.g. by comparing the current fiscal system to a proposed reform. The choice of poverty line might, however, influence our conclusion about which situation entails higher FI. We thus present a partial FI ordering that can be used to determine if FI is unambiguously lower in one situation than another for any poverty line and any measure that satisfies FI monotonicity, focus, normalization, continuity, permutability, translation invariance, linear homogeneity, and subgroup consistency. Since we have already shown that a FI measure satisfies these axioms if and only if it takes the form in Eq. (1), a simple way to test for FI dominance for any measure satisfying those axioms and any poverty line in the domain of poverty lines $z$ is to simply compare the curves $f(y^0_i, y^1_i; z)$ and $f(x^0_i, x^1_i; z)$ across $z$. Interestingly, if the minimum poverty line being considered is 0 (so $z = [0, z^+]$ where $z^+$ is the maximum poverty line), there is an alternative (equivalent) way to test whether FI is unambiguously lower in one situation than another that uses a dominance test already developed in the mobility literature: Foster and Rothbaum’s (2014) second order downward mobility dominance.

**Proposition 2.** The following are equivalent.

a) FI is unambiguously lower in $(y^0, y^1)$ than $(x^0, x^1)$ for any poverty line in $[0, z^+]$ and any measure satisfying FI monotonicity, focus, normalization, continuity, permutability, translation invariance, linear homogeneity, and subgroup consistency.

b) $f(y^0_i, y^1_i; z) < f(x^0_i, x^1_i; z)$ for all $z \in [0, z^+]$.

c) $(y^0, y^1)$ second order downward mobility dominates $(x^0, x^1)$ on $[0, z^+]$.

### 4. Fiscal gains of the poor

Most likely, we will be interested in more than just the extent to which some poor are not compensated for their tax burden with transfers: we will also want to know about the gains of other poor families, and the way in which a comparison of poverty before and after taxes and transfers can be decomposed into the losses and gains of different poor households. In this section, we formally define fiscal gains of the poor, briefly present the axioms for a measure of FGP gains.

---

15 We do not impose a population invariance axiom; this axiom is commonly imposed but is criticized by Hassoun and Subramanian (2012). A subset of measures of form (1) are population invariant: choosing $\kappa = |S|^{-1}$ gives a measure that satisfies population invariance, while $\kappa = 1$ gives a measure that does not.
analogous to those in Section 3.1 for a measure of FI, and present an axiomatic measure and partial ordering of FGP. We then show that a commonly used measure of poverty, the poverty gap, can be decomposed into our axiomatic measures of FI and FGP.

4.1. An axiomatic measure of fiscal gains of the poor

There are fiscal gains of the poor if \( y_i^0 < y_i^1 \) and \( y_i^0 < z \) for some individual \( i \in S \). The individual may or may not receive enough in net transfers to be post-fisc non-poor (i.e., it is possible that \( z < y_i^1 \) or \( y_i^1 < z \)). Consider a pre-fisc poor individual who receives more in transfers than she pays in taxes. If she is given even more transfer income, while the pre- and post-fisc incomes of all others experiencing FGP do not change, FGP should not decrease; if she would have remained in poverty post-fisc without the additional transfer income, FGP should increase with the additional transfer. We impose these conditions in the FGP monotonicity axiom; we also impose FGP analogues of the other axioms from Section 3.1.

**Proposition 3.** A measure satisfying FGP monotonicity, focus, normalization, continuity, permutability, translation invariance, linear homogeneity, and subgroup consistency is uniquely determined up to a proportional transformation, and given by

\[
g(y^0, y^1; z) = \kappa \sum_{i \in S} \left( \min \{ y_i^1, z \} - \min \{ y_i^0, y_i^1, z \} \right). \tag{2}\]

An individual who is pre-fisc poor and gains income from the tax and transfer system, but remains post-fisc poor (\( y_i^0 < y_i^1 < z \)), contributes the amount of her income gain, \( y_i^1 - y_i^0 \), to the measure of FGP. A pre-fisc poor individual that gains income and as a result has post-fisc income above the poverty line (\( y_i^0 < z \leq y_i^1 \)) contributes the amount of net transfers that pulled her pre-fisc income to the poverty line, \( z - y_i^0 \). Someone who is pre-fisc poor and does not gain income (\( y_i^1 \leq y_i^0 < z \)) contributes \( y_i^1 - y_i^0 = 0 \). Someone who is pre-fisc non-poor (\( z < y_i^0 \)) also contributes 0 (for her, the summand equals \( z - z \) if she remains non-poor or \( y_i^1 - y_i^0 \) if she loses income and becomes poor). For \( \kappa = 1 \), \( g \) equals the light-shaded area in Fig. 1.

As with fiscal impoverishment orderings, a fiscal gain partial ordering can be used to make unambiguous FGP comparisons for any poverty line and any measure satisfying our axioms. The ordering compares \( g(y^0, y^1; z) \) to \( g(x^0, x^1; z) \) for all \( z \in \mathbb{Z} \), and for \( z = \{0,2^\mathbb{Z}\} \), coincides with Foster and Rotthaus's (2014) second order upward mobility dominance (the proof proceeds similarly to the proof of Proposition 2 for FI).

4.2. Decomposition of the difference between pre-fisc and post-fisc poverty

The most common measures of poverty used in both policy circles and scholarly papers (e.g., Chen and Ravallion, 2010, Ravallion, 2012) are the poverty headcount ratio, which enumerates the proportion of the population that is poor, and the poverty gap, which takes into account how far the poor fall below the poverty line. The latter might be expressed in absolute terms, summing the gap between each poor person’s income and the poverty line, in which case it can be thought of as the total amount that would need to be given to the poor to eliminate poverty (if targeting were perfect). Or it can be normalized, dividing the absolute poverty gap by the poverty line and population size, for example, to create a scale- and population-invariant measure. We use a general definition of the poverty gap that encompasses its absolute and normalized forms:

\[
p(y; z) = r(S, z) \sum_{i \in S} (z - y_i) \mathbb{I}(y_i < z), \tag{3}\]

where \( r(S,z) \) is a normalization factor. Two special cases are the absolute poverty gap, where \( r(S,z) = 1 \), and the poverty gap ratio, where \( r(S,z) = (z\mathbb{S})^{-1} \). For simplicity and because a comparison of pre- and post-fisc poverty usually occurs for a fixed population and given poverty line, we assume that \( S \) and \( z \) are fixed in what follows.

**Proposition 4.** A change in the poverty gap before and after taxes and transfers is equal to the difference between the axiomatic measures of FI and FGP from Eqs. (1) and (2), multiplied by a constant.

Given the assumption that the population and poverty line are fixed, \( r(S,z) \) is a constant that we denote \( \bar{r} \). The poverty gap in Eq. (3) can be rewritten as \( p(y; z) = \bar{r} \sum_{i \in S} (z - y_i) \mathbb{I}(y_i < z) = \bar{r} \sum_{i \in S} (z - (y_i)) \mathbb{I}(y_i < z) = \bar{r} \sum_{S_{x \leq y_i}} (z - (y_i)) - \bar{r} \sum_{S_{y_i < z}} (z - \min \{y_i^1, z\}) \), or

\[
p(y^1; z) - p(y^0; z) = \bar{r} \left[ \min \{y_i^1, z\} - \min \{y_i^0, y_i^1, z\} \right] - \bar{r} \sum_{S_{y_i < z}} (z - \min \{y_i^1, z\}) \]

\[
= \bar{r} \left[ r \left( y^0, y^1; z \right) - g(y^0, y^1; z) \right].
\]

Comparisons of pre- and post-fisc poverty are often used to assess whether the tax and transfer system helps or hurts the poor. This decomposition can be used to dig deeper into that net effect and observe the extent to which a net reduction in poverty masks the offsetting gains of some poor and impoverishment of others at the hands of the (possibly progressive) tax and transfer system.

5. Illustration

5.1. Results for seventeen developing countries

We saw in Section 2 that in fifteen of seventeen developing countries for which we have data, the tax and transfer system is poverty-reducing and progressive but, in many cases, fiscally impervious, a significant proportion of the poor. In Table 3, we present FI and FGP results for these countries using the axiomatic measures derived in Sections 3 and 4. Column 1 gives total FI (i.e., the axiomatic measure from Eq. (1) with \( \kappa = 1 \)) and column 2 total FGP, both expressed in millions of 2005 US dollars per year using purchasing power parity adjusted exchange rates. Because the axiomatic measure with \( \kappa = 1 \) is population variant, FI and FGP tend to be higher in more populous countries; these absolute amounts of FI and FGP can be useful, for example, in comparisons to the size of a country’s main cash transfer program, as we show for Brazil below. To ease interpretation and comparison across countries, column 3 shows FI expressed as a percent of FGP, while columns 4 and 5 show FI and FGP per capita (where per capita refers to dividing by the entire population), normalized by the poverty line; each of these is population invariant.

There is large heterogeneity in the extent to which some poor are hurt by the tax and transfer system relative to the extent to which other poor gain, despite that the same range of policies, including direct taxes, direct cash and near-cash transfers, indirect consumption taxes, and indirect subsidies were considered in each country study. Among the upper-middle income countries, FI as a percent of FGP (using a poverty line of $2.50 per day) ranges from less than 1% in Ecuador to 40% in Tunisia. In low and lower-middle income countries, FI as a percent of FGP (using a poverty line of $1.25 per day) is even higher in some countries, reaching 55% in Guatemala and
81% in Bolivia; in Ethiopia and Ghana—the two countries in which post-fisc poverty is higher than pre-fisc poverty—FI exceeds FGP.

Column 6 shows the change in the poverty gap ratio from pre- to post-fisc income, which by Proposition 4 can be decomposed into FI per capita minus FGP per capita, both normalized by the poverty line like the poverty gap ratio. This decomposition reveals some interesting traits of each country’s tax and transfer system. For example, Ecuador achieves the same FGP per capita as Brazil but with nearly no FI, compared to substantial FI in Brazil; as a result, the poverty gap is reduced by more in Ecuador. The difference in FI might be attributable to the multiple consumption taxes levied at the state and federal levels in Brazil: these are high and often cascading, and consumption tax exemptions for basic goods are almost non-existent (Corbacho et al., 2013), compared to a system that exempts food, basic necessities, and medicine in Ecuador (Llerena Pinto et al., 2015). Interestingly, most of those experiencing FI are not excluded from the safety net; they do receive government transfers or subsidies: 65% of the impoverished in Brazil receive cash transfers from Bolsa Família, for example.

It is also noteworthy that Peru, one of the countries in which less than a quarter of the post-fisc poor experience FI, nevertheless redistributes low amounts to the poor, and thus has a low reduction in the poverty gap; this is consistent with Jaramillo’s (2014, p. 391) finding that Peru’s low poverty reduction induced by fiscal policy is “associated with low social spending rather than with inefficient spending.” Among three lower-middle income countries that each reduce the poverty gap ratio by about 0.3 percentage points (El Salvador, Guatemala, and Indonesia), Guatemala has high FI but also higher FGP, while El Salvador has lower FGP but very low FI, and Indonesia falls in the middle. We do not attempt to answer whether a lower-FI, lower-FGP or higher-FI, higher-FGP system is preferable from a welfare perspective, but note that this decomposition enables a substantially richer analysis than the typical comparison of poverty before and after taxes and transfers.

5.2. Results for a range of poverty lines in Brazil

So far, the FI and FGP results we have presented use a fixed poverty line ($1.25 in low and lower-middle income countries and $2.50 in upper-middle income countries). We now extend the analysis to a range of poverty lines, focusing the illustration on data from Brazil, using the Pesquisa de Orçamentos Familiares (Family Expenditure Survey) 2008–2009. The precise direct and indirect taxes, direct cash and food transfers, and indirect subsidies included in our analysis are described in detail in Higgins and Pereira (2014).

As we stated in Section 2.3, the tax and transfer system in Brazil is unambiguously poverty-reducing for any poverty line up to $2.50 per person per day, globally progressive, and unambiguously equalizing. This is shown in Fig. 2, where cumulative distribution functions reveal that the post-fisc distribution first order stochastically dominates the pre-fisc distribution on the domain [0,2.5], which implies an unambiguous reduction in poverty for any poverty line in this domain and any measure in a broad class (Atkinson, 1987, Foster and Shorrocks, 1988); the post-fisc concentration curve with respect to pre-fisc income dominates the pre-fisc Lorenz curve, which implies global progressivity (in the income redistribution sense; see Duclos, 2008); and the post-fisc Lorenz curve dominates the pre-fisc Lorenz curve, which implies that the fiscal system is unambiguously equalizing (Atkinson, 1970). If, however, we extend the maximum poverty line to say, $4 per person per day—a poverty line frequently used by the World Bank when studying middle-income Latin American countries (e.g., Ferreira et al., 2013)—poverty is no longer unambiguously lowered by the fiscal system: for poverty lines above about $3 per day, the poverty headcount is higher after taxes and transfers than before. We would thus know

**Table 3**

Fiscal impoverishment and gains of the poor in developing countries.

<table>
<thead>
<tr>
<th>Country (survey year)</th>
<th>Panel A: Upper-middle income countries, using a poverty line of $2.50 per day</th>
<th>Panel B: Low and lower-middle income countries, using a poverty line of $1.25 per day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Total FI ($ millions per year)</td>
<td>(2) Total FGP ($ millions per year)</td>
</tr>
<tr>
<td>Brazil (2008–2009)</td>
<td>676.0</td>
<td>3503.6</td>
</tr>
<tr>
<td>Chile (2013)</td>
<td>2.0</td>
<td>93.3</td>
</tr>
<tr>
<td>Ecuador (2011–2012)</td>
<td>1.1</td>
<td>277.8</td>
</tr>
<tr>
<td>Mexico (2012)</td>
<td>227.7</td>
<td>1446.5</td>
</tr>
<tr>
<td>Peru (2011)</td>
<td>53.7</td>
<td>177.0</td>
</tr>
<tr>
<td>Russia (2010)</td>
<td>84.9</td>
<td>1561.4</td>
</tr>
<tr>
<td>South Africa (2010–2011)</td>
<td>186.6</td>
<td>5964.0</td>
</tr>
<tr>
<td>Tunisia (2010)</td>
<td>20.8</td>
<td>52.0</td>
</tr>
</tbody>
</table>

| Armenia (2011)        | 6.3  | 179.3 | 5.3  | 0.44 | 8.17 | −7.74 |
| Bolivia (2009)        | 25.9 | 32.2  | 80.6 | 0.55 | 0.68 | −0.13 |
| Dominican Republic (2007) | 4.4  | 105.1 | 4.2  | 0.02 | 0.53 | −0.51 |
| El Salvador (2011)    | 1.2  | 11.1  | 11.1 | 0.04 | 0.39 | −0.35 |
| Ethiopia (2010–2011)  | 408.9| 392.8 | 104.1| 1.18 | 1.13 | 0.05 |
| Ghana (2013)          | 25.9 | 9.9   | 262.1| 0.22 | 0.08 | 0.13 |
| Guatemala (2010)      | 20.7 | 37.8  | 54.9 | 0.33 | 0.61 | −0.27 |
| Indonesia (2012)      | 150.2| 3315.3| 28.3 | 0.13 | 0.47 | −0.34 |
| Sri Lanka (2009–2010) | 4.4  | 25.5  | 17.1 | 0.05 | 0.27 | −0.23 |

Sources: For Brazil, authors’ calculations. For other countries, provided to us by the authors of the studies cited in Footnote 1. Notes: p.p. = percentage points. z denotes the poverty line. “$ millions” denotes millions of 2005 US dollars, at purchasing power parity adjusted exchange rates. Country classifications are from the World Bank for the year of the survey.

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16 Nevertheless, the tax and transfer system reduces poverty by less than its potential under the type of optimal redistribution considered by Fellman et al. (1999), which follows a lexicographic maximin principle. Replacing the actual tax system with optimal taxes of this type (which, in total, equal the size of actual taxes), and replacing the actual distribution of Bolsa Familia benefits with the optimal one (redistributing all transfers this way would completely eliminate poverty, so we only optimally redistribute Bolsa Familia for illustration), the lowest income in the population would be $1.92 per day, the post-fisc poverty gap ratio would be 2.6% of the poverty line rather than 5.5%, and the post-fisc Gini would be 45.3 rather than 53.9.

17 We verify that this first order dominance is statistically significant at the 5% level using the asymptotic sampling distribution derived by Davidson and Duclos (2000) with a null hypothesis of non-dominance; the result is also robust to the type of data contamination considered in Cowell and Victoria-Pe˜ser (2002).
that FI occurred using conventional measures and a poverty line above $3 per day, but would still be unaware of its extent without FI measures. Using the $2.50 line, we know that 5.6% of Brazil’s population and over one-third of its post-fisc poor experience FI (Table 2); these impoverished individuals pay a total of $676 million more in taxes than they receive in transfers annually (Table 3), which is equivalent to 10% of the 2009 budget of Bolsa Família, Brazil’s flagship anti-poverty program that reaches over one-fourth of the country’s population. While substantial in size, this FI is dwarfed by FGP from Brazil’s transfer programs, which totals over $3.5 billion. The absolute poverty gap gap, or the minimum amount that would need to be transferred to the poor to eliminate poverty if transfers were perfectly targeted, falls from $12.4 billion before taxes and transfers to $9.6 billion after. The change in the absolute poverty gap, $2.8 billion, looks impressive, but masks differential trends in two groups of the poor: those who gain (a total of $3.5 billion) and those who lose (a total of $676 million), as revealed by the decomposition of the change in the poverty gap derived in Section 4.

Fig. 3 shows how this decomposition and our axiomatic measures of total FI and FGP in Brazil vary with the poverty line. For low poverty lines, FI is essentially non-existent: at $1.25 per day, for example, total FI is $28 million per year, or 0.4% of the 2009 budget of Bolsa Familia (Fig. 3a). This is not surprising in light of the unconditional component of the government cash transfer program Bolsa Familia, available to households with income below 70 reais per person per month ($1.22 per day), regardless of whether the household has children or elderly members, and without conditions. At higher poverty lines, FI begins to increase more rapidly, and at a poverty line of $2.88 the rate of increase of FI exceeds the rate of increase of FGP: this can be seen by comparing the slopes of the solid curves in Fig. 3a, or by looking at the point where the difference between the two curves (plotted as the dashed curve in Fig. 3a) is at its maximum. By Proposition 4, this is also the point at which the absolute poverty gap reduction achieved by the fiscal system reaches its maximum, as seen by the dashed curve in Fig. 3b.

At this poverty line of $2.88 per day, where maximum poverty reduction is achieved, the difference between the pre-fisc and post-fisc poverty gaps is $2.9 billion. The eligibility cut-off for the conditional component of Bolsa Familia, available to families with children who comply with certain education and health requirements, is $2.45 per person per day. Just above this line, a number of families still receive benefits due to program leakages, variable and mismeasured income, or components of income we are measuring that are not taken into account in the estimation of eligible income; not far above this line, however, families become much less likely to receive the program and we see a simultaneous deceleration of fiscal gains and acceleration of impoverishment.

6. Conclusions

Anti-poverty policies are increasingly being discussed in the same breath as the taxes used to pay for them. One example is the focus on mobilizing domestic resources to finance the policies necessary to achieve the United Nations’ Post-2015 Sustainable Development Goals. To analyze transfers, subsidies, and taxes together, poverty comparisons and progressivity measures are often used. These measures, however, can lead us to conclude that the tax and transfer system unambiguously benefits the poor, when in fact a substantial number of poor are not compensated with transfers for their tax burdens. Indeed, we observe this in a number of developing countries: out of seventeen developing countries for which we have data, fifteen have tax and transfer systems that unambiguously reduce poverty and are globally progressive, but in ten of these at least one-quarter of the poor pay more in taxes than they receive in transfers and subsidies. In Brazil, for example, over one-third of the post-fisc poor experience fiscal impoverishment, paying a total of $676 million more in taxes than they receive in transfers and subsidies.

Given this shortcoming of conventional criteria and the debate about anti-poverty policies and the taxes used to pay for them, we propose a set of axioms that should be met by a measure of FI, and show that these uniquely determine the measure up to a proportional transformation. We also propose a partial ordering to determine when one fiscal system, such as that under a proposed reform, induces unambiguously less FI than another, such as the current system, over a range of possible poverty lines. To obtain a complete picture of the fiscal system’s effect on the poor, we propose an analogous measure of fiscal gains of the poor, and show that the difference between the pre-fisc and post-fisc poverty gaps can be decomposed into our axiomatic measures of FI and FGP.

Our results can be extended to comparisons between two points in time or before and after a policy reform, rather than pre- and
post-fisc. In comparison to the tools used to assess whether the tax and transfer system hurts the poor, tools from the literatures on pro-poor growth and policy reforms (tax and subsidy reforms, trade liberalization, etc.) suffer from similar limitations. For pro-poor growth,\(^\text{19}\) poverty measures and stochastic dominance tests are often used to assess whether poverty is unambiguously reduced over time; it directly follows from the first row of Table 1 that these will not necessarily capture that some of the poor become poorer over time. Hence, growth can appear unambiguously pro-poor even if a significant proportion of the poor are immiserized. Growth incidence curves (Ravallion and Chen, 2003) and related pro-poor partial orderings (Duclos, 2009) cannot fail to capture impoverishment for the same reason that stochastic dominance tests do: they are anonymous with respect to initial income. Although their non-anonymous counterparts (Bourguignon, 2011a, Grimm, 2007, Van Kerm, 2009) resolve this issue in theory, in practice—to become graphically tractable—they average within percentiles, and hence impoverishment can still be overlooked if within some percentiles, some poor are “hurting behind the averages” (Ravallion, 2001, p. 1811).

For consumption tax and subsidy reform, Besley and Kanbur (1988) derive poverty-reducing conditions for reallocating food subsidies; these results are extended to commodity taxes and a broader class of poverty measures by Makdissi and Wodon (2002) and Duclos et al. (2008). Again, by the first row of Table 1, unambiguous poverty reduction does not guarantee that a substantial portion of the poor are not hurt by the reform. Studies that evaluate indirect poverty reduction does not guarantee that a substantial portion of the poor are not hurt by the reform. Studies that evaluate indirect poverty measures and stochastic dominance tests over time or the extent to which losers are hurt by policy reforms. Our decomposition could be used to examine the extent to which a decrease in poverty over time or due to a reform balances out the gains and losses of different households. Doing so, we will cease to overlook cases where growth, policy reform, or the tax and transfer system is poverty-reducing and progressive, yet hurts a substantial proportion of the poor.

![Fig. 3. FI, FGP, and poverty gaps in Brazil for various poverty lines. Note: Dashed vertical lines included at common “international” poverty lines of $1.25 and $2.50 per person per day.](image)

**Fig. 3.** FI, FGP, and poverty gaps in Brazil for various poverty lines. Note: Dashed vertical lines included at common “international” poverty lines of $1.25 and $2.50 per person per day.

**Acknowledgments**

For detailed comments on earlier versions of the paper, we are grateful to Francesco Andreoli, Alan Barreca, Jean-Yves Duclos, John Edwards, Charles Kenny, Peter Lambert, Darryl McLeod, Mauricio Reis, Kathleen Short, Rafael Salas, Jay Shimshack, Harry Tsang, Paolo Verme, two anonymous referees, and Maitreesh Gathak, the Editor. We are also grateful to Karim Araar, Abhijit Banerjee, Francois Bourguignon, Satya Chakravarty, Nachiketa Chattopadhyay, Chico Ferreira, Gary Fields, James Foster, Ravi Kanbur, Doug Nelson, Jukka Pirttilä, John Roemer, Jon Rothbaum, and Shlomo Yitzhaki for their useful feedback. For applying our measures to microdata in a number of developing countries and sharing the results with us for this paper, we are grateful to the many country study authors we cite in the paper. We thank Claudiney Pereira for collaboration on the analysis of Brazilian data and Ruoxi Li, Sandra Martinez-Aguilar, Adam Ratzlaff, Mel Reitcheck, and William Smith for research assistance. Work on this project was partially completed when S. Higgins was a visiting Haas School of Business at UC Berkeley and the Center for Economic Studies at El Colegio de México with funding from the Fulbright–Garcia Robles Public Policy Initiative. This paper is part of a larger project that received funding from the Bill & Melinda Gates Foundation (grant numbers OPP1097490 and OPP1335502). These institutions and funders are gratefully acknowledged.

\(^{19}\) Here, we are using the poverty-reducing or weak absolute definition of pro-poor (in the respective taxonomies of Kakwani and Son (2008) and Klasen (2008)), by which “growth is pro-poor if the poverty measure of interest falls” (Kraay, 2006, p. 198). We could instead adopt a relative definition of pro-poor growth (Kakwani and Pernia, 2000); growth-adjusted stochastic dominance tests can be used to determine when growth is unambiguously relatively pro-poor (Duclos, 2009), and it can be shown that this type of dominance can also occur despite a significant portion of the poor becoming poorer.
A.3. Proofs

**Proof of Proposition 1.** We begin with a lemma analogous to one of the propositions in Foster and Shorrocks (1991). To simplify notation, \( x_0 \equiv (y_0^1, y_0^2) \) for a subset \( S_0 \) of a partition of \( S \) into \( m \) subgroups \( a = 1, \ldots, m \); similarly, \( x_a \equiv (x_a^1, x_a^2) \). We also define vectors \( y_{0a} \equiv (y_0^1, y_0^2) \), \( x_{0a} \equiv (x_0^1, x_0^2) \), and \( x_{0a} \equiv (x_0^1, x_0^2) \). □

**Lemma 1.** \( f(x_a, y_{a-1}; z) \geq f(x_a, y_{a-1}; z) \Rightarrow f(x_a, y_{a-1}; z) \geq f(x_a, x_{a-1}; z) \).

**Proof.** By subgroup consistency, \( f(x_a, y_{a-1}; z) \geq f(x_a, y_{a-1}; z) \Rightarrow f(x_a, y_{a-1}; z) \geq f(x_a, z; z) \). (Suppose not. Then \( f(x_a, y_{a-1}; z) \), which by subgroup consistency implies \( f(x_a, y_{a-1}; z) \geq f(x_a, y_{a-1}; z) \), a contradiction.) \( f(x_a, y_{a-1}; z) \geq f(x_a, z; z) \) implies either \( f(x_a, y_{a-1}; z) \geq f(x_a, z; z) \). In the former case, it immediately follows by subgroup consistency that \( f(x_a, y_{a-1}; z) \geq f(x_a, x_{a-1}; z) \). In the latter case, the implication is shown by contradiction. Suppose that \( f(x_a, x_{a-1}; z) < f(x_a, z; z) \). Then by subgroup consistency we have \( f(x_a, y_{a-1}; z) = f(x_a, z; z) \) \( f(x_a, x_{a-1}; z) < f(x_a, x_{a-1}; z) \), which contradicts permutability. □

This lemma shows that a subgroup-consistent and permutable measure of FL is separable by group, using a definition of separability analogous to that used for preferences in the utility literature. Because the lemma can be reiterated within any particular subgroup to further separate individuals in that subgroup, we have that each set of individuals is separable (which is analogous to the “each set of sectors is separable” requirement in Gorman (1968, p. 368)). Hence, from Debreu (1960, Theorem 3), there exists a continuous FL function determined up to an increasing linear transformation of the form

\[
\phi(y_0, y_1; z) = \alpha + \beta \sum_{i=1}^{m} \phi_i(y_i^0, y_i^1; z)
\]

where \( \phi_i \) is a real-valued function for each \( i \in S \). The additional requirement for Debreu’s (1960) proof that more than two of the \( S \) elements of \( S \) are essential is satisfied as long as \( |S| \geq 3 \) and \( f \) is non-constant on \([0, z]\), which in turn is implied by monotonicity as long as at least one individual is impoverished.\(^{20}\)

Permutability implies that \( \phi_i = \phi_j \) for all \( i, j \in S \), so we have \( f(y_0^1, y_1^1; z) = \alpha + \beta \sum \phi(y_i^0, y_i^1; z) \). By the focus and normalization axioms:

\[
\phi(y_i^0, y_i^1; z) = \begin{cases} 
\phi(y_i^0, y_i^1, z) & \text{if } y_i^0 < y_i^1 \text{ and } y_i^1 < z \\
0 & \text{otherwise}
\end{cases}
\]

By the continuity of \( f, \phi, \text{ and } \phi \) must also be continuous. Consider an individual with \( y_0^1 > y_1^1 \). Since all \( y_i^1 \) is not less than \( z, \phi \) is not impermissible, so by Eq. (4), \( \phi(y^0, y^1, z) = 0 \). Now consider an alternative situation where \( y_i^1 = z \) for a sufficiently small \( \epsilon > 0 \). In this scenario, \( \phi \) cannot be a direct function of \( y_i^1 \) or \( \phi \) would be discontinuous at \( z \); instead, \( \phi \) must be a direct function of just \( y_i^1 \) and \( z \) so that an infinitesimal decrease in \( y_i^1 \) below \( z \) results in an infinitesimal increase in \( \phi \). By a similar argument, for an individual with \( y_0^1 < z, y_1^1 = y_0^1 \), and \( y_1^1 = y_0^1 - \epsilon, \phi \) cannot be a direct function of \( z \) and instead must directly depend only on \( y_0^1 \) and \( y_1^1 \) so that an infinitesimal decrease in \( y_1^1 \) below \( y_1^1 < z \) results in an infinitesimal increase in \( \phi \).

\(^{20}\) The assumptions of at least three individuals in society and at least one impoverished individual are innocuous for any real-world application.
Given this, we can rewrite $\tilde{\phi}(y^0, y^1, z) = \phi\left(\min\{y^0, z\}, \min\{y^0, y^1, z\}\right)$. Since $\phi$ is only defined for those who are impoverished (i.e., those for whom $\min\{y^0, y^1, z\} = y^1$), we have

$$\phi(y^0, y^1, z) = \phi\left(\min\{y^0, z\}, \min\{y^0, y^1, z\}\right)$$

and integrating over our domain,

$$\phi(y^0, y^1, z) = \left\{\begin{array}{ll}
\min\{y^0, z\} - \min\{y^0, y^1, z\} & \text{if } i \not\in b_y \\
0 & \text{otherwise.}
\end{array}\right.$$

Proof of Proposition 2. (a) follows immediately from Proposition 1. For (b) =⇒ (c), we begin by defining Foster and Rothbaum’s (2014) second order downward mobility dominance.

**Definition 1.** $(\phi^0, \phi^1)$ second order downward mobility dominates $(\phi^0, \phi^1)$ on $[0, z^+]$ if

$$\int_0^z m(y^0, y^1, c) \, dc < \int_0^z m(x^0, x^1, c) \, dc \quad \forall z \in [0, z^+]$$

where $m(y^0, y^1, z) = |S|^{-1}\sum_{i \in S} (y^1_i - z < y^0_i)$ is Foster and Rothbaum’s (2014) downward mobility curve, measuring the proportion of the population that begins with income below a poverty line and ends with income below the line.

A sufficient condition for (b) being equivalent to (c) is $f(y^0, y^1, z) \propto \int_0^z m(y^0, y^1, c) \, dc$. For a given poverty line $z$, partition the set $S$ into four subsets: $S_1 = \{i \in S | y^0_i < y^1_i < z\}$, $S_2 = \{i \in S | y^0_i < z \leq y^1_i\}$, $S_3 = \{i \in S | y^0_i \geq z \geq y^1_i\}$, $S_4 = \{i \in S | y^0_i < z < y^1_i\}$. For any subset $S_a \subset S$, denote $F_a(z) = \kappa \sum_{i \in S_a} \min\{y^0_i, z\} - \min\{y^0_i, y^1_i, z\}$ and $m_a(z) = |S|^{-1}\sum_{i \in S_a} \min\{y^0_i, z\}$. Each $i \in S_1$ experiences downward mobility on the interval $[0, z]$ for all $z \in (y^0_i, y^1_i)$ if individual $i \in S_1$ increases $m_i(z, c)$ by $|S|^{-1}$ for $z \in (y^0_i, y^1_i)$ and by zero for $z \leq y^0_i$ and $z \geq y^1_i$. Each $i \in S_2$ increases $\int_0^z m_i(z, c) \, dc$ by $|S|^{-1}(y^0_i - y^1_i)$, summing over all $i \in S_2$ and integrating over our domain, we have

$$f_1(\ldots, z) = \kappa |S| \int_0^z m_i(\cdot, c) \, dc.$$

Each $i \in S_2$ experiences downward mobility on the interval $[0, z]$ for all $z \in (y^1_i, z)$, which increases $m_i(\cdot, z)$ by $|S|^{-1}$ for $z \in (y^1_i, z)$ and by zero for all $z \Rightarrow \text{individual } i \in S_2$ increases $\int_0^z m_i(\cdot, c) \, dc$ by $|S|^{-1}(y^0_i - y^1_i)$. Summing over all $i \in S_2$, $\int_0^z m_i(\cdot, c) \, dc = \sum_{i \in S_2} |S|^{-1}(y^0_i - y^1_i)$}

where Eq. (6) follows from translation invariance and Eq. (7) from linearity homogeneity. Noting that $\phi(1, 0)$ is a constant (that is positive by monotonicity) and denoting it $\gamma$, we have

$$\phi(y^0, y^1, z) = \left\{\begin{array}{ll}
\min\{y^0, z\} - \min\{y^0, y^1, z\} \gamma & \text{if } i \not\in b_y \\
0 & \text{otherwise.}
\end{array}\right.$$

Each $i \in S_3$ does not experience downward mobility on the interval $[0, z]$; summing over all $i \in S_3$ and integrating over our domain, we have $\int_0^z m_i(\cdot, c) \, dc = 0$. Hence, by Eqs. (8)-(11),

$$f_2(\ldots, z) = \kappa |S| \int_0^z m_i(\cdot, c) \, dc.$$

Similarly, $\int_0^z m_i(\cdot, c) \, dc = 0$ because each $i \in S_4$ does not experience downward mobility on $[0, z]$ and $y^0_i < z$ and $y^1_i \leq y^1_i \Rightarrow \text{individual } i \in S_4$.

Proof of Proposition 3. Analogous to the proof of Proposition 1 for $\mathcal{F}_i$.

Proof of Proposition 4. Given in text.

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1. Introduction

As indicated in chapter 1, the Commitment to Equity (CEQ) Assessments are produced by applying standard fiscal incidence analysis to address the following four main questions:

--How much income redistribution and poverty reduction is being accomplished in each country through the fiscal system (taxes, social spending, and subsidies)?

--How equalizing and pro-poor are specific taxes and government spending?

--How effective are taxes and government spending in reducing inequality and poverty?

--What is the impact of fiscal reforms that change the size and progressivity of a particular tax or spending program?

The core building block of comprehensive fiscal incidence analysis is the construction of income concepts. Starting from prefiscal income, or what we call market income, the construction of income concepts refers to the method of allocating the burden of taxes and the benefits of government spending to each household. For example, disposable income is constructed by subtracting direct personal income taxes and adding cash

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† Lustig and Higgins (chapter 1 in this Handbook).
transfers to a household’s market income. Although this procedure may sound very simple, allocating taxes and transfers to households is among the most—if not the most—challenging tasks of fiscal incidence analysis. Because results can be significantly affected by the allocation methods, it is essential to carefully document all the assumptions made in the allocation process and carry out sensitivity analyses to assess the implications of such assumptions.

The construction of income concepts entails five main steps. The first step is to obtain access to a recent household survey (ideally, an income expenditure survey) for the country of interest. The second step is to obtain budget data from administrative registries (for example, revenues collected by tax category, spending on cash transfers, subsidies, education, health, and housing, and so on) for the same year of the survey. The third step is to select which components of government revenue and spending will be included in the incidence analysis, and obtain detailed information on the qualitative and quantitative characteristics of the selected fiscal interventions. The fourth step is to allocate these fiscal interventions at the household level. By dividing income by the number of household members (or using an equivalence scale), taxes and transfers become allocated at the individual level. Once the allocation process is complete, the fifth step is to construct the income concepts which will be used to assess the impact of fiscal policy on the distribution of income and poverty as well as the contribution of each fiscal intervention to the fiscal policy-induced changes in inequality and poverty.

This chapter describes how to construct the income concepts and how to complete sections A, B, and C of the CEQ Master Workbook (MWB) (available in the online Appendix). The chapter is organized as follows: section 2 describes the MWB. It also describes the data requirements and methodological assumptions that one needs to make in the treatment of, especially, the micro data from household surveys; and, section 2 explains how to complete section B of the MWB. Section 3 explains the income concepts. Sections 4 and 5 explain how to construct the income concepts, describing the methods used to allocate various fiscal interventions to particular households in microdata from household surveys. In other words, these sections provide information on the process by which taxes, subsidies and transfers are allocated to each household to assess how incomes—and, thus, inequality and poverty indicators—change with fiscal policy. It also explains how to construct the “income” concepts for surveys that include only consumption. Section 6 explains how to complete section C of the MWB which includes a detailed description of the methodologies used to construct each income concept and a summary of key assumptions made by the team in the process.

2. The CEQ Master Workbook

The CEQ MWB is a multi-sheet excel file that houses detailed information on the country’s economic, political, and social context, description of microdata, the country’s fiscal system and the results of the fiscal incidence analysis used as inputs for policy discussions, academic papers and policy reports. The MWB consists of six sections: section A. Country Context, section B. Data, section C. Methodology, section D. Summary of Results, section E. Output Tables, and section F. Compendium of Results by Ethnicity and Race. This chapter focuses on sections A, B, and C. These sections are meant to be filled by the team with information obtained from the household survey, administrative sources, and the methodological assumptions used to estimate the incidence of taxes and public spending. The order of the sections has been chosen having the user of the CEQ exercise in mind. Producers
of a CEQ Assessment should start with section B, the data and information required to implement an assessment. A CEQ Assessment producer can complete section A at the end.

Section A. Country Context, contains information on the country’s context such as the macroeconomic, political and socio-economic context, as well as the evolution of inequality and poverty over time. It also includes information on whether the country experienced a natural disaster, civil strife, or a financial crisis, and whether there was an election or any other special situation that could have affected fiscal policy on the year of the analysis. Section B. Data includes a description of the microdata and the fiscal data utilized in the fiscal incidence analysis. On the microdata, section B includes a detailed description of the survey/s being used to conduct the analysis such as sample size, coverage, and questionnaire, including, for example, the exact survey questions used to construct each component of the income concepts. In the fiscal data section, the team needs to compile the budget information from administrative registries and summarize the characteristics of the fiscal interventions (such as direct taxes, consumption taxes, excise taxes, cash transfers, subsidies, and in-kind transfers) that will be included in the analysis. Section C. Methodology presents the methodology followed to construct the income concepts and key assumptions made in the allocation process, and compares survey-based totals with those from administrative registries for validation purposes.

To produce a comprehensive CEQ Assessment, one must have access to microdata from a recent household survey, government budget data from fiscal accounts, and a detailed description of the characteristics of fiscal policy instruments that will be included in the analysis. The information on the microdata, budget, and components of the fiscal system are saved in section B of the the MWB in sections B1-B2, B3, and B4-B12, respectively.

We will start with sheets B1 and B2 and subsequently proceed to sheets B3, and sheets B4-B12.

The Microdata: Description of the Household Survey and Data Harmonization Assumptions

The available household survey should have, ideally, information on both income and consumption. Since surveys frequently include just one of the two, we will discuss how to adapt the CEQ methodology in order to cope with this limitation. The characteristics of the household survey used in the analysis should be documented in Sheets B1 and B2 of section B of the CEQ MWB. Here the researcher will provide details of the household survey such as name, year, sample size, geographic coverage, recall period, and which income, consumption, and fiscal policy variables are included in the survey (sheet B1). To assess cross-country and over time comparability, the researcher should document the specific wording used to retrieve some key variables in the survey questionnaire (Sheet B2). Tables 5-1 and 5-2 show the contents of sheets B1 and B2, respectively.

Table 5-1: Sheet B1 of Master Workbook: General Survey Information

<p>| Country: |  |</p>
<table>
<thead>
<tr>
<th>Survey information</th>
<th>Year:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey name</td>
<td></td>
</tr>
<tr>
<td>Acronym</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td></td>
</tr>
<tr>
<td>Link to Microdata</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td></td>
</tr>
<tr>
<td>Coverage (for example, national or urban only)</td>
<td></td>
</tr>
<tr>
<td>Representative at…</td>
<td></td>
</tr>
<tr>
<td>Nonresponse rate</td>
<td></td>
</tr>
</tbody>
</table>

**Data on Income and Consumption**

<table>
<thead>
<tr>
<th>Does the survey contain both income and consumption data?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption or income based analysis?</td>
<td></td>
</tr>
<tr>
<td>Which of the following labour market components are included in the survey?</td>
<td></td>
</tr>
<tr>
<td>Labour income: wages, salary, self-employment income, commission, tips, vacation pay, overtime bonuses, fringe benefits</td>
<td></td>
</tr>
<tr>
<td>Business income: non-farm and farm income</td>
<td></td>
</tr>
<tr>
<td>Retirement income</td>
<td></td>
</tr>
<tr>
<td>Corporate income: interest, dividends</td>
<td></td>
</tr>
<tr>
<td>Gross property income</td>
<td></td>
</tr>
<tr>
<td>Contributory pensions (included in market income in contributory pensions as deferred income scenario) - old-age pensions, survivor's benefits, disability</td>
<td></td>
</tr>
<tr>
<td>Private pensions</td>
<td></td>
</tr>
<tr>
<td>Remittances</td>
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<td>-----------------------------</td>
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</tr>
<tr>
<td>Alimony received</td>
<td></td>
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<tr>
<td>Child support received</td>
<td></td>
</tr>
<tr>
<td>Other private transfers</td>
<td></td>
</tr>
<tr>
<td>Are both payments in cash and payments in kind accounted for in the survey?</td>
<td></td>
</tr>
<tr>
<td>Are the total amounts of national income coming from each of the above sources available in national accounts or administrative data?</td>
<td></td>
</tr>
<tr>
<td>What is the recall period for consumption?</td>
<td></td>
</tr>
<tr>
<td>Does the survey’s consumption data include a question about how each good was obtained, with one of the options being produced for own consumption?</td>
<td></td>
</tr>
<tr>
<td>If not, is there a question about the value of goods produced for own consumption?</td>
<td></td>
</tr>
<tr>
<td>If not, how will auto-consumption be estimated?</td>
<td></td>
</tr>
<tr>
<td>Does the survey include a question for home owners about the estimated rental value of their home such as “If you were renting out this home, how much you would charge?” or “If you were renting this home, how much would you expect to pay?</td>
<td></td>
</tr>
<tr>
<td>Does the survey include a question for home owners about the estimated rental value of their home such as “If you were renting out this home, how much you would charge?” or “If you were renting this home, how much would you expect to pay?</td>
<td></td>
</tr>
<tr>
<td>If so, please comment on the reliability of these estimates.</td>
<td></td>
</tr>
</tbody>
</table>
If not, does the survey ask renters how much they pay in rent per month? If so, what other variables could be used in a regression to predict rental values for owner occupiers?

<table>
<thead>
<tr>
<th>Definition of Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit of Analysis (Individuals/Households)</td>
</tr>
<tr>
<td>Treatment of Missing or Zero Incomes</td>
</tr>
<tr>
<td>Treatment of Top Coding</td>
</tr>
<tr>
<td>Treatment of Outliers and Extreme Values</td>
</tr>
<tr>
<td>Are corrections made for under-reporting/under-sampling for top incomes? Explain.</td>
</tr>
<tr>
<td>Are there adjustments made for Adult Equivalence or Economies of Scale within households? If yes, describe the scale used.</td>
</tr>
<tr>
<td>Are there adjustments made for spatial prices? If yes, describe the adjustments.</td>
</tr>
<tr>
<td>Are the income variables expressed in annual terms? Describe the main assumptions that are used to annualize.</td>
</tr>
</tbody>
</table>

**Subsidized Pensions**

| Contributory pensions programs included: |
| Portion of pensions that are subsidized: |
| Source of estimations: |

**Direct Taxes and Contributions**

<p>| Are wages and salaries reported gross of tax or net of tax? |
| Is revenue collection primarily carried out by the federal/central government, or are state/provincial and municipal taxes important in the assessed country as well? |</p>
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>What direct taxes exist in the assessed country?</td>
<td></td>
</tr>
<tr>
<td>Potential direct taxes include:</td>
<td></td>
</tr>
<tr>
<td>Individual income taxes paid by employee</td>
<td></td>
</tr>
<tr>
<td>Individual income taxes paid by employer</td>
<td></td>
</tr>
<tr>
<td>Payroll taxes</td>
<td></td>
</tr>
<tr>
<td>Corporate income taxes</td>
<td></td>
</tr>
<tr>
<td>Property taxes</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
<tr>
<td>Which of the above direct taxes are included in the survey?</td>
<td></td>
</tr>
<tr>
<td>Of those that are not, which can be inferred/imputed/simulated? See the methods described in chapter 5 in this Handbook. Which method will be used?</td>
<td></td>
</tr>
<tr>
<td>How prevalent is informality and tax evasion in the assessed country?</td>
<td></td>
</tr>
<tr>
<td>For the direct taxes that are not taken from the survey, what questions in the survey can be used to help identify which workers most likely worked in the informal sector or evaded direct taxes?</td>
<td></td>
</tr>
<tr>
<td>Are total amounts of revenue collected from each of these taxes available in national accounts or administrative data?</td>
<td></td>
</tr>
<tr>
<td>How is taxable income defined?</td>
<td></td>
</tr>
<tr>
<td>Do these totals include revenues at the federal/central government level only, or at the state/provincial and municipal levels as well?</td>
<td></td>
</tr>
<tr>
<td>What public contributions exist in the assessed country?</td>
<td></td>
</tr>
<tr>
<td>Potential contributions include:</td>
<td></td>
</tr>
<tr>
<td>Contributions to the contributory pension system</td>
<td></td>
</tr>
<tr>
<td>Contributions to the contributory public health insurance system</td>
<td></td>
</tr>
</tbody>
</table>
### Contributions to publicly-run unemployment insurance systems, et cetera

### Other contributions

Which of the above contributions are included in the survey?

If included in the survey, are contributions to the contributory pension system contained in a separate question from the other types of contributions?

Are social contributions paid by employers included?

Of those that are not included, which can be inferred/imputed/simulated? See the methods described in chapter 5 in this Handbook. Which method will be used?

Are total amounts collected from each of these contributions available in national accounts or administrative data?

Is alternate assumption used regarding compliance/evasion on social security contributions?

---

**Direct Transfers**

Do the following direct transfers exist in the assessed country?

- Non-contributory pension programs
- Conditional cash transfer programs
- Unconditional cash transfer/minimum income programs
- Unemployment benefits
- Cash transfers to farmers
- Publicly funded scholarships
<table>
<thead>
<tr>
<th>Other government cash transfers/welfare assistance programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food transfers</td>
</tr>
<tr>
<td>School lunch programs</td>
</tr>
<tr>
<td>Other food/nutrition programs</td>
</tr>
</tbody>
</table>

Which of the above direct transfers are included in the survey?

Of those that are not included in the survey, which can be inferred/imputed/simulated? See the methods in Lustig and Higgins (2017). Which method will be used?

Are total benefits paid by the program (not total spending including administrative costs) available in national accounts or administrative data?

If not, is total spending (including administrative costs) available in national accounts or administrative data? Are estimates of the size of administrative costs of the program available, either from the government or from secondary sources?

Are cash transfer programs mainly administered by the federal/central government, or are cash transfers at the state/provincial and municipal levels important as well?

Are some methods to correct for under/over estimation of beneficiaries of direct transfers applied? If yes, explain.

### Indirect Subsidies

Which of the following consumption items are subsidized (for at least a subset of the population) in the assessed country?

- Fuel: gasoline, diesel, natural gas
- Electricity
<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td></td>
</tr>
<tr>
<td>Farming inputs</td>
<td></td>
</tr>
<tr>
<td>Interest rates for farmers</td>
<td></td>
</tr>
<tr>
<td>Other agricultural subsidies</td>
<td></td>
</tr>
</tbody>
</table>

For each of the subsidies in the assessed country, who is eligible to receive the subsidy?

Is the total spent on each of these subsidies available in national accounts or administrative data?

Does the survey contain the consumption data necessary to impute recipients of the subsidy and how much they received?

If fuel subsidies are important, is there an input-output matrix available for the assessed country?

If utility (water, electricity, communication, transport) subsidies are important, are the tariff structures available?

If not, is it possible to impute/simulate the benefit in some other way?

### Indirect Taxes

Is the total amount collected from indirect taxes available in national accounts or administrative data?

How prevalent is evasion of indirect taxes in your country?
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>How does evasion of indirect taxes differ between rural and urban areas?</td>
<td></td>
</tr>
<tr>
<td>Does the survey include consumption data to impute indirect taxes?</td>
<td></td>
</tr>
<tr>
<td>If so, does each item consumed include a question about the place of purchase (for example, supermarket, farmer’s market, flea market, etcetera)?</td>
<td></td>
</tr>
<tr>
<td>If each item does not include a question about place of purchase, is there a general question about the place where the individual/household normally shops?</td>
<td></td>
</tr>
<tr>
<td>If neither of these is available, how will evasion be incorporated into the analysis?</td>
<td></td>
</tr>
<tr>
<td>Is the total amount collected from indirect taxes available in national accounts or administrative data?</td>
<td></td>
</tr>
<tr>
<td>If not, is a secondary source available that has estimated the incidence of indirect taxes, for example by market or disposable income decile?</td>
<td></td>
</tr>
<tr>
<td>If a secondary source is used to estimate incidence of indirect taxes, explain which methodology is adopted.</td>
<td></td>
</tr>
<tr>
<td>Does the assessed country have a recent input-output table? Provide year.</td>
<td></td>
</tr>
<tr>
<td>If the answer to the question above was yes, provide source and link if available.</td>
<td></td>
</tr>
<tr>
<td>Are there estimates made for tax expenditures?</td>
<td></td>
</tr>
<tr>
<td><strong>In-Kind Education</strong></td>
<td></td>
</tr>
<tr>
<td>Does the government provide free public education in the country?</td>
<td></td>
</tr>
<tr>
<td>Are there user fees (direct or indirect in the form of required uniforms and school supplies)?</td>
<td></td>
</tr>
</tbody>
</table>
Does partially-subsidized education exist in the assessed country?

Does free or partially subsidized pre-school exist in the assessed country?

Does free or partially subsidized tertiary education exist in the assessed country?

For those attending school, does the survey include a question specifying what type of school they attend (public, partially subsidized, private)?

Is the amount of public spending per student available?

Can this data be disaggregated by education level (pre-school, primary, lower secondary, upper secondary, tertiary)?

Can this data be disaggregated by sub-national regions for which the survey is representative (for example, spending per student by level in each state, where the survey is representative at the state level)?

**In-Kind Health**

Does the government provide free public health services in the country?

Are there user fees?

Who is eligible to receive services?

What services are covered?

Do certain facilities offer health services that are partially subsidized by the government?

Does a public health insurance scheme exist in the country?

If so, explain how the scheme operates.

Does the survey include questions about the use of public health services? Specifically:
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>What type of service was received?</td>
<td></td>
</tr>
<tr>
<td>What type of facility provided the service (free/fully public, partially subsidized, private)?</td>
<td></td>
</tr>
<tr>
<td>How many visits were made during the recall period?</td>
<td></td>
</tr>
<tr>
<td>Whether the patient paid any expenses out of pocket, and if so how much</td>
<td></td>
</tr>
<tr>
<td>What is the recall period for the use of health facilities?</td>
<td></td>
</tr>
<tr>
<td>Is the amount of public spending on health services available?</td>
<td></td>
</tr>
<tr>
<td>Can spending on fully public facilities and partially subsidized facilities be distinguished (where applicable)?</td>
<td></td>
</tr>
<tr>
<td>Can spending be disaggregated by type of service received (for example, primary care, in-patient care, and preventative care)?</td>
<td></td>
</tr>
<tr>
<td>Can spending be disaggregated by sub-national regions for which the survey is representative (for example, spending by level in each state, where the survey is representative at the state level)?</td>
<td></td>
</tr>
<tr>
<td>Is the amount of user fees collected from public health facilities available?</td>
<td></td>
</tr>
<tr>
<td>Is there a question on the survey indicating who is covered by the public health insurance scheme?</td>
<td></td>
</tr>
<tr>
<td>If a secondary source is used to estimate incidence of health spending, explain which methodology is adopted.</td>
<td></td>
</tr>
</tbody>
</table>

**Housing Subsidies**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the government subsidize housing?</td>
<td></td>
</tr>
<tr>
<td>Who is eligible to receive government-subsidized housing?</td>
<td></td>
</tr>
</tbody>
</table>
Is the total spent on each of subsidized housing available in national accounts or administrative data?

Does the survey include a question on who receives housing subsidies?

If not, is it possible to impute/simulate the benefit? See the methods described in chapter 5 in this Handbook.

Other Information

Location (urban/rural)

Data on Race and ethnicity

Is the year of the survey the same as the analysis? If not, please explain the method that is used to overcome this situation.

Table 5-2: Sheet B2 of Master Workbook: Survey Questions and Variable Names

<table>
<thead>
<tr>
<th>Income</th>
<th>Components</th>
<th>Name of variable in data set</th>
<th>Includes</th>
<th>Survey Question</th>
<th>Survey Recall Period</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market income</td>
<td>Labor income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wages and salary</td>
<td></td>
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<tr>
<td></td>
<td>Corporate income</td>
<td></td>
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<tr>
<td></td>
<td>Gross property income</td>
<td></td>
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<tr>
<td></td>
<td>Gross contributory pensions</td>
<td></td>
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<tr>
<td>pensions as deferred income scenario</td>
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<tr>
<td>Private transfers</td>
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<tr>
<td>Private pensions</td>
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<tr>
<td>Other</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Remittances</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alimony payments</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imputed rent from owner-occupied housing</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Auto-consumption</td>
<td></td>
<td></td>
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<tr>
<td>Subsidized Pensions</td>
<td></td>
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<tr>
<td>add additional rows as necessary</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Market income + Subsidized Pensions</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Subsidized Pensions</td>
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<tr>
<td>add additional rows as necessary</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Net market income</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct taxes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income tax</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other direct taxes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employee contributions to social security</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pensions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health and others</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>add additional rows as necessary</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Disposable income</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct monetary transfers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Net contributory pensions (contributory pensions as government transfer scenario only)</strong></td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Non-contributory pensions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditional cash transfer</td>
</tr>
<tr>
<td>Scholarships</td>
</tr>
</tbody>
</table>

*add additional rows as necessary*

<table>
<thead>
<tr>
<th><strong>Consumable income</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect subsidies</td>
</tr>
<tr>
<td>Indirect taxes</td>
</tr>
<tr>
<td>Sales tax</td>
</tr>
</tbody>
</table>

*add additional rows as necessary*

<table>
<thead>
<tr>
<th><strong>Final income</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>In-kind transfers</td>
</tr>
<tr>
<td>Education</td>
</tr>
<tr>
<td>Pre-school</td>
</tr>
<tr>
<td>Primary</td>
</tr>
<tr>
<td>Secondary</td>
</tr>
<tr>
<td>Other types of primary education</td>
</tr>
<tr>
<td>Tertiary</td>
</tr>
<tr>
<td>Health</td>
</tr>
<tr>
<td>Primary care</td>
</tr>
<tr>
<td>Hospitalization</td>
</tr>
</tbody>
</table>
One key goal of the CEQ Institute is to create a Data Center on Fiscal Redistribution to be able to compare the impact of fiscal policy on inequality and poverty across countries and over time. Given this goal, the CEQ methodology considers very important for the underlying microdata to be as harmonized as possible. In what follows, we discuss a series of definitions (for example, definition of a household, unit of analysis, and so on) and procedures (for example, treatment of missing and zero incomes, top coding, and so on) used by CEQ for this purpose. We broadly follow the definitions and procedures used by international databases such as LIS, SEDLAC, World Development Indicators (WDI)/PovcalNet by the World Bank.\(^2\)

**Definition of Household**

We adopt the definition of a household used by LIS, SEDLAC, and (in most cases) the World Bank’s PovcalNet, which excludes external members of the household: boarders, live-in domestic servants, and (if applicable) their families are not considered part of the household, and should not be included in any income calculations. That is, if each observation in the data set is a household (known as wide format), they should not be included in the number of members of the household, and their income will not be included in the

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\(^2\) For a summary of definitions and procedures used by the most renowned international inequality databases, see Ferreira, Lustig, and Teles (2015).
household aggregate income or consumption. If each observation in your data set is an individual (known as long format), the boarders, live-in domestic servants, and their families should be dropped from the data set. In practice, rather than dropping individuals from the data set, it can be beneficial to create a dummy variable that marks individuals that should be used in calculations, then include an if-condition in the calculations. This allows one to use the “dropped” individuals in other calculations if necessary—for example, to perform a sensitivity analysis of the decision to not include them in the calculations—without having to go back to the original version of the data set before they were dropped; the disadvantage of this approach is that the user has to remember to always include an if-condition for every estimation, restricting the analysis to the “non-dropped” individuals.

When dropping individuals and households (or marking them with a dummy variable equal to 0 to exclude them from all estimations), it is necessary to re-adjust expansion factors so that the sum of the expansion factors of the non-dropped individuals still sums to the total population in the country, or even better so that the sum of the expansion factors of the non-dropped individuals within each stratum sums to the sum in that stratum prior to dropping individuals. More sophisticated reweighting techniques could also be used.

Unit of Analysis

Unless otherwise specified, all calculations (poverty, inequality, incidence, et cetera) will be in terms of individuals rather than households. In other words, the poverty headcount ratio will equal the proportion of individuals below the poverty line, not the proportion of households below the poverty line. If poor households tend to be larger than non-poor households, the former will be higher than the latter. Note that the CEQ Stata Package automatically makes its calculations using the individual as the unit of analysis, and flexibly allows data sets that are at the individual or household level (where the former must include a variable that serves as each individual’s household identifier and the latter must include a variable with the number of members in each household).

Missing or Zero Incomes

---

3 Consider the following example: in an income survey, if the household head earns $100 and then pays the servant $10, the survey data will show us exactly these numbers: $100 and $10. We drop the servant (and their income) before making household aggregates because otherwise we would aggregate $100+10 = 110 but that would be double counting that $10. In the case of a consumption survey (and ignoring savings), the household (excluding servant) will consume its $100, $10 of which shows up as expenditure on the servant’s income. Then the servant also consumes their $10 of income. If we aggregate without dropping the servant we would have $100+10 = 110, again double counting the $10 that was “consumed” when the household paid the servant, then consumed again by the servant.

4 Note that some studies do not drop boarders and domestic servants from the calculations, but instead count them as a separate household. The implications of adopting one method rather than the other have yet to be rigorously explored, but “exploratory analysis for some countries suggests that for the most part results are not significantly affected by this decision” CEDLAS and the World Bank (2014, p. 15); a table summarizing this exploratory analysis can be found in Appendix E.

5 See for example Pacifico (2014); Kolenikov (2014).
When a survey respondent reports receiving a certain income source but does not report the value or reports a value of zero as their income from that source, we adopt the convention used by SEDLAC almost in full: missing and zero incomes are regarded as zero, unless the household head’s primary income source is missing, in which case the household is excluded from the data. One difference between our treatment and that of SEDLAC is that if the household has zero income after applying the above rules, we include that household in both poverty and inequality measures, whereas SEDLAC includes the household in poverty measures but excludes it from inequality measures. The main argument for excluding them made by SEDLAC is that “some inequality measures collapse when considering zero income.” The inequality measure that we focus on, however—the Gini coefficient—has no problem dealing with zero income. (Measures of the Theil, which also appear in the CEQ MWB, necessarily exclude households with zero income, but we rarely use these results.) Furthermore, in a fiscal incidence analysis, some households will receive all their income from transfers and thus have 0 market income but positive disposable income. It would be inconsistent to exclude these households from the calculation of market income inequality but not that of disposable income inequality; on the other hand, excluding those households from both measures for consistency would lead us to exclude all households with zero market income but positive disposable income from our analysis, which is undesirable. Note that when a household is excluded from the data, the expansion factors must be recalculated so that the expanded sample of the non-excluded households equals the original expanded sample size when they were included (potentially within strata, or using a more sophisticated method, as discussed above).

Top coding

In some surveys, wage and other income variables are top-coded for very high earners to protect the privacy of respondents. The simplest approach to replace the top coded value for that variable—which must be done as a precursor to creating any income concepts—is to replace the top coded values with either the lower bound of the top coding or the maximum non-top coded value, whichever is available. For example, survey documentation might inform us that every income above $100,000 has been top coded; in this case, we use the lower bound of the top coding which is $100,000 for all the households whose income was subjected to top coding. Alternatively, some surveys (such as the Current Population Survey [CPS] in the US) do not report what the cut-off for top coding is, but simply inform us that all observations that have a value for that variable of, say, 999999, are top coded. In this case, we find the maximum of the non-top coded observations (in this example, the observations with a value below 999999 for that variable) and assign it to all of the top-coded variables. For example, suppose the codebook accompanying our household survey data says that 999999 indicates a top coded value, but does not provide us with information about what income level was used as the cut-off for top coding. We check our data and find that the highest value for the corresponding variable that is below 999999 is $585,400. For all households whose income was subject to top-coding, we would assign them with the maximum non-top coded value which is $585,400.

If this approach is taken and multiple years or multiple countries are being compared by the same authors, an adjustment should be made to account for the fact that the top-coding cut-off may be arbitrary and could thus

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6 CEDLAS and World Bank (2014).
7 CEDLAS and World Bank (2014, p. 20).
occur at different points of the variable’s distribution in the different surveys. Box 5-1 describes how to adjust the top coding in a way that it becomes comparable across years or countries.

**Box 5-1: Top coding across multiple years or countries**

Gary Burtless, Senior Fellow and John C. and Nancy D. Whitehead Chair, Brookings Institution

To make cross-year or cross-country comparisons comparable, calculate the lowest percentile in the income distribution that the top-code value represents in all of the years or countries being studied. Then, use this top code percentile to top code each of the years or countries at the same percentile. For example, suppose the top code value is at the 97th percentile in year or country 1, the 98th percentile in year or country 2, and the 96th percentile in year or country 3. Create a new, uniform top-code at the 96th percentile in each of the years or countries. In year or country 1, every respondent with an income value above the 96th percentile is assigned a top-code equal to the 96th percentile of the income distribution in year or country 1; and in year or country 2, every respondent with an income value above the 96th percentile is assigned a top code equal to the 96th percentile of the income distribution in year or country 2. The top codes for year or country 3 are left unchanged since that year or country had the lowest percentile at which top coding occurred. This procedure ignores information about incomes between the 96th and 97th percentile in year or country 1 and between the 96th and 98th percentiles in year or country 2, but the top code procedure makes it feasible to evenhandedly compare income distributions and fiscal incidence across the three years.

More complex approaches involve imputing values to the top-coded values. (Note that if values are imputed, the methods described in the above box for analyses across multiple years or countries are no longer necessary.) If income and consumption data are both available in the survey, a regression using consumption and other characteristics as explanatory variables can be used to predict the missing income component. Alternatively, the top coded values could be imputed using assumptions about the distribution of income at the upper end (for example, that it follows a Pareto distribution—see Box 5-2). A more complex multiple imputation approach is given in Jenkins and others.

The method chosen in the event of top coding must be made based on the nature of the top coding in the data set and the researchers’ preference to employ simpler or more complex solutions. The reasoning behind choosing a particular methodology should always be justified, and ideally, the sensitivity of results to the chosen method should be tested.

*Outliers and Extreme Values*
In the case of outliers for particular income sources and fiscal interventions, these could reflect real inequality in income from that source, or could be caused by misreporting or errors in data entry or processing. We recommend that researchers follow standard procedures to carefully examine outliers in their data (a good first pass is to observe extreme values with Nick Cox’s user-written Stata command extremes). Then, researchers should apply their discretion to determine whether values could reflect true inequality in income from a particular source, or if they reflect error. If they reflect error, they should be replaced with a zero (not a missing value, which would lead all the income aggregates to be missing as well, essentially equivalent to dropping the household) or imputed using missing data techniques.

In the case of fiscal interventions, determining whether outliers reflect true inequality is often an easier task than for other sources such as labor income, as these fiscal interventions often have rules that determine benefit amounts or tax percentage. Even if these rules are not perfectly applied, they are usually not so broadly misapplied that extreme outliers are possible. When unreasonable outliers are detected, the researcher must again use discretion to determine whether these should be replaced by a zero, imputed using missing data techniques, or whether some other approach is appropriate. In the case of Brazil’s conditional cash transfer program Bolsa Família, Higgins and Pereira found that while the survey asked for benefits received over the past month, most of the outliers had values equal to approximately (and in many cases, exactly) twelve times the monthly benefits that could be received according to program rules. Thus, the authors divided by twelve the benefits received by these outliers—assumed to be mistakenly reported in annual rather than monthly terms.

Under-reporting and Top Incomes

Household surveys have two serious limitations that bear on the measures of inequality and poverty derived from them, and hence on the results of the fiscal incidence analysis: under-reporting of incomes (in particular, income from capital) and under-sampling of the rich. Following what most of the existing international databases do, the project does not adjust for under-reporting by scaling-up survey totals (for example, wages, disposable income, private consumption, and so on) to totals obtained from administrative registries. As a result, one ends up with two “economies” for the same country characterized by differences not only in scale (the survey-based usually being considerably smaller in terms of the values of income and consumption than the national accounts totals) but often in structure (for example, the ratio of disposable to market income from the survey may be different from the ratio of disposable income to the closest measure of market income from national accounts). The overriding principle followed in the project is that—unless there are good reasons not to—the information in the surveys is taken as valid and given precedence over the information from administrative registries (see more details on this in the section on income misreporting and discrepancies between survey and administrative data below). However, whenever the team has sufficient evidence to believe

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8 Cox (2004).
10 See Ferreira, Lustig and Teles (2015, table 2). The notable exception is the data on inequality and poverty produced by the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC).
that totals in the survey are less credible than those in administrative registries, the latter should be used and the rationale properly documented in section C of the MWB.

One exception to the above principle might be correcting for the under-estimation of top incomes (or consumption). It is well-known that top incomes are not well-captured by household surveys. One reason for this is that the likelihood that a household refuses to be interviewed is higher among those with top incomes. A growing literature exploits results about the statistical distribution of top incomes to adjust incidence and inequality measures to account for the exclusion of top incomes. We make no adjustments for the exclusion of top incomes in the main analysis, but an additional sensitivity analysis can be performed following the methodologies described in box 5-2 and the references therein. Results should be presented both ways: correcting and not correcting for under-reporting/under-sampling of top incomes.

Box 5-2: Top incomes and inequality measurement

Paolo Verme, Senior Poverty Specialist in the MENA Region, World Bank

The measurement of inequality is known to be susceptible to various statistical problems that relate to the data used for the measurement of inequality such as household income, consumption or expenditure surveys. It is known that households tend to under-report income (income under-reporting), that some households participating to the survey do not report income at all (item non-response) and that other households do not participate in surveys even when selected in the survey sample (unit non-response). These three phenomena can potentially affect the estimation of inequality seriously, although there is still incomplete evidence on the size of these potential biases. To address the first two issues (income under-reporting and item non-response) scholars have adopted various solutions such as using consumption or expenditure in place of income or imputing income using regression techniques and a set of proxies that are known to predict income well.

The third issue (unit non-response) has only recently been studied in relation to the estimation of inequality. Preliminary findings suggest that this phenomenon can bias the estimation of inequality sharply especially when related to the right hand side of the distribution, the top incomes. Korinek, Mistiaen and Ravallion using US data have shown how household non-responses can lead to the under estimation of inequality while Cowell and Flachaire have shown how even one observation at the top of the distribution can change the estimation of inequality by several percentage points. These first findings have called for specific solutions to the problem.

Two alternative approaches have been proposed by the authors above to correct for the bias generated by unit non-responses at the top of the distribution. Korinek, Mistiaen and Ravallion propose a two-stage probabilistic model that, under certain assumptions, provides the true distribution of incomes and allows for the estimation of the correct value of inequality by using a set of weights that correct for unit non-response. Cowell and Flachaire have instead suggested estimating inequality by using a semi-parametric approach whereby inequality is estimated by combining the classic non-parametric
measurement for most of the distribution with a parametric measurement applied to top incomes only. In essence, these authors suggest substituting a theoretical distribution for the top incomes—such as the Pareto distribution—which is known to predict top incomes across countries well and correcting in this way the bias at the top.

A recent paper by Hlasny and Verme proposed an alternative application of the Korinek, Mistiaen and Ravallion model and compared this application with the semi-parametric approach suggested by Cowell and Flachaire. They find rather consistent results between the two approaches although the bias generated by unit non-responses among top incomes is smaller than what found by Korinek, Mistiaen and Ravallion for the US. These initial approaches proposed for correcting unit non-response at the top of the distribution are still in an experimental phase and require further tests but provide a first set of tools available to researchers.

Sources: Cowell and Flachaire (2007); Hlasny and Verme (2013); Korinek, Mistiaen and Ravallion (2006).

Adult Equivalence and Economies of Scale

CEQ generally uses household per capita income or consumption, and thus does not adjust for adult equivalence or economies of scale within households. For each income concept, total household income for the respective concept is divided by the total number of members in the household. The income concept and fiscal intervention variables used with the CEQ Stata package commands should already be expressed in household per capita terms.

The author may want to include additional sensitivity analyses where they test the sensitivity of the results to different assumptions about economies of scale or adult equivalent units. This is especially important in countries where official estimates of poverty and inequality adjust for economies of scale or adult equivalence units; in that case, the “main results” used for the CEQ Assessment may be those that adjust for economies of scale. The sensitivity of incidence results to assumptions about economies of scale—in particular, a comparison of using household per capita income vs. the square root scale suggested by Atkinson, Rainwater, and Smeeding—is discussed in Higgins and others.

For teams who decide to use equivalized income for the CEQ Assessment report, results using per capita income should be produced as well to facilitate comparisons with other countries.

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11 As explained above, total household income should not include the income of boarders, domestic servants, and their families, and the total number of members in the household should not include them either.
13 Higgins and others (2015).
Spatial Price Adjustments

The researchers will have to use their best judgment of whether to adjust for spatial prices based on the spatial price differences in the country and the availability of a spatial price index (SPI) as well as common practice in the country. For teams who decide to use spatially adjusted price indices for the CEQ Assessment report, results should be presented both ways: adjusting and not adjusting for spatial price differences.

Spatial price indices are available for many countries, either calculated by the government itself or by an international organization. If an adjustment is made for spatial price differences, a table should be provided showing the value of the SPI in each region. Note that the choice of which region was used to index the SPI may have been arbitrary. Hence, you should re-index your SPI so that 1.0 equals its weighted average. Consider the following simple example, where the original SPI was indexed to the country’s federal district.

<table>
<thead>
<tr>
<th>Region</th>
<th>Population share</th>
<th>Original SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal District</td>
<td>55%</td>
<td>1.000</td>
</tr>
<tr>
<td>Urban Interior</td>
<td>15%</td>
<td>0.750</td>
</tr>
<tr>
<td>Rural Interior</td>
<td>30%</td>
<td>0.600</td>
</tr>
</tbody>
</table>

We would re-index the SPI as follows: first, compute its weighted average as \((0.55\times1.000 + 0.15\times0.750 + 0.30\times0.600) = 0.8425\). Next, divide the original SPI by its weighted average to create a re-indexed SPI.

<table>
<thead>
<tr>
<th>Region</th>
<th>Population share</th>
<th>Original SPI</th>
<th>Calculation</th>
<th>Re-indexed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal District</td>
<td>55%</td>
<td>1.000</td>
<td>1.000/0.8425</td>
<td>1.1869</td>
</tr>
<tr>
<td>Urban Interior</td>
<td>15%</td>
<td>0.750</td>
<td>0.750/0.8425</td>
<td>0.8902</td>
</tr>
<tr>
<td>Rural Interior</td>
<td>30%</td>
<td>0.600</td>
<td>0.600/0.8425</td>
<td>0.7122</td>
</tr>
<tr>
<td>Weighted Average</td>
<td></td>
<td>0.8425</td>
<td></td>
<td>1.0000</td>
</tr>
</tbody>
</table>

\[^{14}\text{Note that CEQ does not do an automatic adjustment of incomes as other datasets do. For instance, SEDLAC adjusts rural incomes downwards by 15 percent in all the countries for which indicators are produced.}\]
Finally, all of the income concepts and the variables for each of their components should be adjusted for spatial prices, by dividing the value of those variables by the re-indexed value of the SPI corresponding to a particular household’s region. (To see why re-indexing was necessary, note that the above “Original SPI” could have instead been arbitrarily indexed to the rural interior, so that it was Federal District 1.667; Urban Interior 1.250; Rural Interior 1.000. Dividing incomes by the 1.667; 1.250; 1.000 index instead of the 1.000; 0.750; 0.600 index—which tell the exact same story about price differences—would have large implications for poverty. Hence, we re-index for consistency.)

If a reliable SPI is not available, an alternative is to create a SPI using spatial poverty lines, which again might have been calculated by the government or an international organization. Although this solution works well for poverty measures, it is not ideal for inequality measures, since the poverty lines are calculated based on the prices of basic needs, while the prices of other goods may not differ across regions in the same way as basic needs. Nevertheless, it can be better than making no adjustment for the differences in purchasing power experienced by individuals in different regions. Consider the following example.

Table 5-5

<table>
<thead>
<tr>
<th>Region</th>
<th>Population share</th>
<th>Regional poverty line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal District</td>
<td>55%</td>
<td>320 local currency per month</td>
</tr>
<tr>
<td>Urban Interior</td>
<td>15%</td>
<td>250 local currency per month</td>
</tr>
<tr>
<td>Rural Interior</td>
<td>30%</td>
<td>190 local currency per month</td>
</tr>
</tbody>
</table>

Treating the regional poverty lines as a (non-indexed) SPI, we calculate the re-indexed SPI the same way: compute its weighted average as 0.55*320 + 0.15*250 + 0.30*190 = 270.5, and divide the original SPI (that is, the regional poverty lines) by the weighted average to obtain the re-indexed SPI.

Table 5-6

<table>
<thead>
<tr>
<th>Region</th>
<th>Population share</th>
<th>Regional poverty lines</th>
<th>Calculation</th>
<th>Re-indexed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal District</td>
<td>55%</td>
<td>320</td>
<td>320/270.5</td>
<td>1.1830</td>
</tr>
<tr>
<td>Urban Interior</td>
<td>15%</td>
<td>250</td>
<td>250/270.5</td>
<td>0.9242</td>
</tr>
<tr>
<td>Rural Interior</td>
<td>30%</td>
<td>190</td>
<td>190/270.5</td>
<td>0.7024</td>
</tr>
<tr>
<td>Weighted Average</td>
<td></td>
<td>270.5</td>
<td></td>
<td>1.0000</td>
</tr>
</tbody>
</table>
Expressing values in annual terms

Income concept and fiscal intervention variables should be expressed in local currency in annual terms to facilitate the comparison of results from the MWB with results from national accounts. The method to convert local currency into purchasing power parity (PPP) adjusted dollars will be discussed in chapter 7.\textsuperscript{15}

Data on Fiscal Systems

In order to allocate certain taxes and transfers, it is necessary to know the totals that appear in the government budget disaggregated by the categories of interest for the year of the household survey. On Sheet B3 of the CEQ MWB there is a template for the government budgetary data which is reproduced here as table 5-7.

Table 5-7: Sheet B3 of Master Workbook: General Government Budget and Fiscal Totals Included in Analysis

<table>
<thead>
<tr>
<th>Year of Budget Data: Government Revenue &amp; Spending (specify currency and units: for example, in thousands, in millions, et cetera)</th>
<th>Name of Country:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency Amounts in Administrative Accounts (otherwise specified)</td>
<td>Total Included in Analysis (% of GDP)</td>
</tr>
<tr>
<td>Total Revenue &amp; Grants</td>
<td>Revenue</td>
</tr>
<tr>
<td>Tax Revenue</td>
<td>Direct Taxes of which</td>
</tr>
<tr>
<td>Personal income tax</td>
<td>Corporate income tax</td>
</tr>
<tr>
<td>Payroll tax</td>
<td>Taxes on property</td>
</tr>
</tbody>
</table>

\textsuperscript{15} Higgins (chapter 7 in this Handbook).
<table>
<thead>
<tr>
<th>Contributions to Social Insurance of which</th>
</tr>
</thead>
<tbody>
<tr>
<td>From employees</td>
</tr>
<tr>
<td>From employers</td>
</tr>
<tr>
<td>From self-employed</td>
</tr>
</tbody>
</table>

| Indirect Taxes of which                  |
| VAT                                      |
| Sales tax                                |
| Excise taxes                             |
| Customs duties                           |
| Taxes on exports                         |

| Nontax revenue                           |
| Grants                                   |

<table>
<thead>
<tr>
<th><strong>Total Expenditure</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Defense Spending</td>
</tr>
<tr>
<td>Social Spending</td>
</tr>
</tbody>
</table>

<p>| Social Protection                        |
| Social Assistance of which               |
| Conditional or unconditional cash transfers |</p>
<table>
<thead>
<tr>
<th>pensions</th>
<th>Noncontributory</th>
</tr>
</thead>
<tbody>
<tr>
<td>transfers</td>
<td>Near cash</td>
</tr>
<tr>
<td>uniforms,</td>
<td>(food, school uniforms, et cetera)</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Social Insurance of</td>
<td></td>
</tr>
<tr>
<td>which</td>
<td></td>
</tr>
<tr>
<td>Old-age</td>
<td></td>
</tr>
<tr>
<td>pensions</td>
<td></td>
</tr>
<tr>
<td>Education of which</td>
<td></td>
</tr>
<tr>
<td>Pre-school</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
</tr>
<tr>
<td>Post-secondary</td>
<td></td>
</tr>
<tr>
<td>non-tertiary</td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td></td>
</tr>
<tr>
<td>Health of which</td>
<td></td>
</tr>
<tr>
<td>Contributory</td>
<td></td>
</tr>
<tr>
<td>Noncontributory</td>
<td></td>
</tr>
</tbody>
</table>
There are four important aspects to note. First, the budgetary data should be for the general government sector following the definition of the International Monetary Fund’s Government Financial Statistics Manual 2014 (GFS). That is, the budgetary data should include revenues from and spending by central, state, provincial, regional, and local governments, and social security funds. If for any reason, there is only budgetary information for the central government or central and provincial governments, it should be clearly noted both on sheet B3 and reports. Second, the expenditure categories that are required for the comprehensive fiscal incidence analysis in a CEQ Assessment are a combination of what the GFS manual calls economic and

<table>
<thead>
<tr>
<th>Housing &amp; urban of which</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing</td>
</tr>
<tr>
<td>Subsidies of which</td>
</tr>
<tr>
<td>Energy of which</td>
</tr>
<tr>
<td>Electricity</td>
</tr>
<tr>
<td>Fuel</td>
</tr>
<tr>
<td>Food</td>
</tr>
<tr>
<td>On inputs for agriculture</td>
</tr>
<tr>
<td>Infrastructure of which</td>
</tr>
<tr>
<td>Water &amp; Sanitation</td>
</tr>
<tr>
<td>Rural roads</td>
</tr>
<tr>
<td>Grants</td>
</tr>
</tbody>
</table>

| Other Government Spending |

**Fiscal Balance & Government Debt by IMF Functional Classification**

- Primary Fiscal Balance, Including Grants
- Primary Fiscal Balance, Excluding Grants
- Gross Domestic Government Debt
functional categories. For example, while the various categories that comprise social spending on sheet B3 are part of the functional categories\textsuperscript{16}, the GFS classifies spending on what in CEQ (and other places) we call consumption subsidies under “social benefits” in the economic classification of government expenditures.\textsuperscript{17} Third, spending on transfer programs should include administrative costs in the budgetary data but not in the transfers distributed to the population if benefits are simulated. Fourth, for education and health spending, teams should include both recurrent and capital expenditures.

While the categories included in table 5-7 are quite useful, each researcher can of course decide whether s/he would like to disaggregate categories further (for example, in transfers by type of program; in health, by primary vs hospital care).

As can be observed on sheet B3, the author of a CEQ Assessment will need to identify both which components of fiscal policy will be included in the analysis and what proportion of that category is part of the analysis. This will give an idea of how comprehensive the fiscal incidence analysis will be in the country in question. For example, for a country that collects most of its revenues, let’s say, through corporate taxes, the analysis will capture less of the fiscal system than in one in which most of the collection occurs through personal income taxes and/or value added taxes (VAT).

Sheets B4 through B12 in the MWB provide guidelines to describe the qualitative and quantitative characteristics of the fiscal instruments that will be included in the CEQ Assessment, (table 5-8).

Table 5-8: Sheet B4-B12 of Master Workbook: Description of Fiscal System

<table>
<thead>
<tr>
<th>Sheet Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>B4. Tax System</td>
<td>Describe the tax system in the assessed country and specify which ones are included in the analysis; for each item, indicate complete reference (including specific page numbers and/or weblink with date of use).</td>
</tr>
<tr>
<td>B5. Pension System</td>
<td>Describe the portions of the contributory pensions system that are treated as part of market income in the contributory pensions as deferred income scenario and in the contributory pensions as partial deferred scenario.</td>
</tr>
<tr>
<td>B6. Cash Transfer Programs</td>
<td>Fill in the given table requesting information on program name, type of program, whether the program is taxable, target population, number of beneficiaries (year of survey), year of first implementation, budget (year of survey and local currency per year), targeting mechanism and</td>
</tr>
</tbody>
</table>

\textsuperscript{16} GFS (table 6.12, PAGE #? If available).

\textsuperscript{17} GFS (table 6.1 and p. 133).
B7. Near Cash Transfers

Provide a brief description of all near cash transfer programs such as food rations, school uniforms, school feeding programs, and so on. For each item, put complete reference (including specific page numbers and/or weblink with date of use).

B8. Subsidies

Describe the price subsidies in the assessed country and specify which ones are included in the analysis; for each item, indicate complete reference (including specific page numbers and/or weblink with date of use).

B9. Education System

Describe the public education system. For each item, put complete reference (including specific page numbers and/or weblink with date of use).

B10. Health System

Describe the public health system. For each item, put complete reference (including specific page numbers and/or weblink with date of use).

B11. Housing Subsidies

Describe other in-kind transfers such as housing, urban infrastructure, et cetera. For each item, put complete reference (including specific page numbers and/or weblink with date of use). Note that we consider food assistance programs as a direct transfer rather than an in-kind transfer.

B12. Other Country-specific Additional Information

Provide any additional country-specific information that is relevant or that is requested.

Examples of descriptions of fiscal systems can be observed in the country studies included in this Handbook’s Part III. Applications.

3. Income Concepts: Definitions

In the CEQ framework we begin by defining prefiscal income: the income of individuals before taking into account taxes paid and benefits received (henceforth, fiscal policy). Prefiscal income is the income by which
individuals are initially ranked to assess the impact of fiscal policy (when using non-anonymous measures). In CEQ, we call the prefiscal income market income. As we shall see immediately below, the definition of market income can vary depending on the assumptions made regarding old-age pensions from a contributory social security system. Thus, because various scenarios are run to assess the sensitivity of the analysis to the treatment of old-age pensions, in CEQ there can/will be different incomes by which individuals are initially ranked for the same country.

The CEQ framework uses eight core income concepts: market income, market income plus the subsidized component of contributory pensions (or, market income plus subsidized pensions for short), net market income, gross income, taxable income, disposable income, consumable income, and final income. The categories included in each concept are shown in diagram 5-1 and described briefly here; the process for constructing each of these income concepts is described in detail in section 3. These core income concepts were chosen to allow for a variety of analyses and comparisons; in the application of the fiscal incidence analysis, results are presented with individuals ranked by each of these eight core income concepts. We first describe how these income concepts are constructed using an income-based survey, then discuss how to construct the same income concepts using a consumption-based survey.

Market income always should include factor income such as wages and salaries from the formal and informal sectors (also known as earned income) as well as income from capital (rents, profits, dividends, interest, and so on), private pensions, private transfers (remittances and other private transfers such as alimony), imputed rent for owner occupied housing (also known as income from owner occupied housing), and the value of own production. As discussed in chapter 1, one key decision in defining market income is the treatment of contributions to and income from a contributory social security system. In CEQ we recommend running scenarios with three different treatments of contributory pensions (and hence three different definitions of market income):

(i) contributory pensions as pure deferred income.\(^{19}\)
(ii) contributory pensions as partially deferred income (when the pension system is in deficit which is funded from general revenues).
(iii) contributory pensions as a pure government transfer.\(^{20}\)

In the first and second scenarios, contributions to old-age pensions are treated as a form of “forced saving” and subtracted from factor incomes (plus private transfers) to generate market income; and, the income from pensions (scenario 1) or the nonsubsidized component (scenario 2) are treated as deferred factor income and, therefore, added to other forms of market income (if they exist) to households with members who reported receiving income from social security pensions. In countries where the social security system is in deficit and receives a transfer from other general government revenues, the “nonsubsidized pensions” added to market income equal pensions less the transfer. In the scenario in which pensions are treated as a pure government transfer, in order to be able to compare results with other projects such as EUROMOD, contributions are

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\(^{18}\) Lustig and Higgins (chapter 1 in this Handbook).

\(^{19}\) This is equivalent to what we called the “benchmark scenario” in Lustig and Higgins (2013), except that now all income concepts, including market income, are net of contributions to social security pensions to avoid double counting, except in the case in which pensions are treated as a pure transfers and contributions as a pure tax (which before was called the “sensitivity analysis” scenario). More details on this are in the section devoted to the treatment of contributory pensions.

\(^{20}\) This scenario is equivalent to what we called the “sensitivity analysis” in Lustig and Higgins (2013). Immervoll and O’Donoghue (2009) and EUROMOD present results for the first and third definition of prefiscal income as well.
treated as a direct tax and the income from contributory pensions as a cash transfer. More details on all this are presented below in the section dedicated to the treatment of contributory pensions.

*Market income plus subsidized pensions*, of course, equals market income plus the subsidized portion of the income from contributory pensions. When pensions are assumed to be pure deferred income, the two concepts *market income* and *market income plus subsidized pensions* are identical, since subsidized pensions equal zero. When pensions are treated as pure government transfers, subsidized pensions equals the entire income from public contributory pensions. As we shall see below, in countries where the social security system is in deficit and receives a transfer from other general government revenues, the “subsidized pensions” added to market income to generate market income plus subsidized pensions equal the proportion of income.

Note that noncontributory pensions—income from pensions that are received from the government but the pensioner has not contributed (or not contributed enough) to the social security system—are treated as any other cash transfer and never included in the concept *market income plus subsidized pensions*. Noncontributory pensions are sometimes called social pensions and minimum pensions, depending on the country.

*Gross income* equals market income plus direct cash and near-cash (for example, food) transfers. Beneficiary households are assumed to receive the entirety of benefits from these transfers: we ignore spillovers to other households.

*Taxable income* includes only the part of gross income that is taxable. In many developing countries, constructing taxable income may be quite time consuming and the values may end up being very similar to market income. Teams should exercise judgement in terms of how important it is to calculate taxable income depending on the characteristics of the country and the purposes of the CEQ Assessment. If the goal is to use the assessment to simulate policy reforms on direct taxes, calculating taxable income becomes quite relevant, for example.

*Net market income* equals “market income plus subsidized pensions” minus direct taxes and contributions, including individual income taxes and payroll taxes (including those paid to the old-age pension system and paid by the employer) and property taxes.

*Disposable income* is created by adding direct transfers (described above, and in more detail below) to net market income, or subtracting direct taxes and contributions (described above, and in more detail below) from gross income.

*Consumable income* (which is synonymous with *post-fiscal income* from Lustig and Higgins21) equals disposable income plus indirect subsidies minus indirect taxes.

*Final income* equals consumable income plus benefits from public services, such as education and health services.

Diagram 5-1 – Definitions of Income Concepts: A Stylized Presentation

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21 Lustig and Higgins (2013).
The CEQ income concepts are similar but not identical to those used by others. Appendix A presents a description of the income concepts used by the so-called Canberra group.


In the process of constructing income concepts, if taxes and transfers are explicitly available in the surveys, one should use this information unless there are reasons to believe that it is not reliable. However, the information on direct and indirect taxes, transfers in cash and in-kind, and subsidies is often not collected in household surveys. In order to allocate the benefits of transfers and burden of taxation to individuals included in the household surveys, the CEQ Assessments make use of administrative data on revenues and government expenditures as well as knowledge about how the tax and transfer programs work, and allocates them following methods that are described below. Thus, one of the most important aspects of CEQ is a detailed description of how each component of income is allocated (for example, directly identified in the survey or simulated) and the methodological assumptions that are made while calculating them. In many cases, the authors must choose a method based on the institutional structure of the country and the data available. CEQ relies on local experts
as a crucial part of the research team for precisely this reason. In many cases, the researcher must exercise judgment based on their knowledge of the country’s institutions, spending, and revenue collection, and on the availability and quality of the data. It is of the utmost importance to always describe what method was used for a particular tax or transfer, the reasoning for using this method, and—whenever possible—the sensitivity of the results to using alternative methods.

When taxes and transfers can be obtained directly from the household survey, we call this the *Direct Identification Method*. When the direct identification method is not feasible, there are four options: inference, imputation, simulation, and prediction. If the primary survey being used for the CEQ Assessment does not have the necessary information, these methods can be used in an *alternate survey*, then benefits or taxes matched back into the main survey. As a last resort, one can use *secondary sources*: for example, incidence or concentration shares by quintiles or deciles that have been calculated by other authors. Finally, if none of these options can be used for a specific category, the analysis for that category will have to be left blank. We describe the methods in detail right below; often, multiple allocation methods are combined for allocating benefits or taxes from a particular fiscal intervention, as evident from the examples included below.

**Direct Identification**

In some surveys, questions specifically ask if households received cash benefits from certain social programs or paid taxes to tax and social security systems, and how much they received or paid. When this is the case, it is easy to identify transfer recipients and taxpayers, and add or remove the value of the transfers and taxes from their income, depending on the definition of income being used.

Many direct transfer programs are directly identified, and direct taxes on labor income are sometimes directly identified as well. For example, in Brazil, the conditional cash transfer program Bolsa Família, non-contributory pensions, public scholarships, unemployment benefits, and various other direct transfers were directly identified, as were individual income taxes since the survey included a question for each income source not only on the gross amount earned, but also the amount paid in taxes\(^{22}\). Although the majority of surveys do not include direct questions about individual income taxes, various surveys do, including those in Ecuador\(^ {23}\) and Peru.\(^ {24}\)

**Inference**

In some cases, transfers from social programs are grouped with other income sources (in a category for “other income,” for example). In this case, it might be possible to infer which families received a transfer based on whether the value they report in that income category matches a possible value of the transfer in question.

One example of the inference method is the identification of the amount of benefits from non-contributory pensions in Argentina by Lustig and Pessino. Benefits from noncontributory pensions could not be independently identified in the surveys because they were lumped together with contributory pensions and

\(^{22}\) See Higgins and Pereira (2014).

\(^{23}\) See Llerena and others (2015).

\(^{24}\) See Jaramillo (2014).
therefore. Since benefits from the noncontributory system must be below the minimum pension of the contributory system and could not exceed a certain amount by law, the amounts of pensions observed for individuals reporting a pension that was either below the minimum in the contributory system or up to the maximum allowed by the law were considered benefits from noncontributory pensions. Another example is milk transfers in Brazil: Higgins and Pereira used the expenditure module of the survey, which includes a question on the way each consumed good was obtained. For families living in the region of Brazil eligible for this program, the authors assumed that the milk was from the government’s milk transfer program if the household reported the milk as having been donated. A creative use of the inference method came from Sri Lanka, where the survey does not include a question on whether the schools that students attend are public or private, so Arunatilake, Inchauste, and Lustig use questions from the consumption module on whether the household paid facility fees to government schools or school fees to private schools to infer whether the household’s children attend public or private schools.

**Imputation**

The imputation method uses information that directly identifies beneficiaries or payers from the survey, such as the respondent reporting attending public school or receiving a direct transfer in a survey that does not ask for the amount received, or purchasing a particular good in a formal market, and some information from either public accounts, such as per capita public expenditure on education by level, or from the program rules, or from consumption tax rates which apply to goods purchased in formal markets. Methods vary depending on the tax or transfer amount to be imputed and are described in detail below. For example, for imputing consumption taxes, one has information on items consumed and the taxes paid are calculated by applying the effective tax rates (actual collection) to each consumption category. Or, one may have information on children attending public school of a certain level and the benefit is calculated by imputing a value equal to the per student cost of education spending on that same level. The latter has been applied in all country studies in Part III of this MWB.

Examples of the imputation method for direct transfers include food aid in Ethiopia, school lunches, uniforms, and textbooks in Ecuador, and school uniforms and textbooks in Sri Lanka. In each of these cases, whether the household receives the benefit is reported in the survey, but not the amount received. Thus, total government spending on the program from national accounts was distributed to those who reported receiving benefits in the survey. Because the magnitude of income in national accounts is substantially higher than that of surveys, these totals should be scaled down using the method described below before they are allocated to households.

In surveys in which data on personal income taxes are not directly identified but those who work in the formal sector are, we consider this an identification from the survey of who pays the tax, and thus use imputation by combining this information with tax rules to determine the amount paid by those individuals. (If, on the other hand, we do not observe who works in the formal sector, we are not identifying who pays in the survey, and would use the simulation method, described below.)

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27 Hill and others (forthcoming).
28 Llerena and others (2015).
29 Arunatilake, Inchauste, and Lustig (forthcoming).
In many countries, education and health benefits are allocated using imputation. Because surveys include questions about who attends public schools or who uses public health facilities or benefits from public health insurance systems, we use the information from the surveys to determine who benefits, then impute per child, per health visit, or per insured benefits as described in more detail in below.

**Simulation**

When both the information on beneficiaries (taxpayers) and benefits received (taxes paid) is absent from the survey one can estimate the latter based on the program (tax) rules. For example, in the case of a conditional cash transfer that uses a proxy means test to identify eligible beneficiaries, one can replicate the proxy means test using survey data, identify eligible families, and simulate the program's impact. However, this method gives an upper bound, as it assumes perfect targeting and no errors of inclusion or exclusion. If possible, it is ideal to incorporate assumptions about program leakages and imperfect take-up, although robustness checks in Argentina (which used imputation and simulation in its main results) and Brazil (which used direct identification in its main results) found similar results when using reported survey transfers and simulating them with perfect targeting and take-up. In lower-income countries, the perfect targeting and take-up assumption would be far less accurate since various programs only reach a small fraction of the eligible; in Uganda, for example, there was a lack of information to simulate imperfect take-up beyond the number of beneficiaries of the program, so Jellema and others randomly allocated benefits among eligible beneficiaries until the number of beneficiaries in the survey matched the number in national accounts. In the case of taxes, estimates usually make assumptions about informality and evasion.

Examples of simulation for direct transfers include targeted transfers in various countries, such as Argentina, Bolivia, and Uganda. For direct taxes, individual income taxes and payroll taxes paid by the employer are often simulated using reported income and the tax code. Most studies also use simulation for indirect taxes and subsidies: even if consumption of particular goods is included in the survey, this does not identify who pays the tax since some may evade it; instead, the details of who pays the tax are simulated (usually by assuming everyone pays the effective tax rates, or making a broad assumption about evasion such as that rural households do not pay the portion of the tax rate that reflects the good’s last stage value added; see, for example, Jaramillo for Peru).

Some studies outside of CEQ choose to always simulate benefits and taxes rather than using data from surveys, even if the data are there. There are several different types of model, that vary in the types of impact they can be used to assess. Two examples are EUROMOD and LATAX, a description of which is presented in this chapter’s Appendix B and Appendix C, respectively. We view this method as discarding useful information from the survey, which is far from perfect but generally a more accurate reflection of reality than pure

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31 Jellema and others (chapter 16 in this Handbook).
32 For more on tax avoidance and evasion in developing countries, see Alm, Bahl, and Murray (1991).
33 Lustig and Pessino, 2014; Rossignolo (chapter 11 in this Handbook).
34 Paz Arauco and others (2014).
35 Jellema and others (chapter 16 in this Handbook).
36 For further information on the different types of model that can be developed, and the data requirements for each of these, see chapters 1–9 of the Handbook of Microsimulation, C. O’Donoghue (ed.), Emerald Insight (2014).
37 Popova (2013).
39 Also, see Urzua, Carlos, editor (2012) Microsimulation Models for Latin America. Instituto Tecnologico de Estudios Superiores de Monterrey, Mexico.
simulation, especially in developing countries where statutory rules may be far from what actually happens on the ground. In fact, an interesting exercise might be to compare results that come from pure simulation versus those which use information from the survey. The CEQ tool can be used for simulation only purposes as well.

**Prediction**

Another allocation method is the use of regression to predict benefits, with the most common example being the use of a regression of rental rates on housing characteristics among those who rent their dwellings to predict “imputed rent” for owner occupied housing. Another example that combines the prediction, imputation, and alternate survey methods (the latter is described below) was implemented by Higgins and others\textsuperscript{40} for education benefits. Specifically, the main survey (CPS) included a question about whether children attended school but not whether they attended public vs. private school. To predict the probability of attending private school, the authors turned to an alternate survey (American Community Survey; ACS) “which includes questions about income, student and household characteristics, and the public vs. private school enrollment. For the subsample that attends primary or secondary school, we use a probit to estimate the probability of choosing public school conditional on covariates common to both surveys. The coefficients from this ACS regression are used to predict the probability of attending public school for each student in CPS who attends primary or secondary school. We then multiply each student’s probability of attending public school by the average per pupil spending in the student’s state to calculate the expected public spending on education received by that student.”\textsuperscript{41}

The four methods described above rely on at least some information taken directly from the household survey being used for the analysis. However, in some cases the household survey analyzed lacks the necessary questions to assign benefits or taxes to households. In this case, there are two additional methods.

**Alternate Survey**

When the survey lacks the necessary questions, such as a question on the use of health services or health insurance coverage (necessary to impute the value of in-kind health benefits to households), an alternate survey may be used by the author to determine the distribution of benefits. In the alternate survey, any of the four methods above could be used to identify beneficiaries and assign benefits. Then, there are various methods to allocate benefits in the main survey. The first is to use matching techniques to match households in the primary and alternate surveys, and assign each household in the main survey the benefit or tax estimated for its matched household in the alternate survey. Another, when the prediction method is used in an alternate survey, is to use only covariates common to both surveys as independent variables in the prediction, then use the coefficients from the alternate survey regression to predict the tax or benefit (or another variable, such as whether a student attended public school) in the main survey. A final method is to estimate the distribution of

\textsuperscript{40} Higgins and others (2015).

\textsuperscript{41} Higgins and others (2015, p. S30).
benefits or taxes by income quantile (for example, percentile) in the alternate survey and assign the average benefit within each quantile from the alternate survey to individuals in the same quantile in the main survey.

There are various examples of using alternate surveys combined with one of the four methods described above. A combination of an alternate survey with direct identification was used by Indonesia\textsuperscript{42}: the 2012 household survey being used for the analysis did not include a question about the main conditional cash transfer, but the 2013 survey did, so the researchers computed the distribution of benefits by region and expenditure decile in the 2013 survey and distributed benefits in the 2012 survey among eligible households within each region-decile pair. A combination of an alternate survey and simulation was used in Bucheli and others\textsuperscript{43}, who did not have an expenditure module in their main survey thus simulated benefits in an alternate expenditure survey, then allocated benefits into the main survey using the method described in box 5-4, below. A combination of an alternate survey and imputation can be used for health benefits when the main survey does not include data on the use of public health facilities, as in Guatemala\textsuperscript{44} and South Africa\textsuperscript{45}. A combination of an alternate survey, prediction, and imputation was used by Higgins and others\textsuperscript{46} for the United States, as described above.

Secondary Sources

When none of the above methods are possible, secondary sources may be used as a last resort. For example, a secondary source might provide the distribution of benefits (taxes) by quantile. These benefits (taxes) are then imputed to all households in the survey being analyzed; the size of each household’s benefits (taxes) depends on the quantile to which the household belongs. This is the approach followed by Goñi and others\textsuperscript{47} for most of the fiscal interventions and Scott\textsuperscript{48} for personal income taxes, for instance.

In the next sections, we describe in detail how to construct each income concept used in the CEQ Assessments.

Constructing Market Income

Market income should always include factor income such as wages and salaries from the formal and informal sectors (also known as earned income) and income from capital (rents, profits, dividends, interest, and so on), private pensions, private transfers (remittances and other private transfers such as alimony), imputed rent for owner occupied housing (also known as income from owner occupied housing), and the value of own production. When the microdata includes information on incomes, most of these components can be directly extracted from the household survey data; if the household survey only includes consumption data, we assume that the latter equals disposable income and work backwards to construct the “previous” income concepts (additional

\textsuperscript{42} Afkar, Jellema, and Wai-Poi (forthcoming).
\textsuperscript{43} Bucheli and others (2014).
\textsuperscript{44} Cabrera, Lustig, and Moran (2015).
\textsuperscript{45} Inchauste and others (forthcoming).
\textsuperscript{46} Higgins and others (2015).
\textsuperscript{47} Goñi and others (2011).
\textsuperscript{48} Scott (2014).
methodological details are discussed below). When the analysis relies on income data, we do not include extraordinary income from gifts (outside of remittances), the sale of durables, or any other form of dissaving. As with any other inequality or poverty analysis, this introduces a challenge when compared income-based with consumption-based analyses.

As discussed in chapter 1 and section 4 of this chapter, in CEQ we recommend running scenarios with three different treatments of contributory pensions (and hence three different definitions of market income):

(i) contributory pensions as pure deferred income;
(ii) contributory pensions as partially deferred income (when the pension system is in deficit which is funded from general revenues); and
(iii) contributory pensions as a pure government transfer.

Suppose reported income from contributory pensions for household $i$ is $P_i$.

In the first scenario, contributions to old-age pensions are treated as a form of “forced saving” and subtracted from factor incomes (plus the other components listed above) to generate market income. All of the income from contributory pensions, $P_i$, are treated as deferred factor income and, therefore, added to other forms of market income for households with members who reported receiving income from social security pensions.

In the second scenario, contributions to old-age pensions are again treated as a form of “forced saving” and subtracted from factor incomes (plus the other components listed above) to generate market income. A portion of the reported income from contributory pensions are treated as deferred factor income (the “non-subsidized portion”) and another portion of reported income from contributory pensions are treated as a government transfer. Specifically, if a proportion $d$ of the pension system is in deficit and funded by general revenues, then the $(1-d)P_i$ is considered part of market income in the contributory pensions as partially deferred income scenario. The data needs for this scenario may not be available in most cases but, when it is, it should be estimated.

In the third scenario in which pensions are treated as a pure government transfer, in order to be able to compare results with other projects such as EUROMOD, contributions are treated as a direct tax; hence, they are not subtracted from factor incomes (plus the other components listed above) to generate market income. They will be subtracted later, along with other direct taxes. All of the income from contributory pensions, $P_i$, is treated as a cash transfer.

Sometimes, the questions in the survey force the researcher to start at net market income and work backwards: for example, if the questions about income are net of taxes (which occurs in about half of the countries in CEQ), one should construct net market income with data observed in the survey, then “work backwards” and simulate the tax code to (after the next step) arrive at market income. Since the assumption that has been adopted in CEQ Assessments is that taxes paid by employers are shifted to workers in the form of lower wages, the data on wages recorded in surveys will need to be grossed up. Grossing up is the term used to

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40 Lustig and Higgins (chapter 1 in this Handbook).
explain how to calculate market income of, for example, wage earners given the assumption that the economic incidence of payroll taxes paid by employers (also known as employers’ contributions) also falls on wage earners in the form of lower market wages. In essence, we are assuming that in the absence of employers’ contributions, the market wages would have been higher by the amount of these contributions. In the surveys, reported wage income is net of these taxes (compared to the counterfactual in which the tax didn’t exist and the employer paid that additional income to the worker). Hence, market income must be grossed up by the amount paid in the tax, so that when the tax is subtracted out when moving from market to net market income, we arrive back at income net of direct taxes.

_Grossing Up_

Note that these instructions apply regardless of whether income in the survey is reported gross or net of individual income taxes paid by the employee, as grossing up will still need to be done for any employer-paid payroll taxes (since reported wages are always net of taxes paid by the employer), and other taxes that do not constitute a portion of income such as property taxes.

As a simple example, suppose employers in the formal sector must pay x% of the employee’s wage as a payroll tax. The amount of the payroll tax is calculated as x% of the employee’s reported wages, and this amount is added to the individual’s wage income to arrive at a counter-factual pre-employer payroll tax wage income. This process is known as “grossing up” because one needs to gross-up ‘observed’ market income. This counter-factual pre-employer payroll tax wage income is used in the market income aggregate. More concretely, suppose an individual reports wage income from the formal sector of $100 (gross of any taxes or contributions paid by the employee), individual income taxes paid of $10, non-wage sources of market income totaling $20, and $0 in pensions. If the employer-paid payroll tax were not considered, we would have market income plus pensions = $120, direct taxes = $10, net market income = $110. If we now consider a payroll tax paid by the employer of $8 on the employee’s income gross of any taxes paid by the employee (in this case, we have pre-payroll tax counterfactual wage income = $108 and direct taxes = $10 + $8 = $18. This gives market income = $128, direct taxes = $18, and as before net market income = $110. Grossing up should also be performed for property taxes, these should be added into market income before being subtracted out when moving to disposable income.

Some surveys include questions on the amounts paid in taxes on extraordinary income such as inheritance. In this case, it is desirable to include that tax in the analysis since the data is available and we might otherwise be missing a highly progressive tax in our analysis. However, since the extraordinary income was not included in income, while the tax is presumably paid out of that extraordinary income rather than the individual’s annual income stream, this is another instance in which market income must be grossed up: the amount paid in inheritance tax would be added into market income (and subtracted back out when moving from market to net market income). However, for comparison purposes, the author should present results without the extraordinary income and taxes as well.

