HOW ACCURATE IS THE KAKWANI INDEX IN PREDICTING WHETHER A TAX OR A TRANSFER IS EQUALIZING? AN EMPIRICAL ANALYSIS

Ali Enami, Patricio Larroulet, and Nora Lustig

CEQ INSTITUTE
COMMITMENT TO EQUITY
Tulane University

Working Paper 116
January 2022

The CEQ Working Paper Series

The CEQ Institute at Tulane University works to reduce inequality and poverty through rigorous tax and benefit incidence analysis and active engagement with the policy community. The studies published in the CEQ Working Paper series are pre-publication versions of peer-reviewed or scholarly articles, book chapters, and reports produced by the Institute. The papers mainly include empirical studies based on the CEQ methodology and theoretical analysis of the impact of fiscal policy on poverty and inequality. The content of the papers published in this series is entirely the responsibility of the author or authors. Although all the results of empirical studies are reviewed according to the protocol of quality control established by the CEQ Institute, the papers are not subject to a formal arbitration process. Moreover, national and international agencies often update their data series, the information included here may be subject to change. For updates, the reader is referred to the CEQ Standard Indicators available online in the CEQ Institute's website www.commitmentoequity.org/datacenter. The CEQ Working Paper series is possible thanks to the generous support of the Bill & Melinda Gates Foundation. For more information, visit www.commitmentoequity.org.

The CEQ logo is a stylized graphical representation of a Lorenz curve for a fairly unequal distribution of income (the bottom part of the C, below the diagonal) and a concentration curve for a very progressive transfer (the top part of the C).

COMMITMENT
TO EQUITY

CEQ INSTITUTE
COMMITMENT TO EQUITY
Tulane University

HOW ACCURATE IS THE KAKWANI INDEX IN PREDICTING WHETHER A TAX OR A TRANSFER IS EQUALIZING? AN EMPIRICAL ANALYSIS*

Ali Enami‡, Patricio Larroulet§, and Nora Lustig†

CEQ Working Paper 116

JANUARY 2022

ABSTRACT

The Kakwani index of progressivity is commonly used to establish whether the effect of a specific tax or transfer is equalizing. However, in the presence of reranking or the *Lambert conundrum*, a progressive tax could be unequalizing. While it is mathematically possible for counterintuitive results to occur, how common are they in actual fiscal systems? Using a novel dataset that includes fiscal incidence results for 39 countries, we find that the likelihood of the Kakwani index to be progressive (regressive) while the tax or transfer is unequalizing (equalizing) is minimal, except in the case of indirect taxes: in roughly 25 percent of our sample, regressive indirect taxes are *equalizing* (sign-inconsistent cases). Additionally, the likelihood that the index ranks the magnitude of the impact of a tax or a transfer wrongly exists but is also small. Finally, using regression analysis, we find that increasing the size or progressivity of a progressive tax (transfer) is equalizing and statistically robust for sign-consistent cases. For sign-inconsistent cases, the coefficient for the Kakwani index is not statistically significant. In sum, although the Kakwani index could yield interpretations that are inaccurate in actual fiscal systems, the risk seems small except for indirect taxes.

JEL Codes: D31, D63, H22, H23

Key words: Kakwani index, fiscal redistribution, reranking, progressivity, marginal contribution, taxes, transfers, Lambert

---

* This paper, without the appendixes, will appear in a special issue of the Journal of Income Distribution.
We are grateful to the editor and our annonimous referee for their invaluable comments. Corresponding author: Nora Lustig. *Email address: nlustig@tulane.edu.*
‡ *The University of Akron, United States.*
§ *Center for the Study of the State and Society (CEDES), Argentina.*
† *Tulane University, United States.*
This paper was prepared as part of the Commitment to Equity Institute's country-cases research program and benefitted from the generous support of the Bill & Melinda Gates Foundation. For more details, click here www.ceqinstitute.org.

How Accurate is the Kakwani Index in Predicting Whether a Tax or a Transfer is Equalizing? An Empirical Analysis

Ali Enami[a], Patricio Larroulet[b], and Nora Lustig[c,1]