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50 We are grateful to Jorge Martinez-Vazquez for feedback on how to treat taxes on extraordinary income.
Negative farm, business, and self-employed incomes

In some surveys, farm, business, and self-employment incomes can be reported as negative numbers if the interviewee’s business suffered a loss during the reference period. Leaving negative incomes in the data complicates the interpretation of results for many of our measures (for example, imagine trying to draw a Lorenz curve if income for some observations is negative). Hence, we adopt the following convention: the particular variable that has a negative value (for example, farm income) is left as negative, but if total market income ends up being negative once all income components are aggregated at the household level, then that negative market income is converted to zero. In other words, suppose labor income = $10, farm income = -$12, and other components of market income = $0. We would not truncate farm income at $0 (which would give market income = 10 + 0 = 10), but rather leave farm income = -12, and truncate market income = 10 – 12 = -2 to 0. The researcher should report the proportion of the sample which had negative market income that was then converted to zero.51

Having said this, due to the frequency of economy-wide shocks, natural disasters, and idiosyncratic shocks, negative market incomes may not be that uncommon especially in the rural areas in low income countries (or low-income regions in middle income countries). In the face of negative market incomes, poor households may be forced to sell their meager assets at distressed prices or borrow at very high interest rates. Either one would negatively affect households’ long-term welfare. The policy analyst may be interested in determining whether the country’s safety net system is able to cushion the poor and near poor from adverse shocks. Thus, it may make sense for teams to first determine the frequency of negative market incomes. If the proportion of the population that features negative incomes is, just to state a threshold, above 5 percent, the team may want to run a scenario leaving the negative market incomes as such and calculate the indicators of Fiscal Impoverishment (FI) and Fiscal Gains to the Poor (FGP)52 for the four basic income concepts to assess the extent to which the fiscal system provides an effective cushion against the shocks that leave households with negative market income.

Imputed Rent for Owner Occupied Housing

There are multiple methodologies to impute the value of owner-occupied housing. In some countries, survey questionnaires ask families who own their homes to report the amount they think they would be paying in rent for the same dwelling, or for how much they would rent it out. In the case where there is no such question, or if the authors feel that survey respondents do not have sufficient information about housing markets to answer this question reasonably accurately, or find that the distribution of values in response to this question is suspicious, the regression methodology described below can be used instead.

A standard methodology uses a regression to impute the value of owner-occupied housing. This requires that the survey contains information on how much renters pay per month in rent. For the subset of households that rent, (the log of) their monthly rent is the dependent variable in the regression. Potential independent variables include any characteristics about the dwelling, as well as log income per capita of the household. For

51 We are grateful to David Phillips for confirming that this is the method used by the UK in its household income statistics.
52 Higgins and Lustig (2016).
instance, after exploring a number of potential independent variables, we end up using the following variables for the case of Brazil: number of bedrooms, number of bathrooms, log household income per capita, rural dummy, state dummies, interaction terms between state dummies and the rural dummy, sets of dummies for whether the dwelling is a house, apartment, or room in a shared building, the material of the walls, type of sewage, presence of piped water, floor material, roofing material, and an intercept. Alternatively, Paz Arauco and others perform three separate regressions for houses, apartments, and other housing types, using similar dependent variables. The estimated vector of coefficients for households who are renters of their home, is then applied to those variables for owner-occupiers. This generates a predicted rental value for owner occupiers.

The first method requires a response to a survey question about the value of owner-occupied housing, while the second method requires that families who rent their dwellings report how much they pay in rent. If neither piece of information is available, we resort to the methodology used by SEDLAC for countries in this scenario, which only requires a question as to whether households rent their homes. By this methodology, the incomes of families who own their own homes is increased by x%; x can be ascertained from national accounts, as it was in the CEQ Assessment for Armenia.

Value of production for own consumption

The method used to determine the value of production for own consumption depends on the survey data available. Surveys with consumption data often ask whether that item was produced or purchased. The value of items that were produced by the household, taken from the household's own business inventory, or donated to the household (by someone other than the government) are included in market income as production for own consumption. Other surveys simply ask one or more questions about the total value of production for own consumption; in that case this value is added to market income. The researcher should perform a sensitivity analysis testing results both including and excluding the value of production for own consumption in the definition of income and make sure that the results including the value of production for own consumption make sense. As an example, including the value of production for own consumption in the case of Bolivia led poverty rates to be lower than in Mexico (a country with a GDP per capita roughly three times higher than Bolivia), which led us to believe that this variable was flawed and should not be used in our income aggregates.

When no variable is available to estimate production for own consumption (which is more common in less rural countries where production for own consumption is less important), it is simply not included in income.

Constructing Market Income Plus Subsidized Pensions

Paz Arauco and others (2014).
Younger and Khachatryan (2014).
SEDLAC instead sets x to 10% for all Latin American countries, which is a value that is “consistent with estimates of implicit rents in the region” (CEDLAS and World Bank, 2014, p.18).
This income concept equals market income plus the subsidized component of contributory pensions which, as discussed above, can range from zero if contributory pensions are considered to be pure deferred factor income (forced saving plus returns) to the total value of the pension if pensions are considered to be a pure government transfer. Specifically:

i) In the *contributory pensions as pure deferred income* scenario, the entire contributory pension income $P_i$ was included in market income, so subsidized pensions equal 0, and hence *market income* is equal to *market income plus subsidized pensions*.

ii) In the *contributory pensions as partially deferred income* scenario, a portion $(1-d)*P_i$ was included in market income; subsidized pensions is equal to the remaining portion of pensions, $d*P_i$.

iii) In the *contributory pensions as a pure government transfer* scenario, none of the pension was included in market income; the entire pension is considered a government transfer, *subsidized pensions* equals $P_i$.

In all three scenarios, *market income plus subsidized pensions* includes all income from contributory pensions. In the third scenario, however, contributions to pensions have not yet been subtracted out; as a result, *market income plus subsidized pensions* will be equivalent in scenarios 1 and 2, but not 3.

**Constructing Gross Income**

Gross income is constructed by adding Direct Government Transfers to the selected prefiscal income: market income plus pensions or market income.

Direct government transfers include, but are not limited to, conditional cash transfer programs, non-contributory pensions, scholarships, public works programs, and other direct transfers (which may or may not be targeted to the poor). In the case of public works programs (also known as pay for work or welfare to work programs), we include the full value of wages paid in these programs as direct transfers and do not attempt to subtract the opportunity cost of the individual's time in the contributory pensions as deferred income or contributory pensions as direct transfers scenarios; the researcher may wish to perform an additional sensitivity analysis in which they do estimate and subtract opportunity cost. Food transfers, although not cash, are considered a direct transfer because they have a well-defined market value and are close substitutes for cash. Similarly, school scholarships, school uniforms, and other near-cash benefits are treated as direct government transfers. Unemployment benefits and other benefits that might be part of the contributory system but are intended to deal with idiosyncratic shocks are also counted as direct transfers (and should therefore not be included in social security pensions which are part of market income plus pensions).

**Constructing Taxable Income**

We construct a peripheral income concept called “taxable income,” which includes only the portion of gross income that is taxable. This is useful for various reasons. First—although simulations of different taxes will include only the relevant taxable base and not the entire “taxable income” variable—it reminds the researcher not to include non-taxable income in the simulations of various taxes. Second, analyzing how certain results
(such as incidence and concentration) change when the population is ranked by taxable income can be interesting. Third, it allows us to easily compare the proportion of gross income that is taxable across countries.

It is worth noting that, although the CEQ Stata package produces all results for taxable income since it is one of the CEQ core income concepts, it does not make sense to analyze many of the results for taxable income, since taxable income could be 0 for a large proportion of the population. For example, the poverty headcount ratio using taxable income tends to be extremely high.

**Constructing Net Market Income**

One might start with net market income directly because, for example, incomes in the survey are reported net of taxes. If that is the case, as indicated above under “constructing market income”, work backwards to construct market income. Otherwise, Net market income is constructed by subtracting Direct Taxes and Contributions from market income plus subsidized pensions.

Direct taxes and contributions are personal income taxes, payroll taxes (paid by both the employer and employee, net of payroll taxes that go to the contributory pension system in the contributory pensions as deferred income scenario), and property taxes. Corporate taxes and other forms of direct taxes that are not captured by the household survey and not able to be simulated are not included in this analysis.\(^{56}\) When personal income taxes are not reported in the survey, they should be simulated based on the prevailing tax code and, importantly, tax evasion assumptions. When tax incidence is obtained by the simulation method, the latter should be described with detail, including the evasion assumptions. As a last resort, the incidence of taxes could be obtained from other studies on tax incidence for the same country.

The treatment of contributions to the contributory pension system depend on the treatment of contributory pensions:

1. In the *contributory pensions as pure deferred income* scenario, the contribution was treated as “forced saving” and, to avoid double counting income during the working and retirement years, subtracted from market income. It was already subtracted, so it is *not* included in “direct taxes and contributions”, and is *not* subtracted when constructing net market income.
2. In the *contributory pensions as partially deferred income* scenario, the treatment of the contribution is the same as in scenario 1.
3. In the *contributory pensions as a pure government transfer* scenario, for comparison with other studies, the contribution is treated like a direct tax. Hence, it was not subtracted when constructing market income. Instead, it *is* included in “direct taxes and contributions” and *is* subtracted when constructing net market income.

The burden of personal income taxes is assumed to fall entirely on labor in the formal sector, in the form of reduced wages. In other words, if a survey reports gross wages and the amount paid in taxes, the reported

\(^{56}\) For countries that are able to simulate the corporate income tax, the burden of corporate income taxes is assumed to fall entirely on capital income. It is also assumed that all financial assets (not just corporate stock) bear the tax equally. See Piketty and Saez (2007). For a CEQ Assessment that included corporate income taxes with alternative assumptions, see Higgins and others (2015).
amount paid in taxes is subtracted in full from pre-tax income. If the survey reports net wages and the amount paid in taxes, gross wages are obtained by “working backwards” and adding the amount paid in taxes to net wages to obtain gross wages. The burden of payroll taxes is assumed to be borne fully by labor in the formal sector, again recalling that market income must be grossed up to create the pre-payroll tax counterfactual.

The burden of property taxes is assumed to fall entirely on the holders of property. If there is a survey question on property taxes paid, we use this information and assume that the tax is borne by those who reported paying it in the survey. (Note that the amount of property taxes paid might be found in the consumption module of surveys that include consumption.) If there is no question on property taxes paid, information on who is a property owner and the value of their property can be used in combination with knowledge of the tax code, again assuming that the tax is borne fully by owners of property. If information about the value of the property is not available, the researcher will have to assess whether there is enough information on property ownership to simulate the tax.

Note that the base income for any tax simulations should always exclude non-taxable income, which includes but is not limited to the income we are imputing for owner occupied housing, production for own consumption, non-taxable fringe benefits, and the value of grossing up for any taxes that the individual did not pay but are assumed to be borne by the individual (for example, payroll taxes paid by employers).

Constructing Disposable Income

Disposable income is constructed by adding direct transfers (described above under “Constructing Gross Income”) to net market income, or by subtracting direct taxes and contributions (described above under “Constructing Net Market Income”) from gross income.

As we shall see below, when consumption is used instead of income, disposable “income” is set equal to consumption in the pensions as a government transfer scenario, and equal to consumption + contributions to contributory pensions in the pensions as deferred income scenario. Then, work backwards (subtract out direct transfers to get to net market income; add direct taxes and contributions to get to gross income).

Constructing Consumable Income

From disposable income (or consumption if you are using a consumption-based survey), subtract indirect taxes and add indirect subsidies. We provide some detail on estimating and allocating indirect taxes and subsidies below; for more detail, and for a description of estimating the indirect effect of indirect taxes and subsidies.  

See Jellema and Inchauste (chapter 6 of this Handbook)
Subtract Indirect Taxes

The burden of indirect taxes is assumed to fall entirely on the consumer in the form of increased prices. Strictly speaking this assumption should only be applied to nontradeable goods. If you wish to introduce a distinction between the effect of indirect taxes on tradeable and nontradeable goods, follow the methodology discussed in Coady\textsuperscript{58}. Indirect taxes should be simulated using consumption—not income—data, which requires that the survey being used contains both income and consumption data or consumption data only (or that an income-only survey is used in conjunction with a consumption survey and a matching or prediction technique to generate consumption totals by category of consumption good for each household in the income-only survey).

Tax rates for the prevailing indirect taxes (such as consumption taxes in the form of a value-added tax) are applied to each household’s reported consumption of the corresponding items. Because indirect taxes can apply to both final consumption goods and services and inputs, an input-output (IO) table should be used to determine the indirect impact of taxes on inputs on the prices of final consumption goods. For details, see Coady and others\textsuperscript{59}, for example. One clarification is in order: although we call them consumption taxes, strictly speaking we are referring to taxes on current expenditures since we do not include taxes paid on durables purchased before the survey period but partially consumed during the survey period.

Due to tax evasion or informality, which are widespread in developing countries, consumers in rural areas and those who purchase from informal sellers (for example, street vendors, farmers’ markets, and so on—when the survey contains a question about place of purchase) might not directly pay indirect taxes. Rajemison, Haggblade, and Younger show that using statutory rates can overestimate the impact of indirect taxes on incomes. Where estimates are available or can be calculated, effective tax rates reflecting the rates paid in reality—rather than the legal rates, which overestimate actual collection of indirect taxes—should be used.

Box 5-3 shows how Aristy-Escuder, Cabrera, Moreno-Dodson and Sanchez\textsuperscript{60} included assumptions on the evasion of indirect taxes in their study.

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Box 5-3: Inclusion of the assumptions of evasion in the Tax on the Transfer of Industrialized Goods and Services (ITBIS) of the Dominican Republic

Aristy-Escuder, Cabrera, Moreno-Dodson & Sanchez-Martin

Evasion of the ITBIS is a problem to take into account in the Dominican Republic. According to estimates of the General Directorate of Internal Revenue (DGII), for the year 2010, around 29.7% of this tax was evaded. Therefore, it’s considered important to incorporate an adjustment for evasion in the estimation of the CEQ.

Following consultations with experts of the DGII, estimates were obtained of the cash payment of taxes for a specific group of products. Nevertheless, the coverage of these estimates was limited. Thus,

\textsuperscript{58} Coady (2006).
\textsuperscript{59} Coady and others (2006).

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for the rest of the products we made assumptions about taxes paid. From this analysis, we identified that for some goods taxes are generally paid in full, while other goods completely evade and taxes, and for other goods, the evasion or payment of taxes depends on the location of the purchase. Therefore, we grouped consumption goods into four categories:

Highly probable that they will not pay taxes (100% evasion in the purchase of these goods)

Highly probable that they will pay taxes (0% evasion in the purchase of these goods).

Those which have information from the DGII about the proportion of the payment of taxes (we applied the effective rate of the payment of taxes).

Those for which the assumption of the payment of taxes is conditional upon the location of the purchase (evasion conditional upon the location of purchase and the area of purchase—urban or rural).

To realize these adjustments, we used two additional files. The first contains every one of the goods included in the survey and is classified into one of the four previously described categories (code of the product and group of products). The second file defines if the product evades or pays taxes according to the location of the purchase, for those cases where evasion is conditional. With this information we estimated the amount paid in tax (ITBIS) for every good consumed by the households represented in the household income-expenditure survey.

A simpler, but less accurate, option than the one described in box 5-3 is to assume that people living in rural areas or who purchase from informal sellers do not pay consumption taxes. However, even if they might not directly pay indirect (consumption) taxes, they cannot be assumed to have paid no indirect tax because of the indirect effects of indirect taxes on inputs. Hence, an IO table should be used. For details, see Jellema and Inchauste\textsuperscript{61}, as well as Coady and others and Coady\textsuperscript{62}. Goods that are exempt from consumption taxes should also include the indirect effects of indirect taxes on inputs, again computed using an IO table. Only goods that are taxed at zero-rate can be assumed to involve no indirect taxes since producers are reimbursed for any taxes paid on their inputs.

Once effective rates for different groups of consumption goods have been calculated using an IO table, the next step depends on the type of survey data available—in particular, whether the survey has consumption data only or both consumption and income data. (The latter also includes income-only surveys if they are matched with a consumption survey to generate consumption totals by category for each household, or used in conjunction with a consumption survey to predict consumption of various categories in the income-only survey.) In either case, suppose that consumption goods have been divided into $K$ groups, with tax rates $t_k$ and denote the post-tax (including the cost of taxes) amount spent on consumption of goods in category $k$ by

\textsuperscript{61} Jellema and Inchauste (chapter 6 in this Handbook).

\textsuperscript{62} Coady and others (2006); Coady (2006).
household $i$ as $c_k$. (We omit the $i$ subscript for simplicity.) Given that we have defined $c_k$ as post-tax spending, the amount of spending on category $k$ net of taxes is $c_k/(1 + t_k)$.

For a survey with consumption data only (or income and consumption data when consumption is being used as the measure of well-being), the total amount spent on indirect taxes is calculated as $\text{IndT} = \sum_{k=1}^{K} t_k c_k/(1 + t_k)$ and this amount is subtracted from total consumption when moving from disposable “income” (that is, consumption) to consumable “income.”

For a survey with income and consumption data (or where consumption by category is generated by matching/prediction with an alternate survey) when income is being used as the measure of well-being, subtracting $\sum_{k=1}^{K} t_k c_k/(1 + t_k)$ from income when moving from disposable income would be problematic for two reasons. First, we would be measuring the incidence of consumption taxes as a percent of income, which could make them appear regressive even if their incidence is progressive when measured as a percent of consumption. Second, some observations in household survey microdata have reported consumption that is much higher than reported income, either due to underreporting of income, dissaving, or borrowing. Some of the households with consumption much higher than reported income end up with negative consumable income if we simply subtract $\sum_{k=1}^{K} t_k c_k/(1 + t_k)$ from disposable income. Thus, for a survey with income and consumption data when income is being used as the measure of well-being, we follow IDB and estimate indirect taxes as

$$\text{IndT} = \frac{\sum_{k=1}^{K} t_k c_k}{\sum_{k=1}^{K} c_k} \times y^d$$

where $y^d$ denotes disposable income. Note that the first term on the right hand side of the equation gives the proportion of post-tax consumption that is spent on consumption taxes, which is then multiplied by disposable income to get an income-based total amount spent on consumption taxes. The denominator of the first term uses total post-tax consumption, $\sum_{k=1}^{K} c_k$, as this measure is comparable to disposable income (since the disposable income spent on consumption must be large enough to also incur consumption taxes on that consumption).

For example, suppose there are two goods: bread and fuel. The effective tax rate (including direct and indirect effects) on bread is 5% and on fuel is 10%. A household at the lower end of the income distribution has reported disposable income of $10, reported consumption of bread as $8, and reported consumption of fuel of $12. Reported consumption exceeds reported income, which often occurs at the lower end of the distribution, perhaps because the household is borrowing or dissaving to meet its consumption needs or perhaps because of errors in reporting one of them. Rather than computing indirect taxes as $0.05 \times 8 + 0.10 \times 12 = $1.60, and calculate the rate of paid indirect taxes as $1.60/10$ and hence state that the household pays 16%
of its income in indirect taxes (which is higher than the effective tax rate for both bread and fuel!), we would calculate the percent of consumption paid in indirect taxes as \(0.05 \times 8 + 0.10 \times 12)/(8 + 12) = 0.08\) (8%) and then multiply this by disposable income to arrive at total indirect taxes paid of 0.08 \times 10 = $0.80. Although this is not the actual amount of indirect taxes paid, it allows us to correctly estimate the progressivity of indirect taxes.

In the absence of consumption data in the main survey, one can resort to an alternate survey and use prediction to generate consumption data. Box 5-4 describes how it was done for the CEQ Assessment for Uruguay.

### Box 5-4: Example of one way to generate Indirect Taxes in the absence of Consumption Data, by Marisa Bucheli

The household survey used for the analysis in Uruguay has data on income only. In order to estimate the indirect taxes paid by each household, we use the National Household Income and Expenditure Survey (Encuesta Nacional de Gastos e Ingresos de los Hogares; EGIH) collected by the National Institute of Statistics (Instituto Nacional de Estadística; INE) between November 2005 and October 2006. We identify fifty-two consumption baskets using two criteria: a high substitutability and the same tax rate. For each basket we run a multiple regression with household spending on each basket of goods as the dependent variable and a set of independent variables that are available both in EGIH and ECH, such as the household income, the size of the household, the average years of schooling of the adults of the household, a deprivation index, the total hours worked in the labor market by all the members of the household, the Other direct transfers (equivalent to 1.0 percent of GDP in 2009, participation of age-groups by sex in the household (we consider teenage groups), and a set of regional dummies. The first five variables are introduced as a third-order polynomial to have a more parsimonious functional form. Using the coefficients from these regressions, we estimate the consumption on each of the fifty-two baskets for the ECH. We then estimate the indirect taxes assuming no evasion.

When the survey has income data only and no alternate consumption survey is available, secondary sources may be used. For example, a secondary source might provide the percent of consumption spent on indirect taxes by consumption decile. (Note that for the same reasons discussed above, the secondary source should give the percent of consumption spent on indirect taxes, not the percent of income spent on indirect taxes.) This percent by decile is then applied to the disposable income of each individual in the corresponding consumption decile (not income decile; this may require calculating a new variable that denotes each household’s placement in the distribution of consumption) from the CEQ analysis to obtain her spending on indirect taxes. The implicit assumption being made when one uses indirect taxes by consumption decile is that everyone in that consumption decile pays the same proportion of their consumption (equal to the average over the decile) in indirect taxes.

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65 Bucheli and others (2014).
Add Indirect Subsidies

Indirect subsidies can be on final consumption goods and services or on inputs. Consumption subsidies of a fixed percentage can be measured in the same way as consumption taxes described above. Price subsidies on inputs will be passed on to consumers through the cost structure of final consumption goods, both directly and indirectly, which is why we use an IO matrix to measure their impacts on the prices of final goods. Distinctions between tradeables and nontradeables are analogous as well. More details for specific types of subsidies are given below.

It is important to note that the definition of subsidy used here is not equivalent, for example, to the definition used by the World Trade Organization. For the purposes of fiscal incidence analysis, a subsidy refers to a benefit that affects the relative price of the subsidized good or service. Although, given our assumption of perfectly inelastic demand for goods and services, the effect of a subsidy on a person’s income is equivalent to that of a transfer, it is preferable to keep the benefits that operate through the price system separate for two main reasons. First, to facilitate comparability with other indicators of inequality and poverty which practically never are calculated on an income concept equivalent to our consumable income. Estimates of inequality and poverty are usually done using disposable income or private consumption, both of which do not subtract indirect taxes and add indirect subsidies. Second, keeping them separate will facilitate the incorporation of behavioral responses in the future.

Fuel subsidies

If the government subsidizes petroleum products, the incidence of these subsidies should be estimated and their value should be added into income when moving from disposable to consumable income. In many cases, the indirect effects of fuel subsidies (through their effect on the prices of goods for which fuel is an input) are larger than the direct effects, so they should be included in the analysis. The method for doing this is described in Jellema and Inchauste.

Household energy subsidies

In some countries, the government directly subsidizes electricity prices for households who consume low enough amounts of energy, often using an inverted block tariff (IBT) structure. When these subsidies are provided for household energy consumption only, estimating the first-order direct effects is sufficient. Consider the example of Brazil, where the Social Tariff on Electric Energy (TSEE) is an IBT price subsidy on energy. In 2009, eligible households consuming less than 30 kWh per month received a 65 percent discount.

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66 Unlike the Tokyo Round Subsidies Code, the WTO SCM Agreement contains a definition of the term “subsidy”. The definition contains three basic elements: (i) a financial contribution (ii) by a government or any public body within the territory of a Member (iii) which confers a benefit. All three of these elements must be satisfied in order for a subsidy to exist. (Source: https://www.wto.org/english/tratop_e/scm_e/subs_e.htm)

67 Coady and others (2006).

68 Jellema and Inchauste (chapter 6 in this Handbook).
households consuming over 30 but less than 100 kWh received a 40 percent discount, and households consuming between 100 kWh and 220 kWh received a 10 percent discount; households consuming more than 220 kWh were charged market price. Note that inverted block tariffs can also require household consuming above a certain amount to pay higher than market price, to cross-subsidize those who are paying below market price. In this case, the amount each household pays above market price should be calculated using the same method as described below, and treated as an indirect tax.

If the survey provides data on the total kilowatt hours consumed by the household, then it is straightforward to classify each household by their consumption level, which determines the proportional subsidy they receive according to the tariff rule. Then, we multiply this proportional subsidy by the amount they spent on electric energy to get the value of the subsidy. If, however, the survey provides data on the total spent on electricity but not the total kilowatt hours consumed, the latter must be calculated. We will illustrate with an example from Brazil. Denote the market price of electricity as $p$ per kWh. If households consuming less than 30 kWh per month receive a 65% discount as in Brazil, then any household spending less than $(1 - 0.65) \times 30p$ a month on electricity would be assumed to have received the 65% subsidy. Suppose the household reported spending $c < (1 - 0.65) \times 30p$ for the month; the direct effect of the subsidy (the benefit to be allocated to the household) would be calculated as $(0.65/(1 - 0.65))c$. Continuing with the Brazil example, recall that households consuming between 30 and 100 kWh per month receive a 40% discount. Thus, any household reporting spending $c$ greater than $(1 - 0.65) \times 30p$ per month but less than $(1 - 0.40) \times 100p$ per month would be assumed to have received the 40% subsidy, and the direct effect would be calculated as $(0.40/(1 - 0.40))c$. Following this method, the amount of benefits we allocated for household energy subsidies was 77% of the amount spent according to national accounts; the discrepancy might be accounted for by leakages—our simulation assumed perfect coverage and no leakages.

Note that a tool for simulating subsidies—which include household energy subsidies with an inverted block tariff structure—is described in Araar and Verme.

Agricultural subsidies

The incidence of benefits of agricultural subsidies will depend on the elasticity of demand for the agricultural products. If demand is perfectly elastic, the benefit will accrue entirely to the producer, in which case benefits would be imputed based on survey questions revealing who produces the subsidized goods. If it is inelastic, it will accrue entirely to the consumer, in which case the benefits can be estimated using an input-output table as they would be for other subsidized goods, using the method described above. The method to impute

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69 This is a simplification of the actual system for illustrative purposes. See Higgins and Pereira (2014) for more details.
70 Higgins and Pereira (2014).
71 Note that there are tranches of spending amounts that do not coincide with the IBT schedule: for example, if the household reports spending $c$ such that $(1 - 0.65) \times 30p < c < (1 - 0.4) \times 30p$, their total spending $c$ is not possible given the discontinuous IBT schedule. The value they reported for $c$ could be due to misreporting, or for example that the survey’s reference period does not coincide with the billable month. We have arbitrarily chosen to place individuals in this category with the group who received the 40% subsidy; they could also have arbitrarily been placed in the group who received the 65% subsidy.
72 Araar and Verme (2012).
agricultural subsidies will depend on the nature of these subsidies and the demand for the products whose inputs are subsidized.

Subsidies on agricultural inputs: an exception

When production and consumption decisions are intertwined as happens with small subsistence farmers in developing countries, subsidies to inputs should be treated as direct transfers rather than a subsidy (even though they are not strictly “cashable”). In essence, we are assuming that the subsidies to agricultural inputs are "inframarginal" (people were going to buy the inputs anyway). Subsidized or free inputs make the net income of farmers/peasants higher than otherwise. This means that the subsidies to inputs need to be added to get the "true" market income (which without the "transfer" that comes with these subsidies would have been lower).

Housing Subsidy

Impute the in-kind value received by those who live in publicly (fully or partially) subsidized housing. Ideally, the survey will include information on who lives in subsidized housing and, if it is only partially subsidized, how much they paid in rent. The market value of their subsidized housing can be determined using a regression methodology (similar to the regression methodology described to impute the value of owner-occupied housing under the section Imputed Rent for Owner Occupied Housing). If housing is only partially subsidized, the amount they pay in rent should be subtracted from this total. For the observations for which this method results in a negative value, it should be replaced by zero; however, if a negative value results for many observations, this could be an indication that the linear model used to predict housing values is not a good fit and should be revisited.

Constructing Final Income

Add In-kind Transfers

Allocating benefits from public spending on government services such as education and health is not straightforward. The options are summarized by Bastagli73 as follows:

“Studies on the distributive impacts of government services may value these at their production costs, at their opportunity cost in the private sector or at household’s willingness to pay. A basic definition utilised for the unit cost of providing a service is as total government spending on a particular service divided by the number of users of that service. An alternative to production costs is to value services by what an individual would

73 Bastagli (2015, p.12).
have spent if similar services had been bought on the market or on the willingness to pay for them, but the information requirements of these approaches are demanding.”

In the current version of the CEQ Assessment, the value of in-kind transfers is based on production costs. Details, by category of in-kind transfer, are given below. It is important to note that the concept of final income does not include the value of government services that benefit entire communities such as rural roads, water and sanitation, access to electricity and other types of infrastructure. While these are clearly very important in terms of enhancing the welfare and productivity of households, it is difficult to impute a monetary value on them.

Education

From national accounts, obtain public spending per student by level (pre-school, primary [lower and upper if applicable], secondary [lower and upper if applicable], tertiary [university and technical if applicable]); these totals could be further disaggregated, for example by state if available. The spending amount should include administrative costs and both recurring and investment spending. Provide the definition of each level (the corresponding grade levels and age groups). For students who report attending public school, depending on the level they report attending, use the average public spending per student for that level as the valuation of their in-kind benefit from public education, which is added into income when moving from consumable to final income. In addition to having a variable for in-kind education benefits, the researcher should create separate variables for benefits at each level (a variable for pre-school education benefits, another for primary education benefits, et cetera).

If the main survey being used does not have data on whether school attendance was at public or private institutions, the researcher should search for an alternate survey with data on income and on whether school attendance was at public or private. For example, the survey used for our incidence study in the United States— the 2011 CPS—did not include a question about whether school attendance was public or private. We estimated the probability of attending public school for each student attending school in the CPS by using another survey, the 2011 American Community Survey (ACS), which contains variables on public and private school enrollment and income. We performed a probit regression on the population of students attending school, with a dummy variable for attending a public school as the dependent variable and per capita income, race, state, age, and highest level of education in the household as independent variables. The coefficients from this regression were then applied to the same variables in the CPS data to estimate the probability of attending public school for each student attending school. The average amount of education spending per pupil by state was then multiplied by the predicted probability of attending public school to get the expected in-kind education transfer for each student attending school; this expected benefit was then scaled down using the method described above.

Note that in the CPS we don’t know which students attended public school so we are not imputing the full (scaled down) value of per pupil spending to anyone; by multiplying each student’s predicted probability of attending public school by per pupil spending, we are assigning each student the expected value of their in-kind education benefit. As a check of our method, we verify that the average predicted probability from

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74 Higgins and others (2015).
applying the coefficients of the ACS survey to the CPS data is almost identical to the proportion of students attending public school (according to both ACS and administrative data). We also verify that total (scaled down) in-kind education benefits using this method is approximately equal to total (scaled down) education spending in national accounts.

Scaling down education benefits

This method for imputing education transfers will overestimate their redistributive effect, as the monetary value of the transfers received by households is obtained from the budgetary cost of providing these transfers as reported in national accounts, while the totals of other taxes and transfers are not “forced” to be equal to the values in national accounts (and tend to be smaller according to the survey). To correct, for this, we scale down these benefits as follows.

First, obtain a national accounts estimate of disposable income (or total consumption if the analysis uses consumption rather than income data). For each category of education spending, take the ratio of total education spending in that category from national accounts to disposable income in national accounts, and then scale down each category of education benefits in the survey so that the ratio of each category of education benefits in the survey to disposable income in the survey equals the corresponding ratios from national accounts.

In previous iterations of CEQ (in particular, in the working papers for Latin American countries published before August 2013 and the special issue of Public Finance Review), rather than scaling down in-kind benefits to avoid overestimating their redistributive impact, we scaled up all other income components item by item for calculations of inequality and redistribution (but not poverty). In other words, each component had its own scaling up factor based on total income from that component in the survey compared to total income from that component according to national accounts. However, in consultation with numerous experts of incidence analysis, we have switched to scaling down the in-kind benefits because of its numerous advantages. First, it requires less information from national accounts; in some countries all of the information necessary to scale up item by item is not available. Second, in many countries, national accounts totals for particular income components are measured with a great deal of noise, so scaling up each income component by its own factor introduces noise into our calculations. Third, scaling down in-kind benefits avoids any confusion that arose under the previous methodology of which calculations required the use of scaled up income and which required the use of non-scaled income.

Health

Bastagli identifies two general approaches to allocate in-kind health benefits to individuals and households: the ‘actual consumption approach’ and the ‘insurance value approach’. The first approach allocates the value of public services to the individuals that are actually using the service. Second approach assign the same per capita spending to everybody sharing the same characteristic such as age, state, type of care, gender et cetera

\[75\] This section is largely based on O'Donnell and others (2008, chapter 14).
\[76\] Bastagli (2015).
The reliance on one approach over the other depends, mainly, on data availability. As Bastagli\(^{77}\) noted, when identification of beneficiaries is not straightforward, studies “may rely on characteristics of individuals and households rather than actual use of services on the assumption that the probability a person will access these services is the same as that prevailing for others with the same characteristics”.\(^{78,79}\)

To impute the value received from public health services, the household survey must have information about the use of health services, and distinguish between public care (which is usually services received from the public health system or paid for by public health insurance schemes) and private care. In the absence of information about whether the care received was subsidized by government health spending, a survey question about whether the patient is covered by private insurance can be used as a proxy; patients who received health care and report having private health insurance are considered to have received private care, and thus received no in-kind transfer, and patients who report not having private health insurance are considered to have received public care. Ideally, the survey will also contain one or more questions about the type of service received.

If this information is not available in the survey being used, another survey that has information on both income and utilization of public health services – such as a health survey – should be used. In this case, to calculate final income one must then treat the results from the alternate survey similarly to a secondary source and impute values by quantiles (for example, ventiles [groups of 5 percent of the population]) back into the original micro-data.

In addition to data on the use of public health services and the type of services received, data on total government spending on each of the different types of health services in the household survey is required. Some level of disaggregation by type of service received (at a minimum, distinguishing between in-patient and out-patient care) is required, in order to account for the fact that the value of a medical check-up is different from the value of a hospitalization. This data should also be disaggregated by region or state when possible to account for differences in the quality of health services across regions. Data that is disaggregated as described above is generally not available in the main source of public accounts (for example, from the treasury or ministry of development), but can be obtained instead from national health accounts (for example, from the health ministry). The spending totals should include administrative costs and both recurring and investment spending.

In the event that the care received is partially but not fully subsidized, the amount paid for care by the individual or by private health care providers should be subtracted from the total benefit received by that individual. If public health care in the country being studied is, in general, not fully subsidized (for example, there is not a universal free health care system) but the household survey does not ask how much each individual paid for the service they received or how much was not covered by the public health insurance scheme, each individual’s payment can be calculated as the average payment for that service; it is calculated as the total payment from individuals and private health insurers to the state for that service (available in national health accounts) divided by the total number of individuals receiving that service according to the household survey.

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\(^{77}\) Bastagli (2015).

\(^{78}\) Demery (2003);

\(^{79}\) OECD (.2015); chapter 7.
The total annualized net health benefits received by an individual are thus defined as

\[ h_i = \sum_k \alpha_k \left[ q_{ki} \left( \frac{S_{kj}}{\sum_{i' \in j} \omega_i \alpha_k q_{ki}} \right) - f_{ki} \right] \]

where \( q_{ki} \) indicates the number of times that individual \( i \) received care type \( k \) during the recall period, \( S_{kj} \) is the total spending (according to national health accounts) on service \( k \) in the region \( j \) where \( i \) resides, \( i \in j \) indicates that we are summing over all individuals in region \( j \), \( \omega_i \) is the expansion factor corresponding to observation \( i \), and \( \alpha_k \) is the “annualization factor”: for services that have a recall period of one year on the questionnaire (for example, “How many times in the last year did you receive service \( k \?”), \( \alpha_k = 1 \); for services that have a recall period of four weeks, \( \alpha_k = 13 \), et cetera.

Finally, \( f_{ki} \) is the user fee paid by individual \( i \) for service \( k \). In the case of a health system with no user fees, we normally use \( f_{ki} = 0 \) (regardless of whether the system is fully or partially subsidized, because the level of subsidization would already be captured by the term \( S_{kj}/\sum_{i' \in j} \omega_i \alpha_k q_{ki} \)) unless other costs such as waiting times are being incorporated in the analysis. When user fees exist, if the survey asks individuals how much they paid for that particular service or has information (sometimes found along with other consumption questions) about how much they paid in health costs, \( f_{ki} \) can be determined from the survey. Note that \( f_{ki} \) could still equal zero for some \( i \), for example for poor individuals if there are fee exemptions for the poor. In the absence of such survey information, one can determine the average health user fee per visit, \( \bar{f} \), as \( \bar{f} = \frac{N_k}{\sum_k \sum_{i' \in j} \omega_i \alpha_k q_{ki}} \), where \( N_k \) is total user fee revenue, reported in public accounts or national health accounts. In other words, \( \bar{f} \) is total user fee revenue divided by the total number of times all individuals in the country utilized any type of public health service. To complete the calculation of total annualized health benefits received by an individual, one would then replace \( f_{ki} \) in the above equation with \( \bar{f} \).

Scaling down health benefits

The above method for imputing health transfers will overestimate their redistributive effect, as the monetary value of the transfers received by households is obtained from the budgetary cost of providing these transfers as reported in national accounts, while the totals of other taxes and transfers are not “forced” to be equal to the values in national accounts (and tend to be smaller according to the survey). To correct, for this, we scale down these benefits as follows.

First, obtain a national accounts estimate of disposable income (or total consumption if the analysis uses consumption rather than income data). Take the ratio of health spending by category in national accounts to disposable income in national accounts, and then for each category of health spending, scale down the health benefits in the survey so that the ratio of that category of health benefits in the survey to disposable income in the survey equals the corresponding ratio from national accounts.
Additional concerns for in-kind transfers

In countries with a contributory public health insurance scheme, we are also interested in knowing the concentration of coverage, so the concentration coefficients and coverage and leakages sheets of the MWB (sheets D8 and D9, respectively) include a row for Contributory Public Health Insurance in addition to the row for Health Spending. The latter is based on use, using the total annualized health benefits, $h_t$, calculated as explained above. The former is calculated using a variable equal to zero for individuals not covered by the contributory public health insurance schemes and equal to the value of a basic health package for covered individuals.

In the construction of final income, the method for education spending consists of imputing a value to the benefit accrued to an individual of going to public school which is equal to the per beneficiary input costs obtained from administrative data: for example, the average government expenditure per primary school student obtained from administrative data is allocated to the households based on how many children are reported attending public school at the primary level. In the case of health, the approach was analogous: the benefit of receiving healthcare in a public facility is equal to the average cost to the government of delivering healthcare services to the beneficiaries.

The approach to valuing education and healthcare services amounts to asking the following question: how much would the income of a household have to be increased if it had to pay for the free or subsidized public service (or the insurance value in the cases in which this applies to healthcare benefits) at the full cost to the government? Such an approach ignores the fact that consumers may value services quite differently from what they cost. Given the limitations of available data, however, the cost of provision method is the best one can do for now. For the readers who think that attaching a value to education and health services based on government costs is not accurate, the method applied here is equivalent to using a simple binary indicator of whether or not the individual uses the government service. Appendix F by Jeremy Barofsky describes the pros and cons of three methods that can be used to value the distributional impact of health spending: average cost, behavioral-outcome approach, and willingness to pay.

The production costs approach does not take into account variations in need across income groups, does not consider service quality and may not reflect the actual valuation by beneficiaries. Distributional analysis of in-kind transfers may reveal that poorer households gain larger shares of particular categories of public spending than higher-income households. Since the main beneficiaries of public education services (children) and public health care services (elderly) are disproportionately located in the lower half of the income distribution, assessments based on the standard approach of static incidence analysis using per capita income

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80 By using averages, it also ignores differences across income groups and regions: for example, governments may spend less (or more) per pupil on poorer students. We recommend averaging at as disaggregated a level as possible (not only by education level but also by state and rural/urban area within states, for example); the level at which it is possible to disaggregate will depend on data from national accounts. Data obtained from the education ministry is likely to be more disaggregated than that obtained from other national accounts.

81 This is of course only true within a level of education. A concentration coefficient for total non-tertiary education, for example, where the latter is calculated as the sum of the different spending amounts by level, is not equivalent to the binary indicator method.

82 Barofsky (2015).

83 Atkinson and Bourguignon (1990); OECD (2015); Sahn and Younger (2000).
as the underlying welfare measure may show for some countries that in-kind transfers reduce inequality, but ignore the question of demographic and needs variations across socioeconomic groups.

5. Construction of Income Concepts in Practice: Additional Methodological Challenges

Using Consumption Instead of Income

In the literature on incidence analysis, both income and consumption have been used as the basic welfare indicator. Typically, the incidence of direct taxes and transfers is calculated using income, while for the incidence of indirect taxes and subsidies, some authors recommend using consumption (for example, Abramovsky, Attanasio, and Phillips84). However, for a comprehensive analysis, one or the other must be chosen as the indicator of wellbeing.85 Some thoughts on the choice between income and consumption are given in box 5-5.

Box 5-5: On using consumption or income

Gary Burtless, Senior Fellow and John C. and Nancy D. Whitehead Chair, Brookings Institution

Ideally, lifetime consumption (or consumption per year) would be the best measure for an incidence analysis, mainly because it represents our best gauge of long-term well-being. However, this measure is not practical given the data limitations we face in every country, rich and poor. If we use an annual measure of income or consumption our choice should be guided by the best (meaning “most accurate available”) basic source of data available to us. This will vary by country and probably by income class within a country. The most accurate information is likely to be that which is easiest for household heads to report. In rich countries, a lot of evidence suggests it is easier to report income sources (since most households have few of them) than it is to report consumption (which has many categories and time frames, and consequently is very hard for people to report accurately). In poor countries it is easy to believe that a large proportion of people will find it easier to report consumption than income, since income may fluctuate much more than it does in rich countries and be derived from many sources (including irregular transfers from or to family members outside the household). Of course, in many countries the available distributional information will be constrained by the actual surveys that have

85 Coudouel, Hentschel, and Wodon (2002) argue that consumption is a better measure for a number of reasons. Although both are underreported (Brewer and O’Dea, 2012), there is substantial evidence that consumption is better measured for the poor (Meyer and Sullivan, 2003). Consumption is smoothed to a greater degree than income (although income is also smoothed, even among the agricultural workers who are often used as an example of people facing volatile incomes; see Murdoch (1995)). A main advantage of income, also noted by Coudouel, Hentschel, and Wodon (2002), is that it can be disaggregated by source, which can be especially appealing for a fiscal incidence analysis.
When consumption is chosen, for example because income data are unavailable or unreliable, we equate consumption to disposable “income”. When pensions are treated as deferred income rather than a government transfer, and hence contributions to public contributory pensions never subtracted out of income, for theoretical consistency between the income- and consumption-based income concepts, these contributions should be added to consumption before equating it to disposable income. In other words, consumption + contributions to contributory pensions = disposable “income”.

Note that in theory, consumption is equal to expenditures on non-durables plus consumption of own production plus the flow value from use of durables owned by the household. In practice, we include imputed rent for owner’s occupied housing (explained in greater detail below) but do not calculate the imputed value from use of other durables owned by the household. Although the latter should be included from a theoretical standpoint, it requires information about the value and age of assets owned, or at a minimum on assets owned and average prices for these assets. If you have reliable data to estimate the value from use of assets other than housing, you can perform an additional sensitivity analysis including these components in income. If you use consumption do not include the value of consumer durable purchases (whether in cash or credit) because these are extraordinary expenditures. Similarly, the sale of these items is not included in the income aggregate since it represents extraordinary income.

After equating consumption to disposable “income”, one must “work backwards” to construct net market “income”, gross “income”, market “income” plus pensions, and market “income”. From disposable “income”, subtract out transfers to get to net market “income” since net market income + transfers = disposable income ⇒ disposable “income” – transfers = net market “income.” Note that in rare cases, this might result in a negative net market income, in which case we truncate net market income at 0. Similarly, we add taxes to disposable “income” to obtain gross “income”. Market “income” plus pensions is constructed by adding direct taxes to net market “income” or subtracting transfers from gross “income”. Market “income” is constructed by subtracting pensions from market “income” plus pensions. As for net market “income”, if subtracting pensions or transfers results in negative income at any of these stages, we truncate income for those

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86 Some have suggested that consumption should be equated to consumable rather than disposable income. The reason we equate consumption to disposable (rather than consumable) income is as follows. First note that consumable income = disposable income - indirect taxes + indirect subsidies, or equivalently disposable income = consumable income + indirect taxes - indirect subsidies. Since consumption reported in the surveys is based on prices that include indirect taxes (and are net of indirect subsidies), we should be equating it to disposable income which also includes indirect taxes and is net of indirect subsidies based on the second equation above. To illustrate the point about indirect subsidies, suppose a person pays $10 for their electricity bill, which actually has a market value of $15, where the government is subsidizing the extra $5. In the survey the person will report what they spent, which is $10. So we need to equate reported consumption with disposable income, and then we will add in the $5 indirect subsidy when we move from disposable to consumable income.

87 These cases are indeed rare in the contributory pensions as deferred income scenario: for example, in a study for Armenia, this only occurred with four observations. However, in the contributory pensions as transfers scenario, it is more common because contributory pensions need to be subtracted when moving backwards from disposable to net market income since they are assumed to be a government transfer, and pensions can be quite sizeable.
households at 0. Note that this truncation will cause income concept identities, such as net market income + transfers = disposable income, to no longer hold.

To determine direct taxes paid, information on labor income and property ownership would be necessary. If the survey has consumption data only and does not contain information on labor income, the preferred option is to an alternate survey that does have data on labor incomes and other characteristics, then map the estimated taxes in the alternate survey back to the primary data set using matching methods.

An alternative, if an alternative survey with reliable labor income data is not available, or if there is no way to reliably match these into the primary data set, is to predict the proportion of net market “income” (disposable “income” [= consumption, possibly + contributions to contributory pensions, depending on the treatment of pensions] + direct transfers) that comes from wages vs. self-employment income. To do this, regress consumption per capita on various household-level variables including the number of wage earners, average education of wage earners, average age of wage earners, number of self-employed, average education of self-employed, and average age of self-employed. These coefficients can be applied to the corresponding variables in each household to predict the proportion of consumption from wages (this would equal the coefficients for the first three explanatory variables times the values of these variables for the household, divided by their total predicted consumption) and the proportion of consumption from self-employment (this would equal the coefficients for the latter three explanatory variables times the values of these variables for the household). Once the proportion of consumption attributable to wages and self-employment income has been determined, individual income taxes can be estimated to “work backwards” to market income, using the rules of the tax rates on wages and self-employment income.

The final, least preferred option is to use secondary source estimates of direct taxes paid by consumption decile.

When only consumption data is available, an alternative to equating consumption to disposable income is to attempt to account for savings. Because savings data in developing countries are notoriously bad, we do not attempt to account for savings in the contributory pensions as deferred income scenario. However, the authors may wish to perform an additional sensitivity analysis in which they do account for savings. If data is available on savings rate by consumption decile (or other population group), one can add the appropriate percentage of imputed savings to households at each consumption decile. Note that when this is done, households’ consumption rank should be measured in the same way—to the extent possible—as it was by the secondary source from which the savings rates by decile was obtained. In other words, if the secondary source did not include imputed rent for owner occupied housing in their consumption variable, the researcher should create a new consumption variable to match the secondary source’s and determine households’ consumption deciles by this new variable, solely for the purpose of allocating indirect taxes (for other calculations, the researcher would use the income or consumption variable they had constructed following the instructions in this MWB).

Underestimation of Beneficiaries
The number of beneficiaries of targeted anti-poverty programs is often underestimated when compared to national accounts. For example, in Brazil, the number of beneficiary households of Bolsa Família according to the Pesquisa de Orçamentos Familiares is 7.3 million, compared to 12.4 million beneficiary households in 2009 according to the Ministry of Social Development.\textsuperscript{88} If the number of beneficiaries according to national accounts can be trusted to reflect the true number of beneficiaries (for example, if the government publishes a list of beneficiaries as in Brazil), then the program’s coverage and impact will be underestimated by the survey if no correction is made.

Below we recommend a method to adjust for the underestimation of beneficiaries. The choice of whether to use the method will depend on the nature of the program and the reliability of national accounts in the country. Ideally, results should be presented both with and without the adjustment as an upper and lower bound on the number of beneficiaries.

To “impute” likely beneficiaries who did not report receiving the benefit, and match the number of beneficiaries in the survey to the number in national accounts, we follow the methodology suggested by Souza, Osorio, and Soares.\textsuperscript{89} This method assumes that the beneficiaries who reported receiving the benefit are similar to those who did not report receiving the benefit in terms of the distributions of their incomes and characteristics; if data is available from national accounts or administrative data on the characteristics of all beneficiaries, this assumption can be checked by comparing these characteristics to the ones of the beneficiaries who reported receiving the benefit in the survey. Let the number of recipient households identified using this method be $S$, and the (larger) number of recipient households in national accounts be $N$. Finally, let the difference between the number of beneficiaries reported in national accounts and the number reported in the survey be denoted $T \equiv R - F$. The next step is to “identify” the $T$ remaining beneficiary households in the survey. This is done by creating a propensity score for program participation for every household in the survey by running a probit of program participation against household income, possession of various household assets and consumer durables, number of children, race of household head, region or state, rural or urban area, et cetera Then $H$ households are randomly sampled out of the $S$ beneficiary households, and these $H$ beneficiary households are matched to $H$ non-beneficiary households with the closest propensity scores. Program benefits are then imputed to the matched households—the amount of benefit imputed is equal to the amount received (reported in the survey) by the household’s matched beneficiary household.

Note that for the above method to work it is necessary that $H < S < N$. It is also necessary that the probit of program participation converges, which means that the method is likely to work for targeted anti-poverty programs such as conditional cash transfers, but unlikely to work for non-targeted programs. In the case of Brazil, the probit converged for the conditional cash transfer program but not the non-contributory pension program, and was thus used for the former anti-poverty program but not the latter (see Higgins and Pereira).

\textsuperscript{88} Higgins and Pereira (2014).
\textsuperscript{89} Souza, Osorio, and Soares (2011).
The researcher should also verify that the probit not only converges, but also has sufficiently high predictive power by checking the distribution of the predicted probabilities resulting from the probit.\textsuperscript{90}

Sample Stata code to implement this method is included in Appendix D.

Income Misreporting and Discrepancies between Survey and Administrative Data

Most of the time, totals in surveys both for population variables and values of income, consumption, fiscal interventions, et cetera, will not coincide with totals from administrative accounts. The general principle that we follow is to believe in the totals that are in household surveys, unless the teams have a strong reason to think otherwise. First, admin data on disposable income is often not very reliable. Second, even if it is, it is not good at telling us what is going on with the incomes of the poor.\textsuperscript{91} Suppose the discrepancy comes mostly from surveys failing to capture the richest. We could have everyone in the survey reporting what they actually receive from the transfer, and accurately reporting their incomes as well, so the absolute amount of transfers matches in national accounts and surveys, but because we aren't capturing the rich, disposable income in national accounts is 2x higher than in the survey. If we scale to make the ratios equal, we would be falsely deflating the impact of everyone's transfer on their income (both of which they correctly reported). Our recommendation is to look at the absolute amount of the transfer in the survey, not its ratio to disposable income -- if this is higher than in national accounts, then you have a reason to scale it down so it matches the absolute amount in national accounts (unless you think national accounts has underestimated it for some reason). Also look at the amounts that individual households are reporting from the transfer--are these amounts accurate given program rules, or are they too high? This is what CEQ authors did in Brazil, and the amounts individual households were reporting was largely accurate according to program rules.

You could make the following counterargument: suppose the household is underreporting income by half and correctly reporting the transfer. Even in this case we think you should not scale down the transfer. Suppose actual market income is $1 but they report $0.50, and suppose the transfer equals $1 per day, and poverty line is $1.25. In reality the transfer is pulling them out of poverty, from $1 to $2. If you scale down the transfer you get income going from $0.50 to $1 as a result of the transfer, whereas if you don't you would get $0.50 to $1.50 as a result of the transfer. So by scaling down, we do better at estimating the transfer's incidence as a % of income, but worse at estimating its effect on poverty: we would conclude that transfer did not pull the person out of poverty, but in reality it did! And, conversely, we get the correct result, that the transfer pulled the person out of poverty, when we do not scale it down.

For fiscal interventions in which the totals are NOT in the surveys (for example, VAT, some type of transfers, per capita spending on education and health, and so on), the CEQ methodology recommends to scale those totals down so that ratios between the fiscal intervention of interest and, for example, disposable income or private consumption from national accounts equal the ratios for the same variables in the surveys. This scaling-

\textsuperscript{90} A shortcoming of this procedure is that the propensity scores are estimated under the assumption that reported nonparticipants are in fact nonparticipants; however, this is not the case: the entire reason we are undertaking the analysis is that some of the reported nonparticipants must have actually been participants. We are grateful to Gary Burtless for pointing this out.

\textsuperscript{91} Deaton (2005).
down method will yield new totals for the fiscal interventions that need to be analyzed using the imputation method.

For cash transfer programs, the total number of beneficiaries according to the survey is often significantly lower than the total according to national accounts (we are using “national accounts” as a broad term that includes program administrative records, et cetera). This occurs even in rich countries.\textsuperscript{92} As a result, in a number of CEQ countries, authors have imputed benefits to households that did not report receiving benefits from the program but are similar to households that did receive benefits from the program (for example, Higgins and Pereira\textsuperscript{93} for Brazil). The imputation—explained above—uses code adapted from Souza, Osorio, and Soares\textsuperscript{94} included in Appendix D, and causes the number of beneficiary households in the survey to equal the number of beneficiary households from national accounts. This adjustment should only be made if the program administrative accounts are believable (experts agree that they are fairly accurate), as was the case in Brazil.

**Tax Expenditures**

Tax expenditures result in people paying less indirect taxes, so they should not be added to income (because that would be double-counting). Nevertheless, if tax expenditures can be estimated reliably, it would be very interesting to analyze their incidence, since tax exemptions are a (sometimes regressive) form of subsidy.

**When the year of the survey does not match the year of interest of the analysis**

In some countries, household surveys are collected infrequently. When policymakers are interested in a more up-to-date analysis than the year of the available survey, one can follow the method proposed by Aristy-Escuder, Cabrera, Moreno and Sanchez\textsuperscript{95} for the CEQ Assessment for the Dominican Republic. The approach is summarized in box 5-6.

**Box 5-6: When the Household Survey Year is Dated: the CEQ Assessment for the Dominican Republic**

Jaime Aristy-Escuder, Blanca Moreno, Miguel Sanchez (World Bank) and Maynor Cabrera (CEQ Institute)

Due to a lack of updated household survey data, a set of assumptions was used to estimate the impact of recent policies. The latest household income and expenditure survey, ENIGH, was conducted in 2007, and thus the available data do not capture the important policy decisions made between 2007 and 2013. These considerations were incorporated into the CEQ methodology by modifying the major tax rates and bases, and by expanding the coverage of direct transfers. The application of the 2013 tax

\textsuperscript{92} Meyer and Sullivan (2003).
\textsuperscript{93} Higgins and Pereira (2014).
\textsuperscript{94} Souza, Osorio, and Soares (2011).
\textsuperscript{95} Aristy-Escuder and others (2016).
and social program structure to the 2007 survey data enabled a simulation of income and poverty impacts, and 2013 public revenue and spending data were deflated to 2007 prices. Statutory tax rates and income brackets were applied in the estimation of direct tax revenue, similar to other applications of the CEQ methodology (for example Lustig and others, 2013). Tax evasion assumptions, which were based on discussions with the authorities, were applied only to VAT, not direct or other taxes. This analysis only evaluates the equity effects of the tax system, not its buoyancy or efficiency.

It will be important to make some adjustments to account for the policy changes of recent years. Compared to other countries studies with the CEQ methodology, the Dominican Republic is especially challenging because the “departure point,” the most recent household income and expenditure survey, dates to 2007. It is necessary to consider that numerous policy decisions were adopted between 2007 and 2013, including the modification of the rates and bases of the main taxes (for example, ITBIS, ISR, ISC). Furthermore, there has been a notable expansion in the coverage of direct transfers (for example, CEP, BGH, BGCH), and the value of certain in-kind transfers, such as education, has been expanded.

In the light of these changes, the methodology applied the tax and public expenditure structures of 2013 to ENIGH 2007. On the tax side, rates and definitions of the 2013 tax base were used. On the expenditure side, the value of the 2013 peso was deflated by the change in the consumer price index (CPI) between 2007 and 2013. In other words, the public revenues and spending vectors of 2013 were used to calculate income poverty—but in 2007 prices. Expenditures were adjusted only for inflation and not by GDP growth. This is because the majority of the recorded public-spending variations were below the growth rate during the period. Overall, the objective was to adapt the CEQ methodology’s various definitions of income using the ENIGH 2007 and the public revenue and expenditure structure of 2013, expressed in 2007 prices. We opted for this alternative (instead of inflating to 2013 the variables of the ENIGH 2007) because, besides inflation between 2007 and 2013, relative prices of production factors, structure of employment and size of households in Dominican Republic could have experimented important changes in income distribution, that we otherwise would not have been able to replicate with available information. The adjustment factor was 42.5 percent, inflation between June 2007, date of the survey, and December 2013.

**Infrastructure and Other Public Goods**

We do not attempt to impute values for infrastructure and other public goods. O’Dea and Preston lay the groundwork for estimating the distributional impact of public goods, but their methods have yet to be implemented empirically as far as we know. Nevertheless, we estimate equity in access to infrastructure (such as electricity, running water, roads). Which components of infrastructure are included here depends on the questions in the survey.

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96 O’Dea and Preston (2012).
Additional Sensitivity Analyses

We recommend implementing sensitivity analyses and sub-group comparisons to test robustness of results. For example, the researcher might test the sensitivity of their results to different assumptions about economies of scale or adult equivalence; to different allocation methods for various tax and transfer programs; to different assumptions about tax avoidance and evasion; to using regression methods vs. direct identification for the value of owner occupied housing; and so on. Sub-group comparisons could compare incidence results by race of the household head, by gender of the household head, by age of the individual (for example, in three groups: below 20, working age 20-65, and retirement age over 65). Other sensitivity analysis will be country-specific (some countries may want to check the implications of adjusting for the underreporting of beneficiaries of a transfer program, using different methods to impute a subsidy, making different assumptions about consumption tax evasion, et cetera).

6. Completing Section C of the Master Workbook

The heart of a CEQ Assessment is the allocation of taxes and transfers so that one can construct the income concepts for each individual and estimate the impact of fiscal policy on an array of indicators of inequality and poverty both for the system as a whole and by fiscal intervention. Moreover, since one of the key goals of the CEQ Institute is to create a Data Center on Fiscal Redistribution with information that will allow comparisons across countries and over time, painstakingly detailed information on the methods utilized for the allocation process is of the essence. This information should be written up in section C of the MWB.

Section C of the MWB includes a detailed description of the methodologies used to construct each income concept (sheet C1) and a summary of key assumptions made by the team in the process (sheet C2). In sheet C1 (table 5-9), Construction of Income Concepts, various income components and fiscal interventions are listed. CEQ Assessment authors should indicate whether these components and fiscal interventions were included in the analysis (column C). In column D, they should indicate which allocation method was used following the taxonomy in section 3.b of this chapter, and should provide a detailed explanation of the exact process followed. In our experience, authors tend to provide insufficient detail here; the more detail, the better. Columns E through J ask for various statistics about that income component or fiscal intervention, including the total amount received in local currency by all individuals in the survey (using expansion factors, of course) in column E; the share of this as a percent of disposable income or private consumption from the survey in column F, where the country authors should specify which of these two was used as the denominator in cell F11; totals in local currency from administrative accounts in column G; the share of this as a percent of total disposable income or private consumption from administrative accounts in column H, where the country authors should specify which of these two was used as the denominator in cell H11; the total population receiving benefits or income from or paying taxes to the particular fiscal intervention or income source based on data from the household survey in column I; and the same figure but based on data from administrative accounts in column J.

Table 5-9: Sheet C1 of Master Workbook
## Income Concepts and Fiscal Interventions:
Definitions, Methods and Comparisons with Administrative Accounts

<table>
<thead>
<tr>
<th>Included (Yes / No)</th>
<th>Description of Method</th>
<th>Totals in Local Currency from Survey</th>
<th>Share as a % of Disposable Income or Private Consumption from Survey Specify Denominator</th>
<th>Totals in Local Currency from Administrative Accounts</th>
<th>Share as a % of Disposable Income or Private Consumption from Administrative Accounts Specify Denominator</th>
<th>Total Population (for example, taxpayers, beneficiaries, enrolled in school) from Administrative Accounts</th>
<th>Total Population (for example, taxpayers, beneficiaries, enrolled in school) from Administrative Accounts</th>
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<tr>
<td>Earned and unearned incomes of all possible sources and excluding government transfers</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gifts, proceeds from sale of durables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alimony</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto-consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imputed rent for owner occupied housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (add more rows if needed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Market Income**

- **Market Income** includes all earned and unearned incomes from various sources, excluding government transfers. It encompasses income from employed work, self-employment, investments, and other sources, without government transfers.
- **Gifts, proceeds from sale of durables** refer to non-market income, such as gifts, proceeds from selling durable goods, and other nontaxable income.
- **Alimony** is a type of income paid as a result of a legal separation or divorce.
- **Auto-consumption** includes income that is consumed immediately without being saved or invested, such as cash withdrawals or spending on immediate goods.
- **Imputed rent for owner occupied housing** accounts for the market value of housing services provided by homeowners.
- **Other (add more rows if needed)** allows for the inclusion of additional forms of income or categories that may not fit into the predefined lists.
<table>
<thead>
<tr>
<th>Net Market Income = Market Income - (Direct Taxes as well as Employee and Employers Contributions to Social Security)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct Taxes</strong></td>
</tr>
<tr>
<td>Personal income tax</td>
</tr>
<tr>
<td>Corporate income tax</td>
</tr>
<tr>
<td>Payroll tax</td>
</tr>
<tr>
<td>Taxes on property</td>
</tr>
<tr>
<td>Other (add more rows if needed)</td>
</tr>
<tr>
<td><strong>Employee Contributions to Social Security</strong></td>
</tr>
<tr>
<td>Employee contributions to social security for old-age pensions</td>
</tr>
<tr>
<td>Employee contributions to social security for other contributory programs (unemployment, disability, health, etcetera)</td>
</tr>
<tr>
<td><strong>Employer Contributions to Social Security</strong></td>
</tr>
</tbody>
</table>
### Self-Employed Contributions to Social Security

Gross Income = Market Income + Direct Transfers

<table>
<thead>
<tr>
<th>Social Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Assistance</td>
</tr>
<tr>
<td>Conditional and unconditional cash transfers</td>
</tr>
<tr>
<td><strong>Add one row per program analyzed</strong></td>
</tr>
<tr>
<td>Noncontributory pensions</td>
</tr>
<tr>
<td>Near cash transfers (food, school uniforms, et cetera)</td>
</tr>
<tr>
<td><strong>Add one row per program analyzed</strong></td>
</tr>
<tr>
<td>Other (add more rows if needed)</td>
</tr>
<tr>
<td>Social Insurance</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Old-age pensions</td>
</tr>
<tr>
<td>Other (add more rows if needed)</td>
</tr>
</tbody>
</table>

**Taxable Income** = **Gross Income** - **Nontaxable Income**

Add rows if needed

**Disposable Income** = **Net Market Income** + **Direct Government Transfers**

<table>
<thead>
<tr>
<th>Private Consumption</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

**Consumable Income** = **Disposable Income** + **Indirect Subsidies** - **Indirect Taxes**

<table>
<thead>
<tr>
<th>Indirect Taxes</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sale tax</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excise taxes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add one row per excise tax analyzed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customs duties</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (add more rows if needed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indirect Subsidies</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural inputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Other (add more rows if needed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Final Income = Consumable Income + Government In-Kind Transfers**

**Education**

- Pre-school
- Primary
- Secondary
- Post-secondary non-tertiary
- Tertiary
- School fees
- Education net of fees

**Health**

- Contributory
- Noncontributory
- In-patient
- Out-patient
- Copayments or Fees
- Health Net of Co-pay and Fees

**Housing**

**Total Taxes**

**Total Social Spending**
In sheet C2 (table 5-10), key assumptions are listed. Specifically, a number of questions are posed in column B (for example, “Does your survey report income or consumption or both?”) and the answers to these questions should be provided in column C. These answers assist the quality control process by providing the CEQ Institute with information about the survey and assumptions to ensure that the methods employed by the team are the best possible given data constraints and the country-specific context.

Researchers are advised to complete sheets C1 and C2 prior to conducting the analysis (once they have determined the allocation methods and variables from the survey data that will be used for each fiscal intervention and income component) so that these plans can undergo quality control and discussion between the CEQ Assessment authors and the CEQ Institute prior to spending the time conducting the analysis.

Table 5-10: Sheet C2 of Master Workbook

<table>
<thead>
<tr>
<th>Key Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country Name</td>
</tr>
<tr>
<td>Date of MWB on which the following is based</td>
</tr>
<tr>
<td>Name and email of contact person</td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Scenario**

**General Information**

**Year of survey**

**Name of survey and link if available**

**Does the survey report income or consumption or both?**

**Does the survey report self-consumption?**

**Does the survey report imputed rent for owner's occupied housing?**

**Consumption or Income based analysis**

**Does the income or consumption concept used in incidence analysis include: i. self-consumption; ii. imputed rent for owner's occupied housing?**

**Is the income concept reported in the survey before or after taxes both for wage earners and self-employed? If unspecified, which assumptions were made?**

**Which "income concept" is the starting point of the incidence analysis? Note that here authors need to report the income concept that are lifted directly from the survey as a starting point before adding or subtracting anything.**

**Per capita or equivalized consumption/income. If equilvalized is used, specify which formula was used.**

**Describe any particular assumption in construction of international or national poverty lines used in analysis.**

**Government level (see definition of general government on the right hand side of sheet B5)**

Ideally, the analysis should include federal, state and municipal both for revenues and spending.

**List direct taxes included in analysis.**

**List contributions to social security included in analysis.**
List cash and near cash (for example, food, school uniforms, etcetera) transfers included in Pension as Deferred Income scenario; use actual names of the programs.

Name of flagship transfer program (if there is one in the country):

List indirect taxes included in analysis.

List indirect subsidies included in analysis.

List levels of schooling included under education transfers and the years that correspond to each (for example, primary 6 years or primary 4 years, etc).

List levels of health services included (for example, contributory and noncontributory; primary, etcetera).

List other transfers in kind (housing, etc) included.

List any other tax or transfer included in the construction of income concepts not specified above.

What is defined as a household member (for example, boarders and domestic servants are excluded)?

<table>
<thead>
<tr>
<th>Methodological Assumptions Underlying the Incidence of Taxes and Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td>If direct taxes were simulated, which assumptions were made for tax evasion (for example, formal employees, rural vs urban, etcetera)?</td>
</tr>
<tr>
<td>If direct transfers were simulated, which assumptions were made for take-up of program?</td>
</tr>
<tr>
<td>What assumptions were made to take into account the evasion of indirect taxes (for example, by place of purchase, size of locality, rural vs urban, etcetera)?</td>
</tr>
<tr>
<td>What assumptions were made to identify beneficiaries of consumption subsidies?</td>
</tr>
<tr>
<td>Were the indirect effects of indirect taxes included in the incidence analysis? If yes, which method was used? Was an Input and Output Matrix used? If yes, for what year?</td>
</tr>
<tr>
<td>Question</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Were the indirect effects of indirect subsidies included? If yes, which method was used? Was an Input and Output Matrix used? If yes, for what year?</td>
</tr>
<tr>
<td>List the components that were scaled down (for example, education and health spending).</td>
</tr>
<tr>
<td>List the components (if any) that were scaled up.</td>
</tr>
<tr>
<td>To impute health spending, was the &quot;insurance value&quot; or &quot;usage-based&quot; approach used?</td>
</tr>
<tr>
<td>Do the values of cash and near cash transfers spending used in incidence analysis include administrative costs?</td>
</tr>
<tr>
<td>Does spending on education and health values used in incidence analysis include administrative costs?</td>
</tr>
<tr>
<td>Does spending on education and health values used in incidence analysis include capital expenditures?</td>
</tr>
<tr>
<td>Which definition of coverage was used?</td>
</tr>
<tr>
<td><strong>Add any other assumptions that are relevant for the study below.</strong></td>
</tr>
</tbody>
</table>
Appendix A. Canberra Group: Handbook on Household Income Statistics

Ruoxi Li (Tulane University) and Yang Wang (Tianjin University of Finance and Economics)

The second edition of Canberra Group Handbook (CGH) on Household Income Statistics establishes a reference for analyzing income distribution statistics across countries. The following review provides a comparison of income concepts and methodological assumptions in CGH and CEQ Handbook.

The most fundamental difference between the two approaches is that CGH does not include consumption taxes and subsidies in the definition of income concepts.

1. Income Definitions, Concepts and Components

The CGH conceptual definition of total income is “all receipts whether monetary or in kind (goods and services) that are received by the household or by individual members of the household at annual or more frequent intervals, but excludes windfall gains and other such irregular and typically one-time receipts.” CGH also excludes receipts that result from a reduction in net worth of a household, with the exception of pension benefits. The operational definition of CGH further excludes the value of unpaid domestic services, consumer durables and social transfers in kind. The practical definition recommended by CGH for international comparison excludes employers’ social insurance contribution received and paid, current transfers from non-profit institutions and current in-kind transfers from other households compared with the operational definition. The definition of income in CEQ is mostly consistent with the operational definition of CGH but includes social transfers in kind in the analysis.

The main income concepts established in CGH are total income and disposable income. Adjusted disposable income, primary income and income from production are also included in the income concept discussion. The four main income concepts constructed in CEQ are market income, disposable income, consumable income and final income. Market income in CEQ is similar to the operational definition of primary income in CGH except that private transfers (inter-household transfers for example) are only included in CEQ market income. Disposable income in CEQ in the scenario of contributory pensions as a government transfer is consistent with the operational definition of disposable income in CGH. Final income in CEQ is similar to adjusted disposable income in CGH, but for a fundamental difference: the CEQ definition of final income subtracts indirect taxes and adds indirect subsidies.

Both CEQ and the operational definition of CGH income components include paid employment and self-employment income (known as factor income in CEQ), property income (known as income from capital in

98 Lustig and Higgins (chapter 1 in this Handbook).
CEQ), net value of owner-occupied housing services (known as imputed rent for owner occupied housing in CEQ) as well as private transfers paid and received. These income components construct market income in CEQ (in the scenario of contributory pensions as a government transfer) and form primary income less private transfers paid and received in CGH. The CEQ market income in the two scenarios of contributory pensions as deferred income includes contributory pensions and subtract corresponding contributions. Social assistance and social insurance benefits plus all previous income components, excluding private transfers paid, constitute total income in CGH. Adding private transfers paid, social contributions, direct taxes, compulsory fees and fines to CGH total income constructs disposable income in CGH. The public transfers are categorized in a much more detailed manner in CEQ because of the different main objectives – while the income components of CGH are categorized to describe the standard of living of households, those of CEQ are constructed to analyze implications of government fiscal policies. Indirect taxes and indirect subsidies are not included in CGH income concepts but are calculated in CEQ. CGH recommends the imputation of social transfers in kind and indirect taxes when analyzing the redistributive effect of government social policies, but indirect taxes as well as indirect subsidies are not included in the income components and concepts.

Table 5-A.1 summarizes the differences in income components.

Table 5-A.1: Comparing Income Components: the Canberra Group and CEQ

<table>
<thead>
<tr>
<th>Income Components</th>
<th>Included in CEQ Definition</th>
<th>Included in CGH Conceptual Definition</th>
<th>Included in CGH Operational Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee income</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Income from self-employment</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Income from financial assets, net of expenses</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Income from financial assets, net of expenses</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Royalties</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Net value of owner-occupied housing services (imputed rent for owner occupied housing)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Value of unpaid domestic services</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Value of services from household consumer durables</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Social security pensions / schemes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Pensions and other insurance benefits</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Methodological assumptions</td>
<td>CEQ</td>
<td>CGH</td>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td><strong>Similar Assumptions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial price differences</td>
<td>Adjustment can be made. Results should be made separately available.</td>
<td>SPI index method is included in discussion.</td>
<td></td>
</tr>
<tr>
<td>Treatment of negative income</td>
<td>Adjustment is made.</td>
<td>Included in discussion.</td>
<td></td>
</tr>
<tr>
<td>Purchasing power parity</td>
<td>Adjustment is made.</td>
<td>Included in discussion.</td>
<td></td>
</tr>
<tr>
<td><strong>Population weighting</strong></td>
<td>Adjustment is made.</td>
<td>Included in discussion.</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------</td>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Construction of indirect taxes through input-output tables</strong></td>
<td>Included in calculation.</td>
<td>Included in discussion.</td>
<td></td>
</tr>
</tbody>
</table>

#### Different assumptions

| **Public pensions and pension social insurance contributions** | Pensions as deferred income scenario: contributory public pensions (or the nonsubsidized component) are treated as part of market income and social insurance contributions are not considered taxes, but lifetime (forced) savings. Pensions as pure government transfer scenario: contributory pensions are treated as government transfers and pension contributions are considered taxes. | Contributory pensions or private funded pensions may represent a form of dissaving. |

| **Employer contributions to social insurance** | Employers’ contributions are assumed to fall entirely on employees. | In the national accounts, the contributions are treated as part of remuneration. |

| **Equivalence scale** | Per capita income in baseline scenario but some teams use equivalence scales as well. | Several income equilization methods are included in discussion. |

| **Data source** | Surveys as main data sources and administrative accounts as complementary sources when survey data is unreliable. | Administrative income data may be used as an alternative to survey data if suitable data exists. |

| **Missing or zero income** | Treats the missing or zero income as zero. Drops the households if the household head’s primary income source is missing. Households with zero income after applying above procedures are included in both poverty and inequality analyses. | Imputation for missing items is recommended as a common solution. |

| **Dynamic effects** | No adjustment is made. | Included in recommendation. |

<p>| <strong>Treatment of imputed rent</strong> | Included as part of market income. | Results are suggested to be made separately available. |</p>
<table>
<thead>
<tr>
<th>Assumption</th>
<th>CEQ Adjustment</th>
<th>CGH Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement of health service transfers in kind</td>
<td>Distribution of aggregate values across individuals according to the health services they indicate to have used in surveys.</td>
<td>Imputation of values based on characteristics of individuals and households rather than the actual use.</td>
</tr>
<tr>
<td>Assumption uniquely addressed by CEQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underestimation of beneficiaries</td>
<td>Adjustment is made.</td>
<td>Not included in discussion.</td>
</tr>
<tr>
<td>Income misreporting and discrepancies between survey and administrative Data</td>
<td>Adjustment is made.</td>
<td>Not included in discussion.</td>
</tr>
<tr>
<td>Grossing up taxes paid by employees</td>
<td>Adjustment is made.</td>
<td>Not included in discussion.</td>
</tr>
<tr>
<td>Top coding</td>
<td>Adjustment is made.</td>
<td>Solutions not included in discussion.</td>
</tr>
<tr>
<td>Top income under-sampling and under-reporting</td>
<td>No adjustment is made in the main analysis, but two methods are discussed so that a sensitivity analysis can be performed.</td>
<td>Not included in discussion.</td>
</tr>
<tr>
<td>Assumption uniquely addressed by CGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship matrix</td>
<td>No adjustment is made.</td>
<td>Included in discussion.</td>
</tr>
<tr>
<td>PPP choices and comparability across countries and income groups</td>
<td>No adjustment is made.</td>
<td>Included in discussion.</td>
</tr>
<tr>
<td>Reference period</td>
<td>No adjustment is made.</td>
<td>Included in discussion.</td>
</tr>
<tr>
<td>Adjustment for population weight over extended enumeration period</td>
<td>No adjustment is made.</td>
<td>Included in discussion.</td>
</tr>
</tbody>
</table>

**Appendix B. EUROMOD – The Tax-benefit Microsimulation Model for the European Union**

Daria Popova (Institute for Social and Economic Research, University of Essex)
EUROMOD is a static tax-benefit microsimulation model (MSM) for the European Union, developed and maintained by the Institute for Social and Economic Research at the University of Essex. The construction and development of EUROMOD is documented in a number of publications. The current version of the model includes all 28 EU member states. For the majority of countries, it covers policy systems over the period since mid-2000s to 2014/2015. Both the resulting indicators and the underlying model are openly accessible. Because of its generic structure and flexibility, EUROMOD has been successfully used as a platform on which to build models for non-EU countries, including Australia, Russia, Serbia, South Africa.

In general terms, EUROMOD can be used to quantify the consequences, at the micro-level, of changes in tax-benefit policies, given that the characteristics of the underlying population remain constant, and vice versa. By taking full account of interactions between all elements of the tax-benefit system, and of the diversity of characteristics in the population, EUROMOD contributes to a better understanding of complex systems, such as contemporary European welfare states. Considering several countries over several points in time within the same model framework provides a kind of laboratory to analyse the effects of similar policy designs in different contexts and, vice versa. In addition, EUROMOD permits analysis at a supranational level, (for example for the European Union, the Euro zone, a particular welfare regime, et cetera).

In practical terms, EUROMOD represents a software that calculates tax liabilities, benefit entitlements and disposable income for each micro-unit (individual, family, or household) in a representative sample of the population. Cross-national comparability is provided by using a common, specially developed modelling language, a structured naming convention for variables and a user interface. When a user runs EUROMOD, the executable reads the policy rules stored in the user interface, applies them to the input micro-data and produces an individual level output data file containing relevant information from the input data and the tax-benefit simulation which can be further analysed using any statistical software. Some preliminary analysis can be performed directly from the user interface (for example summary statistics, marginal tax rates, labour market adjustments, intertemporal policy effects, et cetera).

Although EUROMOD aims to simulate as many components of household disposable income as possible, due to data constraints, not all taxes and social benefits are currently simulated. Instruments that are simulated in all countries are cash transfers, direct taxes and social insurance contributions. Non-cash transfers, imputed rent and indirect taxes are beyond the scope of the model, although they can be potentially accounted for within the EUROMOD framework. The labour market income and other non-simulated income sources (for example social insurance based benefits) are taken directly from the micro-data and uprated, if necessary, based on the data about average growth by income source taken from external statistics. The input micro-data for simulations are derived from the EU Survey of Income and Living Conditions (EU-SILC). All simulated and non-simulated variables used in the model and the resulting inequality and poverty measures are validated.

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99 For more information see: https://www.iser.essex.ac.uk/euromod.
100 See Figari and Sutherland (2013); Immervoll and O’Donoghue (2009); Lietz and Mantovani (2007); Sutherland (2001); Sutherland and others (2008); Sutherland (2014).
101 Hayes and Redmond (2014).
102 Popova (2013).
103 Žarković-Rakić (2010).
by using external sources (administrative data, National Accounts, Eurostat, et cetera). The model is updated annually in collaboration with national experts from each EU member state.

In the baseline EUROMOD simulations, simulations of actual policy rules (for example Jara and Leventi) the disposable income is calculated as the sum of original income (gross earnings, private pensions, income from capital, private transfers, in-kind income) and governmental transfers (public pensions, non-means-tested benefits and means-tested benefits) minus direct taxes (income tax, property taxes, et cetera) and social insurance contributions (SIC) paid by employees and the self-employed (employers’ SIC are simulated but they are not shifted to the employees). It is important to stress, however, that EUROMOD is very flexible and a user can create a new scenario where income concepts can be adjusted according to his/her research needs.

Being a static micro-simulation model, EUROMOD is primarily intended for the assessment of the first-round effects of changes in taxes and benefits on income distribution. Under certain conditions (namely, if the reform is causing ‘marginal’ changes in the budget constraint faced by agents and all agents are optimizing under their sole budget constraint) the output of the static model might be a good approximation of a final policy effect. In addition to this, several studies have used EUROMOD as a platform for the analysis of behavioural changes, following the implementation of a policy reform, in particular changes in work incentives and in labour supply.

Table 5-B.1 summarizes the main differences in assumptions applied by CEQ and EUROMOD’s baseline simulations.

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>CEQ</th>
<th>EUROMOD’s baseline simulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public pensions and pension social insurance contributions</td>
<td>Pensions as deferred income scenario: contributory public pensions (or the nonsubsidized component) are treated as part of market income and social insurance contributions are not considered taxes, but lifetime (forced) savings.</td>
<td>All public pensions are treated as government transfers; contributions are treated as a tax and deducted from gross market income</td>
</tr>
<tr>
<td></td>
<td>Pensions as pure government transfer scenario: contributory pensions are treated as government transfers, pension</td>
<td></td>
</tr>
</tbody>
</table>

106 Bourguignon and Sparado (2006).

107 See Immervoll and others (2007); Bargain and others (2013); Bargain and others (2014); Immervoll (2004); Immervoll and O’Donoghue (2002); Jara and Tumino (2013).
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employer contributions to social insurance</td>
<td>Employers’ contributions are assumed to fall entirely on employees</td>
<td>Employers contributions are not shifted to employees and not considered in the analysis, although they are simulated</td>
</tr>
<tr>
<td>Consumption taxes and subsidies</td>
<td>Included and are assumed to be shifted forward to consumers.</td>
<td>Not included in general</td>
</tr>
<tr>
<td>In-kind transfers (education, healthcare)</td>
<td>Included.</td>
<td>Not included in general</td>
</tr>
<tr>
<td>Allocation methods</td>
<td>Direct identification. If information is not directly available in microdata, then other methods such as those described in this chapter</td>
<td>Simulation. The information is taken directly from the data only if full or at least partial simulation is impossible due to data constraints</td>
</tr>
<tr>
<td>Economic incidence instead of statutory (for example unreported earnings, tax evasion, non take-up of means-tested benefits)</td>
<td>Included whenever possible</td>
<td>Included whenever possible, but can be switched off</td>
</tr>
<tr>
<td>Behavioral effects</td>
<td>Not explicitly modeled but the incidence exercise acknowledges their existence, especially regarding the treatment of pensions: the counterfactual market income in the case of contributory pensions is not zero income for the pensioner but the private savings alternative; for consumption taxes, it relies on effective rates and not statutory ones; and, so on.</td>
<td>Not included, but the model calculates effective marginal tax rates</td>
</tr>
<tr>
<td>General equilibrium effects</td>
<td>Not included</td>
<td>Not included</td>
</tr>
<tr>
<td>Dynamic effects</td>
<td>Not included</td>
<td>Not included</td>
</tr>
<tr>
<td>How the policy impact is calculated</td>
<td>Mainly average incidence; a few cases with marginal incidence</td>
<td>Marginal incidence</td>
</tr>
</tbody>
</table>
Equivalence scale | Per capita income in baseline scenario but some teams use equivalence scales as well | Equivalized income (the Modified OECD equivalence scale)

Appendix C. LATAX: A Multi-Country Flexible Tax Micro-Simulation Model

Laura Abramovsky and David Phillips108 (Institute for Fiscal Studies, IFS)

LATAX is a multi-country flexible micro-simulation model developed by researchers from the Institute for Fiscal Studies (IFS) for the analysis of VAT, excise duties, income tax and social security contributions, as well as (non means-tested) price subsidies and (means-tested) cash benefits using a representative cross-section of households from a household survey. It can quantify the revenue and distributional impact of tax reforms under both the assumption that individuals do not change their behavior as a consequence of changes in taxes, and the assumption that individuals react to these changes along specific margins. In particular, it has a built-in demand system that can estimate households’ consumer spending responses to indirect tax changes, and can vary the assumptions about the extent to which individuals change their labor supply, and the extent to which firms change their final pricing and compensation strategy when taxes change. This allows the sensitivity-testing of results to varying behavioural assumptions, helping better inform the policy-making process.

So far, LATAX has been used to assess reforms in Mexico, El Salvador, and Colombia. It is designed to allow researchers with a basic understanding of the statistical software Stata (in which LATAX is written) but limited previous experience of microsimulation modeling to adapt it for use in other countries with similar tax and transfer systems. It is designed to be user-friendly, with a separation of the core code which simulates the tax system, from the main interface module – where the user sets simulation options, file names and directories, etcetera –, and parameter modules – where the user sets the tax and transfer rates and rules they wish to model. LATAX produces individual and household level data on incomes, expenditures, tax payments and transfer receipts, and summary revenue and distributional tables (such as gains and losses by deciles of the income or expenditure distribution).

The developers plan to make LATAX available for download in the near future. In the meantime please see the background papers explaining application of the model to Mexico109 and El Salvador110 and the instruction manual111.

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109 Abramovsky and others (2011).
Appendix D. Correcting for Underestimating Number of Beneficiaries

* SAMPLE STATA CODE TO ADJUST FOR UNDERESTIMATION OF BENEFICIARIES
* (Example uses numbers for Bolsa Familia in Brazil)

* Code adapted from code for Souza, Osorio, Soares (2011), provided by Sergei Soares

* preliminaries

scalar S = 7320188 // number of beneficiary households according to survey
scalar N = 12370915 // number of beneficiary households according to national accounts
scalar H = N – S
scalar prop = H/S // proportion of beneficiaries who reported that needs to

    // be randomly sampled and matched to non-reporters

gen transfer1_h_rep = transfer1_h

    // transfer1_h is a variable with the benefit accruing to the household,

    // and equals that value for all members of the household, not just the member

    // that directly received the benefit

* if dataset is individuals, collapse to households:
tempfile original

save `original', replace
drop if head != 1 // where head==1 denotes household head

// note other household vars such as dummy for existence of children in
// household must have already been constructed

* matching
assert !missing(transfer1_h)
generate beneficiary = (transfer1_h > 0)
probit beneficiary lny nmemb child age i.race i.state urban car ///
[pw=s_weight] if incl==1
predict phat if incl==1, p
table beneficiary, c(mean phat p10 phat p25 phat p75 phat p90 phat)
   // the line above checks distribution of predicted probabilities;
   // the researcher should look at its results
set seed 48490251 // can be any number; set seed so random sampling of
// beneficiary HHs doesn't change upon re-running do file
// Randomly sample from beneficiaries the proportion we need to impute
// (then we will match them with most similar non-beneficiaries)
gen selec=(runiform()<=prop) if beneficiary==1 & phat!=.
tempfile households
save `households', replace
keep if selec==1 | (beneficiary==0 & phat!=.)
   // selec==1 are randomly sampled beneficiaries;
   // (beneficiary==0 & phat!=.) are the "donor pool" of non-beneficiaries from which
   // we will select households to impute benefits to
keep hh_code selec beneficiary phat transfer1_h*
gsort -beneficiary -phat

gen simben=(selec!=.)
gen n=.

count if beneficiary==1

forvalues i=1/`r(N)' { // For each of the randomly selected beneficiary households
    quietly {
        // Calculate difference between predicted probability of receiving program between
        // each non-beneficiary household and the `i'th beneficiary household
        gen double abs = abs(phat-phat[`i']) if simben==0
        // Then select the closest non-beneficiary household and impute benefits (replace simben = 1)
        summarize abs
        replace simben = 1 if abs==r(min)
        replace n = `i' if abs==r(min) // n tells you which household they matched with
        // Then give them the same transfer as the matched household
        replace transfer1_h = transfer1_h[`i'] if abs==r(min)
        drop abs
    }
}

keep if simben==1 & beneficiary==0 // only keep new imputed beneficiaries;

    // we will merge them back in to original data set
rename transfer1_h transfer1_h_imp // to be clear it is the imputed value for these households
keep hh_code transfer1_h_imp simben
tempfile imputed
save `imputed', replace

// Now return to original data set to merge in transfer values for "imputed beneficiaries"
use `households', clear
sort hh_code
merge hh_code using `imputed'
drop _merge

// Imputation flag:
generate transfer1_is_imputed = (transfer1_h==0 & simben==1 & beneficiary==0)

// Replace the transfer value (of 0) with the simulated value for those households:
replace transfer1_h = transfer1_h_imp if transfer1_is_imputed==1
keep hh_code transfer1_{1}

save `households', replace
use `original', clear
drop transfer1_h
merge m:1 hh_code using `households'
drop _merge
Appendix E. Definition of Household: Sensitivity Tests

The following table, provided by the Centro de Estudios Distributivos Laborales y Sociales at Universidad Nacional de La Plata (CEDLAS), shows that poverty and inequality results are not very sensitive to the definition of the household (the choice of whether to exclude renters, domestic servants, and their families; to include them as separate households; or to include them as part of the main household).

Table 5-E.1: Poverty and Inequality with Different Household Definitions

<table>
<thead>
<tr>
<th></th>
<th>Households</th>
<th>Observations with ipcf</th>
<th>Members ipcf</th>
<th>Gini</th>
<th>Poverty 2.5 USD a day</th>
<th>Poverty 4 USD a day</th>
<th>Gini</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Argentina 2011</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEDLAC</td>
<td>34,298</td>
<td>110,785</td>
<td>3.163</td>
<td>4.7</td>
<td>2,340.13</td>
<td>7,391.39</td>
<td>0.423</td>
</tr>
<tr>
<td>Alternative 1</td>
<td>34,298</td>
<td>110,850</td>
<td>3.164</td>
<td>4.7</td>
<td>2,337.96</td>
<td>7,400.84</td>
<td>0.423</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>34,359</td>
<td>110,850</td>
<td>3.158</td>
<td>4.7</td>
<td>2,340.21</td>
<td>7,391.13</td>
<td>0.422</td>
</tr>
<tr>
<td><strong>Brazil 2011</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEDLAC</td>
<td>117,796</td>
<td>346,021</td>
<td>3.024</td>
<td>12.6</td>
<td>824.16</td>
<td>2,487.60</td>
<td>0.527</td>
</tr>
<tr>
<td>Alternative 1</td>
<td>117,796</td>
<td>346,797</td>
<td>3.031</td>
<td>12.6</td>
<td>824.53</td>
<td>2,494.24</td>
<td>0.527</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>118,453</td>
<td>346,807</td>
<td>3.015</td>
<td>12.6</td>
<td>824.56</td>
<td>2,481.36</td>
<td>0.527</td>
</tr>
<tr>
<td><strong>Mexico 2010</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEDLAC</td>
<td>27,665</td>
<td>104,493</td>
<td>3.873</td>
<td>12.5</td>
<td>2,720.75</td>
<td>10,525.58</td>
<td>0.474</td>
</tr>
<tr>
<td>Alternative 1</td>
<td>27,665</td>
<td>104,633</td>
<td>3.878</td>
<td>12.5</td>
<td>2,717.32</td>
<td>10,525.58</td>
<td>0.473</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>27,771</td>
<td>104,585</td>
<td>3.862</td>
<td>12.5</td>
<td>2,724.90</td>
<td>10,523.00</td>
<td>0.474</td>
</tr>
</tbody>
</table>

Alternative 1: including domestic servants, their families and renters as household members of the main household

Alternative 2: domestic servants, their families or renters as separate households

Source: Centro de Estudios Distributivos Laborales y Sociales at Universidad Nacional de La Plata (2014)
Appendix F. Comparison of Methods to Value the Distributional Impact of Health Spending

Jeremy Barofsky112 (Brookings Institution)

I. Methods Summary:

The following is a methodological document that synthesizes both previously used methods in the Commitment to Equity (CEQ) project and new methods to measure the value and incidence of in-kind health system spending. This document will describe the conceptual framework behind each of the following approaches: a) average cost with usage, b) behavioral-outcome, and c) willingness-to-pay. In CEQ’s benchmark fiscal analysis, when post-fiscal income \( I_{pf} \) is translated into final income \( I_f \), the in-kind value of health spending is calculated and added, while co-payments and user fees for health services are subtracted. Each of the methods below provide inputs to move from \( I_{pf} \) to \( I_f \).

II. Methods in Depth:

1) Average cost with the usage approach:

Methodology: Previous analyses carried out by CEQ value health spending by using an average cost with usage approach, which is also commonly referred to as basic incidence analysis (BIA) applied to health spending113. That is, in-kind health transfers are valued based on the use of public services and their average cost as reported in government national accounts. This process requires three principal steps: First, utilization of public health services is compared to a measure of living standards (usually income or consumption). Second, each individual’s (or household’s) health utilization is weighted by the unit value of the public subsidy for that service. At a minimum, CEQ analyses use health data that separates utilization into inpatient and outpatient care. Third, the distribution of health subsidies is evaluated against a target distribution.

Measuring Benefits: The incidence of health system benefits is determined by utilization across the distribution of the living standards measure. Optimally in CEQ, the survey already being used for fiscal incidence includes both health services utilization and living standards data as well. If this information is not available, another survey with utilization and living standards is required and values must be inputted by quantile (usually ventiles or groups of 5 percent of the population). Recall periods of past utilization must be sufficiently long such that the sample of observed users is robust (for example, 12 months for inpatient care and 2-4 weeks for ambulatory care) and is normalized across types of care when calculating value. Only publicly subsidized health services should be included and development assistance for health, user fees, and social insurance are relevant if revenues are determined by the state. Also it is best if the survey in use distinguishes between public and private care. However, if not, information on whether a household is covered by public or private insurance can be used as a proxy. This represents a subset of the average cost approach, in addition with valuation occurs based on type of insurance coverage, instead of self-reported medical care utilization. If

112 Barofsky (2015).
113 See Lustig and Higgins (2013); O’Donnell and others (2008).
households receive care and are covered by private insurance, they are assumed to have received private care and therefore did not receive an in-kind public transfer114. Total annualized health system benefits are calculated as the number of services received multiplied by the cost of that service, summed over all health service types and normalized by recall period to be yearly.

**Measuring Costs:** To calculate average cost, aggregate data on total government spending by health service type is required. Minimally, services can be separated into inpatient and outpatient care, although stratifying by geography and facility as well as service type is preferable. Spending includes administrative costs, recurrent spending, and health system investments. It is known that this method overestimates the redistributive effect of health spending because the monetary value of health transfers is forced to be equal to their cost from national accounts data, while totals from other taxes and transfers in the CEQ analysis are not. To correct this overestimate, the value of health transfers is scaled down such that the ratio of health spending to disposable income (or total consumption if consumption instead of income data is used) is equal to the ratio of health benefits to disposable income from the survey in use. When the nation also has a contributory public health insurance scheme, this transfer is measured using the average cost of providing the basic package of services.

**Pros and Cons:** Most developing nations have sufficiently detailed nationally representative surveys and national health spending accounts data such that the BIA approach is widely feasible and allows comparison across nations. In addition, these methods are accessible to researchers and government officials without extensive training in econometrics or causal inference. However, CEQ does not attempt to impute the welfare value of spending on health-related public goods nor the value of statistical life from health gains. O’Dea and Preston115 lay the groundwork for estimating the distributional impact of public goods, but their methods have not been implemented. The provision of a disease- and vector-free environment often constitutes both the most cost-effective and largest health benefit generated by government spending. Moreover, given that service quality varies substantially across geography116, by using government-reported average cost to measure value, these methods are unable to take quality variation into account. In general, the average cost of health services need not directly translate into welfare benefits because of unnecessary or low quality care.

2) **Behavioral-outcome approach:**

**Methodology:** The behavioral-outcome approach to measuring the in-kind benefit and incidence of health systems employs causal inference methods to transform health system spending into monetary value. The hierarchy of causal inference methods, each with a counterfactual, are used depending on available data (experimental, quasi-experimental, and non-experimental) to estimate the observed benefit produced by a given health system in four domains: 1) change in out-of-pocket spending, 2) financial risk protection, 3) health status, and 4) health-related public goods (access to clean water, clean air, and sanitation). In nations with

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114 See Lustig and Higgins (2013).
116 See Das and Hammer (2005).
recent health coverage expansions and segmented health systems, sufficient variation exists to make these estimates. However, as nations move toward the OECD norm of widespread, uniform, and long-standing coverage, causally identifying the impact of national health insurance becomes more challenging since no control group exists. Helpfully, nations that are expanding health coverage and spending are those in which health equity questions are most important and where this approach is most feasible.

Measuring Benefit: To measure the impact of out-of-pocket spending by decile, health expenditure is logged to account for its extreme right-skewed distribution. Many of the suggested methods to account for health expenditure nonlinearities produce similar results\(^\text{117}\). To monetize gains in financial risk protection produced by expanded health insurance coverage, a technique derived from Finkelstein and McKnight\(^\text{118}\) is used. The distribution of medical spending risk that households would have experienced with and without health coverage using quantile regression are inputted into a stylized utility model to calculate the change in risk premium. The risk premium of a gamble represents the maximum amount a risk-averse individual would pay to avoid a given set of risks. Measuring how health coverage changes this premium translates financial risk protection into a money metric. Census data or other nationally representative data (such as hospital discharge records) will be used to calculate the distributional variation in health-related public goods (clean water, clean air, and sanitation). Similarly, given data availability, we can casually identify the effect of each nation’s health system on health outcomes and then translate the impact into a money metric using the value of statistical life literature. At a minimum, based on data availability, health status should include the effect of spending on mortality and child anthropometrics.

Measuring Cost: On the revenue side, national health systems are often organized either as a national health service (NHS) or a social health insurance scheme (SHI, or a combination of both) and this financing structure affects analysis of the health system’s fiscal incidence. If the nation exhibits an NHS organization, then health spending is normally financed out of general revenue. Therefore, the incidence of health system spending is assumed to follow that nation’s overall tax incidence. If a nation has a SHI system, then fiscal incidence is determined based on the payments made into the system, which are often split between employer, employee, and government. In this case, it is important to account not just for the statutory incidence of these payments, but gather information – if available – on their economic incidence as well. In addition, health systems may be financed partly by taxes ear-marked for a specific purpose or sin taxes to encourage behavior change. In both cases, incidence is determined by payments into the system by income decile. For sin taxes, for example a cigarette tax, the literature should also be used on the price elasticity of smoking to estimate behavior change and the health gains produced.

Pros and Cons: The primary difference and contribution of the behavioral-outcome approach is that causal inference methods are used to measure gains, instead of assuming that health costs translate automatically into welfare\(^\text{119}\). This method therefore accounts for variation in care quality if it impacts observable health

\(^\text{117}\) See Buntin and Zaslavsky (2004).
\(^\text{118}\) Finkelstein and McKnight (2008).
\(^\text{119}\) See Barofsky (2015).
outcomes. Another difference is that although imputing the value and distributional impact of public goods has been described before\textsuperscript{120}, these methods have not been implemented. The welfare gain from these public goods is unmeasured currently in CEQ and may represent a large fraction of total health system benefits. The behavioral-outcome method is not without its drawbacks however. Compared to current CEQ practice, causally measuring impact requires greater data availability and more rigorous analysis. In addition, the methods may be less transparent to policymakers and are more computationally intensive. Moreover, nations with no variation in contemporaneous or recent health system coverage cannot be evaluated using this approach.

3) Willingness to pay:

Methodology: The willingness to pay (WTP) approach\textsuperscript{121} uses observed choices and the assumption of utility maximization to calculate how individuals value various forms of medical care. This valuation in money metric terms is determined by calculating the compensating variation between available choices. Generally, compensating variation (CV) refers to the amount of additional monetary compensation an individual needs to achieve their initial level of utility after a change in the economy. In the WTP case, the change is variation in the price of medical care over the range of providers available. The standard economic decision-making model is assumed, in which an individual or household chooses medical care by maximizing utility subject to a budget constraint. This budget constraint is determined by income and the relative prices of available goods and services. With this theoretical framework demand functions can be derived in which the optimal consumption bundle is related to an individual’s income and the relative prices of medical care. The cost function is then derived by substituting all medical care demand functions into the utility function and inverting. The cost function shows what income is required to achieve a given utility level for a set of relative prices. Using the cost function, medical care price variation can be used to translate observed choices into the monetary value derived from those choices (CVs). The difference between the CV for alternative medical care options represents the measure of value in the WTP approach.

Measuring Benefits: Data on observed medical care choice allows estimation of the demand equations. Socio-demographic variables like household size, education, sex, and age are also taken into account. These estimated demand equations provide measures of price elasticity of demand for various medical care options. Demand estimation is complicated by minimal variation in the monetary price of medical care and the fact that medical care is a discrete choice. Individuals must choose what type of care to seek from alternative providers, where each provider offers an expected health improvement for a given price. Quality of care can be defined as the expected improvement in health from a provider’s medical care compared to self-care (that is, the expected marginal product of care). Conditional on individual income and expected quality, individuals choose the provider that maximizes their utility. This utility can be modeled as a function of the expected gain in health from a given provider and other consumption net of the cost of obtaining care.

\textsuperscript{120} See O’Dea and Preston (2012).
\textsuperscript{121} See Gertler and Gaag (1990); Gertler Locay and Sanderson (1987).
Measuring Costs: Costs in the WTP approach are defined as both the monetary price incurred for any care as well as the time and travel costs incurred to obtain care. Therefore, even when there is little variation in the price charged for medical care – as is often the case for developing country government-provided health care – variation in time and travel costs can be used to identify differences in the cost of medical providers. Empirically, when there is sufficient variation in medical care price in the data, the system of demand equations can be estimated. In practice, identification using the WTP method is determined by variation in distance to facility and opportunity costs of time because monetary price for medical care rarely provides sufficient variation. The opportunity cost of time is calculated as the product of the round-trip travel time and an individual’s village-level wage rate. For children, the opportunity cost of the mother’s time can be used.

Pros and Cons: The WTP approach is useful for multiple purposes. First, value is determined by observed choice with real stakes instead of using government-reported average cost. Second, the data requirements are less stringent than the behavioral-outcome approach outlined above. For example, the method can be implemented with one cross-sectional survey that includes socio-demographics, utilization choices, distance to medical facility, and wages to determine the opportunity cost of time. Although extremely useful in the context for which the method was developed (determining the welfare impact of imposing user fees to raise revenue for medical care in developing nations), WTP is limited for measuring the welfare and incidence of health spending. For one, the method is specific to estimating the welfare gain in the consumption of medical care. However, as noted above, much of the value that health system spending provides occurs outside of curative care. Medical care can be separated into three types: 1) curative care, 2) patient-related preventive care, and 3) non-patient related preventive care. Particularly in developing nations where health needs are largest, the greatest gains often occur through preventive care instead of curative. In addition, the method measures the private social welfare benefit, instead of social welfare. These quantities may differ if there are externalities to care seeking (for example, for infectious disease). Moreover, the method rests on the assumption that observed medical care consumption decisions maximize welfare. Yet a robust literature indicates that health care decision-making may not represent optimal decisions because of asymmetric information in medical markets and behavioral biases that impede accurate estimates of care’s costs and benefits.

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122 See De Ferranti (1985).
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Constructing Consumable Income: Including the Direct and Indirect Effects of Indirect Taxes and Subsidies

Jon Jellema and Gabriela Inchauste

October 31, 2016

Chapter 6
Lustig, Nora, editor
Commitment to Equity Handbook
Brookings Institution and CEQ Institute (2017)

Introduction

Chapter 5 by Higgins and Lustig described in detail how to construct income concepts. In this chapter, we discuss how to construct Consumable Income when we want to take into account the indirect impact (that is, through their impact on input prices) of indirect taxes and subsidies.

How--and from whom--a government collects and replenishes public revenues will make a significant difference to the income situation and the pattern of consumption expenditures among individuals and households participating in a nation’s economy. For example, personal income tax schedules often have income exemptions and deductions specifically for larger families or credits for households whose wage and employment-based income are below a certain threshold. Such targeted tax expenditures ease the burden of the personal income tax system on larger households and households where employment-related income is meager. Easing the burden on these types of households may mean that the poverty headcount rate as well as the net-of-tax income inequality are lower than either of these measures would be with, for example, a proportional or “flat tax” system.

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1 Jon Jellema is Associate Director for Africa, Asia, and Europe of the CEQ Institute and Gabriela Inchauste is Lead Economist at the World Bank. For questions, please contact jon.jellema@ceqinstitute.org.
3 “Tax expenditures” (from the point of view of the fiscal system) are the estimated revenue losses from special exclusions, exemptions, deductions, credits, deferrals, and preferential tax rates in tax law.
Whether or not a revenue-collection instrument can be targeted also matters a great deal for inequality and impoverishment created by fiscal policy. Indirect taxes on consumption activity—customs duties, value-added taxes, excise taxes, sales taxes—are not usually administered flexibly; that is, all individuals with at least some market-based consumption activity pay indirect taxes.\(^4\) Though unavoidable for individuals who participate in a nation’s economy, indirect taxes are popular: the international CEQ database demonstrates that, for a 28-country average taken across low- and middle-income countries in Africa, the Middle East, Asia, and Latin America, indirect taxes provide approximately twice as much in public revenues as direct taxes. Accounting for indirect taxes (and subsidies) on consumption activity is therefore doubly important for fiscal incidence: not only does a typical revenue-collection scheme in a low- or middle-income country depend more on indirect taxes (so that the overall magnitude of indirect taxes in the economy will be greater than that of direct taxes), but most households also cannot avoid paying some part of the indirect tax burden.

### 6.1 Direct Impacts of Subsidies and Taxes

Taxes and subsidies on goods and services change final retail prices and therefore directly affect household purchasing power and welfare. When consumption expenditure records are available in the household income and expenditure survey, the direct effects of indirect taxes or subsidies can be traced in a relatively straightforward way. This is typically done by first determining what proportion of total consumption expenditure is sales tax expenditure (or the proportion by which the value of consumption expenditure would increase in the absence of government subsidies), and then creating the “consumable income” concept by subtracting from disposable income the loss (gain) in purchasing power or welfare traceable to these taxes (subsidies).

However, a cross-section of consumption expenditure records (which is the least detailed microdata a CEQ assessment requires) does not provide evidence of what counterfactual expenditures would be in a world without taxes or subsidies. For example, this year’s household budget survey would provide no insight into the distribution of expenditures last year when there was no sales tax on milk. Because a CEQ assessment estimates incomes before (“pre-fiscal”) and after (“post-fiscal”) the application of fiscal programs, the direct impact of an indirect tax or subsidy instrument is described as the change in income that results from the difference between the pattern of expenditures that would occur in the “pre-fiscal” setting, where there are no taxes or no subsidies, and the pattern of expenditure that exists in the current, actual “post-fiscal” world reflected in the consumption choices and expenditures recorded in the household survey.

\(^4\) As long as some part of an individual’s consumption attracts at least one of the existing indirect taxes, then the individual will not avoid indirect taxes. An individual (or a household) subsisting exclusively on gifts and inter-household transfers and own-production/own-consumption will consume without directly paying any indirect taxes.
In order to make such an estimate, we therefore need to employ assumptions that help us describe demand or expenditures in a counterfactual no-tax (or no-subsidy) world. Here we discuss two assumptions, inelastic demand and homothetic preferences, that are commonly employed in the welfare analysis of price changes and that allow the CEQ analyst to specify expenditures in a counterfactual, “pre-fiscal” world in the absence of a model of consumer demand.

**Inelastic Demand**

When demand for any taxed (or subsidized) good or service is inelastic, changes in prices do not lead to changes in quantity demanded. If demand is inelastic, then consumption in the pre-fiscal counterfactual would be equal to consumption recorded in the current, with-tax regime. If we assume demand is inelastic, we can then calculate the Paasche variation in the value of the consumption expenditure. The Paasche variation measures the value of consumption expenditure at two different points in time—call them initial and final—using prices from the final period. For our purposes, the Paasche variation measures the difference in the value of consumption expenditures in the “pre-fiscal” or “no-tax” counterfactual and the value of consumption expenditures in the “post-fiscal” or “with-tax” present reflected in the household survey.

Because we are assuming that demand is inelastic, we are implying that quantities demanded (of the taxed item in question) are constant across the “pre-fiscal” counterfactual and the “post-fiscal” present. This simplifying assumption allows us to generate the net-of-tax value of consumption expenditure by dividing the current value of consumption expenditure ($CE$) by one plus (minus) the relevant tax (subsidy) rate. That is,

\[(6-1) \quad CE_{t,1} = CE_t / (1 + r),\]

where period $t - 1$ is the “pre-fiscal” period, $t$ is the current period (where with-tax prices are reflected in the household survey), and $r$ is the rate of taxation (expressed as a percent of the net-of-tax price). If we are interested in a subsidy, we can use the same formula as long as we remember that the rate $r$ of taxation on a subsidized good must be negative. Figure 6-1, which is a simple demand schedule with quantity demanded, $q$, ($x$-axis) at each price, $p$ ($y$-axis), shows that inelastic demand can be represented by a vertical demand schedule (where the quantity demanded does not change within a certain price range). The Paasche variation can be represented then by the difference (labeled “A” and shaded with hash marks) in the area of two rectangles: $P q_t$ and $P_{t,1} q_{t,1}$. Because $q_t$ is equal to $q_{t,1}$ (under the assumption of inelastic demand), the difference between the two rectangles simplifies to

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5 See Araar and Verme (2016) and their references.
6 In other words, these assumptions can be used to generate the distribution (among households or individuals) of indirect tax burdens without requiring more information than the CEQ analyst already has at hand.
which is simply the current, “post-fiscal” value of consumption expenditures valued at “pre-fiscal” prices multiplied by the (absolute value) of the rate of taxation (subsidization). This is labeled “A” and shaded with hash marks in figure 6-1.

Figure 6-1 is a demand schedule with price on the y-axis and quantity demanded on the x-axis.

Figure 6-1 also makes clear that the Paasche variation is not a welfare measure: a consumer with inelastic demand is just as well-off (in welfare terms) at any price level as long as she is consuming the right quantity. Instead, we can think of the Paasche variation as the change in purchasing power experienced when the tax or subsidy is applied. That is, an individual will have to spend more (less) to acquire the same bundle of goods when taxes (subsidies) are imposed. This leaves less (more) room for purchases of other goods, meaning purchasing power declines (increases). It is the decrease (increase) in purchasing power (measured by the Paasche variation) that is subtracted from (added to) disposable income to arrive at consumable income. Therefore, when a tax is imposed, we can place a negative sign in front

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7 The decline (or increase, for a subsidy) in purchasing power can also be expressed as rate$_i$ * (consumption expenditure$_i$ / (1 + rate$_i$)), where $i$ indexes the household-consumed good and “rate” refers to an indirect tax or subsidy rate. This formulation makes it easier to understand why we call this a “Paasche variation” welfare valuation.
of the first term in equation 6-2 to remind ourselves that an indirect tax reduces purchasing power relative to the counterfactual.

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**Homothetic Preferences**

We can also make headway on the impact of taxes or subsidies in a cross-section of expenditure records if we model consumer demand as described by homothetic preferences. When consumers optimize utility (under a budget constraint) described by homothetic preferences, the ratios of goods demanded depend only on their relative prices and not on income or scale.\(^8\) If consumer demand can be described by homothetic preferences,\(^9\) then in the pre-fiscal counterfactual, quantities demanded are higher (lower) by exactly the amount of the current tax (subsidy): if a good is currently taxed at a 20-percent rate, it is assumed that in a no-tax counterfactual, consumption would be 20 percent higher.\(^10\)

Once we have a description of demand in the pre-fiscal counterfactual, we can proceed as before: compare the consumption expenditure necessary to achieve the optimal bundle of goods in the no-tax (no-subsidy) counterfactual with the consumption expenditure necessary to achieve the optimal bundle in the actual with-tax (with-subsidy) state. Figure 6-2 is a demand schedule under homothetic preferences that shows that the quantity demanded in the pre-fiscal hypothetical \((q_{t1})\) is greater than the quantity demanded in the post-fiscal world by exactly the relative amount by which the price of the good \(P_t\) is higher in the post-fiscal world.

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9 And assuming there are no uncompensated cross-price elasticities.
10 The expenditure share of the taxed good (evaluated at net-of-tax prices) remains constant in both the no-tax counterfactual and the current, with-tax state. This is a consequence of both homothetic preferences and of treating taxes paid (by individuals or households) as income losses.
Figure 6-2 is a demand schedule with price on the y-axis and quantity demanded on the x-axis.

With demand described by homothetic preferences, the difference in total consumer surplus can be represented by the area of the polygon $P_tq_t; P_{t-1}$, which is labeled “B” and shaded with hash marks. Figure 6-2 also demonstrates why this is in fact a Consumer Surplus variation (instead of a variation in purchasing power or a compensating variation, for example): it gives us the amount by which total consumer surplus changes when the optimal bundle of goods changes. The area “B” is also described by the following equation:

\[
CS = P_tq_t^* r^* (1 - 0.5 * r / (1 + \hat{r})).
\]

The $CS$ quantity described by equation 6-3 is equivalent to the burden (benefit) created by the indirect tax (subsidy); it is subtracted from disposable income to arrive at consumable income.

Notice that when we are evaluating the welfare losses (gains) created by the current tax (subsidy) schedules relative to a no-tax (no-subsidy) counterfactual, the Paasche welfare variation (generated by making use of an inelastic demand assumption) will never be greater than the Consumer Surplus welfare variation (generated by making use of a homothetic preferences assumption). The Consumer Surplus variation can only be taken over two optimal demand schedules; optimal demand will be higher (lower) in a no-tax (no-subsidy) state, and the difference between actual recorded demand (which we assume is equal to optimal demand in the current state) and optimal demand in the no-tax or no-subsidy state.
counterfactual must be greater than zero. Araar and Verme\textsuperscript{11} provide both a thorough computational treatment of the size of the differences in these two welfare variations by tax rate and detailed variable-level coding that generates these welfare variations in a cross-section of household-level expenditure.

Notice also that the discussion above has focused on the impacts of taxes or subsidies via a price channel, which means that the CEQ analyst should take care to exclude auto-production and auto-consumption, gifts, in-kind transfers, and other non-market-based purchase or receipt of goods and services when calculating the impacts of indirect taxes and subsidies. We have presented here only two simplifying assumptions, inelastic demand and homothetic preferences, that allow us to calculate incomes in the CEQ pre-fiscal counterfactual and in the post-fiscal environment reflected in the household survey. However, the CEQ analyst may decide that another demand system like Cobb-Douglas demand, the Almost Ideal Demand System, or the Exact Affine Stone Index better suits a particular country- or household-survey context and may therefore estimate welfare losses (gains) from indirect taxes (subsidies) under the assumptions specified by those alternatives. Araar and Verme provide a computational look at the difference in estimated welfare losses from price changes in different demand systems (including those mentioned above) and note that differences in welfare estimates across demand systems are “minimal as compared to changes in other parameters such as the price change or the budget share.”\textsuperscript{12}

6.2 Indirect Impacts of Subsidies and Taxes

The direct impact on households of sales taxes or subsidies that change retail prices is relatively easy to trace through consumption expenditure records (if we are willing to make simplifying assumptions). However, the same price policies may also affect intermediate goods and services prices, and therefore producer prices, across the entire economy. If producers pass some of these higher or lower input prices on to other producers or to final consumers, households will bear more of a total burden or enjoy a larger total benefit than the direct impact alone would indicate. In fact, a 32-country study using micro-datasets to trace the impact of fuels subsidies on household welfare showed that those subsidies produced equal or larger indirect than direct welfare impacts.\textsuperscript{13} In other words, significant indirect effects are the international norm for developing countries.

CEQ assessments estimate incomes before and after the application of fiscal policies including indirect taxes and subsidies; when a CEQ analyst can generate the total (direct plus indirect) impact of such policies on purchasing power, she will have a more comprehensive estimate of a fiscal policy’s impact on poverty and inequality. When household expenditure

\textsuperscript{11} Araar and Verme (2016).
\textsuperscript{12} Araar and Verme (2016, p. 6).
\textsuperscript{13} See Coady, Flamini, and Sears (2015).
levels are recorded with reference to retail prices including any subsidies or taxes, which is very common in household surveys, a household’s real purchasing power may be overvalued when the price paid includes a portion that finances government consumption (such as with a sales tax) or undervalued when the price paid does not include the amount contributed by the government (such as with a subsidy). Such a misvaluation of purchasing power also occurs when households receive subsidy benefits or bear a sales tax burden indirectly.

6.3 Theory: The Price-Shifting Model

The following “price-shifting” model, which describes and quantifies the magnitude of sectoral changes in producer and retail prices resulting from any exogenous (demand, supply, or price) shock, provides a low-cost way for the CEQ analyst to estimate indirect impacts. In the section following this one, we demonstrate how to program such an exogenous shock and solve this model using available software packages.\(^{14}\)

The model is low-cost because its solution is relatively easy to program using only information on the current structure of an economy at current levels of production, reflected in an input/output (I/O) matrix. It makes the following crucial assumption: exogenously-generated price changes are either “pushed forward” to output prices or “pushed backwards” onto factor payments.\(^{15}\) Additional assumptions the model exploits are constant returns to scale in production, perfect competition, and reproducible fixed factors of production economy-wide. These assumptions allow the analyst to use the I/O matrix, which describes the input shares (of all sectors) in the output of all sectors at a point in time and given prevailing prices, to generate producer price changes assuming production technologies and production input shares remain fixed.

Because it refers to a macroeconomic structure at a point in time and does not specify or generate any behavioral changes (by either households or firms) that result in changes to that macroeconomic structure, it is a static model. We therefore take results generated as an upper-bound estimate of the impact of any change in government-administered price policy on household welfare. The rest of this section follows Coady’s appendix 3.2 closely; additional details can be found there.\(^{16}\)

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14 The indeterminate “shock” we describe here in the context of a CEQ exercise corresponds to the indirect tax or subsidy in question, for example, “We need to know what the welfare impacts of Country X’s electricity subsidy are; let’s go about that calculation by using the price-shifting model to determine what would happen if those subsidies were eliminated.”

15 An intermediate solution, where some of the shock to prices is absorbed by output prices and some by factor payments, is possible. However, because (1) CEQ assessments do not attempt to quantify the household welfare impacts from changes in factor prices, and (2) an input/output matrix does not observe factor payments, such intermediate solutions would manifest themselves here as a less-than-complete shock. See also footnote 12.

Suppose that for any economy at any level of production, there are three types of sectors: cost-push sectors in which higher input prices are pushed fully onto output prices; traded/non-cost-push sectors in which output prices are fixed (possibly because they are determined by world prices) and therefore higher domestic input prices are pushed backwards onto lower factor prices (or profits); and controlled sectors in which prices are controlled by the government.

For controlled sectors, producer prices are managed (at level \( \hat{p} \)) so that retail prices (\( \hat{q} \)) and producer prices are equivalent:

\[
(6-4) \quad \hat{q} = \hat{p},
\]

and

\[
(6-5) \quad \Delta \hat{q} = \Delta \hat{p},
\]

where either side of the equation may be specified exogenously (as part of a reform counterfactual, for example).

In the traded sectors (or those that are not cost-push), retail prices are determined by fixed (world) prices (\( p^* \)) and taxes (\( t^* \)),

\[
(6-6) \quad q^* = p^* + t^*,
\]

and \( q^* = p^* - t^* \) because taxes on domestic production alone must be pushed backwards onto lower producer prices and in turn lower factor payments or profits. Changes in retail prices for traded/non-cost-push sectors are given by

\[
(6-7) \quad \Delta q^* = \Delta p^* + \Delta t^*,
\]

where both terms on the right-hand side will be specified exogenously.

Finally, in the cost-push sectors, retail and producer prices are related according to

\[
(6-8) \quad q^c = p^c + t^c,
\]

\[^{17}\text{If price shocks are absorbed by factor payments in the traded sectors, there may be an impact on labor incomes and returns to capital in that sector and (potentially all) other sectors. However, this model was not developed to solve for a general equilibrium.}\]
where \( t \) are sales or excise taxes (which can be negative, for example, for a subsidy). Producer prices are determined by

\[
(6-9) \quad p' = p'(q, w),
\]

where \( q \) are the retail prices for intermediate inputs and \( w \) are factor prices. As all cost increases are pushed forward onto retail prices (and factor payments are therefore fixed), then

\[
(6-10) \quad \Delta q' = \Delta p' + \Delta t.
\]

Using equation 6-9 and an input/output (I/O) matrix, the change in producer prices is given by

\[
(6-11) \quad \Delta p' = \Delta q' \cdot \alpha \cdot A + \Delta q^* \cdot \beta \cdot A + \Delta \tilde{p} \cdot \gamma \cdot A.
\]

Here, price changes are \( n \times 1 \) row vectors (\( n \) = the number of sectors in the I/O matrix); \( \alpha, \beta, \) and \( \gamma \) are \( n \times n \) diagonal matrixes representing the proportions of cost-push, traded, and controlled commodities/sectors (respectively) in sectoral outputs; and \( A \) is an \( n \times n \) technology coefficients matrix.

Further substitution (of equations 6-7 and 6-10 into 6-11) and solving for \( \Delta p' \) yields

\[
(6-12) \quad \Delta p' = \Delta \tilde{p} \cdot \alpha \cdot A \cdot K + \Delta p^* \cdot \beta \cdot A \cdot K + \Delta \tilde{p} \cdot \gamma \cdot A \cdot K,
\]

a solution based on exogenously-determined changes in taxes on, or prices in, cost-push, traded, and controlled sectors, exogenously-determined changes in world prices, and the inverse matrix \( K = (I - \alpha \cdot A)^{-1} \) where \( I \) is an \( n \times n \) identity matrix. The typical element of the inverse matrix \( K, k_{ij} \) captures the combined direct and indirect use of cost-push sector \( i \) used to produce one unit of cost-push sector \( j \).

The CEQ analyst is concerned with government policies, so most often \( \Delta p^* = 0 \). And unless there is good information for any I/O sector in particular, or for the entire production economy, the CEQ analyst will most often make the convenient assumption that \( \beta = 0 \); that
is, all sectors are either cost-push or controlled.\textsuperscript{18} When those assumptions are made, equation 6-12 becomes

\[(6-12)' \quad \Delta p' = \Delta \ell \cdot \alpha \cdot A \cdot K + \Delta \tilde{p} \cdot (1 - \alpha) \cdot A \cdot K,\]

and the change in cost-push retail prices is then given by

\[(6-13)' \quad \Delta q' = \Delta \ell + \Delta \ell \cdot \alpha \cdot A \cdot K + \Delta \tilde{p} \cdot (1 - \alpha) \cdot A \cdot K,\]

which clearly separates the direct effect of the shock (the first term) from the indirect effects arising from changes in producer prices in the cost-push and controlled sectors (the last two terms).

CEQ-generated analytics and results are often disaggregated by specific policy, so the CEQ analyst will most often use the solution in equation 6-12' for a policy counterfactual that includes at most one unique change to price policy. That in turn means running one of the software options described below for the case where, for example, \(\Delta \ell \neq 0\) while \(\Delta \tilde{p} = 0\) (or vice versa). Theoretically this presents no difficulty because equation 6-12 indicates that changes to producer prices (and therefore to retail prices) are decomposable. Note also that even when \(\Delta \ell = 0\), there may still be cost-push price changes arising from a shock to controlled sectors; these price changes arrive via indirect effects exclusively, which will be important to keep in mind during the value-added tax (VAT) discussion below.

This model’s solution provides I/O-sector by I/O-sector changes in producer prices (after a shock). Therefore the level of detail in the solution corresponds to the level of detail in the I/O matrix used. I/O matrixes do not typically distinguish between, for example, high- and low-quality types of a good, or between informally-produced groceries and formally-produced groceries. Fortunately, the level of detail in the I/O matrix carries over only partially to determination of welfare losses at the household level. As we shall see in the next section, calculating the indirect welfare losses (gains) from indirect taxes or subsidies requires knowledge of the amount by which prices are higher or lower in all sectors as a result of the tax (subsidy), as well as of the household budget shares for goods or services from all sectors.

6.4 Methods for Generating Indirect Effects of Indirect Taxes

In the price-shifting model described in the previous section, indirect taxes and indirect subsidies work similarly but with opposite signs: a tax will drive up the final price of a good

\textsuperscript{18} Nonetheless, all the software packages below allow for traded sectors, or sectors where any shock to prices is (implicitly) pushed back onto factor payments instead of forward onto output prices.
(over its economic cost) while a subsidy should drive it down (below its economic cost). For example, for any individual good in the price-shifting model discussed in the previous section, the impact of a 10 percent subsidy will be equal in magnitude (but opposite in sign) to the impact of a 10 percent sales tax.

However, in practice subsidy impacts on household welfare are often relatively easier to account for. First, it is usually the case that a few easily recognizable and popular items (commodities like grains or other dietary staples, fuels, power) are subsidized; therefore purchases of subsidized goods can often be exclusively and exhaustively identified in the household survey alone and can be exclusively and exhaustively mapped to one aggregated economic sector. In contrast, taxes (VAT, excise, sales, import, and so on) typically cover entire classes of goods or services while exemptions are specific and narrow. Using the household survey alone, purchases of non-exempt taxed goods may be more difficult to exclusively and exhaustively identify. It may also be more difficult to exclusively map classes of goods to one economic sector. For example, if food is subject to VAT while there is an exemption for “basic commodities,” the household survey may not ask households to recall specifically their expenditures on any one of the “basic commodity” items. Moreover, “basic commodities” might map correctly to both of the “agriculture products” and “grain mill products” sectors in the I/O matrix.

Additionally, economic theory offers few reasons to expect subsidy avoidance; in other words, if the same good is available at both subsidized and non-subsidized prices, it is reasonable to expect that all household purchases will be made at the subsidized price. In theory and in practice, tax avoidance is to be expected. However, because tax avoidance is “hidden” (except in aggregate) from most of the records that CEQ relies on, it is often difficult for the analyst to acquire enough information to parameterize tax avoidance behavior and the impact of that behavior on household welfare. See the following section, “Taxes versus Subsidies,” for additional discussion of these issues and for suggested solutions that can be programmed into the software tools described below.

**Practical Solutions for Indirect Effects**

The CEQ analyst does not need additional software to evaluate the direct effects of indirect taxes; the consumption expenditure records (available in the household survey) together with the formulas for the Paasche and Consumer Surplus variations are enough to generate the item-by-item tax burden within the consumption expenditure survey or within the algorithm that creates CEQ income concepts. For the direct effects of indirect taxes or subsidies, the analyst will likely spend more time poring over the consumption expenditure item list and

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19 What’s more, there is typically only one subsidy per item. While there are several different channels through which subsidies might affect the final retail price (government-managed prices, rebates, input subsidies, and so on), multiple modes of subsidy on the same good are not common. The same good or service may attract more than one tax type, however, each with its own associated tax-avoidance behaviors.
comparing it with the relevant indirect tax schedules to determine which of the goods or services attract an indirect tax and what the effective rate of taxation and net-of-tax prices (for that item) are likely to be.

The rest of this section instead reviews software options for calculating indirect effects within the constraints imposed by the price-shifting model and its solution (as described previously), which takes place outside of the household survey. We will describe three publicly available software alternatives for estimating indirect effects and discuss general and specific steps the analyst must complete in order to use this software. These steps are as follows:

1. Prepare the input/output (I/O) matrix or Social Accounting Matrix (SAM).
2. Map household consumption expenditures to I/O production sectors.
3. Calculate the subsidy (tax) as a percentage of the market or reference price and map the subsidy (tax) schedule to I/O sectors.
4. Determine which (if any) I/O sectors would continue to have regulated or non-market prices if the price policy under consideration were revised.
5. Read in the I/O matrix or the SAM.
6. Enter exogenous price shocks and designate sectors with fixed prices.
7. Solve the model.

We will also provide examples as we go through each of the steps as well as one extended “toy” example at the conclusion of this section.

Software Options

The International Monetary Fund (IMF) has developed a set of Stata .do files that estimate the direct and indirect effects of indirect taxes (subsidies) using the price-shifting model described above. SimSIP SAM is a Microsoft Excel® based application with MATLAB® running in the background that can be used to analyze input/output tables and social accounting matrixes. SimSIP SAM can be used to analyze both quantity and price models and is powerful enough to allow for structural path and structural change analysis. Finally, the SUBSIM Stata package, a World Bank project designed by Paolo Verme and Abdelkrim

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20 An effective tax rate is calculated as total revenue collection for each tax divided by the tax base. As described in the section “Taxes versus Subsidies,” in the context of evasion, it is often better to use these rates instead of statutory rates.
22 The SimSIP SAM tool is found at http://simsip.org/IOs__SAMs.html and the manual is at http://simsip.org/uploads/SimSIP_SAM.pdf.
23 See Parra and Wodon (2011).
24 SUBSIM software can be found here: http://www.subsim.org/
Araar, provides a set of tools with graphic interfaces and drop-down menus for rapid distributitional analyses of subsidies and simulations of subsidy reforms.

In order to solve the price-shifting model using one of these software alternatives and to use results to trace the impact of price policy on household welfare, the following steps should be completed.

1. **Prepare the input/output (I/O) matrix or Social Accounting Matrix (SAM).**

   Either an I/O matrix or a SAM can be used, but the analyst should choose an I/O or SAM year closest to the year of the primary household survey.\textsuperscript{25} An I/O matrix can be created from a SAM. An I/O matrix or SAM can be used in all the software options discussed here, though preparation costs will be highest in the SAM-IMF or SAM-SUBSIM combinations. Both the OECD and the World Input-Output Database maintain I/O databases that are regularly updated.\textsuperscript{26}

   I/O matrixes, including an I/O matrix recovered from an underlying SAM, are usually stated in flows: each row will describe the value of that sector’s output by destination (that is, did the sector’s output go to other sectors for use as production inputs or to households for consumption?) and each column will contain a complete list of the value of production inputs (from each sector). To calculate the weight of each input in each output, one must calculate the technical coefficients. This is done from the flows in the I/O matrix by dividing each cell in column \( j \) by the row sum (that is, total output) from the final row (where \( i = j \)). Technical coefficients express the value of inputs (in a sector) as a share of the value of total output from that same sector. The IMF software requires that the analyst create these “technical coefficients” from the I/O matrix while SimSIP SAM and SUBSIM will automatically create this matrix.\textsuperscript{27}

2. **Map household consumption expenditures to I/O table (or SAM) sectors.**

   There will likely be a far more disaggregated category list in the household consumption expenditures questionnaire than in the I/O sector list. The analyst will need to use his or her judgment in mapping each household questionnaire item to the relevant I/O sector. In cases where an item consumed by the household could plausibly come from more than one sector, it is reasonable to split each household’s total consumption of that item among all plausible sectors according to sectoral share in total output (according to the I/O table). For example, if expenditures on “grains/cereals/milled wheat/milled rice” from the household survey could plausibly be mapped to either

\textsuperscript{25} If the I/O matrix is relatively old, making use of it would implicitly assume that the structure of the economy has not changed from the time it was assembled.

\textsuperscript{26} The OECD database is available at [http://www.oecd.org/trade/input-outputtables.htm](http://www.oecd.org/trade/input-outputtables.htm) and the World Input-Output Database is available at [www.wiod.org](http://www.wiod.org).

\textsuperscript{27} The analyst should take care, however, to provide to SUBSIM or SimSIP the precise form of the I/O matrix necessary because they are slightly different.
“Agricultural Products” or “Products from Millers” and those two sectors have total output values of 6 million and 4 million (respectively) according to the I/O table, the analyst could direct 0.6 of a household’s total item expenditures to “Agricultural Products” and the remaining 0.4 of the household’s total item expenditures to “Products from Millers.”

3. Calculate the subsidy (tax) as a percentage of the market or reference price and map the subsidy (tax) schedule to I/O table (or SAM) sectors.

The analyst should not expect the tax-schedule-to-I/O map to be seamless. The determination of the tax rate to apply may be particularly complicated due to likely evasion or weak enforcement (see the section “Taxes versus Subsidies” below for a longer discussion of which tax rates to apply). The analyst will need to use his or her judgment for both, although the determination of the correct tax rate to apply should also be discussed among the broader CEQ team.

4. Determine which (if any) I/O sectors would continue to have regulated or non-market prices if the price policy under consideration were revised.

For example, in the case of fuel subsidies, the relevant counterfactual may more likely be one where the government still controls the price of fuel even after eliminating the current subsidy. In such a counterfactual, fuel would be sold at a higher price, but the price at which it was sold would not necessarily be freely determined by market supply and demand.

5. Read in the I/O matrix or the SAM.

For the IMF software, simply change the following Stata code in order to read the correct “Leontief” or “Technology” coefficients I/O matrix into Stata:

insheet using iotable.txt

For SUBSIM, the analyst indicates to the SUBSIM interface where it should find the I/O matrix; the I/O matrix must be saved as a regular Stata .dta (dataset) file.

For SimSIP SAM, one should copy and paste the regular, flow-based SAM (or I/O matrix) and then designate the SAM accounts that are endogenous and those that are exogenous to the price model under consideration. For CEQ analytics, all SAM accounts other than the “activities” and “commodities” accounts should be made exogenous. If one is using SimSIP SAM with an I/O matrix and if the I/O matrix includes double-entry accounts for more than just the commodities sectors, those accounts should be made exogenous. The tool automatically computes the “Leontief”

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28 See section 4.1 in the SimSIP SAM manual.
or “Technology” coefficients matrix and the inverse matrix (among others) once the “Inverse Matrix for Price Model” button is clicked.

6. **Enter exogenous price shocks and designate sectors with fixed prices.**

With the map generated in step 3, enter price change statements (in percent terms) for each sector that describes the counterfactual the analyst wishes to program and solve. For example, “If subsidies were removed, producer prices in this subsidized sector would increase by 20 percent.”

In the IMF code, these statements appear as the following steps:

**Define price changes**

```plaintext
local dpother=0.20          ; ** price change in petrol + diesel
local dpelec=`dpother'*(1/3); ** assume elec price increase is 1/3 of diesel & petrol price increase
```

**Assign simulated price increases to relevant sectors**

```plaintext
matrix dp_sim[1,30]= `dpother'
matrix dp_sim[1,36]= `dpelec'
```

Now use the information from step 4 to designate sectors which would continue to have fixed (or regulated or controlled or administered) prices in the counterfactual. In the IMF code, this happens with the following statement (which occurs just above the previous piece of code):

```plaintext
local fixprice "30 36" ; ** these are the sectors whose prices are fixed
```

All the user needs to do is change the numbers to reflect the I/O sectors which will continue to have controlled prices in the counterfactual.

In the SUBSIM “I/O Matrix and price changes” package, the exogenous price changes should be entered in the “Price Shock and I/O Matrix info” submenu, as shown in figure 6-3:

Figure 6-3. Screenshot of SUBSIM “Price Shocks” Submenu in the “I/O Price Change Model”
In SUBSIM one chooses whether the exogenous shocks are to sectors which will have fixed prices (after the shock). To do so, use the “Permanent price shock” choice in the “Price shocks” submenu in the “I/O price change model” options menu (see figure 6-3). When “Permanent price shock” is chosen, any sectors with price shocks (in the bottom left corner of the “Main” menu in the “I/O Matrix and price changes” package) will automatically become “fixed price” sectors, which means that those sectors will have regulated prices in the post-shock environment.

In SimSIP SAM, programming price shocks is equivalent to “designing an experiment for the price model.” To begin, open up a field for entering the sectors for which prices will be fixed in the counterfactual by selecting the “Specify supply constraints for Price model” button.\textsuperscript{29} The analyst should enter a maximum price change of 1.0 for the relevant controlled sectors.\textsuperscript{30} After specifying which sectors will have fixed prices, the analyst should execute the “Compute Mixed Multipliers for binding constraints” command in the pop-up window. Finally, select the “Experiment for Price Model Under Supply constraints” button.\textsuperscript{31} A field or worksheet will open up in which the

\textsuperscript{29} See section 4.7.4 which refers the reader to section 4.6.1 in the SimSIP SAM manual.

\textsuperscript{30} This is the SimSIP SAM analog to the “local fixprice” statements in the IMF code. Within SimSIP SAM, designating fix-price sectors with a 1.0 entered in the “maximum price change” column in the “Specify supply constraints…” will limit the total price change in that sector to the price change entered in the “Experiment for Price Model…” sheet.

\textsuperscript{31} See sections 4.7.5, 4.4, and 4.6.2 in the SimSIP SAM manual.
analyst should enter the price shocks that she wishes to program as the counterfactual to the relevant sectors.\textsuperscript{32}

In order to generate the correct indirect effects, the price shocks (under the counterfactual) must summarize the change in producer prices. For example, there may be different unit subsidy amounts for household and industrial or commercial electricity users when electricity is subsidized. The analyst should use the household subsidy amount for the direct effects of the electricity subsidy and the industrial or commercial subsidy amount for the indirect effects.

7. Solve the model.

The user can now run the counterfactual scenario with the IMF code and receive (as Stata output) a list of total price changes (in percent) by I/O sector. In order to let the program run, the user has to comment out the rest of the code beginning at Section 4:

\begin{verbatim}
  ********************
** 4. Read in the household expenditure data and map each expenditure
** item to one sector of the IO table. The idea is to arrive at a new
** mapped dataset having household expenditures by I/O sector.
  ********************
\end{verbatim}

The SUBSIM “I/O Matrix and price changes” package allows for the solution of more than one type of model. The SUBSIM modeling choices that generate a model (and its solution) equivalent to the price-shifting model discussed above as well as to the model (and solution) that the IMF code and SimSIP are solving are the “M1: Cost push prices” and “Permanent price shock” and “Long term”\textsuperscript{33} choices in the “I/O price change model menu” as shown in figure 6-4:

Figure 6-4. Screenshot of the SUBSIM “I/O price Change Model Menu”

Source: Screenshot from the SUBSIM program.

\textsuperscript{32} This is the SimSIP SAM analog to the “matrix dp_sim” statements in the IMF code.

\textsuperscript{33} The “Short term” option in SUBSIM corresponds to allowing the exogenous shock to have a first-round effect on prices in all other (non-shocked) sectors and then halting the recursive solution; the increased prices in non-shocked sectors do not then become higher input prices for all sectors.
SimSIP SAM also begins working after the “Experiment for Price Model under Supply Constraints” has been specified by the analyst. The resulting sectoral price changes will automatically populate their respective cells in the same field or worksheet that the analyst opened when selecting the “Experiment for Price Model under Supply Constraints” button.

[H1] Example Calculations: Steps 1 and 6-7

Suppose the CEQ analyst received the following I/O matrix describing the productive sector in some country-level economy producing food and fuel, in any year:

<table>
<thead>
<tr>
<th>Sector/commodity</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Household consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1=Food</td>
<td>40</td>
<td>5</td>
<td>7</td>
<td>34</td>
</tr>
<tr>
<td>2=Fuel</td>
<td>15</td>
<td>35</td>
<td>7</td>
<td>243</td>
</tr>
<tr>
<td>3=Widgets</td>
<td>2</td>
<td>22</td>
<td>10</td>
<td>120</td>
</tr>
<tr>
<td>Output</td>
<td>120</td>
<td>75</td>
<td>80</td>
<td>560</td>
</tr>
</tbody>
</table>

This I/O matrix describes the value of the inputs used in production in all sectors (the columns) and the uses or destinations of all sectoral outputs (the rows) in a double-accounting framework. Step 1 above indicates that we need a technology coefficients matrix, which looks like the following:

<table>
<thead>
<tr>
<th>Sector/commodity</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1=Food</td>
<td>0.3333</td>
<td>0.0667</td>
<td>0.0875</td>
</tr>
<tr>
<td>2=Fuel</td>
<td>0.1250</td>
<td>0.4670</td>
<td>0.0875</td>
</tr>
<tr>
<td>3=Widgets</td>
<td>0.0167</td>
<td>0.2930</td>
<td>0.1250</td>
</tr>
</tbody>
</table>

The technology coefficients in any sector’s column do not sum to 1; we are taking the value of intermediate inputs over the total value of output, but the total value of output also includes payments made to factors (labor, land, capital) in addition to payments made for intermediate inputs.

Suppose the CEQ analyst knows that fuel prices are regulated; in particular, suppose that the analyst finds out that fuel prices are kept 10 percent below the market or reference price through government operations. In other words, the government uses fiscal expenditures to provide fuel at prices that are 10 percent below the price that would occur if government were not making those expenditures. Suppose also that the government would keep the price of fuels at the reference price even if there were no direct subsidy. The CEQ analyst is
interested in the effect of the current subsidy on prices in the food and widget sectors under the cost-push model described above, and so for steps 3, 4, and 6 above, the analyst would enter a 10 percent price change for fuel as well as designate fuel as a “fixed price” sector.

Step 7 asks the analyst to solve the cost-push model of sector prices given the 10 percent shock introduced (representing the no-subsidy counterfactual) in fixed-price fuels. All the software options discussed above first calculate the matrix $K = (I - \alpha A)^{-1}$. As stated above (see equations 6-12 and 6-13), the typical element of $K$ captures the combined direct and indirect expenditure on cost-push sector $i$ used to produce one expenditure unit’s worth of cost-push sector $j$ and the scalar $\alpha$ demarcates cost-push sectors (Sectors 1 (food) and 3 (widgets) in our model) from the controlled sectors (Sector 2 (fuel) in our example). For our example, $K =$

<table>
<thead>
<tr>
<th></th>
<th>s1</th>
<th>s2</th>
<th>s3</th>
</tr>
</thead>
<tbody>
<tr>
<td>s1</td>
<td>1.5040</td>
<td>0.1444</td>
<td>0.1504</td>
</tr>
<tr>
<td>s2</td>
<td>0.0000</td>
<td>1.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>s3</td>
<td>0.0286</td>
<td>0.3380</td>
<td>1.1460</td>
</tr>
</tbody>
</table>

We can then create the indirect price changes for each sector (arising as a result of the exogenous shock or shocks) by multiplying the exogenous shock by $\alpha$ post-multiplied by $K$ (following equation 6-13). Because the fuel sector (2) is controlled, only food (sector 1) and widgets (sector 3) will have indirect price changes. We end up with $\Delta f.\alpha. A. K + \Delta \tilde{p}.(1 - \alpha). A. K =$

<table>
<thead>
<tr>
<th></th>
<th>s1</th>
<th>s2</th>
<th>s3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect price changes</td>
<td>0.0191</td>
<td>0.0000</td>
<td>0.0119</td>
</tr>
</tbody>
</table>

In other words, prices would be expected to increase in sector 1 (food) by approximately 1.9 percent and in sector 3 (widgets) by approximately 1.2 percent if the 10 percent fuel subsidy were to be removed. Notice that food’s use of fuel (as represented by the technology coefficient in cell [2,1] in the I/O matrix) is greater than the widget sector’s use of fuel (as represented by the technology coefficient in cell [2,3] in the I/O matrix), so it makes sense that the indirect effect is greater for food than for widgets.

We know that fuel was a “fixed price” sector and that the only exogenous shock was in fuel, so we can also list the total (direct plus indirect) price changes for all three sectors. That is,

$$\Delta f + \Delta f.\alpha. A. K + \Delta \tilde{p}.(1 - \alpha). A. =$$
Chapter 6, Jellema and Inchauste

<table>
<thead>
<tr>
<th></th>
<th>s1 = food</th>
<th>s2 = fuel</th>
<th>s3 = widgets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total price changes</td>
<td>0.0191</td>
<td>0.1000</td>
<td>0.0119</td>
</tr>
</tbody>
</table>

This is the vector of sector-by-sector price changes that step 8 (below) calls on. Once the household consumption expenditure survey module is re-categorized according to I/O sectors (see step 2 above), all consumption expenditure in that I/O sector can be revalued according to new prices in that sector by either the “inelastic demand” or “homothetic preferences” scenarios listed above in the discussion of the direct effects of indirect taxes and subsidies.

8. **Apply the sectoral price changes to the microdata.**

   a) Use the map generated in step 2 to determine which consumption items will experience which (I/O sector-wide) indirect prices changes.

   b) As for the calculation of the *direct* effects of indirect taxes and subsidies described above, use the formulas for the Paasche variation or the Consumer Surplus variation to calculate—for each item in a household’s consumption basket—the change in purchasing power (or consumer surplus) that the household experiences through purchases of items that have experienced indirect price changes.

Steps 8a and 8b make it clear that a single tax (subsidy) can have both direct and indirect impacts. A fuel subsidy, for example, lowers the price of fuel that a household purchases for vehicles and cooking, but it also lowers the price of agricultural goods and public transport. Under the price-shifting model, households receive the full magnitude of the direct and indirect benefits (burdens) created by a subsidy (tax).

The calculation of indirect effects can also be completed within all the software programs discussed above if the user provides (as inputs) the household expenditure records. SimSIP SAM users can open up the “Poverty and Income Distribution Analysis” module; in the IMF code, section 4 through to the end of the program replicates step 8. SUBSIM users can provide a consumption dataset in which the items have already been mapped to the I/O sectors; SUBSIM will then apply the sector-level price change statements directly to this re-organized dataset. However, none of the software options calculates both the Paasche and Consumer Surplus variations in parallel. Therefore, we suggest that the CEQ analyst use the software only to generate the sector-level price changes (that would occur if a tax or subsidy were removed) and then “import” those price-change vectors into the household consumption expenditure survey to use in calculating the indirect PV and CS magnitudes for the taxes (or subsidies) being analyzed.

Whether the analyst migrates the sectoral price changes “by hand” to the microdata or feeds the microdata in to the software to allow the software to complete step 8, she should pause
at the completion of step 7 to examine the price changes (listed by sector) for consistency and logic. If, for example, an increase in the price of fuel (due to the removal of a fuel subsidy) has very little impact on the transportation sector, then the analyst should re-examine the price change statements and, if necessary, the I/O table to determine the source of the inconsistency.

6.5 Taxes versus Subsidies

Subsidies should lower prices paid whether they are applied at the point of purchase by the consumer or given to goods and services producers themselves. Indirect taxes, meanwhile, have the opposite effect. For a good that is subsidized, the retail price is lower than the economic cost while household expenditure on the good (valued at market prices) will reflect only a portion of the economic cost or the price the good would fetch if there were no subsidy. For a good that is taxed, the retail price is higher than the economic cost, and expenditure by a household on that good represents some household consumption and some revenues collected by the government.

However, because businesses and households have reason to avoid taxes and because exemptions or exceptions for subcategories within a taxed class of goods may mean there will be reduced impact on producer prices, the CEQ analyst should take care to use empirical facts and judicious discretion in programming and simulating pre-fiscal counterfactuals for either taxes or subsidies. The CEQ analyst should use all the analytical tools at her disposal to faithfully reflect the de facto, rather than the de jure, situation. For example, when the statutory VAT rate is 18 percent, but the analyst notes that confirmed revenues from VAT divided by the confirmed sales value of the VAT-able base indicate that the effective VAT rate is something less than 18 percent, the analyst should apply the effective VAT rate to the household survey. Applying the statutory VAT rate to household purchases would likely overestimate the actual VAT burden on households.

The IMF code, SimSIP SAM, and SUBSIM can indirectly accommodate these complications within the price model described above. Take tax avoidance first: when there is no secondary source-data available on tax evasion, the analyst can use effective tax rates instead of policy rates. Effective rates are simply the ratio of (confirmed, verified, or audited) tax revenues divided by the taxable base according to national accounts. Depending on how disaggregated the information used to generate effective rates is, the analyst can then choose to apply one effective rate for all goods or services that attract the tax, or she can differentially apply the various sectoral effective rates, or she can choose to reduce the sectoral policy rates by the same factor by which the global effective rate is lower than the global policy rate. Where the IMF code, SimSIP SAM, or SUBSIM asks for price shocks, the analyst can use these effective rates instead of policy rates.
Whether an indirect tax “compounds” depends on the mechanics of the tax. In principle, a value-added tax should not compound as producers claim rebates on all VAT paid on inputs. However, an excise tax should compound as prices paid for inputs at any production stage will contain taxes paid during the previous production stage (for cost-push sectors under the assumptions of the price model described above).

The analyst can allow for a compounding tax by not entering any fixed price statements; that is, she can let prices in all taxed sectors change by the total (weighted) amount by which all input prices have changed as a result of the initial price shock (for example, the removal of the tax). This will result in the magnitude of the final, total, retail price change in some (possibly all) cost-push sectors being larger than the initial shock.

For a non-compounding tax, the analyst can enter fixed price statements for all sectors in which the counterfactual results in no change to producer prices. For example, suppose the counterfactual under consideration is the removal of a VAT system which has no exemptions. Retail prices in the sectors subject to VAT will drop by exactly the VAT rate, but no further: under a VAT system, producers receive rebates on all taxes paid on inputs so if a VAT is removed, producer prices will not change.

Exemptions within a VAT schedule make it more difficult to put bounds on the minimum and maximum of the actual total change in producer prices. If a VAT schedule designates certain “basic necessity” food items as exempt, for example, then the rebate chain is broken for those items: while consumers will not pay VAT upon purchase, producers of “basic necessity” food items do not receive rebates for any taxes on inputs. To the extent that such producers use standard-rated items as inputs, the final price of a “basic necessity” food item will reflect total input costs, which will now include any VAT paid (and not rebated) by the producer on inputs. Therefore, in a VAT system with at least one exempt good, it is no longer true that producer prices will not change if the VAT system is abolished; indirect effects will need to be calculated.34

As another example, domestic industrial or commercial users of imported goods are often not charged customs duties; in this case producer prices may not change if there is a shock to import duties. Then, as in the case of a VAT system with no exemptions, there will only be direct effects of import duties; there will be no indirect effect that operates through the change in producer prices.

In cases where the indirect tax system in application means that some producer prices would change and some would not in the price-shifting model under the counterfactual, the analyst should break up transmission of higher intermediate prices onto final prices into two steps.

34 For further discussion of the difference between VAT regimes and standard sales or excise taxes (vis-à-vis household welfare impacts), see Coady and Newhouse (2006).
As a preliminary, identify the sectors for which producer prices will not change directly, call the set of those sectors \( I \) and the set of all remaining sectors \( J \). Then (1) enter price shocks (corresponding to the counterfactual) for \( I \) only and solve the price model. From the \( 1 \times (I + J) \) vector of total price changes, select the elements corresponding to \( J \) and (2) enter those as (the only) price shocks in a new price model. Once that new price model has been solved, the elements corresponding to \( I \) in the \( 1 \times (I + J) \) vector of total price changes will represent the indirect changes in producer prices that arise when, for example, non-exempt VAT sectors consume some VAT-exempt inputs in the production process. The indirect impact on producer prices in \( I \) plus the exogenous price shocks in \( I \) will be the total change in final prices in the \( I \) sectors.

The preceding discussion is meant to sound a gentle alarm: knowing the statutory rate of indirect taxation or the policy subsidy rate is not enough information to generate reasonable estimates of the impacts of the indirect tax and subsidy schedule on household purchasing power or welfare. The CEQ analyst will also need to parameterize as completely as possible the de facto application of the tax and subsidy schedule, including any weak tax or subsidy administration and tax avoidance as well as how informal purchases from unregistered sellers are to be treated.

### 6.6 Summary and Conclusion

The impact of indirect taxes (and subsidies) on poverty and inequality can be significant. However, standard poverty headcounts and inequality measures—calculated over a distribution of consumption expenditures—do not typically attempt to apportion the value of household consumption expenditure on goods and services separately from the value of indirect taxes paid while making consumption expenditures.

Accounting for the direct impact of indirect taxes (or subsidies) on household welfare and expenditure levels provides an estimate for only one channel by which fiscal policy might affect inequality and poverty. The indirect impact of indirect taxes (or subsidies), which is created via the interaction of the production side of the economy with the fiscal system and with consumers, can be larger in magnitude than the direct impact as well as proportionally more important for lower-income consumers.

For example, in a 20-country study covering Africa, South and Central America, Asia and the Pacific, and the Middle East and Central Asia, the indirect impact of higher fuel prices on welfare accounted for a nearly 60-percent share of the total impact (direct + indirect). On

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35 In a VAT system, these are the sectors that are not VAT-exempt (so producers receive a rebate on any VAT paid). In an import duty system, these are the sectors in which producers do not have to pay customs duties.

36 See Coady, Flamini, and Sears (2015). Indirect impacts are calculated under the price-shifting model discussed in this chapter and are valued according to the Paasche variation (also discussed in this chapter). The
average, the indirect impact was about 1.34 times greater than the direct impact for the poorest population quintile(s). In other words, the burden on the bottom 20 percent of the population created by the removal of fuel subsidies (or the imposition of a fuel tax) in these countries would be on average 134 percent higher if indirect impacts were taken into account than if only direct impacts were taken into account. Including indirect effects, therefore, is likely to have a significant impact on the level of fiscal impoverishment (see Higgins and Lustig; reproduced as chapter 4 in this Handbook) generated by fiscal policy.

Low- and middle-income countries raise more in revenue from indirect than from direct taxes (on average), so a fiscal-incidence accounting will be missing an important piece if the burden of indirect taxes is not sensibly estimated. This chapter has provided a practical guide with theoretical underpinnings to the CEQ analyst for calculating the item-by-item and household-by-household burden or benefit of indirect taxes or subsidies. These procedures include steps for calculating both the direct and indirect burdens of indirect taxes so that the CEQ analyst can provide a reasonable description of the “pre-fiscal” counterfactual in which taxes or subsidies have been eliminated.

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37 Indirect effects created by the price-shifting model and valued by the Paasche variation.
38 Higgins and Lustig (2016).
39 The estimated impact of fiscal policy on inequality is also likely to change if the indirect effects of indirect taxes (or subsidies) are included because the magnitude of the indirect impact (measured as a share of the total impact) on welfare is greater for the poorest than for the richest quintile in all regions included in Coady, Flamini, and Sears (2015).
References


Producing Indicators and Results, and Completing Sections D and E Of CEQ Master Workbook Using the CEQ Stata Package

Sean Higgins †

October 31, 2016

Chapter 7
Lustig, Nora, editor
Commitment to Equity Handbook
Brookings Institution and CEQ Institute (2017)

Introduction

This chapter describes the indicators and results used in a CEQ Assessment, sections D and E of the CEQ Master Workbook (MWB), and how the results and indicators can be produced and exported to the CEQ MWB using Aranda and Higgins’s CEQ Stata Package.

The results in sections D and E of the MWB are designed to answer the following four questions from a CEQ Assessment, presented in chapter 1 of this Handbook.

--How much income redistribution and poverty reduction is being accomplished through fiscal policy?
--How equalizing and pro-poor are specific taxes and government spending?
--How effective are taxes and government spending in reducing inequality and poverty?
--What is the impact of fiscal reforms that change the size and/or progressivity of a particular tax or benefit?

1 I Am Grateful To Many Ceq Assessment Authors For Testing and Pointing Out Bugs In The User-Written Commands That Make Up The Ceq Stata Package, Particularly Rodrigo Aranda, Maynor Cabrera, Luciana De La Flor, Ali Enami, Nizar Jouini, Sandra Martínez-Aguilar, Luis Felipe Munguia, Barbara Sparrow, Ernesto Yañez, and Stephen Younger. I Am Also Grateful To Rodrigo Aranda, Ali Enami, Nora Lustig, Sandra Martínez-Aguilar, Adam Ratzlaff, and Stephen Younger For Conversations That Helped To Shape The Structure and Features Of The Commands, To Rosie Li For Excellent Research Assistance, and To Rodrigo Aranda For Writing Five Of The Ceq Stata Package Commands.
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2 Aranda and Higgins's (2016)
3 Lustig and Higgins (forthcoming).
Chapter 7, Higgins

It is important to produce a separate set of Excels for sections D and E of the MWB for each different treatment of pensions scenario, as well as for any additional sensitivity analyses conducted by the research team. To recapitulate, there are three main scenarios we consider for the treatment of pensions (see chapter 5 of this Handbook).  

Section 1 presents preliminary definitions. Section 2 describes the structure of Sections D and E of the CEQ MWB and defines the indicators used in a CEQ Assessment. Section 3 describes the suite of user-written Stata commands that make up the CEQ Stata Package.

1. Basic Concepts

I begin by over viewing some basic concepts that are necessary to understand the discussions later in this chapter.

Core income concepts

The income concepts presented in figure 5-1\(^5\) of Higgins and Lustig\(^6\) are the core income concepts. These are the primary income concepts used in a CEQ Assessment; for example, tracing inequality across the income concepts provides a picture of how different types of taxes and transfers affect inequality. For example, tracing the change in inequality between market income and disposable income shows how direct taxes and transfers affect inequality, while tracing from market income to consumable income shows how direct and indirect taxes, direct transfers, and indirect subsidies affect inequality.

Fiscal interventions (also known as fiscal instruments)

Fiscal interventions or instruments refer to any tax, transfer, or subsidy included in a CEQ Assessment.

Income components

Income components refer to elements of income that are not fiscal interventions (they are not collected or provided by the government), such as labor income or production for own consumption.

Extended income concepts

The extended income concepts refer to additional income concepts constructed by adding and subtracting individual fiscal interventions or bundles of fiscal interventions from the core income concepts. For example, one extended income concept would be “market income plus pensions plus conditional cash transfers (CCT).” This extended income concept is useful because, for example, inequality of market income plus pensions can be compared to inequality of this extended income concept to see how CCT affect inequality when we ignore the existence of other direct taxes and transfers. As a second example, another extended income concept would be “disposable income minus CCT” (since disposable income already includes CCT, disposable income minus CCT means disposable

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\(^4\) Higgins and Lustig (forthcoming).

\(^5\) Higgins and Lustig (chapter 5 of this Handbook).

\(^6\) Higgins and Lustig (chapter 5 of this Handbook).
income prior to adding in CCT benefits. This extended income concept is useful because, for example, inequality of disposable income minus CCT can be compared to inequality of disposable income to see how CCT benefits affect inequality when we do take into account the existence of other direct taxes and transfers.

**Initial income**

Initial income refers to the income concept prior to adding (subtracting) the transfer (tax) we are focusing on. In the first example above, initial income would be “market income plus pensions.” In the second, initial income would be “disposable income minus CCT.”

**End income**

End income refers to the post-tax and transfer income concept that we are using in a particular comparison. In the first example above, end income would be “market income plus pensions plus CCT.” In the second, end income would be “disposable income.”

**Pre-fiscal income**

Pre-fiscal income refers to income before any taxes and transfers are accounted for. The relevant income concept is generally market income. In some instances we also refer to pre-fiscal income as original income.

**Post-fiscal income**

Post-fiscal income refers to any income concept after at least some taxes and transfers have been accounted for, for example, disposable income, consumable income, final income, or various extended income concepts.

**Marginal contribution**

The marginal contribution is defined as the contribution of a particular fiscal intervention to an outcome indicator of interest, such as an inequality or poverty indicator. It is defined explicitly in box 1-2 by Ali Enami in Lustig and Higgins. Note that if a fiscal intervention’s marginal contribution to inequality (poverty) is positive, the intervention is equalizing (poverty-reducing) with respect to whatever end income concept was used, while if its negative, the intervention is unequalizing (poverty-increasing).

**Progressivity and Pro-Poorness**

Since one of the criteria for evaluating the distributive impact of fiscal policy depends on the extent of

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7 Lustig and Higgins (chapter 1 Of This Handbook).
progressivity of taxes and transfers, this is a good place to review the definitions used in the literature of what constitutes progressive taxes and transfers. To determine if a tax or transfer is progressive, concentration curves, concentration coefficients, and the Kakwani\(^8\) index are commonly used.

Concentration curves are constructed similarly to Lorenz curves but the difference is that the vertical axis measures the proportion of a tax (transfer) paid (received) by each quantile. Therefore, concentration curves (for a transfer targeted to the poor, for example) can be above the diagonal (something that, by definition, could never happen with a Lorenz curve). Concentration coefficients are calculated in the same manner as is the Gini but with the population ranked by per capita income; for cases in which the concentration coefficient is above the diagonal, the difference between the triangle of perfect equality and the area under the curve is negative, which cannot occur with the Gini for the income distribution by definition. The data used to generate concentration curves and coefficients are derived from incidence analyses. The technical definitions of the Lorenz curve and concentration curve are given in section 3.

The terms “progressive” and “regressive” are used in two different senses in the literature on taxes and transfers.\(^9\) We borrow their concise summary here:

The progressivity/regressivity of a transfer can be measured in absolute terms by comparing the amount of transfers across quantiles or it can be defined in relative terms by comparing transfers as a percentage of the (pre-transfer) income of each quantile. In the tax incidence literature, where the fiscal application of the terms progressive and regressive originated, they are used exclusively in the relative sense. In the benefit (and tax-benefit) incidence literature, it is common practice to use the absolute as well as the relative concepts.\(^10\)

Since CEQ assesses the progressivity of both taxes and transfers, we have opted for the relative definition. Hence, a transfer is progressive when the proportion received (as a percentage of pre-fiscal income) decreases with income. This is consistent with an intuitively appealing principle: in a world with no reranking, a transfer or tax is defined as progressive (regressive) if applying that tax or transfer alone results in a less (more) unequal distribution than that of pre-fiscal income. We distinguish between transfers that are progressive in absolute terms and progressive in relative terms. In particular:

1. A tax is everywhere progressive (regressive) if the proportion paid – in relation to pre-fiscal income – increases (decreases) as income rises.\(^11\) In practice, taxes are not everywhere progressive; for example, if one household manages to evade the tax while another household with slightly lower income and another with slightly higher income do not, it will violate the definition of being everywhere progressive. A tax is globally progressive (regressive) if its concentration curve lies everywhere below (above) the pre-fiscal income Lorenz curve. A necessary but not sufficient condition for this is that the concentration coefficient is positive and larger (smaller) than the pre-fiscal income Gini. This necessary but not sufficient condition is equivalent to saying that the Kakwani index, defined for taxes as the tax concentration coefficient minus the pre-fiscal income Gini, will be positive (negative) if a tax is globally progressive (regressive).

Note that the concentration curve of the tax may cross the pre-fiscal income Lorenz curve, in which case it is ambiguous (neither progressive nor regressive). Its concentration coefficient may be either

---

\(^8\) Kakwani (1977).


\(^10\) Lustig, Pessino, and Scott (2014).

\(^11\) For more on the concept of a tax being everywhere progressive, see Duclos (2008).
less than or greater than the pre-fiscal income Gini. Hence, we use concentration curves—and not concentration coefficients or Kakwani indices alone—to determine progressivity.

2. A transfer is everywhere progressive if the proportion received—in relation to pre-fiscal income—decreases as income rises. There are two types of progressive transfers: absolute and relative. A transfer will be progressive in absolute terms if the per capita amount received increases as income rises. A transfer will be progressive in relative terms if the proportion received in relation to pre-fiscal income decreases as income rises but not so the per capita transfer. Again, transfers in practice are usually not everywhere progressive because someone might not receive the transfer while a slightly poorer and a slightly richer person both do. A transfer is globally progressive in absolute terms if its concentration curve lies everywhere above the 45-degree line. A necessary but not sufficient condition for this is that the concentration coefficient is negative, or equivalently that the Kakwani index, defined for transfers as the pre-fiscal income Gini minus the transfer’s concentration coefficient, is positive and higher than the pre-fiscal income Gini. A transfer is globally progressive in relative terms if its concentration curve lies everywhere between the pre-fiscal income Lorenz curve and the 45-degree line. A necessary but not sufficient condition for this is that the concentration coefficient is positive and lower than the pre-fiscal income Gini, or equivalently that the Kakwani index is positive if a transfer is progressive in relative terms.

If the concentration curve of a transfer crosses the 45-degree line (this could be from above or below and any number of times) but still lies everywhere above the pre-fiscal income Lorenz curve, it is unambiguously progressive, but we cannot say unambiguously whether it is progressive in absolute terms, even if its concentration coefficient is negative.

3. A transfer is everywhere regressive if the proportion received—in relation to initial income—increases as income rises. Again, in practice transfers will not be everywhere regressive. A transfer is globally regressive if the concentration curve lies everywhere below the pre-fiscal income Lorenz curve. A necessary but not sufficient condition for this is that the concentration coefficient is positive and greater than the initial income Gini, or equivalently, that the Kakwani index is negative.

If the concentration curve of a transfer crosses the market income Lorenz curve, we cannot unambiguously say that the transfer is progressive or regressive. Its concentration coefficient may be either less than or greater than the initial income Gini. Hence, we use concentration curves—and not concentration coefficients or Kakwani indices alone—to determine progressivity.

4. A tax or transfer will be neutral (in relative terms) if the distribution of the tax or the transfer coincides with the distribution of pre-fiscal income. A necessary but not sufficient condition for this is that the concentration coefficient is equal to the pre-fiscal income Gini. Equivalently, the Kakwani index will equal zero if a tax or transfer is neutral.

The four cases are illustrated graphically in figure 7-1, where we assume that pre-fiscal income is market income.

---

12 The index originally proposed by Kakwani (1977) only measures the progressivity of taxes. It is defined as the tax’s concentration coefficient minus the pre-fiscal income Gini. To adapt to the measurement of transfers, Lambert (1985) suggests that in the case of transfers it should be defined as pre-fiscal income Gini minus the concentration coefficient (the negative of the definition for taxes) to make the index positive whenever the change is progressive.
As shown in Enami, Lustig, and Aranda\textsuperscript{13} and Enami\textsuperscript{14}, however, a progressive tax or transfer is not necessarily equalizing. Furthermore, it is not necessarily poverty-reducing, and Higgins and Lustig\textsuperscript{15} show that even if a tax and transfer system is poverty-reducing and progressive, it can still make a substantial portion of the poor poorer, and can make some non-poor poor.

**Deciles**

Each decile represents ten percent of the population. Individuals are ordered by income from poorest to richest, with the “first decile” referring to the poorest decile, and the “tenth decile” referring to the richest. The CEQ Stata package automatically produces deciles. If you are producing deciles on your own for any additional calculations, note that the division should be done such that the expanded population in each decile is equal (or approximately equal), rather than the number of raw observations in each decile. The expanded population refers to the number of individuals (not households) when the appropriate expansion factors are applied to each observation.\textsuperscript{16} Individuals in the same household

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\textsuperscript{13} Enami, Lustig, and Aranda (forthcoming).

\textsuperscript{14} Enami (chapters 2 and 3 of this Handbook).

\textsuperscript{15} Higgins and Lustig (2016).

\textsuperscript{16} Expansion factors are a type of sampling weight. Sampling weights re-weight the sample to account for the non-random stratified sample design. Expansion factors are sampling weights that are scaled such that they sum to the total population of the country (if the survey is representative at the national level).
should be kept in the same decile, whereas individuals in different households with the same income may be arbitrarily allocated to different deciles if they are near the cut-off, in order to keep decile sizes approximately equal. This is not possible with Stata’s built-in command `xtile`, and is best accomplished with the user-written command `quantiles` (written by Rafael Guerreiro Osorio; to install, type `ssc install quantiles` in Stata’s command window). Let the data set be at the individual level (each observation is an individual rather than household), and let household per capita market income be saved as `ym`, the variable containing the identifying code for each household be called `hh_code`, and the variable containing the expansion factor be called `s_weight`. Then, the following command will create market income deciles following the instructions above, and create a new categorical variable called `ym_decile` containing the decile of each observation (the new variable will be an integer ranging from 1 to 10):

```
quantiles ym [iw=s_weight], gen(ym_decile) n(10) k(hh_code)
```

Some output tables are non-anonymous, in other words, they follow identified individuals, so for example the first decile always refers to the poorest ten percent of the population by pre-fiscal income. For example, on the Concentration sheets (for example, sheets D5, E10) we are looking at the change in incomes caused by various taxes and transfers to the incomes of identified individuals: we want to know by how much the incomes of those who are initially in the poorest ten percent, etc. changed. On the other hand, other tables are anonymous so we allow reranking between income concepts. For example, on the Lorenz sheets (for example, sheet E3) we are comparing the market incomes of the poorest ten percent of the population ranked by market income to the disposable incomes of the poorest ten percent of the population ranked by disposable income, even though these may not be the same individuals.

**Poverty Lines**

All poverty lines are absolute and income- or consumption-based. By default, sections D and E use the following poverty lines corresponding to the 2005 International Comparison Program (ICP): the standard international poverty lines of US$1.25 dollars per person per day in purchasing power parity (PPP) adjusted 2005 US dollars (which we call "ultra-poverty"), US$2.50 PPP per person per day (extreme poverty), and US$4 PPP per person per day (moderate poverty). The latter corresponds to the moderate poverty line commonly used for middle-income countries such as those in Latin America. These poverty line defaults can be changed using options in the CEQ Stata package commands. For example, if the user is instead doing a PPP conversion using the 2011 ICP and wants to use the World Bank’s extreme poverty line of US$1.90 PPP per day in 2011 dollars, they can do this using the options described in section 3.

Note that, since these defaults correspond to the 2005 ICP, they may be updated in the future when conventions about these lines are established for the 2011 ICP. (As of this writing, the World Bank has established the new official US$1.90 PPP per day poverty line that corresponds to the 2011 ICP, but not other lines). Check the help files of the CEQ Stata Package to verify the current defaults.

---

17 See Ferreira and others (2013).
18 Ferreira and others (2016).
We also include results using national poverty lines, which preferably distinguishes between urban and rural areas and possibly by regions, and “other poverty lines”, such as those calculated by an international organization for the country. The options for these poverty lines in the CEQ Stata Package accept both scalars (if the line is fixed across the country) or variables (for lines that vary, for example by region or household).

**PPP Conversions**
The CEQ Stata package makes PPP conversions automatically, as described in detail in section 3. If the user wishes to manually make PPP conversions for additional calculations, the instructions are as follows.

**PPP Conversions Using 2005 ICP**
To convert the international poverty lines in PPP adjusted 2005 US dollars per day into poverty lines in local currency per month or year of a specific survey year:

1. Multiply the number that is in 2005 PPP per day by the 2005 PPP conversion rate to convert the international poverty lines into 2005 local currency. The PPP conversion factor should be based on private consumption rather than GDP; this factor can be obtained from the World Development Indicators (WDI) Databank using the series “2005 PPP conversion factor, private consumption (LCU per international dollar)” and selecting the year 2005.

2. Use the country’s consumer price index (CPI) to convert the poverty lines in 2005 local currency to survey year local currency. The WDI currently anchors their CPI numbers at the year 2010 (see the series “consumer price index (2010 = 100)”); multiply the poverty line in 2005 local currency by the ratio of the CPI for the survey year divided by the CPI for 2005.

3. If converting to the daily poverty lines to monthly currency (for use with monthly income or consumption data) multiply by 365/12. If converting to yearly currency (for use with yearly income or consumption data) multiply by 365.

In sum, the yearly international poverty line in local currency is equal to the 2005 PPP per day poverty line times the 2005 PPP conversion factor (of 2005 local currency units per 2005 PPP dollar), times the country’s CPI of the survey year over the CPI of 2005, times 365 days per year.

For example, in the case of Brazil, the household survey data used for analysis is 2009, its private consumption-based PPP conversion factor for 2005 is 1.571 Brazilian reais (in 2005) = US$1 PPP (in 2005), the CPI for 2009 is 95.203, and the CPI for 2005 (the base year) is 79.560, so the US$4 PPP per day (using the 2005 ICP) international poverty line would be converted into 2009 local currency (reais) per year as follows:

\[
\frac{\$4\text{PPP}}{1 \text{day}} \times \frac{1.571 \text{ reais}}{\$1 \text{PPP}} \times \frac{95.203}{79.560} \times \frac{365 \text{ days}}{1 \text{ year}} = \frac{2745.20 \text{ reais}}{1 \text{ year}}
\]

Thus, the US$4 PPP per day international poverty line is equivalent to 2,745.20 reais (in 2009) per year.
Chapter 7, Higgins

The CEQ Stata package includes a command to facilitate these conversions: `ceqppp`, which makes use of the user-written program `wbopendata` to pull PPP conversion factors and CPI numbers directly from WDI.\(^\text{19}\) Thus, both the CEQ Stata Package and `wbopendata` need to be installed; to install them use the following Stata code:

```
update all
ssc install ceq, replace
ssc install wbopendata, replace
```

The advantages of obtaining the necessary statistics for a PPP conversion directly in Stata are efficiency and avoiding rounding error. The syntax of the command is as follows:

```
ceqppp , country(string) baseyear(real) surveyyear(real) locals
```

The command has the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>country(string)</code></td>
<td>Three letter country code (see <code>help wbopendata</code>)</td>
</tr>
<tr>
<td><code>baseyear(real)</code></td>
<td>Base year for PPP conversion (either 2005 or 2011)</td>
</tr>
<tr>
<td><code>surveyyear(real)</code></td>
<td>Year of household survey</td>
</tr>
<tr>
<td><code>locals</code></td>
<td>Store these numbers as locals</td>
</tr>
</tbody>
</table>

In Stata, see `help ceqppp` for more details. To use `ceqppp` for the above conversion of the US$4 PPP (using the 2005 ICP) poverty line to local currency for Brazil, the syntax would be:

```
ceqppp , country("bra") baseyear(2005) surveyyear(2009) locals
```

Since the `locals` command was included, the 2005 local currency to 2005 PPP conversion factor will be saved in the local ``ppp`', the CPI for the base year in `cpibase', and the CPI for the survey year in `cpisurvey'. These can now be used as follows:

```
local z = 4 // PPP poverty line to be converted
local z_LCU = `z'*`ppp'*(`cpisurvey'/`cpibase')*365
```

Note that the `ceqppp` command can also be used to feed the 2005 local currency to 2005 PPP conversion factor, CPI for the base year, and CPI for the survey year directly into the results-producing commands in the CEQ Stata package, as described in detail in these commands’ help files and in section 3.

To instead convert numbers from survey-year local currency to 2005 PPP dollars per day (for example, to learn the value of a national poverty line in PPP per day for international comparisons, or to report benefits in PPP dollars per day), follow the reverse sequence. Specifically:

1. If the survey-year local currency numbers are yearly, divide by 365 to obtain local currency per day. If the numbers are monthly, divide by 365/12 to obtain local currency per day.

\(^{19}\) Azevedo (2016).
Chapter 7, Higgins

2. Divide by the ratio of the CPI for the survey year divided by the CPI for 2005, using the series “Consumer price index (2010 = 100)” from WDI to convert survey-year local currency per day to 2005 local currency per day.

3. Divide by the consumption-based 2005 PPP conversion factor (using the series “2005 PPP conversion factor, private consumption (LCU per international dollar)” from WDI) to convert 2005 local currency per day to 2005 PPP dollars per day.

**PPP Conversions Using 2011 ICP**

To convert the international poverty lines in PPP adjusted 2011 US dollars per day into poverty lines in local currency per month or year of a specific survey year:

1. Multiply the number that is in 2011 PPP per day by the 2011 PPP conversion rate to convert the international poverty lines into 2011 local currency. The PPP conversion factor should be based on private consumption rather than GDP; this factor can be obtained from the WDI Databank (http://databank.worldbank.org) using the series “PPP conversion factor, private consumption (LCU per international dollar)” using the year 2011.

2. Use the country’s CPI to convert the poverty lines in 2011 local currency to survey year local currency. The WDI now anchors their CPI numbers at the year 2010 (see the series “consumer price index (2010 = 100)”; multiply the poverty line in 2011 local currency by the ratio of the CPI for the survey year divided by the CPI for 2011.

3. If converting to the daily poverty lines to monthly currency (for use with monthly income or consumption data) multiply by 365/12. If converting to yearly currency (for use with yearly income or consumption data) multiply by 365.

In sum, the yearly international poverty line in local currency is equal to the 2011 PPP per day poverty line times the 2011 PPP conversion factor (of 2011 local currency units per 2011 PPP dollar), times the country’s CPI of the survey year over the CPI of 2011, times 365 days per year.

For example, in the case of Brazil, the household survey data used for analysis is 2009, its private consumption-based PPP conversion factor for 2011 is \(1.6587826\) Brazilian reais (in 2011) = US$1 PPP (in 2011), the CPI for 2009 is \(95.203354\), and the CPI for 2011 (the base year) is \(106.6362\), so the US$1.90 PPP per day (using the 2011 ICP) international poverty line would be converted into 2009 local currency (reais) per year as follows:

\[
\frac{1.90 \, \text{PPP}}{1 \, \text{day}} \times \frac{1.6587826 \, \text{reais}}{1 \, \text{PPP}} \times \frac{95.203354}{106.6362} \times \frac{365 \, \text{days}}{1 \, \text{year}} = \frac{1027.0309 \, \text{reais}}{1 \, \text{year}}
\]

Thus, the US$1.90 PPP per day international poverty line is equivalent to \(1027.03\) reais (in 2009) per year.
This conversion can also be done efficiently in Stata using the \texttt{ceqppp} package by following the example above, replacing \texttt{baseyear(2005)} with \texttt{baseyear(2011)} in the \texttt{ceqppp} options, and replacing \texttt{local z = 1.90}.

To instead convert numbers from survey-year local currency to 2011 PPP dollars per day (for example, to learn the value of a national poverty line in PPP per day for international comparisons, or to report benefits in PPP dollars per day), follow the reverse sequence. Specifically:

1. If the survey-year local currency numbers are yearly, divide by 365 to obtain local currency per day. If the numbers are monthly, divide by 365/12 to obtain local currency per day.

2. Divide by the ratio of the CPI for the survey year divided by the CPI for 2011, using the series “Consumer price index (2010 = 100)” from WDI to convert survey-year local currency per day to 2011 local currency per day.

3. Divide by the consumption-based PPP conversion factor of 2011 (using the series “PPP conversion factor, private consumption (LCU per international dollar)” from WDI) to convert 2011 local currency per day to 2011 PPP dollars per day.

\subsection*{Income Groups}

We define a set of income groups, beginning (by default, but the cut-offs can be changed using the CEQ Stata package options) with the three poor groups defined above: the ultra-poor (household per capita income less than US$1.25 PPP per day), the extreme poor (household per capita income greater than or equal to US$1.25 PPP per day and less than US$2.50 PPP per day), the moderate poor (household per capita income greater than or equal to US$2.50 PPP per day but less than US$4 PPP per day). The non-poor income groups are the vulnerable (household per capita income greater than or equal to US$4 PPP per day and less than US$10 PPP per day), the middle class (household per capita income greater than or equal to US$10 PPP per day but less US$50 PPP per day), and the rich (household per capita income greater than US$50 PPP per day). The naming conventions for these income groups were adopted with middle income countries, particularly those in Latin America, in mind.

The US$1.25 PPP per day line (using the 2005 ICP) approximately represents the average national poverty line of the bottom fifteen low-income, less-developed countries\textsuperscript{20}; thus in the context of middle-income countries we call those living on less than US$1.25 PPP per day the “ultra-poor”. The US$2.50 and US$4 PPP per day poverty lines are commonly used as extreme and moderate poverty lines for Latin America, and roughly correspond to the median official extreme and moderate poverty lines in those countries.\textsuperscript{21} The US$10 PPP per day line is the upper bound of those vulnerable to falling into poverty (and thus the lower bound of the middle class) in three Latin American countries,

\textsuperscript{20} Chen and Ravallion (2010).

\textsuperscript{21} Cedlas and World Bank (2012); Ferreira and others (2013).
calculated by Lopez-Calva and Ortiz-Juarez, Ferreira and others find that an income of around US$10 PPP also represents the income at which individuals in various Latin American countries tend to self-identify as belonging to the middle class and use this as further justification that it should be used as the lower bound of the middle class. The US$10 PPP per day line was also used as the lower bound of the middle class in Latin America in Birdsall and in developing countries in all regions of the world in Kharas. The US$50 PPP per day line is the upper bound of the middle class proposed by Ferreira and others.

Note that, since these defaults correspond to the 2005 ICP, they may be updated in the future when conventions about these lines are established for the 2011 ICP (as of this writing, the World Bank has established a new official extreme poverty line that corresponds to the 2011 ICP, but not other lines). Check the help files of the CEQ Stata Package to verify the current defaults.

**Sampling Weights and Stratification**

Since most surveys are not simple random samples, calculations must always include sampling weights (specifically, expansion factors). If our expansion factors variable is called s_weight, we implement this by adding `[pw=s_weight]` to our command. Some commands in Stata do not work with pweights (sampling weights) so one must instead use iweights (importance weights) or aweights (analytic weights). For the CEQ Stata package commands, pweights should be used. For other commands in the sample Stata code included in this chapter, we always specify which weight is possible with the command being used.

When standard errors are being calculated, the complex stratified sample design must be taken into account. For standard error estimations, using the sampling weights is not sufficient. The survey should have, in addition to the commonly used variable for each observation’s sampling weight, a variable for the primary sampling unit and the strata (note that in some surveys, particularly those using a two-stage sampling design, the primary sampling unit will be the household). In Stata, the survey sample design variables (sampling weight, strata, and primary sampling unit) can be saved with the data set using the `svyset` command (followed by the `save` command so that the next time the data set is opened, Stata will remember the survey sampling design). Once the survey sample design is saved in the data set, commands that are designed to produce standard errors that account for stratification and clustering can be told to account for them using the `svy`: prefix. In addition, the CEQ Stata package commands and some other user-written commands such as those that are part of the Distributive Analysis Stata Package (DASP) automatically use the information about sampling weights, strata, and primary sampling units. However, for programs not in the CEQ Stata Package or DASP, the user should never assume—without consulting the command’s help file—that the command automatically incorporates the survey sampling design information.

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22 Lopez-Calva and Ortiz-Juarez (2013).
23 Ferreira and others (2013).
24 Birdsall (2010).
25 Kharas (2010).
26 Ferreira and others (2013).
27 Araar and Duclos (2013).
Let the sampling weight variable in our data set be saved as `s_weight`, the strata be saved as `s_strata`, and the primary sampling unit be saved as `s_unit` (in two-stage complex sampling designs, the primary sampling unit is often the household). Then the syntax for saving the sampling information would be:

```
svyset s_unit [pw=s_weight], strata(s_strata)
```

After saving, closing, and re-opening the data set, one can make sure that the survey sampling design is saved in the data set by typing `svydes`.

Note that the CEQ Stata commands provide two ways to use the sampling weights and stratification variables: they can either be supplied using `svyset` as described above, or they can be supplied directly to the CEQ Stata commands using the normal weight syntax and the options `psu()` and `strata()` for the primary sampling unit and strata, respectively.
2. The CEQ Master Workbook Sections D and E

2.1 Structure

Section E is produced using the CEQ Stata package, a user-written suite of Stata commands. These commands are described in detail in section 3. To automatically transfer the results to Section E of the MWB, Stata 13 or newer is required. To automatically transfer graphs for certain sheets of section E, Stata 14.1 is required (users with Stata 13 can nevertheless produce the graphs using the CEQ Stata Package commands and manually add them to the sheet; Stata 14.0 users only need to type `update all` in the Stata command window). Section E contains a wealth of information, which can easily become overwhelming for the user; hence, section D summarizes the main results from section E. The production of section D is also automated, using Excel formulas to pull the relevant results from section E once the latter is produced using the CEQ Stata Package.

Tables 1 and 2 describe the contents of sections D and E of the CEQ MWB.

Table 7-1: CEQ Master Workbook: Contents of Section D Summary Results

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Inequality and Poverty; Inequality of Opportunity; Fiscal Impoverishment and Fiscal Gains to the Poor (for Core Income Concepts)</td>
</tr>
<tr>
<td>D2</td>
<td>Effectiveness Indicators: Beckerman &amp; Immerwoll; CEQ Indicators</td>
</tr>
<tr>
<td>D3</td>
<td>Vertical Inequality and Reranking</td>
</tr>
<tr>
<td>D4</td>
<td>Incidence &amp; Net Payers/Net Beneficiaries (Country-specific Granularity for Fiscal Interventions): by Decile and Income Group</td>
</tr>
<tr>
<td>D5</td>
<td>Concentration Shares &amp; Cumulative Concentration Shares (Country-specific Granularity for Fiscal Interventions): by Decile and Income Group</td>
</tr>
<tr>
<td>D6</td>
<td>Income Distribution (for Core Income Concepts): By Decile and Income Group</td>
</tr>
<tr>
<td>D7</td>
<td>Fiscal Profiles for Core Income Concepts (Graphs): Net Payers and Net Beneficiaries, Fiscal Incidence Curves, and Fiscal Mobility Curves by Decile</td>
</tr>
<tr>
<td>D8</td>
<td>Progressivity (Country-specific Granularity for Fiscal Interventions): Marginal Contributions, Derivatives of Marginal Contributions with respect to Size &amp; Progressivity, Concentration Coefficients, Kakwani Indexes, and Size of Intervention for each Tax and Transfer (or Benefit)</td>
</tr>
<tr>
<td>D9a</td>
<td>Coverage and Distribution of Benefits and Beneficiaries by Program Ranked by Disposable Income Group (Total Population) (Country-specific Granularity for Fiscal Interventions)</td>
</tr>
<tr>
<td>D9b</td>
<td>Coverage and Distribution of Benefits and Beneficiaries by Program at Disposable Income (Target) (Country-specific Granularity for Fiscal Interventions)</td>
</tr>
<tr>
<td>D10</td>
<td>Fiscal Mobility Matrices by Income Group</td>
</tr>
<tr>
<td>D11</td>
<td>Education Enrollment Rates Ranked by Disposable Income</td>
</tr>
<tr>
<td>D12</td>
<td>Infrastructure Access Ranked by Disposable Income</td>
</tr>
<tr>
<td>D13</td>
<td>Lorenz Curves (Graphs)</td>
</tr>
<tr>
<td>D14</td>
<td>Concentration Curves (Graphs)</td>
</tr>
<tr>
<td>D15</td>
<td>Cumulative Distribution Functions of Income (Graphs)</td>
</tr>
</tbody>
</table>
D16. Comparison over Time

D17. Comparison with Other Studies

Table 7-2: CEQ Master Workbook: Contents of Section E Output Tables

<table>
<thead>
<tr>
<th>E1.</th>
<th>Descriptive Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>E2.</td>
<td>Population for Core Income Concepts</td>
</tr>
<tr>
<td>E2b.</td>
<td>Population for Extended Income Concepts (One for each core income concept)</td>
</tr>
<tr>
<td>E3.</td>
<td>Lorenz for Core Income Concepts</td>
</tr>
<tr>
<td>E4.</td>
<td>Inequality of Opportunity for Core Income Concepts</td>
</tr>
<tr>
<td>E5.</td>
<td>Fiscal Impoverishment for Core Income Concepts</td>
</tr>
<tr>
<td>E6.</td>
<td>Fiscal Gains to the Poor for Core Income Concepts</td>
</tr>
<tr>
<td>E7.</td>
<td>Statistical Significance for Core Income Concepts</td>
</tr>
<tr>
<td>E8.</td>
<td>Dominance Tests for Core Income Concepts</td>
</tr>
<tr>
<td>E9.</td>
<td>Effectiveness Indicators</td>
</tr>
<tr>
<td>E10.</td>
<td>Concentration Values for Core Income Concepts (One for each core income concept)</td>
</tr>
<tr>
<td>E11.</td>
<td>Fiscal Interventions Concentration Values (One for each core income concept)</td>
</tr>
<tr>
<td>E12.</td>
<td>Lorenz for Extended Income Concepts (One for each core income concept)</td>
</tr>
<tr>
<td>E13.</td>
<td>Marginal Contributions, Size &amp; Marginal Effects (One for each core income concept)</td>
</tr>
<tr>
<td>E14.</td>
<td>Effectiveness (One for each core income concept)</td>
</tr>
<tr>
<td>E15.</td>
<td>Covariance</td>
</tr>
<tr>
<td>E16.</td>
<td>Marginal Statistical Significance for Extended Income Concepts (One for each core income concept)</td>
</tr>
<tr>
<td>E17.</td>
<td>Dominance Tests (One for each core income concept)</td>
</tr>
<tr>
<td>E18.</td>
<td>Coverage (One for each core income concept)</td>
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2.2 Indicators
In chapter 1, we describe how the indicators fit under each of the four question that a CEQ Assessment seeks to answer; the questions are reprinted here for convenience.28

--How much income redistribution and poverty reduction is being accomplished through fiscal policy?
--How equalizing and pro-poor are specific taxes and government spending?
--How effective are taxes and government spending in reducing inequality and poverty?
--What is the impact of fiscal reforms that change the size and/or progressivity of a particular tax or benefit?

Because the indicators from each category spanning various sheets of sections D and E of the CEQ MWB, and because particular sheets include indicators from various categories, in this section the organization reflects the ordering of sheets in the CEQ MWB rather than the categorization based on the four questions above.

The typical indicators of a standard incidence analysis are measures of marginal contributions of fiscal interventions (including both individual interventions and broad aggregates) to inequality and poverty, incidence (the share of taxes paid or transfers received as a proportion of income), concentration coefficients or shares (by decile, income group, quintile, and income bin) of specific or overall taxes and transfers, and measures of progressivity.

One value added by the CEQ framework is the extent of indicators we produce to unpack the redistributive effects seen in the commonly-used measures of progressivity, poverty, and inequality; furthermore, these indicators are automatically produced by the CEQ Stata Package. The indicators are estimated for each of the CEQ income concepts from market income (before any taxes and transfers) to final income (after direct and indirect taxes, direct cash and near-cash transfers, indirect subsidies, and benefits from public spending on education and health); in addition, some are computed for extended income concepts, such as the income defined by adding one particular transfer to market income. Other indicators are calculated for the fiscal interventions themselves with respect to the distribution of a particular core income concept. Table 7-3 summarizes these indicators.

Table 7-3: Summary of Indicators

28 Lustig and Higgins (forthcoming).
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Core Income Concepts</th>
<th>Extended Income Concepts</th>
<th>Fiscal Interventions</th>
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<tr>
<td>Descriptive statistics (for example, mean, median, standard deviation, proportion with non-zero values)</td>
<td>X</td>
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<td>X</td>
</tr>
<tr>
<td>Population totals by income decile, group, centile, and bin for various income concepts</td>
<td>X</td>
<td>X</td>
<td>...</td>
</tr>
<tr>
<td>Inequality and poverty measures for each income concept</td>
<td>X</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Per capita income, shares, cumulative shares, concentration shares, and fiscal incidence by decile, group, centile, and bin</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Inequality of opportunity</td>
<td>X</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Fiscal impoverishment and fiscal gains to the poor</td>
<td>X</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Statistical significance comparing poverty and inequality across income concepts</td>
<td>X</td>
<td>X</td>
<td>...</td>
</tr>
<tr>
<td>Effectiveness indicators</td>
<td>X</td>
<td>X</td>
<td>...</td>
</tr>
<tr>
<td>Marginal contribution of each fiscal intervention to inequality, poverty, etc.</td>
<td>...</td>
<td>...</td>
<td>X</td>
</tr>
<tr>
<td>Dominance tests of income distributions</td>
<td>X</td>
<td>X</td>
<td>...</td>
</tr>
<tr>
<td>Coverage of fiscal interventions (e.g., percent of poor receiving a transfer)</td>
<td>...</td>
<td>...</td>
<td>X</td>
</tr>
<tr>
<td>Leakage of fiscal interventions (e.g., percent of benefits going to non-poor)</td>
<td>...</td>
<td>...</td>
<td>X</td>
</tr>
<tr>
<td>Education enrollment rates by income group</td>
<td>X</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Infrastructure access by income group</td>
<td>X</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Sociodemographic characteristics by income decile, group, centile, and bin</td>
<td>X</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Lorenz curves</td>
<td>X</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Concentration curves</td>
<td>X</td>
<td>...</td>
<td>X</td>
</tr>
<tr>
<td>Cumulative distribution functions</td>
<td>X</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Fiscal impoverishment and fiscal gains to the poor curves</td>
<td>X</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
I now turn to the specific indicators in the results sheets (sections D and E) of the MWB. Expansion factors are omitted from all equations for notational simplicity, but are of course included in the estimation of all indicators by the CEQ Stata Package as long as the sampling weights are supplied to the command using `svyset` or the standard `[pweight=...]` weights syntax.

### Inequality

Sheets D1, D2, E3, E12 and E28 include the following inequality indicators: the Gini, S-Gini, Theil, and 90/10 indices.

Graphically, the Gini is represented by twice the area between the market income Lorenz curve and the line of equality. The market income Lorenz curve maps the cumulative share of market income on the vertical axis against the cumulative share of the population, ordered by market income, on the horizontal axis. It equals $2 \int_0^1 (p - L(p)) \, dp$, where $p$ is the cumulative proportion of the total population when individuals are ordered in increasing income values using market income (graphically, $p$ is also equivalent to the line of perfect equality) and $L(p)$ is the Lorenz curve.

The absolute Gini is equal to the Gini times mean income, $2\mu \int_0^1 (p - L(p)) \, dp$, where $\mu$ is mean income.

The S-Gini is a single-parameter generalization of the Gini index (Donaldson and Weymark 1980, 1983; Kakwani, 1980; Yitzhaki, 1983) that includes an aversion to inequality parameter. It equals $1 - \nu (\nu - 1) \int_0^1 (1 - p)^{\nu - 2} L(p) d(p)$ for $1 < \nu < \infty$ and $0$ for $\nu = 1$. When $1 < \nu < 2$, the indices place relatively greater weight on individuals ranked at the top of the income distribution. When $\nu = 2$, the index corresponds to the popular Gini coefficient. When $\nu$ increases towards $\infty$, more weight is placed on Lorenz ordinates at the lower end of the distribution. In the limit as $\nu \to \infty$, all the social weight is focused on the income share of the poorest individual. Geometrically, the difference in the value of S-Gini indices for two income distributions corresponds to the weighted integral of the area between the Lorenz curve and the line of perfect equality, with the weight determined by $\nu$ (Barrett and Donald, 2009).

We include results for various parameters of $\nu$: $1, 1.25, 1.5, 2.5, 3, 3.5, 4, 5, 6, 7.5, and 10$. These are based on a review of the literature. Using the CPS March Demographic files for 1978, 1988 and 1998, Barrett and Donald presents several members of the S-Gini indices with $\nu = 1.25, 2, 2.5, 3.5$ in order to capture a broad range of normative positions. Based on simulated samples, Demuynck presents S-Gini indices with $\nu = 1.5, 2, 5, 7.5$ and 10. The

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29 Barrett and Donald (2009).
30 Demuynck (2012).
parameters employed by Duclos and Araar\textsuperscript{31} for illustration are 1, 2, 3, and 6. The parameters employed in Giorgi and others\textsuperscript{32} for illustration are 1.5, 2, 2.5, 3, 4, and 5.

The Theil index, also known as the Theil’s T index, is a member of the family of generalized entropy inequality measures, with the parameter $\theta = 1$. Hence, it is sometimes written as $GE(1)$, and is defined as

$$GE(1) = \frac{1}{n} \sum_{i=1}^{n} \frac{y_i}{\bar{y}} \ln \left( \frac{y_i}{\bar{y}} \right)$$

where $y_i$ is individual $i$’s (household per capita) income, using whichever income concept the Theil is being calculated for, and $\bar{y}$ denotes average income. Note that, because it takes the logarithm of income, the Theil cannot include observations with 0 income. This is particularly problematic for fiscal incidence analysis, since some households may have 0 market income but positive gross income (receiving all income from transfers, for example). When this occurs, those with 0 market income are not included in the Theil for market income, but if they have non-zero gross income are included in the Theil for gross income, leading the two to be estimated over different populations. The alternative of not including any households with zero market income in either inequality estimate is also unsatisfactory. As a result, we estimate but do not focus on the inequality results using the Theil index.

The 90/10 measure shows how the relatively rich fare compared to the relatively poor. Specifically, after dividing the population into 100 income percentiles, it is calculated as the average income of those in the 90\textsuperscript{th} percentile divided by the average income of those in the 10\textsuperscript{th} percentile.

**Inequality of Opportunity**

Sheets D1 and E4 measure ex-ante inequality of opportunity based on circumstances sets.\textsuperscript{33} First, circumstances sets are identified: for example, one circumstances set could be {female, black, parents were college graduates, urban}; all individuals with those four traits are grouped together in that circumstances set. Circumstances are pre-determined factors that are not dependent on an individual’s effort, such as race, gender, and parents’ education or parents’ income. Once each individual’s circumstances set has been identified, the mean income of each circumstances set (the mean income of all individuals in that circumstances set) is calculated for each income concept. Contributory pensions as deferred income scenario is used for each income concept. Let $s_i^j$ indicate the mean income for income concept $j$ of everyone in individual $i$’s circumstances set. Each individual is attributed the mean income of their circumstances set, and this income distribution is called the smoothed income distribution. Inequality measured over the smoothed income distribution for each income concept uses the mean log deviation, which gives the measure of inequality of opportunity in

\textsuperscript{31} Duclos and Araar (2005).
\textsuperscript{32} Giorgi and others (2006).
\textsuperscript{33} See Checchi and Peragine (2010); Ferreira and Gignoux (2011).
levels by income concept. Dividing the resulting measure by the mean log deviation for the original income distribution measures the ratio of inequality due to inequality of opportunity as opposed to inequality of effort. The latter, called inequality of opportunity in ratios on Sheet D1 and E4, traces out how each redistributive step affects inequality of opportunity. For example, if the proportion of inequality explained by unequal opportunities decreases from net market to disposable income but increases from disposable to consumable income, this would indicate that direct transfers have an equalizing impact on ex ante opportunities, but indirect taxes and subsidies have an unequalizing effect.

The mean log deviation of the smoothed distribution (for income concept \( j \)) is calculated as

\[
\frac{1}{n} \sum_{i} \ln \left( \frac{\mu^j_i}{s^j_i} \right)
\]

where \( \mu^j \) is the mean income of the population for income concept \( j \) (either the original or smoothed distribution can be used to calculate \( \mu^j \) since they have the same mean by definition), and \( s^j_i \) is defined above.

**Poverty**

Sheets D1, D2, E3, E12, E13 and E28 include poverty indicators that are members of the FGT class of poverty measures Foster, Greer, and Thorbecke\(^{34}\). Let households be ranked by \( y_i \), household per capita income for the income variable for which poverty is being measured, from poorest to richest. Let the poverty line being used be denoted \( z \). Then, following Foster, Greer, and Thorbecke\(^{35}\), denote \( g_i = z - y_i \) the income shortfall of individual \( i \) (the increase in income that would be required for individual \( i \) to no longer be poor), and let \( q \) denote the number of poor individuals and \( n \) the total number of individuals. Then the FGT class of poverty measures is a function of the population’s ordered income vector \( \mathbf{y} = (y_1, \ldots, y_n) \) and the poverty line \( z \), and is defined as follows:

\[
P_a (\mathbf{y}; z) = \frac{1}{n} \sum_{i=1}^{q} \left( \frac{g_i}{z} \right)^{\alpha}.
\]

The headcount index, or the proportion of the population that has income below the poverty line, is equal to the above equation with parameter \( \alpha = 0 \). The poverty gap, which measures the average shortfall (over the whole population, where non-poor individuals are assigned a shortfall of zero) as a proportion of the poverty line, is equal to the above equation with the parameter \( \alpha = 1 \). Finally, the squared poverty gap is distribution-sensitive, giving a higher

\(^{34}\) Foster, Greer, and Thorbecke (1984).

\(^{35}\) Foster, Greer, and Thorbecke (1984).
weight to those who are poorer by weighting each individual's shortfall relative to the poverty line by itself (squaring it). It is equal to the above equation with parameter $\alpha = 2$.

**Fiscal Impoverishment**

Sheets D1 and E5 include measures of fiscal impoverishment (FI) from Higgins and Lustig\(^{36}\), while sheet E27 includes FI curves. When using these measures, please cite the Higgins and Lustig\(^{37}\) article.

Although Higgins and Lustig\(^ {38}\) is available open access in the *Journal of Development Economics*\(^ {39}\) and is reprinted as chapter 4 of this Handbook, I nevertheless include a succinct description of these indicators here.

Let $z$ be the poverty line, $y_0^i$ be pre-fiscal income (one of the “before taxes and transfers” income concepts), and $y_1^i$ be post-fiscal income (one of the “after taxes and transfers” income concepts). There is FI if $y_1^i < y_0^i$ and $y_1^i < z$ for at least one individual $i$. In other words, an individual was pre-fiscal poor and made poorer by the fiscal system, or pre-fiscal non-poor and made poor. Let there be $n$ individuals in society, $q_0$ of whom are pre-fiscal poor, and $q_1$ of whom are post-fiscal poor. The first measure of fiscal impoverishment in the MWB is the fiscal impoverishment headcount (out of total population), or

$$\frac{1}{n} \sum_{i=1}^{n} 1(y_1^i < y_0^i) * 1(y_1^i < z)$$

where $1(\cdot)$ is the indicator function that takes value 1 if its argument is true and 0 otherwise.

The second measure, fiscal impoverishment headcount (out of post-fiscal poor) is defined as

$$\frac{1}{q_1} \sum_{i=1}^{n} 1(y_1^i < y_0^i) * 1(y_1^i < z)$$

These measures have undesirable properties, however. First, they violate monotonicity: if a fiscally impoverished individual becomes more fiscally impoverished, the measures do not change. The latter measure also violates subgroup consistency: it can increase (show more FI) when an additional transfer is made to a poor person without any additional FI being caused, because—if the additional transfer pulls the poor person out of poverty—this reduces the denominator $q_1$. In other words, a good transfer that reduces an individual’s FI without changing anyone else’s FI can increase the fiscal impoverishment headcount (out of post-fiscal poor).

Higgins and Lustig\(^{40}\) thus derive a class of axiomatic measures of FI. The class is given by

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\(^{36}\) Higgins and Lustig (2016).

\(^{37}\) Higgins and Lustig (2016).

\(^{38}\) Higgins and Lustig (2016).


\(^{40}\) Higgins and Lustig (2016).
Another FI measure included in the MWB is total fiscal impoverishment (either in local currency units or PPP dollars), which equals equation (1) for $\kappa = 1$. To further illustrate this measure, Figure 1 orders the population by pre-fiscal incomes on the $x$-axis, and the $y$-axis measures income, showing their pre-fiscal incomes (the increasing curve) and post-fiscal incomes (the wavy curve). The dashed horizontal line represents the poverty line. For those who pay more in taxes than they receive in transfers (and hence experience FI if their post-fiscal income is below the poverty line), the post-fiscal income curve is below the pre-fiscal income curve. Similarly, for those who receive more in transfers than they receive in transfers, the post-fiscal income curve is above the pre-fiscal income curve. Total fiscal impoverishment is given by the sum of the dark shaded areas in chapter 4, figure 4-1.

Another measure of FI included in the MWB is fiscal impoverishment per capita, which equals total fiscal impoverishment divided by the number of individuals in society, or equation (1) with $\kappa = 1/n$. The final axiomatic measure of FI in the MWB (which meets the axioms from Higgins and Lustig\textsuperscript{41}, if we assume $z$ is fixed) is normalized fiscal impoverishment per capita, which equals total fiscal impoverishment divided by the number of individuals and normalized by the poverty line (as the poverty gap ratio is), or equation (1) with $\kappa = 1/(nz)$.

**Fiscal Gains of the Poor**

Sheets D1 and E6 also include measures of fiscal gains of the poor (FGP) from Higgins and Lustig\textsuperscript{42}, while E27 includes FGP curves. When using these measures, please cite the Higgins and Lustig\textsuperscript{43} article.

There is FGP if $y_{i}^{1} > y_{i}^{0}$ and $y_{i}^{0} < z$ for at least one individual $i$. In other words, an individual was pre-fiscal poor and gained income from the fiscal system. The measures of FGP in the MWB are analogous to the measures of FI:

The fiscal gains of the poor headcount (out of total population) is

$$\frac{1}{n} \sum_{i=1}^{n} 1(y_{i}^{1} > y_{i}^{0}) * 1(y_{i}^{0} < z)$$

The fiscal gains of the poor headcount (out of pre-fiscal poor) is

$$\frac{1}{q_{0}} \sum_{i=1}^{n} 1(y_{i}^{1} > y_{i}^{0}) * 1(y_{i}^{0} < z)$$

\textsuperscript{41} Higgins and Lustig (2016).
\textsuperscript{42} Higgins and Lustig (2016).
\textsuperscript{43} Higgins and Lustig (2016).
The axiomatic class of FGP measures is given by

\[ \kappa \sum_{i=1}^{n} \min(y_i, z) - \min(y_i^0, y_i, z) \]

where \( \kappa = 1 \) gives total fiscal gains to the poor (equivalent to the light-shaded area in Figure 1), \( \kappa = 1 \) gives fiscal gains to the poor per capita, and \( \kappa = 1/(zn) \) gives normalized fiscal gains to the poor per capita.

Higgins and Lustig\(^{44}\) also show that the change in a popular poverty measure—the poverty gap ratio—induced by the fiscal system can be decomposed into normalized FGP per capita and normalized FI per capita.

**Effectiveness Indicators**

Sheets D2, D8, E9 and E14 include effectiveness indicators.

The impact effectiveness indicators measure how much inequality or poverty is reduced by a particular fiscal intervention (or set of fiscal interventions) relative to what could be achieved if the same level of spending if redistribution was “optimal” from an inequality-reduction perspective. The spending effectiveness indicators measure how much was spent or collected to achieve the observed level of inequality or poverty reduction relative to the minimum that could have been spent or collected to achieve the same reduction. These are described and illustrated with an example from Iran in Enami (chapter 14 of this Handbook).

In addition, we use a fiscal impoverishment/fiscal gains to the poor effectiveness indicator that assesses the level of FI and FGP caused by the fiscal system or by particular fiscal interventions relative to the amount spent and collected. The FI/FGP effectiveness indicator satisfies a number of desirable properties and is summarized in Box 3 of chapter 1, authored by Ali Enami, Sean Higgins, and Stephen Younger.

We also estimate additional poverty reduction effectiveness indicators from Beckerman\(^ {45}\) and Immervoll and others\(^ {46}\). To define these measures, figure 7-2 shows a stylistic representation of pre- and post-fiscal incomes. The diagram is not to scale, nor are the income curves necessarily straight. In the diagram, total direct transfers is \( A+B+C \), direct transfers reaching the net market income poor is \( A+B \), the total net market income poverty gap is \( A+D \), and the total disposable income poverty gap is \( D \). Beckerman\(^ {47}\) then defines:

Vertical expenditure efficiency = \( (A+B)/(A+B+C) \)
Spillover index = \( B/(A+B) \)
Poverty reduction efficiency = \( A/(A+B+C) \).

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\(^{44}\) Higgins and Lustig (2016).
\(^{45}\) Beckerman (1979).
\(^{46}\) Immervoll and others (2009).
\(^{47}\) Beckerman (1979).
Immervoll and others\(^{48}\) additionally define:

\[
\text{Poverty gap efficiency} = \frac{A}{A+D}.
\]

Figure 7-2: Additional Efficiency Indicators

In more technical notation, we have:

Vertical Expenditure Efficiency

\[
V = \frac{\sum_{i | y_i^n < z} (y_i^d - y_i^n)}{\sum_i (y_i^d - y_i^n)}
\]

Spillover Efficiency

\[
S = \frac{\sum_{i | y_i^n < z s z y_i^d} (y_i^d - z)}{\sum_{i | y_i^n < z} (y_i^d - y_i^n)}
\]

Poverty Reduction Efficiency

\[
P = \frac{\sum_{i | y_i^n < z} (y_i^d - y_i^n) + \sum_{i | y_i^n < z s z y_i^d} (z - y_i^n)}{\sum_i (y_i^d - y_i^n)}
\]

Poverty Gap Efficiency

\[
P = \frac{\sum_{i | y_i^n < z} (y_i^d - y_i^n) + \sum_{i | y_i^n < z s z y_i^d} (z - y_i^n)}{\sum_i (z - y_i^n)}
\]

\(^{48}\) Immervoll and others (2009).
where $y_i^m$ is individual $i$’s household per capita net market income, $y_i^d$ is individual $i$’s household per capita disposable income, and $z$ is the poverty line.

**Progressivity Measures**

Progressivity measures are included on sheet D3, D8, E10, E11 and E13. A useful summary statistic to measure progressivity is the Kakwani index (however, recall that concentration curves should also be used since the Kakwani index does not tell us when a concentration curve crosses the pre-fiscal income Lorenz curve or the 45-degree line). For taxes, the Kakwani index of progressivity can be thought of graphically as twice the area between the initial income Lorenz curve and the tax concentration curve. If the tax concentration curve is above the Lorenz curve, the Kakwani index will be negative, which indicates that taxes are regressive in relative terms. Equivalently, the Kakwani index can be calculated as the tax’s concentration coefficient (with the population ranked by initial income) minus the pre-fiscal income Gini. In other words, $K_{\text{tax}} = D_0^{\text{tax}} - G_0$, where $D_0^{\text{tax}}$ represents the concentration coefficient of a particular tax when the population is ranked by pre-fiscal income.

To adapt to the measurement of transfers, Lambert suggests that in the case of transfers it should be defined as pre-fiscal income Gini minus the concentration coefficient (the negative of the definition for taxes) to make the index positive whenever the change is progressive. Thus, we have $K_{\text{transfer}} = -(D_0^{\text{transfer}} - G_0)$, where $D_0^{\text{transfer}}$ represents the concentration coefficient of a particular transfer when the population is ranked by pre-fiscal income.

Note that, because net taxes (taxes minus transfers) are negative for some individuals and positive for others, the concentration curve for net taxes will not be well-behaved Lambert. Hence, we calculate Kakwani indices separately for taxes and transfers.

The Reynolds-Smolensky index is another summary statistic of progressivity, since a globally progressive system will have a positive Reynolds-Smolensky index (although the converse implication is not true). Graphically, the Reynolds-Smolensky of post-fiscal income with respect to pre-fiscal income is twice the area between the pre-fiscal income Lorenz curve and the concentration curve of post-fiscal income with respect to the pre-fiscal income distribution. Note that the concentration curve of post-fiscal income with respect to pre-fiscal income is not the same as the Lorenz curve for post-fiscal income, as the concentration curve does not re-rank the population (the population is still ranked by pre-fiscal income), whereas the Lorenz curve does re-rank the population (the population would be ranked by post-fiscal income). Equivalently, the Reynolds-Smolensky can be calculated as the pre-fiscal income Gini.

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50 Lambert (1985).
51 Lambert (2002).
minus the concentration coefficient of consumable income when the population is ranked by market income. In other words, \( RS = G_0 - D_0^1 \), where \( D_0^1 \) represents the concentration coefficient of post-fiscal income when the population is ranked by pre-fiscal income.

**Vertical and Horizontal Equity**

Sheet D3 and E10 include a decomposition of the change in inequality due to the tax and transfer system into its vertical and horizontal equity components.

A well-recognized form of horizontal inequity is when fiscal interventions arbitrarily alter the relative position of individuals across the distribution: in other words, there is reranking. Reranking occurs if individual A was poorer than individual B before a fiscal intervention, but B is poorer than A after the intervention for no good reason.\(^{53}\) The definition of horizontal equity postulates that the pre-fiscal policy income ranking should be preserved.\(^{54}\) In other words, if individual A was poorer than individual B before fiscal interventions, individual A should continue to be poorer than individual B after the interventions.

From theory, we know that the total redistributive effect (RE) can be decomposed into two elements: the change in vertical inequality (VE) minus reranking (RR)\(^{55}\). The redistributive effect (RE) is equal to the difference between the Gini coefficient for pre-fiscal income, \( G_0 \), and the Gini coefficient for post-fiscal income, \( G_1 \), or:

\[
RE = G_0 - G_1 \tag{1}
\]

Adding and subtracting \( D_0^1 \), the concentration coefficient for incomes after taxes and transfers, equation (1) can be decomposed into:

\[
RE = (G_0 - D_0^1) - (G_1 - D_0^1). \tag{2}
\]

Then the redistributive effect can be written as:

\[
RE = VE - RR, \tag{3}
\]

where:

- **VE** is equal to the difference between the pre-fiscal Gini coefficient and the concentration coefficient of post-fiscal income with respect to pre-fiscal income; if there is no reranking, \( RE = VE \) by definition because the concentration coefficient for post-fiscal income with respect to pre-fiscal income will be identical to the post-fiscal Gini coefficient.