January 3, 2021

[a] *The University of Akron, United States.*

[b] *Center for the Study of the State and Society (CEDES), Argentina.*

[c] *Tulane University, United States.*

Abstract

The Kakwani index of progressivity is commonly used to establish whether the effect of a specific tax or transfer is equalizing. However, in the presence of reranking or the *Lambert conundrum*, a progressive tax could be unequalizing. While it is mathematically possible for counterintuitive results to occur, how common are they in actual fiscal systems? Using a novel dataset that includes fiscal incidence results for 39 countries, we find that the likelihood of the Kakwani index to be progressive (regressive) while the tax or transfer is unequalizing (equalizing) is minimal, except in the case of indirect taxes: in roughly 25 percent of our sample, regressive indirect taxes are *equalizing* (sign-inconsistent cases). Additionally, the likelihood that the index ranks the magnitude of the impact of a tax or a transfer wrongly exists but is also small. Finally, using regression analysis, we find that increasing the size or progressivity of a progressive tax (transfer) is equalizing and statistically robust for sign-consistent cases. For sign-inconsistent cases, the coefficient for the Kakwani index is not statistically significant. In sum, although the Kakwani index could yield interpretations that are inaccurate in actual fiscal systems, the risk seems small except for indirect taxes.

Keywords: Kakwani index, fiscal redistribution, reranking, progressivity, marginal contribution, taxes, transfers, Lambert

JEL Codes: D31, D63, H22, H23

[1] We are grateful to the editor and our annonimous referee for their invaluable comments. Corresponding author: Nora Lustig. *Email address: nlustig@tulane.edu.*

I. Introduction

When analyzing a fiscal system, we are interested in knowing whether the effect of a specific tax or transfer (or combinations of them) is equalizing or not. To establish this, researchers frequently use the Kakwani index of progressivity.[2] The Kakwani index for a tax is defined as the difference between the concentration coefficient for the tax in question and the Gini coefficient of prefiscal income.[3] A positive (negative) Kakwani index means that the tax or transfer is progressive (regressive).[4] The presumption is that if –based on the Kakwani index– a tax is progressive (regressive), post-tax income inequality will be lower (higher). However, there are (at least) a couple of reasons why this may not be the case. One is reranking. If a progressive tax results in reranking, post-tax income inequality could be higher than pre-tax inequality. A second less known reason was first identified by Lambert (1985, 2001). Lambert showed that -even in the absence of reranking- a regressive tax can be equalizing in the sense that the fiscal system would reduce postfiscal inequality by less if the regressive tax is removed (and replaced by "manna from heaven," for example).[5] Reranking and Lambert's counterintuitive result (hereafter, Lambert's conundrum) also imply that a common dictum used in public finance -namely, that increasing the size or progressivity of a progressive tax (transfer) will be more equalizing –not necessarily holds. Using a novel dataset on fiscal incidence studies for 39 countries, we analyze the extent to which the Kakwani index could produce the wrong answers in actual fiscal systems.

Given that reranking is not uncommon and that the Lambert conundrum is potentially possible, how can one determine whether a specific tax (transfer) will exercise an equalizing force? An unambiguous indicator is obtained by comparing the Gini coefficient for the income concept that includes everything *but* the tax (transfer) with the postfiscal Gini coefficient that includes everything *and* the tax (transfer) of interest.[6] If the latter is lower than the former, that tax (transfer) is equalizing. We call the difference between the "without" and "with" the tax (transfer) Gini coefficient the marginal contribution. If the sign of the marginal contribution is positive (negative), the tax or the transfer under analysis is equalizing (unequalizing).[7]

---

[2] Kakwani, Nanak (1977) "Measurement of Tax Progressivity: An International Comparison," Economic Journal, 87,71-80. See Duclos and Araar (2006) Chaper 8 for a discussion of progressivity indexes.

[3] The Kakwani index for a transfer is usually defined as the difference between the Gini coefficient of prefiscal income and the concentration coefficient for the transfer in question. See, for example, Lambert (2001).

[4] The Kakwani index for a transfer is defined as the difference between the Gini coefficient of prefiscal income and the concentration coefficient for the transfer in question. Again, a positive (negative) Kakwani index means that the transfer is progressive (regressive).

[5] See Appendix A for the mathematical demonstration of Lambert's counterintuitive result. Note that this specific Lambert's result is not equivalent to the well-known result that efficient regressive taxes are "fine" as long as the net fiscal system is equalizing when combined with transfers. The surprising aspect of Lambert's result is that a net fiscal system with a regressive tax can be more equalizing than without the regressive tax. For more general results that apply to taxes and transfers see Enami, Lustig, and Aranda (2018) and Enami (2018).

[6] One can calculate the marginal contribution for a specific tax (transfer) or any combination of them including all taxes (transfers) combined.

[7] If the two Gini coefficients are equal, then the impact of the tax (transfer) on inequality will be null or neutral.