- **RR** is equal to the difference between the post-fiscal Gini coefficient and the concentration coefficient for post-fiscal income with respect to pre-fiscal income.

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53 As an example of a “good reason,” a could have greater needs due to the health characteristics of the individual in which case reranking would not be considered a form of horizontal inequity.

54 See Araar and Duclos (2006).

55 See Duclos and Araar (2006); Urban (2009).
The redistributive effect is diminished by reranking as clearly shown in equation (3). The VE measure is the Reynolds-Smolensky progressivity index (RS) and the RR measure is known as the Atkinson-Plotnick index of horizontal inequity.

**Incidence and Concentration**

Sheets D4, D5, E10 and E11 show the incidence and concentration of fiscal interventions by decile and income group (with income totals also produced by centile and small income bins in section E, which can be used to generate incidence results for these more fine-grained groups as well). Incidence shows the amount each decile or group pays in a particular tax or receives from a particular transfer as a percent of initial income. Concentration shows the percent of a total tax or benefit that is paid or received by each decile or group.

The calculations are non-anonymous, meaning that we do not re-rank the population: the totals by decile that we are comparing are always for a particular income concept. On sheets D4 and D5 deciles and income groups are always determined using pre-fiscal income, which is market income plus pensions for the pensions as deferred income scenario, and market income for the pensions as government transfers scenario; in section E, there are separate sheets for each core income concept, which show incidence and concentration shares when deciles and income groups are defined based on that income concept.

**Income Distribution**

Sheets D6 and E3 provide the income distribution by decile and income group, the income in local currency and proportion of income accruing to each decile or group by income concept. The income distribution indicators are anonymous; the deciles are not fixed using pre-fiscal income. For example, the income distribution for disposable income uses deciles and groups defined by disposable income.

**Fiscal Profiles**

Sheet D7 shows fiscal profiles, graphs that show the difference between each pre-fiscal decile’s post-fiscal and pre-fiscal incomes as a proportion of pre-fiscal income. When this proportion is positive, members of that decile are net gainers from the fiscal system on average; when it is negative, they are net payers to the fiscal system on average.

**Concentration and Kakwani Coefficients**

Sheets D8 and E11 provide the concentration coefficients of individual transfer programs with respect to *post-fiscal* income, as well as aggregate categories such as total direct transfers and CEQ Social Spending in Incidence Analysis. Let $p$ be the cumulative proportion of the
total population when individuals are ordered in increasing income values using market income, and let \( C(p) \) be the concentration curve, the cumulative proportion of total program benefits (of a particular program or aggregate category) received by the poorest \( p \) percent of the population. Then, the concentration coefficient of that program or category is defined as

\[
2 \int_0^1 (p - C(p)) \, dp.
\]

As discussed above, a program that is progressive in absolute terms will have a concentration curve above the line of perfect equality, and thus the area \( 2 \int_0^1 (p - C(p)) \, dp \) will be negative, implying a negative concentration coefficient. Sheet D3, D8 and E11 also includes Kakwani coefficients, defined above in the definition of *progressivity measures*.

**Coverage, Errors of Exclusion, and Errors of Inclusion, and Errors of Social Programs**

Sheets D9a, D9b, E18, and E19 measure the coverage of the poor and those in other income groups by fiscal intervention, errors of exclusion, leakages (errors of inclusion) to the non-poor, and average benefits per capita, per individual in a beneficiary household, and per transfer recipient. The distinction between the latter two deals with the question of how the “average transfer” should be calculated: because the transfer is added to aggregate household income which is then shared by everyone in the household, an economist would most likely measure the average transfer size among a particular income group as the total benefits received by that group divided by the number of individuals in that group who live in households that received the transfer. On the other hand, when the government reports the average transfer size, it usually reports the total spent on transfers divided by the number of transfer recipients, where a transfer recipient is defined as the individual who physically receives the transfer, and not individuals who live in the same household as a transfer recipient.

The following indicators are calculated: the share of benefits going to each income group (which can be used to determine what percent of benefits are leakages to the non-poor), share of individuals in beneficiary households in each income group, percent of individuals in each group who live in beneficiary households (which can be used to determine coverage of the poor), average per capita benefits among beneficiary households by group, average benefits per capita by group, and average benefits per transfer recipient by group. The average benefits are calculated both in local currency and in US$PPP per day.

Another measure of interest is the coverage and leakages of these programs among their target population. Thus, additional D9b and E19 marked “Target” measure coverage among the target population, for example, for conditional cash transfers among households with children, non-contributory pensions and contributory pensions in households with a member over age 65, and education by level in households with children of the corresponding age. For education, the researcher should be sure to specify which ages were used. For health, we measure the coverage of benefits other than preventative care with respect to the target population of those who were sick, if the survey has a question asking individuals if they were
sick during the reference period. The same measures listed above are calculated, but for the target population only. In this case, unlike in the coverage sheet, we currently do not calculate total or mean benefits.

To link this with the conceptual definitions of coverage, errors of exclusion, and errors of inclusion in Chapter 1,56 I follow the same categorization here and elaborate which tables from sheets D9a and D9b have the corresponding results.

**Coverage**

Of households: defined as the total number of households that receive benefits\(^{57}\) divided by the total number of households in the country. This can be found in the “Total” column of the “Coverage Rate of Total Households” table in sheet D9a.

Of individuals (direct and indirect beneficiaries): defined as the total number of individuals living in households that receive benefits, divided by the total number of individuals in the country. This can be found in the “Total” column of the “Coverage Rate of Direct and Indirect Individuals” table in sheet D9a.

Of direct beneficiaries: defined as the total number of individuals directly receiving benefits, divided by the total number of individuals in the country. This can be found in the “Total” column of the “Coverage Rate of Direct Beneficiaries” table in sheet D9a.

Of target households: defined as the total number of eligible or “target” households that receive benefits\(^{58}\) divided by the total number of target households in the country. This can be found in the “Total” column of the “Coverage Rate of Target Direct Individuals” table in sheet D9b.

Of target individuals (direct and indirect beneficiaries): defined as the total number of individuals living in target households that receive benefits, divided by the total number of individuals living in target households in the country. This can be found in the “Total” column of the “Coverage Rate of Target Direct and Indirect Individuals” table in sheet D9a.

Of target direct beneficiaries: defined as the total number of direct target individuals that receive benefits, divided by the total number of direct target individuals in the country. Note that this is only defined for programs that identify eligible *individuals* rather than eligible households. This can be found in the “Total” column of the “Coverage Rate of Target Households” table in sheet D9b.

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56 Lustig and Higgins (forthcoming)
57 For the indicators at the household level, a beneficiary household will be a household that receives a benefit whether one can or cannot identify who within the household is the recipient of the benefit.
58 Depending on the fiscal intervention, eligibility might be defined at the household level, in which case a target household is a household that meets the criteria, or at the individual level, in which case a target household is defined as a household with at least one target individual.
**Coverage of the Poor**

Of households: defined as the total number of poor households that receive benefits divided by the total number of poor households in the country. This can be found in the columns corresponding to the poor (in the 2016 version of the MWB, where group cut-offs are based on the 2005 ICP, these columns are “y<1.25”, “y<2.50”, and “y<4”) of the “Coverage Rate of Total Households” table in sheet D9a.

Of individuals (direct and indirect beneficiaries): defined as the total number of poor individuals living in households that receive benefits, divided by the total number of poor individuals in the country. This can be found in the columns corresponding to the poor of the “Coverage Rate of Direct and Indirect Individuals” table in sheet D9a.

Of direct beneficiaries: defined as the total number of poor individuals directly receiving benefits, divided by the total number of poor individuals in the country. This can be found in the “columns corresponding to the poor of the “Coverage Rate of Direct Beneficiaries” table in sheet D9a.

Of target households: defined as the total number of poor individuals living in eligible or “target” households that receive benefits, divided by the total number of poor individuals living in target households in the country. This can be found in the columns corresponding to the poor of the “Coverage Rate of Target Households” table in sheet D9b.

Of target individuals (direct and indirect beneficiaries): defined as the total number of poor individuals living in target households that receive benefits, divided by the total number of poor individuals living in target households in the country. This can be found in the columns corresponding to the poor of the “Coverage Rate of Target Direct and Indirect Individuals” table in sheet D9a.

Of target direct beneficiaries: defined as the total number of eligible or “target” poor households that receive benefits divided by the total number of poor target households in the country. Note that this is only defined for programs that identify eligible individuals rather than eligible households. This can be found in the columns corresponding to the poor of the “Coverage Rate of Target Direct Individuals” table in sheet D9b.

**Errors of exclusion**

Of households: defined as the total number of poor households that do not receive benefits divided by the total number of poor households in the country. This is not directly reported in the tables, but can be obtained by taking 100 percent minus the coverage of poor households.

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59 Depending on the fiscal intervention, eligibility might be defined at the household level, in which case a target household is a household that meets the criteria, or at the individual level, in which case a target household is defined as a household with at least one target individual.
Of individuals (direct and indirect beneficiaries): defined as the total number of poor individuals living in households that do not receive benefits, divided by the total number of poor individuals in the country. This is not directly reported in the tables, but can be obtained by taking 100 percent minus the coverage of poor individuals.

Of direct beneficiaries: defined as the total number of poor individuals that do not directly receiving benefits, divided by the total number of poor individuals in the country. This is not directly reported in the tables, but can be obtained by taking 100 percent minus the coverage of poor individuals.

Of target households: defined as the total number of eligible or “target” poor households that do not receive benefits divided by the total number of poor target households in the country. This is not directly reported in the tables, but can be obtained by taking 100 percent minus the coverage of poor target households.

Of target individuals (direct and indirect beneficiaries): defined as the total number of poor individuals living in target households that do not receive benefits, divided by the total number of poor target individuals living in target households in the country. This is not directly reported in the tables, but can be obtained by taking 100 percent minus the coverage of poor target individuals.

Of target direct beneficiaries: defined as the total number of poor “target” direct beneficiaries that do not receive benefits, divided by the total number of target direct beneficiaries in the country. Note that this is only defined for programs that identify eligible individuals rather than eligible households. This is not directly reported in the tables, but can be obtained by taking 100 percent minus the coverage of poor target direct beneficiaries.

Errors of inclusion (also known as leakages)

Of households: defined as the total number of non-poor households that receive benefits divided by the total number of households that receive benefits in the country. This can be found in the columns corresponding to the non-poor (in the 2016 version of the MWB, where group cut-offs are based on the 2005 ICP, these columns are “y>4”, “y>10”, and “y>50”) of the “Distribution of Beneficiary Households” table in sheet D9a.

Of individuals (direct and indirect beneficiaries): defined as the total number of non-poor individuals living in households that receive benefits, divided by the total number of individuals living in households that receive benefits in the country. This can be

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60 Depending on the fiscal intervention, eligibility might be defined at the household level, in which case a target household is a household that meets the criteria, or at the individual level, in which case a target household is defined as a household with at least one target individual.
found in the columns corresponding to the non-poor columns of the “Distribution of Direct and Indirect Beneficiaries” table in sheet D9a.

Of direct beneficiaries: defined as the total number of non-poor individuals directly receiving benefits, divided by the total number of direct beneficiaries in the country. This can be found in the columns corresponding to the non-poor columns of the “Distribution of Direct Beneficiaries” table in sheet D9a.

To non-target households: defined as the total number of non-target households that nevertheless receive benefits, divided by the total number of households that receive benefits in the country. This is not directly reported in the tables but can be calculated as 100 percent minus the total coverage of target households.

To non-target individuals (direct and indirect beneficiaries): defined as the total number of individuals living in non-target households that nevertheless receive benefits, divided by the total number of individuals that live in households that receive benefits in the country. This is not directly reported in the tables but can be calculated as 100 percent minus the total coverage of target individuals.

To non-target direct beneficiaries: defined as the total number of non-target direct beneficiaries that nevertheless receive benefits divided by the total number of direct beneficiaries in the country. Note that this is only defined for programs that identify eligible individuals rather than eligible households. This is not directly reported in the tables but can be calculated as 100 percent minus the total coverage of target direct beneficiaries.

Of benefits: defined as the total amount of benefits going to the non-poor divided by the total amount of benefits going to all households. This can be found in the non-poor columns of the “Distribution of Benefits” table.

**Proportion of beneficiary households that are poor**

Of households: defined as the total number of poor households that receive benefits divided by the total number of households that receive benefits in the country. This can be found in the columns corresponding to the poor columns of the “Distribution of Beneficiary Households” table in sheet D9a.

Of individuals (direct and indirect beneficiaries): defined as the total number of poor individuals living in households that receive benefits, divided by the total number of individuals living in households that receive benefits in the country. This can be found in the columns corresponding to the poor columns of the “Distribution of Direct and Indirect Beneficiaries” table in sheet D9a.

Of direct beneficiaries: defined as the total number of poor individuals directly receiving benefits, divided by the total number of direct beneficiaries in the country.
This can be found in the columns corresponding to the poor columns of the “Distribution of Direct Beneficiaries” table in sheet D9a.

Of target households: defined as the total number of poor target households that receive benefits divided by the total number of target households that receive benefits in the country. This can be found in the columns corresponding to the poor columns of the “Distribution of Target Beneficiary Households” table in sheet D9b.

Of target individuals (direct and indirect beneficiaries): defined as the total number of poor individuals living in target households that receive benefits, divided by the total number of individuals that live in households that receive benefits in the country. This can be found in the columns corresponding to the poor columns of the “Distribution of Target Direct and Indirect Beneficiaries” table in sheet D9b.

Of target direct beneficiaries: defined as the total number of poor target direct beneficiaries that receive benefits divided by the total number of poor direct beneficiaries in the country. Note that this is only defined for programs that identify eligible individuals rather than eligible households. This can be found in the columns corresponding to the poor columns of the “Distribution of Target Direct Beneficiaries” table in sheet D9b.

Of benefits: defined as the total amount of benefits going to the poor divided by the total amount of benefits going to all households. This can be found in the poor columns of the “Distribution of Benefits” table.

**Mean benefits**

We also calculate mean benefits going to each of the groups identified above.

**Fiscal mobility matrices**

To see how the income group status of individuals is affected by taxes and transfers, sheet D10 includes fiscal mobility matrices, transition matrices that measures the proportion of individuals that move from a before taxes and transfers income group (for example, non-poor) to another income group (for example, poor) after their income is changed by taxes and transfers. A transition matrix was first used to measure transition between income groups before and after taxes and transfers by Atkinson.\(^6\) Note that taxes and transfers can cause individuals to move up or down the income categories. The matrix in percents is row-stochastic, where rows represent pre-fiscal income groups and columns represent post-fiscal income groups. There are multiple matrices for the different possible definitions of post-fiscal income: for example, there is a mobility matrix for pre-fiscal to disposable income, as well as a mobility matrix for pre-fiscal to consumable income. The mobility matrices have additional rows and columns concatenated to them to show the population shares by income group and the mean market income of that income group, for ease of reference.

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\(^{6}\) Atkinson (1980).
While the fiscal mobility matrix measures the proportion of the population that loses and gains enough to move to a higher income group, it does not capture the amount lost or gained (except to the extent that the amount lost or gained might be large enough to move more than one income group). Thus, the fiscal mobility matrix is complemented by income loss and income gain matrices, which measure the amount lost by those who lose and the amount gained by those who gain, respectively. One version of the loss and gain matrices is in average local currency lost or gained, and the other shows the average loss or gain as a proportion of before taxes and transfers income. The matrix also shows the average market income of the losers in pre-fiscal income group $i$ and post-fiscal income group $j$, which serves as a useful reference point.

**Education Enrollment Rates**

Sheets D11 and E20 shows indicators on education enrollment by income group, where sheet D11 defines income groups by disposable income and sheet E20 defines income groups by each core income concept. Two indicators used to generate other indicators are the target population for each level of education (pre-school, primary school, secondary school, and tertiary) and the total population not attending school (where the disaggregation by level is determined by the age of the students not attending school).

Other indicators have figures disaggregated not only by education level but also by public or private school (with results for the combination of the two, “public and private school,” as well). These indicators include the total population attending school (by education level, regardless of whether the student’s age corresponds to that particular education level); the target population—based on age and the corresponding education level—attending school; net enrollment rates, gross enrollment rates, and the share of students belonging to the target population.

Box 7-1 by Adam Ratzlaff includes a more detailed description of the education enrollment indicators.

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**Box 7-1: Education Enrollment Indicators**

*Adam Ratzlaff, University of Denver*

The provision of public education is an important tool in not just in terms of equalizing consumption across income groups, but also towards equalizing the distribution of income in the future and spurring national growth. The two most frequently used measures of educational usage are the net and gross enrollment rates. These indicators should be generated for each individual level of education (Primary, Secondary, etc.) and for public, private, and total educational enrollment. It is also important to ensure that the target age range for each level of education is well established and does not overlap between educational groups. These indicators may be difficult to produce if data is not available at the individual level or if it is not possible to determine which member of the household is enrolled in a particular
level of education. Note that important information on the share of benefits received and the fiscal impact of education spending can be found on other sheets of the master workbook.

**Educational Enrollment Indicators**

*Standard Educational Enrollment*

1. **Net Enrollment Rate**
   
   Numerator: Number of children of school age who are attending school.
   
   Denominator: Total number of children of school age.
   
   Note: It is useful to calculate these figures not only for the population as a whole, but also by gender, race or ethnicity, income group, or by other characteristics that may be of interest to your study. Additionally, it is important that the target age range for each level of education is set and identifiable.

2. **Gross Enrollment Rate**
   
   Numerator: Total number of individuals who are attending school.
   
   Denominator: Total number of children of school age.
   
   Note: It is useful to calculate these figures not only for the population as a whole, but also by gender, race or ethnicity, income group, or by other characteristics that may be of interest to your study. Additionally, it is important that the target age range for each level of education is set and identifiable. For gross enrollment, it is important to note that it is possible to have rates over 100 percent as there may be a large portion of students who are not within the target age range.

*Household Decision Indicator*

3. **Net Educational Probability**

   Step 1: Within each household calculate:
   
   Numerator: Number of children of school age who are attending school.
   
   Denominator: Total number of children of school age.
   
   Step 2: Take the results of step 1 and take the average across all households with children.

   Note: It is useful to calculate these figures not only for the population as a whole, but also by gender, race or ethnicity, income group, or by other characteristics that may be of interest to your study. Additionally, it is important that the target age range for each level of education is set and identifiable.

**Infrastructure Access**

Sheets D12 and E21 include statistics on infrastructure access by income group, where income groups are defined by either original (for example, pre-fiscal) income or by disposable income. Although we do not create an income concept with the value of access to infrastructure due to the inherent difficulties of allocating benefits, we use dummy variables on access to examine the distribution of infrastructure access.
The infrastructure items we include are access to running water, electricity, quality walls, floor, roof, suitable construction of home, and access to roads.

We measure the number of households with access and the distribution of households with access, as well as the coverage rate (where coverage is defined as above) among households. In addition, we measure these indicators at the individual rather than household level in the part marked “weighted households” (where “weighted” here refers to weighting each household by the number of the households; in all calculations sampling weights would of course be used).

**Sociodemographic Characteristics**

Sheets E22 and E23 include sociodemographic characteristics by decile, income group, centile, and bin, where groups are defined by each core income concept. The columns on this sheet are blank to allow for the user to include the variables that are available in the survey being used and relevant in the country for which the CEQ Assessment is being conducted. Suggested indicators include assets (including both dummy variables for individual assets and an asset index); geographic variables such as region, urban/rural, and type of terrain; household expenditures (in various categories); community characteristics such as presence of a school, medical facility, religious institutions, and community activities; household characteristics such as average age of household members, household size, gender of household head, marital status of household head, age of household head, employment status of household head, number of household members of retirement age, number of children in school, education of household head, literacy of household head, race and ethnicity, religion, main language spoken, labor indicators such as hourly salary and sector, access to infrastructure, and number of migrants in household.

**Lorenz Curves**

To make unambiguous comparisons about whether inequality falls as a result of the fiscal system, sheets D13 and E24 include Lorenz curves; on these sheets, graphs of the Lorenz curves for each core income concept will be included.

The Lorenz curve maps the cumulative share of income (using whichever income concept the curve corresponds to) on the vertical axis against the cumulative share of the population, ordered by income (using whichever income concept the curve corresponds to), on the horizontal axis. Because the horizontal axis is re-ranked with each income concept, the Lorenz curve is an anonymous measure by definition; its non-anonymous analog would be the concentration curve of each income definition with respect to the market income rankings. The Lorenz curve is defined as
\[ L(p) = \frac{1}{\bar{y}} \int_0^{F^{-1}(p)} y \, dF(y) \quad \text{for } p \in [0, 1] \]

where \( \bar{y} \) is mean income, \( F(y) \) is the cumulative density function of income, and \( p \) is the proportion of the population.

**Concentration Curves**

Sheets D14 and E25 include graphs of concentration curves (sometimes called quasi-Lorenz curves), which map the cumulative share of benefits received or taxes paid from a particular category of transfers or taxes on the vertical axis against the cumulative share of the population, ordered by pre-fiscal income, on the horizontal axis. The progressivity of a tax or transfer can be determined by comparing its concentration curve to the market income Lorenz curve, as shown in figure 7-1 (section 1 of this chapter). Whether a progressive transfer is progressive in absolute terms or relative terms, in turn, can be determined by comparing the concentration curve to the 45-degree line. Thus, the concentration curves graph includes the 45-degree line, the pre-fiscal income Lorenz curve, and concentration curves for the following categories of transfers and taxes: direct taxes, direct transfers, indirect subsidies, indirect taxes, in-kind education, and in-kind health. In the contributory pensions as government transfers scenario, the graph would also include contributory pensions.

For tax or transfer \( t \), the concentration curve with respect to pre-fiscal income is defined as

\[ C(p) = \frac{1}{\bar{t}} \int_0^{F_0^{-1}(p)} t \, dF_0(t) \quad \text{for } p \in [0, 1] \]

where \( \bar{t} \) is the mean of the tax or transfer over the population (including those who do not receive the transfer or pay the tax), \( F_0(c) \) is the cumulative density function of transfer \( t \) with respect to the pre-fiscal income distribution, and \( p \) is the proportion of the population.

**Cumulative Distribution Functions of Income**

This set of graphs included in sheets D15 and E26 shows the cumulative distribution functions (CDFs) of contributory pensions as deferred income scenario, net market, disposable, and consumable income. The CDF of income is then defined as \( \int f(y)dy \) where \( f(y) \) is the probability density function (PDF) of income. Hence, the CDF is anonymous by definition: the underlying distribution is ranked by whatever income concept is being measured, rather than maintaining the pre-fiscal income ranking. Following Atkinson\(^62\) and Foster and Shorrocks,\(^63\) if one income concept first order stochastic dominates another (its CDF lies everywhere below the other’s) over a domain of poverty lines, then the headcount index is

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\(^{63}\) Foster and Shorrocks (1988).
unambiguously lower for the first income concept over that domain of poverty lines. With respect to other poverty measures beyond the headcount index, if one income concept first order stochastic dominates another over the range of poverty lines from 0 to a maximum poverty line, then poverty is unambiguously lower in the first income concept for any poverty measure that is continuous, non-decreasing in income, and additively separable. In the case where first order stochastic dominance is not found (the CDFs of two income concepts cross), poverty can still be unambiguously lower in one of the income concepts if the poverty measure is distribution-sensitive such as the squared poverty gap. More specifically, if one income concept second order stochastic dominates another (if the integral under its CDF is less than that of the other) from 0 to a maximum poverty line, then poverty is unambiguously lower in the first income concept for any poverty measure that is continuous, non-decreasing in income, and (weakly) concave in income Atkinson.  

Comparison over Time

Although CEQ is initially completed for a particular year, subsequent analysis can entail completing the analysis for multiple survey years, and there is space for this comparison on sheet D16 of the MWB.  

For analyses over time, we propose a simple but new decomposition of the change in the disposable income Gini into a change in the pre-intervention (market income) Gini and a change in the level of redistribution, as follows.

Let \( G_0^t \) and \( G_1^t \) be the pre-fiscal and post-fiscal income Gini in year \( t \), respectively; and \( G_0^{t'} \) and \( G_1^{t'} \) be the pre-fiscal and post-fiscal Gini in year \( t' \). Denoting \( R^t \) and \( R^{t'} \) the portion of the change from market income Gini to disposable income Gini, we can write:

\[
G_1^t = G_0^t - R^t
\]

and

\[
G_1^{t'} = G_0^{t'} - R^{t'}
\]

Subtracting the latter from the former yields:

\[
(G_1^{t'} - G_1^t) = (G_0^{t'} - G_0^t) - (R^{t'} - R^t)
\]

or

\[
(R^{t'} - R^t) = (G_0^{t'} - G_0^t) - (G_1^{t'} - G_1^t)
\]

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64 Atkinson (1987).

65 examples of CEQ studies that have completed the analysis for multiple years are Lustig and Pessino (2014), Scott (2014), and Lopez-Calva, Lustig, Scott, and Castañeda (2013).
So, \((R^t - R^f)\) is the portion in the change in post-fiscal inequality between two points in time that can be attributed to a change in the redistribution component (in comparison to a change in pre-fiscal inequality).

**Descriptive Statistics**

Sheet E1 includes descriptive statistics about each of the income concepts and fiscal interventions, where the latter are in rows that are originally blank in the MWB, but get filled in automatically by the CEQ Stata Package using the variable labels of the variables included in the command’s options, as explained in section 3. The descriptive statistics include the proportion of the population with non-zero values; the mean, standard deviation, and median of the variable (among those with non-zero values only, in other words, those who have non-zero income or receive benefits from or pay taxes to the corresponding fiscal intervention).

**Population**

Sheet D6 and E2 includes the population by decile, income group, centile, and bin, for each of the core and extended income concepts, for four definitions of population: number of households in sample, number of individuals in sample, number of households in expanded sample, and number of individuals in expanded sample. The first two provide evidence on what occurs in the survey itself before applying sampling weights, and can provide evidence about small cells (for example, some countries may have so few observations with income below US$1.25 per day or above US$50 per day that any statistics about these groups are inherently noisy and should not be used). The number of households in the expanded sample shows the total households in the country represented by the sampled households, while the number of individuals in the expanded sample shows the analogue for individuals. Note that deciles and centiles are defined so that the number of individuals in the expanded sample is as equal as possible across groups; as a result, the size of each centile and bin for the other population definitions will not be equal.

The population by bin can be useful, for example, if a user without access to the microdata but with access to MWB wants to use the results produced in a MWB to calculate the poverty headcount ratio for a poverty line not included on sheets D1 and E3. For example, suppose the 2011 ICP was used and the user wants to calculate the poverty headcount ratio using the US$3.10 PPP per day poverty line, which is the median of country-specific poverty lines across the world using the 2011 ICP. This could be accomplished by using population results by bin from the “number of individuals in expanded sample” column (for example, column G of the E2 sheets). Specifically, the population in each income bin from the first bin, US$0.00-0.05, to the US$3.05-3.10 bin would be summed, then divided by the total population; the formula to do this would be \(\text{SUM(G139:G200)}/G501\).

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66 Ferreira and others (2016).
Statistical significance

Sheet E7 gives point estimates and corresponding p-values for tests of statistical significance between inequality and poverty indices for each possible pair of core income concepts. The point estimates are point estimates of the difference between inequality or poverty. Unlike comparing Gini coefficients across countries, comparing across income concepts implies that the incomes being compared come from a bivariate distribution with non-zero covariance (since a household’s pre-fiscal income is highly correlated with its disposable income, for example). Thus, the test of statistical significance of the difference in Ginis, $G_1$ and $G_0$, relies on

$$Var(G_1 - G_0) = Var(G_1) + Var(G_0) - 2Cov(G_1, G_0),$$

but $2Cov(G_1-G_0)$ is non-zero and has not been derived in the literature. Thus, statistical significance is determined using a bootstrap procedure (and, as a result, the CEQ Stata commands that produce the statistical significance sheets are slow).

In the matrices of p-values, a p-value of less than 0.05 would mean that the difference between the Ginis of the corresponding income concepts are statistically significantly different than 0, while a p-value above 0.05 would mean that we cannot reject that the difference in Ginis is different than 0 (if we have selected a significance level of 5 percent); in other words, a p-value above 0.05 would tell us that the Ginis of the two income concepts are not statistically different than each other.

Sheet E16 gives statistical significance for extended income concepts, defined similarly.

Dominance Tests

Sheets E8 and E17 presents results from dominance tests of the CDFs and concentration curves of pairs of income concepts. Using CDFs as an example, if it computes number of crossings in the CDFs (to determine if one first order stochastically dominates the other) and, if there are no crossings, the p-value of a test that the two distributions are not the same. If we adopt a significance level of 5 percent, a p-value less than 0.05 would mean that we reject that the two distributions are the same, in other words, we can conclude that one dominates the other; on the other hand, a p-value greater than 0.05 would mean that we fail to reject that the two distributions are the same, and we thus cannot claim that one dominates the other.

Marginal Contributions to Inequality

Sheet D8 and E13 includes marginal contributions of each fiscal intervention to poverty and inequality, with respect to each core income concept, progressivity indicators such as the Kakwani index, concentration coefficient, redistributive effect, and vertical equity. Note that the column titles are blank, but are filled in automatically by the CEQ Stata Package using the
variable labels of the variables included in the command’s options. Marginal contributions are described in chapter 1, box 1-1.

**Marginal Contributions to Poverty**

Marginal contributions to poverty are calculated similarly, but present unique issues. For example, suppose an individual’s pre-fiscal income is US$10 below the poverty line and the person receives three transfers of US$6 each. Since marginal contributions are calculated with respect to the end income, the marginal contribution of each program to that individual’s poverty status is 0, since the other two programs pushed her out of poverty. This is the issue of path dependence that computations of the Shapley value attempt to circumvent, but those are outside of the scope of this Handbook.

**Marginal Contributions to Vertical Equity and Reranking**

While the marginal contribution to poverty or inequality is defined based on the fiscal intervention and a particular core income concept (the marginal contribution of Bolsa Família to inequality, with respect to disposable income, is calculated as the Gini of disposable income minus the Gini of disposable income. For the marginal contribution to vertical equity or reranking, however, both an initial and end income must be defined, for example the marginal contribution of Bolsa Família to the vertical equity going from market to disposable income. Specifically, these more complex marginal contribution indicators are calculated as follows.

Since these can be defined for any initial and end incomes (not necessarily the ones we typically consider pre-fiscal and post-fiscal incomes), we change the notation slightly. Let $X$ denote initial income, $Z$ denote end income, and $Z \setminus T_1$ (equivalently $Z \setminus B_1$) is the $Z$ income concept without tax $T_1$ (equivalently without benefit $B_1$). For example, suppose $Z$ is final income, $T_1$ is personal income taxes, and $B_1$ is a conditional cash transfer (CCT). Then $Z \setminus T_1$ is constructed by adding personal income taxes to final income (by adding them, we get final income prior to subtracting out personal income taxes) and $Z \setminus B_1$ is constructed by subtracting CCT benefits from final income (by subtracting them, we get final income prior to adding in CCT benefits).

The marginal contribution of tax $T_1$ to vertical equity going from income concept $X$ to income concept $Z$ is calculated as

$$MVE_{T_1} = (G_X - D^X_Z) - (G_X - D^X_{Z \setminus T_1})$$

where $G$ and $D$ indicate Gini coefficients and concentration coefficients, as before. The marginal contribution of benefit $B_1$ to vertical equity going from income concept $X$ to income concept $Z$ is calculated as

---

67 The indicators in this sub-section were derived by Ali Enami.
The analogous marginal contributions to reranking are calculated as

\[ MRR_{T_1} = (D_Z^X - G_Z) - (D_{Z,T_1}^X - G_{Z,T_1}) \]

and

\[ MRR_{B_1} = (D_Z^X - G_Z) - (D_{Z,B_1}^X - G_{Z,B_1}) \]

We can also compute derivatives of these marginal contributions with respect to the size of tax 1 or benefit 1, which can be useful if we want to know if marginally increasing the size of a tax or transfer will increase its marginal contribution. Let the relative size of tax \( i \) as a proportion of initial income be \( g_i \) and the relative size of transfer \( j \) as a proportion of initial income be \( b_j \). The derivative of the marginal contribution of tax \( T_1 \) to inequality with respect to its size is

\[
\frac{\partial M_{T_1}}{\partial g_1} = \frac{\Pi(X,Z,T_1) + (D_Z^X - G_Z)}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}
\]

where \( \Pi(X,Z,T_1) = D_{T_1}^Z - D_X^Z \). The derivative of the marginal contribution of benefit \( B_1 \) to inequality with respect to its size is

\[
\frac{\partial M_{B_1}}{\partial b_1} = \frac{\rho(X,Z,B_1) - (C_X^Z - G_Z)}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}
\]

where \( \rho(X,Z,B_1) = C_X^Z - C_{B_1}^Z \).

The derivative of the marginal contribution of tax \( T_1 \) to vertical equity with respect to its size is

\[
\frac{\partial MVE_{T_1}}{\partial g_1} = \frac{\Pi(X,Z,T_1) + (G_X - C_X^Z)}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}
\]

and for benefit \( B_1 \) it is

\[
\frac{\partial MVE_{B_1}}{\partial b_1} = \frac{\rho(X,Z,B_1) - (G_X - C_Z^X)}{1 - \sum_{i=1}^n g_i + \sum_{j=1}^m b_j}
\]

The derivative of the marginal contribution of tax \( T_1 \) to reranking with respect to its size is

\[
\frac{\partial MRR_{T_1}}{\partial g_1} = \frac{\partial M_{T_1}}{\partial g_1} - \frac{\partial MVE_{T_1}}{\partial g_1}
\]

and for benefit \( B_1 \) it is

\[
\frac{\partial MRR_{B_1}}{\partial g_1} = \frac{\partial M_{B_1}}{\partial g_1} - \frac{\partial MVE_{B_1}}{\partial g_1}
\]
Covariance

Sheet E15 shows the covariance between each core income concept, as well as each fiscal intervention (whose column titles are currently blank, but are filled in automatically by the CEQ Stata package using the variable labels) with the fractional rank of the same core income concepts, which can be used to manually calculate the Gini coefficient and concentration coefficients. Specifically, Pyatt and others\(^68\) and Lerman and Yitzhaki\(^69\) show that the Gini coefficient can be expressed as \(G = \frac{2}{\mu} \text{Cov}(y, F(y))\) where \(F(y)\) is the fractional income rank in the distribution of income (or, equivalently, the CDF of income) and \(\mu\) is mean income. Similarly, the concentration coefficient of a tax or transfer \(t\) with respect to income concept \(y\) can be expressed in terms of the covariance as follows: \(C = \frac{2}{\mu} \text{Cov}(t, F(y))\) where \(\mu\) is still mean income.

Assumption Testing

Sheet E28 is meant to test various assumptions used to construct the income concepts and quickly compare the implications of these assumptions on a limited number of summary measures (the mean, median, standard deviation, Gini, Theil, 90/10, and poverty using various poverty lines and the headcount, poverty gap, and squared poverty gap, as well as totals by decile and income group). For example, suppose the team is comparing two methods for imputed rent for owner occupied housing: the first is to use a survey question where respondents report what they think they would rent their house for if it were rented rather than owned, and the second is to use the prediction method, regressing rental rates against housing characteristics among the subset who rent their homes (as described in chapter 3 of this Handbook). After creating a pre-fiscal income variable under each of these two possible methods, these two variables would be used with the \texttt{ceqassump} command to quickly compare how the decision of how to allocate imputed rent for owner occupied housing affects mean income, inequality, and poverty.

3. CEQ Stata Package

Table 7-4 presents the user-written Stata commands that make up the CEQ Stata Package, describes the indicators that they compute, the variables for which indicators are estimated, and the sheets of the CEQ MWB section E that are automatically populated with results by the CEQ Stata Package commands. As described in section 2, section D provides a summary of the results from section E and is populated using the “Fill Results” buttons in the sheets of section D. The CEQ Stata package requires Stata version 13 or newer since it uses the \texttt{putexcel} command, introduced in Stata 13, to export results directly to the pre-formatted MWB.

\(^{68}\) Pyatt and others (1980).
\(^{69}\) Lerman and Yitzhaki (1984).
<table>
<thead>
<tr>
<th>Command</th>
<th>Indicators</th>
<th>Variables</th>
<th>Sheet of MWB Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>ceqppp</td>
<td>Preliminary command to obtain numbers needed for PPP conversions</td>
<td>N/A</td>
<td>E</td>
</tr>
<tr>
<td>ceqdes</td>
<td>Percent with non-zero, mean, standard deviation, median, percent of income</td>
<td>Core income concepts and fiscal interventions</td>
<td>E1. Descriptive Statistics</td>
</tr>
<tr>
<td>ceqpop</td>
<td>Population (number of households, number of individuals, in sample and in expanded sample) by decile, group, centile, and bin</td>
<td>Core income concepts</td>
<td>E2. Population</td>
</tr>
<tr>
<td>ceqextpop</td>
<td>Population (number of households, number of individuals, in sample and in expanded sample) by decile, group, centile, and bin</td>
<td>Extended income concepts</td>
<td>E2b. Ext. Population</td>
</tr>
<tr>
<td>ceqlorenz</td>
<td>Mean, median, standard deviation; inequality (Gini, S-Gini, Theil, 90/10); poverty (headcount index, poverty gap, squared poverty gap); income totals by decile, group, centile, bin; shares, cumulative shares, anonymous incidence by decile, group</td>
<td>Core income concepts</td>
<td>E3. Lorenz</td>
</tr>
<tr>
<td>ceqlop</td>
<td>Inequality of opportunity using mean log deviation</td>
<td>Core income concepts</td>
<td>E4. Inequality of Opportunity</td>
</tr>
<tr>
<td>ceqfi</td>
<td>Fiscal impoverishment (FI headcount, FI headcount among post-fiscal poor, total FI, per capita FI, per capita FI normalized by the poverty line; fiscal gains of the poor (same as above for FGP instead of FI)</td>
<td>Core income concepts (from one income concept to another)</td>
<td>E5. Fisc. Impoverishment, E6. Fisc. Gains to the Poor</td>
</tr>
<tr>
<td>ceqstatsig</td>
<td>Statistical significance (p-values) for changes in inequality, poverty, concentration coefficients</td>
<td>Pairs of core income concepts</td>
<td>E7. Statistical Significance</td>
</tr>
<tr>
<td>ceqdom</td>
<td>Dominance tests</td>
<td>Core income concepts</td>
<td>E8. Dominance</td>
</tr>
</tbody>
</table>
Chapter 7, Higgins

ceqef | Effectiveness indicators | Core income concepts | E9. Effectiveness
ceqconc | Mean, median, standard deviation, concentration coefficient, redistributive effect, Reynolds-Smolensky, reranking effect; concentration totals by decile, group, centile, bin; concentration shares, cumulative shares, non-anonymous incidence by decile, group | Core income concepts; separate sheet for ranking by each core income concept | E10. Concentration (eight sheets E10.m, …, E10.f)
ceqfiscal | Mean, median, standard deviation, concentration coefficient, Kakwani index; totals by decile, group, centile, bin; shares, cumulative shares, non-anonymous incidence by decile, group | Fiscal interventions, separate sheet for ranking by each core income concept | E11. FiscalInterventions (eight sheets E11.m, …, E11.f)
ceqextend | Mean, median, standard deviation; inequality (Gini, S-Gini, Theil, 90/10); poverty (headcount, poverty gap, squared poverty gap); concentration coefficients ranked by each core income concept; income totals by decile, group, centile, bin; shares, cumulative shares, anonymous incidence by decile, group | Extended income concepts, separate sheet for extended income concepts with respect to each core income concept | E12. Extended Income Concepts (eight sheets E12.m, …, E12.f)
ceqmarg | Marginal contributions to inequality, progressivity, vertical and horizontal equity, poverty | Fiscal interventions, separate sheet for ranking by each core income concept | E13. Marg. Contrib. (eight sheets E13.m, …, E13.f)
ceqefext | Effectiveness indicators | Extended income concepts, separate sheet for extended income concepts with respect to each core income concept | E14. Effectiveness (eight sheets E14.m, …, E14.f)
ceqcov | Covariance | Core income concepts and | E15. Covariance
Chapter 7, Higgins

cqeqextsig Statistical significance (p-values) for changes in inequality, poverty, concentration coefficients

fiscal interventions

Extended income
concepts

E16. Extended Income Stat Sig (eight sheets E16.m, …, E16.f)

cqdomext Dominance tests

Extended income
concepts

E17. Dominance Tests (eight sheets E17.m, …, E17.f)

cqcoverage Coverage

Fiscal interventions, separate sheet for ranking by each core income concept

E18. Coverage Tables (eight sheets E18.m, …, E18.f)

cqtarget Coverage for target population

Fiscal interventions, separate sheet for ranking by each core income concept

E19. Coverage (Target) (eight sheets E19.m, …, E19.f)

cqeduc Education enrollment rates

Education enrollment by level; age

E20. Edu Enrollment Rates (eight sheets E20.m, …, E20.f)

cqinfra Infrastructure Access

Infrastructure access variables

E21. Infrastructure Access

cqhhchar Household Sociodemographic Characteristics

Household-level sociodemographic characteristic variables and core income concepts

E22. GroupSociodemoCharac (eight sheets E10.m, …, E10.f)

cqindchar Individual Sociodemographic Characteristics

Individual-level sociodemographic characteristic variables and core income concepts

E23. IndivSociodemoCharac (eight sheets E10.m, …, E10.f)

cqgraph progressivity Graphs of Lorenz curves

Core income concepts

E24. Lorenz Curves

cqgraph conc Graphs of concentration curves

Core income concepts

E25. Concentration Curves

cqgraph cdf Graphs of cumulative distribution functions

Core income concepts

E26. CDF

cqgraph fi Graphs of FI and FGP headcounts; FI and FGP per capita; FI and FGP per capita normalized by the poverty

Core income concepts (from one income concept to another)

E27. FIFGP
line; and total FI and FGP, over different poverty lines

```
ceqassump
```

Any income concept created to test assumptions

```
ceqrace
```

Many indicators

Core income concepts, extended income concepts, fiscal interventions

Section F (see Aranda and Ratzlaff, chapter 8 of this handbook)

Notes: CDF = cumulative distribution function; FGP = fiscal gains of the poor; FI = fiscal impoverishment; FIFGP = FI and FGP; MWB = Master Workbook; PPP = purchasing power parity.

### 3.1 Preliminaries

To install the CEQ Stata Package, include the following Stata code in a .do file or enter it into Stata’s command prompt:

```stata
update all
ssc install ceq, replace
```

Once the package is installed, a short description of each command and links to the help files for each command can be found by typing

```
help ceq
```

Most of the CEQ Stata Package commands produce results for specific sheets of section E of the MWB, as shown in table 7-2. These share a common structure and many share common options, which are described in section 3. There is one preliminary command in the package that is used to extract the numbers necessary to convert local currency units into PPP adjusted dollars, so that income totals can be compared to “international” poverty lines: `ceqppp`. This command pulls three numbers needed to perform PPP conversions: the consumption-based PPP conversion factor, which converts local currency from the “base year” in which price data was collected by the ICP—usually 2005 or 2011—to dollars for the same year; the country’s consumer price index (CPI) for the base year; and the country’s CPI for the year of the household survey. The command uses Azevedo’s[70] `wbopendata` to extract this information from the World Bank’s World Development Indicators (WDI).

The syntax of `ceqppp` is as follows:

```stata
ceqppp , country(string) baseyear(real) surveyyear(real) [locals]
```

The command’s options are described in table 7-5.

---

Table 7-5: Options for `ceqppp`

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>country(string)</code></td>
<td>Three letter country code (see help <code>wbopendata</code>)</td>
</tr>
<tr>
<td><code>baseyear(real)</code></td>
<td>Base year for PPP conversion (either 2005 or 2011)</td>
</tr>
<tr>
<td><code>surveyyear(real)</code></td>
<td>Year of household survey</td>
</tr>
<tr>
<td><code>locals</code></td>
<td>Store these numbers as locals</td>
</tr>
</tbody>
</table>

If `locals` is specified, the needed numbers are saved in the locals `ppp`, `cpibase`, and `cpisurvey`.

As an example, the study for Brazil by Higgins and Pereira\textsuperscript{71} used data from the 2008-2009 Family Expenditure Survey (Pesquisa de Orçamentos Familiares). When the survey spans two years, authors must determine whether the data are already deflated to one of the two years; in the case of Brazil, all prices in the microdata had already been deflated to January 2009 prices by the Brazilian Geographical and Statistical Institute (IBGE), so 2009 was used as the survey year. If the survey spans two years and prices in the microdata are not deflated, the country authors should deflate them to one of the two years before doing PPP conversions. Thus, to convert to 2005 international dollars (using the 2005 ICP):

```stata
ceqppp, country("bra") baseyear(2005) surveyyear(2009) locals
```

The relevant numbers are printed in the Stata results window, and are also saved in the locals `ppp`, `cpibase`, and `cpisurvey`, which can be fed directly into the `ppp()`, `cpibase()`, and `cpisurvey()` commands of the relevant CEQ Stata Package commands, described below.

Using `ceqppp` rather than manually obtaining the PPP conversion factor and CPIs from WDI has multiple advantages: for example, it is more efficient, avoids human error, avoids rounding error, and increases the transparency and replicability of one's research. In addition, since the CEQ Stata Package commands print these numbers in row 3 of each sheet of section E, `ceqppp` can be used by those conducting quality control of a CEQ Assessment to quickly confirm that the numbers used by a country team for the PPP conversion match those from WDI (and request an explanation from the team if they do not match).

### 3.2 Structure and Options

The CEQ Stata Package commands have a common syntax:

```stata
command [if] [in] [weight] [using filename], options
```

where `command` is the name of the command, for example `ceqdes`. For most commands, there is no `varlist` specified after the command name because income concept variables, fiscal intervention

\textsuperscript{71} Higgins and Pereira (2014).
variables, and other variables are all specified using command options. Exceptions are discussed below in section 3.3.

The optional `if` and `in` arguments allow the user to restrict the analysis to a particular subset of the data. For example, the `if` argument could be used to perform subgroup-specific analyses (for example, by urban/rural area or region), or to restrict the analysis to “non-dropped” observations if a marker dummy variable is used to mark observations that should be dropped.

For weights, `pweight` is allowed; see `help weight`. Alternatively, weights can be specified using `svyset`.

Results are automatically exported to the CEQ MWB if using `filename` is specified, where `filename` is the file of the corresponding sheet of the MWB. (It is a good idea to keep a blank version of each Excel file included in the MWB and create copies for each scenario or sensitivity analysis undertaken as part of the CEQ Assessment, adding the three-letter country abbreviation and an abbreviation of the scenario. For example, PDI for pensions as deferred income, as well as the date the analysis was run, to the MWB copies that will be supplied to the command with using `filename`.) There are a number of options that govern this automatic export, which are described in more detail below.

Note that completing the different scenarios for the treatment of pensions requires running the command more than once, with separate MWB `filename`s, and additional scenarios or sensitivity analyses would require additional runs with other `filename`s. The variables used in the command’s options would be different depending on the treatment of pensions, as described in more detail below.

a. **Income Concept Options**

The first group of options are income concept options, in which the user supplies the variables for each of the core income concepts described in Higgins and Lustig. The income concepts should already be adjusted for the number of household members, and if desired for economies of scale and adult equivalence. In other words, if household per capita income is being used (as is most common in CEQ Assessments), these variables should already be in household per capita terms (total household income divided by the number of members of the household). Alternatively, if an equivalence scale is being used, such as the square root scale recommended by Buhmann and others and used for a CEQ Assessment comparing Brazil and the US in Higgins and other, these income concepts should already be in equivalized terms, dividing in this case by the square root of the number of household members. They should be in local currency units per year, as the CEQ Stata commands automatically perform PPP conversions to dollars per day for comparison with international poverty lines. When generating the income concept variables during the data preparation stage, these variables should be generated as double-precision variables using `generate double`, in order to avoid rounding errors (which can be compounded when applying expansion factors and summing across all observations in the sample).

---

72 Higgins and Lustig, chapter 5 of this Handbook
73 Higgins and Lustig, chapter 5 of this Handbook
74 Buhmann and others (1988).
75 Higgins and others (2016).
76 The commands are flexible enough to accommodate local currency per month or day rather than per year, but we highly recommend converting all income concept variables to annual terms so that results can easily be compared to numbers from national accounts.
At least one income concept option must be specified for the command to run. Table 7-6 shows the income concept options, which are used by all commands in the CEQ Stata Package (with the exception of the preliminary commands discussed in section 3.1).

As described in Higgins and Lustig, there are three scenarios for the treatment of pensions. We recapitulate these scenarios, and describe how they affect the market income and market income plus subsidized pensions variables, which will in turn be supplied to the \texttt{market(varname)} and \texttt{mpluspensions(varname)} options.

i) In the \textit{contributory pensions as deferred income} scenario, the entire contributory pension is included in market income, so \texttt{subsidized pensions} equal 0, and hence \texttt{market income} is equal to \texttt{market income plus subsidized pensions}. As a result, the same variable can be supplied to both the \texttt{market(varname)} and \texttt{mpluspensions(varname)} options (or two separate but equivalent variables could be used).

ii) In the \textit{contributory pensions as partially deferred income} scenario, the non-subsidized portion of pensions is included in market income, while both the non-subsidized and subsidized portions are included in market income plus subsidized pensions, so the two variables will differ.

iii) Likewise, in the \textit{contributory pensions as a pure government transfer scenario}, none of the pension is included in market income, so the variables supplied to \texttt{market(varname)} and \texttt{mpluspensions(varname)} differ.

Also note that, in the \textit{contributory pensions as deferred income} and \textit{contributory pensions as partially deferred income} scenarios, the variable supplied to \texttt{mpluspensions(varname)} will be identical across the two scenarios. In the \textit{contributory pensions as a pure government transfer scenario}, however, contributions to pensions have not yet been subtracted out of market income plus subsidized pensions, whereas in the other two scenarios all income concepts are net of these contributions to avoid double counting, so the \texttt{market income plus subsidized pensions} variable will be equivalent in scenarios 1 and 2, but not 3.

b. Fiscal Intervention Options

The second group of options are fiscal intervention options, in which the user supplies each of the variables for particular taxes, transfers, subsidies, and in-kind benefits. These variables should be expressed in the same units as the income concept variables, local currency per year in household per capita or per adult equivalent terms. Like the income concept variables, these variables should also be created using \texttt{generate double} during the data preparation stage.

The fiscal intervention options are only included in the syntax of commands that provide results by fiscal intervention or extended income concepts: \texttt{cegdes, ceqfiscal}, and \texttt{ceqextend}. These options are described in table 7-7. All of the fiscal intervention variables fed to these options should be labeled using

\begin{verbatim}
label variable varname ("label")
\end{verbatim}

\footnote{Higgins and Lustig, chapter 5 of this Handbook}
since many of the CEQ Stata Package commands automatically use these variable labels as the titles of rows or columns of results in the MWB. Examples of these labels are “conditional cash transfers from Bolsa Familia (household per capita),” “Non-contributory pensions from BPC (household per capita),” and “Tobacco excise tax (household per capita).”

[Table 7-7 here]

Each option accepts a \textit{varlist} so that multiple variables can be included for each program or tax. There might be ten different direct cash transfer programs; each of these would be a variable, and all ten variables would be included with the \texttt{dtransfers(varlist)} option.

The \texttt{pensions(varlist)} option should include variables that include only the subsidized portion of contributory pensions, which will vary based on the scenario. In the \texttt{contributory pensions as pure deferred income} scenario, the subsidized portion of pensions equals 0 so the \texttt{pensions(varlist)} option would not be used. In the \texttt{contributory pensions as partially deferred income} scenario, a variable with only the subsidized portion of pensions would be supplied to the \texttt{pensions(varlist)} option. The treatment of pensions also affects the option for contributions, \texttt{contribs(varlist)}. This option could in theory include variables for both contributions to the contributory pension system and for other contributions. However, in the \texttt{contributory pensions as deferred income} and \texttt{contributory pensions as partially deferred income} scenarios, all income concepts are already net of contributions to the contributory pension system to avoid double counting, so this variable should \textit{not} be included in the \texttt{contribs(varlist)} option. As explained in and Higgins and Lustig \cite{Lustig2012} in the \texttt{contributory pensions as a pure government transfer} scenario—for comparability with other studies—market income, market income plus subsidized pensions, and gross income are \textit{not} net of contributions, and these are subtracted along with direct taxes when constructing gross, disposable, and the other core income concepts. Thus, only in the \texttt{contributory pensions as a pure government transfer} scenario, a variable with contributions to the contributory pension system should be included in the \texttt{contribs(varlist)} option.

I now provide some examples of programs included in the fiscal interventions options. \texttt{dtransfers(varlist)} commonly includes separate variables for each conditional cash transfer program, unconditional cash transfer program, public scholarship program, non-contributory pension program for the elderly poor, food transfer program, and other direct transfer programs. \texttt{dtaxes(varlist)} commonly includes separate variables for individual income taxes and property taxes. \texttt{contribs(varlist)} commonly includes variables for contributions to each contributory program (for example, pensions, unemployment insurance); \texttt{subsidies(varlist)} commonly includes variables for each indirect subsidy. For example, the CEQ Assessment for Ghana included fertilizer, kerosene, and electricity \cite{Younger2015}; \texttt{indtaxes(varlist)} commonly includes variables for indirect taxes for various categories. Also, the CEQ Assessment for Indonesia included variables for the value-added tax and tobacco excise \cite{Afkar2015}, while the CEQ Assessment for Tanzania included a variable for the value-added tax, a variable for import duties (including their indirect effects), and ten separate variables for excise taxes \cite{Younger2016}; \texttt{health(varlist)} and \texttt{userfeeshealth(varlist)} commonly include variables for different types of care, for example, in-patient, out-patient, and preventative care; \texttt{education(varlist)} and

\cite{Lustig2012, Younger2015, Afkar2015, Younger2016}
userfees educ (varlist) commonly include variables for different levels of public education spending: pre-school, primary, secondary, tertiary.

In countries with health, education, or other user fees, the transfer benefits supplied to the health (varlist), education (varlist), and otherpublic (varlist) options should be gross benefits. In other words, in countries where the user fee goes directly to the government and hence the calculated benefits are gross of those user fees, the variables obtained using the imputation method would be used; in countries where the user fee goes to the doctor’s pocket and thus the imputed benefit based on costs from national accounts does not include proceeds from the user fee, the researcher should add in the user fees to obtain gross benefit variables, and supply these to the health (varlist), education (varlist), and otherpublic (varlist) options.

Tax, contribution, and user fee variables may be saved as either positive or negative values, as long as one is used consistently for all tax, contribution, and user fee variables.

c. PPP Conversion Options

Table 7-8 includes the options used to convert from local currency units to PPP-adjusted dollars; the conversion is done automatically by the commands once the PPP conversion factor, CPI for the base year (year of PPP, usually 2005 or 2011), and CPI for the survey year are supplied. The PPP conversion options are only included in commands that compare incomes to poverty lines or other income group cut-offs, the commands that have poverty results or results by income group: ceqpop, ceqextpop, ceqlorenz, ceqfi, ceqstatsig, ceqconc, ceqfiscal, ceqextend, ceqextsig, ceqcoverage, ceqtarget, ceqinfra, ceqeduc, ceqhhchar, ceqindchar, ceqgraph cdf, ceqgraph fi and ceqassump.

The CEQ Stata Package commands automatically convert local currency variables to PPP dollars, using the PPP conversion factor given by ppp (real), the CPI of the year of PPP (2005 or 2011) given by cpibase (real), and the CPI of the year of the household survey used in the analysis given by cpisurvey (real). The year of PPP, also called base year, refers to the year of the ICP that is being used, 2005 or 2011. The survey year refers to the year of the household survey used in the analysis. We recommend using ceqppp with the locals option to obtain these figures from WDI, as described in section 2; then these can be fed into the CEQ Stata Package commands as follows:

```
command ..., ppp (`ppp') cpibase (`cpibase') cpisurvey (`cpisurvey') ...
other options
```

If obtaining the numbers for the PPP conversion manually from WDI or another source (rather than using the ceqppp command to automatically obtain them from WDI), make sure that the PPP conversion factor is consumption-based: if the year of PPP is 2005, the PPP conversion factor should be the “2005 PPP conversion factor, private consumption (LCU per international dollar)” indicator from the World Bank’s WDI. If the year of PPP is 2011, use the “PPP conversion factor, private consumption (LCU per international dollar)” indicator from WDI. The PPP conversion factor should convert from year of PPP to year of PPP. In other words, when extracting the PPP conversion factor, it is possible to select any year; DO NOT select the year of the survey, but rather the year that the ICP was conducted to compute PPP conversion factors (2005 or 2011). The base year (year of PPP) CPI,
which can also be obtained from WDI, should match the base year chosen for the PPP conversion factor. The survey year CPI should match the year of the household survey.

Finally, for the PPP conversion, the user can specify whether the original variables are in local currency units per day (daily), per month (monthly), or per year (yearly, the default assumption). All variables in currency must be in the same units, and we highly recommend using local currency units per year, since the figures (total disposable income) will then be comparable to analogous figures from national accounts, which are expressed in annual terms.

d. Survey Information Options

Information about the survey is provided through the survey information options shown in table 7-9.

If the data set is at the individual level (each observation is an individual), the variable with the identification code of each household (a unique household identifier that takes the same value for all members within a household) should be specified in the hhid(varname) option and the hsize(varname) option should not be specified. If the data set is at the household level (each observation is a household), a variable containing the number of members in each household should be specified in the hsize(varname) option and the hhid(varname) option should not be specified. In either case, the weight used (or supplied via svyset) should be the household sampling weight and should not be multiplied by the number of members in the household, since the program will do this multiplication automatically in the case of household-level data.

There are two options for including information about weights and survey sample design so that the estimates and statistical significance tests are calculated correctly. The sampling weight can be entered in the usual fashion using weight or supplied via svyset. Information about complex stratified sample designs can also be entered using svyset since the CEQ Stata Package commands automatically use the information specified using svyset. Alternatively, the primary sampling unit variable can be entered using the psu(varname) option, and the strata variable can be entered using the strata(varlist) option.

e. Poverty Line Options

For the CEQ Stata commands that produce poverty results (ceqlorentz, ceqfi, ceqextend, ceqgraph fi, ceqgraph cdf and ceqassump), poverty results are produced using three international poverty lines, a national extreme and national moderate poverty line, and—if applicable—an additional extreme and moderate poverty line (for example, poverty lines produced by the regional UN Economic Commission for the country, or the income cut-off used to determine social program eligibility if this differs from the official poverty line). Table 7-10 shows the poverty line options.

[Table 7-10 here]
The “international” poverty lines in PPP dollars per day can be set using the `p11(real)`, `p12(real)`, and `p13(real)`; the defaults for these are the commonly-used US$1.25, US$2.50, and US$4 PPP poverty lines. For example, if using 2011 as the base year for PPP conversions (using the 2011 ICP round rather than the 2005 ICP round), the user would likely want to change the lowest poverty line from its default of US$1.25 PPP per day, which was calculated based on national poverty lines in the poorest countries in 2005 using 2005 dollars, to US$1.90 PPP per day, based on inflating these same countries’ national poverty lines to 2011 currency and converting them to dollars using the 2011 PPP conversion factors. To do this, simply use the PPP conversion factor and base year CPI for 2011 and specify the `p11(1.90)` option.

Poverty lines in local currency can be entered using the `nationalextremepl(string)`, `nationalmoderatepl(string)`, `otherextremepl(string)`, and `othermoderatepl(string)` options. Local currency poverty lines can be entered as real numbers (for poverty lines that are fixed for the entire population) or variable names (for poverty lines that vary, for example across space), and should be in the same units as the income concept variables (preferably local currency units per year).

In addition to the above absolute poverty lines, we also estimate relative poverty using a poverty line equal to \( x \) percent of median income (using whichever income concept poverty is being estimated for). By default, the line is set at 50 percent of median income, but this can be changed with the `proportion(real)` option, which takes values between 0 and 1 (and has a default of 0.5).

f. Income Group Cut-off Options

Some CEQ Stata commands that produce results by income bin, for example, total incomes for those with incomes between US$0 and US$1.25 per day, between US$1.25 and US$2.50 per day, etc.; these include `ceqpop`, `ceqextpop`, `ceqlorenz`, `ceqconc`, `ceqfiscal`, `ceqextend`, `ceqcoverage`, `ceqtarget`, `ceqinfra`, `ceqeduc`, `ceqhhchar` and `ceqassump`. Like the poverty lines, the income cut-offs can be adjusted, using the income group cut-off options summarized in table 7-11.

[Table 7-11 here]

These cut-offs are based on 2005 PPP dollars, and as described in Higgins and Lustig, the names are based on the context of middle income countries. For the groups referred to as vulnerable and middle class, the US$10 PPP per day line is the upper bound of those vulnerable to falling into poverty (and thus the lower bound of the middle class) in three Latin American countries, calculated by Lopez-Calva and Ortiz-Juarez. Ferreira and others find that an income of around US$10 PPP also represents the income at which individuals in various Latin American countries tend to self-identify as belonging to the middle class and use this as further justification that it should be used as the lower

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82 Ravallion and others (2009); Chen and Ravallion (2010).
83 Ferreira and others (2016).
84 The US$1.90 line is fairly robust to alternate methods of estimating the global poverty line (Lustig and Silber (2016, Table 1), such as taking the median line from a broader set of poor countries Joliffe and Pydts (2016) or a population-weighted average of poverty lines from 101 countries Kakwani and Son (2016).
85 Higgins and Lustig (chapter 5 of this Handbook).
86 Lopez-Calva and Ortiz-Juarez (2014).
87 Ferreira and others (2013).
bound of the middle class. The US$10 PPP per day line was also used as the lower bound of the middle class in Latin America in Birdsall and in developing countries in all regions of the world in Kharas. The US$50 PPP per day line is the upper bound of the middle class proposed by Ferreira and others.

Suppose we were converting to 2011 PPP dollars rather than 2005 PPP dollars, and thus wanted to change the cut-off for the lowest income group (referred to as ultra-poor) to US$1.90, the World Bank's new global poverty line, and the cut-off for the second-lowest group (referred to as extreme poor) to US$3.10, which corresponds to the median of country-specific poverty lines across the world. We would then specify the options cut1(1.90) cut2(3.10), making the poorest group range from US$0 to US$1.90 PPP per day and the second-poorest from US$1.90 to US$3.10. If we did not specify the cut3(real) option, that cut-off would remain at its default value of US$4, so the third group would then range from US$3.10 to US$4 PPP per day.

g. Produce a Subset of Results

To increase speed and efficiency for those wishing to only produce a subset of results within a sheet, many commands include options to only produce a subset of results. The commands that produce results by decile, income group, centile, and bin (ceqpop, ceqextpop, ceq Lorenz, ceq conc, ceq fiscal, ceqextend, ceq hhchar, ceq indchar and ceq assump) have at least one of the options nodecile, nogroup, nocentile, and nobin to refrain from producing the corresponding subsets of results.

The ceq fi command also includes the nobin option to not produce results by income bin. Furthermore, to only produce results for some of the fiscal impoverishment (FI) and fiscal gains to the poor (FGP) indicators from Higgins and Lustig, the following options can be specified (where specifying none of the following options is equivalent to specifying all of them, results will be produced for all indicators if none of the options are specified): headcount to produce results for FI and FGP headcounts; headcountpoor to produce results for FI and FGP headcounts among the poor, total to produce results for total FI and FGP; per capita to produce results for per capita FI and FGP, and normalized to produce results for per capita FI and FGP normalized by the poverty line.

h. Export Directly to the CEQ MWB

As mentioned above, results are automatically exported to the CEQ MWB if using filename is specified, where filename is the file of the corresponding sheet of the MWB. (It is a good idea to keep a blank version of each Excel file included in the MWB and create copies for each scenario or sensitivity analysis undertaken as part of the CEQ Assessment, adding the three-letter country abbreviation and an abbreviation of the scenario, for example, PDI for pensions as deferred income, as well as the date the analysis was run, to the MWB copies that will be supplied to the command with using filename.) By default, each command prints to a sheet with a specific name, which is the sheet's default name in the MWB. If you change sheet names, you can inform the CEQ Stata Package

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88 Birdsall (2010).
89 Kharas (2010).
90 Ferreira and others (2013).
91 Ferreira and others (2016).
92 Higgins and Lustig (2016).
commands of these changes using the `sheet(string)` option, for commands that print to one sheet; `sheetm(string)`, `sheetmp(string)`, `sheetn(string)`, `sheetg(string)`, `sheett(string)`, `sheetd(string)`, `sheetc(string)`, and `sheetf(string)` options for commands that print to eight sheets, one for each core income concept; and the `sheetfi(string)` and `sheetfg(string)` options for the `ceqfi` command that prints to sheets E5 for fiscal impoverishment and E6 for fiscal gains of the poor.

The options for directly exporting to the MWB are included in table 7-12.

[Table 7-12 here]

Row 3 of each sheet in section E of the MWB includes information on the country, authors, survey year, the date that the sheet was completed, and—on sheets that require a PPP conversion only—the base year (year of PPP, usually 2005 or 2011), the PPP conversion factor (from base year local currency units to base year PPP dollars), the country’s CPI in the base year, its CPI in the survey year, and the resulting PPP conversion factor from survey year LCU to base year PPP. For the country, survey year, authors, and (if applicable) base year for the PPP conversion to be automatically filled in by the command, the user should include strings with this information in the `country(string)`, `surveyyear(string)`, `authors(string)`, and `baseyear(real)` options. The date is generated automatically, and the other information about the PPP conversion is generated based on the numbers supplied to the PPP conversion options.

The `open` option can be used to automatically open `filename` after the results have been exported to the MWB.

i. Option to Ignore Missing Values

By default, the CEQ Stata Package does not allow income concept or fiscal intervention variables to have missing values; if one of these variables has missing values, the commands will produce an error. Other Stata commands (for example, `regress`) merely exclude observations that have a missing value from the calculations. The CEQ Stata Package commands instead produce an error because the missing values are often due to user error: if a household has 0 income for an income concept, receives 0 from a transfer or a subsidy, or pays 0 of a tax, the household should have 0 rather than a missing value. For flexibility, however, the CEQ Stata Package commands include an `ignoremissing` option that will drop observations with missing values for any of these variables, thus allowing the command to run even if there are missing values.

j. Option to Allow Calculations of Indicators with Negative Values

By default, when negative values are included for each core income concept or fiscal intervention, concentration coefficient, redistributive effect, Reynolds-Smolensky index and reranking effect are not produced in `ceqconc`; concentration coefficient and Kakwani index are not produced in `ceqfiscal`; Gini coefficient, Theil index, concentration coefficient, poverty gap and squared poverty gap are not produced in `ceqextend`. This is because these measures are no longer well-

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93 `baseyear(real)` takes a real number as its argument whereas `surveyyear(string)` takes a string because the survey year may actually be multiple years, for example, in the case of Brazil we would use the option `surveyyear("2008-2009")`. 


behaved when negative values are included. For example, these measures can exceed 1, and other desirable properties of these measures when incomes or fiscal interventions are non-negative no longer hold if negative values are allowed. For flexibility, however, these commands include a negatives option that allows for the calculation of all indicators despite the presence of negative values in core income concepts or fiscal interventions.

3.3 Specific Commands

This section describes the details specific to each command, and summarizes the indicators and results that each command produces, which were described in more detail in section 2.

a. **ceqdes**

The `ceqdes` command calculates descriptive statistics for the CEQ core income concepts and fiscal interventions (taxes, transfers, subsidies, and in-kind benefits). It exports these indicators to sheet “E1. Descriptive Statistics” of the MWB.

The descriptive statistics are the percent of individuals in the expanded sample that have positive values for the income concept or non-zero values for the fiscal intervention variables. Among those with positive or non-zero values, the mean, median, and standard deviation of the variable are included. Among all individuals, the total for that variable as a proportion of total income, using each of the core income concepts in the denominator, is included. The results for the core income concepts are included in rows 11 to 18, while the results for fiscal interventions are included in rows 19 on in sheet E1 of the MWB. Rows 19 on do not have names of fiscal interventions in column A because these will be filled in automatically using the variable labels of the corresponding variables fed to the fiscal intervention options. Of the categories of options described above, the options for income concepts, fiscal interventions, survey information, exporting, and ignoring missing values are relevant for `ceqdes`.

b. **ceqpop**

The `ceqpop` command calculates the population by decile, income group, centile, and bin, for each of the core income concepts, for four definitions of population: number of households in sample, number of individuals in sample, number of households in expanded sample, and number of individuals in expanded sample. It exports them to sheet “E2. Population” of the MWB. The command requires installation of `quantiles` to assign households to deciles or centiles; to install, `ssc install quantiles`.

The number of households and individuals in the sample provide evidence on what occurs in the survey itself before applying sampling weights, and can provide evidence about small cells (for example, some countries may have so few observations with income below US$1.25 per day or above US$50 per day that any statistics about these groups are inherently noisy and should not be used). The number of households in the expanded sample shows the total households in the country represented by the sampled households, while the number of individuals in the expanded sample shows the analogue for individuals. Note that deciles are defined such that the number of individuals in the expanded sample is as equal as possible across groups; as a result, the size of each centile and bin for

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94 Osorio (2007).
the other population definitions will *not* be equal. Of the categories of options described above, the options for income concepts, PPP conversions, survey information, income group cut-offs, producing a subset of results, exporting, and ignoring missing values are relevant for `ceqpop`.

c. **ceqextpop**

The `ceqextpop` command calculates the same definitions of population by decile, income group, centile, and bin as the `ceqpop` command, except for the extended rather than core income concepts. It exports results to the “E2b_{y} Ext. Population” sheets where \( y \) is a letter representing one of the eight core income concepts: \( m, m+p, n, g, t, d, c, f \). The command requires installation of `quantiles`\(^95\) to assign households to deciles or centiles; to install, `ssc install quantiles`.

As explained in Higgins and Lustig,\(^96\) extended income concepts are constructed by adding or subtracting particular fiscal interventions (or bundles of interventions) from core income concepts. For example, *market income plus pensions* plus conditional cash transfers is an extended income concept, as is *disposable income* minus conditional cash transfers (disposable income prior to adding conditional cash transfers, but with all other direct transfers included). Even though the results produced by `ceqextpop` are anonymous, and hence do not need a separate sheet for each core income concept ranking, there are eight sheets due to the sheer number of extended income concepts. Continuing the example above, the sheet for market income plus pensions would include these indicators for the *market income plus pensions* plus conditional cash transfers extended income concept, while the sheet for disposable income would include these indicators for the *disposable income* minus conditional cash transfers extended income concept.

A description of the definitions of decile, income group, centile and bin is included under the `ceqpop` section. Of the categories of options described above, the options for income concepts, PPP conversions, survey information, income group cut-offs, producing a subset of results, exporting, and ignoring missing values are relevant for `ceqextpop`.

d. **ceqlorenz**

The `ceqlorenz` command calculates anonymous summary statistics and detailed information by income decile, group, centile, and bin for each of the CEQ core income concepts. It exports them to sheet “E3. Lorenz” of the MWB. The command requires installation of `quantiles`\(^97\) to assign households to deciles or centiles and `sgini` to calculate S-Gini coefficients;\(^98\) to install, `ssc install quantiles` and `net install sgini`, from([http://medim.ceps.lu/stata](http://medim.ceps.lu/stata)).

“Anonymous” means that the ranking is not held fixed: for example, market income shares by decile would have deciles defined by market income, while disposable income shares by decile would have deciles defined by disposable income. (An individual in the lowest market income decile is not necessarily in the lowest disposable income decile if reranking occurs.)

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\(^95\) Osorio (2007).

\(^96\) Higgins and Lustig (chapter 5 of this Handbook).

\(^97\) Osorio (2007).

\(^98\) Van Kerm (2009).
The summary statistics include the mean, median, standard deviation, Gini, absolute Gini, S-Gini with a variety of parameters, Theil, 90/10, and headcount index, poverty gap, and squared poverty gap for a number of poverty lines. The detailed information by income centile and income bin, at a highly disaggregated level (income bins are 5-cent groups, for example, US$0-0.05 dollars per day, US$0.05-0.10 per day, et cetera), includes total income in local currency units (per year if the income concept variables supplied to the command are annual). The detailed information by decile and income group (at a more aggregated, but still informative, level), includes these income totals in local currency and the same totals in PPP dollars per day, as well as per capita income in local currency (per year if the income concept variables supplied to the command are annual) and PPP dollars per day, shares of total income, cumulative shares of total income, and fiscal incidence with respect to (income relative to) market income, market income + pensions, net market income, gross income, and disposable income. Although these latter indicators are not provided at the more disaggregated level by centile and income bin (to make the command faster and the MWB smaller in file size), they can all be generated directly with the total incomes in local currency that are produced by centile and bin, in addition to the population information by centile and bin included on sheet E2 and produced by ceqpop.

Of the categories of options described above, the options for income concepts, PPP conversions, survey information, poverty lines, income group cut-offs, producing a subset of results, exporting, and ignoring missing values are relevant for ceqlorenz.

c. ceqiop

The ceqiop command measures ex-ante inequality of opportunity based on a particular circumstance set specified by users for each of the CEQ core income concepts, following the non-parametric method in Ferreira and Gignoux. Circumstances are pre-determined factors that are not dependent on an individual’s effort, such as race, gender, parents’ education and parents’ income. The command exports results to sheet “E4. Inequality of Opportunity” of the MWB. ceqiop requires installation of oppincidence, which is part of the CEQ Stata Package; to install, ssc install ceq, replace.

The circumstance sets are specified using the groupby(varlist) option. For example, one circumstance set could be (female, black, parents were college graduates, urban): all individuals with those four traits are grouped together in one circumstance set. If the data set is at the individual level (each observation is an individual), the circumstance variables specified in groupby(varlist) could be defined at the individual level. In this case, the condition identifying household heads must be specified. For example, if we have a variable called hh_status that takes a value of 1 for the household head, 2 for the spouse, et cetera, we would specify head(hh_status==1). If a variable name is given rather than a condition, such as head(hh_status), ceqiop assumes that household heads are individuals for whom that variable is equal to 1. If the data set is at the household level, the variables

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99 Ferreira and Gignoux (2011).
100 Higgins (2012).
given in `groupby(varlist)` should be variables for the household head, for example, a variable for gender would indicate the gender of the household head.

The indicators include levels of inequality of opportunity (mean log deviation of the smoothed distribution as described in 2.2 above), ratios of inequality of opportunity (levels of inequality of opportunity divided by the mean log deviation for the actual income distribution), and Shapley decomposition of contributions of each circumstance. Of the categories of options described above, the options for income concepts, survey information, exporting, and ignoring missing values are relevant for `ceqiop`.

f. `ceqfi`

The `ceqfi` command calculates the measures of FI and FGP derived in Higgins and Lustig.\textsuperscript{101} It exports the FI results to the “E5. Fisc. Impoverishment” sheet and the FGP results to the “E6. Fisc. Gains to the Poor” sheet.

These indicators include the FI and FGP headcounts (where the denominator is the total population); the FI and FGP headcounts among the poor (where the denominator is the total number of post-fiscal poor for FI or pre-fiscal poor for FGP); total FI and FGP (in PPP dollars per day adjusted for PPP); FI and FGP per capita (in PPP dollars per day), where $k = 1/n$ a (total FI or FGP is divided by the total population); normalized FI and FGP, where $k = 1/(nz)$ and $z$ is the poverty line (per capita FI or FGP as a proportion of the poverty line). Of the categories of options described above, the options for income concepts, PPP conversions, survey information, poverty lines, producing a subset of results, exporting, and ignoring missing values are relevant for `ceqfi`. As described above, the options for producing a subset of results in `ceqfi` are different than in other commands: the subset options include `nобin`, `headcount`, `headcountpoor`, `total`, `percapita`, `normalized`.

g. `ceqstatsig`

The `ceqstatsig` command test the statistical significance of the change in inequality or poverty between core income concepts. It exports the p-values of these tests to sheet “E7. Statistical Significance” of the MWB.

The command uses modified versions of the routines from Araar and Duclos’s\textsuperscript{102} Distributive Analysis Stata Package to compute p-values for a test of the null hypothesis that the difference between inequality or poverty estimates for two income concepts is zero. (Specifically, it uses modified versions of the commands `digini`, `dientropy`, `dinineq`, and `difgt`; the modified code is included in the CEQ Stata Package as `ceqdigini`, `ceqdientropy`, `ceqdinineq`, and `ceqdifgt`, but these programs run “under the hood” and do not need to be directly used by the researcher.)

The included measures are the Gini, absolute Gini, Theil, 90/10, poverty headcount ratio at various poverty lines, poverty gap ratio at various poverty lines, squared poverty gap (also known as poverty

\textsuperscript{101} Higgins and Lustig (2016).
\textsuperscript{102} Araar and Duclos (2013).
severity) at various poverty lines, and the concentration coefficients of income concepts with respect to each of the eight core income concepts. It produces matrices of the difference in point estimates as well as the p-values from the above statistical test. Of the categories of options described above, the options for income concepts, PPP conversions, survey information, poverty lines, exporting, and ignoring missing values are relevant for ceqstatsig.

h. ceqdom

The ceqdom command calculates the CEQ dominance estimations for the CEQ core income concepts. It exports results to sheet “E8. Dominance Tests” of the MWB.

The command uses the routines from Araar and Duclos’s\textsuperscript{103} Distributive Analysis Stata Package, specifically domineq to compute the number of crossings and ksmirnov to test the equality of the two distributions. (However, these two programs run “under the hood” and do not need to be directly used by the researcher.) The command requires installation of glcurve Van Kerm and Jenkins\textsuperscript{104} to generates two new variables with the generalized Lorenz ordinates; to install, ssc install glcurve.

Dominance estimations include number of crossings of income CDF curves as well as concentration curves between core income concepts. The estimations also include p-values from bootstrapped Kolmogorov-Smirnov tests between the two distributions if there is no crossing. A set of matrices of estimations is produced for concentration curves ranked by each income concept. Hence, ceqdom produces eight sets of matrices for concentration curves and one set of matrices for income CDF curves. Of the categories of options described above, the options for income concepts, survey information and exporting are relevant for ceqdom.

An option specific to ceqdom is reps(\textit{real}), where users can specify number of iterations for bootstrapped Kolmogorov-Smirnov tests. The default is 10.

i. ceqef

The ceqef command calculates the CEQ effectiveness indicators (impact and spending effectiveness indicators), Beckerman-Immerwoll poverty effectiveness indicators\textsuperscript{105}, and the FI/FGP indicators for comparisons of each of the CEQ core income concepts. The command exports results to the sheet “E9. Effectiveness”.

Of the categories of options described above, the options for income concepts, PPP conversions, survey information, poverty lines, income group cut-offs, and exporting are relevant for ceqef.

j. ceqconc

The ceqconc command calculates non-anonymous summary statistics and detailed information by decile, income group, centile, and income bin for each of the CEQ core income concepts. “Non-

\textsuperscript{103} Araar and Duclos (2013).
\textsuperscript{104} Van Kerm and Jenkins (1999).
\textsuperscript{105} Beckerman, (1979); Immerwoll and others (2009).
anonymous” refers to the fact that deciles, groups, centiles, and bins are defined holding the income concept fixed within each sheet. Hence, `ceqconc` produces one sheet for each of the CEQ core income concepts; the income concept defining the ranking of each sheet will be referred to as the ranking variable. The command exports results to the “E10.y Concentration” where y is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f. The command requires installation of `quantiles` to assign households to deciles or centiles; to install, `ssc install quantiles`.

Summary statistics include the mean, median, standard deviation, and a number of measures for each core income concept with respect to the ranking variable: its concentration coefficient, redistributive effect, Reynolds-Smolensky (or vertical equity), and reranking effect. The detailed information by decile, income group, centile, and income bin includes total income in local currency units (preferably per year) and PPP dollars per day, per capita income in local currency (preferably per year) and PPP dollars per day, concentration shares, cumulative concentration shares, and fiscal incidence with respect to the ranking variable.

The detailed information by decile and income group (at a more aggregated, but still informative, level), includes these income totals in local currency and the same totals in PPP dollars per day, as well as per capita income in local currency (per year if the income concept variables supplied to the command are annual) and PPP dollars per day, concentration shares, cumulative concentration shares, and fiscal incidence with respect to (income relative to) the ranking variable. Although these latter indicators are not provided at the more disaggregated level by centile and income bin (to make the command faster and the MWB smaller in file size), they can all be generated directly with the total incomes in local currency that are produced by centile and bin, in addition to the population information by centile and bin included on sheet E2 and produced by `ceqpop`.

Of the categories of options described above, the options for income concepts, PPP conversions, survey information, income group cut-offs, producing a subset of results, exporting, ignoring missing values and allowing negative values for producing indicators are relevant for `ceqconc`.

**k. ceqfiscal**

The `ceqfiscal` command calculates summary statistics and detailed information by decile, income group, centile, and income bin for fiscal interventions (taxes, transfers, subsidies, and in-kind benefits), where deciles, groups, centiles, and bins are defined holding the income concept fixed within each sheet. Hence, `ceqfiscal` produces results to eight sheets: one sheet for each of the CEQ core income concepts; the income concept defining the ranking of each sheet will be referred to as the ranking variable. The command exports results to the “E11.y FiscalInterventions” sheets, where y is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f. The command requires installation of `quantiles` to assign households to deciles or centiles; to install, `ssc install quantiles`.

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107 Osorio (2007).
Summary statistics include the mean, median, standard deviation, and measures for each fiscal intervention with respect to the ranking variable: its concentration coefficient and Kakwani coefficient. The detailed information by decile, income group, centile, and income bin includes—for each fiscal intervention—the total received or paid in local currency units (per year if the variables supplied to the command are annual); the detailed information by decile and income group additionally includes totals received or paid in PPP dollars per day, per capita amount received or paid in local currency (per year if the variables supplied to the command are annual) and PPP dollars per day, concentration shares, cumulative concentration shares, and fiscal incidence with respect to the ranking variable.

Of the categories of options described above, the options for income concepts, fiscal interventions, PPP conversions, survey information, income group cut-offs, producing a subset of results, exporting, ignoring missing values and allowing negative values for producing indicators are relevant for ceqfiscal.

1. **ceqextend**

The `ceqextend` command calculates the same anonymous indicators as the `ceqlorenz` command, except for the extended rather than core income concepts. In addition, it calculates concentration coefficients for each extended income concepts with respect to the ranking given by each core income concept. It exports results to the “E12,$y$ Extended Income Concepts” sheets, where $y$ is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f. The command requires installation of `quantiles`\(^{108}\) to assign households to deciles or centiles and `sgini` to calculate S-Gini coefficients;\(^{109}\) to install, `ssc install quantiles` and `net install sgini`, from [http://medim.ceps.lu/stata](http://medim.ceps.lu/stata).

As explained above, extended income concepts are constructed by adding or subtracting particular fiscal interventions (or bundles of interventions) from core income concepts. For example, *market income plus pensions* plus conditional cash transfers is an extended income concept, as is *disposable income* minus conditional cash transfers (disposable income prior to adding conditional cash transfers, but with all other direct transfers included). Even though the majority of results produced by `ceqextend` are anonymous, and hence do not need a separate sheet for each core income concept ranking, there are eight sheets due to the sheer number of extended income concepts. Continuing the example above, the sheet for market income plus pensions would include these indicators for the *market income plus pensions* plus conditional cash transfers extended income concept, while the sheet for disposable income would include these indicators for the *disposable income* minus conditional cash transfers extended income concept.

Of the categories of options described above, the options for income concepts, fiscal interventions, PPP conversions, survey information, poverty lines, income group cut-offs, producing a subset of results, exporting, ignoring missing values and allowing negative values for producing indicators are relevant for `ceqextend`.

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\(^{108}\) Osorio (2007).

\(^{109}\) Van Kerm (2009).
m. ceqmarg

The ceqmarg command calculates the marginal contributions of fiscal interventions to inequality (redistributive effect), vertical equity, reranking, the derivatives of these marginal contributions with respect to size of the tax or transfer, and marginal contribution to poverty. It exports results to the “E13.y Marg. Contrib.” sheets, where y is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f. These eight core income concepts identify the income concepts with respect to which the marginal contributions are calculated.

Of the categories of options described above, the options for income concepts, fiscal interventions, PPP conversions, survey information, poverty lines, income group cut-offs, producing a subset of results, exporting, ignoring missing values and allowing negative values for producing indicators are relevant for ceqextend.

n. ceqefext

The ceqefext command calculates the CEQ effectiveness indicators (impact and spending effectiveness indicators), Beckerman-Immerwoll poverty effectiveness indicators,\textsuperscript{10} and the FI/FGP indicators for comparisons of each of the extended income concepts. The command exports results to the sheet “E14.y Effectiveness” of the MWB, where y is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f.

Of the categories of options described above, the options for income concepts, fiscal interventions, PPP conversions, survey information, poverty lines, and income group cut-offs are relevant for ceqefext.

o. ceqcov

The ceqcov command calculates the covariance between core income concepts or fiscal interventions and fractional rank in the distribution of core income concepts. These covariances are useful because they are a building block of the calculation of the Gini coefficient and concentration coefficients. It exports results to the “E15. Covariance” sheet.

Of the categories of options described above, the options for income concepts, fiscal interventions, survey information, exporting, and ignoring missing values are relevant for ceqcov.

p. ceqextsig

The ceqextsig command test the statistical significance of the change in the same measures of inequality and poverty as ceqstatsig, except between the extended rather than core income concepts. It exports the p-values of these tests to sheets “E16.y Extended Inc Stat Sig” of the MWB, where y is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f.

\textsuperscript{10} Beckerman (1979); Immerwoll and others (2009).
The command uses modified versions of the routines from Araar and Duclos’s\textsuperscript{111} Distributive Analysis Stata Package to compute p-values for a test of the null hypothesis that the difference between inequality or poverty estimates for extended income concept and core income concept is zero. (Specifically, it uses modified versions of the commands digini, dientropy, dinineq, and difgt; the modified code is included in the CEQ Stata Package as ceqdigini, ceqdientropy, ceqdinineq, and ceqdifgt, but these programs run “under the hood” and do not need to be directly used by the researcher.)

The construction of extended income concepts is explained under ceqextend section. The command produces matrices of the difference in point estimates as well as the p-values from the above statistical test. Of the categories of options described above, the options for income concepts, fiscal interventions, PPP conversions, survey information, poverty lines, exporting, and ignoring missing values are relevant for ceqextsig.

\textbf{q. ceqdomext}

The ceqdomext command calculates the CEQ dominance estimations for the CEQ extended income concepts. It exports results to sheets “E17.y Dominance” of the MWB, where \( y \) is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f.

The command uses the routines from Araar and Duclos’s\textsuperscript{112} Distributive Analysis Stata Package, specifically domineq to compute the number of crossings and ksmirnov to test the equality of the two distributions. (However, these two programs run “under the hood” and do not need to be directly used by the researcher.) The command requires installation of glcurve\textsuperscript{113} to generates two new variables with the generalized Lorenz ordinates; to install, ssc install glcurve.

Dominance estimations include number of crossings of income CDFs and concentration curves between each extended income concept and core income concept. The construction of extended income concepts is explained under ceqextend section. The estimations also include p-values from bootstrapped Kolmogorov-Smirnov tests between the two distributions if there is no crossing. A set of matrices of estimations is produced for concentration curves ranked by each income concept. Hence, ceqdomext produces one sheet for each of the extended income concepts. Of the categories of options described above, the options for income concepts, fiscal interventions, survey information and exporting are relevant for ceqdomext. An option specific to ceqdomext is reps(\textit{real}), where users can specify number of iterations for bootstrapped Kolmogorov-Smirnov tests. The default is 10.

\textbf{r. ceqcoverage}

The ceqcoverage command calculates coverage and leakage indicators as well as direct beneficiary indicators by income group for fiscal interventions (taxes, transfers, and subsidies), where income groups are defined holding the income concept fixed within each sheet. Hence, ceqcoverage produces one sheet for each of the CEQ core income concepts. The command exports results to

\textsuperscript{111} Araar and Duclos (2013).
\textsuperscript{112} Araar and Duclos (2013).
\textsuperscript{113} Van Kerm and Jenkins (1999).
sheets “E18.y Coverage Tables” of the MWB, where $y$ is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f.

The indicators include total benefits by group, the distribution of benefits (what percent of benefits goes to each group), the number of beneficiary households, the number of direct and indirect beneficiaries (members of beneficiary households), the distribution of beneficiary households and direct and indirect beneficiaries (what percent of beneficiaries belong to each group), coverage within each group (what percent of households or people in that group receive benefits), and mean benefits (per beneficiary household and per beneficiary). The fit between these indicators and conceptual definitions of coverage, errors of exclusion, and errors of inclusion is described in section 2.2.

Of the categories of options described above, the options for income concepts, fiscal interventions, PPP conversions, survey information, income group cut-offs, exporting ignoring missing values are relevant for ceqcoverage. In addition, options to directly mark beneficiaries are needed; these are described below.

--Options to Specify Direct Beneficiary Markers

To estimate the number of direct beneficiaries (the person who directly receives the transfer or directly pays the tax), an additional piece of information is needed: which individuals in the household directly received a particular transfer or directly paid a particular tax. This information cannot be obtained from the fiscal interventions variables described above, since those variables are already at the household per capita level. For example, they would be positive for all direct and indirect beneficiaries (other members of the direct beneficiary's household). Thus, the command ceqcoverage includes the "direct beneficiary marker" options where, for each fiscal intervention variable given in the fiscal intervention options, a variable identifying which individuals are direct beneficiaries (or payers) of that fiscal intervention is given. The options are presented in table 7-13 below.

For a data set at the individual level, the variables supplied to the direct beneficiary marker options should be dummy variables that equal 1 if the individual is a direct beneficiary/payer and 0 otherwise. For a data set at the household level, they should equal the number of household members that are direct beneficiaries/payers. For each category of fiscal intervention, the number of variables supplied to these options must be the same as the number of variables supplied to the corresponding fiscal intervention variables, and they should be supplied in the same order. For example, suppose the data set is at the individual level, there are two levels of education: primary and secondary, and that household per capita benefits are included in pc_primary and pc_secondary, and dummy variables identifying which individuals are the direct beneficiaries are DB_PRIMARY and db_secondary. Then the fiscal intervention and direct beneficiary marker options for education would be educ(pc_primary pc_secondary) and receduc(db_primary db_secondary). For fiscal interventions for which the survey does not specify who is the direct beneficiary (for example, if a question only asks whether anyone in the household receives benefits from a program), mark one member of the household (for example, the head) as a direct beneficiary.

s. ceqtarget

The ceqtarget command calculates coverage and leakage indicators among eligible or “target” households and individuals, as well as direct beneficiary indicators by income group for fiscal
interventions (taxes, transfers, and subsidies), where income groups are defined holding the income concept fixed within each sheet. Hence, \texttt{ceqtarget} produces one sheet for each of the CEQ core income concepts. The command exports results to sheets “E18.$y$ Coverage (Target)” of the MWB, where $y$ is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f.

The syntax is identical to that of \texttt{ceqcoverage}, including the use of the direct beneficiary marker options, with one addition: a set of options to mark the target households or individuals must also be identified.

--Options to Specify Target Household or Individual Markers

To identify the target households or individuals, target markers are necessary. For data sets at the individual level and programs that define eligibility at the individual level, these variables should equal 1 for target individuals and 0 otherwise. For data sets at the individual level and programs that define eligibility at the household level, these variables should be equal to 1 for some arbitrary member of the household (good practice is to select the household head) and 0 otherwise. For data sets at the household level, results for direct beneficiaries of programs that define eligibility at the individual level cannot be produced, but the other indicators can. In this case, these variables should equal 1 for target households (or households with at least one target individual for programs that define eligibility at the individual level) and 0 otherwise. The options are presented in table 7-14 below.

[Table 7-14 here]

t. \texttt{ceqeduc}

The \texttt{ceqeduc} command calculates education enrollment indicators by income group. The dataset for \texttt{ceqeduc} has to be on individual level. These indicators are calculated at four levels of education: preschool, primary, secondary, and tertiary. The income groups are defined holding the income concept fixed within each sheet. Hence, \texttt{ceqeduc} produces one set of calculations for each of the CEQ core income concepts. The command exports results to the sheet “E20. Edu Enrollment Rates” of the MWB.

The indicators include target population, total population attending school, target population attending school, target population NOT attending school, net enrollment rates, gross enrollment rates and share of enrolled students belonging to target population. Of the categories of options described above, the options for income concepts, PPP conversions, survey information, income group cut-offs, exporting, and ignoring missing values options are relevant for \texttt{ceqeduc}. In addition, the user must specify education enrollments using the following options specific to \texttt{ceqeduc}.

--Options to Specify Education Enrollments

The command \texttt{ceqeduc} provides options to specify individual attendance of schools in order to calculate education enrollment indicators at four levels of education: preschool, primary, secondary, and tertiary. The data set must be at the individual level, and the options should be specified by dummy variables that equal to one if the individual attended a particular level of education. In addition, the command includes options that allow for identifying whether the individuals are within the target age cohort for a particular level of school. These options are specified by dummy variables that equal to one if the individual’s age corresponds to the target age cohort. Finally, there is an option used to
indicate whether the individual attends public school (the dummy variable equals to 1), attends private school (equals to 0) or does not attend school (missing value). Table 7-15 provides a list of education enrollment options.

[Table 7-15 here]

**u. ceqinfra**

The `ceqinfra` command calculates the coverage and distribution of infrastructure access by income group, for infrastructure access variables supplied by users. The income groups are defined holding the income concept fixed within each sheet. Hence, `ceqinfra` produces one set of calculations for each of the CEQ core income concepts. The command exports results to the sheet “E21. Infrastructure Access” of the MWB.

Infrastructure variables include electricity, drinkable water, sanitation, and roads. These variables should be specified using `varlist` following directly after the command name `ceqinfra`. Up to eight infrastructure access variables can be used. If the users specify more than eight variables, only the first eight will be taken for calculations.

Indicators include individuals with access to infrastructure, distribution of individuals with access to infrastructure, coverage of direct and indirect recipients of infrastructure, households with access to infrastructure, distribution of households with access to infrastructure, and coverage of infrastructure for households. Of the categories of options described above, the options for income concepts, PPP conversions, survey information, income group cut-offs, exporting and ignoring missing values are relevant for `ceqinfra`.

**v. ceqhhchar**

The `ceqhhchar` command calculates mean and median values for household-level sociodemographic characteristic variables supplied by users as well as their standard deviation. In addition, it calculates the mean of these variables by income decile, group, centile, and bin, where these categorization measures are defined holding the income concept fixed within each sheet. Hence, `ceqhhchar` produces one sheet for each of the CEQ core income concepts. The command exports results to sheets “E22.y GroupSociodemoCharac” of the MWB, where y is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f.

The household-level sociodemographic characteristic variables are variables defined at household level such as "age of household head", "access to piped water", or "number of rooms". These variables should be specified using `varlist` following directly after the command name `ceqhhchar`. There is no limit on the number of variables that can be supplied. Of the categories of options described above, the options for income concepts, PPP conversions, survey information, income group cut-offs, producing a subset of results, exporting and ignoring missing values are relevant for `ceqhhchar`.

**w. ceqindchar**

The `ceqindchar` command calculates mean and median values for individual-level sociodemographic characteristic variables supplied by users as well as their standard deviation. In addition, it calculates the mean of these variables by income decile, group, centile, and bin, where these...
categorization measures are defined holding the income concept fixed within each sheet. Hence, `ceqindchar` produces one sheet for each of the CEQ core income concepts. The command exports results to sheets “E23.y IndivSociodemCharac” of the MWB, where y is a letter representing one of the eight core income concepts: m, m+p, n, g, t, d, c, f.

The individual-level sociodemographic characteristic variables are variables defined at individual level such as "age", "years of schooling", "has a bank account". These variables should be specified using `varlist` following directly after the command name `ceqindchar`. There is no limit on the number of variables that can be supplied. Of the categories of options described above, the options for income concepts, PPP conversions, survey information, income group cut-offs, producing a subset of results, exporting and ignoring missing values are relevant for `ceqindchar`.

x. `ceqgraph`

The `ceqgraph` command graphs cumulative distribution functions, Lorenz and concentration curves, and fiscal impoverishment and gains to the poor. It is used with the sub-commands summarized in table 7-16.

[Table 7-16 here]

y. `ceqassump`

The `ceqassump` command calculates the same anonymous indicators as the `ceqlorenz` command, except for the income concepts constructed by users rather than core income concepts. It is designed to be used to test at a glance how different assumptions used to construct income concepts affect the main inequality, poverty, and distribution indicators used in a CEQ Assessment. The command exports results to the “E28. Assumption Testing” sheet. The command requires installation of `quantiles`\(^\text{114}\) to assign households to deciles or centiles and `sgini` to calculate S-Gini coefficients\(^\text{115}\); to install, `ssc install quantiles` and `net install sgini`, from(http://medim.ceps.lu/stata).

The income concept variables provided by users, which may or may not be CEQ core income concepts, should be specified in `varlist` following directly after the command name `ceqassump`. To give an example of the income concepts users can construct, suppose the user wants to test the impact of including or excluding own production from the market income measure. The user would create two versions of market income (at the household per capita or per adult equivalent level) and provide the variables for these two versions of market income. As another example, suppose the user wants to test the impact of tax exemptions. Since income in the survey already includes the benefits of tax exemptions, these cannot be added in the same way as other benefits. Instead, the user could compare "consumable income minus tax exemptions" (income that would have existed in the absence of tax exemptions) with consumable income to see the marginal contribution of tax exemptions to inequality.

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\(^{114}\) Osorio (2007).

\(^{115}\) Van Kerm (2009).
Of the categories of options described above, the options for PPP conversions, survey information, poverty lines, income group cut-offs, producing a subset of results, exporting, and ignoring missing values are relevant for `ceqassump`.
References


Aranda, Rodrigo and Sean Higgins. “CEQ: Stata module to carry out Commitment to Equity (CEQ) fiscal incidence analysis.” Boston College Department of Economics Statistical Software Components S457605.


As shown in previous chapters, the Commitment to Equity (CEQ) analysis provides researchers with a comprehensive and comparable set of indicators to determine the impacts of fiscal intervention on poverty and inequality. However, inequality may take many different forms and be based on biases that are beyond the control of individuals. Race, gender, location, and parental characteristics can have important implications on the economic and social outcomes of individuals. In Latin America, ethno-racial inequalities are particularly prevalent; indigenous peoples and African descendants are faced with higher rates of poverty, lower average incomes, and lower access to services. In an effort to determine if government fiscal interventions are exacerbating or reducing ethno-racial inequalities in Latin America, the Inter-American Development Bank (IDB) has partnered with the CEQ Institute to finance the adoption of the CEQ analysis to explore the impacts of fiscal policies on ethno-racial inequality in the Latin America and Caribbean region (LAC).

1 This chapter and the corresponding component of the 2016 CEQ Master Workbook were prepared as part of the Inter-American Development Bank’s technical cooperation “Improving Race and Ethnicity Data Instruments for Policy Analysis and Formulation” (RG-T1906), led by Judith Morrison, Senior Advisor, Gender and Diversity Division (SCL/GDI). Through this technical cooperation, funding was made available for the Inter-American Development Bank-Commitment to Equity Incidence of Taxes and Social Spending by Ethnicity and Race Study for Bolivia, Brazil, Guatemala, and Uruguay.

2 Ph.D. Candidate at Tulane University, Department of Economics.

3 Sié Fellow and M.A. Candidate at Josef Korbel School of International Studies, University of Denver.

4 Chapter 1 (Lustig and Higgins, 2017), Chapter 5 (Higgins and Lustig, 2017), Chapter 6 (Jellema and Inchauste, 2017), Chapter 7 (Higgins, 2017).

5 Molinas Vega and others (2012).

6 de Ferranti and others (2004); Hall and Patrinos (2006); Ñopo (2012).
A necessary first step in measuring the impact of fiscal policy on reducing ethno-racial inequality is to determine the appropriate measures that should be used to measure ethno-racial inequalities and what measures should be used to determine the impact of fiscal policy on these indicators. To do this, we will utilize the measures discussed by Lustig.\(^7\) To measure levels of inequality across ethno-racial lines, four different measures will be utilized;

1. **Income gaps**, in terms of the mean incomes or share of income held by different ethno-racial populations, provide for absolute and relative sizes of the ethno-racial inequality at the aggregate level.

2. **Contribution to overall inequality** can be determined using a decomposable measure of inequality such as the Theil coefficient. This can then be decomposed to determine the level of national inequality due to inter- and intra-ethno-racial group inequalities. This is particularly important as it provides us with a better understanding of the dynamics not only between ethno-racial groups, but also within these populations. It is important to note here that policies may reduce inequality between groups while exacerbating inequalities within specific populations.

3. **Inequality of opportunity** is a concept popularized by Roemer\(^8\) and further applied in Ferreira and Robalino\(^9\) and Molinas Vega and others\(^10\) to determine the extent to which characteristics or circumstances outside of an individual’s control (for example, not due to personal effort or preference) affect their economic and social outcomes. These circumstances frequently include characteristics such as gender, location (urban/rural), levels of parental education, and race or ethnicity. In a society that is ethno-racially equal or color-blind, one would expect to see no inequality of opportunity due to ethno-racial differences. Here, inequality of opportunity can be used to assess the extent to which fiscal policy equalizes opportunities and reduces inequality. More details on how this is calculated are provided below.

4. **Poverty** headcounts, gaps, and severity measures can be utilized to provide a better understanding of differences in the well-being of different ethno-racial populations with a particular emphasis on what is happening at the bottom of the income distribution. Having data on the different levels and magnitudes of poverty is particularly important as it details what types of policies are benefitting the most disadvantaged segments of the population.

All of the measures indicated above can be calculated using the different income concepts utilized in the CEQ analysis, allowing us to determine the fiscal impact of specific sets of policies on ethno-racial inequality. In order to determine the effectiveness of programs at reducing ethno-racial inequality, two different measures will be utilized to determine if the impact of specific programs or sets of programs help to reduce ethno-racial inequality;

\(^7\) Lustig (forthcoming).
\(^8\) Roemer (1998).
\(^9\) Ferreira and Robalino (2010).
\(^10\) Molinas Vega and others (2012).
1. **Progressivity** will be determined by calculating the share of benefits going to different ethno-racial groups relative to their respective shares of the population or the share of income. A program is deemed to be relatively progressive if the share of benefits received is greater than the disadvantaged group’s\(^{11}\) share of income (for example, making incomes more equitable) and are considered absolutely progressive if the share of benefits received are greater than their share of the total population.

2. **Pro-Disadvantaged Group:** While examining progressivity provides a way of measuring if fiscal policy reduces ethno-racial inequality, a targeted poverty reduction policy may appear to be progressive due to the number of individuals of a particular ethno-racial group that are in poverty. Fiscal policy is designated as pro-disadvantaged group if the impact of direct taxes and transfers produces a greater likelihood for members of the disadvantaged group to escape poverty than for advantaged populations.

It is important to note that for a policy to be pro-disadvantaged group, it must violate horizontal equity, or the premise that individuals of equal income should be treated equally. By treating the poor of a particular ethno-racial group differently, a policy violates this criterion.

Section F of the CEQ Master Workbook, 2016 edition, allows users to produce all of the results necessary to conduct an analysis of the impacts of fiscal policy across ethno-racial lines in one easy to use workbook with accompanying Stata ado-file. This workbook presents a compendium of the CEQ main results in a manner that allows for easy interpretation of results across ethno-racial lines. This chapter describes the different indicators presented in Section F of the Master Workbook and details on how to use the ceqrace.ado Stata command to produce these results for each sheet of the workbook (Table 8-1).

Table 8-1

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\(^{11}\) The group that has lower per capita incomes is considered the disadvantaged group in this exercise. In all of the four countries analyzed, this refers to the indigenous or African descendant population.
<table>
<thead>
<tr>
<th>Sheets Presented in Section F, Socio-Demographic Comparisons Compendium of Results By Race and Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Background Information</strong></td>
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<tr>
<td>F1. Key Assumptions*</td>
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<td><strong>II. Results</strong></td>
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<tr>
<td>F5. Population Composition</td>
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<td>F6. Income Distribution</td>
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<tr>
<td>F7. Summary Poverty Rates</td>
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<td>F8. Summary Poverty Gap Rates</td>
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<td>F10. Summary Inequality Indicators</td>
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<td>F11. Mean Incomes</td>
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<td>F12. Incidence by Decile</td>
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<td>F13. Incidence by Income Group</td>
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<td>F14. Cross-Race Incidence**</td>
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<td>F15. Horizontal Equity**</td>
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<td>F16. Fiscal Profile</td>
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<td>F17. Coverage Rates (Total Population)</td>
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<td>F19. Leakages**</td>
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<td>F20. Mobility Matrices</td>
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<td>F21. Education (Totals)</td>
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<td>F22. Education (Rates)**</td>
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<td>F23. Educational Probability</td>
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<td>F24. Infrastructure Access</td>
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<td>F25. Theil Disaggregation</td>
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<tr>
<td>F26. Inequality of Opportunity</td>
</tr>
<tr>
<td>F27. Significance</td>
</tr>
</tbody>
</table>

1 Sheets with an * must be filled in manually. Sheets with an ** are filled in automatically using the results from a different sheet. The remaining sheets can be completed using the ceqrace.ado command in Stata.
The ceqrace.ado Stata command is designed to automatically fill in the values for twenty of the Excel sheets listed above. The program allows users to estimate the results for each of these sheets separately in Stata and export them to the Excel workbook. It is also designed to be flexible such that it can match the different data and statistical requirements of each country.