The implications of reranking and Lambert's conundrum for real fiscal systems are significant. To determine whether a particular tax (transfer) is inequality-reducing (increasing) –and by how much– or whether the dictum that increasing the progressivity or size of a progressive tax (transfer) is equalizing, one must resort to numerical calculations that include the whole fiscal system. This can be very time- and resource-consuming. In contrast, calculating the Kakwani index for a particular tax (transfer) is simpler because it requires the incidence of just the tax or transfer of interest. However, if the Kakwani index can give us the wrong answers, we may be hesitant to use it. While it is mathematically possible for counterintuitive results to occur, how common are they in actual fiscal systems? In this paper we address this question empirically using a novel data set housed in the CEQ Institute Data Center on Fiscal Redistribution. This data set contains detailed results from applying comprehensive fiscal incidence analyses using a common methodological approach.[8]

Our empirical analysis consists of the following. We use information on Kakwani indexes, marginal contributions, and size of taxes and transfers for 87 country studies. The country studies include different countries, the same country for different years, and different scenarios regarding contributory pensions.[9] We first calculate the probability of consistent and inconsistent cases for four categories of fiscal policy: direct taxes, direct transfers, indirect taxes, and indirect subsidies for all the country studies. That is, we first measure the frequency of cases in which the Kakwani index and the marginal contribution have the same sign (sign-consistent cases) versus the frequency in which the Kakwani index fails to accurately predict whether a tax or a transfer is equalizing or unequalizing (sign-inconsistent cases). Our results show that for everything but indirect taxes, inconsistent results appear only in three cases. That is, the risk of a Kakwani index yielding a misleading result is minimal. However, in the case of indirect taxes, we find that in 22 country cases the two indicators do not have the same sign. That is, in roughly 25 percent of our sample there is sign-inconsistency: regressive indirect taxes, based on the Kakwani index, are *equalizing* (i.e., the marginal contribution is positive).

For the cases in which there is sign-consistency, how similar is the ranking between the two indicators in terms of order of magnitude (magnitude-consistency)? We find 9 pairs of cases (about 6 percent of the possible pairs) in which the magnitude of the Kakwani index and the magnitude of the size of the tax or the transfer do not map into a similar magnitude for the marginal contribution.

Given the above results, one main conclusion of the paper is that the frequency of both sign-inconsistency and magnitude-inconsistency are relatively small, but they exist. Sign-inconsistency is more common only in the case of indirect taxes which means that one should be cautions to use a partial analysis (i.e., the Kakwani index) when assessing their impact on inequality.

[8] A detailed description of the approach is in Lustig (2018).
[9] In terms of countries, our data covers 39.

To test the dictum that increasing the size or progressivity of a progressive tax (transfer) is equalizing (hereafter, fiscal redistribution dictum-consistency), we regress the marginal contribution of each component of fiscal policy on their respective Kakwani index and size.[10] Our results show that in general the dictum is statistically robust whenever there is no inconsistency between the prediction of the Kakwani index and the marginal contribution. However, when looking at inconsistent cases only (which mainly occur for indirect taxes), the coefficient for the Kakwani index is not statistically and/or economically significant. The latter means that making those interventions more progressive, will not necessarily make the equalizing (unequalizing) effect higher (lower). It is reassuring, however, that the regression results do not suggest that the result could be that making the intervention more progressive would reduce (increase) the equalizing (unequalizing) effect.

In sum, our results suggest that the Kakwani index of progressivity is an empirically robust indicator of the impact of taxes or transfers on inequality except for indirect taxes. To the best of our knowledge, this is the first time that the accuracy of the Kakwani index is assessed empirically with cross-country data for such a diverse sample of cases. This is our primary contribution to the literature. Additionally, the fact that our analysis relies on a novel database constructed from applying a comparable and comprehensive fiscal incidence methodology to the countries in the sample is another contribution of our paper to the literature.

The paper is organized as follows. The next section describes the methodology and data. Section III presents results. Section IV concludes.

II. Methodology and Data

II.a. Research Design

A fundamental question in analyzing fiscal systems is whether taxes (transfers) are equalizing or unequalizing. A commonly used indicator to address this question is the Kakwani index, defined as follows:

$$\boldsymbol{\Pi_T^K = C_T - G_X} \quad \textbf{(1)}$$

where C_T is the concentration coefficient of the tax t and G_X is the Gini coefficient of prefiscal income. For transfers, the two elements in the right-hand side are usually inverted so that a positive sign is always associated with a progressive fiscal intervention.

$$\boldsymbol{\rho_B^K = G_X - C_B} \quad \textbf{(2)}$$

In a world with a single fiscal intervention and no reranking, it is sufficient to know whether the Kakwani index for a particular intervention indicates that it is progressive or regressive to give an unambiguous response to the question mentioned above. That is, in the absence

[10] Size is defined as the ratio of the total amount of the relevant component of fiscal policy (e.g., total direct taxes) in the fiscal incidence exercise to the relevant total prefiscal income. Because both the numerators and denominators might be different from fiscal budget and GDP data, the ratios used here do not necessarily match the sizes measured with administrative data.

of reranking, 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. In a world of a single intervention and no reranking, progressivity (regressivity) and equalizing (unequalizing) are terms that can be used interchangeably.