In order to utilize the ceqrace.ado, it is necessary to have the basic software requirements of Stata 13.0 (or a more recent version) and Microsoft Excel (xls or xlsx format). As for data requirements, the program works on Stata datasets with data at the individual level that includes the main variables used in the CEQ framework such as income concepts, taxes, transfers, as well as sociodemographic characteristics of individuals. While the other sections of the CEQ analysis are designed to utilize either individual or household level data, for the analysis by race and ethnicity only individual level data sets can be utilized. This is due to the ability to the need to identify individuals by their race or ethnicity. While there are some indicators in the analysis that are generated at the household level, using the ethno-racial identity of the head of the household for identification purposes, it is preferable to utilize the self-identification method for all individuals in the household.

The main syntax for the command is:

```
ceqrace using filename [weight] [if] [in] [, table(name) options]
```

For each of the different tables the command asks for the Excel filename, the number of the table, weights and ethno-racial group identifiers. The race or ethnic group identifiers must be dichotomous variables and should be arranged such that:

---race1: White/Non-Ethnic Population
---race2: Indigenous Population
---race3: African Descendant Population
---race4: Other Races/Ethnicities
---race5: Non-Responses

The program requires that at least two different groups have been defined as dichotomous variables. The remaining options for running the analysis are specific to the sheet and will be discussed in detail below. For a summary of variables, their format and options to be used with this command see Table 8-2 at the end of this chapter.

It is also important to note that this workbook is preset to produce results using the regional income group definitions as well as country specific poverty results. Where the country specific poverty lines are used, authors will input the value of the national extreme and moderate poverty lines in their Stata command. The regional breakdown that is present uses the poverty lines of US$1.25 purchasing power parity (PPP) per capita per day, US$2.50 PPP per capita per day (extreme poverty) and US$4 PPP per capita per day (moderate poverty) as well as income groupings for the vulnerable, with income
between US$4 and US$10 PPP per capita per day, the middle class, with incomes between US$10 and US$50 PPP per capita per day, and a grouping for all individuals with per capita per day incomes above US$50 PPP. All of these income groupings utilize the 2005 PPP conversion rate. Although the sheet is preset to analyze these income lines, users may opt to change poverty lines to fit their research needs using the option cut(). It is however important to note that this will not change the labels presented in the Excel file. It is important that if users choose to use different income groups, they manually adjust these labels as it may cause confusion for end users of the workbook.

1. Background Information

The first part of Section F of the Master Workbook requires authors to fill in much of the background information necessary to conduct the general CEQ analysis, information on the different ethno-racial populations that are being analyzed, and some of the relevant background information for analyzing the results of the study. Many of these sheets will need to be filled in manually (without the aid of the ceqrace.ado command).

**Sheet F1. Key Assumptions**

Sheet F1 presents the key assumptions utilized in the CEQ analysis. This sheet is highly important for end users of the data as it is critical to have this information available while interpreting the results of the study. While this sheet will need to be filled in manually by authors, it includes similar information as that presented in the ‘Key Assumptions’ sheet featured in section C of the CEQ Master Workbook (sheet C2). Despite having similar information as section C of the Workbook, it is important that authors complete the information in this workbook as well as it allows users to conduct much of the CEQ analysis by race and ethnicity using only one workbook and assures that results are interpreted correctly and accurately.

**Sheet F2. Ethno-Racial Definitions**

While some countries clearly define ethno-racial categories that should be utilized for the CEQ fiscal incidence analysis, the definitions used to define ethno-racial categories vary by country and by survey. While most Latin American countries have transitioned to using self-identification as the primary method for determining the ethno-racial categorization of individuals or households, some countries in the region continue to use maternal language as the determinant of ethno-racial group. Additionally, some populations may have multiple identities depending on the context in which they are being considered. As such, defining how each study examines ethno-racial populations may be an important factor for providing policy recommendations specific to different segments of society. Further questions on how race and ethnicity should be imputed to individuals who are not asked to self-identify and how to impute race or ethnicity to the household level are important and can have profound effects on the results of the analysis. In order to ensure that results are comparable to other

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12 As discussed above, the default options are cut1(1.25), cut2(2.50), cut3(4.00), cut4(10.00), and cut5(50.00).
studies as well as to verify that the definitions used are understandable to a broader audience, authors should define how the different ethno-racial populations are defined for the purpose of their study.

Additionally, this sheet includes information not only on the survey being used, but also on national census results. This information is important for several key reasons. First, the definitions of different ethno-racial categories, the manner in which the question on ethno-racial identity was asked, or how the sample was constructed in the census as compared to the survey being utilized may lead to findings that contradict what would be expected based on census results. Having information on how ethno-racial populations are defined in these two data sets allows users to see if there are differences and if so what these differences may be.

This sheet must be filled in manually by the authors.

**Sheet F3. Ethno-Racial Populations**

Sheet F3 expands upon the information presented in the previous sheet by looking at the size of each ethno-racial population and comparing them to census figures. This allows researchers to have a better understanding of the representativity of the survey being used (when compared to census results) and allows them to express whether they believe that the trends that are seen across ethno-racial lines are truly representative (both in magnitude as well as direction) with national results. This is particularly important given that the sample design in some countries may not take race and ethnicity into account. While most of this sheet is completed using the ceqrace.ado Stata command, data from national censuses must be completed manually by authors as this comes from an alternative data source.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables and weights are required. Below is an example of how this can be run:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f3)
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file being used and the race variables are all dichotomous. It is important to note that the table option must include the number of the sheet preceded by an “f” in order to automatically fill in the excel file.

**Sheet F4. Linked Information**

The linked information contained in this sheet provides some additional background information on the different policies that are considered as part of the CEQ analysis as well as allows authors to quickly fill in much of the background information that is necessary to complete tables throughout this workbook. Data that should be filled in by the authors includes information on calculating the conversion rates from local currency units (LCU) to international dollars to international dollars in 2005 and 2011 purchasing power parity (PPP), information on the national poverty lines used in the country, additional information on the programs that are being analyzed as part of the CEQ assessment, and information on the countries education system. Data for generating the conversion factors between LCU and 2005 or 2011 PPP can be found in the World Bank’s World Development
Indicators. This information will be used to convert LCU into PPP on several sheets throughout section F of the workbook and to convert national poverty lines in LCU into PPP numbers. Official names of the different programs that are being aggregated or used in this section of the analysis should also be provided so that end users are better able to understand the different elements that are being considered as part of the analysis. For education information, it is important that users input the targeted age ranges for different educational levels as this information has important implications for calculating educational enrollment rates (see sheets F21 and F22).

Authors must complete this sheet manually.

2. Results

Part 2 of Section F of the CEQ Master Workbook presents the results of the CEQ analysis necessary to conduct the analysis across ethno-racial lines in a user friendly format. This section provides many of the tables and figures that authors may want to consider when writing papers comparing the impact of fiscal policy across ethno-racial lines.

Sheet F5. Population Composition

An important element in understanding ethno-racial inequality is understanding how the population is distributed across socio-economic and ethno-racial lines. This sheet presents the population distribution and magnitude disaggregated by decile and income group across ethno-racial lines for original and disposable income concepts. It is important to note that, although national results will be the same, the ethno-racial results by decile will differ from those presented in sections D and E of the CEQ Master Workbook as this work sheet defines deciles nationally and then disaggregates by ethno-racial category rather than presenting the deciles within each ethno-racial group. In other words, the results presented here will express the share of the different population segments in each decile rather than presenting the characteristics of the different ethno-racial groups by decile.

To fill in this sheet using the ceqrace.ado Stata command, it is required to have variables generated for original income, disposable income, household identifier, consumer price index, and purchasing power parity variables, and dummy variables for each ethno-racial category. The syntax should follow:

```stata
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx, race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f5) o(y_m) d(y_d) hhid(hhid) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file being used, the race variables are dichotomous, original(varname) specifies the original income variable in local currency units,14

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13 Original income might vary depending whether one is running an analysis using pensions as deferred income (PDI) or pensions as government transfers (PGT) so market income or market income plus pensions variables have to be used for this option depending on the scenario.

14 Original income might vary depending whether one is running an analysis using pensions as deferred income (PDI) or pensions as government transfers (PGT) so market income or market income plus pensions variables have to be used for this option depending on the scenario.
disposable(varname) is disposable income, hhid(varname) is the variable that uniquely identifies the household, ppp() is the purchasing power parity (PPP) conversion factor (local currency units [LCU] per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is the consumer price index (CPI) of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that income variables are defined in annual terms (although it is preferable to use annualized data, daily and monthly can also be specified if the author chooses).

**Sheet F6. Income Distribution**

Sheet F6 builds upon the data presented in sheet F5 by presenting the distribution of income by ethno-racial group as well as nationally. Results are presented using both decile and income groups for original and disposable income. As with sheet F5, these decile results will differ from the disaggregation presented in sections D and E the CEQ Master Workbook due to the manner in which deciles are defined in this workbook relative to the other workbooks.\(^\text{15}\)

To fill in this sheet using the ceqrace.ado Stata command, it is required to have variables generated for original income, disposable income, household identifier, consumer price index and purchasing power parity variables, and dummy variables for each ethno-racial category. The syntax should follow:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd)
race4(orace) race5(nonrace) table(f6) o(y_m) d(y_d) hhid(hhid) ppp(7.65) cpibase(78.661)
cpisurvey(105.196) year
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file being used, the race variables are dichotomous, original(varname) specifies the original income variable in local currency units,\(^\text{16}\) disposable(varname) is disposable income, hhid() is the variable that uniquely identifies the household, ppp() is the purchasing power parity (PPP) conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is the consumer price index (CPI) of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that income variables are defined in annual terms (daily and monthly can also be used).

**Sheet F7. Summary Poverty Rates**

Poverty headcount rates are one of the key manners in which we can discuss levels of social exclusion and inequality across ethno-racial lines. Sheet F7 presents poverty headcount rates by race and ethnicity as well as nationally for each of the different core income concepts and generates tables that can be used to demonstrate the impacts of fiscal policy on poverty across ethno-racial lines.

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\(^{15}\) For description of why decile results may differ, please refer to the discussion of sheet F5.

\(^{16}\) Original income might vary depending whether one is running an analysis using pensions as deferred income (PDI) or pensions as government transfers (PGT) so market income or market income plus pensions variables have to be used for this option depending on the scenario.
To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname), disposable(varname), consumable(varname), nextreme(string), and nmoderate(string) options are required and the following syntax should be used:

```stata
cceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx, race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f7) m(y_m) mplusp(y_mp) n(y_nm) g(y_g) taxab(y_taxab) d(y_d) c(y_c) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year next(137) nmod(350)
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, m(varname) specifies the market income variable in local currency units, mplusp(varname) is market income plus pensions, n(varname) is net market income, g(varname) is gross income, taxab(varname) is taxable income, d (varname) is disposable income, and c(varname) is consumable income. ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency. next() and nmod() set the national extreme and moderate poverty lines which should be in LCU and the same periodicity as the income variables.

**Sheet F8. Summary Poverty Gap Rates**

This sheet mirrors the results presented on sheet F7, but utilizing poverty gap rates rather than the poverty headcount. In addition to tables and figures presenting the poverty gap results, this sheet also automatically calculates the budget that would be required to completely eliminate poverty assuming that programs were perfectly targeted at each of the core income concepts.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname), disposable(varname), consumable(varname), final(varname), poverty line options, nextreme(string), and nmoderate(string) are required and the following syntax should be used:

```stata
cceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx, race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f8) m(y_m) mplusp(y_mp) n(y_nm) g(y_g) taxab(y_taxab) d(y_d) c(y_c) f(y_f) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year next(137) nmod(350)
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, m(varname) specifies the market income variable in local currency units, mplusp(varname) is market income plus pensions, n(varname) is net market income, g(varname) is gross income, taxab(varname) is taxable income, d (varname) is disposable income, c(varname) is consumable income, and f(varname) is final income. ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency. next() and nmod() pare
Sheet F9. Summary Poverty Gap Squared Rates

Sheet F9 completes the Foster–Greer–Thorbecke family of poverty measures by presenting results on poverty severity (poverty gap-squared) across ethno-racial lines for each of the core income concepts. As with the previous two sheets, sheet F9 presents the results alongside easy to use figures for regional and national extreme and moderate poverty lines.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname), disposable(varname), consumable(varname), final(varname), nextreme(string), and nmoderate(string) are required and the following syntax should be used:

```stata
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx, race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f9) m(y_m) mplusp(y_mp) n(y_nm) g(y_g) taxab(y_taxab) d(y_d) c(y_c) f(y_f) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year(next(137) nmod(350))
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, m(varname) specifies the market income variable in local currency units, mplusp(varname) is market income plus pensions, n(varname) is net market income, g(varname) is gross income, taxab(varname) is taxable income, d (varname) is disposable income, c(varname) is consumable income, and f(varname) is final income.

ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency. next() and nmod() are the national extreme and moderate poverty lines which should be in LCU and the same periodicity as the income variables.

Sheet F10. Summary Inequality Indicators

Many different measures are used to calculate income inequality in a given society. This sheet features three of these measures: the Gini Coefficient, the Thiel Coefficient and the 90/10 index. While the national results presented on this page may be more important than those disaggregated by ethno-racial group as they capture inter- and intra-group inequality rather than just intra-group inequality, it is important to examine these results both at the national level as well as disaggregated as some policies may decrease inequality nationally while exacerbating inequalities within particular ethno-racial groups. Similarly, programs may increase inequality nationally while decreasing intra-group inequalities. As with sheet F7 through F9, sheet F10 presents results with easy to use tables and figures.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname),
disposable(varname), consumable(varname), final(varname) are required and the following syntax should be used:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx, race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f10) m(y_m) mplusp(y_mp) n(y_nm) g(y_g) taxab(y_taxab) d(y_d) c(y_c) f(y_f)
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, m(varname) specifies the market income variable in local currency units, mplusp(varname) is market income plus pensions, n(varname) is net market income, g(varname) is gross income, taxab(varname) is taxable income, d (varname) is disposable income, c(varname) is consumable income, and f(varname) is final income.

**Sheet F11. Mean Incomes**

Another measure that is important in examining inequalities across ethno-racial lines is to examine gaps in mean incomes held by individuals of different ethno-racial groups. Sheet F11 presents the mean incomes experienced by each ethno-racial population at each of the different income concepts. Results are presented both in 2005 PPP dollars as well as in local currency units. As with the preceding sheets, results are presented as easy to use figures and tables.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname), disposable(varname), consumable(varname), final(varname) are required and the following syntax should be used:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx, race1(indig) race2(white) race3(afrd) table(f11) m(y_m) mplusp(y_mp) n(y_nm) g(y_g) taxab(y_taxab) d(y_d) c(y_c) f(y_f)
```

**Sheet F12. Incidence by Decile**

When conducting the CEQ fiscal incidence analysis, one of the most important elements is determining the incidence of different fiscal interventions on household income. When analyzing the effects of fiscal policy across ethno-racial lines the same still holds true. Sheet F12 presents the magnitude of interventions on each decile, disaggregated by ethno-racial group as well as nationally, measured in local currency units. Results are also presented as a share of original income among each population. While the results presented on this sheet should be the same as those presented on sheet D4 of the master workbook and in section E for the national level, as with previous sheets, when disaggregated by ethno-racial group, results will be different than those presented in a particular group's respective sections D and E of the Master Workbook as deciles are defined differently.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, hhid(varname) original(varname), market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname), disposable(varname), consumable(varname), final(varname), dtax(varname), contributions(varname), compensions(varname), contypensions(varname), contypensions(varname),
noncontributory(varname), flagcct(varname), otransfers(varname), isubsidies(varname), itax(varname), ikeducation(varname), ikhealth(varname), and hurban(varname) are required and the following syntax should be used:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx, race1(indig) race2(white) race3(afrd) race4(oracle) race5(nonrace) table(f12) hhid(hhid) o(y_m) m(y_m) contp(contp) conyp(conyp) mplusp(y_mp) dtax(dtax) n(y_nm) nonc(nonc) flagcct(fctct) otran(otran) g(y_g) taxab(y_taxab) d(y_d) isub(isub) itax(itax) c(y_c) ike(ik_e) ikh(ik_h) hu(hu) f(y_f)
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, hhid() is the variable that uniquely identifies the household, o(varname) specifies the original income variable in local currency units, m(varname) is market income, contp(varname) are contributions to pensions, conyp(varname) are contributory pensions, mplusp(varname) is market income plus pensions, dtax(varname) are direct taxes, n(varname) is net market income, nonc(varname) are non-contributory pensions, flagcct(varname) is the Flagship Conditional Cash Transfer Program (CCT), otran(varname) are other direct transfers, g(varname) is gross income, taxab(varname) is taxable income, d(varname) is disposable income, isub(varname) and itax(varname) are indirect subsidies and taxes respectively, c(varname) is consumable income, ike(varname), ikh(varname), and hu(varname) are in–kind education, health, and housing and urban respectively, and f(varname) is final income.

**Sheet F13. Incidence by Income Group**

While Sheet F12 presents the incidence results of the analysis by decile, sheet F13 compliments this by conducting the same analysis by income group. This allows researchers to utilize populations that have the same income or to examine the impact of policies on particular income groups within the different ethno-racial groups. These results will be the same as those presented on sheet D4 of the Master Workbook for each respective ethno-racial group.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, original(varname), market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname), disposable(varname), consumable(varname), final(varname), dtax(varname), contributions(varname), contpensions(varname), contypensions(varname), noncontributory(varname), flagcct(varname), otransfers(varname), isubsidies(varname), itax(varname), ikeducation(varname), ikhealth(varname), hurban(varname), and poverty line options are required and the following syntax should be used:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx, race1(indig) race2(white) race3(afrd) race4(oracle) race5(nonrace) table(f13) o(y_m) m(y_m) contp(contp) conyp(contyp) mplusp(y_mp) dtax(dtax) n(y_nm) nonc(nonc) flagcct(fctct) otran(otran) g(y_g) taxab(y_taxab) d(y_d) isub(isub) itax(itax) c(y_c) ike(ik_e) ikh(ik_h) hu(hu) f(y_f) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, o(varname) specifies the original income variable in local currency units, m(varname) is market income, contp(varname) are contributions to pensions, conyp(varname) are contributory pensions,
mplusp(varname) is market income plus pensions, dtax(varname) are direct taxes, n(varname) is net market income, none(varname) are non-contributory pensions, flagcct(varname) is the CCT, otran(varname) are other direct transfers, g(varname) is gross income, taxab(varname) is taxable income, d(varname) is disposable income, isub(varname) and itax(varname) are indirect subsidies and taxes respectively, c(varname) is consumable income, ike(varname), ikh(varname), and hu(varname) are in-kind education, health, and housing and urban respectively, and f(varname) is final income.

Sheet F14. Cross-Race Incidence

While sheets F12 and F13 present the results of the fiscal incidence analysis across ethno-racial lines, the presentation of these results may be difficult to read. Sheet F14 utilizes the analysis presented on Sheet F12 to present the findings of the incidence analysis by ethno-racial group in an easy to read table. The results presented reveal the share of benefits (or payments) received (paid out) by each ethno-racial group as a share of total benefits (or payments). When this is compared to the population (row 8) or income (rows 9, 15, and 18 for market, disposable, and consumable, respectively) shares, one can examine the progressivity of different policy interventions. As discussed above, policies are considered to be regressive where the share of benefits (taxes) being received (paid) by the disadvantaged population is less (more) than their share of national income, a policy is relatively progressive where the share of benefits (taxes) being received (paid) by the disadvantaged population is more (less) than their share of national income and absolutely progressive when the share of benefits being received by the disadvantaged population is more than their share of the population.

This sheet is filled in automatically using the results calculated from sheet F12.

Sheet F15. Horizontal Equity

The impact of the fiscal policies targeted to the poor may appear to be ethno-racially progressive due to greater poverty rates among the disadvantaged population(s). This can lead to questions about whether the program benefits the poor of a particular group more or less than those of other segments of the population. Sheet F15 examines the incidence of different policy interventions among the poor of each ethno-racial group relative to their population and income shares. This allows us to examine whether policies are disproportionately benefitting the poor of a particular program or if certain policies appear ethno-racially progressive or regressive due to differences in the socio-economic statuses of the different populations. If the share of benefits going to a particular population is equal to their share of the poor, policies are considered to be color-blind as they do not violate horizontal equity by benefitting the poor of particular populations more than others.

This sheet is filled in automatically using the results calculated on sheet F13.

Sheet F16. Fiscal Profile

In addition to looking at the share of benefits going to each ethno-racial population, it is important to see what the impact on incomes within each of these populations is. Looking at the fiscal profile sheet allows us to see these changes in mean income, both in terms of local currency units as well as a share
of the different income concepts. In addition to looking at the impacts on mean income among individuals of each race or ethnicity, this sheet looks at the differences that occur in households headed by members of different races or ethnicities. This allows us to see if there are differences between inter-racial households and single race households.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, original(varname), disposable(varname), consumable(varname), final(varname), age(varname), pensions(varname), hhe(varname), hhid(varname), and poverty line options are required and the following syntax should be used:

```stata
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f16) o(y_m) d(y_d) c(y_c)f(y_f) pens(pensions) hhe(hhe_id) hhid(hh_id) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, o(varname) specifies the original income variable in local currency units. Original income is used to be able to assert whether the analysis that is being run uses pensions as deferred income (PDI) or pensions as government transfers (PGT). d(varname) is disposable income, c(varname) is consumable income, f(varname) is final income, pens(varname) are pensions, hhe(varname) is a dummy variable that identifies the household head, hhid(varname) is the household identifier, ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency.

**Sheet F17. Coverage Rates (Total Population)**

In addition to looking at the impacts of fiscal policy between ethno-racial groups on the aggregate, it is important to look at what share of the each ethno-racial population is receiving benefits from the different fiscal interventions. The coverage rates of the different populations allow researchers to have a better understanding of the targeting of programs to compliment the impact of them on incomes and poverty. Sheet F17 looks at the coverage rates of the total population, regardless of whether they are the desired targets of particular fiscal interventions. These results are disaggregated by ethno-racial group as well as by income group.

There are multiple ways that one can calculate coverage rates. For the purpose of the CEQ analysis, coverage rates of direct beneficiaries, indirect beneficiaries and households may all be interesting. As such, coverage rates have been calculated for each of these distinct populations. In order to understand the differences between the different coverage rates, it is necessary to understand what populations are being considered as part of each group.

1. **Direct beneficiaries** are those who report being recipients of a particular intervention. In cases where benefits are directed at the household, this will be imputed to the head of the
household or to all members of the household depending on the targeting method being utilized. In some cases, households may have more than one direct beneficiary.

2. **Beneficiary households** are households in which at least one direct beneficiary resides.

3. **Direct and indirect beneficiaries** are all individuals who reside within a beneficiary household.

To calculate the coverage rates using these different methods requires dividing the number of beneficiaries by the total population, in the case of direct and indirect beneficiaries, and by the total number of households in the case of beneficiary households. For additional information on how to calculate each of the different coverage rates, please refer to Chapter 7.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, original(varname), cct(varname), noncontrib(varname), unemploy(varname), foodtransf(varname), otransfers(varname), health(varname), pensions(varname), hhc(varname), hhid(varname), and poverty lines are required and the following syntax should be used:

```stata
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f17) o(y_m) cct(cct) nonc(nonc) unem(unemployment) foodt(f_tran) otran(o_tran) hea(health) pen(pensions) hhc(hhc_id) hhid(hh_id) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, o(varname) specifies the original income variable in local currency units, cct(varname) are transfers CCT, nonc(varname) are non-contributory pensions, unem(varname) are unemployment benefits, foodt(varname) are food transfers, otran(varname) are other direct transfers, hea(varname) are health transfers, pen(varname) are pensions, hhc(varname) is a dummy variable that identifies the household head, hhid(varname) is the household identifier, ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is the CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency.

**Sheet F18. Coverage Rates (Target Population)**

Building upon the results of sheet F17, this sheet examines the coverage rates among the population that is the desired target of specific interventions. The target population is likely to differ by intervention. For example, pensions may be targeted to individuals over a particular age while some social cash transfers may be targeted to heads of households with children within a particular age range. These targeted coverage rates are calculated using the same three population definitions that are assessed above. However, these do not include recipients who are not of the desired population in the numerator and reduce the size of the population to those that belong to the desired population.

In the case of households, the denominator includes all households where at least one individual with the desired characteristics resides, while for direct and indirect beneficiaries, the denominator includes all individuals that reside in a household where at least one individual with the desired characteristics resides.
To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, original(varname), cct(varname), noncontrib(varname), pensions(varname), hhe(varname), hhid(varname), tarcct(varname), tarpen(varname), and poverty line options are required and the following syntax should be used:

ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd) race4(orre) race5(nonrace) table(f18) o(y_m) cct(cct) nonc(nonc) pen(pensions) hhe(hhe_id) hhid(hh_id) tarncp(tncp) tarcct(tcct) tarpen(tpen) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, o(varname) specifies the original income variable in local currency units, cct(varname) are transfers from CCT, nonc(varname) are non-contributory pensions, pen(varname) are pensions, hhe(varname) is a dummy variable that identifies the household head, hhid(varname) is the household identifier, tarncp(varname) is a dummy variable that identifies non-contributory pensions target population, tarcct(varname) is a dummy variable that identifies CCT’s target population, tarpen(varname) is a dummy variable that identifies pensions target population, ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is the CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency.

**Sheet F19. Leakages**

Programs are often likely to have some of the benefits go to a segment of the population that does not meet the desired targeting characteristics. Using the results of the two different coverage sheets (F17 and F18), this sheet seeks to explain if the leakages from these programs benefit a particular ethno-racial group more than another. These are calculated by taking the total size of benefits and subtracting the amount of benefits that are received by the target population. Results are calculated in both 2005 PPP values and local currency as well as as a percentage of total spending on a particular intervention.

This sheet is filled in automatically using the results presented on sheets F17 and F18.

**Sheet F20. Mobility Matrices**

In order to determine if a program is ‘pro-disadvantaged group’, it is necessary to determine if the impact of fiscal policies leads to a higher probability of escaping poverty for the disadvantaged population than for the advantaged population. To calculate this, this workbook utilizes the mobility matrices discussed in Lustig and Higgins.\(^\text{17}\) These matrices look at the population that is in or out of poverty at two different income concepts. This sheet presents these mobility matrices for each of the different ethno-racial populations and calculates the probability of an individual living in poverty at

\(^{17}\) Lustig and Higgins (2013).
market income escaping poverty through fiscal interventions. Probabilities of escaping poverty are calculated from Consumable, Disposable and Final income, all with respect to market income for each of the different ethno-racial populations using the regional poverty lines of $2.50 PPP per capita per day and $4 PPP per capita per day. The results resented in the mobility matrices on this sheet should match those found on sheet D10 for each of the ethno-racial groups’ respective Part I of the CEQ Master Workbook.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, original(varname), disposable(varname), consumable(varname), final(varname), and poverty lines are required and the following syntax should be used:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f20) o(y_m) d(y_d) c(y_c) f(y_f) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, o(varname) specifies the original income variable in local currency units, mplusp(varname) is market income plus pensions, n(varname) is net market income, g(varname) is gross income, taxab(varname) is taxable income, d (varname) is disposable income, c(varname) is consumable income, and f(varname) is final income, ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is the CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency.

**Sheet F21. Education (Totals)**

One area that is commonly cited as a source of ethno-racial inequality is educational outcomes, an area where government provision of services is an important tool in closing ethno-racial inequalities. As such, looking at the differences in educational attainment and enrollment can be an important tool in explaining ethno-racial inequalities. This sheet looks at the size of different ethno-racial populations that are attending public and private educational institutions as a way to see the impacts of government services at closing inequalities in access to education.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, original(varname), edpre(varname), edpri(varname), edsec(varname), edter(varname), redpre(varname), redpri(varname), redsec(varname), redter(varname), edpublic(varname), edprivate(varname), and attend(varname) are required and the following syntax should be used:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f21) o(y_m) edpre(ed_pre) edpri(ed_pri) edsec(ed_sec) edter(ed_ter) attend(attendschool) redpre(red_pre) redpri(red_pri) redsec(red_sec) redter(red_ter) hhe(id_hhead) hhid(id_hh) edpriv(private) edpub(public)
```
Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, o(varname) specifies the original income variable in local currency units, edpre(varname), edpri(varname), edsec(varname), edter(varname) are pre-school, primary, secondary and tertiary level of education dummies respectively, redpre(varname), redpri(varname), redsec(varname), redter(varname) are pre-school, primary, secondary and tertiary age ranges dummies respectively, attend(varname) is a dummy that defines whether the individual attends school, hhe(varname) is a dummy variable that identifies the household head, hhid(varname) is the household identifier, edpriv(varname) and edpub(varname) are dummies that identify whether the individual attends a private or public school, ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is the CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency.

Sheet F22. Education (Rates)

Utilizing the population numbers presented on sheet F21, different education rates are calculated and presented in easy to use tables. Both gross and net enrollment rates are calculated for each ethno-racial population at each level of education that is available for analysis, ranging from pre-school through tertiary education. These rates are further disaggregated by income group at disposable income.

This sheet is filled in automatically using the results presented on sheet F21.

Sheet F23. Educational Probability

While net and gross enrollment rates are the most common measure of educational activity used, this sheet presents an alternative measure for examining the differences in educational activity across ethno-racial lines that we refer to as net educational probability. Rather than examining the share of children enrolled in education (as net enrollment rates do), this indicator attempts to examine what the probability is of a family with given characteristics sending their children to the correct level of schooling. For the purposes of this analysis, the characteristics that are considered are the head of household’s race or ethnicity and the household’s per capita income bracket.

This can be considered as the net enrollment rate within each household averaged across households. This is calculated by:

1. For each household calculate:

   \[
   \frac{\text{The Number of children in the household within the target age cohort attending school}}{\text{The Total Number of Children in the household within the target cohort}}
   \]

2. Take the results of step 1 and take the average across all households with children in the target age cohort.

---

18 If an individual is between the age range of each education level then the variable takes the value of one.
To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, original(varname), edpre(varname), edpri(varname), edsec(varname), edter(varname), redpre(varname), redpri(varname), redsec(varname), redter(varname), attend(varname), hhid(varname), and hhead(varname) are required.

Example:

ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1 (indig) race2 (white) race3 (afrd) race4 (orace) race5 (nonrace) table (f23) o (y_m) edpre (ed_pre) edpri (ed_pri) edsec (ed_sec) edter (ed_ter) attend (attendschool) redpre (red_pre) redpri (red_pri) redsec (red_sec) redter (red_ter) hhid (id_hh) hhe (id_hhead) ppp (7.65) cpibase (78.661) cpisurvey (105.196) year

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, o(varname) specifies the original income variable in local currency units, edpre(varname), edpri(varname), edsec(varname), edter(varname) are pre-school, primary, secondary, and tertiary level of education dummies respectively, redpre(varname), redpri(varname), redsec(varname), redter(varname) are pre-school, primary, secondary and tertiary age ranges dummies respectively, attend(varname) is a dummy that defines whether the individual attends school, hhe(varname) is a dummy variable that identifies the household head, hhid(varname) is the household identifier, ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is the CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency.

Sheet F24. Infrastructure Access

Another element of ethno-racial inequality comes from the non-monetary deprivations that may be experienced by these different populations. These may include access to key services that are often considered to be connected to economic performance such as access to potable water or electricity. This sheet presents the different coverage rates experienced by individuals of different ethno-racial populations for access to running water, electricity, sewage, and roads as well as to quality constructed walls, floors, and roofs. These results are calculated using two different methods; one that examines the coverage rate of the population and one that is weighted by individuals with access and one that looks at the share of households that receive benefits.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, original(varname), hhid(varname), hhead(varname), water(varname), electricity(varname), walls(varname), floors(varname), roof(varname), sewage(varname), roads(varname), and poverty lines are required. If one of the infrastructure variables does not include in the dataset, the adofile will leave those observations blank.

---

19 If an individual is between the age range of each education level then the variable takes the value of one.
Example:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd)
race4(orac) race5(nonrace) table(f24) o(y_m) hhid(id_hh) hhe(id_hhead) water(water)
electricity(elect) walls(walls) floors(floors) roof(roof) sewage(sewage) roads(roads) ppp(7.65)
cpibase(78.661) cpisurvey(105.196) year
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, o(varname) specifies the original income variable in local currency units, hhe(varname) is a dummy variable that identifies the household head, hhid(varname) is the household identifier, water(varname), electricity(varname), walls(varname), floors(varname), roof(varname), sewage(varname), and roads(varname) are all dummies for having running water, electricity, walls, floors, roof, sewage, and roads respectively. ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is the CPI of the base year (year of PPP, usually 2005 or 2011), cpisurvey() is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency.

**Sheet F25. Theil Decomposition**

As discussed above, one of the ways that one can determine the effect of fiscal policy and the magnitude of ethno-racial inequality is to use a decomposable inequality indicator to determine what share of inequality is due to differences in income between income groups. This sheet does just that and uses the decomposable Thiel coefficient to determine what share of inequality is due to differences in incomes between groups and what share of inequality is due to intra-group inequalities. These results are calculated for each of the eight core income concepts. These can be compared to see if the share of inequality due to ethno-racial differences declines as a result of fiscal interventions.

To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname), disposable(varname), consumable(varname), final(varname), gender(varname), urban(varname), and edpar(varname) are required.

Example:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd)
race4(orac) race5(nonrace) table(f25) m(y_m) mplusp(y_mp) n(y_nm) g(y_g) taxab(y_taxab) d(y_d)
c(y_c) f(y_f) gender(sex) urban(rururb) edpar(parentsed)
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, m(varname) specifies the market income variable in local currency units, mplusp(varname) is market income plus pensions, n(varname) is net market income, g(varname) is gross income, taxab(varname) is taxable income, d (varname) is disposable income, c(varname) is consumable income, and f(varname) is final income, gender(varname) is a dummy variable specifying the gender of the individual (1 for women and zero otherwise), urban(varname) is also a dummy specifying if the
individual lives in urban or rural areas, and edpar(varname) specifies the years of education of the parent.

**Sheet F26. Inequality of Opportunity**

As discussed above, one of the manners in which one can measure ethno-racial inequality is through inequality of opportunity. This measure seeks to explain if differences in outcomes are due to characteristics or circumstances outside of an individual’s control rather than due to personal preferences or effort. In this case, the characteristics that are considered part of the analysis are the individuals’ gender, location (urban/rural), and race or ethnicity. For the purpose of the CEQ race and ethnicity analysis, this looks specifically at how these characteristics affect inequality of income at each of the different income concepts. By looking at the mean incomes seen by the different combinations of individuals with these characteristics, one can calculate to what extent each of the different characteristics describes the differences in mean incomes. By looking at the change in the share of inequality of opportunity explained by race and ethnicity, one can determine if fiscal policy reduces the share of inequality of opportunity explained by race and ethnicity.

To fill in this sheet using the ceqrace ado Stata command, race dummy variables, weights, market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname), disposable(varname), consumable(varname), final(varname), gender(varname), urban(varname) are required.

Example:

cceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f26) m(y_m) mplusp(y_mp) n(y_nm) g(y_g) taxab(y_taxab) d(y_d) c(y_c) f(y_f) gender(sex) urban(rururb)

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, m(varname) specifies the market income variable in local currency units, mplusp(varname) is market income plus pensions, n(varname) is net market income, g(varname) is gross income, taxab(varname) is taxable income, d(varname) is disposable income, c(varname) is consumable income, and f(varname) is final income, gender(varname) is a dummy variable specifying the gender of the individual (1 for women and zero otherwise), and urban(varname) is also a dummy specifying if the individual lives in urban or rural areas.

**Sheet F27. Significance**

In order to ensure that there are in fact differences in the incomes of different ethno-racial populations, it is necessary to verify that these values are statistically significant. To do this, one can calculate P-values comparing the different indicators across ethno-racial lines. This sheet looks at the p-values for the poverty headcounts (US$2.50 and US$4 PPP/day), Gini coefficient and Theil coefficient between each pairwise set of ethno-racial groups. These are calculated for each of the eight core income concepts.
To fill in this sheet using the ceqrace.ado Stata command, race dummy variables, weights, market(varname), mpluspensions(varname), netmarket(varname), gross(varname), taxable(varname), disposable(varname), consumable(varname), final(varname), psu(varname), strata(varname), and poverty line options are required.

Example:

```
ceqrace [pw=weight] using CEQ_Ethno_Racial_MWB.xlsx,race1(indig) race2(white) race3(afrd) race4(orace) race5(nonrace) table(f27) m(y_m) mplusp(y_mp) n(y_nm) g(y_g) taxab(y_taxab) d(y_d) c(y_c) f(y_f) psu(upm) strata(strata) ppp(7.65) cpibase(78.661) cpisurvey(105.196) year
```

Where CEQ_Ethno_Racial_MWB.xlsx is the name of the Excel file, the race variables are dummies, m(varname) specifies the market income variable in local currency units, mplusp(varname) is market income plus pensions, n(varname) is net market income, g(varname) is gross income, taxab(varname) is taxable income, d(varname) is disposable income, c(varname) is consumable income, and f(varname) is final income, gender(varname) is a dummy variable specifying the gender of the individual (1 for women and zero otherwise), urban(varname) is also a dummy specifying if the individual lives in urban or rural areas, psu(varname) is the primary sampling unit, strata(varname) is the strata variable, ppp() is the PPP conversion factor (LCU per international dollar, consumption-based) from the year of PPP (usually either 2005 or 2011), cpibase() is the CPI of the base year (year of PPP, usually 2005 or 2011), cp(1),(996)is the CPI for the year of the household survey, and finally, year indicates that the income variables are in yearly currency.
### Table 8-2: Types of variables and options guide for ceqrace.ado

<table>
<thead>
<tr>
<th>Concept</th>
<th>Option in ceqrace.ado</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethno-Racial Groups</td>
<td>race1(varname), race2(varname), race3(varname), race4(varname), race5(varname)</td>
<td>All variables have to be dummies and identify the ethnicity-race of each individual. Race1 is for Indigenous population, race2 is for White/non-ethnic population, race3 is for African descendant population, race4 other races, and race5 for non-responses.</td>
</tr>
<tr>
<td>Income Concepts</td>
<td>original(varname), market(varname), mpluspensions(varname), netmarket(varname),</td>
<td>These variables must have the per-capita income concepts in local currency units.</td>
</tr>
<tr>
<td></td>
<td>gross(varname), taxable(varname), disposable(varname), consumable(varname), final(varname)</td>
<td></td>
</tr>
<tr>
<td>Tax and Transfer Concepts</td>
<td>dtax(varname), contrib(varname), conypensions(varname), compensions(varname),</td>
<td>These variables must have the tax or transfer concepts in per-capita local currency units.</td>
</tr>
<tr>
<td></td>
<td>noncontrib(varname), flagcct(varname), otransfers(varname), isubsidies(varname),</td>
<td></td>
</tr>
<tr>
<td></td>
<td>itax(varname), ikeduc(varname), ikhealth(varname), hurban(varname)</td>
<td></td>
</tr>
<tr>
<td>PPP Conversion Options</td>
<td>ppp(real), cpibase(real), cpisurvey(real), daily, monthly, yearly</td>
<td>These options only accept numbers, only one of the daily, monthly and yearly options can be used.</td>
</tr>
<tr>
<td>Poverty Lines and Income Group</td>
<td>nextreme(string), nmoderate(string), cut1(real), cut2(real), cut3(real), cut4(real),</td>
<td>nnextreme() and nmoderate() accept numerical values as well as a variable, the values have to be at the same time and currency unit as the income variables. The cut() options allow the user to use different thresholds</td>
</tr>
<tr>
<td>Cut-offs</td>
<td>cut5(real)</td>
<td></td>
</tr>
</tbody>
</table>
References


Fiscal Policy, Income Redistribution and Poverty Reduction in Low and Middle Income Countries.¹

Nora Lustig²

November 18, 2016

Chapter 9
Lustig, Nora, editor

Commitment to Equity Handbook
Brookings Institution and CEQ Institute (2017)

Introduction

This paper analyzes the impact of fiscal policy on inequality and poverty in twenty-eight low and middle income countries for around 2010.³ The studies apply the same fiscal incidence methodology described in detail in Lustig and Higgins and chapters 1, 5, and 7 of this Handbook.⁴ With a long tradition in applied public finance, fiscal incidence analysis is designed to respond to the question of who benefits from government transfers and who ultimately bears the burden of taxes in the economy.⁵ The fiscal policy instruments included here are: personal income and payroll taxes, direct transfers, consumption taxes, consumption subsidies and transfers in-kind (in the form of education and healthcare services).

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¹ I am very grateful to Israel Martinez for his excellent help in preparing the database used here. All errors and omissions remain my sole responsibility.

² Nora Lustig is Samuel Z. Stone Professor of Latin American Economics and Director of the Commitment to Equity Institute (CEQ), Tulane University and nonresident senior fellow of the Center for Global Development and the Inter-American Dialogue, and nonresident senior research fellow at UNU-WIDER.

³ The World Bank classifies countries as follows. Low-income: US$1,025 or less; lower-middle-income: US$1,026-4,035; upper-middle-income: US$4,036-12,475; and, high-income: US$12,476 or more. The classification uses Gross National Income per capita calculated with the World Bank Atlas Method, September 2016: http://data.worldbank.org/about/country-and-lending-groups. Using the World Bank classification, the group includes three low-income countries: Ethiopia, Tanzania and Uganda; ten lower middle-income countries: Armenia, Bolivia, El Salvador, Ghana, Guatemala, Honduras, Indonesia, Nicaragua, Sri Lanka and Tunisia; twelve upper middle-income countries: Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, Georgia, Iran, Jordan, Mexico, Peru, Russia and South Africa; two high-income countries: Chile, and Uruguay; one unclassified (upper middle-income, most likely): Argentina; and, one advanced economy: the United States.


⁵ Musgrave (1959); Pechman (1985); Martinez-Vazquez (2008).
Chapter 9, Lustig

The data utilized here is based on twenty-nine CEQ Assessments available in the Commitment to Equity Institute’s database on fiscal redistribution: Argentina, Armenia, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Ethiopia, Georgia, Ghana, Guatemala, Honduras, Indonesia, Iran, Jordan, Mexico, Nicaragua, Peru, Russia, South Africa, Sri Lanka, Tanzania, Tunisia, Uganda, United States, and Uruguay. The CEQ Assessments for Bolivia, Brazil, Mexico, Peru, and Uruguay, were published in Lustig (2016). The CEQ Assessments for Armenia, the Dominican Republic, Ethiopia, Georgia, Indonesia, Jordan, Russia, South Africa and Sri Lanka, will appear in the edited volume by Inchauste and Lustig (forthcoming). The CEQ Assessments for Argentina, El Salvador, Iran, Tunisia, and Uganda, are chapters in this handbook. Finally, the studies for Chile, Colombia, Costa Rica, Ecuador, Ghana, Honduras, Nicaragua, and Tanzania are published in the CEQ Working Paper series available in www.commitmenttoequity.org. The household surveys used in the country studies include either income or consumption as the welfare indicator. As explained in chapter 1 of this Handbook, given that contributory pensions are part deferred income and part government transfer, results were calculated under both scenarios.

While fiscal policy unambiguously reduces income inequality, that is not always true for poverty. In Ethiopia, Tanzania, Ghana, Nicaragua, and Guatemala the extreme poverty headcount ratio is higher after taxes and transfers than before. In addition, to varying degrees, in all countries a portion of the poor are net payers into the fiscal system and are thus impoverished by the fiscal system. While by definition all taxes are poverty increasing as long as the poor and near poor have to pay taxes, 

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6 Launched first as a project in 2008, the Commitment to Equity Institute (CEQ) at Tulane University was created in 2015 with the generous support of the Bill and Melinda Gates Foundation.

7 Lustig, Pessino, and Scott (2014).

8 Cabrera, Lustig and Moran (2015) and Higgins and others (2016).

9 Inchauste and Lustig (forthcoming).

10 Chile (Martinez-Aguilar, Fuchs and Ortiz-Juarez, 2016); Colombia (Harker and others, 2016); Costa Rica (Sauma and Trejos, 2014); Ecuador (Llecren and others, 2015); Ghana (Younger, Osei-Assibey and Oypong, 2015); Honduras (Castañeda and Espino, 2015); Nicaragua (Cabrera and Moran, 2015) and Tanzania (Younger, Myamba and Mdadila, 2016).


12 Because most of the studies were completed before the latest revision of the World Bank’s global poverty line, the line used here is the old poverty line of US$1.25 per day in purchasing power parity of 2005.

13 Higgins and Lustig (2016).
consumption taxes are the main culprits of fiscally-induced impoverishment. As for the impact of specific instruments on inequality, net direct taxes and spending on education and health are always equalizing and net indirect taxes are equalizing in nineteen countries of the twenty-eight. An examination of the relationship between pre-fiscal inequality and social spending (as a share of GDP) and fiscal redistribution suggests that there is no evidence of a “Robin Hood paradox”: the more unequal countries tend to spend more on redistribution and show a higher redistributive effect. However, preliminary results of regression-based analysis indicate that the positive association between initial inequality and the size of the redistributive effect is not robust across the board. When one controls for income per capita and leaves out the “outliers” or measures redistribution in percent change instead of Gini points, the coefficient is often not statistically significant.

Several caveats are in order. The fiscal incidence analysis used here is point-in-time and does not incorporate behavioral or general equilibrium effects. That is, no claim is made that the original or market income equals the true counter-factual income in the absence of taxes and transfers. It is a first-order approximation that measures the average incidence of fiscal interventions. However, the analysis is not a mechanically applied accounting exercise. The incidence of taxes is the economic rather than statutory incidence. It is assumed that individual income taxes and contributions both by employees and employers, for instance, are borne by labor in the formal sector. Individuals who are not contributing to social security are assumed to pay neither direct taxes nor contributions. Consumption taxes are fully shifted forward to consumers. In the case of consumption taxes, the analyses take into account the lower incidence associated with own-consumption, rural markets and informality.

1. The Redistributive and Poverty Reducing Effect of Fiscal Policy

Two key indicators of a government’s (or society’s) commitment to equalizing opportunities and reducing poverty and social exclusion are the share of total income devoted to social spending and how equalizing and pro-poor this spending is. Typically, redistributive social spending includes cash benefits and benefits in kind such as spending on education and health. As shown in chapters 2 by Enami, Lustig, and Aranda and 3 by Enami of this Handbook, the redistributive potential of a

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15 “Cash” benefits typically include cash transfers and near-cash transfers such as school feeding programs and free uniforms and textbooks. Depending on the analysis, cash benefits also include consumption subsidies (for example, on food) and energy consumption and housing subsidies. The studies included here include cash and near-cash transfers as well as (in most cases) consumption subsidies. Housing subsidies are not included.
16 Social spending as a category frequently includes spending on pensions funded by contributions. Following Lindert (1994), this analysis does not include them. Strictly speaking, one should include the subsidized portion of these pensions as part of redistributive social spending (for example, the portion of contributory pensions that is paid out of general revenues and not from contributions). However, estimates of these subsidies are hard to produce. As an alternative, the results for the scenario in which contributory pensions are treated as a government transfer and part of social spending are available upon request. Noncontributory pensions (also known as social or minimum pensions) are treated as any other cash transfer.
country does indeed depend on the size and composition of government spending and how it is financed, as well as the progressivity of all the taxes and government spending combined.

Analogously, the impact of fiscal policy on poverty, will depend on the size and incidence of government spending and revenues. Recall that, in theory, a fiscal system can be inequality reducing but poverty increasing. How so? If every individual in the system pays more in taxes than he or she receives in transfers but the proportion of net tax payments (as a share of pre-fiscal or market income) is higher for the rich than for the poor, the system would be inequality reducing but poverty increasing. As we shall see below, this result is not uncommon in actual fiscal systems, especially when we focus on the cash portion of the fiscal systems (i.e., do not include the impact of the monetized value of government services). Given the importance of the size and composition of government revenues and spending, we start by showing the patterns observed in the twenty-eight countries analyzed here.

1.1 Taxes and Public Spending: Levels and Composition

Figure 9-1 shows government revenues as a share of GDP for around 2010. The revenue collection patterns are heterogeneous. Mexico relies heavily on nontax revenues (from the state-owned oil company), followed by Ecuador, Brazil, Jordan, and Peru. In general, indirect taxes are the largest component of government revenues (as a share of GDP), except for Mexico and Ecuador (where nontax revenues from oil-producing companies is the largest), Iran (social security contributions is the largest) and South Africa (direct taxes is the largest).

Figure 9-1: Size and Composition of Government Revenues (as a % of GDP; circa 2010).
Chapter 9, Lustig

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results. Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Oliva, 2014); Ethiopia (Hill, Tsehaye and Woldehanna, 2014); Georgia (Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Assibey and Oppong, 2016); Guatemala (Cabrera and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Jellema, Wai Poi and Afkar, 2015); Iran (Enami, Lustig and Taqdiri, 2016); Jordan (Abdel-Halim and others, 2016); Mexico (Scott, 2013); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2015); Russia (Malytsin and Popova, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake and others, 2016); Tanzania (Younger, Myamba and Mdadila, 2016); Tunisia (Shimeles and others, 2015); Uganda (Jellema and others, 2016) and Uruguay (Bucheli and others, 2014).

Notes: Year of household survey in parenthesis. Data shown here is administrative data reported by the studies cited above and the numbers do not necessarily coincide with those of multilateral organizations. Gross National Income per capita on right axis is in 2011 PPP from World Development Indicators, August 29th, 2016: http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD.

Figure 9-2 shows the level and composition of primary and social spending plus contributory pensions (panel A), and the composition of social spending for the following categories: direct transfers, education, health, and other social spending around 2010 (panel B). On average, the twenty-eight low-income and middle-income countries analyzed here allocate 10.1 percent of GDP to social spending while the advanced countries in the OECD group, allocate 18.8 percent of GDP, that is, almost twice as much. The twenty-eight countries on average spend 1.9 percent of GDP on direct transfers, 4.3 percent on education and 3.0 percent on health. In comparison, the OECD countries, on average,
spend 4.4 percent of GDP on direct transfers, 5.3 percent on education and 6.2 percent on health. The largest difference between the OECD group and our sample occurs in direct transfers. Regarding spending on contributory pensions (includes contributory pensions only and not special social pensions, which are part of direct transfers), the twenty-eight low-income and middle-income countries spend 3.3 percent of their GDP while OECD countries, spend 7.9 percent.

Figure 9-2: (Panel A and B): Size and Composition of Primary and Social Spending Plus Contributory Pensions (as a % of GDP; circa 2010).

Panel A: Primary and social spending plus contributory pensions as a % of GDP.
Panel B: Composition of social spending plus contributory pensions as a % of GDP.

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results: Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escudier and others, 2016); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Oliva, 2014); Ethiopia (Hill, Tsehaye and Woldehanna, 2014); Georgia (Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Assibey and Oppong, 2016); Guatemala (Cabrera and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Jellem, Wai Poi and Afkar, 2015); Iran (Enami, Lustig and Taqdiri, 2016); Jordan (Abdel-Halim and others, 2016); Mexico (Scott, 2013); Nicaragua (Cabrera and Moran, 2015); OECD (2011), Peru (Jaramillo, 2015); Russia (Malysin and Popova, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake and others, 2016); Tanzania (Younger, Myamba and Mdadila, 2016); Tunisia (Shimeles and others, 2015); Uganda (Jellem and others, 2016) and Uruguay (Bucheli and others, 2014).

Notes: year of household survey in parenthesis. Data shown here is administrative data reported by the studies cited above and the numbers do not necessarily coincide with those of multilateral organizations. Gross National Income per capita on right axis is in 2011 PPP from World Development Indicators, August 29th, 2016: http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD.

The scenario for South Africa assumed free basic services are direct transfers. For Tanzania, fiscal year runs from July 2011 - June 2012. Figure for OECD average (includes only advanced countries) was directly provided by the statistical office of the organization.
Given the size of social spending (from highest to lowest), Argentina, Brazil, Uruguay, Russia, Costa Rica, Bolivia, and South Africa have the largest amount of resources at their disposal to engage in fiscal redistribution. At the other end of the spectrum are Uganda, Indonesia, Sri Lanka, and Guatemala. Whether the first group achieve their higher redistributive potential, however, depends on how the burden of taxation and the benefits of social spending is distributed. This shall be discussed below. First, however, the next section presents a brief description of the fiscal incidence methodology utilized in the twenty-eight studies.

2 Fiscal Policy and Inequality

Recall that in order to measure the redistributive effect, each CEQ Assessment constructs four income concepts: market income, disposable income, consumable income, and final income. To refresh the reader’s memory, we replicate the diagram presented in chapter 1 of this Handbook:
Diagram 9-1: Basic Income Concepts.

**Market Income**
Wages and salaries, income from capital, private transfers (remittances, private pensions, etc.) before taxes, social security contributions and government transfers AND contributory social insurance old-age pensions ONLY in the case in which pensions are treated as deferred income.

**BENEFITS**
- Direct cash and near cash transfers: conditional and unconditional cash transfers, school feeding programs, free food transfers, etc.
- Indirect subsidies: energy, food and other general targeted price subsidies.
- In-kind transfers: free or subsidized government services in education and health.

**TAXES**
- Personal income taxes AND employee contributions to social security ONLY in the case that contributory pensions are treated as transfers.
- Indirect taxes: VAT, excise taxes and indirect taxes.
- Co-payments, user fees.

**Disposible Income**
- +
- 

**Consumable Income**
- +
- 

**Final Income**

A typical indicator of the redistributive effect of fiscal policy is the difference between the market income Gini and the Gini for income after taxes and transfers, where “after” can refer to just direct taxes and transfers as in disposable income, to the latter plus the effect of net indirect taxes as in consumable income, and to the latter plus the effect of education and health spending as in final income. If the redistributive effect is positive (negative), fiscal policy is equalizing (unequalizing).

Figure 9-3 presents the Gini coefficient for market income and the other three income concepts shown in diagram 9-1: disposable, consumable and final income. In broad terms, disposable income measures how much income individuals may spend on goods and services (and save, including mandatory savings such as contributions to a public pensions system that is actuarially fair). Consumable income measures how much individuals are able to actually consume. For example, a given level of disposable income—even if consumed in full—could mean different levels of actual consumption depending on the size of indirect taxes and subsidies. Final income includes the value of public services in education and health if individuals would have had to pay for those services at the average cost to the government. Based on the fact that contributory pensions can be treated as deferred income or as a direct transfer, here all the calculations are presented for two scenarios: one with contributory pensions included in market income and another with them as government transfers. For consistency, remember that in the first scenario contributions to the system are treated as mandatory savings and in the second as a tax.

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18 All the theoretical derivations that link changes in inequality to the progressivity of fiscal interventions have been derived based on the so-called family of S-Gini indicators, of which the Gini coefficient is one case. See for example, Duclos and Araar (2006). While one can calculate the impact of fiscal policy on inequality using other indicators (and one should), it will not be possible to link them to the progressivity of the interventions.

19 Other measures of inequality such as the Theil index or the 90/10 ratio are available in the individual studies. Requests should be addressed directly to the authors.
Figure 9-3: (Panel A and B): Fiscal Policy and Inequality (circa 2010): Gini Coefficient For Market, Disposable, Consumable, and Final Income.

Panel A: Contributory pensions as deferred income.
Panel B: Contributory pensions as transfers.

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results. Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Oliva, 2014); Ethiopia (Hill, Tsehaye and Woldehanna, 2014); Georgia (Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Assibey and Oppong, 2016); Guatemala (Cabrera and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Jellema, Wai Poi and Afkar, 2015); Iran (Enami, Lustig and Taqdiri, 2016); Jordan (Abdel-Halim and others, 2016); Mexico (Scott, 2013); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2015); Russia (Malytsin and Popova, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake and others, 2016); Tanzania (Younger, Myamba and Mladila, 2016); Tunisia (Shimeles and others, 2015); Uganda (Jellema and others, 2016) and Uruguay (Bucheli and others, 2014).

Notes: Bolivia does not have personal income taxes. In Bolivia, Costa Rica, Ecuador, Honduras, South Africa, and Sri Lanka, market income does not include consumption of own production because the data was either not available or not reliable. For Brazil, the results for the analysis presented here differ from the results published in Higgins and Pereira (2014) because the latter include taxes on services (ISS), on goods and services to finance pensions (CONFINS) and to finance Social Workers (PIS), while the results presented here do not include them. Post publishing the mentioned paper, the authors concluded that the source for these taxes was not reliable. Gini coefficients for Chile are estimated here using total income and, thus, differ from official figures of inequality which are estimated using monetary income (i.e., official figures exclude owner’s occupied imputed rent). In South Africa, the results presented here assume that free basic services are a direct transfer. In Armenia, Costa Rica, Iran, Peru, South Africa and Uruguay, there are no indirect subsidies. For Dominican Republic, the study analyzes the effects
of fiscal policy in 2013, but the household income and expenditure survey dates back to 2006-07. For Indonesia, the fiscal incidence analysis was carried out adjusting for spatial price differences. Personal income taxes are assumed to be zero because the vast majority of households have implied market incomes below the tax threshold. The only contributory pensions in South Africa are for public servants who must belong to the GEPF. Since the government made no transfers to the GEPF in 2010/11, there is no scenario with contributory pensions as transfer. The same occurs in the cases of Ethiopia, Ghana, and Tanzania. The only contributory pensions in Sri Lanka are for public servants and income from pensions has been considered as part of the public employees’ labor contract, rather than a transfer in spite of the fact that the funding comes from general revenues. In other words, for Ethiopia, Ghana, South Africa, Sri Lanka, Tanzania, and Uganda, there is no scenario in which contributory pensions are considered as a transfer. Georgia has a noncontributory public pension scheme only and, therefore, they are only treated as a transfer. In all these cases, the scenario is the same in both panels. In Uganda, consumption expenditure is the primary income measure, and as all other income concepts including market income are derived from consumption expenditure, it is not created the taxable income concept.

As can be observed, in Honduras, Guatemala, and Indonesia, fiscal income redistribution is quite limited while in Argentina, Georgia, South Africa, and Brazil, it is of a relevant magnitude. One can observe that—in the scenario in which contributory pensions are treated as deferred income—Argentina and South Africa are the countries that redistribute the most; South Africa, however, remains the most unequal even after redistribution. It is interesting to note that although Brazil and Colombia start out with similar market income inequality, Brazil reduces inequality considerably while Colombia does not. Similarly, Mexico, Costa Rica, and Guatemala start out with similar levels of market income inequality but Mexico and Costa Rica reduce inequality by more. Ethiopia is the less unequal of all twenty-eight and fiscal redistribution is also the smallest in order of magnitude. In almost all cases, the largest change in inequality occurs between consumable and final income. This is not surprising given the fact that governments spend more on education and health than on direct transfers and pensions. However, one should not make sweeping conclusions from this result because—as explained in chapters 1 and 5 of this Handbook—in-kind transfers are valued at average government cost which is not really a measure of the “true” value of these services to the individuals who use them.

As indicated in chapter 1 of this Handbook, contributory pensions are in many cases a combination of deferred income and government transfer. Given that at present the CEQ methodology does not include a way to estimate which portion of a contributory pension is deferred income and which is a government transfer (or a tax, if the individual receives less than what he or she should have received given his/her contributions), the CEQ Assessments produce results for both “extreme” assumptions: contributory pensions as pure deferred income (in which contributions are a form of mandatory savings) and as pure government transfer (in which contributions are treated as any other direct tax). Panels A and B in Figure 9-3 show that the patterns of inequality decline are similar whether one looks at the scenario in which contributory pensions are considered deferred income (and, thus, part of market income) or with pensions as transfers. In Argentina, Armenia, Russia, and Uruguay, the redistributive effect is considerably larger when contributory pensions are treated as a transfer. These are countries with higher coverage and an older population. In Chile, Costa Rica, Ecuador, Iran, and Jordan, the effect is larger but very slightly. Interestingly, in Bolivia, Brazil, Colombia, Dominican
Republic, El Salvador, Honduras, Mexico, Nicaragua, and Tunisia, the redistributive effect is smaller when contributory pensions are considered a government transfer versus deferred income.

3. Measuring the Marginal Contribution of Taxes and Transfers

As discussed in chapter 1 of this Handbook, the CEQ methodology measures the impact of a tax or a transfer by relying on the marginal contribution which, as formally discussed in chapter 2 of this Handbook, is equal to the difference between the Gini (or other inequality measures) for a post-fiscal income concept without the fiscal intervention of interest (e.g., a particular tax) and the post-fiscal income including all the interventions. Figure 9-4 shows the marginal contribution on net direct taxes (direct taxes net of direct transfers), net indirect taxes (indirect taxes net of subsidies), and spending on education and health. Existing fiscal redistribution studies frequently stop at direct taxes and direct transfers. Note that an equalizing (unequalizing) effect is presented with a positive (negative) sign but with downward point bars. The first result to note is that net direct taxes are, as expected, always equalizing. The second result to note is that net indirect taxes are equalizing in nineteen of the twenty-eight countries. The marginal contribution of government spending on education and health is always equalizing.

Figure 9-4 (Panel A, B, and C): Marginal Contribution of Taxes and Transfers (circa 2010).
Panel A: Marginal Contributions of Net Direct Taxes (Contributory Pensions as Deferred Income).

Panel B: Marginal Contributions of Net Indirect Taxes (Contributory Pensions as Deferred Income).

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20 For example, the data published by EUROMOD, op. cit.
21 Note that for the reasons mentioned in the paragraph immediately above, one cannot compare the orders of magnitude between categories of income.
Panel C: Marginal Contributions of In-Kind Transfers in Education and Health (Contributory Pensions as Deferred Income).

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results.
Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Oliva, 2014); Ethiopia (Hill, Tsehay and Woldehanna, 2014); Georgia (Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Assibey and Oppong, 2016); Guatemala (Cabrera and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Jellema, Wai Poi and Afkar, 2015); Iran (Enami, Lustig and Taqdiri, 2016); Jordan (Abdel-Halim and others, 2016); Mexico (Scott, 2013);
Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2015); Russia (Malytsin and Popova, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake and others, 2016); Tanzania (Younger, Myamba and Mdadila, 2016); Tunisia (Shimeles and others, 2015); Uganda (Jellema and others, 2016) and Uruguay (Bucheli and others, 2014).

Notes: The marginal contribution of net direct taxes is calculated as the difference between Gini of market income plus contributory pensions and disposable income (panel A). The marginal contribution of net indirect taxes is calculated as the difference between Gini of disposable income and consumable income (panel B). The marginal contribution of in-kind transfers is calculated as the difference between Gini of consumable income and final income (panel C).

Country specific results indicate that, as expected, direct taxes, direct transfers, and spending on education and health are equalizing. However, contrary to expectations, indirect taxes, indirect subsidies, and spending on tertiary education are more frequently equalizing than unequalizing. Results also show the presence of Lambert’s conundrum (see chapters 1 and 2 of this Handbook) in the case of Chile where the VAT is regressive—the Kakwani coefficients is negative—and yet its marginal contribution is equalizing.

4. Is There Evidence of a Robin Hood Paradox?

One of the most important findings in Lindert’s path-breaking work is that both across countries and over time, resources devoted to the poor are lower in the nations in which poverty and inequality are greater. According to Lindert,

History reveals a “Robin Hood paradox,” in which redistribution from rich to poor is least present when and where it seems most needed. Poverty policy within any one polity or jurisdiction is supposed to aid the poor more, … the greater the income inequality. Yet over time and space, the pattern is usually the opposite. While there are exceptions to this general tendency, the underlying tendency itself is unmistakable, both across the globe and across the past three centuries.

In contrast to Lindert’s findings, however, I do not find evidence of a “Robin Hood” paradox in this group of twenty-eight low and middle income countries (even if we leave out “outliers” and even if we change the sample size). First, as it is shown in Figure 9-5, the more unequal countries devote more resources to tax-based redistribution measured by the size of social spending as a share of GDN. Second, as shown in Figure 9-6, redistribution from rich to poor is greater in countries where market income inequality is higher, a result that seems consistent with the prediction of the Meltzer and

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22 These results are available upon request.
Richard median-voter hypothesis. This result is robust even if Argentina, Georgia, or South Africa are removed from the sample. The result is also robust if the redistributive effect is measured as a percentage change instead of Gini points. An OECD study illustrates that more market income inequality tends to be associated with higher redistribution, for a sub-set of OECD countries, both within countries (over time) and across countries.

Figure 9.5: Initial Inequality and Social Spending, circa 2010. (Social spending/GDP and market income plus pensions inequality (Contributory pensions as deferred income)).

\[
y = 0.2215x^{***} - 0.0039 \\
R^2 = 0.2655
\]
Figure 9-6: Initial Inequality and Fiscal Redistribution, circa 2010.
(Redistributive effect and market income plus contributory pensions inequality (Contributory pensions as deferred income)).

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results. Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Oliva, 2014); Ethiopia (Hill, Tsehay and Woldehanna, 2014); Georgia (Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Assibey and Oppong, 2016); Guatemala (Cabrera and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Jellema, Wai Poi and Afkar, 2015); Iran (Enami, Lustig and Taqdiri, 2016); Jordan (Abdel-Halim and others, 2016); Mexico (Scott, 2013); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2015); Russia (Malysin and Popova, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake and others, 2016); Tanzania (Younger, Myamba and Mladila, 2016); Tunisia (Shimeles and others, 2015); Uganda (Jellema and others, 2016) and Uruguay (Bucheli and others, 2014).

Notes: The dotted line in red is the slope obtained from a simple regression with the redistributive effect as a dependent variable. Redistributive effect is defined as the difference between Gini of market income plus contributory pensions and disposable. In parentheses are t statistics. * p<0.1, ** p<0.05, *** p<0.01.

Could the above results be driven because more unequal countries tend to be richer and therefore have higher capacity to raise revenues and afford higher levels of spending? Preliminary results from regressing the redistributive effect (measured as change in the Gini coefficient from market to final income in Gini points) on GNI per capita and the market-income Gini shows that the coefficient for the latter is positive: i.e., the more unequal, the more redistribution. The coefficient for GNI per capita is significant but small. The coefficient for market income inequality, however, is not significant when the redistributive effect is measured from market to disposable income only, when pensions are considered a pure transfer, when
removing Argentina and South Africa, or when the redistributive effect is measured in percent (instead of Gini points). In a few cases, the coefficient for the market-income Gini is even negative but not significant.  

Differences in redistribution change the ranking of countries by inequality level. Figure 9-7, panel A displays the levels of income inequality before (horizontal axis) and after (vertical axis) accounting for fiscal policies. Since all data points fall below the diagonal, fiscal policies reduce inequality in all countries. South Africa continues to be the most unequal country and Ethiopia the least unequal country based on income before or after fiscal policy. However, due to lower redistribution, Peru ends up being more unequal than Brazil once fiscal policies are considered while the opposite was true when inequality is measured with market income.

Figure 9-7 (Panel A and B): Market Income Plus Contributory Pensions Gini Versus Final Income Gini, circa 2010.

Panel A: Final income inequality and market income plus contributory pensions inequality (Contributory pensions as deferred income).

\[ y = 0.7103x^{***} + 0.0696^* \]
\[ R^2 = 0.7747 \]

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29 Results are available upon request.
Panel B: Final income inequality and market income inequality (Contributory pensions as transfers).

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results. Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Oliva, 2014); Ethiopia (Hill, Tsehaye and Woldehanna, 2014); Georgia (Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Assibey and Oppong, 2016); Guatemala (Cabrera and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Jellema, Wai Poi and Afkar, 2015); Iran (Enami, Lustig and Taqdiri, 2016); Jordan (Abdel-Halim and others, 2016); Mexico (Scott, 2013); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2015); Russia (Malytsin and Popova, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake and others, 2016); Tanzania (Younger, Myamba and Mdadila, 2016); Tunisia (Shimeles and others, 2015); Uganda (Jellema and others, 2016); Uruguay (Bucheli and others, 2014).

Notes: The dotted line in red is the slope obtained from a simple regression with the final income Gini as a dependent variable. The dotted line in blue is a 45 degree line. In parentheses are t statistics. * p<0.1, ** p<0.05, ***p<0.01.

The number of countries in panel B is smaller because it does not include the countries for which—for different reasons—there is no additional scenario in which contributory pensions were considered a transfer, namely: Ethiopia, Georgia, Ghana, South Africa, Sri Lanka, Tanzania, and Uganda.

5. Redistributive Effect: a Comparison with Advanced Countries

How do these twenty-eight countries compare with the fiscal redistribution that occurs in advanced countries? Although the methodology is somewhat different, one obvious comparator is the analysis produced by EUROMOD for the twenty-eight countries in the European Union. ³⁰ Given that EUROMOD covers only direct taxes, contributions to social security and direct transfers, the comparison

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can be done for the redistributive effect from market to disposable income. A comparison is also made with the United States.\textsuperscript{31}

There are three important differences between the advanced countries and the twenty-eight ones analyzed here. First, market income inequality tends to be somewhat higher for the twenty-eight countries.\textsuperscript{32} However, the difference is most striking when pensions are treated as transfers. The average market Gini coefficient for the twenty-eight countries for the scenario in which pensions are treated as deferred income and the scenario in which they are considered transfers is 47.3 and 49.0 percent, respectively. In contrast, in the EU, the corresponding figures are 35.6 and 46.3 percent, respectively; and in the US, they are, 44.8 and 48.4, respectively. One important aspect to note, however, is that in the EU, pensions include both contributory and noncontributory social pensions while in the twenty-eight countries and the US, the category of pensions includes only contributory pensions. In the scenario where we consider the pre-fiscal income market income plus contributory pensions, the Gini for the pre-fiscal income would be lower.

Second, as expected and shown in figure 9-8, the redistributive effect is larger in the EU countries and, to a lesser extent, in the United States if pensions are considered a government transfer. In the twenty-eight countries, whether pensions are treated as deferred income or a transfer makes a relatively small difference. This is not the case in the EU countries where the difference is huge. In the EU, the redistributive effect with contributory pensions as deferred income and contributory pensions as a transfer is 7.7 and 19.0 Gini points, respectively. In the United States, the numbers are less dramatically different: 7.2 and 11.2, respectively. In the twenty-eight countries, the numbers are 2.7 and 3.8 Gini points, respectively. Clearly, the assumption made about how to treat incomes from pensions, again, makes a big difference. The results for the scenario with pensions as transfers for the EU and the US are influenced by what in chapter 1 of this Handbook we called the presence of “false poor:” that is, many households composed of retirees appear, by definition, with zero or near zero market income. However, as discussed in chapter 1 of this Handbook, the counterfactual income should not be zero but what these households would have been able to spend during retirement based on the history of their contributions and market returns.

\textsuperscript{31} Higgins and others. (2016).
\textsuperscript{32} South Africa pulls the average up but Indonesia pulls it down.
Figure 9-8: Redistributive Effect: Comparing Developing and Advanced Countries. (Change in Gini Points; circa 2010).

Panel A: Individual Countries.

Panel B: Low and Middle Income Countries, the United States, and average for EU-28.
Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results. Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escudер and others, 2016); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Oliva, 2014); Ethiopia (Hill, Tsehaye and Woldehanna, 2014); European Union (EUROMOD version no. G3.0); Georgia (Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Assibey and Oppong, 2016); Guatemala (Cabrera and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Jellema, Wai Poi and Afkar, 2015); Iran (Enami, Lustig and Taqdiri, 2016); Jordan (Abdel-Halim and others, 2016); Mexico (Scott, 2013); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2015); Russia (Malytsin and Popova, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake and others, 2016); Tanzania (Younger, Myamba and Mdadila, 2016); Tunisia (Shimeles and others, 2015); Uganda (Jellema and others, 2016); United States (Higgins and others, 2016) and Uruguay (Bucheli and others, 2014).

Notes: year of household survey in parenthesis. For definition of income concepts see the section on methodological highlights in text. Redistributive effect is defined as the difference between Gini of market income plus contributory pensions and disposable income with contributory pensions treated as deferred income and the difference between Gini of market income and disposable income with contributory pensions treated as transfers. The graph is ranked from the smallest to the largest by redistributive effect with contributory pensions treated as deferred income.

The number of countries in the scenario in which contributory pensions are treated as a transfer is smaller because it does not include the countries for which—for different reasons—there is no additional scenario in which contributory pensions were considered a transfer, namely: Ethiopia, Georgia, Ghana, South Africa, Sri Lanka, Tanzania, and Uganda.

While in low and middle income countries pensions can sometimes be equalizing and unequalizing at other times, in no European country nor in the United States, contributory pensions are ever unequalizing. On the contrary, vis-à-vis market income without pensions, they exert a large equalizing force in the EU and less so in the US. Using data for 2011, for example, the difference between the market income Gini and the market income Gini plus contributory pensions is 10.7 percentage points in the EU and 3.6 in the United States.

How does social spending in today’s developing countries compare with that of today’s advanced countries but when their income per capita was similar the former’s? Around 2010, among the countries that spent the least on education is El Salvador: 2.9 percent of GDP. According to Angus Maddison’s estimates, in 1900 international dollars, El Salvador’s GDP per capita in 2008 was similar to that of the United States in 1880, and Guatemala’s and Peru’s were similar to the United States’ around 1900. The United States, a pioneer in public education, according to Lindert devoted only 0.74 percent of GDP in 1880 and 1.24 percent in 1900.33 That is, the lowest spenders on public education of the twenty-eight countries in this chapter spent more than twice the amount spent by the United States when it was approximately equally poor. Sweden was as rich as today’s El Salvador around 1910, at which time Sweden spent 1.26 percent of GDP on public education, or about half as much as El Salvador in 2010. Around 2010, Indonesia showed among the lowest spending on health: 0.9 percent of GDP; the figure for Ethiopia was 1.25 percent and for Brazil above 5 percent. When the United States (around 1900) was as rich as Indonesia in the early twenty-first century (2008), according to Lindert it spent about 0.17 percent of GDP in government

33 Appendix C in Lindert (2004).
subsidies for health care.\textsuperscript{34} When the United States was as rich as Brazil was in 2008, it spent only 0.4 percent of GDP in health subsidies.\textsuperscript{35}

6. Fiscal Policy and the Poor

The above discussion has concentrated on the impact of fiscal policy on inequality. As important is the impact of fiscal policy on poverty. In particular, because the results not necessarily go in the same direction: in other words, an inequality reducing fiscal system could be poverty increasing. The effect of fiscal policy on poverty can be measured using the typical indicators such as the headcount ratio for market income and income after taxes and transfers. Another measure that one can use to assess the impact of fiscal policy on the poor is the extent to which market income poor end up being net payers to the fiscal system in cash terms (leaving out in-kind services). A third measure is that of fiscal impoverishment; in other words, the extent to which fiscal policy makes the poor (non-poor) poorer (poor).

When analyzing the impact of fiscal interventions on poverty, it is useful to distinguish between the net benefits in cash from the benefits received in the form of free government services in education and health. The cash component of fiscal policy impact is measured by comparing the indicators for consumable income with the same indicators using market income. The level of consumable income will tell whether the government has enabled an individual to be able to purchase private goods and services above his or her original market income. As shown in figure 9-9 (panel A), using the $2.50 (PPP 2005 a day) poverty line,\textsuperscript{37} fiscal policy reduces the headcount ratio for consumable income in most countries.\textsuperscript{38} However, there is a startling result. In the scenario in which pensions are considered deferred income, the consumable income headcount ratio for Armenia, Bolivia, Ethiopia, Ghana, Guatemala, Honduras, Nicaragua, Sri Lanka, and Tanzania is higher than the headcount ratio for market income. This is a worrisome result. Poverty should not be higher as a result of fiscal policy. Note that this result occurs despite the fact that the net fiscal system (even without including in-kind transfers) reduces inequality. This emphasizes the fact that the impact of fiscal interventions on inequality and poverty should be studied separately, as indicated in chapter 1 of this Handbook.

\textsuperscript{34}Table 1D in Lindert (1994).
\textsuperscript{35}The United States in about 1925 was as rich as Brazil in 2008. The health spending figure corresponds to 1920 (Lindert 1994).
\textsuperscript{36}Higgins and Lustig, (2016).
\textsuperscript{37}The $2.50 a day poverty line is considered to be a reasonable international extreme poverty line for middle-income countries: for example, in the case of Latin America, this poverty line is close to the average of the local extreme poverty lines.
\textsuperscript{38}Chile’s result is particularly high because market income poverty is lower in Chile than in the other countries. Thus, a similar change in percentage points represents a large change when measured in percentage change as done in Figure 9 above.
Figure 9-9: (Panel A and B): Fiscal Policy and Poverty Reduction (circa 2010): Change in Headcount Ratio from Market to Disposable and Consumable Income; in percent.

Panel A: Contributory Pensions as Deferred Income.

<table>
<thead>
<tr>
<th>Country</th>
<th>Market income plus pensions to disposable income</th>
<th>Market income plus pensions to consumable income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana (2013)</td>
<td>+9.1%</td>
<td>+11.4%</td>
</tr>
<tr>
<td>Tanzania (2011)</td>
<td>+5.7%</td>
<td>+0.3%</td>
</tr>
<tr>
<td>Uganda (2013)</td>
<td>+4.1%</td>
<td>+0.3%</td>
</tr>
<tr>
<td>Nicaragua (2009)</td>
<td>+5.4%</td>
<td>+0.5%</td>
</tr>
<tr>
<td>Sri Lanka (2008)</td>
<td>+1.1%</td>
<td>+0.0%</td>
</tr>
<tr>
<td>Honduras (2011)</td>
<td>-0.8%</td>
<td>+0.0%</td>
</tr>
<tr>
<td>Colombia (2010)</td>
<td>-11.4%</td>
<td>+0.8%</td>
</tr>
<tr>
<td>Peru (2009)</td>
<td>-10.5%</td>
<td>+0.3%</td>
</tr>
<tr>
<td>Armenia (2011)</td>
<td>-0.6%</td>
<td>+0.0%</td>
</tr>
<tr>
<td>Tunisia (2010)</td>
<td>+4.7%</td>
<td>-2.8%</td>
</tr>
<tr>
<td>El Salvador (2009)</td>
<td>-21.4%</td>
<td>-35.9%</td>
</tr>
<tr>
<td>Bolivia (2009)</td>
<td>+2.2%</td>
<td>-40.6%</td>
</tr>
<tr>
<td>Costa Rica (2009)</td>
<td>+24.0%</td>
<td>-35.1%</td>
</tr>
<tr>
<td>Ecuador (2010)</td>
<td>+29.1%</td>
<td>-35.6%</td>
</tr>
<tr>
<td>Russia (2010)</td>
<td>+35.4%</td>
<td>-51.3%</td>
</tr>
<tr>
<td>Georgia (2013)</td>
<td>+35.1%</td>
<td>-51.1%</td>
</tr>
<tr>
<td>Chile (2013)</td>
<td>+34.8%</td>
<td>-74.1%</td>
</tr>
<tr>
<td>Uruguay (2009)</td>
<td>+35.9%</td>
<td>-75.1%</td>
</tr>
<tr>
<td>Average</td>
<td>+11.7%</td>
<td>-79.8%</td>
</tr>
</tbody>
</table>

(ranked by poverty reduction in %; poverty line $2.50 2005 PPP/day)
Panel B: Contributory Pensions as Transfers.

Source: CEQ Institute's Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results. Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Olivia, 2014); Ethiopia (Hill, Tsehaye and Woldehanna, 2014); Georgia (Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Asisbey and Opong, 2016); Guatemala (Cabrera and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Jelkema, Wai Poi and Afkar, 2015); Iran (Enami, Lustig and Taqdiri, 2016); Jordan (Abdel-Halim and others, 2016); Mexico (Scott, 2013); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2015); Russia (Malysin and Popova, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake and others, 2016); Tanzania (Younger, Myamba and Mdakila, 2016); Tunisia (Shimeles and others, 2015); Uganda (Jelkema and others, 2016) and Uruguay (Bucheli and others, 2014).

Notes: Percentage of poverty reduction is defined as percentage change in headcount ratio from market income (or market income plus contributory pensions) to consumable income. The number of countries in panel B is smaller because it does not include the countries for which—for different reasons—there is no additional scenario in which contributory pensions were considered a transfer, namely: Ethiopia, Georgia, Ghana, South Africa, Sri Lanka, Tanzania, and Uganda.
In principle, it would be desirable for the poor—especially the extreme poor—to be net receivers of fiscal resources in cash so that poor individuals can buy/consume the minimum amounts of food and other essential goods imbedded in the selected poverty line. Figure 9-10 shows at which market income category, individuals—on average—become net payers to the fiscal system (again, this calculation only takes into account direct transfers in cash or near cash such as food). In Ghana, Nicaragua, and Tanzania net payers to the fiscal system begin in the income category $US0-$US1.25/day in purchasing power parity (ultra-poor). In Guatemala, Ethiopia, and Armenia net payers begin in the income group of extreme poor with $US1.25-$US2.50/day. In Sri Lanka, Peru, El Salvador, Dominican Republic, Honduras and Bolivia net payers to the fiscal system begin in the income category $US2.50-$US4/day in purchasing power parity. That is, in the group classified as moderately poor. In 11 countries; the net payers start in the group known as “vulnerable.” In Iran and Indonesia, only the “rich” are net payers to the fiscal system (on average). If contributory pensions are considered a government transfer (not shown), net payers to fiscal system start in extreme poor income group in Guatemala and Nicaragua, and moderately poor group in Peru, Honduras, El Salvador, Dominican Republic, Bolivia, and Armenia.

39 Note that this graph presents a non-anonymous result: it looks at the extent to which the market income poor become net payers to the fiscal system on average. This information cannot be extrapolated from the typical poverty measures where winners and losers are not tracked.

40 These income categories are based on Lopez-Calva and Ortiz-Juarez (2014) and Ferreira and others (2012).
Figure 9-10: Net Payers to the Fiscal System by Income Groups (Contributory Pensions as Deferred Income).

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results. Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Oliva, 2014); Ethiopia (Hill, Tsehaye and Woldehanna, 2014); Georgia
(Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Assibey and Oppong, 2016); Guatemala (Cabrera and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Jellema, Wai Poi and Afkar, 2015); Iran (Enami, Lustig and Taqdiri, 2016); Jordan (Abdel-Halim and others, 2016); Mexico (Scott, 2013); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2015); Russia (Malytsin and Popova, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake and others, 2016); Tanzania (Younger, Myamba and Mdadila, 2016); Tunisia (Shimeles and others, 2015); Uganda (Jellema and others, 2016) and Uruguay (Bucheli and others, 2014).

Using the measures discussed in Higgins and Lustig, as can be seen in table 9-1, the proportion of poor (nonpoor) people who were made poorer (poor) of the by fiscal policy as a share of the total population and, in particular, the consumable income poor is nontrivial. Moreover, this is so even though in the majority of countries shown on the table, the fiscal system is inequality and poverty reducing as revealed by the change in the headcount ratio and the Gini coefficient.

41 Higgins and Lustig (2016); also included as chapter 4 in this handbook.
Table 9-1: Fiscal Impoverishment (circa 2010): Contributory Pensions as Deferred Income; in Percentage.

<table>
<thead>
<tr>
<th>Country (survey year)</th>
<th>Market income plus contributory pensions</th>
<th>Change in poverty headcount (p.p.)</th>
<th>Market income plus contributory pensions inequality (Gini)</th>
<th>Reynolds-Smolensky Change in inequality (▲Gini)</th>
<th>Fiscally impoverished as % of population</th>
<th>Fiscally impoverished as % of consumable income poor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Upper-middle income countries, using a poverty line of $2.5 PPP per day</strong></td>
<td>2005</td>
<td>Brazil (2009)</td>
<td>16.8</td>
<td>-0.8</td>
<td>57.5</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chile (2013)</td>
<td>2.8</td>
<td>-1.4</td>
<td>49.4</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ecuador (2011)</td>
<td>10.8</td>
<td>-3.8</td>
<td>47.8</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mexico (2012)</td>
<td>13.3</td>
<td>-1.2</td>
<td>54.4</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Peru (2011)</td>
<td>13.8</td>
<td>-0.2</td>
<td>45.9</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Russia (2010)</td>
<td>4.3</td>
<td>-1.3</td>
<td>39.7</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South Africa (2010)</td>
<td>49.3</td>
<td>-5.2</td>
<td>77.1</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tunisia (2010)</td>
<td>7.8</td>
<td>-0.1</td>
<td>44.7</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>Panel B: Lower-middle income countries, using a poverty line of $1.25 2005 PPP per day</strong></td>
<td>2011</td>
<td>Armenia (2011)</td>
<td>21.4</td>
<td>-9.6</td>
<td>47.4</td>
<td>12.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bolivia (2009)</td>
<td>10.9</td>
<td>-0.5</td>
<td>50.3</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dominican Republic (2013)</td>
<td>6.8</td>
<td>-0.9</td>
<td>50.2</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>El Salvador (2011)</td>
<td>4.3</td>
<td>-0.7</td>
<td>44.0</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethiopia (2011)</td>
<td>31.9</td>
<td>2.3</td>
<td>32.2</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ghana (2013)</td>
<td>6.0</td>
<td>0.7</td>
<td>43.7</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guatemala (2010)</td>
<td>12.0</td>
<td>-0.8</td>
<td>49.0</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indonesia (2012)</td>
<td>12.0</td>
<td>-1.5</td>
<td>39.8</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sri Lanka (2010)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tanzania (2011)</td>
<td>5.0</td>
<td>-0.7</td>
<td>37.1</td>
<td>1.3</td>
</tr>
</tbody>
</table>


7. Education and Health Spending

To what extent are the poor benefitting from government spending on education and health? The pro-poorness of public spending on education and health here is measured using concentration coefficients (also called quasi-Ginis). In keeping with conventions, spending is defined as regressive whenever the

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42 Section based on Lustig (2015).

43 A concentration coefficient is calculated in a way analogous to the Gini coefficient. Let \( p \) be the cumulative proportion of the total population when individuals are ordered in increasing income values using market income, and let \( C(p) \) be the concentration curve; the
concentration coefficient is higher than the Gini for market income. When this occurs, it means that the benefits from that spending as a share of market income tend to rise with market income. Spending is progressive whenever the concentration coefficient is lower than the Gini for market income. This means that the benefits from that spending as a share of market income tend to fall with market income. Within progressive spending, spending is neutral in absolute terms -- spending per capita is the same across the income distribution--whenever the concentration coefficient is equal to zero. Spending is defined as pro-poor whenever the concentration coefficient is not only lower than the Gini but also its value is negative. Pro-poor spending implies that the per capita government spending on the transfer tends to fall with market income. Any time spending is pro-poor or neutral in absolute terms, by definition it is progressive. The converse, of course, is not true. The taxonomy of transfers is synthesized in Figure 1-4 in chapter 1.

A clarification is in order. In the analysis presented here, households are ranked by per capita market income, and no adjustments are made to their size because of differences in the composition by age and gender. In some analyses, the pro-poorness of education spending, for example, is determined using children—not all members of the household—as the unit of analysis. Because poorer families have, on average, a larger number of children, the observation that concentration curves are pro-poor is a reflection of this fact. It doesn’t mean that poorer families receive more resources per child.

Table 9-2 summarizes the results regarding the pro-poorness of government spending on education (total and by level) and health. Total spending on education is pro-poor (that is, per capita spending declines with income) in upper-middle-income and high-income countries except for South Africa and Iran, where it is (approximately) neutral in absolute terms. Total per capita spending on education tends to be the same (neutral in absolute terms) across different income groups in low-income and lower-middle-income countries, except for Armenia and El Salvador where it is pro-poor, and Ethiopia and Uganda where it is progressive only in relative terms. Pre-school tends to be pro-poor in all countries for which there is data except for Georgia. Primary school is pro-poor in all countries other than Ethiopia. For secondary school, spending is pro-poor in all upper-middle-income and high-income countries for which there is data except for Ecuador, where it is (approximately) neutral in absolute terms. Secondary school spending is neutral in most low-income and lower-middle-income countries other than Bolivia (pro-poor), and Ethiopia and Uganda (progressive only in relative term). Government spending on tertiary education is regressive in Ethiopia, Uganda, Tanzania, Ghana, and Guatemala and progressive only in relative terms in various degrees in the rest.

44I say “tend” because for global regressivity/progressivity to occur it is not a necessary condition for the share of the benefit to rise/fall at each and every income level. When the latter occurs, the benefit is regressive/progressive everywhere. Whenever a benefit is everywhere regressive/progressive, it will be globally regressive/progressive, but the converse is not true.

45This case is also sometimes called progressive in absolute terms.

46As mentioned above, care must be taken not to infer that any spending that is progressive (regressive) will automatically be equalizing (unequalizing).
Table 9-2: Progressivity and Pro-Poorness of Education and Health Spending, Summary of Results.

<table>
<thead>
<tr>
<th></th>
<th>Education Total</th>
<th>Preschool</th>
<th>Primary</th>
<th>Secondary</th>
<th>Tertiary</th>
<th>Health</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Argentina (2012)</td>
<td>+</td>
<td>+</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Armenia (2011)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bolivia (2009)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Brazil (2009)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Chile (2013)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Colombia (2010)</td>
<td>--</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Costa Rica (2010)</td>
<td>--</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Dominican Republic (2013)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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</tr>
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</table>

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on the following Master Workbooks of Results: Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2014); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2016); Chile (Martinez-Aguilar and Ortiz-Juarez, 2016); Colombia (Melendez and Martinez, 2015); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2014); Ecuador (Llerena and others, 2014); El Salvador (Beneke, Lustig and Oliva, 2014); Ethiopia (Hill, Tschaye and Woldehanna, 2014); Georgia (Cancho and Bondarenko, 2015); Ghana (Younger, Osei-Assibey and Oppong, 2016); Guatemala (Cabrera and Moran,
Notes:

A = Pro-poor, concentration coefficient is negative. B = Same per capita for all, concentration coefficient equals zero. C = Progressive, concentration coefficient positive but lower than market income plus contributory pensions Gini. D = Regressive, concentration coefficient positive and higher than market income plus contributory pensions Gini.

-- is not available

If the Concentration Coefficient is higher or equal to -0.5 but not higher than 0.5, it was considered equal to 0.

The scenario for South Africa assumed free basic services are direct transfers.

Health spending is pro-poor (that is, per capita spending declines with income) in Georgia, Brazil, Dominican Republic, Ecuador, South Africa and all high-income economies. In Armenia, Bolivia, Ghana, Honduras, Sri Lanka, Mexico, Nicaragua, Tunisia, and Uganda, the per capita benefit is roughly the same across the income scale. In Ethiopia, Tanzania, El Salvador, Guatemala, Indonesia, Peru, and Jordan, health spending per person is progressive in only relative terms.

While the results regarding the pro-poorness of spending on education and health are quite encouraging, a caveat is in order. Guaranteeing access and facilitating usage of public education and health services for the poor is not enough. As long as the quality of schooling and healthcare provided by the government is low, distortive patterns (for example, mostly the middle-classes and the rich benefitting from free tertiary education), such as those observed in Brazil and South Africa, will be a major obstacle to the equalization of opportunities. However, with the existing information, one cannot disentangle to what extent the progressivity or pro-poorness of education and health spending is a result of differences in family composition (the poor have more children and, therefore, poor households receive higher benefits in the form of basic education transfers) or frequency of illness (the poor have worst health than the non-poor) versus the “opting-out” of the middle-classes and the rich.

8. Conclusions

In order to analyze the impact of fiscal policy on income inequality it is useful to separate the “cash” portion of the system (direct taxes, direct transfers, indirect taxes, and indirect subsidies) from the “in kind” portion (the monetized value of the use of government education and health services). The results show that the reduction in inequality induced by the cash portion of the fiscal system is quite heterogeneous. Redistributive success is broadly determined primarily by the amount of resources and their combined progressivity. Net direct taxes are always equalizing. The effect of net indirect taxes is equalizing in nineteen of the twenty-eight countries.

47 Among the reasons for this outcome is the fact that children of poor households tend to drop out of high school more and the rich children who receive enough quality (often private) education are better equipped to pass the entrance examination.
While the cash portion of the net fiscal system is always equalizing, the same cannot be said for poverty. In Armenia, Bolivia, Ethiopia, Ghana, Guatemala, Honduras, Nicaragua, Tanzania, and Sri Lanka the headcount ratio measured with the international extreme poverty line of US$2.50 (PPP 2005 per day) is higher for consumable income than for market income. In these countries, fiscal policy increases poverty, meaning that a significant number of the market income poor (non-poor) are made poorer (poor) by taxes and transfers.\footnote{Higgins and Lustig (2016).} This startling result is primarily the consequence of high consumption taxes on basic goods.

Turning now to the in-kind portion of the fiscal system, spending on education and health is equalizing and its contribution to the reduction in inequality is rather large. This result is not surprising given that the use of government services is monetized at a value equal to average government cost. While the results concerning the distribution of the benefits of in-kind services in education and health are encouraging from the equity point of view, it is important to note that they may be due to factors one would prefer to avoid. The more intensive use of services in education and health on the part of the poorer portions of the population, for example, may be caused by the fact that, in their quest for quality, the middle-classes (and, of course, the rich) chose to use private providers. This situation leaves the poor with access to second-rate services. In addition, if the middle-classes opt out of public services, they may be much more reluctant to pay the taxes needed to improve both the coverage and quality of services than they would be if services were used universally.

An important result to note is that there is no evidence of a “Robin Hood paradox”: the more unequal countries tend to spend more on redistribution and show a higher redistributive effect. However, regression-based analysis indicates that this last result is not robust across the board when one controls for income per capita and leaves out the “outliers” or measures redistribution in percent change instead of Gini points.

There are a few lessons that emerge from the analysis. Let’s start with those pertaining to the diagnostic of fiscal redistribution. First, the fact that specific fiscal interventions can have countervailing effects underscores the importance of taking a coordinated view of both taxation and spending rather than pursuing a piecemeal analysis. Efficient regressive taxes (such as the value added tax) when combined with generous well-targeted transfers can result in a net fiscal system that is equalizing. Even more, because a net fiscal system with a regressive tax could be more equalizing than without it (Lambert’s conundrum), policy recommendations—such as eliminating the regressive tax—based on a piecemeal analysis could be flatly wrong. Second, to assess the impact of the fiscal system on people’s standard of living, it is crucial to measure the effect of taxation and spending not only on inequality but also on poverty: the net fiscal system can be equalizing but poverty-increasing.

Regarding policy prescriptions, one fundamental lesson emerges: governments should design their tax and transfers system so that the after taxes and transfers incomes (or consumption) of the poor are not lower than their incomes (or consumption) before fiscal interventions. Leaving out in-kind transfers, the so-called cash portion of the fiscal system should not impoverish the poor (or make the non-poor poor). The
results indicate that the ultra-poor in Ghana, Nicaragua, and Tanzania, the extreme poor in Armenia, Ethiopia, and Guatemala and the moderate poor in Sri Lanka, Peru, El Salvador, Dominican Republic, Honduras, and Bolivia are net payers into the fiscal system. In the case of Brazil, the cause is the high consumption taxes paid on staple goods. In the case of Peru, cash transfers are too small to compensate for what the poor pay in taxes. Furthermore, as shown in Higgins and Lustig, fiscal impoverishment can be quite pervasive and, in low-income countries, larger in magnitude than fiscal gains to the poor.

The current policy discussion (and the literature) focuses primarily on the power of fiscal policy to reduce inequality and much less (and often not at all) on the impact of fiscal policy on the standard of living of the poor. If the policy community is seriously committed to eradicating income poverty, governments will need to explore ways to redesign taxation and transfers so that the poor do not end up as net payers. This could become an overriding principle in the design of fiscal systems that could be explicitly added to the frameworks proposed by Atkinson and Stiglitz to build more equitable societies.

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49 Higgins and Lustig (2016).
51 Stiglitz (2012).
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The Impact of Reforming Energy Subsidies, Cash Transfers, and Taxes on Inequality and Poverty in Ghana and Tanzania

Stephen D. Younger

October 31, 2016

Chapter 10
Lustig, Nora, editor
Commitment to Equity Handbook
Brookings Institution and CEQ Institute (2017)

Introduction

A Commitment to Equity (CEQ) analysis aims to give as comprehensive a description as possible of the distributional consequences of government’s fiscal policy, focusing on the status quo. This chapter shows how one can use methods similar to CEQ to analyze the distributional consequences of prospective policy changes. Those changes may be driven by a desire to increase redistribution, but it is more common for policy makers to make changes to close budget deficits while trying to minimize the poverty impact. In both situations, simulations of policy changes provide useful information.

Particularly for poorer countries, it is common for a CEQ assessment to find that redistribution is minimal, often much less than policymakers expect. This is certainly true in Ghana and Tanzania, where the taxation and expenditure activities of the fisc measured in this study reduce the Gini coefficient by 0.035 and 0.037, respectively. Results for poverty reduction are even less encouraging.

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1 Stephen Younger is Associate Director for Africa, Asia, and Europe of the CEQ Institute. For questions, please contact stephen.younger@ceqinstitute.org.
2 This study is based on Younger, Osei-Assibey, and Oppong (2015) and Younger, Myamba, and Mdadila (2016). The Commitment to Equity Institute collaborated with the University of Ghana and the World Bank in Ghana and REPOA in Tanzania. These studies were possible thanks to the generous support of the Bill & Melinda Gates Foundation.
Were it not for the in-kind benefits from health and education spending, the fisc would actually increase poverty in Ghana and Tanzania by 0.022 and 0.025, respectively, for the headcount index at the national poverty lines. This effect is almost entirely because poor people pay indirect taxes, as in every other country. Assuming that the governments of Ghana and Tanzania would like their taxation and social expenditure policies to be more redistributive than is currently the case, what can it do? This chapter simulates several policy changes and analyzes their impact on inequality and poverty.

Both Ghana and Tanzania also face chronic budget deficits, limiting their ability to reduce poverty by simply increasing social expenditures. Faced with such strictures, both governments would like to find ways to reduce expenditures and increase taxes in ways that least hurt the poor. The chapter also simulates policy changes directed at budgetary savings to assess their distributional consequences.

The methods used here are descriptive, like the methods in a standard CEQ analysis. But because the simulated policies are hypothetical, we cannot simply describe those policies’ beneficiaries as observed in the data but must rather make some assumptions about who would benefit from each of the proposed policies. Some changes mainly affect existing payers of a tax or beneficiaries of an expenditure. In other words, these changes refer to what is known as a policy’s intensive margin, as opposed to the extensive margin, which would involve increasing the number of taxpayers or beneficiaries. Modeling these changes is straightforward because the survey indicates who the existing tax payers and expenditure beneficiaries are. For example, if the value-added tax (VAT) rate were increased, because the consumers of items subject to VAT are already known, their tax burden would simply be increased by the amount of the proposed change. This approach is applicable to any policy reform that changes the rate on an existing direct or indirect tax or an indirect subsidy. In the examples that follow, we consider changes to indirect subsidies to electricity and petroleum products and changes to direct and indirect tax rates.

On the other hand, some policy proposals change an extensive margin: they expand taxes or benefits to people who are not currently affected. For these changes, stronger assumptions must be made about who the new tax payers or beneficiaries would be and those people must be identified in some way in the survey data. A common example might be expanding the VAT to informal enterprises that currently evade it. It might be possible to identify in the survey the households with informal enterprises, but it is difficult to know which of these households are likely to be captured by the reform efforts and which will continue to evade them. Still, for some extensive margins, it is possible to model the households affected by the change. For example, governments sometimes fund campaigns to ensure that vaccination rates are 100 percent. Survey data often record data on childhood vaccinations, allowing us to identify the unvaccinated as the likely beneficiaries of such a campaign. In the examples that follow, we focus on expansion of conditional cash transfer (CCT) programs to previously unaffected households. In most cases, the targeting mechanism for these programs is well defined, usually including a proxy means test (PMT). The sorts of data that such a
test uses are usually available in household surveys, allowing us to calculate a proxy means score for the survey households and thus identify the likely beneficiaries of a program expansion on the extensive margin.

As with the main CEQ analysis, the results of these simulations provide a first-order approximation of the actual distributional consequences of the policy changes, ignoring behavioral and general equilibrium effects. See figure 1-1 in chapter 1 of this volume.

**Examples**

The following section estimates the effects of four possible policy changes that involve eliminating energy subsidies and, in some cases, expanding conditional cash transfers.

*Eliminating Energy Subsidies*

Governments looking for ways to trim expenditures face a difficult task. Large parts of the budget go to items that are difficult or impossible to cut, such as health and education spending, debt service, and public employees’ compensation. One line item that stands out for both its size and economic inefficiency is the subsidy for electricity and petroleum products. This is the case in both Ghana and Tanzania. In Ghana in 2013, the year of this study, the government spent 1.1 billion cedis (1.2 percent of GDP) on electricity subsidies and indirectly subsidized fuel imports by offering the bulk oil companies an artificially low exchange rate, saving them about 600 million cedis that year. In Tanzania in 2011/12, the government spent 0.5 percent of GDP on electricity subsidies and 0.4 percent on fuel subsidies. In both countries, then, removing these subsidies would offer significant savings. Nevertheless, subsidy removal is unpopular, often bringing protesters to the streets. The strongest complaint against subsidy removal is that it hurts the poor. A distributional analysis allows us to assess the validity of that complaint.

Table 10-1 shows the results of four separate simulations of the elimination of electricity subsidies in Ghana and Tanzania. These subsidies existed at the time that I performed the original CEQ analyses, so I had already calculated the benefits to each household. These four simulations remove those benefits in different ways. The original studies first calculated the rate that each household paid for electricity based on its reported total consumption. The subsidy benefit is the difference between that rate and one that was estimated to be sufficient to cover all generation and distribution costs.

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### Table 10-1: Simulated Effects of Eliminating Electricity Subsidies in Ghana and Tanzania

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<thead>
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<th>Simulation</th>
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<td>Tanzania</td>
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<tr>
<td>Extreme poverty</td>
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<tr>
<td>Inequality</td>
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<tr>
<td>Budgetary savings (percent GDP)</td>
<td>0.43</td>
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</tbody>
</table>

Sources: Younger, Osei-Assibey, and Oppong (2015); Younger, Myamba, and Mdadila (2016). Simulations are based on data from annual household surveys in Ghana (2013) and Tanzania (2011).

Note: Results are for consumable income (see chapters 1 and 5 of this volume). Changes in poverty are measured as the difference between the headcount ratio obtained under the corresponding policy simulation and the headcount ratio before any policy simulation. Analogously, changes in inequality are measured as the difference between the Gini coefficient obtained under the corresponding policy simulation and the Gini coefficient before any policy simulation. Poverty lines are nationally determined.

Simulation descriptions:

1. Eliminates the electricity subsidy with no compensation.
2. Eliminates subsidy except for lifeline tariff for first 50kwh, which is held constant.
3. Eliminates electricity subsidy and uses all the funds to expand CCT coverage by raising PMT threshold.
4. Eliminates electricity subsidy and uses enough funds to expand CCT to leave poverty roughly unchanged.

The first simulation removes this subsidy completely, requiring every household to pay a new, higher rate sufficient to cover all electricity costs. This measure saves the government a considerable
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amount of money: 1.4 percent of GDP in Ghana and 0.4 percent in Tanzania.\(^4\) Eliminating the subsidy also reduces inequality in both countries but only by a very small amount. Poverty increases, however, especially in Ghana, as critics of these policies have claimed.

Both Ghana and Tanzania have lifeline tariffs for electricity, which are low rates for the first 50 kilowatt hours of consumption that are meant to concentrate electricity subsidies among those who consume low amounts of electricity and who might be presumed to be poorer than people who consume more. The second simulation maintains the lifeline tariff in each country but increases other rates to full cost recovery, thus removing the subsidy on marginal (but not infra-marginal) consumption for heavier users. This measure reduces the fiscal savings by about half in Ghana and less in Tanzania, but it also reduces the (negative) poverty impact in Ghana by almost half, though by much less in Tanzania. In Tanzania and to a lesser extent in Ghana, the lifeline tariff seems not to benefit the poor very much, most likely because the poor do not have access to the electricity mains.

One possible response to the small but negative impact on poverty is to make an off-setting increase in another poverty-reducing expenditure: the conditional cash transfer. In both Ghana and Tanzania, this transfer is one of the most progressive government expenditures and should therefore be more efficient in reducing poverty than expenditure on electricity subsidies. The third simulation completely eliminates electricity subsidies and uses all of the funds saved to expand each country’s CCT program. These amounts are huge increases to the CCT budgets of both countries, so it is not reasonable to allocate them only to existing beneficiaries. Instead, we expand the pool of recipients in each country, or in other words, we increase the extensive margin of the CCTs. In Ghana, we did this by calculating the proxy means formula for each household and using its benefit cutoff plus the other criteria for CCT benefits applicable in 2013 to identify all eligible households in the country (see the following section for details on the eligibility criteria in Ghana). Even with this expanded pool, we could not exhaust the savings from the elimination of the electricity subsidy, so we also increased each recipient’s benefit by 89 percent. In Tanzania, we expanded the pool of recipients by starting with the lowest proxy means scores and working our way up until all the electricity savings were exhausted. By design, these simulations have zero net benefit for the fisc, but they do show large reductions in poverty, especially in Tanzania, despite the elimination of the electricity subsidies.

The fourth simulation takes a slightly different tack. Here, we eliminate the subsidy entirely but increase the CCT just enough to keep poverty from increasing, providing smaller poverty and inequality reductions than in the third simulation but generating substantial fiscal savings, 0.8 percent of GDP in Ghana and 0.3 percent in Tanzania.\(^5\) Ultimately, then, both Ghana and Tanzania would do better to remove the electricity subsidies, which are poorly targeted, and offset the poverty

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\(^4\) The effect on the budget comes from the fact that central government must make transfers to the electricity providers to cover the losses they incur by charging rates below full cost recovery.

\(^5\) Because the poverty increase is different for each income concept and poverty line, we would need to run a slightly different simulation for each one if we want to have poverty stay constant. Instead, we targeted the income and poverty line that showed the worst poverty increase in the first simulation and held it to zero, which implies small poverty reductions for the other income/poverty line combinations.
consequences with an increase in a well-targeted expenditure like CCTs if poverty is the main objection to electricity subsidy removal.

Expanding Conditional Cash Transfers

Both Ghana and Tanzania had nascent CCT programs at the time our survey data were collected. In Ghana the program operated only in some districts selected for relatively high poverty rates, whereas in Tanzania, a pilot program was operational in three districts only. Because these programs have among the lowest concentration coefficients of any government expenditure (−0.29 in Ghana and −0.50 in Tanzania), they are prime candidates for increased expenditures meant to reduce poverty and inequality.

Both countries use a PMT along with additional criteria to target households. In Ghana, the CCT targets households in eligible districts headed by a child, an elderly person, or a disabled person, and those that include an elderly person or a vulnerable child (including children who have lost one or both parents or who are disabled). Within this household category, funds available to the district are allocated to the households with the lowest proxy means score. After the survey date, Ghana updated its PMT because there was some concern that the previous test was not targeting poor households effectively. In Tanzania, the pilot CCT targets the vulnerable elderly (those who have no caregivers, are in poor health, or are very poor) and vulnerable children (those who have lost one or more parents, whose parents are chronically ill, or who are chronically ill themselves). The program relies on local communities to identify households that include such vulnerable people, applies a PMT to the identified households, and makes the CCT payment to all households who fall below the cutoff level for the PMT.

Although we took slightly different approaches in the two countries, in general, we simulated several options for expanding each country’s CCT to a budget of 0.5 percent of GDP, an amount that is fairly typical for countries with new CCTs. Unlike in many similar simulations, we pay for these additional transfers by increasing the VAT, which offsets the poverty reduction impact somewhat. Table 10-2 shows the results for Ghana and table 10-3 shows those for Tanzania.

For Ghana, we ran five simulations. The first expands the CCT to all eligible persons in the entire country using the old PMT, representing a complete expansion of the existing program. To keep the total cost to 0.5 percent of GDP, this expansion requires scaling down the benefit to each recipient by 30 percent.

The second simulation changes the targeting to the new PMTs, allocating transfers to all people found to be extremely poor by that test’s criteria. This change greatly improves the targeting from a
concentration coefficient of $-0.29$ to $-0.65$, which is better than most middle-income countries.\textsuperscript{6} In this simulation, everyone who is extremely poor receives a transfer, not just the elderly, handicapped, and vulnerable children currently targeted. Keeping the total cost to 0.5 percent of GDP requires scaling down the benefit to each recipient by 49 percent in this simulation.

The third simulation targets transfers to the poorest people as judged by the new PMT at current benefit rates (no scaling down), until total payments are 0.5 percent of GDP. This method is in one sense perfect targeting: the money goes to the poorest people in the sample as identified by the PMT (though not, perhaps, the absolutely poorest people because the PMT is not a perfect predictor).

The fourth simulation increases benefits to current beneficiaries only until total transfer payments reach 0.5 percent of GDP---that is, it uses only the current targeting. Because current (2013) beneficiaries are so few, this increase produces a huge and unrealistic payment to them, one that is 16 times larger than the current 24 cedis per person per month.

The fifth simulation keeps the program size constant at the 2013 level of 0.02 percent of GDP, much smaller than the other simulations, and changes the targeting to the new PMT.

Note that all of these simulations except the fourth require us to identify an extensive margin, new beneficiaries who are not receiving benefits at the time of the survey. In the case of cash transfers in these two countries, identifying new beneficiaries is relatively easy because the eligibility criteria are clear and rely on information collected in the survey: age, disability, and orphan status, and a proxy means test that also uses variables readily available in the survey.\textsuperscript{7} Accordingly, we can identify the extensive margin in the survey without recourse to any behavioral analysis. That said, our simulations may be overly optimistic if in practice the selection process fails to choose according to the eligibility criteria.

| Table 10-2: Simulated Effects of Expanding Conditional Cash Transfers in Ghana |
|-----------------|--------|--------|--------|--------|--------|
| **Simulation**  | (1)    | (2)    | (3)    | (4)    | (5)    |
| **Extreme poverty Disposable income** | $-0.0065$ | $-0.0173$ | $-0.0188$ | $-0.0066$ | $-0.0015$ |
| **Consumable income** | $-0.0032$ | $-0.0157$ | $-0.0175$ | $-0.0044$ | $-0.0006$ |
| **Poverty Disposable income** | $-0.0085$ | $-0.0159$ | $-0.0124$ | $-0.0077$ | $-0.0004$ |
| **Consumable income** | $-0.0044$ | $-0.0112$ | $-0.0081$ | $-0.0042$ | $-0.0002$ |

\textsuperscript{6} In practice, the new PMT will not work this well. Because it is estimated using the same Ghana Living Standards Survey 6 (GLSS-6) data that we use here, it is particularly well suited to identifying the poor in this sample, but because of sampling error, it will do less well in the general population.

\textsuperscript{7} In fact, the proxy means test is usually estimated on a survey very similar to the ones we use.
Chapter 10, Younger

<table>
<thead>
<tr>
<th>Disposable income</th>
<th>-0.0035</th>
<th>-0.0082</th>
<th>-0.0081</th>
<th>-0.0040</th>
<th>-0.0002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inequality Consumable income</td>
<td>-0.0039</td>
<td>-0.0088</td>
<td>-0.0087</td>
<td>-0.0043</td>
<td>-0.0002</td>
</tr>
<tr>
<td>Scaling factor</td>
<td>0.70</td>
<td>0.70</td>
<td>0.51</td>
<td>1.00</td>
<td>16.29</td>
</tr>
</tbody>
</table>


Note: Results are for consumable income (see chapters 1 and 5 of this volume). Changes in poverty are measured as the difference between the headcount ratio obtained under the corresponding policy simulation and the headcount ratio before any policy simulation. Analogously, changes in inequality are measured as the difference between the Gini coefficient obtained under the corresponding policy simulation and the Gini coefficient before any policy simulation. Poverty lines are nationally determined.

In all simulations except (5), VAT is increased to pay for the increased program size.

Simulation descriptions:

1. Expands program to all eligible persons in the entire country using the old PMT, then scales benefits down so the total expenditure is 0.5 percent of GDP.
2. Expands program to all people judged to be extremely poor using the new PMT, then scales benefits down so the total expenditure is 0.5 percent of GDP.
3. Expands program to the poorest people as judged by the new PMT at current benefit rates until total payments are 0.5 percent of GDP.
4. Increases benefits to current beneficiaries only until total payments are 0.5 percent of GDP.
5. Keeps program payments constant, but converts to the new PMT.

In interpreting the results, recall that disposable income is measured prior to incorporating the effect of VAT, so the impact shown for disposable income reflects the impact of the CCT increase only, whereas impacts for consumable income account for both the additional transfer and its assumed financing via additional VAT. 8

The first simulation shows that increasing the transfer to nationwide coverage using existing targeting criteria while holding the overall budget to 0.5 percent of GDP would reduce disposable income poverty by 0.85 percentage points and extreme poverty by 0.65 percentage points. Including the effect of the VAT increase (the consumable income row) reduces the gains to 0.32 and 0.44 percentage points. Reductions in the Gini are small: 0.39 percentage points.

The second simulation does much better, demonstrating the advantages of better targeting. Here, disposable income poverty declines by 1.59 percentage points and extreme poverty by 1.73

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8. See chapters 1 by Lustig and Higgins and, especially, 5 by Higgins and Lustig for a description of income concepts.
Chapter 10, Younger

percentage points. Including the losses from imposing additional VAT, the gains are still much larger: 1.12 and 1.57 percentage points, respectively.

The third simulation reflects “perfect targeting,” but it does only about as well as the second. In fact, it does a little worse on some of the measures. How can this be? Here, transfers are perfectly targeted to the PMT value, not the actual incomes used to calculate the poverty rates, and the rank correlation of the PMT and incomes is therefore not perfect. The fact that the third simulation does not do much better than the second indicates that the PMT does not predict household consumption per adult equivalent perfectly and also that there is not that much difference between the poorest of the extremely poor and the rest of the extremely poor when we use actual household expenditures per adult equivalent to measure well-being.

Results for the fourth simulation are very similar to the first because both use the old PMT. It is interesting to note, though, that the poverty and inequality effects are broadly similar for an expansion of the transfer’s extensive margin (adding new beneficiaries as in the first simulation) and intensive margin (increasing benefits to existing beneficiaries as in the fourth simulation).

Finally, the fifth simulation shows almost no change in poverty or inequality measures, despite the switch to the better targeting of the new PMT, because the program size does not change here. Thus even greatly improved targeting of a small program cannot have much impact on poverty and inequality. Larger program size is essential.

Table 10-3 simulates three possible ways of scaling up Tanzania’s CCT so that its total expenditures would be 0.5 percent of GDP. The first simulation expands the CCT to all vulnerable children and elderly people, regardless of their score on the PMT. This expansion would require almost 1 percent of GDP in additional expenditures so, to keep the budget to 0.5 percent of GDP, we scale down the benefits for each recipient. The second simulation expands the program to eligible participants by raising the PMT threshold until the additional expenditures total 0.5 percent of GDP. The third simulation opens the CCT to all people, not just vulnerable children and the elderly, and raises the PMT threshold until the additional expenditures total 0.5 percent of GDP.
Chapter 10, Younger

<table>
<thead>
<tr>
<th>Change</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Poverty</td>
<td>-0.0113</td>
<td>-0.0172</td>
<td>-0.0212</td>
</tr>
<tr>
<td>Consumable Income</td>
<td>-0.0110</td>
<td>-0.0183</td>
<td>-0.0229</td>
</tr>
<tr>
<td>Extreme Disposable Income</td>
<td>-0.0148</td>
<td>-0.0163</td>
<td>-0.0236</td>
</tr>
<tr>
<td>Poverty Income</td>
<td>-0.0104</td>
<td>-0.0138</td>
<td>-0.0146</td>
</tr>
<tr>
<td>Disposable Income</td>
<td>-0.0045</td>
<td>-0.0073</td>
<td>-0.0087</td>
</tr>
<tr>
<td>Poverty Consumable Income</td>
<td>-0.0063</td>
<td>-0.0094</td>
<td>-0.0108</td>
</tr>
<tr>
<td>Inequality Consumable Income</td>
<td>-0.0063</td>
<td>-0.0094</td>
<td>-0.0108</td>
</tr>
<tr>
<td>Scaling factor</td>
<td>0.55</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Source: Younger, Myamba, and Mladila (2016). Simulations are based on data from the 2011 household survey in Tanzania.

Note: Changes in poverty are measured as the difference between the headcount ratio obtained under the corresponding policy simulation and the headcount ratio before any policy simulation. Analogously, changes in inequality are measured as the difference between the Gini coefficient obtained under the corresponding policy simulation and the Gini coefficient before any policy simulation. Poverty lines are nationally determined.

In all simulations VAT is increased to pay for the increased program size.

Simulation descriptions:

(1) Expands CCT to all eligible persons, then scales benefits down so the total CCT expenditure is 0.5 percent of GDP.

(2) Expands CCT at current benefit rates to the poorest eligible people according to the proxy means test until total CCT payments are 0.5 percent of GDP.

(3) Expands CCT at current benefit rates to the poorest people regardless of VC/elderly according to the proxy means test until total CCT payments are 0.5 percent of GDP.

The first simulation would seem to be the least effective approach to an expansion, both because some of the vulnerable children and the elderly are not poor to begin with and because the additional VAT and reduced benefits levels used to finance the program expansion would impoverish some people. Nevertheless, this simulation does reduce extreme poverty by about one percentage point, and poverty by a little more.

The second simulation has a larger effect on both poverty and inequality, which is to be expected because it limits benefits to those with the lowest PMT scores. The third simulation does even better, suggesting that the government could improve the CCT’s targeting by eliminating the restriction of benefits to vulnerable children and the elderly and focusing instead only on those with...
low PMT scores. But regardless of the approach a fairly limited expansion of the CCT to 0.5 percent of GDP would have significant effects on poverty and inequality in Tanzania as a reflection of this program’s excellent targeting.

Making Taxation More Progressive

In Ghana and Tanzania as in most countries, direct taxation is more progressive than indirect (with the exception of some excise taxes). This is especially true in countries with large informal sectors because direct taxes fall only on formal sector employees who tend to be much wealthier than the rest of the population. Thus, the government might consider shifting from the use of indirect to direct taxation. To explore this possibility, we simulated two very extreme tax policy changes in Ghana and Tanzania. In Ghana, we eliminate both VAT and import duties, replacing the revenue with higher taxes on earned income in the formal sector (pay as you earn [PAYE]) and presumptive taxes on small businesses. In Tanzania, we removed import duties and offset the revenue loss with increased taxes on formal sector earnings (also PAYE) and presumptive taxation. Clearly, neither of these simulations is practical or even possible. Formal sector employees are already heavily taxed, especially in Tanzania, so considerable tax increases would induce a large shift to informality. We pursue these policy changes to show that even shifting very large amounts of revenue, 5.9 percent of GDP in Ghana and 1.2 percent in Tanzania, from indirect to direct taxes has a relatively modest overall effect on poverty and inequality. Table 10-4 gives the results.

<table>
<thead>
<tr>
<th>Change</th>
<th>Extreme Poverty Headcount</th>
<th>Poverty Headcount</th>
<th>Gini Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana</td>
<td>−0.0031</td>
<td>−0.0056</td>
<td>−0.0034</td>
</tr>
<tr>
<td>Tanzania</td>
<td>−0.0049</td>
<td>−0.0071</td>
<td>−0.0037</td>
</tr>
</tbody>
</table>

Sources: Younger, Osei-Assibey, and Oppong (2015); Younger, Myamba, and Mdadila (2016). Simulations are based on data from annual household surveys in Ghana (2013) and Tanzania (2011).

Note: Results are for consumable income (see chapters 1 and 5 of this volume). Changes in poverty are measured as the difference between the headcount ratio obtained under the corresponding policy simulation and the headcount ratio before any policy simulation. Analogously, changes in inequality are measured as the difference between the Gini coefficient obtained under the corresponding policy simulation and the Gini coefficient before any policy simulation.

9. In Tanzania, the VAT is actually quite progressive, so the difference between VAT and direct taxes is not as dramatic as the difference between import duties and direct taxes.
simulation and the Gini coefficient before any policy simulation. Poverty lines are nationally determined.

Why are the effects so small? Even though direct taxes are more progressive than indirect, concentration coefficients for indirect and direct taxes are not so different. In Ghana, they are 0.42 for import duties, 0.44 for VAT, and 0.73 for PAYE, by far the largest source of direct taxation in this study. The difference between these is about 0.3, whereas the difference between the concentration coefficients for electricity subsidies and Ghana’s CCT studied in the previous section is 0.76. In Tanzania, the concentration coefficients are 0.38 for import duties and 0.91 for PAYE, the highest concentration coefficient for a tax we have ever observed. Still, that difference of about 0.5 is less than the difference of 1.2 between electricity subsidies and the CCT.

This result is important for policy makers in two ways. First, broad-based indirect taxes like the VAT are generally considered to be more efficient than direct taxes, whereas direct taxes are more equitable. Thus there is a trade-off between equity and efficiency when choosing tax instruments. But the results here suggest that the trade-off is not too severe. The governments of Ghana and Tanzania can continue to rely on broad-based indirect taxes, knowing that their use instead of direct taxation has only a minor effect on poverty and inequality. Second, the result suggests that to have a large redistributional impact, governments need to consider combinations of taxes with large positive concentration coefficients and expenditures with large negative concentration coefficients, which are usually those like CCTs that explicitly target the poor.
Chapter 10, Younger

References


The Impact of Taxes and Expenditures on Poverty and Income Distribution in Argentina

Dario Rossignolo

October 31, 2016

Chapter 11

Lustig, Nora, editor

Commitment to Equity Handbook


Brookings Institution and CEQ Institute (2017)

Introduction

Starting in 2003, tax collection and public expenditures experienced exceptional growth in Argentina. In 2014, the tax burden reached 32.5 percent of GDP. This increase was due to several factors. Taxes that were sporadically levied in previous periods such as export duties and taxes on financial transactions, were significantly expanded. The economic recovery, as expected, resulted in a boon to tax collection. In addition, no adjustments for inflation to financial reporting and thresholds impacted the burden of corporate income tax (CIT) and personal income tax (PIT). Additional revenues were obtained through the (re) nationalization of the pension system.

On the expenditures side, public spending at the federal, provincial, and municipal levels increased from 26 percent of GDP in 2004 to around 45 percent in 2013. The most important changes in social spending were the expansion of the so-called Pension Moratorium -- a sort of early retirement program with a moratorium for those who did not complete the 30-year contributions requirement--, the Educational Financing Law which required to increase education spending to 6 percent of GDP, and the expansion of the Universal Allowance per Child, extending the benefits to include not only formal sector workers but also workers in the informal sector and the unemployed. Aside from the increase in social spending, expenditures on subsidies—in particular,
electricity, gas, and transportation subsidies--increased greatly and reached around 6 percent of GDP in 2013.

With this extraordinary expansion during the last decade, the size of the state in Argentina reached a level similar to that in many advanced countries. To what extent did the government use this additional fiscal space to reduce inequality and poverty through taxes and transfers? This chapter applies the CEQ methodology described in previous chapters to estimate the impact of taxes and public expenditures on income distribution and poverty. It uses data from the National Household Survey on Incomes and Expenditures (ENIGHo), which was conducted by the National Bureau of Statistics in Argentina (INDEC) from March 2012 to February 2013.\(^5\)

While several studies have analyzed the impact of taxes and expenditures, jointly or separately, on income distribution, very few have analyzed their impact on poverty. Gasparini, for example, analyzed the distributional impact of the tax system for 1996, taking per capita income and per capita consumption expenditures as welfare indicators.\(^6\) In the former case, the author found that taxes were highly regressive, whereas in the latter, the incidence was moderately progressive.

Gómez Sabaini and others analyzed the impact of taxes on income distribution for 1997, considering per capita income adjusted for underreporting as a welfare measure.\(^7\) The incidence was regressive in this case, chiefly because of the value added tax (VAT) and other indirect taxes.

Gómez Sabaini and Rossignolo analyzed the incidence of taxes for 2006, again considering per capita income adjusted for underreporting.\(^8\) When measured with the Gini coefficient, the redistributive impact of taxes was moderately progressive, mainly as the result of export taxes and the increasing importance of income tax and payroll taxes. However, when inequality was measured with the ratio of average incomes of the richest to poorest deciles, it increased. On the spending side, the Secretary of Economic Policy (SPE) and the Secretary of Economic and Regional Programming (SPER) estimated the incidence of public expenditures, with results that show an unequivocal reduction in inequality.\(^9\) Similarly, Gasparini concluded that benefits of public expenditures were received more strongly by lower income brackets.\(^10\) The net effect of taxes (both direct and indirect) and public expenditures (cash transfers and spending on education and health) on income distribution has been calculated in Gasparini, SPE, and Gómez Sabaini and others.\(^11\)

Although the methodologies differ to a certain extent, all the studies find that the two highest income quintiles transfer resources to the lowest ones. All of the studies also note a significant equalizing effect, though the magnitude of the redistributive impact varies. The only study that has looked at the effect of social spending on both income distribution and poverty is by Lustig and Pessino.\(^12\) Following CEQ methodology, the authors find that the inequality and poverty reducing

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\(^5\) No official statement has been made about the reliability of this survey.
\(^6\) Gasparini (1998).
\(^7\) Gómez Sabaini and others (2002).
\(^8\) Gómez Sabaini and Rossignolo (2009).
\(^9\) See SPE (Secretaría de Política Económica) (2002) and SPER (Secretaría de Programación Económica y Regional) (1999).
\(^10\) Gasparini (1999). Several studies have analyzed the impact of specific programs on poverty reduction, such as Maurizio (2009), who explored the impact of different cash transfers on poverty, and Marchionni and others (2008), who examined the impact of simulated subsidy schemes.
\(^12\) Lustig and Pessino (2014).
impact of social spending in Argentina was quite high due, to a large extent, to the growing importance of noncontributory pensions in the last decade, and to a lesser extent to the expansion of other cash transfers such as the Universal Allowance per Child.

The analysis presented here differs from the above studies in that it measures the impact of taxes and spending combined not only on inequality but also poverty. In addition, except in one case, the existing studies rely on information by decile rather than the entire distribution and except in one case, they do not include the analysis of price subsidies. Another important difference is that existing studies which look at both taxes and expenditures assume a balanced budget and scale up the totals by decile to equal totals for the same items from budgetary data. In contrast, following CEQ, in this study I neither scale up totals nor assume a balanced budget.

As recommended by the CEQ methodology, I produced two scenarios of the fiscal incidence analysis: one in which contributory pensions are treated as pure government transfers (and contributions as a form of direct taxation) and another in which contributory pensions are treated as deferred income (and contributions as mandatory saving). The results show that the impact of direct taxes net of direct transfers on inequality is quite significant. In the scenario in which pensions are considered a transfer, the Gini coefficient for disposable income is 35 percent lower than the market income Gini. The impact of consumption taxes net of subsidies is equalizing. When the monetized value of education and health spending is included, the Gini coefficient for final income is 51 percent lower than the market income Gini coefficient. While the numbers are smaller, the redistributive effect in the scenario in which pensions are deferred income are also quite significant. However, in terms of poverty reduction, the results are less auspicious. While the headcount ratio for disposable income is 78 percent lower than the market income headcount ratio, with the moderate poverty line, the headcount ratio for consumable income is higher than the market income headcount ratio. This result indicates that a relatively large number of poor individuals are net payers to the fiscal system. This happens because consumption taxes weigh heavily on many of the poor.

1. The Fiscal System in Argentina: Taxes and Expenditures

Table 11-1 shows taxes and public expenditures by category as a share of GDP. The direct taxes analyzed are personal income tax (PIT), payroll taxes, and other taxes on income. The indirect taxes considered are the value added tax (VAT), excise taxes, fuel taxes, and the provincial turnover tax. These taxes represent about 71 percent of total national and provincial tax revenues for 2012; of that 71 percent, 80 percent were simulated with the methods described below. On the expenditure side, direct transfers include the flagship cash transfer program Universal Allowance per Child; the two noncontributory pensions under the so-called Pension Fund Inclusion Plan (in Spanish Plan de Inclusion Previsional): the Pension Moratorium (Moratoria Previsional) and the Early Retirement Program (Jubilacion Anticipada), and other cash and near-cash transfers which are described below. Subsidies include subsidies to electricity, domestic gas, and transportation.

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13 Export duties have been excluded from this analysis. Gómez Sabaini and Rossignolo (2009) and Gómez Sabaini and others (2013), following a different methodology than the one used here, conclude that these taxes are progressive following the standard Gini and concentration coefficients.
Chapter 11, Rossignolo

Transfers in-kind include spending on public education and health. In total, these spending categories represent 65 percent of total national and provincial public spending for 2012, from which around 74 percent were imputed and simulated.\textsuperscript{14}

Table 11-1. Government Spending and Revenue Structure in Percentage of GDP for Argentina 2012

<table>
<thead>
<tr>
<th>Government Spending and Revenue</th>
<th>Percentage of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Government Spending</td>
<td>43.9</td>
</tr>
<tr>
<td>Social Spending (excludes contrib pensions)</td>
<td>20.8</td>
</tr>
<tr>
<td>Direct Transfers (Total Cash &amp; Near Cash Transfers)</td>
<td>5.8</td>
</tr>
<tr>
<td>Flagship Cash or Near Cash Transfer program</td>
<td>0.5</td>
</tr>
<tr>
<td>Noncontributory Pensions</td>
<td>2.9</td>
</tr>
<tr>
<td>Other Cash &amp; Near Cash Transfers</td>
<td>2.4</td>
</tr>
<tr>
<td>Total In-kind Transfers</td>
<td>13.1</td>
</tr>
<tr>
<td>Education</td>
<td>7.4</td>
</tr>
<tr>
<td>Basic (primary and secondary)</td>
<td>4.6</td>
</tr>
<tr>
<td>Tertiary and University</td>
<td>1.4</td>
</tr>
<tr>
<td>Science, culture and education non discriminated</td>
<td>1.5</td>
</tr>
<tr>
<td>Health</td>
<td>5.6</td>
</tr>
<tr>
<td>Contributory</td>
<td>3.1</td>
</tr>
<tr>
<td>Noncontributory</td>
<td>2.5</td>
</tr>
<tr>
<td>Housing and Urban</td>
<td>0.6</td>
</tr>
<tr>
<td>Other Social Spending</td>
<td>1.3</td>
</tr>
<tr>
<td>Contributory Pensions</td>
<td>7.1</td>
</tr>
<tr>
<td>Non-Social Spending</td>
<td>14.0</td>
</tr>
<tr>
<td>Indirect Subsidies</td>
<td>5.9</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0.3</td>
</tr>
<tr>
<td>Energy, fuel and mining</td>
<td>2.6</td>
</tr>
<tr>
<td>Industry</td>
<td>0.1</td>
</tr>
<tr>
<td>Transportation</td>
<td>2.4</td>
</tr>
<tr>
<td>Communication</td>
<td>0.2</td>
</tr>
<tr>
<td>Other indirect subsidies</td>
<td>0.3</td>
</tr>
<tr>
<td>Other Non-Social Spending</td>
<td>8.1</td>
</tr>
<tr>
<td>Debt Servicing</td>
<td></td>
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<tr>
<td>Interest payments</td>
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</tr>
<tr>
<td>Total Tax Revenue</td>
<td>32.5</td>
</tr>
<tr>
<td>Direct Taxes</td>
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</tr>
<tr>
<td>Personal Income Tax</td>
<td>2.0</td>
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<tr>
<td>Simplified Tax Regime (Monotributo)</td>
<td>0.1</td>
</tr>
<tr>
<td>VAT and Other Indirect Taxes</td>
<td>12.3</td>
</tr>
<tr>
<td>Other Taxes</td>
<td>18.1</td>
</tr>
<tr>
<td>of which Social Security Contributions with Pensions</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Source: Author’s calculations based on data from the Argentine Ministry of Economy and Public Finance.

1.1 Direct Taxes

PIT is a global-type tax, structured with progressive rates. Its taxable base has been expanded by several pieces of legislation. The Income Tax Act identifies four categories of income based on

\textsuperscript{14} Several expenditure items such as housing, urban services, water and sanitation programs; expenditures on science and culture; discretionary pensions; and, other non social expenditure, could not be allocated because of lack of adequate information in the household survey.
their source: land rent, capital gains, corporate income, and personal income. A single taxpayer may receive income from one or more income categories at the same time. The calculation of taxable income is based on the income and expenses corresponding to the four categories and a few other items on income derived from businesses and other activities. Several income categories are also exempt.¹⁵

In the analyzed period, PIT is determined by taxable net income bracket, based on a sliding scale consisting of a fixed amount plus a rate increasing from 9 to 35 percent on the excess of each income bracket bottom level. Individuals paying income tax are classified as either self-employed taxpayers or salaried workers. Self-employed taxpayers (that is, independent workers registered as income tax payers) must pay income tax each fiscal year in five bi-monthly advance payments.

One group of taxpayers primarily comprised of the self-employed and small businesses is subject to a simplified tax regime called “single tax” (Monotributo). This regime replaces the PIT and VAT with a monthly fixed tax plus social security and health insurance contributions. The tax levied is a fixed amount established according to specific categories mapped into income brackets in which the taxpayer falls. These categories are determined based on invoicing, the surface area of the facilities, or the amount of electricity consumed during production. No deductions for dependents or any other special deductions apply.

Taxes on wages are analyzed as part of the tax system, including contributions made by both the employee and the employer. In both cases, the amount collected is deposited into the Federal Tax Administration and that revenue is distributed according to the corresponding legal provisions.

For formal sector employees, we consider contributions to the social security system (11 percent), health insurance (3 percent), and the national pension fund (3 percent, up to a ceiling of Arg$21,248 monthly, the maximum taxable base), for a total rate of 17 percent.

For employers, we consider contributions to the social security system (12.71 percent), health insurance (6 percent), the national pension fund (1.62 percent), the fund for family allowances (5.56 percent) and the national employment fund (1.11 percent), which amounts to 27 percent of earnings in the formal sector. This rate pertains to employers whose activity is concentrated in the services sector; for other employers, the rate is 23 percent.

For the self-employed workers, we consider their contributions to the social security system (27 percent) and the national pension fund (5 percent). These rates are applied to a scaled tax base that is progressive and differs between professionals and traders. These workers have been identified in the household survey by years of education.

1.2 Indirect Taxes

¹⁵ There are numerous exemptions. The most important are those on interest accrued on saving accounts deposits, special saving accounts and term deposits, income derived from securities, shares, bonds, bills of exchange, notes and other securities issued or to be issued in the future by a governmental authority, and the rental value of the residence when occupied by its owners. The following items are not exempt: pensions, retirement payments, other compensations, and salaries received during medical leave.
VAT is a consumption tax on all stages of the production and distribution of goods and services. It is not cumulative and uses the “tax against tax” system, where the balance between tax credits (charged to sales) and tax debits (charged to purchases) is paid to the seller every month. This procedure is equivalent to applying the tax on the value added at every elaboration stage. It is levied on imports in a similar way to domestic production, but exports are zero rated.

The general VAT rate is 21 percent. There are few exemptions because most have been eliminated in successive reforms. There are also differential rates: the highest is 27 percent on the invoices of public services provided to companies that are liable for the tax; the lowest is 10.5 percent on new home sales and a very limited list of goods and services.

Excise taxes apply to the domestic sale and import of a specific list of goods and transactions: alcoholic beverages (20 percent), beer (8 percent), soft drinks and other nonalcoholic beverages (4 to 8 percent), automobiles and diesel engines (10 percent), and insurance (2.5 percent).

For all taxes on goods, the taxable basis includes the tax itself. The taxable basis is the net price billed by the responsible party, defined as the remainder after discounts and bonuses, financing interest, and the VAT generated by the operation are deducted. In the case of cigarettes, the taxable basis is the sale price to the end user, excluding the VAT. In the case of insurance, the taxable basis does not include the tax itself, which is the only case in domestic taxes where the legal or nominal rate is applied to the taxable basis.

In 2012, liquid fuel and natural compressed gas were taxed (at 62 to 70 percent). The fuel tax is applied to all forms of gasoline: solvent, turpentine, gas oil, diesel oil, and kerosene. The tax also falls on compressed natural gas for motor vehicles distributed through pipelines. The tax must be applied in a single circulation stage for the sale of national or imported products. Importers of liquid fuel and companies that refine or market it, are subject to the fuel tax, as are distributors of gas before it enters the pipeline. Fuel tax is therefore calculated by applying the rate to the net sales price listed on the invoice for resellers at the dispatching plant.

The so-called provincial tax on gross incomes is an important source of revenue for the subnational governments and is applied by all provinces. It is a cascading tax because it falls on all stages of production and distribution of goods and services. It taxes gross income without deducting the tax already paid and cumulated through previous purchases in the production process. Because it forces vertical integration of firms and discriminates in favor of imports that do not contain taxes paid on every production stage, the provincial turnover tax alters neutrality.

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16 Among exemptions with considerable tax collection importance in 2012 were books, brochures and similar printed material, non-carbonated water, milk without additives, buyers who are end consumers or tax-exempt individuals, medicines, goods at the resale stage and for which the tax has been paid at the import or manufacturer’s stage, medical services rendered through Health Insurance Services by trade unions, theater performances, international passenger and cargo transportation, and life insurance.

17 The lowest tax rate includes some basic foods (meat, fruit, vegetables, bread), newspapers, magazines and periodicals, goods at the selling stage to the general public, and domestic transportation services for passengers by land, water, or air, except for taxis and rental car services on routes less than 100 km. In the case of exempt goods, the 1997 Input / Output table was used, with data from 1993. The taxable input proportion was estimated for each exempt good: the incidence of taxable inputs was estimated for the sales amount of exempt goods, and the same structure was applied to the total of VAT purchases deriving from the consumption of exempt goods.

18 Alternatively, although there is no reliable study in Argentina determining the percentage of fuel cost that is part of the transportation cost transferred to the consumer, at present, and basically due to the existence of transportation and fuel subsidies distorting relative values, we assumed that 30 percent of the tax is transferred.
Although tax rates follow similar patterns across the country, rates vary highly due to differences in economic activities and corresponding jurisdictions. In general, the highest rates appear in commerce and services, intermediate rates are applied to industrial activities, and the lowest rates occur in the primary sector.

In order to calculate tax incidence, we applied the tax rates described in this section to the data on consumption reported in the household survey. According to several authors, effective tax rates are about twice as high as rates on final consumption. Consequently, rates on retail consumption have increased 150 percent in every province in order to account for the taxes included at every production stage. The methodology applied is the same as that for VAT and excise taxes. Because the tax base excludes VAT, excises, and fuel tax, the provincial turnover tax is the closest to input costs and should be included in the tax base of the previously mentioned taxes.

1.3 Flagship Cash Transfer Program: the Universal Allowance per Child

The target population for the Universal Allowance per Child is parents with dependent children under the age of 18 who are informal workers with an income lower than the minimum salary of the formal sector, unemployed people without unemployment benefits, and domestic service workers.

The targeting mechanism consists of a monthly transfer of Arg$270 per child in 2012, raised to Arg$340 in September 2012. Parents receive benefits for each of up to five children. The first 80 percent of the benefit is received by direct deposit; the remaining 20 percent is transferred with proof that the children are attending school and have received the mandatory vaccines. This benefit includes a means testing mechanism in the sense that beneficiaries cannot receive other social benefits while receiving Universal Allowance per Child.

1.4 Non-Contributory Pensions

In 2005, the government instituted a retirement program through a moratorium for those who had not completed thirty years of service known as the Pension Moratorium (Moratoria Previsional). In 2007, the government added a program that allowed workers who had completed the required thirty years of service but who were at least five years younger than the official retirement age (65 for men, 60 for women) to receive an Early Retirement pension (Jubilacion Anticipada). In the case of the Pension Moratorium, beneficiaries receive their transfer net of a reduction that corresponds to the number of years the person has not contributed to the system. For the Early Retirement pension, the transfer is 50 percent of the benefit that the person would receive at full retirement age, although the amount cannot be lower than the minimum pension.

1.5 Other Cash and Near Cash Transfers

This category includes the following programs: Family Allowances (Asignaciones Familiares), Employment and Training Insurance (Seguro de Capacitacion y Empleo), Families for Social

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19 See, for instance, Rossignolo (2015).
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Inclusion Program (Programa Familias por la Inclusión Social), University Scholarships (Becas Universitarias), Youth with More and Better Jobs (Programa Jóvenes con Más y Mejor Trabajo), Unemployment Insurance (Seguro de Desempleo, and School Feeding Programs and Community Kitchens (Comedores Escolares y Comunitarios).

Family Allowances provides benefits to households based on the number of dependent (spouses, children, adopted children, and disabled children) and in support of school attendance for children living in the household. Eligible beneficiaries include wage earners in the formal sector who have children up to 18 years of age and wages below a maximum threshold, as well as pensioners and unemployment compensation beneficiaries with children under 18. Benefits are determined based on income and the reported number of eligible beneficiaries. For instance, the fixed amount for every child in June 2012 was Arg$270 if the worker’s wage was between Arg$100 and Arg$2,800; the amount decreased to Arg$204 for a wage between Arg$2,800 and Arg$4,000, and to Arg$136 for a wage between Arg$4,000 and Arg$5,200. These amounts were higher in the southern region of the country. A household might be excluded from this benefit in there are no children, or if the head of household is not working in the formal sector, is retired, is unemployed and receiving unemployment benefits, or if the head of household is earning an income higher than the maximum allowed for the benefit (Arg$5,200 per month in 2012).

The beneficiaries of the Heads of Household Program, a safety net program launched in 2002 to help households cope with the surge in unemployment resulting from the financial crisis, were divided in two groups according to their employability potential. Those considered more “employable” were incorporated in the Training and Employment Insurance program, a 24-month transfer of Arg$225 for the first 18 months and Arg$200 for the remaining six months. The beneficiaries must attend training courses to increase their skills. Workers whose employability potential was considered low received benefits from the Families for Social Inclusion Program. Benefits are based on the number of dependent children under age 18, from two to six children. The benefit starts at Arg$155 per child and increases to Arg$380 for six children or more for families below the poverty line.

The National Program of University Scholarships is for college-level students attending an officially recognized program of any national university. Beginning in 2009, students receive AR$3000 in 10 installments throughout the year. The target population of the Youth with More and Better Jobs Program is people between 18 and 24 years of age who neither work nor study. The beneficiaries must be unemployed, with incomplete primary or secondary education. The amount of the transfer is Arg$150 a month for 2 to 18 months; in addition, transfers are made against the presentation of a project for which the beneficiary receives Arg$4,000 per project (in 2012).

Workers who have lost their jobs through no fault of their own and have been unemployed for at least 36 months are entitled to receive unemployment insurance, which consists of a transfer of between Arg$250 and Arg$400, calculated as a percentage of the highest previous salary. Maximum coverage lasts one year.

20 There are other two additional scholarship programs: Bicentennial Scholarships (Programa de Becas Bicentenario), for students preparing for scientific careers, and National Program of Scholarships (Programa Nacional de Becas de Grado), for students of information technology. The study presented here might overestimate the amount received by students somewhat because it cannot establish which program the beneficiaries are studying.
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Schools, clubs, and other organizations that serve meals to children or the unemployed receive a transfer under the School Feeding Program and Community Kitchen, which consists of a cash transfer related to the cost of milk or a basic food basket provided to feed children or adults below the poverty line.

1.6 Subsidies

Subsidies are directed to transportation, communications, energy and fuel, industry and agriculture, and other sectors. The most important subsidies are those for transportation, and energy and fuel; transportation subsidies are mainly oriented to supply, whereas energy and fuel are oriented to both supply and demand. Subsidies to energy include fuel, gas, and electricity; subsidies to transportation comprise tariffs for trains, subways, airplanes, and buses.

Argentina has become a net importer of fuel after being a net exporter of fuel in the 1990s and at the beginning of the 2000s. The price of the imported gas oil is subsidized through a fiduciary fund, and the consumer receives the difference between the price of fuel within the internal market and the same product at international prices. For gas, there are two kinds of subsidy: for those who receive gas through a pipeline, the subsidy is included in the reduced cost of imported gas, which is included in the tariff. Those who buy bottled gas pay a subsidized price in which the government gives the producers the difference between the market price and the subsidized price. The total amount paid varies depending on the volume of the previous year’s gas consumption. For electricity, the government created a fiduciary fund to subsidize tariffs for households. The subsidy depends on the volume of the previous year’s electricity consumption.

1.7 Education and Health

In 2006, the National Education Law was passed following the Education Financing Law, which extended compulsory education to the end of secondary school. Data show that when compulsory education is extended, attendance increases but that students also continue to drop out at the same ages as before the law was passed.21

There are two educational systems at every level in Argentina: a free, public education system, and a subsidized, private system. Primary education is managed by the municipalities, secondary education is the responsibility of the provinces, and university is administered at a national level (with several exceptions at all levels). The public education system served 73 percent of total students in 2012, of which 28.2 percent were enrolled in primary public schools. Public universities enrolled 79 percent of university students. Because there is no reliable information on public spending by level, the results for the distributional impact of education aggregate expenditures for basic education, including initial, primary and secondary school, and tertiary education.22

The Argentine health system is split into several parts because different population groups access different providers. One component of health insurance covers the population dependent on

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21 See Gómez Sabaini and others (2013).
22 For each educational level, the results for public and private subsidized education can be shown and are available from the author upon request.
formal wage earners or retired pensioners. Populations that are not covered have access to the public health system. The high-income population has access to the private system.

For formal workers in both the private and public sectors as well as at national and provincial levels, health benefits are delivered mainly through the health insurance systems of trade unions. These workers comprise the greatest share of beneficiaries. Pensioners are covered by the health insurance system known as the INSSjyP (Instituto Nacional de Servicios Sociales para Jubilados y Pensionados; or, National Institute for Social Services for Retirees and Pensioners (also known as PAMI), a subsystem that finances private health service providers. The public health system (hospitals) covers those who do not have a health insurance system.

It is worth noting that the population covered by the private system can also receive public system benefits. Public expenditures for health have risen to 5.4 percent of GDP, 2.4 percent of which belongs to health insurance systems. Low-complexity hospitals were decentralized to the provinces and municipalities in the 1990s, while the high-complexity ones still remain under federal administration.

2. Data Sources and Methodological Assumptions

The main source of information for this report was the National Household Expenditure Survey (ENGHo; Encuesta Nacional de Gastos de los Hogares) which collects information on households’ incomes and expenditures and which was conducted by the Federal Statistics and Census Institute (INDEC; Instituto Nacional de Estadística y Censo) between March 2012 and February 2013. The ENGHo is a large-scale survey that obtains detailed answers from approximately 20,960 households across the country.

The survey collects information from households, which are units made up of any person or group of people, related or unrelated, living in the same home under a family system and consuming food paid for by the same budget.

The ENGHo is a representative sample of 86.8 percent of the population, mainly urban. Rural towns with fewer than 5000 inhabitants were excluded.

Regarding macroeconomics aggregates, as of the completion of this study, Argentina did not have a consolidated GDP series. The official information consists of two series with different base years, 1993 and 2004. The series with base year 1993 was used for the first three quarters and the 2004 series was substituted in the fourth quarter of 2013. The 2004 series shows higher nominal GDP values than the 1993 series, around 22 percent for the same period, which is a reflection of the previous government’s effort to avoid measuring inflation rates accurately.23

The 2012-2103 survey used for this study was published before the base year was changed, so the nominal values are from base year 1993. The amounts of public spending and taxes used in this work, in contrast, correspond to base year 2004. So, if we had maintained the nominal values for incomes and expenditures as they appear in the survey, the redistributive impact would have been

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23For reference, the annual inflation officially recognized by INDEC was around 9.5 percent on average for the 2007-2014 period, whereas unofficial estimates (from an average of seven to nine provinces from Centro de Estudios para el Desarrollo Argentino, Fundación de Investigaciones Económicas Latinoamericanas) showed annual averages of 23 percent.
overestimated. In order to avoid such a distortion, the nominal values for taxes and transfers were adjusted downward in the order of 22 percent (the ratio of GDP with 1993 as the base year and GDP with 2004 as the base year).

There was also no national accounts information on disposable income which based on the CEQ methodology should be used to generate the coefficient to scale down public spending in education and health to the level of disposable income found in the survey. Accordingly, a new macroeconomic available income calculation was made (ad hoc) to use for scaling down the budget values on education, health, and economic benefits expenditure. These available income values were calculated according to the methodology of previous work on replacing official data. With these calculations, available income represents only 67 percent of 2012 official GDP rather than the official 97 percent.

With regard to consolidated public spending, after 2009 there is no information covering the three jurisdictional levels: national, provincial, and municipalities. To estimate this amount, we projected the components of aggregate spending by objective and function, based on the evolution of some partial components of expenditure included in the budgets of jurisdictions and different agencies such as the National Administration of Social Security and the Ministry of Education, among others. Because information is not available on each of the existing programs for every jurisdiction, the most representative programs were identified, which were then used to calculate the impact of public spending on social inequality and poverty.

The calculation of the effect on equity of the following direct transfer programs—Universal Allowance per Child, Family Allowances, Employment and Training Insurance, Families for Social Inclusion Program, Youth with More and Better Jobs, Unemployment Insurance, School Feeding Programs and Community Kitchens, and college scholarships was carried out through using one of the methods described in Chapter 5 by Higgins and Lustig. Because the household survey only reported the value of total cash transfers, including both private and government transfers, the incidence of the Universal Allowance per Child and Unemployment Insurance had to be imputed. This was done by imputing the amounts that would have corresponded to households which included members who reported receiving benefits from one or both of these programs. The imputed amounts were subtracted from the total reported cash transfers; the remainder were assumed to be private transfers and, thus, were included as part of market income. It should be noted that, since in 2012-2013 the self-employed were not included as beneficiaries in the Universal Allowance per Child program, I made sure that the self-employed did not appear as beneficiaries of these cash transfers. In order to assess how sensitive the results are to these specific assumptions, I estimated the incidence of cash transfers assuming that the entire amount reported as transfers were government transfers to obtain an “upper bound.” The redistributive and poverty effects are not so different from the ones reported here which can be taken as evidence that results are quite robust to alternative assumptions. For the rest of the transfers, the benefits were simulated based on the statutory rules.

The incidence of the noncontributory pension programs known as Pension Moratorium and Early Retirement was inferred. The household survey reports “pensions” as a total without specifying

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25 It should be noted that the term “non-contributory” pensions in Argentina refers to other forms of non-contributory pensions. Here, I always refer to the two programs mentioned in this paragraph.
whether they are pensions from the contributory system, these two noncontributory pension programs, or private pensions. The survey does indicate whether a household member received a pension, although it does not state whether that income corresponds to one of the two noncontributory pensions or to a contributory pension. Here, I assumed that noncontributory pensions were included in the reported amount. In order to determine the amount corresponding to contributory pensions, from the pensions reported by households I subtracted the pensions whose amount was below the minimum in the contributory system (for the Pension Moratorium) and the pensions received by beneficiaries whose age was at least five years earlier than the legal retirement age (for the Early Retirement program).

Since Argentina did not have reliable estimates of the Consumer Price Index, to convert the values of income thresholds expressed in 2005 and 2011 purchasing power parity into 2012 prices, I used the implicit GDP deflator.

Also, since the government did not report consolidated expenditures on subsidies for transport services, gas, and electricity, to generate these totals I used data reported by the Argentine Public Spending Association on the amounts that were transferred from the public sector to private companies to keep prices unchanged.

For the inclusion of taxes paid on inputs, we partially adapted the information aggregated from the input output matrix of 1997, which is particularly relevant for the case of VAT exemptions or the fuel tax.

Information on direct taxes is rarely collected directly by surveys; instead, surveys report earnings and the incidence of taxes needs to be simulated. Wage earners in the formal sector report income after taxes. For wage earners in the informal sector, the self-employed, capital income earners, and people receiving pensions and transfers, the assumption is that reported income reflects earnings before taxes. In this study, as in the majority of studies based on a partial equilibrium framework, I assume that the burden generated by taxes/subsidies on goods and services is fully shifted to consumers via a higher/lower price and that the burden of PIT and other income taxes falls on the person required to pay them (the income earner). Tax evasion here is taken into account in two ways. For purchases made in informal markets, I assume that no consumption taxes have been paid. Wage earners in the informal sector (i.e., those who do not contribute to the social security system), I assume that they do not pay PIT.

3. Main Results

This section presents several results of the CEQ analysis of the impact of taxes and public spending on poverty and inequality in Argentina. The main results will focus on the benchmark case, in

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26 In particular, the household survey reports incomes by source, as follows: wages and salaries, self-employed income, employer’s income, rents, retirement pensions, and cash transfers. Among the latter, the survey does not distinguish whether pensions or transfers are public or private. The survey, however, asks whether the household received benefits from the Universal Allowance per Child and the Unemployment Insurance, private transfers, and pensions from the national or provincial systems. These questions are responded as “yes” or “no.” Thus, strictly speaking, one cannot determine whether the reported amounts (in total or in part) for transfers and pensions should be classified as government transfers. Hence the various assumptions that were made to obtain an estimate of their incidence.
which pensions are a part of market income. Results from the sensitivity analysis, where pensions are treated as a government transfer, will be presented as well.

### 3.1 Impact on Inequality and Poverty

The evolution of the Gini coefficient and headcount ratio (using the international poverty lines of US$2.50 purchasing power parity [PPP] and US$4.00 PPP per day—extreme and moderate, respectively—and the national moderate poverty lines) for the scenario with contributory pensions as deferred income (also called “benchmark” scenario) and with pensions as a government transfer (also called “sensitivity analysis”) are presented in Table 11-2 and Figures 11-1 and 11-2.

#### Table 11-2: Gini and Headcount Index by Income Concept for Argentina 2012

<table>
<thead>
<tr>
<th></th>
<th>Market Income</th>
<th>Net Market Income</th>
<th>Disposable Income</th>
<th>Consumable Income</th>
<th>Final Income</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benchmark Case: Pensions Are Part of Market Income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gini coefficient</td>
<td>0.481</td>
<td>0.435</td>
<td>0.403</td>
<td>0.401</td>
<td>0.303</td>
</tr>
<tr>
<td>Headcount index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US$2.5 PPP (%)</td>
<td>4.7</td>
<td>5.1</td>
<td>1.8</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>US$4 PPP (%)</td>
<td>12.3</td>
<td>13.9</td>
<td>7.3</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>National Moderate PL (INDEC) (%)</td>
<td>10.3</td>
<td>12.0</td>
<td>5.6</td>
<td>9.7</td>
<td></td>
</tr>
<tr>
<td>Other Moderate PL (FIEL) (%)</td>
<td>28.8</td>
<td>33.1</td>
<td>28.4</td>
<td>37.8</td>
<td></td>
</tr>
<tr>
<td><strong>Sensitivity Analysis 1: Pensions Are a Government Transfer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gini coefficient</td>
<td>0.528</td>
<td>0.481</td>
<td>0.344</td>
<td>0.341</td>
<td>0.258</td>
</tr>
<tr>
<td>Headcount index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US$2.5 PPP (%)</td>
<td>8.5</td>
<td>9.0</td>
<td>1.8</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td>US$4 PPP (%)</td>
<td>17.3</td>
<td>19.0</td>
<td>7.3</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>National Moderate PL (INDEC) (%)</td>
<td>14.7</td>
<td>16.8</td>
<td>5.6</td>
<td>9.8</td>
<td></td>
</tr>
<tr>
<td>Other Moderate PL (FIEL) (%)</td>
<td>33.8</td>
<td>39.3</td>
<td>28.5</td>
<td>37.9</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.

PL. Poverty line.

National moderate PL. Source: INDEC.

Other moderate PL. Source: FIEL (Fundación de Investigaciones Económicas Latinoamericanas; Foundation for Latin American Economic Research).

As shown, the impact of direct taxes and direct transfers combined is equalizing and poverty-reducing. In the scenario with contributory pensions as deferred income, the disposable income Gini declines by around 16 percent and extreme poverty falls by 61 percent (Figures 11-1 and 11-2, respectively). Because contributory pensions are progressive, the declines are considerably higher in the scenario in which contributory pensions are treated as a transfer (remember that the noncontributory Pension Moratorium and Early Retirement are always treated as government transfers).

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27The National extreme poverty line is calculated by INDEC and refers to the minimum consumption basket necessary to meet adult daily food needs; the moderate poverty line adds to the former other minimum daily expenditures.
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Consumable income adds the net effect of indirect taxes and economic subsidies to disposable income. The high impact of subsidies more than compensates for the unequalizing effect of taxes (Figures 11-1). With the international poverty line of $2.50, the consumable income headcount ratio is lower than market income poverty (though higher than disposable income poverty). However, with the $4 line, the consumable income headcount ratio is above market income poverty. Except for the very poor, low-income consumers pay more in indirect taxes than what they receive in subsidies.

In-kind transfers in education and health are quite equalizing, as shown when calculating the Gini index with final income. The final income Gini (compared to the market income Gini) declines by 24 percent when pensions are considered deferred income. When pensions are considered a government transfer, the impact is—as expected—considerably higher.

Figure 11-1. Evolution of Inequality through Different Income Concepts
a. Gini coefficient
b. Percent change in Gini

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHO) 2012.

Figure 11-2. Evolution of Poverty through Different Income Concepts
a. Headcount index
b. Percent change in Headcount index
3.2 Coverage and Effectiveness of Direct Transfers

Table 11-3 presents indicators that measure the extent to which direct transfers are effective and efficient in reducing poverty (using both international and national poverty lines) for the scenarios with contributory pensions as deferred income and as transfers.

The Vertical Expenditure Efficiency (VEE) indicator measures the amount of direct transfers that go to the poor. This indicator shows that 11 percent of direct transfers reach the extreme poor while 31 percent of direct transfers reach the total poor population (using international poverty lines). (The results were 43 percent and 50 percent in the sensitivity analysis.) The spillover index (S) indicates how much of the spending that reached the poor was in excess of the strictly necessary amount required for the beneficiaries to reach the poverty line. As shown, the spillovers are high.

The Poverty Reduction Efficiency (PRE) indicator is the product of VEE times S. Finally, the Poverty Gap Efficiency (PGE) measures the transfers’ effectiveness in reducing the poverty gap. PGE estimates indicate that direct transfers are more efficient in reducing extreme poverty gaps than in reducing total poverty gaps.

Table 11-3. Poverty Reduction Efficiency and Effectiveness Indicators of Direct Transfers for Argentina 2012 in Percentages
Inequality
Change in Gini (direct transfers) | Benchmark Case (national accounts) | Sensitivity Analysis (national accounts)
-----------------------------------|-------------------------------------|-------------------------------------
0.6 | 1.1

Poverty
Change in Headcount Index ($2.50 PPP per day) | 0.6 | 0.6
Change in Headcount Index ($4 PPP per day) | 1.2 | 0.9

Beckerman (1979) and Immervoll et al. (2009) Effectiveness Indicators
$2.50 PPP per day
Vertical Expenditure Efficiency | 0.1 | 0.4
Poverty Reduction Efficiency | 0.0 | 0.1
Spillover Index | 0.6 | 0.8
Poverty Gap Efficiency | 0.7 | 0.9

$4.00 PPP per day
Vertical Expenditure Efficiency | 0.3 | 0.5
Poverty Reduction Efficiency | 0.1 | 0.1
Spillover Index | 0.5 | 0.7
Poverty Gap Efficiency | 0.6 | 0.9

National Extreme PL
Vertical Expenditure Efficiency | 0.0 | 0.4
Poverty Reduction Efficiency | 0.0 | 0.0
Spillover Index | 0.7 | 0.9
Poverty Gap Efficiency | 0.8 | 1.0

National Moderate PL
Vertical Expenditure Efficiency | 0.3 | 0.5
Poverty Reduction Efficiency | 0.1 | 0.1
Spillover Index | 0.6 | 0.8
Poverty Gap Efficiency | 0.6 | 0.9

Source: Author's calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.

Table 11-4 shows coverage levels and the distribution of benefits for every disaggregated area of public spending. The table shows that Universal Allowance per Child, Families for Social Inclusion Program, and the Pension Moratorium (and hospitals, among in-kind transfers) are the programs most targeted to the extreme poor. Meanwhile, tertiary education and indirect subsidies concentrate their benefits more heavily on the non-poor (that is, those who exceed the US$4.00 PPP per day line).

Table 11-4. Coverage and Distribution of Benefits and Beneficiaries by Program in Argentina 2012
### 3.3 Incidence Analysis

The incidence analysis has been calculated through the ratio of benefits to market income by market income deciles (see tables 11-5 and 11-6). The effect of direct taxes and direct transfers leads to a reduction in inequality: the highest decile by market income ranking is the one that bears the highest proportion of direct taxes. Meanwhile, in the case of direct transfers, the effect is the inverse because the lowest market income deciles receive the highest proportion of transfers.

The analysis of indirect taxes shows that the lowest market income deciles pay a higher proportion of their market income in taxes than other deciles, although this effect is partially mitigated by the indirect subsidies. In-kind transfers (health and education) benefit heavily on the lowest market income deciles.
Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.

As expected, when pensions are considered a government transfer, the impact is outstanding for the lowest deciles of income distribution (table 11-6). However, such an impact is not a measure of the pensions’ targeting because, by definition, retirees will have zero or near zero market income.

Table 11-6. Incidence of Taxes and Transfers on Income Distribution in Percentages for Argentina 2012 (Sensitivity Analysis)

<table>
<thead>
<tr>
<th>Deciles</th>
<th>Direct Taxes %</th>
<th>Contributions to SS %</th>
<th>Contributory Pensions %</th>
<th>Non-contributory Pensions %</th>
<th>Flagship CCT %</th>
<th>Other Direct Transfers %</th>
<th>Targeted or Not</th>
<th>All Direct Transfers %</th>
<th>Indirect Subsidies %</th>
<th>Indirect Taxes %</th>
<th>Net Indirect Taxes %</th>
<th>In-kind Educational %</th>
<th>In-kind Health %</th>
<th>In-kind Transfers %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-0.8</td>
<td>-2.3</td>
<td>1501.4</td>
<td>226.0</td>
<td>36.3</td>
<td>57.9</td>
<td>1821.6</td>
<td>142.1</td>
<td>-432.3</td>
<td>-290.2</td>
<td>161.5</td>
<td>435.7</td>
<td>597.2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>-0.4</td>
<td>-4.4</td>
<td>428.8</td>
<td>6.2</td>
<td>11.8</td>
<td>15.9</td>
<td>76.7</td>
<td>13.1</td>
<td>-41.2</td>
<td>-28.2</td>
<td>57.7</td>
<td>62.4</td>
<td>120.1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>-0.3</td>
<td>-6.5</td>
<td>19.6</td>
<td>4.0</td>
<td>5.0</td>
<td>6.4</td>
<td>35.0</td>
<td>11.0</td>
<td>-30.9</td>
<td>-20.0</td>
<td>33.9</td>
<td>43.0</td>
<td>76.9</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-0.3</td>
<td>-10.8</td>
<td>16.0</td>
<td>2.3</td>
<td>1.9</td>
<td>4.0</td>
<td>24.2</td>
<td>7.9</td>
<td>-27.1</td>
<td>-19.2</td>
<td>23.8</td>
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<td>3.0</td>
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<td>8.2</td>
<td>-24.8</td>
<td>-16.6</td>
<td>16.9</td>
<td>14.4</td>
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<td>-17.7</td>
<td>6.3</td>
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<td>0.1</td>
<td>1.3</td>
<td>8.7</td>
<td>5.6</td>
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<td>6.9</td>
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<tr>
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<td>-1.7</td>
<td>-19.2</td>
<td>4.0</td>
<td>0.3</td>
<td>0.0</td>
<td>0.3</td>
<td>4.8</td>
<td>4.4</td>
<td>-19.6</td>
<td>-15.2</td>
<td>5.3</td>
<td>2.5</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>-11.5</td>
<td>-21.2</td>
<td>1.5</td>
<td>0.1</td>
<td>0.0</td>
<td>0.2</td>
<td>1.8</td>
<td>3.2</td>
<td>-14.9</td>
<td>-11.7</td>
<td>2.4</td>
<td>0.9</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Total Population</td>
<td>-4.9</td>
<td>-18.0</td>
<td>11.0</td>
<td>1.6</td>
<td>0.7</td>
<td>1.5</td>
<td>14.8</td>
<td>5.8</td>
<td>-21.2</td>
<td>-15.4</td>
<td>9.5</td>
<td>8.4</td>
<td>17.9</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.

SS. Social security.

3.4 Progressivity
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Figure 11.3 presents social spending by program, total social spending, and indirect expenditures, sorted by their degree of progressivity. The concentration coefficient for social spending shows progressivity in absolute terms (a pro-poor characteristic).

Most direct cash transfers, education expenditures, and health benefits are progressive in absolute terms. Spending in tertiary and university education, however, is “pro-rich” because it benefits wealthier households more than poorer ones (in absolute terms). This result coincides with other studies. By contrast, expenditures that are regressive in absolute terms (pro-rich) are dominated by indirect subsidies (public transfers designed to keep tariffs low). Transportation, electricity, and gas are among these expenditures because richer households receive a higher benefit in absolute terms than low-income individuals do.

Figure 11.3. Concentration Coefficient by Spending Category with Respect to Market Income, Argentina 2012

a. Benchmark case

b. Sensitivity analysis

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHO) 2012.

Income distribution by decile for the benchmark case and the sensitivity analysis is presented in Table 11.7. For instance, the first decile concentrates 1.2 percent of market income for the benchmark case and 0.3 percent of market income when pensions are considered a government transfer. After government intervention, the first decile concentrates 3.9 percent of final income.

The richest decile concentrates 35.7 percent of market income in the benchmark case and 38.5 percent in the sensitivity analysis, although taxes and public expenditures reduce its share to 27.3 percent of final income.

Table 11.7. Income Distribution by Decile for Argentina 2012

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28See, for example, Gómez Sabaini and others (2013).
Figure 11-4 presents Lorenz and concentration curves for aggregate public expenditures and market income. Social expenditures, direct transfers, and non-contributory expenditures are progressive in absolute (pro-poor) and relative terms, whereas indirect subsidies benefit the rich in absolute terms.

Figure 11-4. Lorenz and Concentration Curves for Aggregate Public Expenditures for Argentina 2012
a. Benchmark case
b. Sensitivity analysis

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.

Figure 11-5 shows these curves for every income concept expresses the redistribution through taxes and public expenditures. The Lorenz curve corresponding to final income lies above that of market income, showing that public intervention improves income distribution.

Figure 11-5. Redistributional Effect of Taxes and Public Expenditures, Argentina 2012
a. Benchmark case
b. Sensitivity analysis

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.
Chapter 11, Rossignolo

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.

3.5 Poverty

Tables 11-8 and 11-9 show the results for poverty. The picture is roughly similar to that of inequality in that most poor households benefit strongly from direct and in-kind transfers (health and education) and the richest receive a greatly reduced proportion of these benefits. The impact on the lowest deciles is much higher when pensions are considered a public transfer but because under this scenarios retirees with by definition zero or near zero market income are classified as poor.

Table 11-8. Incidence of Taxes and Transfers on Poverty in Percentages (Benchmark Analysis) in Argentina 2012

<table>
<thead>
<tr>
<th>Group:</th>
<th>Direct Taxes %</th>
<th>Contributions EXCLU DING CONTRIBUTIONS TO PEN SIONS %</th>
<th>Non-contributory Pensions %</th>
<th>Flagship CCT %</th>
<th>Other Direct Transfers (Targeted or Not) %</th>
<th>All Direct Transfers %</th>
<th>Indirect Subsidies %</th>
<th>Indirect Taxes %</th>
<th>Net Indirect Taxes %</th>
<th>In-kind Education %</th>
<th>In-kind Health %</th>
<th>In-kind Transfers %</th>
</tr>
</thead>
<tbody>
<tr>
<td>y &lt; 1.25</td>
<td>-0.9</td>
<td>-1.1</td>
<td>60.8</td>
<td>98.9</td>
<td>86.5</td>
<td>246.2</td>
<td>36.6</td>
<td>-81.3</td>
<td>-44.7</td>
<td>321.3</td>
<td>437.1</td>
<td>758.3</td>
</tr>
<tr>
<td>1.25 &lt;= y &lt; 2.50</td>
<td>-0.4</td>
<td>-1.6</td>
<td>57.4</td>
<td>24.4</td>
<td>20.8</td>
<td>102.6</td>
<td>18.5</td>
<td>-47.3</td>
<td>-28.8</td>
<td>98.3</td>
<td>136.5</td>
<td>234.8</td>
</tr>
<tr>
<td>2.50 &lt;= y &lt; 4.00</td>
<td>-0.3</td>
<td>-3.5</td>
<td>33.7</td>
<td>13.9</td>
<td>17.9</td>
<td>65.5</td>
<td>13.3</td>
<td>-37.7</td>
<td>-24.4</td>
<td>61.9</td>
<td>69.1</td>
<td>131.0</td>
</tr>
<tr>
<td>4.00 &lt;= y &lt; 10.00</td>
<td>-0.3</td>
<td>-8.3</td>
<td>4.1</td>
<td>3.5</td>
<td>5.6</td>
<td>13.2</td>
<td>8.1</td>
<td>-25.3</td>
<td>-17.2</td>
<td>28.3</td>
<td>29.6</td>
<td>57.9</td>
</tr>
<tr>
<td>10.00 &lt;= y &lt; 50.00</td>
<td>-1.2</td>
<td>-15.5</td>
<td>0.9</td>
<td>0.2</td>
<td>1.0</td>
<td>2.1</td>
<td>5.9</td>
<td>-20.2</td>
<td>-14.3</td>
<td>7.8</td>
<td>6.2</td>
<td>13.9</td>
</tr>
<tr>
<td>50.00 &lt;= y</td>
<td>-11.7</td>
<td>-19.8</td>
<td>0.1</td>
<td>0.0</td>
<td>0.2</td>
<td>0.3</td>
<td>2.6</td>
<td>-14.6</td>
<td>-12.0</td>
<td>2.1</td>
<td>0.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Total Population</td>
<td>-4.4</td>
<td>-16.1</td>
<td>1.4</td>
<td>0.6</td>
<td>1.3</td>
<td>3.4</td>
<td>5.2</td>
<td>-19.1</td>
<td>-14.0</td>
<td>8.5</td>
<td>7.5</td>
<td>16.0</td>
</tr>
</tbody>
</table>

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.

y<2.5. Income below US$2.50 PPP.
2.5<y<4. Income between US$2.50 PPP and US$4.00 PPP.

y>4. Income higher than US$4.00 PPP.

Table 11-9. Incidence of Taxes and Transfers on Poverty in Percentages (Sensitivity Analysis) in Argentina 2012
Similarly to the income distribution analysis by decile, table 11-10 presents the distribution by socioeconomic group based on poverty analysis and shows that the greatest proportion of the population lies in the fifth bracket (US$10.00 to US$50.00 PPP). The fiscal system reduces the percentage of the population below the poverty lines, even in the highest bracket. For the benchmark case, 30.9 percent of the population was below US$50.00 PPP when considering market income in the benchmark case, whereas when considering consumable income, that percentage dropped to 13 percent. In the sensitivity analysis, 7.1 percent of the population was below US$50.00 PPP considering market income, but when considering consumable income, that proportion decreased to 2.4 percent.

Table 11-10. Income Distribution by Socioeconomic Group in Argentina 2012

<table>
<thead>
<tr>
<th>Group</th>
<th>Benchmark case</th>
<th>Sensitivity analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>y &lt; 1.25</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>1.25 &lt;= y &lt; 2.50</td>
<td>0.27</td>
<td>0.36</td>
</tr>
<tr>
<td>2.50 &lt;= y &lt; 4.00</td>
<td>0.95</td>
<td>1.36</td>
</tr>
<tr>
<td>4.00 &lt;= y &lt; 10.00</td>
<td>8.12</td>
<td>12.22</td>
</tr>
<tr>
<td>10.00 &lt;= y &lt; 50.00</td>
<td>59.77</td>
<td>69.24</td>
</tr>
<tr>
<td>50.00 &lt;= y</td>
<td>30.87</td>
<td>16.77</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.

y<2.5.Income below US$2.50 PPP.
2.5<y<4.Income between US$2.50 PPP and US$4.00 PPP.
y>4.Income higher than US$4.00 PPP.

3.6 Fiscal mobility

Table 11-11 and table 11-12 display the fiscal mobility matrixes for the benchmark case and the sensitivity analysis, respectively. For the benchmark case, around 27 percent of the population
under extreme poverty in the market income group remains in that condition in the disposable income classification, which means that around 73 percent of that population can rise out of that condition into a group with between US$1.25 and US$10.00 PPP when considering disposable income.

Table 11-11. Fiscal Mobility Matrices (Benchmark case): Market to Disposable, Consumable and Final Income

<table>
<thead>
<tr>
<th>Market Income groups</th>
<th>Disposable Income groups</th>
<th>% of Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>y &lt; 1.25</td>
<td></td>
</tr>
<tr>
<td>y &lt; 1.25</td>
<td>27.39</td>
<td>1.16</td>
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<tr>
<td>1.25 &lt;= y &lt; 2.50</td>
<td>41.66</td>
<td>2.89</td>
</tr>
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<td>2.50 &lt;= y &lt; 4.00</td>
<td>17.08</td>
<td>0.00</td>
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<td>13.88</td>
<td>0.00</td>
</tr>
<tr>
<td>10.00 &lt;= y &lt; 50.00</td>
<td>0.00</td>
<td>6.05</td>
</tr>
<tr>
<td>50.00 &lt;= y</td>
<td>0.00</td>
<td>24.54</td>
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</table>

<table>
<thead>
<tr>
<th>Market Income groups</th>
<th>Consumable Income groups</th>
<th>% of Population</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>y &lt; 1.25</td>
<td></td>
</tr>
<tr>
<td>y &lt; 1.25</td>
<td>38.15</td>
<td>1.16</td>
</tr>
<tr>
<td>1.25 &lt;= y &lt; 2.50</td>
<td>38.10</td>
<td>2.89</td>
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<tr>
<td>2.50 &lt;= y &lt; 4.00</td>
<td>19.56</td>
<td>0.00</td>
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<td>0.00</td>
<td>24.54</td>
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<td>57.50</td>
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<table>
<thead>
<tr>
<th>Market Income groups</th>
<th>Final Income groups</th>
<th>% of Population</th>
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<tr>
<td></td>
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<td>2.89</td>
</tr>
<tr>
<td>2.50 &lt;= y &lt; 4.00</td>
<td>13.11</td>
<td>0.00</td>
</tr>
<tr>
<td>4.00 &lt;= y &lt; 10.00</td>
<td>80.49</td>
<td>6.41</td>
</tr>
<tr>
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<td>6.41</td>
<td>0.00</td>
</tr>
<tr>
<td>50.00 &lt;= y</td>
<td>0.00</td>
<td>24.54</td>
</tr>
</tbody>
</table>

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENGHo) 2012.

y<2.5. Income below US$2.50 PPP.
2.5<y<4. Income between US$2.50 PPP and US$4.00 PPP.
y>4. Income higher than US$4.00 PPP.

Analyzing consumable income, 38.1 percent of the population is in the group below US$1.25 PPP, an increase from the percentage in the disposable income analysis, which indicates the effect of indirect taxes and transfers.

When comparing market income and final income groups, about 80 percent of the population that was below the extreme poverty threshold considering market income move into groups between US$4.00 to US$10.00 PPP when considering final income due to the effect of in-kind taxes and transfers.
In the sensitivity analysis, around 4 percent of the population under extreme poverty in the market income group remains in that condition in the disposable income classification. Around 63 percent can move out of that condition and into the group with between US$10.00 and US$50.00 PPP when considering disposable income.

When analyzing consumable income, 6 percent of the population is below US$1.25 PPP; the effect of indirect taxes and transfers increases this proportion compared to disposable income.

In the event of comparing market income and final income groups, about 24 percent of the population that was below the extreme poverty threshold considering market income rise to between US$4.00 to US$10.00 PPP when considering final income due to the effect of in-kind taxes and transfers.

Table 11-12. Fiscal Mobility Matrixes (Sensitivity Analysis), Market to Disposable, Consumable and Final Income

<table>
<thead>
<tr>
<th>Market Income groups</th>
<th>Disposable Income groups</th>
<th>Consumable Income groups</th>
<th>Final Income groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>y &lt; 1.25</td>
<td>y &lt; 1.25</td>
<td>y &lt; 1.25</td>
<td>y &lt; 1.25</td>
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<tr>
<td>1.25 &lt;= y &lt; 2.50</td>
<td>1.25 &lt;= y &lt; 2.50</td>
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<td>2.50 &lt;= y &lt; 4.00</td>
<td>2.50 &lt;= y &lt; 4.00</td>
</tr>
<tr>
<td>4.00 &lt;= y &lt; 10.00</td>
<td>4.00 &lt;= y &lt; 10.00</td>
<td>4.00 &lt;= y &lt; 10.00</td>
<td>4.00 &lt;= y &lt; 10.00</td>
</tr>
<tr>
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<td>10.00 &lt;= y &lt; 50.00</td>
<td>10.00 &lt;= y &lt; 50.00</td>
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<tr>
<td>50.00 &lt;= y</td>
<td>50.00 &lt;= y</td>
<td>50.00 &lt;= y</td>
<td>50.00 &lt;= y</td>
</tr>
</tbody>
</table>

Source: Author’s calculations based on National Household Survey on Incomes and Expenditures (ENHo) 2012.

y<2.5. Income below US$2.50 PPP.
2.5<y<4. Income between US$2.50 PPP and US$4.00 PPP.
y>4. Income higher than US$4.00 PPP.

4. Conclusions
This chapter has introduced the CEQ methodology to analyze the impact of public expenditures and taxes on income distribution and poverty in Argentina using ENGHo survey data from 2012-2013. The results show that fiscal policy had a very high impact on inequality. While fiscal policy reduces extreme poverty, however, moderate poverty increases mainly as a result of the impact of indirect taxes. Indirect subsidies and programs like Family Allowances in the formal sector transfer a significant portion of fiscal resources to the non-poor. That is, there is room for re-allocating resources from the higher income deciles to the poor. In addition, given the fact that tax collection reached its peak, it is unlikely that this magnitude of redistribution could be sustained and, simultaneously, keep macroeconomic balance and incentives to invest in place.
References


Gómez Sabaini, Juan Carlos, and Darío Rossignolo. 2001. “Análisis de la incidencia de los impuestos y de la política fiscal sobre la distribución del ingreso en Argentina.” Noveno Congreso Tributario del CPCECABA.


Chapter 11, Rossignolo


Ethno-Racial Poverty and Income Inequality in Brazil

Claudiney Pereira

October 31, 2016

Chapter 12
Lustig, Nora, editor
Commitment to Equity Handbook
Brookings Institution and CEQ Institute (2017)

12.1 Introduction

Historically, Brazil has had one of the highest levels of inequality in the world; in 1989, for example, Brazil had a Gini coefficient of 0.63, making it the second most unequal country in the world, narrowly behind Sierra Leone. However, inequality has fallen in Brazil every year since 2001. The recent decline is largely due to increased public cash transfers and a more equitable distribution of educational attainment resulting from expanded access to education in the 1990s. Social spending has become both larger and more progressive. Poverty decreased every year since 2003 - whether measured by the headcount index, poverty gap index, or squared poverty gap index. Brazil’s conditional cash transfer program, Bolsa Família, is very effective at reducing poverty, especially in rural areas. There is also evidence that the racial divide has declined; as showed by Soares and Blackman and others, the income ratio between whites and non-whites (blacks and pardos) decreased between 1987-2012, albeit slowly.

Despite its relative success in reducing overall income inequality and poverty, Brazil’s ethno-racial divide is still substantial. Afro-Brazilians lag behind in almost every social indicator. This paper is part of the project “Incidence of Taxes and Social Spending by Ethnicity and Race,” a joint initiative of the Commitment to Equity (CEQ) Institute and the Gender and Diversity Division of the Inter-American Development Bank.
poverty rates are twice those of white Brazilians.\textsuperscript{12} Afro-Brazilian unemployment rates are typically 35\% higher than those of whites, income per capita is about 50\% less than that received by whites – according to that study, it would take 41 years to equalize it if we keep the same trend from 2001-2012\textsuperscript{13}. Lower Afro-Brazilian educational attainment is one explanation for the income divide. In 2012, less than 13\% of the Afro-Brazilian population over 16 had tertiary education compared to almost 28\% of whites. However, even if we consider the same level of education, Afro-Brazilians with tertiary education earned only 70\% (men) and 41\% (women) compared to whites. According to Campante, Crespo, and Leite\textsuperscript{14}, discrimination may explain up to 25\% of the wage gap between whites and Afro-Brazilians.

Given these facts, the extent to which governments use fiscal policy to reduce inequality and poverty differentials between Afro-Brazilians and other ethno-racial groups is of great relevance. Most Brazilian fiscal incidence studies do not disaggregate the results by such socially relevant groups.\textsuperscript{15} This chapter summarizes the results of applying a standard benefit-tax incidence analysis to estimate the effect of taxes and social spending on inequality and poverty among ethnic groups in Brazil using the Pesquisa de Orçamento Familiar (POF), 2009. In particular, I use the methodology described in chapter 1 (Lustig and Higgins), chapter 5 (Higgins and Lustig), chapter 7 (Higgins), and chapter 8 (Aranda and Ratzlaff)\textsuperscript{16} to estimate the effects of taxation (direct and indirect) as well as cash transfers, indirect subsidies, and in-kind benefits on income distribution and poverty among ethnic groups in Brazil. The rich detail of our data set allows us to single out the effects of each direct tax and transfer without needing to simulate most taxes or benefits.

The chapter is organized as follows. The next section describes the social spending and taxation systems in Brazil in addition to describing the data and methodology used. Section 3 summarizes the main results of our incidence analysis. Conclusions are presented in section 4.

12.2. Methodology

In addition to describing the social spending and taxation systems in Brazil, this section focuses on the aspects of methodology that are unique to the country.

12.2.1. Definitions and Measurements

\textsuperscript{12} Paixão and others (2010).
\textsuperscript{13} Blackmand and others (2014).
\textsuperscript{14} Campante, Crespo, and Leite (2004).
\textsuperscript{15} Recent incidence analyses for Brazil include Immervoll and others (2009); Nogueira, Siqueira, and Souza (2011); Silveira and others (2011); Higgins and Pereira (2014). However, as far as we know, there is no fiscal incidence analysis accounting for the ethno-racial divide.
The fiscal incidence analysis is based on the CEQ methodology as described in chapters 1, 5, 7, and 8 in this handbook.\textsuperscript{17} As described in chapter 1, we use four income concepts in our incidence analyses: market, disposable, consumable, and final income.\textsuperscript{18} Market income is total current income before direct taxes. It is equal to the sum of gross (pre-tax) wages and salaries in the formal and informal sectors (also known as earned income), income from capital (dividends, interest, profits, rents, etc.) in the formal and informal sectors (excludes capital gains and gifts), auto-consumption, imputed rent for owner-occupied housing, private transfers (remittances and other private transfers such as alimony), and old-age and other pensions from the contributory social security system. Disposable income equals market income minus direct personal income taxes on all income sources (included in market income) that are subject to taxation and all contributions to social security except for the portion going towards pensions\textsuperscript{19} plus direct government transfers (mainly cash transfers, but can include food transfers). Consumable income is defined as disposable income plus indirect subsidies minus indirect taxes (e.g., value added tax, sales tax, et cetera). Final income is defined as consumable income plus government in-kind transfers in the form of free or subsidized services in education, health, and housing, minus co-payments or user fees.\textsuperscript{20}

In the fiscal incidence literature, pensions from contributory systems are sometimes treated as part of deferred income or other times as government transfers.\textsuperscript{21} Since this is an unresolved issue, we estimate both scenarios in our study. In the deferred income scenario, contributory pensions are part of market income. In the government transfer scenario, contributory pensions are treated as any other government transfer. The results presented here are for the scenario in which pensions are deferred income.\textsuperscript{22}

12.2.2. Social Spending and Taxation in Brazil\textsuperscript{23}

Social spending used in our analysis accounts for about 15 percent of GDP in Brazil in 2009.\textsuperscript{24} This figure includes social assistance (direct transfers and other social assistance), health spending, and education spending and includes spending at the federal, state, and municipal levels. Direct transfers include conditional cash transfer programs, non-contributory pensions, food transfers, unemployment benefits, special circumstances pensions, and others. In-kind transfers are benefits received from universal free public education and health systems.

\textsuperscript{17} Although this paper was based on an earlier version of the CEQ Handbook (Lustig and Higgins, 2013), the relevant reading is chapters 1, 5, 7, and 8 in this Handbook.
\textsuperscript{18} For more details on concepts and definitions, see Lustig and Higgins (2013).
\textsuperscript{19} Since here we are treating contributory pensions as part of market income, the portion of the contributions to social security going towards pensions is treated as “saving.”
\textsuperscript{20} One may also include participation costs such as transportation costs or foregone incomes because of use of time in obtaining benefits. In our study, they were not included.
\textsuperscript{21} See Lustig and Higgins (2013) for more details.
\textsuperscript{22} For an explanation of why it might be more appealing to choose this scenario, see chapter 1 by Lustig and Higgins.
\textsuperscript{23} A complete description of the transfer and tax systems is given on Higgins and Pereira (2014).
\textsuperscript{24} Social spending including contributory pensions is about 26% of GDP. The complete table with all different groups of social spending and their share of GDP is available on Higgins and Pereira (2014, page 349).
There are more than eighty-five taxes in Brazil. Total tax revenues at the federal, state, and municipal levels were about 35 percent of GDP in 2009. Direct taxes represent 45 percent of the taxes levied by the government and indirect taxes 55 percent. The Brazilian tax system is exceedingly complex and the “cascading effect” is one of its major distortions as taxes (federal, state, and municipal) compound on each other and are applied to the final sales price of the good, not the pre-tax sales price. The cascading effect was estimated to be 18% of the tax collected in 2003 and the overall cost of the distortions created by it was about 2 percent of GDP.

The distortions generated by the Brazilian tax system are even more important in our study due to the effects of indirect taxes on the purchasing power of the poorer families. The cascading effect and inexistence of exemptions, even for the basic basket of goods and services, can have detrimental effects on those that spend a larger proportion of their income on food.

12.3. Data

Ethno-racial groups in Brazil considered in our study are: whites, pardos, blacks, and indigenous. The self-reported information is collected by the Brazilian national statistical office (IBGE). In the 2010 census, the proportion of whites, pardos, blacks, and indigenous were 48.8, 43.1, 7.7, and 0.4% respectively. In some studies, Soares and Paixão and others, pardos and blacks are aggregated as blacks, but they will kept separated here.

The data on household incomes, taxes, and transfers come from the most recent Pesquisa de Orçamento Familiares (Family Expenditure Survey, POF) 2008-2009. This survey has national coverage, sampling 56,091 households using a two-stage stratified sample design, and is conducted approximately once every five years. It contains detailed information about many labor and non-labor income sources, direct taxes paid, transfers received, use of public education, and consumption. Data on the use of public health services come from the Pesquisa Nacional por Amostra de Domicílios (National Household Sample Survey, PNAD) 2008, which contains income data and a detailed supplemental health survey containing the necessary information regarding the use of public health services. Both POF and PNAD are representative at the state level. In-kind education benefits are equal to the average spending per student by level (early childhood development, pre-school, primary, lower secondary, upper secondary, and tertiary), which is obtained from national accounts and imputed to students who attend public school.

26 Amaral, Olineike, and Amaral Viggiano (2007).
27 Nogueira, Siqueira, and Souza (2010).
29 Asian descendants accounted for about 1% and undeclared individuals 0.003%. Both groups were counted as whites.
31 Paixão and others (2010).
32 A new issue of the POF has been delayed due to budget problems and is expected to be released in 2017.
33 See IBGE (2008, 2012) for more information on PNAD and POF respectively.
Data on government revenues and spending, which are used to scale up household survey data for the inequality (but not poverty) calculations, come from Brazil’s national accounts. In general, the amounts received from direct transfers are directly identified from the survey. On the tax side, individual income taxes (IRPF and the portion of ISS paid by workers) and property taxes (IPTU and ITR)\(^{34}\) are directly identified in the survey. By using the values reported in the survey, we are implicitly assuming that the incidence of individual income tax is borne entirely by labor (specifically, those workers who report paying the taxes in the household survey) and property taxes entirely by the owners of property (specifically, those who report them in the survey). Consumption taxes are imputed by applying effective tax rates to the very detailed consumption data available from the survey. We assume that the incidence of consumption taxes falls fully on consumers.

To impute indirect subsidies, we use the total spent on electricity, in combination with income, to determine who was eligible for the electricity subsidy. We assume that all eligible households received the subsidy.

**12.3. Results**\(^{35}\)

Figure 12-1 shows the distribution of ethnic groups according to their income (market, disposable, and consumable). Their income ranges from less US$1.25 to greater than US$50. There is clearly a great divide between whites and non-whites. The vast majority of those living with less than US$4 are pardos and blacks. On other end, whites are the overwhelming majority of those living with more than US$4 daily, with an increasing representation as income rises. In addition, Brazil’s great divide persists after accounting for taxes and transfers (consumable income).

**Figure 12-1:** Brazil’s Great Divide. Distribution of the Population by Ethnic Groups, Market Income (full line), Disposable Income (dashed line) and Consumable Income (dotted line)

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\(^{34}\) IRPF is “imposto de renda da pessoa física” (households’s income tax), ISS is “imposto sobre serviços” (municipal service tax), IPTU is “imposto predial e territorial urbano” (urban property tax), and ITR is “imposto territorial rural” (rural property tax).

\(^{35}\) Tables and graphs are based on Higgins and Pereira (2013).
Note: Y is income (PPP).

Fiscal policy played an important role in reducing poverty and inequality in Brazil, but how much redistribution and poverty reduction is being accomplished across ethnic groups? How was the ethno-racial divide affected by fiscal policy? The results are shown in section 3.

12.3.1 Inequality

As seen in table 12-1, market income inequality at the national level is considered very high in Brazil, with a Gini coefficient of 0.579. Indigenous and whites present the highest inequality with a Gini coefficient of 0.588 and 0.558, respectively. Blacks present the lowest level of inequality with a Gini coefficient of 0.525. When we consider the impact of direct taxes and direct transfers (disposable income vs. market income) inequality falls for all ethnic groups, but the effects of fiscal policy are relatively equal across groups. The average reduction in the Gini coefficient is about 3% for whites,

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36 Higgins and Pereira (2014).
pardos, and blacks and slightly higher for indigenous. Therefore, direct transfers are not playing a significant role in reducing the great divide.

Table 12-1: Gini Coefficient and its Change with Respect to Market Income by Ethnic Groups

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Gini/Change</th>
<th>Market</th>
<th>Disposable</th>
<th>Consumable</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>Gini</td>
<td>0.558</td>
<td>0.527</td>
<td>0.528</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>Change</td>
<td>…</td>
<td>-0.031</td>
<td>-0.029</td>
<td>-0.107</td>
</tr>
<tr>
<td>Pardo</td>
<td>Gini</td>
<td>0.552</td>
<td>0.512</td>
<td>0.515</td>
<td>0.376</td>
</tr>
<tr>
<td></td>
<td>Change</td>
<td>…</td>
<td>-0.039</td>
<td>-0.037</td>
<td>-0.175</td>
</tr>
<tr>
<td>Black</td>
<td>Gini</td>
<td>0.525</td>
<td>0.486</td>
<td>0.488</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td>Change</td>
<td>…</td>
<td>-0.038</td>
<td>-0.036</td>
<td>-0.165</td>
</tr>
<tr>
<td>Indigenous</td>
<td>Gini</td>
<td>0.588</td>
<td>0.536</td>
<td>0.541</td>
<td>0.408</td>
</tr>
<tr>
<td></td>
<td>Change</td>
<td>…</td>
<td>-0.051</td>
<td>-0.046</td>
<td>-0.179</td>
</tr>
<tr>
<td>National</td>
<td>Gini</td>
<td>0.579</td>
<td>0.544</td>
<td>0.546</td>
<td>0.439</td>
</tr>
<tr>
<td></td>
<td>Change</td>
<td>…</td>
<td>-0.035</td>
<td>0.033</td>
<td>-0.139</td>
</tr>
</tbody>
</table>

... means the value is not applicable

When compared with disposable income inequality, net indirect taxes are slightly unequalizing. As shown in table 12-1, when adding the monetized value of education and health spending, the Gini coefficient falls more significantly, especially for non-whites. Income inequality for pardos and indigenous falls by about 17% compared to only 10% for whites and 13% at the national level. The lower effect on inequality may be only reflecting whites opting out of the public health and educational systems. In fact, according to the Educational Census (IBGE, 2005), non-whites accounted for just 30% of those attending a private school.

In spite of the apparent improvement, the per capita incomes of Afro-Brazilians is still about 50% of whites (figure 12-2). The fiscal system is reducing the gap, but only moderately and only after monetized values for public health and education are added.

Figure 12-2: Distribution of Income Between Groups
12.3.2 poverty

To measure the impact of fiscal policy on poverty, we use three poverty lines: US$1.25 PPP per day (ultra-poverty), US$2.50 PPP per day (extreme poverty), and US$4.00 PPP per day (moderate poverty). Results are showed in table 12-2.

Market income poverty shows a wide difference between whites and non-whites. For any poverty line, prevalence of poverty among pardos, blacks, and indigenous is at least twice as high as that of whites, with the largest difference occurring among the ultra-poor.

At the national level, ultra-poverty is reduced by 54 percent by direct transfers (net of any direct taxes paid), extreme poverty by 26 percent, and moderate poverty by 11 percent. Nonetheless, when indirect taxes are considered, the reduction in ultra-poverty is weakened, and extreme and moderate poverty actually increase when one compares market income with consumable income. In other words, the number of near-poor who are pushed into moderate poverty by paying more in taxes than they receive in benefits (i.e., direct transfers and indirect subsidies) is higher than the number of poor who escape poverty by receiving more in transfers and subsidies than they pay in taxes.

<table>
<thead>
<tr>
<th>Market Income</th>
<th>White</th>
<th>Pardo</th>
<th>Black</th>
<th>Indigenous</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.25 (ultra poor)</td>
<td>2.8</td>
<td>8.8</td>
<td>7.1</td>
<td>8.2</td>
<td>5.8</td>
</tr>
<tr>
<td>$2.5 (extreme poor)</td>
<td>8.2</td>
<td>22.1</td>
<td>19.2</td>
<td>18.3</td>
<td>15.1</td>
</tr>
</tbody>
</table>

37 The poverty lines are in 2005 purchasing power parity.
Ultra-poverty is reduced for all four ethnic groups, anywhere from 40 to 57%. However, whites had a considerably higher reduction at 57% compared to pardos and blacks with a 40% and 49% reduction respectively. A similar result is also found on extreme poverty (US$2.50) and poverty (US$4.00) with whites having a significantly higher reduction than other ethnic groups. In all poverty lines, whites had a higher poverty reduction than the national average. Considering net indirect taxes, consumable income (compared to market income) poverty reduction is tempered for the ultra-poor and increased for the other two poverty lines across all groups. After accounting for all taxes and transfers, the prevalence of poverty between non-whites and whites stayed practically unchanged, however the headcount ratio between pardos and whites increased from 3.1 to 3.3 for those living under US$1.25.

At the national level, the moderate success of direct transfers at reducing poverty can be attributed to high coverage of the poor: 85 percent of the poor live in households receiving at least one direct transfer. This figure is even higher among the extreme poor (93 percent) and ultra-poor (98 percent). Table 12-3, shows the percent of individuals living in beneficiary households across different ethnic groups. The ultra-poor (white, pardo, and black) have similar coverage also comparable to the national average. The overall coverage for the extreme poor and poor is higher for pardos and blacks than whites.

While non-whites have higher overall coverage, table 12-3 shows that the per capita transfer for whites is higher for all income groups. The table also shows difference being higher on the two extremes (below $1.25 and above $50). The average benefit for pardos living under $1.25 is just 60 percent of the amount received by whites. For those living above $50, whites are receiving more than twice the amount per capita received by pardos.

This unwelcome result occurs because coverage for two particularly generous programs is considerably higher for the white population than non-whites. Coverage for Special Circumstances Pensions and Scholarships programs is higher for whites than pardos and blacks at any poverty line (U$1.25, US$2.50, and US$4). The coverage for the Scholarships program is twice as big for whites.
living with less than US$1.25. Special Circumstances Pensions have a significantly higher coverage for whites at any poverty line.

Table 12-3: Percent of Individuals Living in Beneficiary Households

<table>
<thead>
<tr>
<th>White Groups</th>
<th>PERCENT OF INDIVIDUALS LIVING IN BENEFICIARY HH</th>
<th>BENEFITS PER CAPITA IN DAILY US$$PPP DOLLARS (PPP 2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>y&lt;1.25 1.25&lt;y&lt;2.5 2.5&lt;y&lt;4 4&lt;y&lt;10 10&lt;y&lt;50 y&gt;50</td>
<td>y&lt;1.25 1.25&lt;y&lt;2.5 2.5&lt;y&lt;4 4&lt;y&lt;10 10&lt;y&lt;50 y&gt;50</td>
</tr>
<tr>
<td>Bolsa Familia</td>
<td>84.40% 70.90% 53.40% 18.50% 2.40% 0.20%</td>
<td>0.31 0.26 0.18 0.06 0.01 0.00 0.06</td>
</tr>
<tr>
<td>Scholarships</td>
<td>1.50% 2.50% 1.20% 0.90% 1.20% 0.20%</td>
<td>0.19 0.02 0.01 0.02 0.03 0.10 0.03</td>
</tr>
<tr>
<td>BPC</td>
<td>7.00% 4.20% 3.30% 2.40% 0.40% 0.20%</td>
<td>0.17 0.09 0.08 0.05 0.01 0.00 0.04</td>
</tr>
<tr>
<td>Unemployment</td>
<td>2.40% 3.30% 3.20% 5.70% 4.70% 0.90%</td>
<td>0.01 0.02 0.02 0.04 0.05 0.01 0.04</td>
</tr>
<tr>
<td>Special Circumstances Pensions</td>
<td>18.10% 16.40% 12.40% 12.50% 10.50% 5.70% 11.40%</td>
<td>0.62 0.62 0.49 0.56 0.68 1.82 0.71</td>
</tr>
<tr>
<td>Other Transfers</td>
<td>1.30% 2.50% 2.30% 2.40% 2.80% 2.20%</td>
<td>0.00 0.01 0.01 0.01 0.01 0.02 0.01</td>
</tr>
<tr>
<td>All Above</td>
<td>98.40% 84.50% 67.20% 37.70% 20.70% 10.70% 34.20%</td>
<td>1.30 1.02 0.77 0.73 0.79 1.96 0.89</td>
</tr>
<tr>
<td>Pardo Groups</td>
<td>y&lt;1.25 1.25&lt;y&lt;2.5 2.5&lt;y&lt;4 4&lt;y&lt;10 10&lt;y&lt;50 y&gt;50</td>
<td>y&lt;1.25 1.25&lt;y&lt;2.5 2.5&lt;y&lt;4 4&lt;y&lt;10 10&lt;y&lt;50 y&gt;50</td>
</tr>
<tr>
<td>Bolsa Familia</td>
<td>93.20% 87.30% 69.00% 30.90% 5.10% 1.00%</td>
<td>4.20% 0.36 0.32 0.24 0.10 0.02 0.01 0.15</td>
</tr>
<tr>
<td>Scholarships</td>
<td>0.80% 2.10% 1.80% 1.30% 1.00% 1.00%</td>
<td>1.30% 0.00 0.01 0.01 0.01 0.02 0.05 0.01</td>
</tr>
<tr>
<td>BPC</td>
<td>7.30% 4.50% 3.70% 2.30% 0.60% 0.40%</td>
<td>2.80% 0.16 0.08 0.08 0.05 0.01 0.00 0.01</td>
</tr>
<tr>
<td>Unemployment</td>
<td>2.60% 3.40% 3.40% 5.60% 5.10% 2.70%</td>
<td>4.50% 0.01 0.01 0.02 0.03 0.05 0.06 0.03</td>
</tr>
<tr>
<td>Special Circumstances Pensions</td>
<td>12.00% 9.30% 9.40% 9.80% 9.20% 5.00% 9.60%</td>
<td>0.26 0.23 0.21 0.33 0.54 0.71 0.36</td>
</tr>
<tr>
<td>Other Transfers</td>
<td>1.30% 2.60% 2.40% 3.30% 3.00% 0.90%</td>
<td>2.80% 0.00 0.01 0.01 0.01 0.01 0.01</td>
</tr>
<tr>
<td>All Above</td>
<td>98.30% 93.10% 77.50% 46.20% 22.20% 10.50% 54.70%</td>
<td>0.80 0.66 0.57 0.54 0.65 0.84 0.62</td>
</tr>
</tbody>
</table>

The reasons why whites have better coverage than non-whites on those programs are still not completely understood. The Special Circumstance Pensions program benefits those living in urban areas and working in the formal sector more than their counterparts as you must be enrolled in the social security system to be eligible. If pardos and blacks occupy a majority of the informal sector and/or rural areas, then they will be underrepresented. The data available corroborates such a possibility. According to Araujo and Lombardi, using 2009 data, about 56% of all pardos and blacks were working in the informal sector versus 44% % in the case of the white population.

The fact that poverty is not reduced further despite Brazil’s high spending on direct transfers is also due to high leakages to the non-poor (in addition to the deleterious effect of indirect taxes): 73 percent of total direct transfer benefits go to the population that is above the US$4.00 poverty line.

12.4 Conclusions

This chapter summarizes the results of applying a standard benefit-tax incidence analysis to estimate the effect of taxes and social spending on inequality and poverty among ethnic groups in Brazil.

Direct transfers through fiscal intervention had similar effects on inequality across ethnic groups. The average reduction of the Gini coefficient is 3% for whites, pardos, and blacks and slightly higher for indigenous. Adding monetized in-kind benefits, health and education, the reduction in inequality for

38 Araujo and Lombardi (2013).
pardos is significantly higher than for whites (17% vs. 10%). However, the income ratio between whites and non-whites is virtually unchanged from market income to final income. Non-whites’ incomes are still about half of that of whites. The fiscal system reduces the divide, but only very slightly. The higher effect in the Gini coefficient for pardos may be only reflecting whites opting out of the public health and educational systems. According to the Educational Census, about 70% of those attending private schools were whites.\(^{40}\) In addition, the proportion of pardos and blacks with private health insurance is less than 18% compared to over 32% for whites.\(^{41}\)

Poverty rates are at least twice as high for non-whites for any poverty line (US$1.25, $2.50, and $4.00). The fiscal system reduces poverty across all ethnic groups and poverty lines after accounting for direct transfers. However, consistent with Higgins and Pereira\(^ {42}\), such positive effects are offset by a deleterious effect from indirect taxes, reversing the benefits accrued all ethnic groups. In fact, the results for ultra-poverty are weakened, and extreme and moderate poverty actually increased.

In addition, we found another unwelcomed result. While direct transfers have a high coverage of the poor especially for pardos and blacks, per capita transfers are on average higher for whites and benefits can be twice as large as those for non-whites.

Brazil has experienced a significant decrease in income inequality and poverty over the last fifteen years. Fiscal policy played an important role, especially on reducing inequality at the national level.\(^ {43}\) However, our study shows that fiscal interventions did not have a significant impact in reducing the divide between whites and non-whites.

\(^{40}\) IBGE (2005).
\(^{41}\) IBGE (2009).
\(^{42}\) Higgins and Pereira (2014).
\(^{43}\) Higgins and Pereira (2014).
References


Introduction

El Salvador is a middle-income country with a population of 6.2 million and an average per capita income of US$7,441.70 in purchasing power parity (PPP) in 2012. In that year, the Gini coefficient was 0.425 and the poverty rate, measured using the international poverty line of US$2.50 a day PPP 2005, was 14.7 percent. With growing debt and a persistent fiscal deficit, El Salvador faces major fiscal policy challenges. In this context, it is essential to know the impact of fiscal policy on inequality and poverty to have a basis for evaluating alternative courses of action to achieve fiscal stability.

To this end, we present here a fiscal impact study to estimate the effect of taxes, social spending, and subsidies on inequality and poverty. To determine the distribution of the fiscal burden and the benefits of social spending, we developed concepts of income before and after fiscal interventions, by category and as a whole based on data from the 2011 Multi-Purpose Household Survey (EHPM), and administrative data from various sources. The study uses the methodology proposed by the Commitment to Equity (CEQ) Institute, so that

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1 This paper is based on the CEQ Assessment for El Salvador prepared by the authors and the CEQ Institute for the Inter-American Development Bank
2 Margarita Beneke and Jose Andres Oliva are at FUSADES, El Salvador and Nora Lustig at Tulane University. The authors are grateful for the research assistantship received from Sean Higgins, Nicole Florack, and Yang Wang.
3 Equivalent to US$3,819 in current dollars.
4 See, especially, chapter 1 (Lustig and Higgins, 2017), chapter 5 (Higgins and Lustig, 2017), and chapter 7 (Higgins, 2017) in this Handbook. The methodology used here is based on an earlier edition of the CEQ Handbook (Lustig and Higgins, 2013).
the results for El Salvador can be compared with countries that have similar income levels in Latin America and outside the region, where the same methodology has been applied.

Some fiscal incidence studies available for El Salvador analyze only a subset of fiscal policy components; for example, Acevedo and González\(^5\) analyzed the impact of taxes on inequality, but did not consider public spending. The Central American Institute for Fiscal Studies (ICEFI)\(^6\) analyzed the impact on inequality of taxes and public spending in the social area, but did not include the effect of subsidies. Barreix, Martín, and Roca\(^7\) and Cubero and Hollar\(^8\) dealt with progressivity and regressivity of taxes and spending for education and health for the Central American countries, including El Salvador; however, none of the above studies considered the effects on poverty.

In contrast to existing literature, this study analyzes the incidence of the various components of fiscal policy not only on inequality, but also on poverty. Social spending includes direct cash transfers, such as the Rural Solidarity Communities (RSC) or the Temporary Income Support Program (PATI), as well as transfers in kind. These include school lunches and the farm and school packages, subsidies for gas, water, electricity, and public transportation, education services (preschool, primary, secondary, and tertiary), and health services provided by the state. With respect to taxes paid by individuals, we considered direct and indirect taxes as well as contributions to health systems. We also analyzed contributory pensions.

The analysis shows that the direct transfer programs (sometimes also called social programs) are generally aimed at lower income households, but since the budget dedicated to them is small, their impact on inequality and poverty is limited. The analysis also shows that a large part of the resources used to subsidize liquid petroleum gas (LPG), electricity, water, and public transportation reach households in the upper deciles of income distribution, so although their budget is larger, their impact on poverty is small. These taxes are progressive as a whole, but their impact on equality is also limited. The analysis also shows that the component with the greatest effect on inequality is (the monetized value of) social spending for education and health services provided by the government.

Direct transfers reduce the incidence of poverty, measured at both national and international poverty lines. However, this effect is almost completely offset when we take into account indirect taxes net of subsidies. The state’s net fiscal action—in terms of purchasing power—results in a higher percentage of individuals living under said poverty lines. In fact, starting with the second poorest decile, the population is a net payer; the population pays more in direct and indirect taxes than it receives in direct transfers and subsidies.

In summary, El Salvador’s fiscal policy, has little, no, or even a negative effect on poverty reduction (depending on the line used). Using the international poverty line of US$2.50 (PPP), El Salvador fares relatively well in comparison with other countries with similar per capita income, such as Armenia and Guatemala. El Salvador, however, redistributes relatively less in comparison to the general trend in countries both inside and outside of the region with similar per capita income.

\(^5\) Acevedo and González (2003).
\(^6\) ICEFI (2009).
\(^7\) Barreix, Martín, and Roca (2009).
\(^8\) Cubero and Hollar (2010).
The analysis makes it possible to identify areas in which fiscal policy could be changed to obtain better results. For example, since electricity subsidies to households that use more than 99 kWh represent a low percentage of the income that they receive, this resource could be redirected to strengthen coverage in preschool or middle school.

### 13.1 Taxes and Public Spending

The following is a detailed description of the taxes and fiscal spending used in this research. The government’s total revenue was US$5,126.8 million in 2011, or 18.2 percent of GDP; net fiscal revenue was 13.8 percent of GDP and gross was 15.1 percent. Direct taxes were 5.2 percent of GDP, 1.97 percent of which was individual income tax. Indirect taxes accounted for 10 percent, with 7.8 percent coming from the value added tax (VAT). Nontaxed income totaled 3.5 percent and external grants equaled 1 percent of GDP. In 2011, public expenditures\(^9\) in El Salvador represented 22.3 percent of GDP; primary spending was 19.9 percent, and social spending 8.6 percent of GDP, respectively (table 13-1).

It is important to clarify that the CEQ concepts and definitions standardize social spending and do not correspond exactly with the classification used in El Salvador’s national budget. CEQ social spending is defined as the sum of direct transfers from the state to the population, plus the monetary value of education, health, and other services provided directly to the population (for example, Women’s City [\textit{Ciudad Mujer}]). Direct transfers include both those made in cash and those made in kind (for example, food, uniforms, et cetera) if they have a defined market value and are near substitutes for cash. Indirect subsidies to public services are not considered direct transfers, because they do not contribute to available household income.

Table 13-1: El Salvador: Composition of Spending and Fiscal Revenue (2011)

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\(^9\) Includes spending by the non-financial public sector (NFPS), for example the central government, city governments, and non-financial decentralized and autonomous institutions. It does not include the public financial sector (Central Reserve Bank [BCR], Mortgage Bank, the Development Bank of El Salvador [BANDESAL], the National Fund for Popular Housing [FONAVIPO], and the Social Fund for Housing [FSV]).
<table>
<thead>
<tr>
<th>Item</th>
<th>Amount (Millions of US$)</th>
<th>% of GDP Total</th>
<th>In analysis /1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL REVENUE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Net tax collection (A.1-A.2)</td>
<td>3206.5</td>
<td>13.86</td>
<td>9.40</td>
</tr>
<tr>
<td>A.1 Tax collection (gross)</td>
<td>3499.9</td>
<td>15.13</td>
<td>9.40</td>
</tr>
<tr>
<td>A.1.1 Direct taxes (income tax)</td>
<td>1192.8</td>
<td>5.15</td>
<td>1.11</td>
</tr>
<tr>
<td>A.1.1.1 Income tax - individuals</td>
<td>455.6</td>
<td>1.97</td>
<td>1.11</td>
</tr>
<tr>
<td>A.1.1.1.1 Personas naturales asalariadas</td>
<td>256.1</td>
<td>1.11</td>
<td>1.11</td>
</tr>
<tr>
<td>A.1.1.1.2 Non-salaried individuals</td>
<td>199.5</td>
<td>0.86</td>
<td>...</td>
</tr>
<tr>
<td>A.1.1.2 Income tax - corporations</td>
<td>630.5</td>
<td>2.72</td>
<td>...</td>
</tr>
<tr>
<td>A.1.1.3 Tax withholding (corporations and individuals)</td>
<td>106.7</td>
<td>0.46</td>
<td>...</td>
</tr>
<tr>
<td>A.1.2 Indirect taxes</td>
<td>2307.1</td>
<td>9.97</td>
<td>8.30</td>
</tr>
<tr>
<td>A.1.2.1 Value added tax</td>
<td>1801.3</td>
<td>7.78</td>
<td>7.80</td>
</tr>
<tr>
<td>A.1.2.2 Duties</td>
<td>167.3</td>
<td>0.72</td>
<td>...</td>
</tr>
<tr>
<td>A.1.2.3 Specific taxes on products</td>
<td>140.4</td>
<td>0.61</td>
<td>0.50</td>
</tr>
<tr>
<td>A.1.2.4 FEFE, FOVIAL and public transportation (gasoline)</td>
<td>116.4</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>A.1.2.5 Other indirect taxes and contributions</td>
<td>81.7</td>
<td>0.35</td>
<td>...</td>
</tr>
<tr>
<td>A.2. Refunds</td>
<td>293.4</td>
<td>1.27</td>
<td>...</td>
</tr>
<tr>
<td>B. Non-tax revenue</td>
<td>799.8</td>
<td>3.46</td>
<td>1.66</td>
</tr>
<tr>
<td>B.1. Contributions to social security (health)</td>
<td>385.2</td>
<td>1.66</td>
<td>1.66</td>
</tr>
<tr>
<td>B.2. Public corporations</td>
<td>169.0</td>
<td>0.73</td>
<td>...</td>
</tr>
<tr>
<td>B.3. Others (includes capital income, excludes FEFE)</td>
<td>245.6</td>
<td>1.06</td>
<td>...</td>
</tr>
<tr>
<td>C. Donations</td>
<td>213.9</td>
<td>0.92</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>TOTAL SPENDING OF THE NON-FINANCIAL PUBLIC SECTOR</strong></td>
<td>5126.8</td>
<td>22.16</td>
<td>13.88</td>
</tr>
<tr>
<td>Interest on the debt</td>
<td>517.9</td>
<td>2.24</td>
<td>...</td>
</tr>
<tr>
<td><strong>Primary spending (A + B + C + D)</strong></td>
<td>4608.9</td>
<td>19.92</td>
<td>11.15</td>
</tr>
<tr>
<td>A. Social spending (A.1 + A.2)</td>
<td>1989.06</td>
<td>8.60</td>
<td>8.43</td>
</tr>
<tr>
<td>A.1. Direct transfers (in cash or goods)</td>
<td>317.16</td>
<td>1.37</td>
<td>1.36</td>
</tr>
<tr>
<td>A.1.1. Cash transfers</td>
<td>195.3</td>
<td>0.84</td>
<td>0.84</td>
</tr>
<tr>
<td>A.1.1.1 Rural Solidarity Partnership Communities</td>
<td>17.1</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>A.1.1.2 Temporary Income Support Program (PADI)</td>
<td>14.7</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>A.1.1.3 Direct subsidy to gas (in cash)</td>
<td>163.5</td>
<td>0.71</td>
<td>0.71</td>
</tr>
<tr>
<td>A.1.2. Non-contributory pensions (Universal Basic Pension)</td>
<td>7.1</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>A.1.3. Other direct transfers (in goods)</td>
<td>114.8</td>
<td>0.50</td>
<td>0.49</td>
</tr>
<tr>
<td>A.1.3.1 School package</td>
<td>71.0</td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>A.1.3.2 School lunch</td>
<td>15.3</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>A.1.3.3 Glass of milk</td>
<td>1.9</td>
<td>0.01</td>
<td>...</td>
</tr>
<tr>
<td>A.1.3.4 Agricultural package</td>
<td>26.5</td>
<td>0.11</td>
<td>0.11</td>
</tr>
<tr>
<td>A.2. Social services</td>
<td>1671.9</td>
<td>7.23</td>
<td>7.08</td>
</tr>
<tr>
<td>A.2.1. Education</td>
<td>677.6</td>
<td>2.93</td>
<td>2.93</td>
</tr>
<tr>
<td>A.2.2. Health</td>
<td>901.7</td>
<td>4.29</td>
<td>4.15</td>
</tr>
<tr>
<td>A.2.2.1 Health- non-contributory (MINSAL)</td>
<td>532.70</td>
<td>2.30</td>
<td>2.30</td>
</tr>
<tr>
<td>A.2.2.2 Health - contributory (ISSS)</td>
<td>358.10</td>
<td>1.55</td>
<td>1.55</td>
</tr>
<tr>
<td>A.2.2.3 Health - contributory (Teachers’ Well-being)</td>
<td>50.10</td>
<td>0.22</td>
<td>0.22</td>
</tr>
<tr>
<td>A.2.2.4 Health - contributory (Military Health Command, COSAM)</td>
<td>19.20</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>A.2.2.5 Health - others</td>
<td>31.60</td>
<td>0.14</td>
<td>...</td>
</tr>
<tr>
<td>A.2.3. Women's s' City</td>
<td>2.6</td>
<td>0.01</td>
<td>...</td>
</tr>
<tr>
<td>B. Indirect subsidies</td>
<td>224.3</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>B.1. Electricity</td>
<td>115.2</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>B.2 Water</td>
<td>56.5</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>B.3. Public transportation</td>
<td>52.6</td>
<td>0.23</td>
<td>0.23</td>
</tr>
<tr>
<td>C. Other spending</td>
<td>1989.94</td>
<td>8.60</td>
<td>...</td>
</tr>
<tr>
<td>C.1. Administrative direction</td>
<td>460.4</td>
<td>1.99</td>
<td>...</td>
</tr>
<tr>
<td>C.2 Administration of justice and citizen security</td>
<td>625.6</td>
<td>2.70</td>
<td>...</td>
</tr>
<tr>
<td>C.3. Others</td>
<td>903.9</td>
<td>3.91</td>
<td>...</td>
</tr>
<tr>
<td>D. Contributory pensions</td>
<td>405.6</td>
<td>1.75</td>
<td>1.75</td>
</tr>
<tr>
<td>Deficit</td>
<td>-906.6</td>
<td>-3.92</td>
<td>...</td>
</tr>
</tbody>
</table>
Fiscal revenue: Taxes and contribution fees

The two main taxes in El Salvador are the income tax and the VAT. Specific taxes applied to selected articles, such as automobiles (tax on the first registration), liquor and beer, cigarettes, firearms, and ammunition. In addition, there are special fees for special purposes, of which the most important are those applied to fuel. Here is a description of the taxes and contributions considered in this analysis.

**Income tax**

El Salvador has a progressive tax on personal income. Corporations are subject to a 25 percent tax rate on declared earnings up to US$150,000. Above that amount the rate is 30 percent.

In 2011, there were four levels for the personal income tax: exemption for income below US$2,514.30 and three levels with progressive rates of 10, 20, and 30 percent. Taxable income excluded alimony payments, compensation for death or disability, payments received for services abroad, rental income from the house of residence, and interest on investment funds abroad. Individuals with an annual income of less than US$5,714.29 could take a standard deduction of US$1,371.43. Those with high incomes could only take this deduction with evidence of expenditures for health or education.

As of 2012, with the tax reform that took effect that year, the annual income exemption was increased to US$4,064.00. Also, if an individual’s income does not exceed US$9,100 for the year, they can take a standard deduction of US$1,600.00.

**Value added tax**

VAT is collected for each transaction at the various stages of production for a taxed good or service, generating a tax credit to the next stage, so that finally the end user pays the tax. The VAT rate is 13 percent. Exported goods are not exempt from the law, but they have a 0 percent rate. Taxes paid for the production of export goods are reimbursed, with a few exceptions.

Corporations or individual vendors whose sales are less than US$5,714.29 per year, or US$476.19 per month, and have assets less than US$2,285.71, are not obliged to charge VAT to their clients. However, they are subject to the tax for the purchase of inputs. In other words, they are exempt from the VAT generated at the last link of the chain.

**Special fees – gasoline**

Three different fees for specific users are applied to fuel consumption. In total, US$0.46 is collected for each gallon of gasoline and US$0.30 for each gallon of diesel.
Chapter 13, Beneke, Lustig, and Oliva

1. In 1981, the Economic Development Stabilization Fund (FEFE) was established. Currently, the earnings are used to pay part of the subsidy for LPG. This fund’s budget comes from a fee of US$0.16 collected for each gallon of gasoline purchased; diesel purchases are excluded. From July to December 2011, this fee was temporarily suspended to compensate for the high cost of gasoline. In 2011, the FEFE collected US$13.6 million.

2. In 2001, a compulsory contribution was established to generate funds for highway maintenance and repairs through the Highway Conservation Fund (FOVIAL). The fee is US$0.20 per gallon of gasoline or diesel. In 2011, the amount collected was US$68.9 million.

3. In 2007, another fee was added to generate funds to pay the public transportation subsidy, the Special Contribution to Stabilize Public Bus Fares (COTRANS). The fee is US$0.10 per gallon of gasoline or diesel. In 2011, the amount collected was US$33.9 million.

**Contributions to Social Security (health)**

Contributions to the Salvadoran Social Security Institute (ISSS) cover the general health system and professional risks. Workers contribute 3 percent of their wages while the employer contributes 7.5 percent. For both, the maximum taxable salary is US$685.70 per month. Contributions are deducted directly from the employee’s pay.

**Social spending**

In El Salvador, social spending falls into two main categories: (1) *direct transfers* to households, in cash or in kind, either through *social programs* for specific population groups, which are currently part of the Universal Social Protection System, or through cash transfers, such as the subsidy for cooking gas, and (2) *social services* provided by the state, principally education and health services. In 2011, direct transfers represented 1.4 percent of GDP, and social services 7.2 percent of GDP. In that year, social spending was 8.6 percent of GDP.

Other public resource spent on household benefits includes *indirect subsidies* plus the cash transfer, related to Liquid petroleum gas (LPG) and *pensions*, which represented 1.7 percent and 1.75 percent of GDP, respectively.

**Social programs**

Social programs in El Salvador include direct cash transfers and transfers of goods. Some programs provide different services within the same infrastructure to facilitate access. Table 13-2 lists these programs, the number of beneficiaries, and the corresponding expenditure.
Table 13-2: Social Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Responsible Institution</th>
<th>Year implemented</th>
<th>Beneficiaries</th>
<th>Expenditure, % PIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash transfers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural Solidarity partnership communities</td>
<td>FISDL</td>
<td>2005</td>
<td>83,654</td>
<td>112,311</td>
</tr>
<tr>
<td>Universal Basic Pension</td>
<td>FISDL</td>
<td>2009</td>
<td>0</td>
<td>6,487</td>
</tr>
<tr>
<td>PATI</td>
<td>FISDL</td>
<td>2010</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Urban bonus</td>
<td>FISDL</td>
<td>2012</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Veterans’ pensions</td>
<td>FISDL</td>
<td>2012</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Transfers of goods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School package</td>
<td>MINED</td>
<td>2010</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>School lunch programs</td>
<td>MINED</td>
<td>1992</td>
<td>877,041</td>
<td>1,310,286</td>
</tr>
<tr>
<td>Glass of milk</td>
<td>MINED/MAG</td>
<td>2011</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Agricultural package</td>
<td>MAG</td>
<td>1997</td>
<td>436,998</td>
<td>550,003</td>
</tr>
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<td>Integrated services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women’s City</td>
<td>Secretariat for Inclusion</td>
<td>2011</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


Cash transfers

Rural Solidarity Communities (RSC) is a program created in 2005 as the Solidarity Network that includes cash transfers based on public education and health services usage in households in the poorest 100 of the country’s 262 municipalities, according to the Social Investment Fund for Local Development’s (FISDL) 2004 Poverty Map. These municipalities account for about 12 percent of total of households nationwide. Households are eligible if they meet the following criteria when the program starts in their community. For the education transfer, they were eligible if they had children between the ages of 6 and 18 who had not completed primary school. For the health transfer, they were eligible if the household included a pregnant woman or any child aged 0 to 5. The education transfer is contingent upon enrollment and school attendance to complete primary school. The health transfer is contingent upon monitoring the children’s development, their timely vaccination, and prenatal care for pregnant women. The amount of the transfer is US$15 per month if the household is only eligible for either the education or health transfer and US$20 per month if it is eligible for both. The payments do not vary depending on the number of eligible children in the household and the amount has not changed since 2005.

In rural areas, all households in a municipality that met the eligibility requirements when the census was conducted by the implementing agency (FISDL) were registered in the program. In urban areas, all eligible households entered the program in municipalities with “severe” extreme poverty. However, in urban municipalities with “high” extreme poverty, a means test with proxy variables was applied to selected beneficiaries. It is important to note that the only way a household could get into the RSC program was to meet the requirements at the time the FISDL census was conducted in a given municipality. This means that

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10 According to the Census of Population and Housing of 2007.
if a household met the eligibility criteria after the program started in a community, for example due to the birth of their first baby, that household was not eligible. For that reason, new families have not been incorporated, and as a result, the number of beneficiaries has decreased as households leave the program (when the children complete primary school or reach the age of 18) or when they no longer meet the criteria.

In total there were 75,385 households benefiting from the program in 2013 (equal to about 5 percent of total households and about 14 percent of the poor households). These beneficiaries received approximately US$14.6 million that year. In 2011, the year analyzed for this study, there were 90,997 total household beneficiaries and the average transfer per household was US$15.65 per month.

--The non-contributory Universal Basic Pension was established in 2009 for older adults in municipalities with “severe” and “high” extreme poverty. This is an unconditional transfer of US$50 per month given to anyone over the age of 70 who does not receive any other pension. There can be more than one beneficiary per household.

In 2013 there were 28,200 beneficiaries in the program (accounting for about 7 percent of all the senior adults in the country and 20 percent of those living in poverty). That year they received about US$18.8 million. In 2011, the year analyzed in this study, the total number of beneficiaries was 15,300.

--FMLN Veterans’ Pension is a program of non-contributory pensions that began in 2012 for ex-combatants consisting of a monthly pension of US$50 paid to about 2,000 veterans.11

--Temporary Income Support Program (PATI) was designed to protect the income of vulnerable households that face adverse situations of various kinds by means of a monetary transfer of US$100 per month for six months, in exchange for their participation in community projects and their attendance at 80 hours of training (64 hours of technical training and 16 hours on job hunting and skills to start a business). The amount of the transfer is less than half the minimum urban wage, so it is not a disincentive for beneficiaries to participate in the labor market. Beneficiaries can participate in it only once and for a maximum of 6 months. There is no limit on the number of beneficiaries in the same household.

PATI is implemented in informal urban settlements (AUP) classified with levels of extreme or high poverty in the Urban Poverty Map. It has been implemented in 37 municipalities: 11 that were ravaged by tropical storm Ida and 26 that have the highest number of persons living in AUP who are included in the Map of Violence and the Register of the Secretariat for Strategic Affairs. The program is designed for youth ages 16 to 24, as well as female heads of household. However, since it is a program of self-selection, any person at least 16-years-old who lacks a formal job and is not studying during the day is eligible and can participate. In 2011, there were 14,525 participants.13

--The Urban Bonus, designed to increase the demand for secondary education, was implemented in 2012. The program consists of a cash transfer that covers part of transportation costs and is contingent upon the individual’s continued class attendance. The program seeks to include vulnerable groups. Therefore, the amount of the transfer is higher for women, adolescent mothers, and disabled students. In addition, it provides

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12 FLACSO, MINEC, UNDP (2010).
13 Secretaría Técnica de la Presidencia (2014).
an incentive to attend technical schools. To encourage students to complete secondary education, the amount of the transfer increases as the student’s progress; when they graduate, they get an additional bonus. In 2012 there were 2,691 beneficiaries.

--Liquid petroleum gas, or cooking gas, has been subsidized for many years. Previously, to compensate for the difference between the market price and the fixed price, the government would transfer this difference in cost to distributors. All consumers, regardless of their income, could buy gas at the regulated price.

This system changed in 2011 when the subsidy began to be paid directly to the households. At that time, the price of a 25-pound canister, which was US$5.10, increased to a market price calculated at US$14.70, and households began to receive a cash transfer of US$9.10, provided that they used less than 199 kWh of electricity per month. The transfer was given when the consumers paid their electric bill. Households without electric service had to register to receive a “subsidy card” that permitted them to receive the monthly cash transfer in offices located throughout the country. In December 2011 there were 1.2 million beneficiaries, 80 percent of the total households in the country.

A different mechanism was implemented in the middle of 2013. Households had to register as beneficiaries using the head of household’s sole identity document (DUI). When consumers bought gas, they had to show their DUI and the vendor would then key in that information on a mobile device connected to the beneficiary system, resulting in a payment of US$9.10 toward the bill. The beneficiary only had to pay the difference. However, the number of beneficiaries remained at 1.2 million.14

Starting in January 2014, registered consumers received a subsidy card called the Solidarity Card, which they had to present when making a purchase, instead of their DUI. In March 2014, the amount of the subsidy varied with the real cost of the gas, so that the amount paid by the consumer would remain constant. The total amount that a household received in 2014 could be less than in previous years, because the subsidy is no longer a fixed amount of cash per month, but it is applied at the time of purchase, which might not be made every month.

Part of the money used to fund this subsidy comes from the gasoline tax, though the amount collected is insufficient. For example, in 2011 the government transferred US$163.0 million to consumers, while the gasoline tax only collected US$18.6 million.

Direct Transfers in Kind

--School package: Since 2010 all students from preschool to ninth grade in the public schools receive two complete uniforms, a pair of shoes, and school supplies. The cost of the uniforms is about 60 percent of the total cost of the package. In 2011 there were 1,386,767 beneficiaries.

--School lunch program: This program, dating back more than 20 years, provides a meal to all students from preschool to sixth grade in rural public schools. The program was expanded to the ninth grade in 2008. Urban public schools have been included since the beginning of 2010.

14 Information from the Ministry of Economy.
-- **Glass of Milk** Program: The Ministry of Agriculture and Livestock (MAG) buys milk from local producers, and the Ministry of Education (MINED) distributes a glass of milk twice a week to students from preschool to ninth grade in public schools in sixty-three municipalities in four departments: Ahuachapán, Santa Ana, Sonsonate, and La Libertad. In 2011, an estimated 250,000 students benefited. The program was expanded to other municipalities to benefit about 500,000 students in 2012 and more than 800,000 in 2013.

-- **Agricultural packages**: This subsidy includes the distribution, without cost, of seeds and fertilizer to producers of corn and beans who have less than 2.25 hectares of land. Each package includes twenty-five pounds of corn seed and 100 pounds of fertilizer, enough to cultivate 0.7 hectares. In addition, some farmers receive twenty-five pounds of beans for seed, enough to cultivate 0.2 hectares. Those who receive beans generally also receive packages of corn. The content of the individual packages has been the same for the past five years.

Theoretically, all corn producers who cultivate small parcels are eligible to receive packages for this crop. For beans, the packages are given to the small producers in geographical areas selected as being best suited for bean production. In 2011, it is estimated that all producers of corn or beans received packages. The lists of eligible beneficiaries have historically been compiled by extension agents, producers’ organizations, and municipal authorities, although the farmers can also sign up directly. The number of recipients varies; in the case of corn, the number of beneficiaries doubled between 2007 and 2013, but prior to 2008, the number of bean producers that received the subsidy was insignificant.

**Subsidies**

In El Salvador, subsidies take the form of government assistance with consumer goods widely used by the population. The main goods include electricity, liquid petroleum gas, public transportation, and water service when it is provided by the public water supply agency (the National Administration of Aqueducts and Sewerage, [ANDA]). In total, these subsidies represent 1.7 percent of GDP and account for 19.8 percent of social spending.

**Electricity**

The state regulates the price of electricity to the consumer and electric companies receive transfers from the state to cover any difference. The subsidy has two levels: one for households with monthly consumption of up to 99 kWh and the other for consumption between 99 and 200 kWh, funds for which come from earnings generated by the public electric company CEL (Lempa River Executive Hydroelectric Commission). Between April and October 2011, up to 300 kWh was subsidized. During 2011, 80 percent of households received the subsidy: 60 percent at the level of lower consumption, which in total represented US$88.1 million, and 20 percent at the higher consumption level, which was US$27.1 million.

**Water**

Residential water service has an indirect and implicit subsidy through regulation of the price when the service is provided by the public entity ANDA. The rates per cubic meter increase as more water is consumed. However, in general, the amount collected from the official tariffs does not cover the cost of operation and
maintenance, so there is an implicit subsidy for the consumer. ANDA only serves about half of the population. In 2011 the subsidy was US$56.2 million.

In rural areas and small urban zones, water service and sanitation are provided by local providers who receive a discount on their electric bill from the state electric company to subsidize the pumping and re-pumping of water. This way their consumers also receive a subsidy, indirectly. In 2011 this subsidy was US$6.9 million.

**Public transportation**

Public transportation is provided by private operators who receive permits from the Vice Ministry of Transportation for each of the established routes. The price of transportation is regulated. To compensate the operators, the government pays a fixed monthly amount for each vehicle that they operate regardless of the number of passengers served. This system was established in 2007 to compensate operators for the high prices of gasoline so they could continue to charge users the regulated fares. In 2007 the transfers were $400 per bus and $200 per minibus. In 2009, the amounts increased to $500 and $250, respectively. The amount was increased again in 2011, to $750 and $375, respectively. Finally, in 2013, the amounts reverted to the original $400 and $200.

**Social Services: In-kind Transfers**

Transfers in kind considered are related to the services provided by the state in two particular areas: education and health.

**Education**

El Salvador has the following educational levels: initial education (0-3 years); preschool (4-6 years); basic education (7-15 years) divided into primary (grades 1 to 6, 7-12 years) and third cycle (lower secondary, grades 7 to 9, 13-15 years); middle education (16-18 years) divided into general (grades 10 and 11) or technical-vocational (grades 10 to 12); and higher education, which includes university and non-university. Basic education is compulsory; basic and middle education are free in public schools.

In 2011 there were 1.7 million students enrolled, excluding higher education. Of these, 87 percent were in the public sector. In basic education, nearly 90 percent of the students were in public schools. In preschool that percentage was about 84 percent and in middle education it was 75 percent.

According to statistics from MINED, the primary education net enrollment rate is higher than 92 percent. The other levels have greater problems with access. Net enrollment rates are 0.6 percent in initial education, 54 percent in preschool, 62 percent in lower secondary (third cycle), and 35.4 percent in upper secondary (middle education).

**Health**

El Salvador’s public health system has a non-contributory component, with services provided by the Ministry of Health (MINSAL), and a contributory component with services provided by three institutions: ISSS, which provides services to workers in the formal sector and employers; the Salvadoran Institute for Teachers’ Well-
being (ISBM), which provides services to teachers in the public sector; and the Military Health Command (COSAM), which provides services to military personnel.

MINSAL covers all those not affiliated with public contributory programs or covered by private insurance, which is estimated to be 4.5 million persons or 73 percent of the population. ISSS, Teachers’ Well-being, and Military Health Command cover 23 percent, 1.6 percent and 1.2 percent, respectively, which includes affiliated workers, spouses, and children to a certain age.

The distribution of the budget among the public health institutions is not equal. In 2011, according to the National Health Accounts, the per capita budget available for the MINSAL was US$118, US$242 for ISS, US$484 for ISBM, and US$251 for COSAM.

**Women’s City**

Women’s City is a program that provides various public services for women such as health, services related to domestic violence, legal services, labor training, and more, all within the same facility. This program began in 2011 with a facility in the municipality of Colón. During that first year it provided assistance to 35,614 women, with services valuing a total of US$2.6 million. In 2012 another facility was opened in Usulután and in 2013 three more were opened in San Miguel, Santa Ana, and San Martín. In 2013, the program benefitted 82,874 women, services valuing US$22 million. This program does not include any type of transfer in cash or goods.

**Contributory pensions**

Before 1998, there was a joint contributory pension system with withholding called the Public Pension System (SPP), which covered disability and old-age pensions. Starting in June of that year, there was a reform establishing a system of individual capitalization called the Pension Savings System (SAP) managed by private Pension Fund Administrators (AFP). At that time, all men between the ages of 36 and 55 and all women between 36 and 50, could opt to remain in the old system or change to the new one. These workers were given a guarantee that their pensions would be similar to those that they could have obtained in the public sector. All workers under age 36 were transferred to the SAP, while workers above the given age bracket had to remain in the SPP. With SAP, all contributions go directly to the individual’s account.

Currently, pensions are for workers who remained in the SPP or opted for SAP. Public system pensions are fully funded by the government. Other workers’ pensions come in part from their contributions to SAP and in part from government funds. Upon retirement, the government transfers a matching amount to an individual’s AFP. In both systems, the pensions cannot be less than US$207.60. The government may transfer an additional amount to the AFP to guarantee the minimum pension (known as a Complementary Transfer Certificate or CTC).

During 2011, about 101,000 people received pensions from SPP and 42,000 from SAP. That year the government issued bonds equivalent to US$405.6 million to pay benefits, this includes pensions paid directly to beneficiaries of SPP and the transfer certificate (CT) and CTC transferred to SAP. Public spending for pensions was 1.75 percent of GDP.
13.2 Data

The analysis in this study uses the results of the 2011 EHPM, carried out by the Ministry of the Economy (MINEC). The EHPM was conducted from January to December, with a sample of 21,413 households. These households were representative at various levels: country-wide, urban, rural, within the Metropolitan Area of San Salvador (AMSS), the departmental level, as well as within the fifty largest municipalities. The survey compiles information on each member of the household, 85,291 individuals. For the 77,929 individuals 5 years of age or older, detailed information was collected on their workforce participation, consumption, and pensions. Additionally, data was collected regarding usage of education and health services and information from each household on income from a variety of sources, such as remittances. In addition, the survey includes a detailed module on household consumption. Before 2011, the survey did not take into direct account the value of cash transfers from the government such as the LPG subsidy, the payments of RSCs, and non-contributory pensions. Additional information comes from official budget reports of various agencies.

13.3 Methodology

The impact analysis is based on CEQ methodology presented in the previous chapters of this handbook. This method basically consists of generating concepts of income that include taxes and transfers to create a menu of indicators that measure the progressivity of the system of taxes and transfers and its impact on inequality and poverty in a quantifiable manner (without considering changes in the behavior of the stakeholders or the effects of general balance). Next we present an explanation of how each component was constructed for El Salvador.

Market income

All necessary components to estimate market income can be calculated using direct identification methods using information included in the EHPM. The survey has sufficient detail to permit estimation of the individual components of income: pre-tax gross labor income (formal or informal), self-consumption, capital income, and imputed rent for owner-occupied housing. Private transfers (including remittances and others), gifts, and contributory pensions can be identified directly; the survey reports the dollar amount for each individual. In the sensitivity analysis, pensions from the contributory system are excluded from market income and are treated as government transfers.

Disposable income

Disposable income is equal to market income less direct taxes on personal income from all taxable sources (including market income) and all contributions to social security, except for the portion earmarked for old-age pensions. Using information included in the EHPM, taxes and direct contributions can be estimated using imputation methods.
Chapter 13, Beneke, Lustig, and Oliva

**Direct taxes** paid are not reported directly to the EHPM. Given that income tax is paid mainly by formal workers,\(^15\) the amount of the tax was estimated taking into account the gross monthly salary reported by formal workers as a baseline and then applying the rules and rates determined by the income tax law. However, income taxes paid by non-salaried workers could not be identified using the EHPM, so they are not included in the analysis.

**Contributions to health systems** are also not reported directly in the EHPM. However, the survey does include information on the health system to which the worker belongs. Contributions were thus estimated by taking the gross monthly salary reported and applying the official rates.

Currently, since most contributions to pension funds in El Salvador go to individual workers’ accounts\(^16\) they are considered savings, and therefore are not deducted in the sensitivity analysis.

**Plus** all direct government transfers in cash or kind. In the sensitivity analysis, contributory pensions are included. The EHPM has questions on the types of benefits received from social programs, so it is possible to estimate direct transfers using *imputation methods*.

**Direct cash transfers:**

-- If the household reported receiving conditioned payments (RSCs), US$15 or US$20 per month was assigned to the household based on the rules of the program.

-- If the household reported receiving non-contributory pensions, US$50 per month was assigned to eligible adults.

-- If the household reported receiving PATI benefits, US$100 per month was assigned for a period of six months.

-- If the household reported receiving LPG subsidies, US$9.10 per month was assigned to the household.

**Direct transfers of goods:**

-- The EHPM reports if each individual attends school, their level of education, and the type of institution attended (public or private). Each public school student from preschool to 9\(^{th}\) grade receives a school package and a meal. The annual cost per capita of both programs for each student was assigned to the household: for uniforms and supplies they were assigned US$50.77 for preschool and US$53.26 for the rest, and for the lunches US$11.40 was assigned for all.

-- The EHPM asks questions about agricultural activities. If a household meets the eligibility requirements, the average cost of the corresponding package is added: US$64.50 for corn and US$48.50 for beans.\(^17\)

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\(^{15}\) The survey has a question that makes it possible to determine whether employees are formal or informal.

\(^{16}\) In 2011, the SAP covered 602,382 persons, while the SPP had only 14,788. Information gathered in the EHPM does not identify to which of the two systems the worker belongs.

\(^{17}\) Information from the Ministry of Agriculture and Livestock.
The EHPM does not have enough information to determine whether the students in the household benefit from the Glass of Milk program, so this was not included in the analysis; its budget is very small.

**Consumable income**

Consumable income is disposable income plus the indirect subsidies received, less indirect taxes and contributions paid.

**Indirect subsidies:** The EHPM contains questions on the amount spent for each of the subsidized services, so indirect subsidies can be estimated using *imputation methods*.

--The **electricity subsidy** was imputed estimating the kWh used based on the expenditure reported, using the rates current at the time of the survey. The subsidy received is estimated as the difference between the real amount paid and the total of the non-subsidized amount.\(^{18}\)

--The **water subsidy** was imputed using the household expenditure reported by households that receive service from ANDA, the public provider. Cubic meters used was estimated based on reported spending using the rate schedule and then the real cost per cubic meter was applied to estimate the non-subsidized cost. The estimated subsidy received is the difference between the actual amount paid and the non-subsidized amount.\(^{19}\)

--The **public transportation subsidy** was imputed using the reported household spending for public transportation; the number of trips was estimated based on the expenditure reported. The subsidy was calculated multiplying the estimated number of trips by US$0.09 outside the AMSS and by US$0.092 inside it.\(^{20}\)

Greater detail can be found in the appendix.

Indirect taxes and contributions are also estimated using imputation methods:

--VAT: The EHPM has detailed information on consumption, including place of purchase. Using this, total consumption subject to VAT was estimated (omitting exempt articles and food purchases in informal

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\(^{18}\) The rules for the subsidy for 2011 are as follows: Each quarter a rate sheet is established that remains in force for three months. Households that use less than 99 kwh paid fixed tariffs for electricity, and the subsidy they received is the difference between the rate sheet in force (full rate) and the fixed rate. Households that used more than 99 kwh paid the full rate during the first quarter of the year, so they did not receive a subsidy. In the second and third quarters, households that used between 99 kwh and 300 kwh paid the rate in effect during the first quarter, receiving a subsidy for the difference between the full rate and the rate that they had during the previous quarter; in the fourth quarter, the maximum amount subsidized was reduced to 200 kwh. All these aspects were taken into account for the imputation, using the amount of the bill paid and the date when the household survey was conducted.

\(^{19}\) Similarly, the amount reported as paid in the survey was used to estimate the quantity of cubic meters consumed, based on the rate sheet in effect at the time of the survey. The subsidy was the difference between the amount paid and the cost per cubic meter of water reported by ANDA.

\(^{20}\) In 2011, the public transportation subsidy was US$750 for each bus and US$375 for each minibus. On average, each bus has 60 seats and each minibus has 25. On average, a seat on a bus has a daily subsidy of US$0.5, and a seat on a minibus has a daily subsidy of US$0.41. A study done by the Vice Ministry of Transportation (2010) has found that on average each bus makes 4.6 trips per day and each minibus 5.4 trips. As a result, the subsidy per bus seat is estimated at US$0.0905 per trip, and the subsidy per minibus seat is US$0.0925 per trip. The same study found that in the metropolitan area 60% of the public transportation units are minibuses. By contrast, outside the metropolitan area 80% are buses. Based on the foregoing, the weighted amount of the subsidy in the metropolitan area was estimated at US$0.09178 and in other areas it was US$0.0909.
establishments\textsuperscript{21}). Then the amount of VAT was imputed multiplying the “effective rate” by disposable income, according to the CEQ manual.\textsuperscript{22}

- Special fees - fuel: Fees applied to fuel consumption were imputed estimating the number of gallons consumed based on the reported spending, using the average fuel price in the month of the survey. To calculate the taxes and contributions, the number of gallons was multiplied by US$0.46.\textsuperscript{23}

**Final income**

Final income is consumable income plus the monetary value of social services provided by the state. With information included in the EHPM, these in-kind transfers can be estimated using *imputation methods*.

**Public education**: The EHPM reports whether an individual attends school, the level of education, and the type of institution (public or private). The amount of the benefit is estimated as an average annual cost per student if they attend public schools: US$314.50 at the preschool level, US$416.70 during basic education (first to ninth grade), US$567.70 in middle education, and US$788.60 in tertiary education.

**Public health**: The EHPM has information on the type of contributory health system to which the household has access (ISSS, ISBM, or COSAM). It is assumed that everybody without access to contributory health systems or private health insurance uses public health services. For each individual in the household, the average cost per patient per type of provider is imputed: US$117 for public health, US$242 for ISSS, US$484 for Teachers’ Well-being, and US$251 for COSAM.\textsuperscript{24,25}

**Women’s City**: The EHPM does not have sufficient information to determine if a woman in the household is a beneficiary in this program, so it is not included in the analysis. In 2011, this program’s budget was very small.

**13.4 Impact of fiscal policy on inequality and poverty**

As shown in table 13-3, direct taxes and transfers have an equalizing effect of 0.0156 Gini points. The combined effect of indirect taxes net of indirect subsidies is equalizing. Adding the impact of transfers in kind (public spending on education and health), the Gini coefficient is reduced by 0.0455 points. With respect to poverty reduction, fiscal policy has achieved very little, in both rural and urban areas. Table 13-3 shows that direct transfers reduce the incidence of poverty measured with disposable income (and compared with the incidence measured with market income plus pensions) using any of the national and international poverty lines. However, this effect is almost null when considering indirect taxes net of subsidies.\textsuperscript{26} In other words,

\textsuperscript{21} Informal establishments include: dining hall, chalet, itinerant cart, and informal store.
\textsuperscript{22} Lustig and Higgins (2013).
\textsuperscript{23} Including the following contributions: FOVIAL (US$0.20), FEFE (US$0.16), COTRANS (US$0.10). The FEFE does not apply to diesel consumption, but the EHPM does not specify the type of fuel used. In practice, most vehicles for domestic use are gasoline-powered.
\textsuperscript{24} National Health Accounts (2011).
\textsuperscript{25} The imputation of average costs does not include in the analysis the differences in access to health services that may apply to individuals with different income levels, owing to factors such as aspects related to the institutional organization or personal decision. That analysis was not possible because the information reported by the survey was insufficient.
\textsuperscript{26} All differences with respect to incidence measured with market income are statistically significant.
the incidence of poverty with consumable income is practically equal to the one that prevails with market income, at both national and international extreme poverty lines. In the case of moderate poverty, measured with either the international or national poverty lines, the incidence of poverty for consumable income is higher than for market income. In other words, fiscal policy results in a greater proportion of individuals below the moderate poverty lines. The poverty gap remains almost unchanged. However, the squared poverty gap declines, so at least the poorest individuals are less poor even after the effect of net indirect taxes. However, this last indicator can lead to unwarranted complacency because starting with the second poorest decile, the population is a net payer, meaning it pays more in direct and indirect taxes than it receives in direct transfers. Furthermore, using the fiscal impoverishment indicators developed by Higgins and Lustig, even with the ultra-poverty line of US$1.25/day in 2005 PPP, close to 30 percent of the poor population was made poorer by taxes net of cash transfers and subsidies.

27 With the poverty gap or the poverty gap squared index this does not occur; both indicators decrease slightly. This means that although fiscal policy can increase the proportion of poor when taking into account the effect of net indirect taxes, at least the poorest in these groups experience some improvement (something already registered with the incidence measured with the extreme poverty lines).

28 Higgins and Lustig (2016).
### Table 13-3: Impact of Fiscal Policy on Inequality and Poverty (Contributory Pensions as Deferred Income) / 1

<table>
<thead>
<tr>
<th></th>
<th>Level</th>
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<th>Consumable</th>
<th>Final</th>
<th>Change (from market to disposable)</th>
<th>Change (from market to consumable)</th>
<th>Change (from market to final)</th>
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<tr>
<td></td>
<td>Rural</td>
<td>19.3</td>
<td>17.0</td>
<td>19.0</td>
<td></td>
<td>-11.8</td>
<td>-1.6</td>
<td>-13.4</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>11.8</td>
<td>11.1</td>
<td>12.1</td>
<td></td>
<td>-6.0</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td><strong>Poverty gap squared</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Poverty US$2.5 PPP</strong></td>
<td>National</td>
<td>2.9</td>
<td>2.1</td>
<td>2.5</td>
<td></td>
<td>-26.3</td>
<td>-13.7</td>
<td>-39.0</td>
</tr>
<tr>
<td></td>
<td>Rural</td>
<td>6.0</td>
<td>4.5</td>
<td>5.3</td>
<td></td>
<td>-26.0</td>
<td>-12.6</td>
<td>-38.6</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>0.9</td>
<td>0.7</td>
<td>0.8</td>
<td></td>
<td>-26.9</td>
<td>-17.2</td>
<td>-44.1</td>
</tr>
<tr>
<td><strong>Poverty US$4 PPP</strong></td>
<td>National</td>
<td>7.9</td>
<td>6.6</td>
<td>7.4</td>
<td></td>
<td>-15.8</td>
<td>-6.0</td>
<td>-21.8</td>
</tr>
<tr>
<td></td>
<td>Rural</td>
<td>14.3</td>
<td>12.3</td>
<td>13.8</td>
<td></td>
<td>-13.8</td>
<td>-3.4</td>
<td>-17.2</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>3.7</td>
<td>3.2</td>
<td>3.5</td>
<td></td>
<td>-13.6</td>
<td>-4.4</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>National</td>
<td>1.3</td>
<td>0.8</td>
<td>1.0</td>
<td></td>
<td>-38.2</td>
<td>-25.2</td>
<td>-63.4</td>
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<tr>
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<td>Rural</td>
<td>2.2</td>
<td>1.3</td>
<td>1.6</td>
<td></td>
<td>-43.2</td>
<td>-28.2</td>
<td>-71.4</td>
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<tr>
<td></td>
<td>Urban</td>
<td>0.8</td>
<td>0.5</td>
<td>0.6</td>
<td></td>
<td>-29.9</td>
<td>-19.5</td>
<td>-49.4</td>
</tr>
<tr>
<td><strong>Moderate poverty National line 2/1</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>National</td>
<td>7.2</td>
<td>6.2</td>
<td>6.9</td>
<td></td>
<td>-14.5</td>
<td>-4.1</td>
<td>-18.6</td>
</tr>
<tr>
<td></td>
<td>Rural</td>
<td>10.1</td>
<td>8.3</td>
<td>9.5</td>
<td></td>
<td>-18.3</td>
<td>-6.7</td>
<td>-25.0</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>5.5</td>
<td>4.9</td>
<td>5.4</td>
<td></td>
<td>-10.4</td>
<td>-1.4</td>
<td>-11.8</td>
</tr>
</tbody>
</table>


Notes: 1/ All changes with respect to market income are statistically significant. For inequality, changes are in Gini points while for poverty they are changes in percent. Cells in blank mean that the indicator was not calculated for that income concept because it is not applicable.

2/ The moderate poverty line is twice the amount of the extreme poverty line; the latter is equivalent to the market value of the basic food basket. In local currency, the extreme poverty line is equal to $49 and $33.9 per month for urban and rural areas, respectively and the moderate poverty line is equal to $98.2 and $67.9 for urban and rural areas, respectively. The local currency value of the PPP lines is $51.1 per month for the US$2.50 a day and $83.1 per month for the US$4 a day.

… means the value is not applicable
Chapter 13, Beneke, Lustig, and Oliva

Table 13-4: Impact of Fiscal Policy on Inequality and Poverty (Contributory Pensions as Government Transfers) /1

<table>
<thead>
<tr>
<th></th>
<th>Level</th>
<th>Market</th>
<th>Disposable</th>
<th>Consumable</th>
<th>Final</th>
<th>Change (from market to disposable)</th>
<th>Change (from market to consumable)</th>
<th>Change (from market to final)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gini</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>National</td>
<td>0.4369</td>
<td>0.424</td>
<td>0.4197</td>
<td>0.4002</td>
<td></td>
<td>-0.0129</td>
<td>-0.0172</td>
<td>-0.0367</td>
</tr>
<tr>
<td>Rural</td>
<td>0.3992</td>
<td>0.382</td>
<td>0.3786</td>
<td>0.3511</td>
<td></td>
<td>-0.0172</td>
<td>-0.0206</td>
<td>-0.0481</td>
</tr>
<tr>
<td>Urban</td>
<td>0.416</td>
<td>0.4042</td>
<td>0.3984</td>
<td>0.3845</td>
<td></td>
<td>-0.0118</td>
<td>-0.0176</td>
<td>-0.0315</td>
</tr>
<tr>
<td></td>
<td>Poverty Headcount Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In percent</td>
<td>Changes in percent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poverty US$2.5 PPP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nacional</td>
<td>20.2</td>
<td>17.3</td>
<td>19.1</td>
<td></td>
<td>...</td>
<td>-14.3</td>
<td>-5.4</td>
<td>...</td>
</tr>
<tr>
<td>Rural</td>
<td>35.3</td>
<td>32.0</td>
<td>34.9</td>
<td></td>
<td>...</td>
<td>-9.4</td>
<td>-1.0</td>
<td>...</td>
</tr>
<tr>
<td>Urban</td>
<td>11.0</td>
<td>8.4</td>
<td>9.5</td>
<td></td>
<td>...</td>
<td>-23.3</td>
<td>-14.0</td>
<td>...</td>
</tr>
<tr>
<td>Poverty US$4 PPP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nacional</td>
<td>40.0</td>
<td>38.3</td>
<td>40.8</td>
<td></td>
<td>...</td>
<td>-5.2</td>
<td>1.1</td>
<td>...</td>
</tr>
<tr>
<td>Rural</td>
<td>60.5</td>
<td>58.7</td>
<td>62.0</td>
<td></td>
<td>...</td>
<td>-2.9</td>
<td>2.5</td>
<td>...</td>
</tr>
<tr>
<td>Urban</td>
<td>28.2</td>
<td>25.9</td>
<td>28.0</td>
<td></td>
<td>...</td>
<td>-8.1</td>
<td>-0.6</td>
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<td>Extreme poverty National line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nacional</td>
<td>12.5</td>
<td>9.6</td>
<td>10.8</td>
<td></td>
<td>...</td>
<td>-23.2</td>
<td>-13.6</td>
<td>...</td>
</tr>
<tr>
<td>Rural</td>
<td>17.4</td>
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<td></td>
<td>...</td>
<td>-20.9</td>
<td>-8.9</td>
<td>...</td>
</tr>
<tr>
<td>Urban</td>
<td>9.6</td>
<td>7.1</td>
<td>7.8</td>
<td></td>
<td>...</td>
<td>-26.0</td>
<td>-18.9</td>
<td>...</td>
</tr>
<tr>
<td>Relative poverty National line 2/</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nacional</td>
<td>41.6</td>
<td>39.3</td>
<td>42.6</td>
<td></td>
<td>...</td>
<td>-5.5</td>
<td>2.4</td>
<td>...</td>
</tr>
<tr>
<td>Rural</td>
<td>49.4</td>
<td>46.6</td>
<td>50.9</td>
<td></td>
<td>...</td>
<td>-5.6</td>
<td>3.1</td>
<td>...</td>
</tr>
<tr>
<td>Urban</td>
<td>36.8</td>
<td>34.9</td>
<td>37.5</td>
<td></td>
<td>...</td>
<td>-5.3</td>
<td>1.8</td>
<td>...</td>
</tr>
</tbody>
</table>


Notes: 1/ All changes with respect to market income are statistically significant. For inequality, changes are in Gini points while for poverty they are changes in percent. Cells in blank mean that the indicator was not calculated for that income concept because it is not applicable.

2/ The moderate poverty line is twice the amount of the extreme poverty line; the latter is equivalent to the market value of the basic food basket. In local currency, the extreme poverty line is equal to $49 and $33.9 per month for urban and rural areas, respectively and the moderate poverty line is equal to $98.2 and $67.9 for urban and rural areas, respectively. The local currency value of the ppp lines is $51.1 per month for the US$2.50 a day and $83.1 per month for the US$4 a day.

… means the value is not applicable

Coverage and Leakages

Why does fiscal policy have practically no effect on the incidence of poverty? To answer this question, it is important to analyze the targeting effectiveness of direct transfers. Table 13-5 presents several relevant indicators.29 The vertical efficiency indicator measures the percentage of spending on direct transfers that goes to the poor population for different poverty lines. As seen in table 13-5, the percentage channeled toward the population in extreme poverty under international and national lines is between 25 and 16 percent, respectively. For the total poor population (extreme and moderate), the resources allocated are between 47 percent and 49 percent, respectively.

The spillover amount measures the percentage destined for the poor population in excess of what would be needed to bring it to the income of the corresponding poverty line. This number is quite small, which means that the average size of the benefits received is not excessive.

29 Beckerman (1979).
TABLE 13-5: DIRECT TRANSFERS, EFFICIENCY AND EFFICACY IN POVERTY REDUCTION, EL SALVADOR 2011

<table>
<thead>
<tr>
<th></th>
<th>Headcount poverty indicators</th>
<th>Vertical Expenditure Efficiency (VEE)</th>
<th>Spillover (s)</th>
<th>Poverty Reduction Efficiency (PRE)</th>
<th>Poverty Gap Efficiency (PGE)</th>
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</thead>
<tbody>
<tr>
<td>Benchmark: Contributory pensions as part of Market Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US$ 2.5 PP</td>
<td>1.784</td>
<td>0.252</td>
<td>0.084</td>
<td>0.231</td>
<td>0.204</td>
</tr>
<tr>
<td>US$ 4 PP</td>
<td>1.248</td>
<td>0.473</td>
<td>0.030</td>
<td>0.459</td>
<td>0.105</td>
</tr>
<tr>
<td>Extreme National Poverty Line</td>
<td>1.733</td>
<td>0.165</td>
<td>0.146</td>
<td>0.141</td>
<td>0.303</td>
</tr>
<tr>
<td>Moderate national Poverty line</td>
<td>1.577</td>
<td>0.491</td>
<td>0.038</td>
<td>0.018</td>
<td>0.004</td>
</tr>
<tr>
<td>Sensitivity Analysis: Pensions are treated as government transfer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US$ 2.5 PP</td>
<td>1.082</td>
<td>0.218</td>
<td>0.423</td>
<td>0.126</td>
<td>0.256</td>
</tr>
<tr>
<td>US$ 4 PP</td>
<td>0.877</td>
<td>0.361</td>
<td>0.277</td>
<td>0.261</td>
<td>0.141</td>
</tr>
<tr>
<td>Extreme National Poverty Line</td>
<td>1.063</td>
<td>0.175</td>
<td>0.510</td>
<td>0.086</td>
<td>0.374</td>
</tr>
<tr>
<td>Moderate national Poverty line</td>
<td>1.051</td>
<td>0.399</td>
<td>0.257</td>
<td>0.058</td>
<td>0.030</td>
</tr>
</tbody>
</table>

Source: CEQ Master Workbook for El Salvador May 12th, 2015, Prepared by the authors based on data from the Multi-Purpose Household Survey (2011) and National Accounts.

The efficiency indicator for the poverty gap shows the percentage of the total gap that is covered with direct transfers. As can be seen, the extreme poverty gap is closed by only roughly 20 percent. In part this is because resources are not concentrated on the poorest, as noted in the indicator on vertical efficiency. However, as table 13-6 shows, this is not because money is being spent on the middle or upper class. An important share of benefits from direct transfers goes to households with income of between US$4 and US$10 PPP, or what has come to be known as the “vulnerable groups”.

In addition, as can be seen in table 13-6, of the total number of people receiving direct transfers only 26.6 percent are individuals with income below the extreme poverty line of US$2.50 PPP. For example, of the beneficiaries of RSCs and PATI, 50.9 percent have income below the international extreme poverty line of US$2.50. The same holds true with beneficiaries of the rest of the programs, which cover 29.4 percent. Only 12.5 percent of the beneficiaries of indirect subsidies are among the extreme poor. Although they partially offset the effect of indirect taxes, their impact is limited for reducing consumable poverty (table 13-6).

---

Footnote: López-Calva and Ortiz-Juarez (2011); Ferreira and others (2012).
Chapter 13, Beneke, Lustig, and Oliva

Table 13-6: Distribution of Benefits and Beneficiaries by Income Group

<table>
<thead>
<tr>
<th>El Salvador (2011)</th>
<th>Share of benefits by income group</th>
<th>Share of beneficiaries by income group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>y&lt;2.5</td>
<td>2.5&lt;y&lt;4</td>
</tr>
<tr>
<td></td>
<td>4&lt;y&lt;10</td>
<td>10&lt;y&lt;50</td>
</tr>
<tr>
<td>Direct transfers</td>
<td>24.7%</td>
<td>22.0%</td>
</tr>
<tr>
<td>Rural Solidarity Partnership Communities and PATI</td>
<td>48.3%</td>
<td>23.2%</td>
</tr>
<tr>
<td>Non-contributory pensions (older adults)</td>
<td>62.4%</td>
<td>19.6%</td>
</tr>
<tr>
<td>Gas subsidy (cash)</td>
<td>32.7%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Remaining direct transfers /2</td>
<td>25.7%</td>
<td>20.6%</td>
</tr>
</tbody>
</table>

As shown in table 13-7, coverage for some of the programs is also rather low among the extreme and moderate poor.

Table 13-7: Percent of Beneficiaries in Each Income Group 1

<table>
<thead>
<tr>
<th>El Salvador (2011)</th>
<th>Percent of beneficiaries in each income group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>y&lt;2.5</td>
</tr>
<tr>
<td></td>
<td>4&lt;y&lt;10</td>
</tr>
<tr>
<td>Rural Solidarity Partnership Communities and PATI</td>
<td>18.2%</td>
</tr>
<tr>
<td>Non-contributory pensions (older adults)</td>
<td>1.0%</td>
</tr>
<tr>
<td>Gas subsidy (cash)</td>
<td>42.3%</td>
</tr>
<tr>
<td>Remaining direct transfers /2</td>
<td>85.2%</td>
</tr>
<tr>
<td>Transportation</td>
<td>27.7%</td>
</tr>
<tr>
<td>Electricity</td>
<td>73.7%</td>
</tr>
<tr>
<td>Water</td>
<td>13.1%</td>
</tr>
<tr>
<td>Preschool Education</td>
<td>74.2%</td>
</tr>
<tr>
<td>Basic Education</td>
<td>95.6%</td>
</tr>
<tr>
<td>Middle Education</td>
<td>27.6%</td>
</tr>
<tr>
<td>Tertiary Education</td>
<td>1.3%</td>
</tr>
<tr>
<td>Contributory pensions</td>
<td>1.4%</td>
</tr>
<tr>
<td>Population</td>
<td>19.2%</td>
</tr>
</tbody>
</table>

Source: CEQ Master Workbook for El Salvador May, 12th, 2015 based on data from the Multi-Purpose Household Survey (2011). Notes: 1/ Except for education, coverage for each income group here is defined as the total number of individuals from that group who live in households where there is at least one beneficiary divided by the total population in that same group. In the case of education, refers to coverage here the total number of individuals in this income group, living in households where at least one is enrolled in school independently if have the appropriate age, divided by the population in that income group, living in households where at least one has the corresponding school age. 2/ Includes the Agricultural Package, School Package, and School Lunch Program.
13.6 Conclusions and Recommendations

Fiscal policy affects inequality and poverty, but its impact is limited. When compared with other countries inside and outside the region, El Salvador has a medium to small-sized government. However, in comparing the results with those of economies with a similar level of per capita income in purchasing power, the reduction in poverty and inequality is relatively small. There is room for greater influence and to increase the incidence with current resources. In this regard, the results on poverty and inequality could be stronger. This could be done by reorienting funds from other public spending items or from transfers and subsidies that go to higher income households and channeling them toward social spending. At the same time, the effectiveness and efficiency of the programs and direct transfers should be increased to ensure better focus.

El Salvador redistributes slightly less than the general trend in countries with the same purchasing power of per capita income. Together transfers and direct taxes reduce inequality by 1 percentage point. When the effect of indirect subsidies and taxes on consumption is added, the result is slightly more equalizing. Finally, factoring in the impact of public spending on education and health, the Gini coefficient is reduced by 3.6 percent. This means the country redistributes slightly less than the trend line predicts for a country with similar gross per capita income, measured in PPP.

In general, on the income side, direct taxes on individuals and contributions to social security for health are progressive. Indirect taxes as a whole are neutral from the distributive perspective. On the spending side, direct transfers, taking into consideration the social programs evaluated, such as RSCs, Universal Basic Pension, PATI, the School Package, the School Lunch Program, and the Agricultural Packet, are progressive in absolute terms. This means the amount per individual decreases with income. However, spending on these programs is small, 1.3 percent of primary spending and 0.3 percent of GDP.

Subsidies are progressive in relative terms, due in mainly to the electricity and gas subsidy. However, the water subsidy, up to the 5\textsuperscript{th} decile or for the half of the population that has lower income, and the public transportation subsidy are regressive. However, the latter must be taken with caution due to the concentration of beneficiaries in urban areas where the cost of living is higher.

With respect to health, the amount assigned is progressive only in relative terms. Non-contributory public health spending is progressive in absolute terms. In regards to education, basic and preschool education are progressive in absolute terms, while middle education is neutral in absolute terms. In other words, all receive about the same amount per pupil. Tertiary education is neutral in relative terms and its percentage of incidence is low.

Fiscal policy has little impact on poverty reduction. Although the direct transfers are properly focused, their coverage among the poorest is low, and they represent only a small percentage of primary spending. In this regard, including the effect of indirect taxes net of subsidies, extreme poverty is practically equal while total poverty is increasing, when compared with what is obtained from market income using both international and national poverty lines.

Despite the limited effect observed in the reduction of extreme poverty measured with after-tax income, the country comes out fairly well when comparing the results of other economies in the region that used the same
methodology. For example, poverty increased in other countries, including one country with considerably more income per capita, Brazil, while remaining practically the same in El Salvador.

A significant part of the benefits of direct transfers reaches households with income between US$4 and US$10 per day in PPP, the so-called “vulnerable groups.” However, the main cause of the low impact of direct transfers on poverty reduction is the relatively low coverage. This is due to the limited percentage of beneficiaries with income below the international poverty line of US$2.5 per day in PPP; only 26.6 percent receive some direct transfer.

[H2] Recommendations

Expand the beneficiaries and coverage of targeted social programs that have proved effective. As has been noted, the weak impact on poverty reduction is due to the nature of direct transfers which, although concentrated, do not have wide coverage among the poorest.

Improve subsidy targeting to reorient resources to the poorest. Although subsidies are progressive in relative terms, they have limited impact on the reduction of poverty and inequality owing to the fact that a major portion of the subsidies goes to people who are not poor. Therefore, it is possible to improve the outcome by reorienting resources to programs that reach lower-income households. For example, since the electricity subsidies for households using more than 99 kWh represent a low percentage of the income they receive, meaning their relative incidence is low, consideration could be given to eliminating this subsidy to those consumers and diverting it to social spending, such as expanding education coverage.

Improve the coverage and quality of health services provided by the Ministry of Health, as well as education coverage for preschool and middle education levels, especially for the poorest. Due to the large public social spending budget for health and education services, these services have a strong effect on reducing inequality. Therefore, improving their coverage and quality, especially amongst the poorest, would improve the impact of fiscal policy on this population. For example, increasing the supply of preschool and middle education, which are the levels with the lowest net enrollment rates, and increasing resources for non-contributory health services, would have a greater impact on the reduction of inequality.
Chapter 13, Beneke, Lustig, and Oliva

References


Chapter 13, Beneke, Lustig, and Oliva


[H1] Appendix: Estimating the Incidence of Consumption Subsidies

Electricity Subsidy

The subsidy for electricity consumption in El Salvador is indirect. A significant portion of households pay less than market value for electricity, so this subsidy was incorporated in this exercise to calculate consumable income.

To estimate the value of the electricity subsidy for households, the database of the Household Multi-Purpose Survey (EHPM, from its acronym in Spanish) was used. The EHPM reports monthly electricity expenditure in US dollars, which includes any discount for the subsidy in eligible households plus the value added tax (VAT). The monthly expenditure was adjusted using institutional rules for the subsidy, as given by the laws and regulations applied to the sector.

The elements that affect the amount of the subsidy are: electricity consumption of households, expressed in kilowatt hours (kWh), the level of rates in force as established in the tariff schedule dictated by the General Superintendency of Electricity and Telecommunications (SIGET, from its acronym in Spanish), and the kWh threshold set by policy to qualify for the subsidy.

Because the survey does not contain the amount of kWh consumed and this is an important parameter, the first step was to estimate the kWh consumed from the bill paid with subsidy and VAT. The tariff schedule corresponded to the month in which the household was surveyed. In the exercise conducted for 2011, the tariff schedule changed every quarter, or four times during the year, and corresponded to the month in which the interview of the survey was taken.

The electricity tariff schedule was divided into four ranges: from 0-50 kWh, from 51 to 99 kWh, from 100 up to 200 kWh, and over 200 kWh. With the data from the tariff schedule, 16 regressions (four calendar quarters multiplied by four tariff ranges) were performed, using as explanatory variable the amount payable including subsidy and VAT, and as an outcome variable the number of kWh consumed, and the slope or subsidized price per kWh was calculated. The regressions based on the tariff schedule are accurate ($R^2 = 99$ or with a total sum of squared errors of zero). The amount of kWh charged was obtained by substituting these equations into the monthly cost of electricity reported by the household survey.

The second step was to calculate the subsidy. In El Salvador the subsidy is granted in two tranches. The first, between 0 and 99 kWh, is where households pay a fixed price stipulated by regulations in the Law of the National Investment Fund in Electricity and Telephony, (FINET) adopted in May 1999, Article 16, which determines a rate of US$0.067/kWh. In these cases, the subsidy is 89.5%, the difference between the price of US$0.067 and the average market price or rate schedule set out in the corresponding month excluding VAT. The State delivered the subsidy via a transfer directly to the electric distribution company, and was reflected in consumers´ electricity bills. For the second tranche, above 99 kWh, the maximum threshold for subsidy is set by policy. For 2011, during the first quarter, consumers above 99 kWh paid the rate of January 2011. However, in April 2011, the rate was scheduled to increase an average of
16.4%, so the maximum threshold to receive the subsidy was increased to 300 kWh. With the price change in April, a legislative decree was approved to keep prices at their January 2011 level for part of their consumption. For the last quarter of 2011, the threshold was decreased to 200 kWh.

If the household was surveyed between April and July 2011, their consumption between 99 and 300 kWh received the subsidy (paying at the January 2011 price), while consumption over 300 kWh paid 100% of the new, higher rate. If the household was surveyed after October 2011, the consumption between 99 and 200 kWh reflected the subsidized rate, while excess was calculated as paying the higher, non-subsidized rate. Similarly, the amount of the subsidy value was made by means of a direct transfer from government to the electricity distribution companies.

In general, when analyzing the amount of kWh, it was observed that if a household paid US$10 in the month for electricity, it was located below the 99 kWh threshold and was paying the fixed price from May 1999. After April 2011, if the household paid between US$10 and US$46, it consumes less than 200 kWh, and the price paid per kWh is that of January 2011. The subsidies covered 91% of residential users, of which 69.7% are up to 99 kWh consumption, 21.3% between 99 and 200 kWh, and 4.9% between 200 and 300 kWh.

**Public Transportation Subsidy**

The subsidy operates as an indirect transfer, since the users of public transport pay a fixed price. The service is subject to state regulation which establishes the rates to be charged by companies who offer the service and are licensed for specific bus routes.

The government has subsidized the system of public transportation since 1974. Due to the increase in oil prices in 2007, the "Transitional Law for the Stabilization of Tariffs for Public Transportation" was passed and has been extended to present day. The subsidy is granted to the supply side and operates by delivering a fixed amount of money per unit of transport.

According to the parameters of the law, the State transferred the following to entrepreneurs: US$375 per month per full-sized bus and US$750 per month for each smaller bus during 2011. In addition, according to a study by the Israeli Institute for Transport Planning and Research in 2000, full-size buses cover an average of 4.6 trips on their routes per day, while smaller buses cover 5.4 trips a day. Taking the daily average amount of monthly allowance commensurate with the amount of travel, each full size bus receives US$5.43 and each smaller bus US$2.31 per trip. Then, according to the number of seats of each unit (60 in full-size buses and 25 in smaller buses), each seat allowance amounts to US$0.0905 in full-size buses and $0.0925 in smaller buses.

The same study found that in the Metropolitan Area of San Salvador (AMSS, from its abbreviation in Spanish), 40 percent of public transportation units are full-size buses and 40 percent are smaller buses. Conversely, outside the AMSS, 80 percent are full-size and 20 percent
are smaller. Taking this into account, and the per seat amounts on both size buses, the weighted average subsidy per seat on every trip was US$0.09178 in AMSS and US$0.0909 outside AMSS.

On the demand side, the price paid by the population is fixed. According to Agreement No. 292 from the Transportation Ministry, tariffs of service for passengers in public transportation are US$0.25 for full-size buses and US$0.28 for smaller buses. The EHPM collects the monthly amount allocated to public transport. This expenditure was divided by the weighted average rate of US$0.261 to calculate the number of trips made in each household. To impute the subsidy, the number of trips was multiplied by the parameters indicated above, US$0.09178 in AMSS and US$0.0909 outside the AMSS.

**Water Subsidy**

The public sector is the principal potable water supplier, through the autonomous National Administration of Aqueducts and Sewers (ANDA, from its abbreviation in Spanish). The law gives ANDA the authority to propose tariffs to the Executive, which will be approved by the Ministry of Economy. The current tariff schedule was approved by the Ministry of Economy in June 2011. These rates are exempt from VAT.

Similar to the case of electricity subsidy, the tariff schedule throughout the year 2011 was approved on February 24, 2010 and was separated into 13 levels. Consistent with this rate schedule, thirteen regressions were performed, where the explanatory variable was the amount to pay including the subsidy and the result variable was the volume consumed in cubic meters, while the slope or price per cubic meter with subsidy was calculated. Similarly, regressions based on the tariff schedule are accurate ($R^2 = 99$ or with a total sum of squared errors of zero). Using these equations for the monthly spending per household on potable water reported in the survey, the number of cubic meters consumed was calculated.

The estimated volume consumed was calculated for each household based on the reported expense using information from households that answered the EHPM survey who received service directly from ANDA. Also, according to ANDA records, the cost of providing 1 cubic meter of potable water was US$0.85, which was used to calculate the non-subsidized water bill by multiplying by the volume of water consumed by each household. Finally, the subsidy is the difference between the water cost without subsidy and the bill actually paid.

**LP Gas Subsidy**

Before 2011, the gas subsidy was transferred directly to the supply side, to companies who imported liquefied petroleum gas (LPG) into the country. Previously, the domestic price was fixed.

The price of a 25lb tank, which is widely used for cooking, stood at US$5.10. This was the lowest price in Central America and all El Salvadorians paid the same price. On the other hand, the US$0.16 per gallon tax on gasoline consumed was used to finance the LPG subsidy.
However, increases in the price of petroleum products pushed the difference between the market price and that facing consumers, which increased the amount that the government had to subsidize.

During 2011, several changes were made in how the gas subsidy is delivered. The government began a program known as the "Plan for Comprehensive Management and Market Transparency for LPG", with which changes in the regulation of gas prices were made. First, it allowed the price of tanks to rise to their market value, reaching US$14.60 for 25lbs, and went on to deliver the subsidy directly to households, with a fixed monthly amount of US$9.10 if the household consumed less than 99 kWh of electricity per month. Also, the Ministry of Economy engaged in efforts to reduce exclusion errors by granting the subsidy to other households in poverty without an electrical connection, to subsistence businesses and to other non-governmental charities. To impute the subsidy, the EHPM identifies if a household is a subsidy recipient through a direct question. If awarded, the subsidy of US$9.10 was linked to the household.
Measuring the Effectiveness of Taxes and Transfers in Fighting Poverty and Inequality in Iran

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October 31, 2016

Chapter 14
Lustig, Nora, editor

Commitment to Equity Handbook
Brookings Institution and CEQ Institute (2017)

Introduction

As indicated in the Introduction, one of the key questions to be addressed by a CEQ Assessment is how effective taxes and government spending in reducing inequality and poverty are. This chapter introduces new Commitment to Equity (CEQ) effectiveness indicators to evaluate the effectiveness of taxes and transfers in reducing inequality and poverty, and applies them to Iran. The main goal of the effectiveness indicators defined here is to provide policymakers with meaningful but easy-to-interpret indexes that measure fiscal interventions’ “bang for the buck” in terms of inequality or poverty reduction relative to the amount collected and spent. Special attention has been given to the design of these indicators to fulfill the mathematical requirements of “proper ordering”: specifically, the design of the indicators assures that, everything else being equal, an intervention with higher marginal contribution to the reduction of inequality (or poverty) has a higher ranking. By contrast, an intervention with higher potential to reduce inequality (or poverty) but with lower realized effect receives a lower ranking. A brief description of the effectiveness indicators can also be found in Chapter 1 by Lustig and Higgins. Chapter 7 by Higgins describes how these indicators are calculated with the CEQ Stata Package. All the effectiveness indicators are calculated by the CEQ Stata

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1 This paper was possible thanks to the generous support of the Economic Research Forum.
2 Ali Enami is a doctoral student of the PhD in Economics at Tulane University and Research Associate of the CEQ Institute. For questions, please contact aenami@tulane.edu.
3 I am very grateful to Sean Higgins, Nora Lustig, and Stephen Younger for their insightful comments on the previous drafts of this paper. I also would like to thank Alireza Taqdiri for providing the data for Iranian Household Expenditure and Income Survey.
This chapter begins by introducing two general indexes, the Impact and Spending Effectiveness indicators, which are designed to measure the effectiveness of fiscal policies in reducing poverty and inequality. The chapter then reviews the Fiscal Impoverishment and Gains Effectiveness Indicator (FI/FGP) designed by Enami and others, based on the concepts of fiscal impoverishment (FI) and fiscal gains to the poor (FGP) introduced by Higgins and Lustig. This effectiveness indicator can better capture the poverty reducing or increasing effects of fiscal interventions. Finally, taxes and transfers in Iran are evaluated with respect to these indicators. I find that taxes are very effective in raising revenue without increasing poverty in a significant way and also moderately effective in reducing inequality. In contrast, because transfers are universal and not targeted to the poor, they realize less than 16 percent of their potential to reduce poverty with no one transfer exceeding 21 percent of its potential. With regard to inequality, transfers are more similar to taxes in terms of moderately realizing their potential to reduce inequality, with the “Social Assistance” program leading the interventions with a realized power of about 40 to 45 percent. Among taxes, only income tax demonstrates an effectiveness of this magnitude.

Before introducing these indicators, the next section will briefly review the concept of marginal contribution (MC), which is central to the construction of the CEQ effectiveness indicators here, as well as the notation used throughout this paper.

### 14.1 Notation

This paper uses $T$ and $B$ to refer to taxes and benefits, where $T$ can refer to any combination of direct and indirect taxes, and $B$ can refer to any combination of direct transfers, indirect subsidies, and in-kind transfers from public spending on health and education. The indicators can also be defined as combinations of taxes and transfers, which is why $T$ (and/or $B$) is used throughout. One can calculate the marginal contribution (MC) of any combination of taxes or benefits as follows:

$$MC_{\text{End income}}^T (\text{and/or } B) = \text{Index}_{\text{End income} \setminus T (\text{and/or } B)} - \text{Index}_{\text{End income}}$$

Index refers to any inequality or poverty indexes that may be used to calculate the marginal contribution. For example, this chapter uses the Gini index as a measure of inequality. The subscript of the Index, End income, refers to the income concept used to calculate the marginal contribution to the index of a tax or benefit. For example, $\text{Gini}_{\text{Disposable Income}}$ refers to the Gini coefficient of disposable income, and using $\text{Gini}_{\text{Disposable Income}}$ for $\text{Gini}_{\text{End income}}$ implies that we are interested in calculating the marginal contribution of a tax or benefit to the disposable income Gini. $\text{End income} \setminus T (\text{and/or } B)$ refers to the income concept that is equivalent to End income prior to the tax or benefit of interest. For example, $\text{Disposable Income} \setminus \text{Direct Taxes}$ equals disposable income plus direct taxes (to find the income concept prior to subtracting out direct taxes). Intuitively,

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4 See Enami, Higgins, and Younger (2016) and Higgins and Lustig (2016).
\(MC_{\text{End income} \ T \ (\text{and/or B})}\) is the change in the value of \(\text{Index}_{\text{End income}}\) if \(T\) (and/or \(B\)) is removed from the fiscal system or replaced with a tax (or benefit) of the same size that has no effect on inequality (or poverty) when it is added to the fiscal system. It should be noted that \(\text{End income}\) does not have to be one of the CEQ core income concepts. For example, if we wanted to calculate the marginal effect of indirect taxes with respect to disposable income, because indirect taxes have not yet been subtracted out of disposable income, the end income concept would be \(\text{Disposable Income minus Indirect Taxes}\). The MC in this case would be calculated as follows:

\[
MC_{\text{Disposable Income minus Indirect Taxes}} = \text{Index}_{\text{Disposable Income}} - \text{Index}_{\text{Disposable Income minus Indirect Taxes}}
\]

On the other hand, if we were calculating the MC of direct taxes with respect to disposable income, because disposable income is already net of direct taxes, the end income would be disposable income, whereas the end income without the fiscal intervention would require taking disposable income and adding back in direct taxes, as follows:

\[
MC_{\text{Disposable Income}} = \text{Index}_{\text{Disposable Income plus Direct taxes}} - \text{Index}_{\text{Disposable Income}}
\]

In calculating MC, the important point is that we have two income concepts that are different from each other only because of one component or a bundle of taxes or transfers. In other words, one can use components of a fiscal system separately and also in different combinations (or bundles) to perform a marginal contribution analysis. An example would be to evaluate the inequality reducing effect of different taxes in a system separately first and then of the whole taxation system together as one entity. Regardless of how a component or bundle is set up, we consider the MC of a fiscal intervention to be the difference between these two income concepts (the \(\text{End income}\) with and without that specific component or bundle) for a particular inequality (or poverty) index.

Although the preceding examples are all related to the Gini index, the concept of MC is applicable to any inequality or poverty index.

### 14.2 New CEQ Effectiveness Indicators

Before introducing the new indicators, it is helpful to review why they have replaced the previous CEQ effectiveness indicators. Following this review, the new indicators will be discussed.

**Shortcomings of the 2013 Effectiveness Indicator**

The effectiveness indicator introduced in the previous handbook (2013) was defined as follows:

\[
\text{CEQ Old Effectiveness Indicator} = \frac{MC_{\text{End income} \ T \ (or B)}}{T \ (or B)} \times GDP
\]

This indicator suffers from some shortcomings. The first one relates to the mathematical interpretation of this indicator. The indicator in the equation above states how much the marginal
contribution of a tax (or transfer) would change if that tax (or transfer) were scaled up to the size of GDP. Because this is a linear interpolation, the values could easily exceed the reasonable boundaries. For example, values beyond unity (in absolute terms) are meaningless for the power of a tax (transfer) to reduce inequality simply because the change in Gini cannot exceed unity (in absolute terms).

Even if this awkward interpretation were ignored, the indicator would fail to rank the taxes and transfers properly, especially with respect to the inequality reduction effectiveness. One would expect the indicator to remain constant if a program were scaled up proportionally. The reduction in Gini is a non-linear function of $T$ (or $B$) so if $T$ (or $B$) were multiplied by two, the reduction in Gini would not necessarily be multiplied by two (note that the change in Gini cannot exceed unity in absolute value). Therefore, even if a completely efficient program were scaled up in the most mathematically efficient way, the indicator would be likely to reduce (it never increases). As a result, bigger programs would be unreasonably penalized.

With respect to poverty reduction, the indicator is not problematic in ranking the taxes and transfers individually if the proper indicator is used. However, this indicator is not developed adequately to assess bundles of taxes and transfers. In the case of poverty reduction of a bundle, the two concepts Fiscal Gains to the Poor (FGP) and Fiscal Impoverishment (FI) should be accounted for separately because transfers can only create the former while taxes exclusively affect the latter.

Impact and Spending Effectiveness Indicators

The two new CEQ effectiveness indicators are introduced in this section.

Impact Effectiveness

Impact Effectiveness is defined as the ratio of the observed MC of a tax (transfer) to the optimum MC of that tax (transfer) if it is distributed in a way that maximizes its inequality or poverty reducing impact. The following equation shows how this indicator is defined mathematically:

$$\text{Impact Effectiveness} = \frac{MC_{\text{End income}}^{\text{End income}}}{MC_{T(\text{and/or } B)}^{\text{End income}}}$$

where $MC_{T(\text{and/or } B)}^{\text{End income}}$ is the maximum possible $MC_{T(\text{and/or } B)}^{\text{End income}}$ if the same amount of $T$ (and/or $B$) is distributed differently among individuals. For example, for the Gini index we deduct taxes from (add benefits to) the richest (poorest) until her income becomes equal to the second richest (poorest), then deduct taxes from (add benefits to) these two richest (poorest) until their incomes become equal to the third richest (poorest), and we continue this procedure until we end up with the same total value of $T$ ($B$) that we observe in the actual system. If the indicator of interest is a Gini or
S-Gini index, the Impact Effectiveness indicator is identical to what is proposed by Fellman and others.\(^5\)

This indicator shows the relative realized power of a tax or transfer in reducing inequality, or of a transfer (or combined tax-transfer system) in reducing poverty. (Because taxes can only increase poverty, the poverty reduction indicator is only defined for benefits and combined tax-transfer systems that have a positive marginal contribution.) An example shows how to interpret this indicator: if the impact effectiveness of a transfer is equal to 0.7, it means the transfer has realized 70 percent of its potential power in reducing inequality. Therefore, the higher the value of this indicator, the more effective a tax (transfer) is in fulfilling its potential to reduce inequality.

One can calculate this indicator for taxes and transfers with both positive and negative MC for inequality. To see why this indicator properly ranks taxes and transfers with a positive MC to inequality or poverty, assume taxes A and B cause the same reduction in inequality but A is larger than B. In this case, B is preferred to A because both taxes do good (by reducing inequality), but A has a higher (unrealized) potential to reduce inequality because it is larger. So when \(MC_{T (\text{and/or} \ B)}^\text{End income} > 0\), the Impact Effectiveness indicator abides by this ranking because \(MC_{T (\text{and/or} \ B)}^\text{End income} \cdot \) is in the denominator and is increasing in the size of \(T\). Now to see why the indicator properly ranks taxes and transfers with a negative MC to inequality (that is, taxes and transfers that cause an increase in inequality), assume tax A has a similar negative effect on inequality as tax B but tax A is larger. This would mean that, while A and B both do harm, tax A at least collects more revenue while doing the same harm.\(^6\) In other words, if tax B were scaled up to collect the same revenue as tax A, its negative effect on inequality would be higher (its MC would be more negative). Thus, tax A is preferred to B, and this is indeed the information given by the Impact Effectiveness indicator because \(MC_{T (\text{and/or} \ B)}^\text{End income} \cdot \) is in the denominator and is increasing in the size of \(T\) (note that here \(MC_{T (\text{and/or} \ B)}^\text{End income} < 0\)).

For poverty, one can calculate the Impact Effectiveness indicator (using the formula above) for benefits or combined tax-benefit systems. For taxes, which can only increase poverty, the denominator will always be zero (so the optimal effect of a tax on poverty is zero). Therefore, the denominator is modified in the following expression to reflect the most harmful way of taxing (taxing the poorest until her income equals zero, then the second poorest until her income equals zero, and so on). We denote this harmful taxation as \(MC_{T (\text{or} B)}^\text{End incomeH}\) and calculate

\[
\text{Poverty Impact Effectiveness}_{T}^{\text{End income}} = -\frac{MC_{T}^{\text{End income}}}{MC_{T}^{\text{End incomeH}}}.
\]

\(^5\) See Fellman and others (1999).

\(^6\) This is not exactly a mathematical property because the MC of taxes A and B is calculated with respect to different reference points, so having different potentials does not necessarily correspond to collecting more revenue.
where the negative sign is included to ensure that the higher the value of the indicator, the less harmful the tax is relative to its potential to do harm.

**Spending Effectiveness**

The Spending Effectiveness indicator is defined as the ratio of the minimum amount of a tax (transfer) required to be collected (spent) in order to create the observed MC of the tax (transfer), if the tax (transfer) is instead redistributed optimally. The following equation shows how this indicator is calculated:

\[
\text{Spending Effectiveness}_{T (\text{and/or } B)}^{\text{End income}} = \frac{T^* (\text{and/or } B^*)}{T (\text{and/or } B)},
\]

where \( T^* (\text{and/or } B^*) \) is the minimum amount of \( T \) (or \( B \)) that is needed to create the same \( MC_{T (\text{and/or } B)}^{\text{End income}} \) using the same optimal redistribution procedure that was discussed previously to find the maximum MC.

This indicator shows how much less tax (transfer) is required to achieve the same observed outcome (in terms of inequality reduction) if the tax (transfer) is collected (spent) in an optimal way. For example, a value of 70 percent for spending effectiveness of a transfer means that the same MC could be achieved by spending only 70 percent of the current resources if those resources were spent optimally (if the objective function is to maximize equality). This indicator can only be calculated for the taxes and transfers with a positive MC (and as a result, the spending effectiveness of taxes on poverty reduction is undefined).

Spending effectiveness has an important interpretation as a measure of efficiency as well. Because the value of the normative index of interest (for example, the Gini index) is kept constant, spending effectiveness shows how the fiscal intervention could have reached the same social goal with less distortion through a smaller size of tax or transfer. Therefore, this indicator not only ranks the effectiveness of different taxes and transfers in reducing inequality and poverty but it can also be used to rank alternative taxes and transfers from the view of economic efficiency.

**Fiscal Impoverishment and Gains Effectiveness Indicators**

This section reviews the effectiveness indicators introduced by Enami and others.\(^7\) These indicators are specific to the effect of taxes and transfers on fiscal impoverishment (FI) and fiscal gains to the poor (FGP). Axiomatic indicators for FI and FGP are derived by Higgins and Lustig and described earlier in this handbook.\(^8\) Consider a set of policies that may include both benefits and taxes. We measure the effectiveness of these policies at reducing poverty as

---

\(^7\) See Enami, Higgins, and Younger (2016).

\(^8\) See Higgins and Lustig (2016).
\[
\text{Effectiveness}_{FL/FGP} = \left( \frac{B}{T + B} \left( \frac{FGP \cdot MC_B^{End \text{ income}}}{B} \right) \right) + \left( \frac{T}{T + B} \left( 1 - \frac{FL \cdot MC_T^{End \text{ income}}}{T} \right) \right)
\]

where \( T \) and \( B \) are the size of total taxes and transfers (both positive values), \( FGP \cdot MC_B^{End \text{ income}} \) is the marginal contribution of transfer \( B \) to FGP (always a non-negative value), and \( FL \cdot MC_T^{End \text{ income}} \) is the marginal contribution of tax \( T \) to FI (always a non-negative value).\(^9\)

This indicator is a weighted average of the income reductions for some poor people and income increases for other poor people as a result of the tax and transfer system. For analyzing bundles that include only taxes, including a single tax, the indicator reduces to

\[
\text{Tax Effectiveness}_{FL} = \frac{FL \cdot MC_T^{End \text{ income}}}{T}.
\]

For policies that include only benefits, it reduces to

\[
\text{Transfer Effectiveness}_{FGP} = \frac{FGP \cdot MC_B^{End \text{ income}}}{B}.
\]

These indicators vary between zero and one and the higher the value of the indicator, the better a tax or transfer is in terms of its effectiveness in reducing poverty. Note that taxes can only hurt and transfers can only help the poor, and even though both of the preceding indicators have positive values, one should not compare the effectiveness of a tax to a transfer in reducing poverty.

### 14.3 Data

The data for this paper is from the 1390 (2011-12) round of the Iranian Household Expenditure and Income Survey (HEIS). The Statistical Center of Iran conducts this survey every year and its sample represents all rural and urban areas of Iran. In 2011-2012, the year of survey that is used in this analysis, there were 18,727 urban and 19,786 rural households in the sample. These households represent about 56.4 million urban and 23.1 million rural individuals. For each one of the households in the sample, I follow the CEQ income concepts diagram in chapter 1 by Lustig and Higgins of this handbook and reproduced below, which shows how different CEQ income concepts are created, and I construct different main income concepts as well as income components (that is, taxes and transfers) as described in table 14-1. A detailed review of this system and empirical statistics are provided by Enami and others.\(^{10}\) Here, I focus on calculating the effectiveness indicators discussed in the previous section, using Disposable, Consumable, and Final Incomes as the income concepts for \( End \text{ income} \) in the previous notations. Therefore, the effectiveness of each tax and transfer will be with respect to these income concepts.

\(^9\) FGP and FI are in Higgins and Lustig (2016) and the article is reproduced as Chapter 4 of this Handbook. A brief description can be found in Chapter 1 by Lustig and Higgins and the instructions on how to calculate them with the CEQ Stata Package are in Chapter 7 by Higgins.

\(^{10}\) See Enami, Lustig, and Taqdiri (2016).
Figure 14-1. Income Concepts Diagram According to the CEQ Methodology
Table 14-1. Description of Market Income and Other Income Components for Iran

Source: Adapted from Chapter 1 in this Handbook: Lustig and Higgins (2017).
<table>
<thead>
<tr>
<th>Main Category</th>
<th>Subcategories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Income</td>
<td>...</td>
<td>All monetary and non-monetary income received as an employee or self-employed individual excluding any subsidy or social assistance and including imputed rent for home-owners. All components are directly observed in the survey.</td>
</tr>
<tr>
<td>Contributory Pensions</td>
<td>...</td>
<td>All pensions received through the retirement programs. The relevant information is observed directly in the survey.</td>
</tr>
<tr>
<td>Direct Taxes and Contributions</td>
<td>Income tax</td>
<td>Income tax for self-employed individuals (observed directly in the survey) and payroll tax for employees (imputed using the data about gross and net income as well as contributions to pensions).</td>
</tr>
<tr>
<td>Direct Taxes and Contributions</td>
<td>Employee contributions to health insurance</td>
<td>The deductions from employees’ paychecks paid toward health insurance. The relevant information is observed directly in the survey.</td>
</tr>
<tr>
<td>Direct Taxes and Contributions</td>
<td>Employer contributions to health insurance</td>
<td>The employers’ payment toward the health insurance of employees. Because this is a mandatory payment and we assume it results in lower payments to employees, we include it as a type of deduction. The relevant information is observed directly in the survey.</td>
</tr>
<tr>
<td>Direct Taxes and Contributions</td>
<td>Employee contributions to social security insurance</td>
<td>The deductions from employees’ paychecks paid for social security insurance (pension) of employees. The relevant information is observed directly in the survey.</td>
</tr>
<tr>
<td>Direct Taxes and Contributions</td>
<td>Employer contributions to social security insurance</td>
<td>The employers’ payment toward the social security insurance (pension) of employees. Because this is a mandatory payment and we assume it results in lower payments to employees, we include it as a type of deduction. The relevant information is observed directly in the survey.</td>
</tr>
<tr>
<td>Direct Transfers</td>
<td>Targeted subsidy program</td>
<td>The direct cash transfer program established by the government following the energy subsidy reform in Iran. The relevant information is observed directly in the survey.</td>
</tr>
<tr>
<td>Direct Transfers</td>
<td>Social assistance</td>
<td>Includes all cash transfers to low-income individuals through public organizations. The relevant information is observed directly in the survey.</td>
</tr>
<tr>
<td>Direct Transfers</td>
<td>Semi-cash transfers (food)</td>
<td>Includes the monetary value of all edible items that a household receives for free. The values are imputed assuming all edible goods that are obtained “free but not from other households” are provided by the different public...</td>
</tr>
</tbody>
</table>
Indirect Taxes

Sales taxes. Imputed using the 3-percent rule of thumb and the information available in the survey about the consumption expenditure of each household.

In-kind Transfers

Education

Includes a nominal subsidy for each student in a household depending on the grade minus any user fees (the latter is observed directly in the survey).

Health

Includes a nominal subsidy for each individual in a household with health expenditure minus these health costs (the latter is observed directly in the survey).

… Not applicable.

14.4 Results: Effectiveness of Taxes and Transfers in Reducing Inequality and Poverty in Iran

This section provides the value of the effectiveness indicators discussed previously for different taxes and transfer programs in Iran. Note that the Impact and Spending Effectiveness indicators are only estimated for the Gini index. Tables 14-2, 14-3, and 14-4 present the results for the Impact Effectiveness, Spending Effectiveness, and FI-FGP Effectiveness indexes respectively.

Focusing on table 14-2 with respect to final income, income tax has the highest impact effectiveness among direct taxes in fulfilling about 40 percent of its potential in reducing inequality. The highest effectiveness, however, belongs to “Social Assistance” (a direct transfer), which fulfills about 45 percent of its potential. The lowest impact effectiveness among interventions with a positive MC is “Employee Contributions to the Health Insurance,” with about 12 percent effectiveness. Health user fees are the worst with regard to increasing the effect on inequality while having relatively more potential to reduce it.

Table 14-2. Impact Effectiveness Indicators for Taxes and Transfers in Iran

<table>
<thead>
<tr>
<th>Elements of Fiscal System</th>
<th>Disposable income</th>
<th>Consumable income</th>
<th>Final income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Taxes and Income tax</td>
<td>0.3287</td>
<td>0.3547</td>
<td>0.4048</td>
</tr>
<tr>
<td>Employee contributions</td>
<td>0.0838</td>
<td>0.0789</td>
<td>0.1246</td>
</tr>
<tr>
<td>Contributions to health insurance</td>
<td>0.2214</td>
<td>0.2267</td>
<td>0.2383</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Employer contributions to health insurance</td>
<td>0.1479</td>
<td>0.1195</td>
<td>0.1718</td>
</tr>
<tr>
<td>Employee contributions to social security</td>
<td>0.3178</td>
<td>0.3354</td>
<td>0.3056</td>
</tr>
<tr>
<td>Total direct taxes and contributions</td>
<td>0.2564</td>
<td>0.2540</td>
<td>0.2871</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Direct Transfers</th>
<th>0.3880</th>
<th>0.3936</th>
<th>0.3839</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targeted subsidy program</td>
<td>0.4250</td>
<td>0.4369</td>
<td>0.4490</td>
</tr>
<tr>
<td>Social assistance</td>
<td>−0.0214</td>
<td>−0.0245</td>
<td>−0.0319</td>
</tr>
<tr>
<td>Semi-cash transfers (food)</td>
<td>0.4194</td>
<td>0.4239</td>
<td>0.4110</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indirect Taxes (Sales Taxes)</th>
<th>…</th>
<th>−0.1395</th>
<th>−0.1303</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-kind Transfers</td>
<td>0.2327</td>
<td>0.1630</td>
<td>0.3287</td>
</tr>
<tr>
<td>Education transfers</td>
<td>…</td>
<td>…</td>
<td>0.2327</td>
</tr>
<tr>
<td>Education user-fees</td>
<td>…</td>
<td>…</td>
<td>0.1630</td>
</tr>
<tr>
<td>Health transfers</td>
<td>…</td>
<td>…</td>
<td>0.3287</td>
</tr>
<tr>
<td>Health user-fees</td>
<td>…</td>
<td>…</td>
<td>−0.2490</td>
</tr>
</tbody>
</table>

Source: Author’s calculations using the Iranian household survey of year 1390 (2011-12).

The table includes the value of the Impact Effectiveness indicator for each component of the fiscal system. The value of the index is between −1 and +1. The Gini coefficient is the index used to calculate the effectiveness indicator here.

… Not applicable.

With regard to the spending effectiveness (table 14-3) shown in the “Final Income” column, “Social Assistance” (with about 41 percent) and “Income Tax” (with about 39 percent) are the two most effective interventions. The least effective category is “Employee Contributions to Health Insurance” with almost zero effectiveness. That result means that with a contribution only a small
fraction of its current size, the same level of reduction in inequality could be achieved as is currently produced.

Table 14-3. Spending Effectiveness Indicators for Taxes and Transfers in Iran

<table>
<thead>
<tr>
<th>Elements of Fiscal System</th>
<th>Spending Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disposable income</td>
</tr>
<tr>
<td>Direct Taxes and Contributions</td>
<td></td>
</tr>
<tr>
<td>Income tax</td>
<td>0.3693</td>
</tr>
<tr>
<td>Employee contributions to health insurance</td>
<td>≦0</td>
</tr>
<tr>
<td>Employer contributions to health insurance</td>
<td>0.1855</td>
</tr>
<tr>
<td>Employee contributions to social security</td>
<td>0.1237</td>
</tr>
<tr>
<td>Employer contributions to social security</td>
<td>0.2843</td>
</tr>
<tr>
<td><strong>Total direct taxes and contributions</strong></td>
<td><strong>0.2475</strong></td>
</tr>
<tr>
<td>Direct Transfers</td>
<td></td>
</tr>
<tr>
<td>Targeted subsidy program</td>
<td>0.2863</td>
</tr>
<tr>
<td>Social assistance</td>
<td>0.4147</td>
</tr>
<tr>
<td>Semi-cash transfers (food)</td>
<td>NMC</td>
</tr>
<tr>
<td><strong>Total direct transfers</strong></td>
<td><strong>0.2966</strong></td>
</tr>
<tr>
<td>Indirect Taxes (Sales Taxes)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>…</td>
</tr>
<tr>
<td>In-kind Transfers</td>
<td></td>
</tr>
<tr>
<td>Education transfers</td>
<td>…</td>
</tr>
<tr>
<td>Education user fees</td>
<td>…</td>
</tr>
<tr>
<td>Health transfers</td>
<td>…</td>
</tr>
<tr>
<td>Health user fees</td>
<td>…</td>
</tr>
</tbody>
</table>

Source: Author’s calculations using the Iranian household survey of year 1390 (2011-12).
Enami, Chapter 14 (Iran)

The table includes the value of the Impact Effectiveness indicator for each component of the fiscal system. The value of the index is between 0 and +1. The Gini coefficient is the index used to calculate the effectiveness indicator here.

NMC. Fiscal interventions with “NMC” have a negative marginal contribution, making it mathematically impossible to calculate their spending effectiveness.

… Not applicable.

FI-FGP effectiveness indicators are presented in table 14-4. As previously mentioned, taxes and transfers should not be compared to each other because taxes can only increase poverty whereas transfers can only reduce it. All taxes are highly effective in raising revenue without increasing poverty in a significant way, whereas direct transfers are not very efficient in reducing poverty. “Social Assistance” has the highest effectiveness (about 21 percent with respect to consumable income) and “Semi-Cash Transfers” has the lowest (about 4 percent with respect to consumable income). The poverty reduction effectiveness of the targeted subsidy program is about 14 percent. Finally, it is worth mentioning that the fiscal system as a whole is moderately effective in reducing poverty (relative to its potential), realizing about 41 percent and 48 percent of its potential with respect to disposable income and consumable income respectively.

Table 14-4. Fiscal Impoverishment and Fiscal Gains to Poor (FI/FGP) Effectiveness Indicators for Taxes and Transfers in Iran

<table>
<thead>
<tr>
<th>Elements of Fiscal System</th>
<th>US$4 PPP FI-FGP Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disposable income</td>
</tr>
<tr>
<td>Direct Taxes and Contributions</td>
<td>0.9976</td>
</tr>
<tr>
<td>Direct</td>
<td>0.1297</td>
</tr>
</tbody>
</table>

Income tax                          | 0.9994              | 0.9987            |
Employee contributions to health insurance | 0.9921              | 0.9895            |
Employer contributions to health insurance | 0.9981              | 0.9971            |
Employee contributions to social security | 0.9956              | 0.9943            |
Employer contributions to social security | 0.9995              | 0.9991            |
Transfers | Social assistance | 0.1813 | 0.2050 |
| Semi-cash transfers (food) | 0.0342 | 0.0385 |
| **Total direct transfers** | **0.1422** | **0.1569** |

**Indirect Taxes (Sales Taxes)** | ... | 0.9587 |

**Total System** | 0.4094 | 0.4829 |

Source: Author’s calculations using the Iranian household survey for year 1390 (2011-12).

The FI-FGT effectiveness indicators are bounded between zero and one and the higher the value of an indicator, the better the tax is at not increasing poverty and a transfer is at reducing poverty.

PPP. Purchasing power parity. In calculating PPP values, I use the 2005 round of International Comparison Program (ICP) as reported in the World Development Indicators (WDI) published by the World Bank. To transform monetary values from the year of the survey to 2005, we used the CPI index from the WDI.

... Not applicable.

### 14.5 Conclusion

This chapter introduced two new CEQ effectiveness indicators for evaluating the performance of taxes and transfers in reducing inequality and poverty. The first indicator is the Impact Effectiveness indicator, which takes the size of a tax or transfer as given and compares the realized reduction in inequality (or poverty) to the maximum possible reduction. The second indicator, Spending Effectiveness, takes the reduction in inequality (or poverty) as given and compares the actual size of a tax or transfer to the minimum required tax or transfer to create the same reduction in inequality (or poverty). The Spending Effectiveness index has an interpretation as a measure of efficiency as well because it determines how much unnecessary tax (or transfer) is collected (distributed), which if avoided would have resulted in less distortion. This chapter also reviewed another family of indicators that are specific to the effectiveness of taxes and transfers in reducing poverty.\(^\text{11}\) These indicators are based on the indexes of fiscal impoverishment and fiscal gain to the poor introduced in Higgins and Lustig.\(^\text{12}\) Finally, an application of these indicators for the case of taxes and transfers in Iran was presented.

In terms of how effective taxes and transfers are in reducing inequality and poverty compared to their potential, I find mixed results. Taxes are very effective in raising revenue without increasing

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\(^\text{11}\) Enami, Higgins, and Younger (2016).

\(^\text{12}\) See Higgins and Lustig (2016).
poverty and moderately effective in reducing inequality. Transfers, on the other hand, exhibit a similar and moderate effectiveness in reducing inequality (compared to taxes), but they are not focused on the poor households and only realize less than 16 percent of their potential power to reduce poverty.
References


Introduction

In 2011, Tunisia went through a profound political transformation involving the democratization of its institutions. This political reform coincided with the period of the global Great Recession and its aftershocks. Coping with this adverse external environment while simultaneously responding to heightened social demands generated fiscal imbalances: the fiscal deficit rose from 1 percent of GDP in 2010 to 6.8 percent in 2013. Due to the combination of this reduced fiscal space and political demands for a more equitable society, fiscal policy is at the heart of the reform agenda. In this context, it is essential to know who benefits from transfers and subsidies and who bears the burden of taxation. This chapter estimates the impact of Tunisia's tax and transfers system on inequality and poverty reduction and assesses who benefits from public spending on education and health. Using the National Survey of Consumption and Household Living Standards for 2010, the most recent survey data available, we apply standard fiscal incidence analysis as described in Lustig and Higgins and in chapters one (Lustig and Higgins), five (Higgins and Lustig), and seven (Higgins). Because this methodological framework has been...
applied to other middle-income countries under the Commitment to Equity (CEQ) project, we will be able to compare the results for Tunisia with those of other countries.\textsuperscript{4}

Existing studies have looked at the equity implications of specific fiscal interventions in Tunisia. One study that examined cash transfers and subsidies, for example, found that they reduced poverty from 16.5 percent to 15.5 percent when poverty was measured with the national poverty line and that 48.8 percent of the poor were not covered.\textsuperscript{3} The same study also found that subsidies were not well-targeted: the poor received only 9.2 percent of total subsidies and 12 percent of food subsidies in particular. A World Bank study on energy subsidies found that 13 percent were allocated to the poorest quintile while the richest quintile received 29 percent of these subsidies.\textsuperscript{6} Currently, however, no studies have analyzed the incidence of fiscal policy from both the spending and revenue sides. The purpose of our chapter is to fill this gap.

Our results show that when taxes and transfers (including the monetized value of education and health services) are taken together, Tunisia’s fiscal policy reduces the Gini coefficient from 0.43 to 0.35. Comparisons to other middle-income countries indicate that the redistributive effect is somewhat lower than in Brazil and Chile but higher than in Mexico and much higher than in Indonesia and Peru.\textsuperscript{7} When in-kind transfers in public education and health are excluded, the Gini declines by 0.05 points, which means that two-thirds of the inequality reduction is accounted for by the combined effect of taxes, cash transfers, and subsidies. This redistributive effect is higher than in any of the countries mentioned above and lower only than in South Africa. Thus, fiscal policy is quite redistributive in Tunisia.

The impact of fiscal policy on rates of poverty depends on the poverty line. For the lower poverty lines of US$1.25 and US$2.50 per day in 2005 purchasing power parity (PPP), the combined effect of taxes, transfers, and subsidies reduces poverty. However, this is not true when one uses Tunisia’s national poverty line (TD 5.02 per day, equivalent to US$3.40 in 2005 PPP) or the middle-income international poverty line of US$4.00 per day (in 2005 PPP). After taking into account all taxes, direct cash transfers, and indirect subsidies and using Tunisia’s national poverty line, the rate of poverty increases from 12.3 percent to 13 percent. This increase is due particularly to the high burden of direct taxes and social contributions on those at relatively low income levels.

Spending on primary and secondary education is progressive in absolute terms (“pro-poor”): the concentration coefficient is negative. Spending on tertiary education, however, is progressive in relative terms only and not pro-poor, but because its concentration coefficient is much lower than market income Gini, it is equalizing. Health spending is progressive in absolute terms, except for hospitalization.

We think that our results remain relevant even during the period post-revolution because the structure of social programs remains the same. Some of these programs have benefited from additional resources, including subsidies, which increased by almost 300 percent between 2010

\textsuperscript{4} The results are based on the Commitment to Equity Assessment Master Workbook from September 9, 2015, which is available upon request.

\textsuperscript{3} AfDB, CRES (June 2013).

\textsuperscript{6} World Bank (2013).

\textsuperscript{7} Lustig (2015a).
and 2013 (energy subsidies in particular experienced an increase of five times), and cash transfers, which increased by 50 percent during the same period.

15.1 Taxation and Social Spending in Tunisia

With a Gini coefficient of 0.397, Tunisia is one of the most equal countries in the Middle East and North Africa region. Many consider Tunisia a success story based on its sustained rate of growth between 4 and 5 percent since 1990. In 2010, the year of the survey used in this study, the population was estimated at about 10.5 million and gross national income (GNI) per capita in current dollars was US$4,160 (US$9,700 in 2011 PPP international dollars). The World Bank classifies Tunisia in the upper-middle income group. With primary spending at around 29.1 percent of its GDP in 2010, Tunisia’s government spending is above the average of other developing countries.8 Poverty measured with the official poverty line of US$4.30 per day in 2011 PPP decreased from 32.4 percent in 2000 to 15.5 percent in 2010. Within the country, disparities exist regionally and by population density: rural poverty is almost twice as high as urban poverty, and the poorest regions are the West Central and the North West followed by the southern sub-regions, compared to the wealthier littoral and the north.9 Although the decline in poverty has been driven by economic growth, it is also due to increased government transfers and subsidies. Tunisia created an array of programs following the IMF-led structural adjustment program (SAP) in 1986. The current Tunisian safety net system includes programs that have been initiated since then.

Taxation

The Tunisian tax system is composed of two main categories: direct taxes and indirect taxes. Direct taxes include the personal income tax (PIT) and corporate tax whereas indirect taxes include value-added tax (VAT) and consumption duties. As reported in table 15-1, the ratio of total tax revenue to GDP was about 20 percent in 2010, which is comparable to other middle-income countries. Indirect taxes are the main source of tax revenue (almost two-thirds of total tax revenue) and the share of other consumption taxes to GDP is the same as VAT. Even so, direct taxes represent a high burden on labor in particular if we add social contribution to PIT. Despite this high burden, the amount of tax collected remains below the standards of developed and emerging countries.

Table 15-1. Tunisian General Government Revenue Collection, 2010

<table>
<thead>
<tr>
<th></th>
<th>2010 (% of GDP)</th>
<th>Incidence analysis (% of GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total general government revenue</td>
<td>23.48</td>
<td>27.21</td>
</tr>
<tr>
<td>Tax revenue</td>
<td>20.19</td>
<td>27.24</td>
</tr>
<tr>
<td>Direct taxes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal income tax</td>
<td>8.00</td>
<td>14.93</td>
</tr>
</tbody>
</table>

8 Lustig (2015b).
Chapter 15, Shimeles and Others

**Corporate income tax** 
3.87 ... 

**Indirect taxes** 
12.19 12.29 

**VAT** 
... 12.29 

**Customs taxes** 
... ... 

**Consumption duties** 
... ... 

**Other indirect taxes** 
... ... 

**Non-tax revenue** 
3.29 ... 

Source: Calculation based on data from the Tunisian Ministry of Finance 2011.¹⁰

“Non-tax revenue” includes oil and gas revenue and revenue from privatization and participation. … Not applicable.

**Personal Income Tax**

The PIT is levied on different sources of income such as labor, pensions, interest, and dividends. The tax rates imposed start at 15 percent and rise to 35 percent as indicated in table 15-2. PIT is paid primarily via a source withholding tax on wages on amounts greater than TD 1,000 (US$696) paid by the state and public authorities or greater than TD 5,000 paid by corporations and individuals. Several deductions are permitted, including for employees earning the minimum wage, salaries of foreign consuls, interest from deposits in foreign currency, interest on housing savings or special savings accounts, premiums on life insurance, and for marital status and dependents.

**Table 15-2. Taxable Income Brackets in Tunisia, 2010**

<table>
<thead>
<tr>
<th>Taxable income brackets (TD, annual)</th>
<th>US$</th>
<th>Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1,500</td>
<td>0 – 1,044</td>
<td>0</td>
</tr>
<tr>
<td>1,500 – 5,000</td>
<td>1,044 – 3,480</td>
<td>15</td>
</tr>
<tr>
<td>5,000 – 10,000</td>
<td>3,480 – 6,960</td>
<td>20</td>
</tr>
<tr>
<td>10,000 – 20,000</td>
<td>6,960 – 13,920</td>
<td>25</td>
</tr>
<tr>
<td>20,000 – 50,000</td>
<td>13,920 – 34,800</td>
<td>30</td>
</tr>
<tr>
<td>More than 50,000</td>
<td>More than 34,800</td>
<td>35</td>
</tr>
</tbody>
</table>

Source: Tunisian Ministry of Finance 2011.¹¹

TD=Tunisian dinar.

---


Social Security Contributions

The Tunisian social security system is a contributory system administrated completely by the government. Compulsory social security covers benefits related to pensions, family benefits, and coverage of risk such as illness, accidents at work, and occupational diseases. All benefits were provided either by National Social Security Fund (Caisse Nationale de Sécurité Sociale [CNSS]) or the National Pension and Social Security Fund (Caisse Nationale de Retraite et de Prévoyance Sociale [CNRPS]); CNSS covers workers from the private sector whereas the CNRPS covers all employees of the state and local public authorities and public institutions. Since 2007, the National Health Insurance Fund (CNAM) has administered the health insurance component. Social security contributions vary depending on whether the worker belongs to an agricultural or non-agricultural sector. Self-employed workers are required to join the National Social Security Fund (CNSS). They may voluntarily insure against work accidents and illnesses. The contribution rates and social protections vary across regimes: for example, non-agricultural employees do not receive family allowances. Agricultural workers, independent operators, and self-employed workers in agriculture benefit from different rates.

Under CNSS and CNRPS, the main benefit for contributors is a retirement pension. The pension is based on wages, subject to contributions that the insured has made during the ten years prior to reaching retirement age. For 120 months of contributions, the pension rate is 40 percent of salary; beyond this level, the pension is increased by 0.5 percent for every three months of additional contribution and may not exceed 80 percent of salary after 30 years of work. The description of social security contributions is summarized in table 15-3.

<table>
<thead>
<tr>
<th>Non-agricultural regime</th>
<th>Employer contribution (%)</th>
<th>Employee contribution (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pension</td>
<td>7.76</td>
<td>4.73</td>
<td>12.50</td>
</tr>
<tr>
<td>Sickness, maternity</td>
<td>4.61</td>
<td>2.90</td>
<td>7.60</td>
</tr>
<tr>
<td>Family allowances</td>
<td>2.21</td>
<td>0.88</td>
<td>3.10</td>
</tr>
<tr>
<td>Accidents, occupational diseases</td>
<td>0.40–4.00</td>
<td>…</td>
<td>0.40–4.00</td>
</tr>
<tr>
<td>Welfare workers: Special State Fund</td>
<td>1.51</td>
<td>0.38</td>
<td>1.90</td>
</tr>
<tr>
<td>Total</td>
<td>16.97–20.57</td>
<td>9.18</td>
<td>26.15–29.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Agricultural regime</th>
<th>Employer contribution (%)</th>
<th>Employee contribution (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pension</td>
<td>3.50</td>
<td>1.75</td>
<td>5.25</td>
</tr>
<tr>
<td>Sickness, maternity</td>
<td>4.18</td>
<td>2.80</td>
<td>6.98</td>
</tr>
<tr>
<td>Accidents, occupational diseases</td>
<td>0.04</td>
<td>0.01</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Indirect Taxes

Indirect taxes are collected mainly through the VAT, which represents almost 50 percent of total indirect tax revenues. Other taxes include customs taxes (7.3 percent) and consumption taxes, including excise taxes (20.3 percent). VAT is collected using the credit invoice method and the rate varies from 6 percent for fertilizer, handicrafts, medical activities, canned food, and compound feed for cattle, to 12 percent for computers, computer services, hospitality, food, equipment not produced locally, and four-horsepower cars, to an 18 percent general rate for products and services not subject to another rate. Exports are zero rated. There are a number of exempt goods, the most important ones being primary foods, nurseries, schooling (primary, secondary, tertiary, vocational), equipment for the agriculture sector, air transport, and interest from banks. Consumption taxes are also applied to alcoholic beverages, wine and tobacco, personal vehicles, and fuels. Rates are applied as ad valorem rates or as specific taxes, in particular for alcoholic beverages and tobacco.

Other indirect taxes include customs taxes and registration fees, which are applied to the sale of property (rates range from 2 to 5 percent of the value), professional training tax (1 percent of gross payroll for manufacturing industries), and tax on insurance contracts (5 percent for contracts in maritime and air transport and 10 percent for others).

In our incidence analysis, we include VAT, excise taxes on alcohol, cigarettes, coffee, tea, Coke, gas oil, jewelry, and some transport services, and import duties on dried fruits, bananas, air conditioning, and perfume.

Corporate Taxes

Corporate income tax is imposed on companies established in Tunisia. The tax rate amounts to 30 percent of profits, except for small businesses and agriculture (10 percent) and firms dealing with the financial, telecommunications, insurance, oil production, refining, transportation, and
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distribution sectors (35 percent). It is worth noting that 97 percent of companies are microenterprises with between zero and five employees. Most of these enterprises do not pay taxes and are part of the informal sector, which highlights the problem of tax evasion.

Social Spending

Social spending excluding contributory pensions (our benchmark scenario in the fiscal incidence analysis is presented in table 15-4) accounts for 10 percent of GDP. This amount includes direct cash transfers and in-kind spending on education and health. Direct transfers include the cash transfer program PNAFN (Programme National des Familles Nécessiteuses [National Needy Families Assistance Program]) and scholarship assistance given to students. These two programs amounted to 0.3 percent of GDP in 2010. Other cash transfers represent a combined 0.5 percent of GDP and include grants distributed to local communities, youth activities, NGOs, and special treasury funds.

In-kind transfers are benefits received from the universal free public education and health systems. The main programs are described below, and their budget sizes are given in table 15-4. Contributory pensions amount to 8.7 percent of GDP; thus, if contributory pensions are included, total social spending equals 18.7 percent of GDP.

Table 15-4. General Government Expenditure for Tunisia, 2010

<table>
<thead>
<tr>
<th></th>
<th>2010 (% of GDP)</th>
<th>Incidence analysis (% of GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total general government expenditure</td>
<td>28.47</td>
<td>…</td>
</tr>
<tr>
<td>Primary government spending</td>
<td>22.68</td>
<td>…</td>
</tr>
<tr>
<td>Social spending</td>
<td>8.75</td>
<td>14.22</td>
</tr>
<tr>
<td>Total cash transfers</td>
<td>0.83</td>
<td>0.62</td>
</tr>
<tr>
<td>PNAFN</td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>Scholarships</td>
<td>0.00</td>
<td>…</td>
</tr>
<tr>
<td>Other cash transfers</td>
<td>0.52</td>
<td>0.31</td>
</tr>
<tr>
<td>In-kind transfers</td>
<td>7.92</td>
<td>13.60</td>
</tr>
<tr>
<td>Education</td>
<td>6.32</td>
<td>10.86</td>
</tr>
<tr>
<td>Health</td>
<td>1.60</td>
<td>2.74</td>
</tr>
<tr>
<td>Housing and urban</td>
<td>0.02</td>
<td>…</td>
</tr>
<tr>
<td>Subsidies</td>
<td>2.38</td>
<td>5.12</td>
</tr>
<tr>
<td>Contributory pensions</td>
<td>8.78</td>
<td>15.95</td>
</tr>
</tbody>
</table>


PNAFN. Programme National des Familles Nécessiteuses (National Needy Families Assistance Program).

… Not applicable.
Chapter 15, Shimeles and Others

Created in 1986, the PNAFN is the main cash transfer program for monthly cash assistance to low-income households. This national program was designed to mitigate the adverse effects of the IMF-led structural adjustment program, particularly in areas with high numbers of poor families. In 2010, this program covered 520,337 beneficiaries (135,000 households) for a total of about TD 100 million, compared to 1986 when it covered 250,000 beneficiaries (74,000 households). The monthly amount paid per beneficiary was around TD 70 (US$48.80) per household in 2010. Household eligibility for PNAFN is based on social surveys conducted by the Ministry of Social Affairs; criteria include income below the poverty threshold, inability to work, absence of head of household, lack of family support, or the presence of disabled or chronically ill family members. Although no evaluation of the program was conducted before the revolution, it has now been recognized as suffering from both poor identification of families in need and subjective criteria.

Direct social assistance also includes a scholarship program for students in tertiary education. The number of beneficiaries was 98,533 in 2010 (according to a 2010 report from the Ministry of Higher Education) and the total amount of grants is equivalent to TD 56 million (US$38.9 million) per year. The head of household’s total income cannot exceed the official minimum wage for a student to be eligible to receive the scholarship.

Other cash transfers account for 0.5 percent of GDP and include grants distributed to local communities, NGOs, nurseries, and cultural activities in the local areas.12

Indirect Subsidies

The subsidy system in Tunisia has long been directed at basic consumption products, energy, and transportation. These subsidies were equal to 2.4 percent of the GDP in 2010, lower than the 1988 amount when subsidies equaled 8.5 percent of GDP.13 Since the Tunisian revolution, subsidies have risen again to reach 6.9 percent of GDP in 2013. In 2010, the composition of subsidies was 1.2 percent for food, 1 percent for energy consumption, and 0.3 percent for transportation.14 Existing studies point to the need for reform of the subsidy system because subsidies are relatively regressive.15 However, these subsidies play a key role in maintaining purchasing power for vulnerable groups who spend almost all their revenue on food consumption.

The composition and the weight of each product or group of products in the subsidized basket witnessed many changes between the 1990s and 2010. Although subsidies on primary products and transport were established in the 1990s, the energy subsidy was introduced for the first time in 2003, following increases in energy prices in the international market, in order to promote the competitiveness of the private sector and support the purchasing power of the middle class.

In-kind Transfers

12 Other programs such as the national fund for employment “Fond National de l’Emploi” (FNE), microcredits of “Banque Tunisienne de Solidarité” (BTS) to reduce unemployment, and a public agency to improve housing for vulnerable families in urban settings are not considered social spending and their incidence was not analyzed here.
13 At that time, almost half of the subsidy costs were related to hard and soft wheat.
14 World Bank (2013).
15 AfDB, CRES (2013); World Bank (2013).
Chapter 15, Shimeles and Others

The next section describes the education and health systems in Tunisia as part of the in-kind transfers analyzed in this chapter.

Education

At all levels of education, there are two systems: a public education system and a private education system. Tunisia’s public education system includes mandatory basic, secondary, and tertiary education. Mandatory basic education is composed of two cycles: six years of primary school and three years of lower secondary school or a preparatory cycle. Secondary school is four years. Public primary and secondary education is almost free (beneficiaries pay only US$3 per year). Tertiary education is also considered free as students pay about US$25 per year for undergraduate education and US$50 for graduate education. Primary and secondary education spending amounted to 5 percent of GDP in 2010 and tertiary education accounted for 1.7 percent.

Since 2002, primary school gross enrollment has been almost universal, averaging 100 percent for both sexes. The net enrollment rate for individuals ages 6 to 16 years has increased by 3.3 percent, reaching 93.4 percent. Access to basic and secondary education has mainly benefited girls, who since 2005 have made up the majority of enrollment. In terms of net enrollment of youth between 12 and 18 years, girls represented 84.5 percent compared to 75.8 percent for boys. Greater enrollment, however, has not been accompanied by improvements in the quality of education. Scores from the Program for International Student Assessment (PISA) in 2007 and 2011 show almost no change in rankings, with fewer Tunisian students passing the low international baseline for fourth and eighth grade in mathematics and science than the international average.16

The enrollment rate in tertiary education for individuals between 20 and 24 years increased from 25 percent to 37 percent between 2000 and 2010, an increase of about 139,876 students. The number of students in 2010 reached 346,876 as the result of a state effort to increase the number of enrolled students through a budget share expansion from 3.7 percent of GDP to 6.1 percent. The number of enrolled students in 2010 totaled 346,000, of which a majority (61 percent) was girls. Despite this quantitative surge in the number of students, the quality did not improve at the same rate, which is reflected in international rankings (for example, not a single Tunisian university was included in the Shanghai ranking of the 500 best universities in the world). Tunisian students also had limited prospects for finding employment after graduation.

Health

Healthcare in Tunisia is provided through two systems: a contributory national health insurance program for the non-poor and a free or subsidized system for low-income individuals and households. The first of the two low-income programs, the Free Health Care (AMG1) program, targets poor families and provides a five-year assistance program. Decree number 98-1812 establishes the conditions for allocating the “free healthcare card” to complying beneficiaries for

16 Although enrollment has been going up, due to demographic transition, the number of students enrolled in primary and lower secondary school has been declining since 2002, from 1.8 million students in 2002 to 1.4 million students in 2012. Secondary education enrollment increased until 2005, but has been falling since, from 508,790 students in 2005 to 453,090 students in 2012.
Chapter 15, Shimeles and Others

a period of five years. The second program is the Subsidized Health Care (AMG2) program, which grants “healthcare discount cards” to families based on income and family size. For two-member households, annual family income cannot exceed an amount equal to the guaranteed minimum wage (SMIC). Annual income cannot exceed 1.5 times the minimum wage for families with three to five members, or twice the minimum wage for families with more than five members. Beneficiaries receive a lump-sum payment based on the costs of the service. The healthcare discount card is also issued for a period of five years and needs to be validated every year at a cost of TD 10 (US$7).

In 2010, the contributory system had 2,202,447 affiliates, and the free and subsidized systems had 197,411 and 448,810, respectively. Public expenditure on health care was equivalent to 1.66 percent of GDP in 2010.

15.2 Methodology and Data

This study uses the CEQ methodology as presented in in Lustig and Higgins and in chapters one (Lustig and Higgins), five (Higgins and Lustig), and seven (Higgins). Essentially, the method consists of allocating taxes and transfers to derive five income concepts, including market income, net market income, disposal income, post-fiscal income, and final income. It then assesses the impact on different concepts of inequality and poverty reduction.

This study is data intensive and requires many categories of macro- and microdata. We focused on using as much official data as possible to minimize judgment and ad-hoc estimation. In the case of Tunisia, surveys on income are not available and the only existing module on income data is not related to the consumption survey (that is, surveyed households are not the same). For this reason, we use the consumption survey to estimate the income concepts in the incidence analysis. As recommended in chapter five of this handbook, we assume that consumption is equivalent to disposable income and work backwards to construct market income. The consumption variable includes expenditures on non-durable goods, consumption of own production, and imputed rent for owner-occupied housing. We used the National Survey of Consumption and Household Living Standards of 2010 from the National Institute of Statistics. It includes three components: expenditures, living standards, and food. In our analysis, we only included individuals who simultaneously appear in all three components. The final sample is national in scope and is statistically representative for large cities, medium-sized cities, and small towns and rural areas. This sample has 23,764 individuals and 5,456 households, which represents about half of the households in the full expenditure component.

To estimate the incidence of taxes and transfers, we used macroeconomic data from the Ministry of Finance. Data on indirect taxes and subsidies for primary products and energy was taken from the statistics department of DGELF (La Direction Générale des Etudes et de la Législation Fiscale [General Directorate of Tax Studies and Legislation]) of the Ministry of Finance. Data on direct taxes includes only income tax and was imputed according to the tax rate of each income level. Here we assume that formal workers are defined as those who contribute to social security and do not evade taxes. Information on which individuals contribute to the social security system

17 Lustig and Higgins (2013), Lustig and Higgins (2017), Higgins and Lustig (2017), and Higgins (2017). It should be noted that this chapter uses primarily Lustig and Higgins (2013).
is reported in the survey and contributions were imputed according to whether the household head is salaried or non-salaried and works in the agricultural or non-agricultural sector. The number of beneficiaries for the PNAFN program (for poor families) and the scholarship program for students was obtained from the surveys. The amount transferred to each individual or household was imputed. For PNAFN, the total benefits came from CRES (Centre de recherche des Etudes Sociales [Research Center for Social Studies]), and for scholarships, the total benefits came from the Ministry of Higher Education.

In-kind transfers were calculated from data included in the budget of the Ministry of Higher Education for tertiary education, the Ministry of Education for primary and secondary education, and the Ministry of Health for health expenditures. Imputed spending amounts include current and capital expenditures for 2010.

### 15.3 Main Assumptions

Because the survey used in the incidence analysis reported expenditures but not income, we followed the recommendation in Lustig and Higgins to obtain the different revenue concepts. Following their recommendation, we started by assuming that consumption equals disposable income and worked backwards to obtain net market income and market income. Because our consumption survey did not include the imputed rent for owner-occupied housing, we used an estimation from the National Institute of Statistics. We estimated the imputed rent through a log linear regression model, including variables controlling for the characteristics of the housing and geographic locations. According to these estimations, the housing rent is valued at TD 211 (US$147) per month per household in cities, TD 129 (US$90) in small- and medium-sized towns, and TD 119 (US$83) in non-communal cities.

Regarding taxation, because the consumption survey in Tunisia does not include information on personal income tax, the tax burden had to be simulated. We adopted two different tax rates following Tunisian tax law: a regular regime for salaried workers and a flat regime for independent workers. Under both regimes, we assume that taxpayers include only those individuals who reported affiliation with the social security system. In order to have similar proportions, we adjusted the level of direct taxes downward to match their ratio to private consumption in administrative accounts and the household survey. The rate of tax evasion, calculated from the survey as the percentage of workers who do not pay income tax, is found to be 40 percent, and the percentage of tax revenue paid by salaried workers reached 73 percent. These ratios are comparable to the data reported in national accounts for salaried workers (75 percent of total PIT) and for the informal sector (40 percent according to some studies). The simulation of VAT is more straightforward and uses detailed consumption data on consumption products, energy products, transportation, and health. The VAT rates vary between 6, 12, and 18 percent, plus special rates on imported products.

The survey directly reports the number of workers who contribute to each social security regime. The imputed contributions to social security are simulated as a percentage of market income and include pension contributions, health contributions, and death benefits. The contributions

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18 See Lustig and Higgins (2013).
include both employee and employer contributions and the rate depends on three factors: whether the worker is in the public sector (Caisse Nationale de retraite et de prévoyance sociale [CNRPS]) or the private sector (Caisse Nationale de sécurité sociale [CNSS]), under the salaried regime or non-salaried regime, and whether the worker is in the agricultural or non-agricultural sector.

Regarding spending, the third part of the survey, called Quality of Life, reports information on cash transfer recipients by inquiring whether the individual received free healthcare and therefore benefited automatically from the PNAFN monthly allocation for poor families. The survey also reports information on recipients of the scholarship program for students from low-income families. The amount of cash transfer for each beneficiary equals the mean of the total annual amount paid divided by the number of beneficiaries in the survey (the number of beneficiaries in the survey is almost equal to the number reported by the ministry).

Direct transfers in this study do not take into account all programs executed by the government because information related to these programs is missing in the survey. The programs that were included in the survey are PNAFN and scholarships allocated to students. The survey, however, only reports the number of recipients and not the amount of the transfers. The total number of beneficiaries in the surveys for the analyzed programs is very similar to that in the administrative data. The amount of the benefits was imputed by taking the values from the administrative accounts for each of the programs. In order to keep the transfers in scale with the income reported in the surveys, they were scaled down so that the ratio of transfers to disposable income in the survey matched that of the national accounts.

To estimate the in-kind benefits derived from government spending on education and health, the average cost of the service was imputed from the budget of each ministry. This cost includes administrative and capital expenditures divided by the number of beneficiaries. For education, we separate the cost of primary and secondary education from the average cost of tertiary education, because those services are administered by two different ministries with independent budgets. In the second stage, we scale down spending for the different levels of education so the ratio of total spending by level divided by disposable income in the survey is the same as administrative accounts. The survey reports whether individuals attend school (and if so, whether public or private school) and their level of education. The number of beneficiaries is aggregated from the household survey. The annual cost per capita is the ratio between the annual budget and the number of beneficiaries.

The health benefit is equal to Ministry of Health budget data on capital and current expenditures incurred in public hospitals and health centers. By dividing the total budget by the number of beneficiaries from the survey, we determined the average spending per individual. Following survey categorizations, we split health expenditures into normal care spending, expenditures related to maternity care, and hospital spending. Hospital spending represents five times the average cost of normal care or maternity care, which is taken here as a metric unit. Each category of spending is a multiplier of the unit average cost of normal care. The total multiplier coefficient for each individual is a function of the type of care the patient received and the number of times the individual received services. The average cost unit is calculated by dividing the Ministry of Health’s budget by the total multiplier coefficient of all patients reported in the survey.
Subsidies in this study are calculated based on information reported on food and non-food consumption. They include subsidies on primary consumption products, energy subsidies, and transport subsidies. The amount of subsidies is adjusted downward to match their ratio to disposable income in administrative accounts and the household survey.

15.4 The Impact of Fiscal Policy on Inequality and Poverty

Under the benchmark scenario in which contributory pensions are treated as deferred income, fiscal policy in Tunisia reduces market income inequality quite significantly: the Gini coefficient for market income per capita declines from 0.43 to a final income Gini of 0.35, a decline of 0.08 Gini points (see table 15-5). When in-kind transfers to public education and health are excluded, the Gini declines by 0.05 points, which means that two-thirds of inequality reduction is accounted for by taxes, cash transfers, and subsidies. Compared to other middle-income countries, the redistributive effect of taxes, cash transfers, subsidies, and in-kind transfers (from market to final income) is somewhat lower than in Brazil and Chile but higher than in Mexico and much higher than in Indonesia and Peru. However, the redistributive effect of taxes, cash transfers, and subsidies is higher than for any of the countries mentioned above and lower only than in South Africa. Thus, fiscal policy is quite redistributive in Tunisia.

Table 15-5. Inequality and Poverty Indicators for Each Income Concept, Tunisia 2010

<table>
<thead>
<tr>
<th>Inequality indicators</th>
<th>Market income</th>
<th>Disposable income</th>
<th>Post-fiscal income</th>
<th>Final income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini coefficient</td>
<td>0.43</td>
<td>0.39</td>
<td>0.38</td>
<td>0.35</td>
</tr>
<tr>
<td>Theil index</td>
<td>0.33</td>
<td>0.28</td>
<td>0.25</td>
<td>0.21</td>
</tr>
<tr>
<td>90/10</td>
<td>7.78</td>
<td>6.34</td>
<td>5.64</td>
<td>4.74</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Headcount poverty indicators (%)</th>
<th>Market income</th>
<th>Disposable income</th>
<th>Post-fiscal income</th>
<th>Final income</th>
</tr>
</thead>
<tbody>
<tr>
<td>National poverty line</td>
<td>12.90</td>
<td>13.14</td>
<td>13.00</td>
<td>…</td>
</tr>
<tr>
<td>US$1.25 per day at 2005 PPP</td>
<td>0.52</td>
<td>0.34</td>
<td>0.24</td>
<td>…</td>
</tr>
<tr>
<td>US$2.50 per day at 2005 PPP</td>
<td>5.03</td>
<td>4.60</td>
<td>3.76</td>
<td>…</td>
</tr>
<tr>
<td>US$4.00 per day at 2005 PPP</td>
<td>14.27</td>
<td>14.89</td>
<td>15.00</td>
<td>…</td>
</tr>
</tbody>
</table>

Source: Data from 2010 Tunisian National Survey of Consumption and Household Living Standards. Calculations from CEQ Tunisia Master Workbook 2015.

TD 5.026 per day equivalent to US$3.40 in 2005 PPP.

… Not applicable.

The redistributive effect generates a low rate of horizontal inequality in the sense of re-ranking. For example, considering the redistributive effect of market income to post-fiscal income, the

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20 Lustig (2015a).
extent of horizontal inequity is evaluated at 0.0069, which represents 12 percent of the vertical equity (see table 15-6).

Table 15-6. Overall Redistributive Effect of Taxes, Transfers, and Subsidies in Bolivia, Brazil, Indonesia, South Africa, and Tunisia*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini (market income)</td>
<td>0.43</td>
<td>0.771</td>
<td>0.503</td>
<td>0.579</td>
<td>0.394</td>
</tr>
<tr>
<td>Gini (post-fiscal income)</td>
<td>0.38</td>
<td>0.695</td>
<td>0.503</td>
<td>0.546</td>
<td>0.391</td>
</tr>
<tr>
<td>Redistributive effect</td>
<td>n.a.</td>
<td>0.077</td>
<td>0.000</td>
<td>0.033</td>
<td>0.003</td>
</tr>
<tr>
<td>Vertical equity (VE)</td>
<td>0.05</td>
<td>0.083</td>
<td>0.003</td>
<td>0.048</td>
<td>0.006</td>
</tr>
<tr>
<td>Reranking effect (RR)</td>
<td>0.006</td>
<td>0.006</td>
<td>0.003</td>
<td>0.014</td>
<td>0.003</td>
</tr>
<tr>
<td>RR/VE</td>
<td>0.12</td>
<td>0.075</td>
<td>1.000</td>
<td>0.300</td>
<td>0.451</td>
</tr>
</tbody>
</table>

Sources: Tunisian figures are based on data from the 2010 National Survey of Consumption and Household Living Standards; calculations from CEQ Tunisia Master Workbook 2015. Other figures: Paz Arauco and others, 2014 (Bolivia); Higgins and Pereira, 2014 (Brazil); Afkar and others, forthcoming (Indonesia); Inchauste and others, 2015 (South Africa).

*Decline shown as positive.

Table 15-5 shows that the impact of fiscal policy on poverty rates depends on the poverty line. For the lower poverty lines of US$1.25 and US$2.50 per day (in 2005 PPP), the combined effect of taxes, transfers, and subsidies reduces poverty. However, this is not true using Tunisia’s national poverty line (TD 5.02 per day, equivalent to US$3.40 in 2005 PPP) or the middle-income international poverty line of US$4.00 per day (in 2005 PPP). In relation to the national poverty line, the rate of poverty increases from 12.3 percent to 13 percent after taking into account all taxes, direct cash transfers, and indirect subsidies. This increase is due particularly to the high burden of direct taxes and social contributions on relatively low income levels, as shown in table 15-7. For people in the bottom forty percent, direct taxes and social contributions amount to roughly 4 percent of market income, which cannot be compensated by the direct transfers, except for those in the poorest decile. In fact, an unusual result for the case of Tunisia is that individuals become net payers to the fiscal system after direct taxes and transfers from the second decile onwards. After considering the impact of indirect taxes net of indirect subsidies (on which Tunisia relies heavily as a redistributive instrument), net payers in cash terms start at higher income levels: the third decile. Nevertheless, in spite of the large amount of subsidies, the headcount ratio based on post-fiscal income is still a bit higher than the one for market income with the national poverty line due to indirect taxes.

Table 15-7. Fiscal Incidence by Decile in Tunisia, 2010
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In sum, the poorest decile is the only decile that does relatively well. The poorest decile receives transfers equivalent to its market income (104 percent), including in-kind transfers, mainly imputed to education (55 percent) and indirect subsidies (23 percent), and to a lesser extent, health (19 percent) and cash transfers (6.1 percent). Moreover, this category is supported by a low burden of direct taxes which stands at 2 percent of its market income, although indirect taxes amount to 15 percent of market income. Overall, the poorest decile’s market income is increased by 87 percent.

Who Benefits from Direct Transfers and Subsidies and Who Bears the Burden of Taxes?

In table 15-8, we show the concentration shares of each component of fiscal policy analyzed here. Several results stand out. The share of benefits of PNAFN and “Other direct transfers” received by the poorest twenty percent is 32.5 percent and 24.7 percent, respectively. In other words, spending on these direct transfers appears to be pro-poor. However, the richest ten percent also benefit from these transfers: they receive 8.2 percent and 6.6 percent, respectively. Most importantly, indirect subsidies, which account for 2.3 percent of government spending as shown above, are not pro-poor at all. The bottom twenty percent of the population receives 11.7 percent of indirect subsidies, whereas the richest ten percent receives 18.3 percent.

Table 15-8. Concentration Shares of Taxes and Transfers by Decile in Tunisia 2010

<table>
<thead>
<tr>
<th>Decile</th>
<th>Direct taxes (%)</th>
<th>Contributions (%)</th>
<th>Flagship CCT (%)</th>
<th>Other direct transfers (%)</th>
<th>Indirect subsidies (%)</th>
<th>Indirect taxes (%)</th>
<th>In-kind education (%)</th>
<th>In-kind health (%)</th>
<th>Housing and urban (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.20</td>
<td>0.30</td>
<td>19.20</td>
<td>13.20</td>
<td>5.20</td>
<td>2.20</td>
<td>9.40</td>
<td>12.20</td>
<td>21.40</td>
</tr>
<tr>
<td>2</td>
<td>0.60</td>
<td>1.00</td>
<td>13.30</td>
<td>12.20</td>
<td>6.50</td>
<td>3.50</td>
<td>11.10</td>
<td>7.00</td>
<td>17.60</td>
</tr>
<tr>
<td>3</td>
<td>0.90</td>
<td>1.50</td>
<td>10.60</td>
<td>11.10</td>
<td>7.60</td>
<td>5.00</td>
<td>9.30</td>
<td>7.30</td>
<td>6.30</td>
</tr>
<tr>
<td>4</td>
<td>2.30</td>
<td>3.10</td>
<td>9.70</td>
<td>12.30</td>
<td>8.30</td>
<td>6.00</td>
<td>9.50</td>
<td>9.50</td>
<td>14.90</td>
</tr>
<tr>
<td>5</td>
<td>3.50</td>
<td>4.70</td>
<td>9.50</td>
<td>10.80</td>
<td>8.70</td>
<td>7.50</td>
<td>9.30</td>
<td>12.90</td>
<td>13.20</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th></th>
<th>5.10</th>
<th>6.60</th>
<th>8.60</th>
<th>10.40</th>
<th>9.30</th>
<th>8.80</th>
<th>10.40</th>
<th>10.20</th>
<th>5.60</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>7.50</td>
<td>9.40</td>
<td>7.10</td>
<td>11.90</td>
<td>10.70</td>
<td>9.70</td>
<td>11.10</td>
<td>11.80</td>
<td>20.10</td>
</tr>
<tr>
<td>8</td>
<td>12.00</td>
<td>13.80</td>
<td>6.60</td>
<td>7.20</td>
<td>11.80</td>
<td>12.50</td>
<td>10.60</td>
<td>7.10</td>
<td>0.00</td>
</tr>
<tr>
<td>9</td>
<td>19.70</td>
<td>19.20</td>
<td>7.20</td>
<td>4.40</td>
<td>13.70</td>
<td>16.50</td>
<td>9.80</td>
<td>11.50</td>
<td>0.00</td>
</tr>
<tr>
<td>10</td>
<td>48.20</td>
<td>40.40</td>
<td>8.20</td>
<td>6.60</td>
<td>18.30</td>
<td>28.10</td>
<td>9.60</td>
<td>10.40</td>
<td>0.90</td>
</tr>
<tr>
<td>Total population</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Data from the 2010 National Survey of Consumption and Household Living Standards. Calculations from CEQ Tunisia Master Workbook 2015. “Other direct transfers” includes targeted and non-targeted transfers.

Spending on education is fairly even across deciles. Our results show that spending on primary and secondary education is progressive in absolute terms: the concentration coefficient is negative (see table 15-9). This result is expected because enrollment rates are becoming almost universal in Tunisia, including among people in vulnerable categories. Spending on tertiary education is progressive in relative terms only, however, but because its concentration coefficient is much lower than the market income Gini, it is equalizing, if not pro-poor. The number of students in tertiary education from the poorest decile was low, roughly 0.1 percent of the total, compared to 0.8 percent for primary and secondary school.21

Health spending is progressive in absolute terms, except for hospitalization. The monetized value of health spending is distributed fairly equally across all deciles, increasing market income for poorest decile by 18 percent compared to 1 percent for the richest decile (see table 15-7).

Table 15-9. Concentration Coefficients by Specific Category for Tunisia, 2010

<table>
<thead>
<tr>
<th>Program</th>
<th>Concentration coefficient with respect to Benchmark Case market income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditional cash transfer</td>
<td>−0.17</td>
</tr>
<tr>
<td>Primary &amp; secondary education spending</td>
<td>−0.08</td>
</tr>
<tr>
<td>Subsidy</td>
<td>0.21</td>
</tr>
<tr>
<td>Other scholarships</td>
<td>−0.18</td>
</tr>
<tr>
<td>Tertiary education spending</td>
<td>0.21</td>
</tr>
<tr>
<td>Health spending</td>
<td>0.04</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>0.07</td>
</tr>
<tr>
<td>Contributory pensions</td>
<td>0.56</td>
</tr>
<tr>
<td>Direct cash transfers</td>
<td>−0.17</td>
</tr>
<tr>
<td>Total contributory pensions</td>
<td>0.56</td>
</tr>
<tr>
<td>Total education spending</td>
<td>−0.01</td>
</tr>
</tbody>
</table>

21 The figure 0.1 percent represents the proportion of pupils from the first decile as a percentage of the total number of pupils in primary and secondary; 0.8 percent represents the number of students from the first decile as a percentage of the total number of students in the survey.
Chapter 15, Shimeles and Others

<table>
<thead>
<tr>
<th>Total health spending</th>
<th>0.04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CEQ social spending</td>
<td>0.00</td>
</tr>
<tr>
<td>Total CEQ social spending plus contributory pensions</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Source: Data from the 2010 National Survey of Consumption and Household Living Standards. Calculations from CEQ Tunisia Master Workbook 2015.

The observed distribution of benefits from direct transfers and subsidies indicates that there is room for improving the situation of the poorest and most vulnerable groups (those with incomes from US$4.00 to US$10.00, 2005 PPP per day) through better targeting. Furthermore, once the burden of taxation is taken into account, the combination of direct and indirect taxes puts a significant burden on the vulnerable, who represent 37 percent of the population and are net payers into the fiscal system. On average, this income group pays 8 percent of their market income when only the cash components of fiscal policy are taken into account (that is, without considering the imputed value of in-kind transfers in education and health). This group receives 34.6 percent of total subsidies and 46.7 percent of total direct transfers, however. Adding the in-kind benefits, they are net gainers: final income is on average 17.3 percent higher than market income for the vulnerable.

15.5 Conclusion

This chapter estimates the incidence of the government’s taxation and spending in Tunisia. Fiscal analysis has been applied to three subcomponents of the 2010 consumption survey: spending, food, and quality of life. On the tax side, the analysis includes direct tax (only for personal income) and indirect tax (VAT on consumption goods and services). On the expenditure side, we have analyzed the incidence of 43 percent of general government expenditures, including direct cash transfers (PNAFN and scholarships), contributory pensions, subsidies, and health and education spending.

Taking into account net cash transfers, only the bottom two deciles receive more in transfers than they pay in direct and indirect taxes. When basic services are included, this proportion increases to the bottom seven deciles while the three richest top deciles bear the brunt of redistribution of income. In fact, this redistribution goes from the richest to the poorest, with 43 percent of the top two deciles joining a lower income class and 40 percent of the three bottom deciles joining a higher income class. Ninety-five percent of the vulnerable, with an income ranging between US$4.00 and US$10.00 a day, maintain the same class. When all transfers and taxes are taken into account, the distance between the average per capita income between the top decile and the poorest decile decreases from 18 to 6 times.

The Gini coefficient falls from 0.43 (before taxes and transfers) to 0.35 (after taxes and transfers), mainly due to taxes (30 percent of the decrease) and in-kind services (30 percent of the decrease). Most of the equalization is produced by personal income taxes and contributions to social security. Direct taxes are progressive and the VAT is regressive. Cash transfers contribute little to redistribution. Although direct transfers are strongly progressive and equalizing, their share in the budget remains very limited (only 0.2 percent). Subsidies are equalizing, though much less so than...
cash transfers because benefits to the non-poor are higher than their population share (that is, subsidies are progressive but only in relative terms). Primary and secondary education are strongly redistributive and equalizing whereas tertiary education is progressive only in relative terms because the poor still have limited access. Health spending is progressive and equalizing for primary health care whereas hospitalization services are progressive in relative terms.

In light of the areas of Tunisian fiscal policy in need of improvement, we make the following policy recommendations:

1. Reinforce direct transfer programs to target the segments of the population that do not benefit from the basic services of education and health, especially programs related to tertiary education (scholarship programs for the poor) and hospitalization.
2. Strengthen and improve the existing PNAFN cash transfer program through revision of the allocation criteria.
3. Reduce energy subsidies and replace them with more targeted programs for the poor. The less vulnerable groups could receive a decrease in tax burden against the removal of the subsidy.
References


Lustig, Nora. 2015a. “Inequality and Fiscal Redistribution in Middle Income Countries: Brazil, Chile, Colombia, Indonesia, Mexico, Peru and South Africa. Evidence from the Commitment to Equity Project (CEQ),” CEQ Working Paper 31 (New Orleans: Center for Inter-American Policy and Research, Department of Economics, Tulane University, and Inter-American Dialogue).


Introduction and Country Context

Over the last 25 years Uganda has made great strides in reducing poverty; it is one of the few Sub-Saharan African countries that achieved the Millennium Development Goal of halving the proportion of people living in poverty between 1990 and 2015, and it reached this goal five years ahead of time.\(^3\) Even so, figure 16-1 indicates that high income inequality remains: as measured by the Gini coefficient – where a coefficient of 0 represents perfect equality and a coefficient of 1 perfect inequality – inequality has fluctuated around 0.4 since the beginning of this millennium.\(^4\) A growing body of international evidence suggests that high income inequality may slow growth\(^5\) and can also have negative effects on socio-economic stability\(^6\). In recognition of the negative effects of income inequality, the Ugandan government has repeatedly declared the reduction of income inequality a priority policy goal (see the Uganda National Development Plans I and II, for example).

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\(^1\) The CEQ Assessment in Uganda was generously supported by the International Growth Center.

\(^2\) Jon Jellema is the Commitment to Equity Institute Associate Director for Africa, Asia, and Europe. Nora Lustig is the Commitment to Equity Institute Director as well as Samuel Z. Stone Professor of Latin American Economics, Tulane University and nonresident fellow of the Center for Global Development and the Inter-American Dialogue. Astrid Haas is Country Economist for the International Growth Centre, Uganda. Sebastian Wolf is Country Economist for the International Growth Centre, Uganda. The authors are grateful to Richard Newfarmer for comments on an earlier draft.

\(^3\) Duponchel, McKay, and Ssewanyana (2015).

\(^4\) MoFPED (2014).


\(^6\) Bardhan (2015).
However, the overall impact of fiscal policy on inequality in income, consumption, savings, and other outcomes is often poorly understood. This study provides policy makers with an assessment of the redistributive impact of fiscal policy – both its individual elements as well as the composite whole – in Uganda, using an internationally recognized methodology developed by the CEQ Institute. This study estimates the impact of fiscal revenue collections (taxes) and fiscal expenditures – direct cash and near-cash transfers, in-kind benefits, subsidies – on household-level income inequality and poverty. By using an internationally consistent methodology, the results from the Uganda CEQ Assessment can be compared with results from other CEQ countries.

To our knowledge, fiscal incidence has so far not been studied systematically in Uganda. The assessment summarized in this report comes at a crucial time for Ugandan fiscal policy. On the revenue side, the government wants to raise the tax-to-GDP ratio from 13.9 percent in 2014/15 to 16.3 percent in 2020/21. This implies new directions in tax policy and tax collection that may have negative impacts on poor and non-poor households alike, depending on which tax instrument the government intends to use to generate the bulk of the revenue increase. On the expenditure side, the government has committed to large infrastructure projects that will leave little fiscal space for other social spending, for targeted spending on social protection, or for introducing new initiatives to reduce income inequality. Gaining a clear understanding of the impact of the current fiscal system will be crucial in the design of a pro-poor fiscal system for the years to come.

The Ugandan government’s strategy to tackle poverty and income inequality over the last 25 years can be broken down in two periods. The first period was characterized by an expansion of the provision of in-kind education, healthcare, water, and sanitation benefits. After a period of civil war and chaos, the new National Resistance Movement government’s extensive liberalization agenda, combined with disciplined monetary and fiscal policy reforms, triggered a period of sustained economic growth and trade in the early 1990s. Alongside gains from increased economic activity, the establishment of the semi-autonomous Uganda Revenue Authority led to large improvements in domestic revenue collections. The tax-to-GDP ratio rose from 6 to 13 percent in between 1990 and 2000. With additional resources at hand, the government

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7 For details on the methodology, please see the Introduction to this Handbook and chapter 1 (Lustig and Higgins, 2017), chapter 5 (Higgins and Lustig, 2017), chapter 6 (Jellema and Inchauste, 2017), and chapter 7 (Higgins, 2017).
8 MoFPED (2016).
formulated a comprehensive Poverty Reduction Plan in 2007 that would increase service delivery drastically. The centerpiece of the plan was the introduction of universal primary education. Delivery of many of these services was to be managed in a decentralized fashion, funded by transfers from central government. Donors aided these efforts with budget support.9

When the growth of taxes relative to GDP began to level off in the early 2000s, the government refocused. Infrastructure and investments in productive sectors were prioritized over further expenditure increases on service delivery transfers, arguably shifting fiscal policy away from the pro-poor, redistributive agenda that had been taken on in the 1990s to focus more directly on economic growth. This policy shift meant that in real terms, service delivery transfers largely peaked around 2003, with later adjustments mainly covering increases in the wage bill.10

The second period was characterized by the introduction of targeted cash and in-kind benefits. Responding to chronic inequality among regions caused by political instability and conflict, the government shifted to smaller programmes specifically targeted to reduce regional imbalances in the early 2000s. The first Northern Uganda Social Action fund was introduced in 2003 and was followed by the introduction of the Social Assistance Grants for Empowerment programs in 2009 and the second Northern Uganda Social Action fund in 2010. These regionally-focused programs are still on-going, but given the large infrastructure investments the government is undertaking it is unclear whether there will be sufficient fiscal space to expand them from their current rather small size. Furthermore, first evaluations have raised concerns of these projects’ effectiveness.11

The government foresees large infrastructure investments going forward. These commitments leave little space to expand targeted poverty-reduction or income-equality programs and require intensified tax- and other revenue-collection efforts. In this context, the government is embarking on a reform to improve the efficiency of the service delivery transfer systems already in place. As part of these reforms, the government is reformulating transfer amounts and spending regulations to achieve a more equitable transfer distribution among districts and a more efficient delivery of in-kind education, healthcare, water, and sanitation benefits. The introduction of performance conditionality and transparency initiatives, it is hoped, will increase the accountability of decentralized government units.

Income inequality has a complex set of drivers including educational opportunities, access to healthcare, water, and sanitation, availability of infrastructure, financial inclusion, and gender inequality. Not all of these are influenced by fiscal policy, but the progressivity of taxes and government expenditures is undisputedly significant. It is important to note that the assessment summarized in this report aims to uncover only the extent of redistribution achieved by the fiscal system and remains silent on its dynamic and long-term effects on income inequality as well as their channels. These issues are beyond the scope of the study and the interested reader is referred to the 2015 issue of the IMF’s Regional Economic Outlook for Sub-Saharan Africa for an overview. Furthermore, this study focuses solely on the fiscal year 2012/13, because this is the latest year in which the Uganda National Household Survey was carried out. Additional

9 Kuteesa and others (2009).
10 Aziz and others (2016).
assessments of earlier or later periods are required to uncover trends, so further research is called for.

The Ugandan CEQ Assessment demonstrates that fiscal policy in Uganda is equalizing and does not increase poverty. However, the redistributive impact is quite small, especially when compared with similar low-income countries such as Ethiopia and Tanzania and with the trend observed for twenty-eight low- and middle-income countries (including Uganda). The small effect is primarily driven by low social spending (as a share of GDP), which in turn may be driven by low revenues from domestic collections and low revenues overall. Tax revenues in the year 2012/13 were just under 12 percent of GDP (provisional figures), lower than in Ethiopia and Tanzania, for example. At just over 12 percent, fiscal expenditures were also small (as a proportion of GDP), and the social expenditures that were executed at least partly to redistribute income accounted for approximately one-third of the total.

Within the social expenditures, education and health had the largest effect in reducing national income inequality, achieving a reduction of 1.6 Gini points (education and health make up a reduction of about 1.0 and 0.6 Gini points each individually). These in-kind transfers also constituted the largest proportion of social expenditure (at 2.4 and 1.6 percent of GDP, respectively). Direct transfers have provided meaningful income to the poor, but geographical coverage of these transfers is very limited and thus they have led only to a modest reduction in income inequality of 0.1 Gini points. Indirect subsidies of water, electricity, and agricultural inputs had a negligible, but equalizing redistributive impact in the period studied, reducing inequality by only 0.05 Gini points. On the tax side, VAT and excise taxes are neutral to slightly equalizing in distributive terms, in part due to their exemption schedule. Income taxes, which do not affect the poorest 50 percent of the population, help reduce inequality in disposable income by 1.2 Gini points.

Uganda’s fiscal system leaves the incidence of poverty virtually unchanged: when the impact of indirect taxes and indirect subsidies is taken into account, Uganda’s “no change” is the third-best result in a seven-country comparator group (Bolivia, Ethiopia, Ghana, Honduras, Nicaragua, Tanzania, and Uganda). Furthermore, Uganda is the only low-income country in Africa in which the poverty headcount after taking into account the effect of indirect taxes and subsidies does not rise above the market income (or “pre-fiscal”) poverty headcount. This remarkable outcome has as much to do with the value of non-market consumption (autoproduction, autoconsumption) in rural areas where the majority of the poor are located as with the set of indirect tax exemptions and indirect subsidies on the provision of water, electricity, and agricultural inputs. These results are relevant when considering options to increase domestic resource mobilization in Uganda. Whatever path is chosen, it is important to assess the impact of reforms on the tax and subsidy system on the poor.

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12 Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2016); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2014); Chile (Martinez-Aguilar, Fuchs, and Ortiz-Juarez, 2016); Colombia (Harker and others, 2016); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2015); El Salvador (Beneke, Lustig, and Oliva, 2014); Ethiopia (Harker and others, 2016); Georgia (Cancho and Bondarenko, 2016); Ghana (Younger et al., 2015); Guatemala (Cabrera, Lustig, and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Afkar, Jellema, and Wai-Poi, 2016); Iran (Enami, Lustig, and Taqdiri, 2016); Jordan (Alam, Inchauste, and Serajuddin, 2016); Mexico (Scott, 2014); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2014); Russia (Lopez-Calva and others, 2016), South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake, Inchauste, and Lustig 2016); Tanzania (Younger, Myamba, and Mdadila, 2016); Tunisia (Shimeles and others, 2016); and Uruguay (Bucheli and others, 2014).
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The rest of this report is organized in the following manner: section 2 will provide an overview of the main transfers and taxes in Uganda; section 3 will explain the methodology behind the assessment and a description of the data sources; section 4 will provide an overview of the main findings from the Uganda assessment together with international benchmark comparisons; and section 5 will conclude and spell out the implications the results have for policy in Uganda.

16.1 Social Spending and Taxation in Uganda

The following sections examine the level and composition of public social expenditures and revenue collection.

Social Spending and Subsidies

Social spending in Uganda can be divided in three categories: in-kind transfers, direct transfers, and indirect subsidies. As outlined in the introduction, in-kind transfers were the government’s main instrument to address income inequality until around 2003, and they remain today the largest transfer item (in terms of expenditure magnitudes) in the government’s portfolio of expenditures. Beginning in the early 2000s, however, the government shifted focus and concentrated on more targeted direct transfers aimed at reducing regional inequalities as their main inequality reduction tool. Targeted, direct transfers may see their share of public expenditures decrease as the government has declared that, going forward, it intends to focus on reducing poverty and inequality by boosting agricultural productivity and by increasing investment in other productive sectors.13

Table 16-1 provides a snapshot of expenditures in the fiscal year 2012/13. Social expenditures – social protection, education, health, and housing and urban spending – account for nearly two-fifths of total expenditures; infrastructure approximately one-third; defense spending one-tenth; and other sectors (for example, energy and mineral development, information and communications technology, tourism, trade, and industry; these are not shown in table 16-1, the remaining 17 percent.

Table 16-1 also provides a snapshot of the fiscal expenditures covered by Uganda’s CEQ Assessment. Defense spending (“security” in Uganda budget report terminology) and infrastructure are not covered while most of the social protection portfolio is incorporated. The only “in-kind” social spending that is not covered by this CEQ Assessment is “housing/urban” spending, of which there is very little in Uganda as a whole and virtually none undertaken outside of the capital, Kampala.

Table 16-1: Uganda Government Expenditures, 2012/13

13 MoFPED (2016).
In-kind Transfers

**Education:**

The main education expenditure is for capitation grants for primary and secondary school students, which are allocated to schools based on their current enrollment figures. At a primary level, schools receive a grant of about 7,000 Ugandan shillings (UGX) in 2012/13 (currently about US$2.11) per student per year. For secondary school the amount was about 41,000 UGX (currently about US$12.35) for government schools and 47,000 UGX for public private partnership schools (currently about US$14.16) per student per year enrolled in one of the identified schools under Uganda's Universal Secondary Education Program (Uganda Ministry of Education and Sports, 2013). At a tertiary level, the government allocates scholarships for study at public institutions.
Health:
Uganda abolished user fees in public health facilities in 2001 in support of the government's overall aim of attaining universal health care coverage. Health transfers are made through grants to a district government level. These transfers include payments of wages for health workers at all district health facilities, funding for service delivery operations by the health departments, as well as a development grant for constructing and rehabilitating health facilities.14

Direct Transfers

Social Assistance Grants Transfer for Empowerment (SAGE):

This programme – which began as a pilot in 2011 and is targeted at the poorest and most vulnerable members of society with an aim of providing them a minimum level of income security – is currently being delivered in fourteen districts in Northern Uganda. As part of the SAGE program, regular cash transfers are made to individuals or households under two separate schemes. The first is the Senior Citizen Grant (SCG) targeting individuals who are above 65 years of age (or in the case of the Karamoja region, above 60 years). The second is the Vulnerable Family Support Grant (VFSG) which targets households with low labor capacity as a result of age or physical disability and high dependency ratios, with district specific thresholds. The exact eligibility is determined through a targeting exercise that takes place every two to three years. Under both schemes, each individual or family receives about 25,000 UGX (approximately US$7.50) per month. This figure is revised on an annual basis to ensure it is in line with inflation.

Northern Uganda Social Action Fund (NUSAF):

The second round of this program (NUSAF II) began in 2009 under the auspices of the Office of the Prime Minister. It was established to support communities in previously war-torn Northern Uganda, which remains one of the poorest regions of the country. Two programs under NUSAF are focused on transferring cash and assets to vulnerable individuals: the Household Income Support Programme (HISP) and the Public Works Programme (PWP). HISP finances income-generating activities and supports livelihood and skills development initiatives that create further opportunities for self-employment. Under this program, transfers of livestock or other productive assets are made to groups of up to fifteen individuals. To be eligible, groups have to include the most vulnerable members of society, determined by a community participatory wealth-ranking exercise, and they have to be comprised of at least 50 percent women. The overall value of the transfer can be up to US$5000 per group. The government aims to target 8000 groups with these transfers.

PWP targets beneficiaries geographically based on a set of pre-determined poverty and socio-economic indicators. This program supports labor intensive interventions to provide poor household with additional income support that can help them weather the impact of rising food prices. On average, each project employs up to 250 people for the period of one month. The maximum funding is US$20,000 per district and US$10,000 per project. The target under

14 MoFPED (2016).
NUSAF II is to fund 1000 such projects, generating about 5.5 million employment days, over a period of five years.

Indirect Subsidies

*Water and Electricity:*
In urban areas, heavy direct subsidies of water and electricity consumption had been phased out by the time of the Uganda National Household Survey (UNHS) 2012/13 (our primary source for micro-data; see below), but both utility sectors still receive indirect subsidies in the form of infrastructure investment contributions. In the case of water, tariffs in urban areas are set to cover operating and maintenance costs, so consumption of water in urban areas is only subsidized indirectly by lowering the investment cost component that would otherwise have to be recovered through higher tariffs. In rural areas, water supply is directly subsidised from the national budget, which funds part of the operating costs of water delivery.

The situation is slightly different in the case of electricity where some cross subsidization occurs; while serving rural customers is more expensive than serving urban customers, both pay the same tariff, and no direct government subsidies of operating costs are in place, not even in rural areas. This cross subsidization (enforced by government contracting, but not funded from government revenues directly) is not included in the Uganda CEQ Assessment. Similar to the water sector, the government also provides indirect subsidies of infrastructure to expand rural electrification. These expenditures are counted as indirect subsidies and are included in the Uganda CEQ Assessment.

*National Agricultural Advisory Services (NAADS):*

NAADS is a semi-autonomous public agency under the Ministry of Agriculture, Animal Industries, and Fisheries that is responsible for the provision of extension services to farmers across the country. NAADS organizes the distribution of a range of agricultural inputs to support interventions along the value chain, for example seeds, seedlings, and farming equipment such as hoes. The government is currently planning an expansion of NAADS, so it likely that the importance of indirect subsidies of agricultural inputs will increase in the years to come.

**Revenues**

Table 16-2 provides a snapshot of public revenue sources in the fiscal year 2012/13. Uganda’s revenues come largely from indirect taxes like a VAT, excise taxes (including on petroleum products), and trade taxes. Direct taxes – the pay as you earn (PAYE) personal income tax and various corporate income taxes (including on capital gains and a withholding tax) – make a contribution to public revenues that is approximately half as large as the contribution from indirect taxes.

| Table 16-2: Uganda Government Revenues, 2012/13 | 8 |
### Table 1

<table>
<thead>
<tr>
<th>Description</th>
<th>UGX, (billions)</th>
<th>% of GDP</th>
<th>Included?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Revenue and Grants</td>
<td>9,213</td>
<td>14.9%</td>
<td>...</td>
</tr>
<tr>
<td>Revenue</td>
<td>8,277</td>
<td>13.4%</td>
<td>...</td>
</tr>
<tr>
<td>Tax Revenue</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Direct taxes of which</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Income Tax</td>
<td>1,197</td>
<td>1.9%</td>
<td>Yes</td>
</tr>
<tr>
<td>Corporate Income Tax</td>
<td>598</td>
<td>1.0%</td>
<td>No</td>
</tr>
<tr>
<td>Corporate Withholding Tax</td>
<td>389</td>
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</tr>
<tr>
<td>Taxes on Property</td>
<td>n.c.</td>
<td>n.c.</td>
<td>...</td>
</tr>
<tr>
<td>Contributions to Social Insurance</td>
<td>n.c.</td>
<td>n.c.</td>
<td>...</td>
</tr>
<tr>
<td>Indirect Taxes of which</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAT</td>
<td>2,353</td>
<td>3.8%</td>
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</tr>
<tr>
<td>Sales Tax</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Excise Taxes</td>
<td>1,466</td>
<td>2.4%</td>
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</tr>
<tr>
<td>Customs Duties</td>
<td>753</td>
<td>1.2%</td>
<td>...</td>
</tr>
<tr>
<td>Taxes on Exports</td>
<td>0</td>
<td>0.0%</td>
<td>No</td>
</tr>
<tr>
<td>Nontax revenue</td>
<td>191</td>
<td>0.3%</td>
<td>No</td>
</tr>
<tr>
<td>Grants</td>
<td>936</td>
<td>1.5%</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Source: Uganda Annual Budget Performance Report 2012/13

Note: Revenue collections (and expenditures) included in Uganda’s CEQ Assessment may not be fully allocated within the Uganda National Household Survey (UNHS) for various reasons – see section 3 below for more detail on the allocative methods and assumptions.

Key: ... means that the value is not applicable

n.c. means the value was not calculated.

The Uganda CEQ Assessment covers the majority of indirect taxes and the personal income tax (including the PAYE component, which is essentially personal income tax withholding). We do not have enough information to allocate corporate income tax burdens to UNHS households and we do not have enough administrative information to allocate social insurance contributions. The paragraphs below provide further detail on the taxes included in Uganda’s CEQ Assessment.

**Taxes**

Uganda’s tax-to-GDP ratio, provisionally at 11.6 percent of GDP\(^\text{a}\) in the 2012/13 fiscal year, is one of the lowest in Sub-Saharan Africa. The tax compliance gap in Uganda is large and collections rest on a very small base. In light of this, the government has declared increasing its domestic revenue base as a policy priority. Under the National Budget Framework, the government declared the goal to raise the tax-to-GDP ratio at a rate of 0.5 percent per annum with the goal of achieving a ratio of 16.3 percent by the 2020/21 fiscal year. To achieve this goal, reforms targeted at improving efficiency (rather than increasing rates) are planned: increasing investment in revenue collection, saving on costs and modernizing systems, and integrating tax systems operating at different levels of government (*inter alia*).

\(^\text{a}\)Official government reports, for example the “Annual Economic Performance Report 2012-13”, indicate total domestic revenues from taxes at 12.9 percent of GDP while giving the same Ugandan Shilling figure as we report here for total revenues from taxes. Our measure of GDP comes from the World Bank’s database (http://data.worldbank.org/); we are unable to locate the GDP denominator used in these other reports. The GDP figure may have been rebased and/or revised after the publication of the AEPR 2012-13.
The main domestic taxes in Uganda are the following:
--- Income taxes:
  --- The personal income tax (including PAYE withholding); marginal rates range from 0 to 40 percent\(^\text{16}\)
  --- Corporate tax: the standard rate is 30 percent
  --- Withholding tax on corporate income: 6 percent
  --- Presumptive income tax: 1.5 percent of gross turnover or a flat fee depending on the bracket

--- Consumption taxes:
  --- VAT: 18 percent
  --- Excise duties (including on fuels)
  --- Customs duties

Although the VAT has a uniform rate, there are various exemptions and zero-rated products. These are targeted at goods that have been identified to be consumed by the poor and represent an attempt to make the consumption tax less regressive. Examples of exempt goods are unprocessed foodstuffs and agricultural products (except for wheat grain) and supply of various agricultural inputs. Customs duties are applied at common external tariff (CET) rates specified in the East African Community (EAC) framework; the EAC-CET specifies zero percent rates for raw materials, capital goods, agricultural inputs, and medicines and medical equipment and lower rates (than the CET rate) for intermediate goods and other essential industrial inputs, and finished goods.

16.2 International Perspective on Fiscal Magnitudes and Composition

Based on figures 16-2 and 16-3 below, it is clear that Uganda’s domestic revenue collections effort are below similar low-income countries such as Ethiopia and Tanzania (figure 16-2) and the broader trend for twenty-eight low- and middle-income countries (figure 16-3). In fact, Uganda raises revenues below the trend on every revenue source except personal income and payroll taxes (as shown in figure 16-4).

Figure 16-2: Composition of Total Government Revenues (as % of GDP): Bolivia, Ethiopia, Ghana, Honduras, Nicaragua, Tanzania, and Uganda (around 2010)

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\(^{16}\) Technically, the PAYE rate converges to 40 percent with income; the 40 percent marginal rate is only applied to income over 120 million UGX.
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Figure 16-3: Total revenue/GDP vs. Gross National Income Per Capita (around 2010)

Notes
1. The year for which the analysis was conducted in parentheses.
2. Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on Bolivia (Paz-Arauco and others, 2014); Brazil, (Higgins and Pereira, 2014); Ethiopia (Hill and others, 2016); Ghana, (Younger, Osei-Assibey, and Oppong, 2015); Honduras, (Castañeda and Espino, 2015); Nicaragua (Cabrera and Moran, 2015); and Tanzania, (Younger, Myamba, and Mdadila, 2016).

Notes
1. The dotted line is the slope obtained from a simple regression with total revenue as the dependent variable.
3. t statistics in parentheses
   * p<0.1, ** p<0.05, *** p<0.01

Source: Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2016); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2014); Chile (Martínez-Aguilar, Fuchs, and Ortiz-Juarez, 2016); Colombia (Harker and others, 2016); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Arísty-Escudé and others, 2016); Ecuador (Llerena and others, 2015); El Salvador (Beneke, Lustig, and Oliva, 2014); Ethiopia (Hill and others, 2016); Georgia (Cancho and Bondarenko, 2016); Ghana (Younger, Osei-Assibey, and Oppong, 2015); Guatemala (Cabrera, Lustig, and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Afkar, Jellema, and Wai-Poi, 2016); Iran (Enami, Lustig, and Taqdiri, 2016); Jordan (Alam, Inchauste, and Serajudin, 2016); Mexico (Scott, 2014); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2014); Russia (Lopez-Calva and others, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake, Inchauste, and Lustig 2016); Tanzania (Younger, Myamba, and Mdadila, 2016); Tunisia (Shimeles and others, 2016); and Uruguay (Bucheli and others, 2014).
Chapter 16, Jellema, Lustig, Haas, and Wolf

Figure 16-4: Personal and Payroll Taxes vs. Gross National Income Per Capita (around 2010)

Notes
1. The dotted line is the slope obtained from a simple regression with direct taxes as the dependent variable.
3. t statistics in parentheses
   * p<0.1, ** p<0.05, *** p<0.01

Source: Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2016); Brazil (Higgins and Pereira, 2014); Chile (Martinez-Aguilar, Fuchs, and Ortiz-Juarez, 2016); Colombia (Harker and others, 2016); Costa Rica (Sauma and Trejos, 2016); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2015); El Salvador (Beneke, Lustig, and Oliva, 2014); Ethiopia (Hill and others, 2016); Georgia (Cancho and Bondarenko, 2016); Ghana (Younger, Osei-Assibey, and Oppong, 2015); Guatemala (Cabrera, Lustig, and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Afkar, Jellema, and Wai-Poi, 2016); Iran (Enami, Lustig, and Taqdiri, 2016); Jordan (Alam, Inchauste, and Serajuddin, 2016); Mexico (Scott, 2014); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2014); Russia (Lopez-Calva and others, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake, Inchauste, and Lustig 2016); Tanzania (Younger, Myamba, and Mdadila, 2016); Tunisia (Shimeles and others, 2016); and Uruguay (Buchelli and others, 2014).

Given comparatively low revenue collections, it is not surprising that figures 16-5 and 16-6 (below) demonstrate that Uganda’s total spending and redistributive spending (spending on direct transfers, education, health, other social spending, and indirect subsidies) is lower than that of Ethiopia and Tanzania, and significantly below the trend of the twenty-eight low- and middle-income countries. Ethiopia, though poorer, dedicates more fiscal resources to redistributive spending than Uganda. In terms of the composition of social spending (direct transfers, education, health, and other social spending), Uganda allocates a similar share of GDP to direct transfers as Ghana, Nicaragua, and Tanzania, but much less than Ethiopia (figure 16-7). The same is true for education spending. For health, however, Uganda spends a share similar to Ghana and Tanzania, and a slightly higher share than Ethiopia.

Figure 16-5: Total Primary and Redistributive Spending (% of GDP): Bolivia, Ethiopia, Ghana, Honduras, Nicaragua, Tanzania, and Uganda (around 2010)
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Figure 16-6: Redistributive Spending vs. Gross National Income Per Capita (around 2010)

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on Bolivia (Paz-Arauco and others, 2014); Ethiopia (Hill and others, 2016); Ghana, Younger, Osei-Assibey, and Oppong, 2015); Honduras, (Castañeda and Espino, 2015); Nicaragua (Cabrera and Moran, 2015); and Tanzania, (Younger, Myamba, and Mdadila, 2016).

Source: Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2016); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2014); Chile (Martinez-Aguilar, Fuchs, and Ortiz-Juarez, 2016); Colombia (Harker and others, 2016); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2015); El Salvador (Beneke, Lustig, and Oliva, 2014); Ethiopia (Hill and others, 2016); Georgia (Cancho and Bondarenko, 2016); Ghana (Younger, Osei-Assibey, and Oppong, 2015); Guatemala (Cabrera, Lustig, and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Afkar, Jellema, and Wai-Poi, 2016); Iran (Enami, Lustig, and Taqdiri, 2016); Jordan (Alam, Inchauste, and Serajuddin, 2016); Mexico (Scott, 2014); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2014); Russia (Lopez-Calva and others, 2016), South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake, Inchauste, and Lustig 2016); Tanzania (Younger, Myamba, and Mdadila, 2016); Tunisia (Shimeles and others, 2016); and Uruguay (Bucheli and others, 2014).
Chapter 16, Jellema, Lustig, Haas, and Wolf

Figure 16-7: Composition of Social Spending (percent of GDP): Bolivia, Ethiopia, Ghana, Honduras, Nicaragua, Tanzania, and Uganda (around 2010)

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on Bolivia (Paz-Arauco and others, 2014); Ethiopia (Hill and others, 2016); Ghana, (Younger, Osei-Assibey, and Oppong, 2015); Honduras, (Castañeda and Espino, 2015); Nicaragua (Cabrera and Moran, 2015); and Tanzania, (Younger, Myamba, and Mdadila, 2016).

16.3 Methods and Data
The following sections describe the CEQ fiscal incidence assessment methodology in general as well as the specific methodological choices made for the Uganda CEQ Assessment.

Methodological Summary

The CEQ Assessment takes specific fiscal policy elements, programs, expenditures, or revenue collections — such as those described above — and allocates them to individuals and households appearing in a micro-level socio-economic survey. Once the allocations are made, the CEQ analytical program consists of calculating different measures of poverty and impoverishment, inequality and progressiveness, and the amount of redistribution accomplished (inter alia) on the measures of income — or “income concepts” — that exclude (“pre-fiscal”) and include (“post-fiscal”) these fiscal policy elements. Figure 16-8 summarizes the construction of these income concepts.

The Uganda CEQ Assessment incorporates every type of fiscal policy element listed in figure 16-8 below. However, as the income module in the UNHS was judged to be unreliable and would likely lead to underreporting of income for those with little-to-no income from the sources listed
in the UNHS as well as for those with very high incomes (from any source), we chose to use consumption expenditure as our measure of primary income.\textsuperscript{17} We assumed total consumption expenditures – including the value of imputed rent for those living in owner-occupied housing as well as the implied value of any auto-production/auto-consumption – were equal to the CEQ disposable income concept (approximately in the middle of the flowchart in figure 16-8) and work “backwards” and “forwards” from disposable income to other CEQ income concepts.\textsuperscript{18}

\textbf{Figure 16-8: CEQ Income Concepts and Fiscal Policy Elements}

\begin{center}
\includegraphics[width=\textwidth]{figure16-8.png}
\end{center}

Source: Chapter 5 in this Handbook (Higgins and Lustig, 2017).

\textit{Data Sources}

\textsuperscript{17} See Bollinger and Hirsch (2013); Bollinger and Hirsch (2007). These examples include thorough treatments of the difficulties created by recall error and item non-response in socio-economic survey income modules.

\textsuperscript{18} As consumption expenditure is our primary income measure, and as all other income concepts including market income are derived from consumption expenditure, we do not create a taxable income concept; other CEQ Assessments do produce this income concept when relevant. Creating a taxable income concept requires knowledge of the composition of market income, a Ugandan household’s expenditure profile (in the UNHS) cannot provide any information in the composition of income. Relatedly, we are unable to say anything about the savings or current asset profile UNHS households for the same reason: a current consumption expenditure profile does not provide any information on investment spending nor on the returns accruing to any households assets.
Chapter 16, Jellema, Lustig, Haas, and Wolf

The primary micro-level dataset providing the individual- and household-level information necessary to allocate fiscal policy elements is the UNHS 2012/13.\(^{19}\) The Uganda Bureau of Statistics carries out two nationally representative surveys that cover consumption and income behavior on a regular basis, the Uganda National Panel Survey (UNPS) and UNHS. The UNHS has twice the sample size of the UNPS (6887 households surveyed in the UNHS vs 3188 households in the UNPS) and provides better statistical power at sub-national levels, which is especially important for allocating direct transfers in Uganda (see below). The UNHS is conducted approximately every three years using a two-stage stratified sample design that allows for reliable estimations of key indicators at the national, rural-urban, regional and separately for the sub-regional level. Apart from coverage of in-kind transfers received, the survey contains detailed information about income sources and consumption levels that enable imputations of effective taxation, as well as the imputation of effective indirect transfers and subsidies.

The source for total revenues collected by the government from households – via the PAYE, VAT, and excise taxes – is the Annual Budget Performance Report (ABPR) 2012/13 published by the Ministry of Finance, Planning and Economic Development (MoFPED). To impute “effective” or actually prevailing rates (which may differ from statutory rates), we first scale down the expected tax take from UNHS households so that the ratio of VAT (for example) revenues in the ABPR to Private Final Household Consumption Expenditure in Uganda National Accounts data is equivalent to the ratio of VAT collections from UNHS households to the value of cumulative UNHS household consumption expenditure. For VAT and the excise taxes, the total revenue figure from the ABPR we use includes revenues via the application of those taxes (when applicable) to domestically-produced goods and services.\(^{20}\)

Government expenditure on indirect subsidies for water and electricity, and in-kind transfers of healthcare and education services are also taken from the ABPR 2012/13. Expenditures on agricultural input subsidies (delivered by the NAADS agency – see above) were provided by the MoFPED. These subsidies and in-kind transfers are scaled in a manner equivalent to the scaling of taxes. The ABPR also provides aggregate expenditure information for the government agency responsible for the two programs that feature direct transfers, NUSAF and SAGE (as explained in the previous section). We use operational reports, program characteristics, and rules to allocate uniform transfer magnitudes to all households that are imputed to be eligible (or to households deemed to host at least one eligible individual) for these programs. The total amount of direct transfer expenditure allocated, then, is not scaled in the way that the other fiscal policy elements described above are.

Allocation Assumptions

When and where possible, CEQ Assessments allocate fiscal policy elements to individuals or households based on direct observation. For example, when an individual queried in a socio-economic survey is asked to recall how much she has paid in VAT on all her purchases in the last 7 days, or is asked to provide receipts detailing VAT payments, then we directly “observe” the total VAT collection from that individual. These VAT payments recorded by individuals are then

\(^{19}\) The allocations – including the assumptions and choices implicit in them – are described in the following section.

\(^{20}\) While imported goods also attract VAT and excise (potentially), we are unable to determine which UNHS household expenditures are for imported goods and which for domestic goods.
assumed to be the same VAT revenues listed in the executive, administrative, and other budget reporting for the same year. In Uganda, however, very few fiscal policy elements could be allocated via direct observation; the subheadings below provide a summary of allocation assumptions and decisions for various fiscal policy elements.

Personal Income Taxes

PAYE income tax collections allocated in the UNHS were scaled such that the ratio of total PAYE revenues in administrative records to National Accounts Household Final Consumption Expenditure was equivalent to the ratio of PAYE collected from UNHS households to total UNHS Consumption Expenditures. The PAYE rate schedule was adjusted so that the marginal change in PAYE rates between PAYE brackets remained intact while total PAYE collections remained equal to the amount described above. Taxpayer status was imputed based on a combination of (a) having recorded taxable income above the PAYE policy threshold, (b) the respondent indicating positively that he or she had made either PAYE payments or social security payments (or had them made on his or her behalf), and (c) the respondent having a higher score of two or greater on a “formality of employment” scale if and when there were no determinate answers to the questions listed in (b). The “formality of employment” score was generated within the household survey and is additive across seven characteristics including the receipt of paid sick leave and vacation, the duration of the contract, and other benefits.

Simulated Direct Transfers

Both of the umbrella programs under which Uganda’s direct transfers are executed – the Social Assistance Grants for Empowerment and the Northern Uganda Social Action Fund – operate in limited areas and there is no question in the UNHS that records receipts of any direct transfers. Instead, we use program reports (from the Ugandan executing agency as well as multilateral development agencies) to understand eligibility, (annual) coverage, and (annual) benefit levels. We then parameterize eligibility and generate transfer-eligible populations within the household survey and randomly allocate program-specific benefits to program-specific eligible household pools until we reach (approximately) the average number of beneficiaries and benefits delivered yearly according to program reporting.

VAT, Excise, and Fuel Excise: based on expenditure records

We cannot directly identify VAT or excise tax amounts paid, so instead we back out, for each purchased item, the share of the item’s value that is a VAT or excise charge. In order to determine this share, these taxes are scaled in two ways. The first scale factor involves selecting the proportion of the total tax collection we expect to be generated by household expenditure. For VAT, non-fuel excise, and fuel excise, these first scale factors are 0.5, 1.0, and 0.1 (respectively). When this first scale factor is less than one, it indicates our assumption that the

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21 These first factors are not chosen arbitrarily. For VAT we had a preview of estimates (generated by the Uganda Revenue Authority) of sector-level VAT collections: over 80 percent of VAT collections (in the 2012/13 fiscal year) were generated from just two sectors: manufacturing and electricity/gas/steam and air-conditioning supply. As final consumers in these sectors need not be exclusively households or private citizens, we guessed that less than 100 percent of VAT collections were coming from direct purchases by households. We then chose a proportion of VAT to allocate to households based on the effective rate that it implied (14.6 percent) compared with the statutory rate (18 percent). For the fuel excise, we knew that only 6 percent of UNHS
tax in question is not collected exclusively from households. For example, the 0.1 factor on the fuel excise indicates we assume 90 percent of the fuel excise collection total (listed in table 16-1 above) is coming from the commercial/industrial/enterprise and government/NGO sectors. We do not assume the fuel excise collected from the non-household sectors does not create a burden for households (through higher prices of other goods and services consumed); however in this report we only allocate the direct burden of indirect taxes like VAT and the excise tax.\footnote{We do not have access to the sales value of the VAT-able base by sector or good/service category, so we instead assume that VAT was collected at the same rate (proportional to net-of-VAT price) over all goods that attract the VAT. Uganda's excise tax applies to sugar, alcoholic beverages, tobacco, cell phone minutes, cement, cosmetics, and the statutory excise rates occupy a range, but because excise collections are not available by sector, the total excise collection from UNHS households is accomplished in a manner similar to that for VAT; that is, we assume that excise is collected at the same rate (proportional to net-of-excise price) over all goods attracting the excise.}

The second scale factor is generated in the following way: we calculate the ratio of revenues collected (per indirect tax) in the ABPR to Household Final Consumption Expenditure in the National Accounts and set it equal to the ratio of revenues collected from UNHS households (per tax) to cumulative UNHS consumption expenditure. We then create categories of goods in the UNHS consumption module which, according to tax statutes, attract the tax in question. For example, the only good listed in the UNHS consumption module which attracts the fuel excise tax is fuel itself; only UNHS households who record nonzero expenditure on fuel are allocated a fuel excise tax.\footnote{See Jellema and Inchauste, chapter 4 in this volume for a theoretical model and estimation tools and procedures for estimating the indirect effects of indirect taxes within the CEQ Assessment framework.} For the VAT, we created within the UNHS consumption expenditure records a measure of “VAT-able” consumption expenditure, and applied our imputed effective VAT rate to those expenditures only. We decided which items were “VAT-able” according to policy and statutes.

We then determine the share of the tax in the total expenditure value of the taxed good (or good category). From this share we determine what “effective” rate of taxation would, when applied to the value of the good, net of the indirect tax paid, give us back the actual sales value of the good as recorded by households in the UNHS.

The “effective” rate, or the on-average actual rate, so calculated allows us to take care not to allocate indirect taxes to purchases of goods or services which are exempt from the tax. We also implicitly exclude any informal purchases that are not included in the sales over which an indirect tax is collected. However, because we do not directly observe informal purchases, the reduction in taxes collected (and therefore the reduction in taxes allocated to UNHS households) due to informal purchases or weak tax administration is allocated to all households purchasing the good (or category of goods) which is taxed.

Electricity and Water Subsidies

As the previous section indicates, water and electricity tariffs are not directly subsidized, but the Rural and Urban Water Supply programs and the Rural Electrification program provide (to the households recorded positive fuel purchases. As for VAT, we chose the first fuel excise factor, 0.1, based on the effective rate of taxation (on fuel) that it implied (217 percent) compared to the statutory rate (217 percent). The non-fuel excise is collected primarily from alcoholic beverages, tobacco, chewing gum, sweets, chocolate, and other comestibles as well as from furniture, cosmetics and perfumes, banking fees and money transfers, and cement. All of these items (save for cement) are plausibly purchased by households.
utility operators) a fixed, on-budget sum annually that is meant to cover network maintenance, investment, and upgrading costs. In other words, without this budget support, utility operators would raise prices so that total revenues collected privately covered these costs as well. For these programs, we divide the total (scaled) expenditure on these programs by the total number of eligible users in the UNHS to get a per-user subsidy. We are allocating to eligible households an amount that would cover, for example, a fixed “connection charge”; this in turn means more intensive utility users receive the same total subsidy as less intensive users.

Agricultural Input Subsidy

The NAADS Agricultural Input Subsidy provides beneficiaries with (some) free agricultural inputs. The UNHS does not record the source of the purchase for those individuals who purchase agricultural inputs. We turn to Uganda’s National Service Delivery Survey (NSDS) to generate a propensity score (at the household level) for acquiring NAADS-subsidized inputs (conditional on having purchased any agricultural inputs). We then generate that propensity score (again at the household level) for UNHS households and select households with the highest propensity scores until the number of NAADS-subsidy beneficiaries in the UNHS (as a percent of the agricultural-input-purchasing pool of households in the UNHS) matches the number of NAADS-subsidy beneficiaries in the NSDS (as a percent of agricultural-input-purchasing pool of households in the NSDS). Given the technique we use to allocate NAADS expenditures, this allocation can be described as the expected allocation of expected benefits available under the NAADS program.

In-kind Transfers

Uganda’s expenditures on education and health are allocated to those UNHS households where at least one member utilizes the public education or public healthcare service system (respectively). As for the water and electricity subsidies, scaled in-kind spending is divided by the total number of UNHS users in order to get a “per student” or “per patient” subsidy; this uniform subsidy amount is then allocated to all directly-identified users. So a single household with an enrolled primary school student, an enrolled secondary school student, one visit to a (public) hospital, and two visits to the (public) outpatient clinic, would receive five different in-kind subsidies for the five service types utilized.

16.4 Results

The following sections summarize the impact of Ugandan fiscal policy on contemporaneous poverty and inequality.

*Does Fiscal Policy have an Impact on Inequality and Poverty?*

Overall, inequality would be higher in Uganda if the fiscal policy elements covered here (see tables 16-1 and 16-2 above) were eliminated; in other words, **Uganda fiscal policy does reduce inequality.** For example, table 16-3 below demonstrates that the Gini coefficient estimated over incomes that do not include direct taxes, pension benefits and contributions, and other direct transfers (market income in CEQ nomenclature) is 0.413, or 1.3 Gini points higher than the Gini coefficient of 0.400 estimated over incomes that include those elements (disposable income). The Gini coefficient measured at final income - which includes indirect taxes, subsidies, and in-kind
benefits in addition to the fiscal policy elements included in disposable income - is 0.381; therefore the total impact of fiscal policy on inequality is a reduction of approximately 3 Gini points, from 0.413 to 0.381.

<table>
<thead>
<tr>
<th>Income Concept</th>
<th>Gini Coefficient</th>
<th>Poverty Headcount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Income</td>
<td>0.413</td>
<td>19.9%</td>
</tr>
<tr>
<td>Market Income + Pensions</td>
<td>0.414</td>
<td>19.8%</td>
</tr>
<tr>
<td>Net Market Income</td>
<td>0.401</td>
<td>19.8%</td>
</tr>
<tr>
<td>Disposable Income</td>
<td>0.400</td>
<td>19.7%</td>
</tr>
<tr>
<td>Consumable Income</td>
<td>0.398</td>
<td>19.9%</td>
</tr>
<tr>
<td>Final Income</td>
<td>0.381</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

Key: ... means that the value is not applicable

Fiscal policy does not increase poverty rates significantly (nor do the poverty gap or squared poverty gap change). For example, the poverty headcount rate at the national poverty line stays at approximately 20 percent when moving from market income to consumable income (which includes pensions, all taxes, direct transfers, and subsidies\(^\text{24}\)). Likewise, at the US$1.25 PPP (2005) international poverty line, the poverty headcount hovers right at 18 percent in between market income and consumable income.

Fiscal policy is therefore modestly inequality-reducing, while there is essentially no change in poverty (due to fiscal policy). Among the set of countries with low fiscal expenditures, the estimated impact of Ugandan fiscal policy on inequality is approximately average. As seen in figure 16-9, the redistributive effect (measured as the absolute difference between the Gini for market income and the Gini for final income) in Uganda is larger than in Ethiopia and Honduras, but noticeably smaller than Bolivia, Nicaragua, and Tanzania. In figure 16-10, one can observe that, although starting from a higher market income (pre-fiscal) inequality level, Uganda’s redistributive effect is below the trend. In contrast, while Ethiopia and Tanzania start from a lower market income inequality, their corresponding redistributive effect is practically on trend. Figure 16-11 demonstrates that Uganda’s redistributive effect is slightly above trend given the share of social spending to GDP: therefore the modest redistributive effect is associated with low overall tax collections and social spending, rather than ineffective social spending in particular.

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\(\text{24} \) Consumable income does not include in-kind transfers; in-kind transfers are to value appropriately in terms of household purchasing power.
2. RE is measured in absolute changes of Gini for market income less Gini of final income.
Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on Bolivia (Paz-Arauco and others, 2014); Ethiopia (Hill and others, 2016); Ghana, (Younger, Osei-Assibey, and Oppong, 2015); Honduras, (Castañeda and Espino, 2015); Nicaragua (Cabrera and Moran, 2015); and Tanzania, (Younger, Myamba, and Mdadila, 2016).

Figure 16-10: Initial Inequality and Redistributive Effect (around 2010)

1. The dotted line in red is the slope obtained from a simple regression with the redistributive effect as a dependent variable.
2. t statistics in parentheses; * p<0.1, ** p<0.05, *** p<0.01
3. Contributory pensions are treated as deferred income.
4. Redistributive Effect is measured in absolute changes of Gini for market income less Gini of final income.
Source: Lustig (forthcoming) and CEQ Institute’s Data Center on Fiscal Redistribution. Based on Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2016); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2014); Chile (Martinez-Aguilar, Fuchs, and Ortiz-Juarez, 2016); Colombia (Harker and others, 2016); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escuder and others, 2016); Ecuador (Llerena and others, 2015); El Salvador (Beneke, Lustig, and Oliva, 2014); Ethiopia (Hill and others, 2016); Georgia (Cancho and Bondarenko, 2016); Ghana (Younger, Osei-Assibey, and Oppong, 2015); Guatemala (Cabrera, Lustig, and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Alfkar, Jellema, and Wal-Poi, 2016); Iran (Zafari, Lustig, and Taqdiri, 2016); Jordan (Alam, Inchauste, and Serajuddin, 2016); Mexico (Scott, 2014); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2014); Russia (Lopez-Calva and others, 2016); South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake, Inchauste, and Lustig 2016); Tanzania (Younger, Myamba, and Mdadila, 2016); Tunisia (Shimeles and others, 2016); and Uruguay (Bucheli and others, 2014).

Figure 16-11: Social Spending (as % of GDP) versus Redistributive Effect (around 2010)

1. The dotted red line is the slope obtained from a simple regression with the redistributive effect as a dependent variable.
2. Social spending includes direct transfers and spending on education and health. The information displayed here are administrative data as reported in the study cited above and the numbers do not necessarily coincide with the IDB bases (or some other multilateral organization).

3. t-statistics in parentheses; * p<0.1, ** p<0.05, *** p<0.01

4. Contributory pensions are treated as deferred income.

Source: Lustig (forthcoming) and CEQ Institute’s Data Center on Fiscal Redistribution. Based on Argentina (Rossignolo, 2016); Armenia (Younger and Khachatryan, 2016); Bolivia (Paz-Arauco and others, 2014); Brazil (Higgins and Pereira, 2014); Chile (Martinez-Aguilar, Fuchs, and Ortiz-Juarez, 2016); Colombia (Harker and others, 2016); Costa Rica (Sauma and Trejos, 2014); Dominican Republic (Aristy-Escud er and others, 2016); Ecuador (Llerena and others, 2015); El Salvador (Beneke, Lustig, and Oliva, 2014); Ethiopia (Hill and others, 2016); Georgia (Cancho and Bondarenko, 2016); Ghana (Younger, Osei-Assibey, and Oppong, 2015); Guatemala (Cabrera, Lustig, and Moran, 2015); Honduras (Castañeda and Espino, 2015); Indonesia (Afkar, Jellema, and Wai-Poi, 2016); Iran (Enami, Lustig, and Tafqirdi, 2016); Jordan (Alam, Inchauste, and Serajuddin, 2016); Mexico (Scott, 2014); Nicaragua (Cabrera and Moran, 2015); Peru (Jaramillo, 2014); Russia (Lopez-Calva and others, 2016), South Africa (Inchauste and others, 2016); Sri Lanka (Arunatilake, Inchauste, and Lustig 2016); Tanzania (Younger, Myamba, and Mdadila, 2016); Tunisia (Shimeles and others, 2016); and Uruguay (Bucheli and others, 2014).

The redistribution Uganda achieves through fiscal policy has virtually no effect on poverty. However, compared with other low-income countries such as Ethiopia and Tanzania, the impact of Ugandan fiscal policy on poverty reduction looks more significant. Figure 16-12 indicates that when the impact of indirect taxes and indirect subsidies is taken into account, Uganda’s “no change” in the poverty headcount is actually the third best in this group of African and Central American low to low-middle income countries. Among African countries (in figure 16-12), Uganda is the only one of the four in which consumable income poverty does not rise (noticeably) above market income (pre-fiscal) poverty. This is a remarkable outcome and possibly a consequence of the low indirect tax burden on the poor as a result of exemptions and the fact that, although subsidies also benefit the nonpoor, the poor are benefitting from subsidies disproportionately.

Figure 16-12: Percent change, Poverty Headcount: Bolivia, Ethiopia, Ghana, Honduras, Nicaragua, Tanzania, and Uganda circa-2010

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</thead>
<tbody>
<tr>
<td></td>
<td>-11.5%</td>
<td>-16.1%</td>
<td>-2.3%</td>
<td>-1.7%</td>
<td>-1.7%</td>
<td>-0.2%</td>
<td>-1.3%</td>
<td>-1.0%</td>
</tr>
</tbody>
</table>

Source: CEQ Institute’s Data Center on Fiscal Redistribution. Based on Bolivia (Paz-Arauco and others, 2014); Ethiopia (Hill and others, 2016); Ghana, (Younger, Osei-Assibey, and Oppong, 2015); Honduras, (Castañeda and Espino, 2015); Nicaragua (Cabrera and Moran, 2015); and Tanzania, (Younger, Myamba, and Mdadila, 2016).

How many Ugandans are Impoverished by Taxes, Transfers, and Subsidies?

Calculating the poverty headcount before and after fiscal policy elements are applied gives us a broad indication of the advantage or disadvantage created by that policy: if the poverty headcount is higher after the policy is allocated, then the policy has disadvantaged some individuals.
However, anyone receiving (as benefits) a fiscal expenditure sees their income increase; and anyone paying a tax (or other revenue collection) sees their income decrease. We can summarize those individual losses and gains through the fiscal impoverishment (FI) and fiscal gains to the poor (FGP) indices (first proposed by Higgins and Lustig).

The FI index “tracks” each individual who becomes poor upon the execution of a fiscal policy (or a collection of fiscal policies) to determine how much their income decreased and therefore by how much they were impoverished. Table 16-4 below shows that in Uganda, the net position of all households after the addition of the PAYE income tax, direct transfers, the indirect VAT, excise, and fuel excise taxes, and the water, electricity, and agricultural input subsidies to market income is such that 12 percent of the population is impoverished (column 4) if poverty is measured using the US$1.25 PPP [2005] line. In other words, 12 percent of the population would not have become impoverished (on net) had there been no net fiscal-policy adjustment to their market incomes.

Table 16-4 indicates that Uganda’s FI index (for poverty measured at the US$1.25 PPP [2005] line) puts it in the middle of the distribution of FI performance in lower-middle income countries. Sri Lanka and the Dominican Republic generate significantly less FI through their fiscal systems while Ghana and Ethiopia generate significantly more; Armenia, Bolivia, and Guatemala all have somewhat lower levels of FI through their fiscal systems. Column 5, which presents FI among the individuals who are poor (rather than in the population at large), shows that even in Sri Lanka, where FI is negligible when measured as a percent of the total population, about one-third of the consumable-income poor have been impoverished by the (net) fiscal system.

Table 16-4: Fiscal Impoverishment (circa 2010)

<table>
<thead>
<tr>
<th>Country (survey year)</th>
<th>(1) Market income plus contributory pensions Poverty headcount (%)</th>
<th>(2) Change in poverty headcount (percentage points)</th>
<th>(3) Market income plus contributory pensions inequality (Gini)</th>
<th>(4) Fiscally impoverished as % of population</th>
<th>(5) Fiscally impoverished as % of consumable income poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armenia (2011)</td>
<td>12.8</td>
<td>-1.0</td>
<td>40.3</td>
<td>6.2</td>
<td>52.3</td>
</tr>
<tr>
<td>Bolivia (2009)</td>
<td>10.0</td>
<td>-0.2</td>
<td>50.3</td>
<td>6.6</td>
<td>63.2</td>
</tr>
<tr>
<td>Dominican Republic (2013)</td>
<td>5.7</td>
<td>-0.8</td>
<td>51.4</td>
<td>1.0</td>
<td>16.3</td>
</tr>
<tr>
<td>Uganda (2012/13)</td>
<td>17.9</td>
<td>0.1</td>
<td>41.3</td>
<td>12.2</td>
<td>67.7</td>
</tr>
<tr>
<td>Ethiopia (2011)</td>
<td>31.9</td>
<td>1.3</td>
<td>32.2</td>
<td>28.5</td>
<td>83.2</td>
</tr>
<tr>
<td>Ghana (2013)</td>
<td>6.0</td>
<td>0.8</td>
<td>43.7</td>
<td>5.1</td>
<td>76.6</td>
</tr>
<tr>
<td>Guatemala (2010)</td>
<td>5.6</td>
<td>0.1</td>
<td>51.3</td>
<td>7.0</td>
<td>62.2</td>
</tr>
<tr>
<td>Indonesia (2012)</td>
<td>12.1</td>
<td>-1.5</td>
<td>39.4</td>
<td>4.1</td>
<td>39.2</td>
</tr>
<tr>
<td>Sri Lanka (2010)</td>
<td>5.0</td>
<td>-0.7</td>
<td>37.1</td>
<td>1.6</td>
<td>36.4</td>
</tr>
<tr>
<td>Tanzania (2011)</td>
<td>43.7</td>
<td>7.8</td>
<td>38.2</td>
<td>50.9</td>
<td>98.6</td>
</tr>
</tbody>
</table>


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26 That additional 12 percent of the Ugandan population represents approximately 68 percent of the consumable-income poor.
How many Poor Ugandans Experience Income Gains via Fiscal Expenditures?

The FGP index is the mirror of FI: it tracks pre-fisc poor households receiving (net) benefits to determine by how much their incomes are increased from this receipt. At consumable income, and using the same US$1.25 PPP [2005] poverty line as in table 16-4, 28.4 percent of the pre-fisc poor – those whose market income (including pensions) is below the poverty line – receive (net) benefits from the Ugandan fiscal policy. The fiscal system adds about 8 percent (on average) to pre-fisc-income among the poor individuals who receive net transfers.

Overall, then, the fiscal system adds more income to fewer of the pre-fisc poor and takes away less income from more of the post-fisc poor. The result is by now familiar: on net, the poverty headcount is basically unchanged in between market income plus pensions and consumable income.

Market to Disposable Income: Pensions, Personal Income Taxes, and Direct Transfers

The addition of pensions, personal income taxes, and direct transfers to market income creates disposable income (see figure 16-1 above).27 Table 16-5, which presents the marginal impact of fiscal policy elements on inequality and poverty, demonstrates that pensions reduce inequality and poverty slightly, indicating that some pension benefits are received by poorer households.28

Uganda’s PAYE personal income tax also reduces inequality slightly while leaving the poverty headcount unchanged. As any tax collection from an individual necessarily reduces that individual’s purchasing power over all other goods and services, then a tax (whether direct or indirect) considered individually will always at best leave the poverty headcount unchanged (relative the to pre-tax poverty headcount), so the Ugandan PAYE result could not be any better. The lack of an impact on poverty is likely a result of the decision to impute taxpayer status by developing a “formality” scale for contracted labor and allocating simulated tax amounts only to those who claim to have paid PAYE (or to have had it deducted) or who score high on the formality scale, and have reported taxable income above the tax threshold. There are very few poor or near-poor households who are either formally employed or who claim to have paid PAYE with taxable income greater than the tax threshold.29

Direct transfers in Uganda are minimal and thinly spread. The direct transfers covered here – the HISP and the PWP, both delivered under the NUSAF, and the SCG and the VFSG under the SAGE – cover few individuals or households. The cumulative value of these transfers is approximately 0.1 percent of cumulative market income. NUSAF is, as its name implies, targeted to a specific region while the SAGE program was still a pilot program in 2012. As a result, there

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27 Pension contributions are not allocated in this Uganda CEQ Assessment because of a lack of data on both the household side and the budget and administrative side.

28 In the UNHS, we find one poor household who records receipt of pension income.

29 Our imputation gave us only two observations where a household was poor and paid PAYE; they were both rural households and they were imputed to be in the lowest tax bracket where the effective marginal rate was determined to be about 8.5 percent. Both these households are also estimated to be poor households at market income and market income + pensions income concepts, meaning they would have been poor whether or not there was a PAYE system and whether or not they actually contributed to PAYE revenues.
is no significant impact of any one of these programs on either poverty or inequality (table 16-5); their joint impact is to reduce both poverty and inequality by very small amounts.

The bottom two deciles are estimated to receive over 50 percent of the transfers available; transfers received represent about 7 percent of the pre-fisc income of transfer beneficiaries or 9.5 percent of the pre-fisc income of poor beneficiaries. In other words, direct transfers in Uganda are well targeted and make a significant difference to those who receive them, but overall less than 3 percent of Ugandan households receive these transfers (in a given year). The nationwide distribution of income is largely unchanged even after these programs are executed, meaning that though they do reduce poverty and inequality their impact on nationwide indicators is minimal.

Table 16-5: Marginal Impacts on Inequality and Poverty (at Final Income): Direct Taxes and Direct Transfers

<table>
<thead>
<tr>
<th>Contributions</th>
<th>Inequality</th>
<th>Poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contributions to Pensions</td>
<td>....</td>
<td>....</td>
</tr>
<tr>
<td>Contributory Pensions</td>
<td>-0.0001</td>
<td>-0.001</td>
</tr>
<tr>
<td>PAYE Personal Income Taxes (imputed)</td>
<td>-0.013</td>
<td>0.000</td>
</tr>
<tr>
<td>Net Market Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Direct Transfers (excl. contrib. pensions)</td>
<td>-0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>PWP</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>HISP</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>SCG</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>VFSG</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Disposable to Final Income: Indirect Taxes and Subsidies; In-kind Health, and Education Expenditures

Inequality decreases slightly from disposable to consumable income, meaning that once we add income received as indirect subsidies and subtract income that represents indirect taxes paid, the resulting distribution is more equal. The indirect taxes included here are the VAT and the excise tax (including the fuel excise); the revenue collections allocated under these taxes are equivalent to approximately 2 percent of cumulative market income plus pensions. VAT, the non-fuel excise, and the fuel excise account for approximately 52, 45, and 3 percent of the total indirect taxes allocated. The indirect subsidies included here are the Rural Electrification Program, the Water Supply Program, and the Agricultural Input Subsidy Program; these three subsidies together provide benefits equal to approximately 0.2 percent of cumulative market income. The Water Supply Program is the largest indirect subsidy (in terms of

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30 The disposable income concept, based on consumption expenditures valued at prevailing prices, does not explicitly contain the expenditure done by the government on behalf of the consumer (in the form of a subsidy) nor does it explicitly ignore expenditure done by the consumer on behalf of the government (in the form of indirect taxes paid).

31 We generate “effective” rates of taxation within the UNHS of 14.6, 20.2, and 245 percent for the VAT, non-fuel excise, and fuel excise taxes. The statutory VAT rate is 18 percent, the statutory non-fuel excise rate varies, and the statutory fuel excise is a fixed nominal amount per liter.
expenditure) while the Rural Electrification Program and the Agricultural Input Subsidy Program transfer approximately the same benefit totals. Table 16-6 provides the marginal impacts of these fiscal policy instruments on inequality and poverty (at final income).

**Most households pay more in indirect taxes than they receive in indirect subsidies, but enough poor households receive enough subsidies such that the poverty rate actually stays constant when indirect taxes and subsidies are allocated.** Rural households, primarily, may be lifted out of poverty when the government spends to deliver goods and services (water, electricity, and agricultural inputs) at below market prices (table 16-6). Among poor households only, total subsidies received represent about 0.8 percent of their (cumulative) disposable income, but the share of total subsidies received rises with income. Subsidies can have a poverty-reduction impact, but relative to direct transfers they are an inefficient way to assist poor and vulnerable households as subsidies are targeted towards higher-volume users by design.

Table 16-6: Marginal Impacts on Inequality and Poverty (at Final Income): Indirect Taxes, Subsidies and Spending on Education and Health

<table>
<thead>
<tr>
<th>Indirect Subsidies</th>
<th>Inequality</th>
<th>Poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disposable Income</td>
<td>-0.0005</td>
<td>-0.002</td>
</tr>
<tr>
<td>Electricity</td>
<td>0.0000</td>
<td>0.000</td>
</tr>
<tr>
<td>NAADS – Ag. Inputs</td>
<td>-0.0002</td>
<td>0.000</td>
</tr>
<tr>
<td>Indirect Taxes</td>
<td>-0.002</td>
<td>0.005</td>
</tr>
<tr>
<td>VAT</td>
<td>-0.0013</td>
<td>0.0032</td>
</tr>
<tr>
<td>Excise</td>
<td>-0.0007</td>
<td>0.0025</td>
</tr>
<tr>
<td>Fuel excise</td>
<td>-0.0003</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In-kind spending</th>
<th>-0.017</th>
<th>n.c.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>-0.010</td>
<td>n.c.</td>
</tr>
<tr>
<td>Primary school</td>
<td>-0.010</td>
<td>n.c.</td>
</tr>
<tr>
<td>Secondary</td>
<td>-0.002</td>
<td>n.c.</td>
</tr>
<tr>
<td>Tertiary</td>
<td>0.002</td>
<td>n.c.</td>
</tr>
<tr>
<td>Health</td>
<td>-0.006</td>
<td>n.c.</td>
</tr>
<tr>
<td>Clinic-based care</td>
<td>-0.005</td>
<td>n.c.</td>
</tr>
<tr>
<td>Hospital-based care</td>
<td>-0.001</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

Key: n.c. means the value was not calculated

In the CEQ framework, only those who utilize the public service provision system can benefit from publicly-financed outputs in health and education. Even so, in Uganda, **these “in-kind” services make the largest impact on inequality**: the Gini index of inequality drops by 1.7 points in between consumable and final income, and the marginal contribution of in-kind spending is approximately double that of the fiscal policy element with the next largest marginal contribution (personal income taxes). **Education makes a larger marginal contribution to inequality reduction** – see the international comparisons in table 16-7 – but there are higher total expenditures in the public education system.
The impact of public education expenditures depends on rates of enrollment – is enrollment higher among poorer or richer households, and does the difference vary across schooling levels? The impact of public education expenditure also depends on the generosity of the benefits provided – typically, the education benefit level rises with the level of schooling, such that public university enrollees will receive an in-kind transfer with a larger monetary value than will primary school enrollees. In Uganda, education benefits do rise with education levels: the capitation grant (alone) is five to six times as large for secondary school students as for primary school students, for example (see section 2 above). However, poorer household enrollment is weighted heavily toward primary school, so poorer households have a larger share of the available primary school benefits but smaller shares of the available secondary and tertiary school benefits. Overall, the public education benefit share of the poorest decile (ranked by market income) is roughly 7.5 percent while the same share for the middle and richest deciles are 9.5 and 15.5 percent (respectively). Compare this to health benefits, where the poorest decile has a 10.5 percent share of the total public health benefits available, the middle decile a 9.7 percent share, and the top decile a 10.3 percent share.

However, the education benefits received by the poorest decile represent 6.7 percent of market income in that group, while the education benefits received by the richest decile represent 1.1 percent of market income in that group. For health benefits the analogous numbers are 6.5 percent (for the poorest decile) and 0.5 percent (for the richest decile). Even though shares of total public health spending are more equitably distributed (than education benefits), nonetheless public health benefits are of smaller magnitude (than education benefits) and the total impact on inequality from public health is less than that from public education spending.

As can be seen from table 16-7 below, the profile of impacts from in-kind spending in Uganda is slightly better than average: both primary and secondary education and health are pro-poor in that per-capita amounts spent fall as income rises. Only tertiary education is unequalizing (benefits as a share of market income rise as income rises) in Uganda, but that is true in Ethiopia, Ghana, and Tanzania as well.

Table 16-7: Inequality-reduction profile of in-kind spending, by country (around 2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>Education (Total)</th>
<th>Pre-school</th>
<th>Primary</th>
<th>Tertiary</th>
<th>Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina (2012)</td>
<td>A</td>
<td>A</td>
<td>n.a.</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Armenia (2011)</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>B</td>
</tr>
<tr>
<td>Bolivia (2009)</td>
<td>B</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>B</td>
</tr>
<tr>
<td>Brazil (2009)</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Chile (2013)</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Dominican Republic (2013)</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>A</td>
</tr>
</tbody>
</table>

Encouragingly, we find that total education expenditures – including capital spending and other supplies, administrative costs, teacher salaries, and others – per pupil are approximately five times as large for a secondary school student as for a primary school student, and approximately three times as large for a tertiary school student as for a secondary school student. In the Uganda CEQ Assessment, we allocate to each household with one or more publicly-enrolled students a uniform benefit equal to total education expenditure (by schooling level) per enrolled student (at that level).
Imagine two different fiscal scenarios in a two-person economy with one poor individual having $48 and one rich individual with $52 in income (so that total income in this economy is $100). In the first scenario, fiscal policy taxes all income from non-poor individuals at 3.85 percent and then executes an omnibus transfer to poor households such that the rich individual has a final income of $50.01 and the poor individual a final income of $49.99 (and the government funds its operations with external aid). In this scenario, redistribution is limited, but the impact on inequality is large. In the second scenario, fiscal policy (overall) taxes all income from any individual at 100 percent and then executes transfers such that the (formerly) rich individual ends up with $48 and the (formerly) poor individual ends up with $52 (and again the government receives external aid to fund its operations). In this scenario, redistribution is extensive but there is essentially zero impact on inequality.

The reranking (RR) index summarizes – for any pre- and post-fiscal distribution of income – the impact that any redistributive program has on “horizontal” equity due to re-ranking (as described
intuitively above). Horizontal equity here captures the degree to which households who are “near” each other (in terms of their ranking in the income distribution) are treated equally. In the first scenario above, horizontal equity was complete, in that the first- and second-ranked individuals remained the first and second-ranked individuals after the government had completed its fiscal policy. In the second scenario, horizontal equity was incomplete as top-ranked individual fell to the bottom rank in the post-fiscal income distribution. In lay terms, the RR index summarizes how much “place swapping” there is for any amount of redistribution of income.

Uganda’s RR index is quite small absolutely as well as when measured relative to the total amount of redistribution accomplished by fiscal policy. For example, total redistribution (or the vertical equity component) from market income to final income is 3.2 Gini points, while 0.3 points of that redistribution contributed to place-swapping. In other words, approximately 8 percent of the total redistribution that occurred (and is attributable to fiscal policy) had no impact on inequality. From market income to disposable income, approximately 7 percent of the total redistribution that occurred and is attributable to the execution of fiscal policy had no impact on inequality.

16.5 Conclusions and Policy Implications

Fiscal policy – including many of constituent elements – is inequality-reducing in Uganda. For example, inequality including personal income tax is lower than inequality would be if there were no personal income tax. Likewise, inequality is reduced when the SAGE and NUSAF direct transfers are received, and inequality is reduced after public healthcare services are accessed. The only fiscal policy element in Uganda (among those included in Uganda’s CEQ Assessment) that increases inequality is tertiary education spending, but this result, too, would be overturned if there were a greater number of students from poor households in upper education levels.

However, the impact of fiscal policy on current-year inequality is modest: fiscal policy achieves a reduction of approximately 3 Gini points in Uganda. The impact magnitude is tied to low levels of spending in Uganda generally. For example, Ethiopia\footnote{2011 Ethiopia (Uganda) GNI per-capita (2011 PPP factor): $1160 ($1620)}, a country with a similar per-capita income level, spends approximately twice as much as Uganda does overall, twice as much on redistributive spending (so that Ethiopia’s redistributive spending as a share of total spending is approximately equal to Uganda’s), and approximately twice as much on direct transfers as well as education (relative to GDP). The impact of fiscal policy in Ethiopia (relative to pre-fisc inequality levels) is approximately average, while in Uganda the impact of fiscal policy (relative to pre-fisc inequality levels) is below average. In other words, the redistributive spending that Uganda executes, and the targeting of both social expenditures as well as the revenue collections that support them, help reduce inequality. The small impact is due to low revenue collection and spending overall.

The impact of fiscal policy on poverty is negligible. While an insignificant number of poor or near-poor households are burdened by the personal income tax, it is also true that very few households receive any of the direct transfers available under the SAGE or NUSAF programs. The net income position of most households after indirect taxes are paid and indirect subsidies are received is slightly lower than before those fiscal policy elements are allocated. However, the
poor households that do receive net additions to their incomes receive more (as a percent of their pre-fiscal income) than the poor households that become net payers into the fiscal system.

Poverty-neutral fiscal policy looks very good relative to African countries with similar income levels. The execution of fiscal policy in Ethiopia, Ghana, and Tanzania (for example) leaves the post-fiscal poverty rate higher than the pre-fiscal poverty rate.

Recent directions in fiscal policy have focused on increasing revenues without concurrent social spending increases. For example, the tax-to-GDP ratio has risen since the 2012/13 fiscal year, but total direct and indirect benefit expenditure has increased at a slower rate during the same period. Since 2012/13-era personal income tax thresholds were high enough to protect poor households, if the increased revenues have come primarily from more efficient personal income tax collection, then it is likely that poor households are no worse off in 2015/16 than in 2012/13.

On the other hand, in 2012/13, Uganda’s tax collections came primarily from VAT, excise, and customs duties. If the increase in revenues (from taxes) since 2012/13 has proceeded proportionally to 2012/13 tax instrument shares – if in other words most of the increase to 2015/16 is coming from the indirect tax instruments mentioned above – then it is likely the case that poor and near-poor households face greater disadvantage today. The VAT and excise taxes were widespread – over 95 percent of households paid at least one of the indirect taxes and the burden they create is approximately neutral with respect to consumption expenditure. So if the increase in revenues has been achieved by closing exemptions for particular goods – unprocessed agricultural goods, for example, or health and education services – then poor households will face a proportionally-greater burden in 2015/16 than in 2012/13.

If in the future indirect taxes on “luxury goods” – or a set of products and services which are primarily consumed by non-poor households – can contribute the bulk of marginal revenues from indirect taxes, then poor households may remain (marginally) unaffected by the drive to increase revenues. For example, the fuel excise does not create a direct burden for poor or near-poor households, and therefore does not contribute to an increase in the poverty headcount, because lower-income households in Uganda purchase no fuel directly. Targeting marginal revenue increases from indirect taxes to “luxury” good purchases would similarly protect poor households and unlike fuel would not create an indirect burden for households as long as the luxury goods targeted were not themselves important inputs for the production of other goods and services.

Recent budgets have allocated more resources towards investment in the productive sectors and infrastructure. If this focus on infrastructure were broadened to include human-capital-enhancing infrastructure like schools, health facilities, and low-cost, high-quality housing, the impact on inequality of fiscal policy would likely be enhanced. As the Uganda CEQ Assessment has demonstrated, the equalization of access to public education and healthcare services provides over half of the reduction in inequality from fiscal policy overall.

However, public services alone cannot create a more equal future for Ugandans; despite relatively high enrolment numbers, Uganda’s results in standardized assessments of education performance are below average. In addition, tertiary education appears to be out of reach for most low-
middle-income households in Uganda. Likewise, current investments in electricity should continue increasing the rate of access among poor and disadvantaged households, but the impact of this access on inequality will depend on the (regulated) tariff-setting procedures that the government decides. Increasing public service provision reduces inequality in the short-term, but longer-term impacts will depend also on how the public service delivery and public capital investment are managed.

Capital spending (or other infrastructure investment) may also have a salutary effect on poverty and inequality in the short-term when it is channelled through a broad-coverage PWP like the Productive Safety Net Program in Ethiopia, the Vision 2020 Umurenge Program in Rwanda, or the Program Nasional Pemberdayaan Masyarakat (PNPM) community-driven development program in Indonesia. These programs allocate public expenditures for infrastructure investment at least partially to poor or vulnerable households through the payment of wages for labor contributions on the infrastructure projects themselves. While in the longer-term the areas receiving infrastructure and other physical capital may benefit more generally, in the short-term poor and vulnerable individuals benefit directly from paid employment for labor contributed. Uganda already has experience with such a program – the community-based PWP in NUSAF II – and could adapt operational lessons learned to a national, broad-coverage PWP program.

These recent fiscal policy developments – increased revenue collections and an emphasis on infrastructure spending – are general in that they affect nearly all Ugandans. Specifically-disadvantaged populations (the elderly poor; the jobless or under-employed poor) may require specifically-targeted programs, and Uganda already has a few such instruments in place. The planned increases in the SAGE program – for example – will likely further reduce inequality as well as the poverty headcount. However, as SAGE was previously donor-financed, any increase in SAGE expenditures will require a concurrent increase in revenue collections (at least in present-value terms), and the source of these additional revenues will determine whether on net the fiscal system is poverty- and inequality-reducing.
References


Chapter 16, Jellema, Lustig, Haas, and Wolf