However, as Lambert (2001) pointed out, the biunivocal relationship between the Kakwani index of a fiscal intervention and its redistributive effect no longer necessarily holds with multiple interventions even if there is no reranking. Lambert showed that the net redistributive effect can be written as a weighted sum of the Kakwani indexes for taxes and transfers. Mathematically, the formula is:

$$\boldsymbol{\Pi_N^{RE}} = \frac{(\boldsymbol{g\Pi_T^K + \mathbf{b}\,\rho_B^K})}{(\mathbf{1 - g + b})} \qquad \textbf{(3)}$$

where $\boldsymbol{\Pi_N^{RE}}$ is the redistributive effect (that is, the difference between the prefiscal and postfiscal Gini coefficients); $\mathbf{g}$ and $\mathbf{b}$ are the ratio of taxes and transfers to pre-fiscal income, respectively; and, $\boldsymbol{\Pi_T^K}$ and $\boldsymbol{\rho_B^K}$ are the Kakwani indexes for total taxes and total transfers, respectively.

Given the above equation, it is possible for a fiscal system to reduce inequality by more when it includes a regressive tax ($\Pi_T^K < 0$) comparing to an alternative fiscal system that excludes such tax (and the necessary tax revenue is replaced by "manna from heaven", for example). We call this the *Lambert conundrum* and it is theoretically possible as long as the following holds (more details are presented in Appendix A):

$$\boldsymbol{\Pi_T^K} > \; -\frac{(\boldsymbol{b})}{(\mathbf{1}+\boldsymbol{b})}\boldsymbol{\rho_B^K} \qquad \textbf{(4)}$$

In the presence of reranking, as shown by Enami (2018), it is possible to have a progressive (regressive) Kakwani but the tax or transfer be unequalizing (equalizing), even if there is a single intervention.[11]

An unambiguous indicator of whether a tax or a transfer is equalizing (unequalizing) is the *marginal contribution*. 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 considering. For instance, taking the Gini coefficient as the inequality measure, and calculating the marginal contribution of direct taxes to disposable income:

$$\boldsymbol{MC_{Direct\ taxes}^{Disposable\ income}} = \boldsymbol{G_{Disposable\ income\ excluding\ Direct\ taxes} - G_{Disposable\ income}} \qquad \textbf{(5)}$$

If this difference is positive (negative), then the direct taxes are equalizing (unequalizing). If the difference equals zero, the tax or transfer is "neutral". These are always mathematically true even in the presence of reranking or Lambert's conundrum. From a policy perspective, the marginal contribution has a straightforward interpretation: Would disposable income

[11] In the above formula, the $\boldsymbol{\Pi_N^{RE}}$ term is the Reynolds-Smolensky index of vertical equity (see Duclos and Araar, 2006, chapter 7), and not the redistributive effect. It is theoretically possible then to have progressive Kakwani indexes for taxes and transfers, and the system to show no redistribution, just reranking.

inequality be higher, equal, or lower with direct taxes than without them? The marginal contribution of a particular component of fiscal policy depends on the postfiscal income concept used to calculate them. Thus, as shall be seen below, there will be more than one marginal contribution for each component of fiscal policy.[12]

While it is mathematically possible for a component of fiscal policy to be Kakwani progressive (regressive) yet unequalizing (equalizing), how frequently does this occur in actual fiscal systems? As stated in the Introduction, to assess the extent to which the Kakwani index yields accurate predictions regarding the impact of taxes and transfers on postfiscal inequality, we do the following. First, we calculate the frequency with which we observe that both the Kakwani index and the marginal contribution show that a fiscal intervention is equalizing (unequalizing). We call this the sign-consistency check. Second, for the cases in which there is sign-consistency, how frequently the magnitude of the Kakwani index and the magnitude of the size of the tax or the transfer map into a similar magnitude for the marginal contribution? We call this the magnitude-consistency check. Finally, to test the dictum that increasing the size or progressivity of a progressive tax or transfer is equalizing (hereafter, fiscal redistribution dictum-consistency), we regress the marginal contribution on the Kakwani index and size exploiting the cross-country variation in these variables in the data used here.[13] Our consistency analyses are carried out for four broad categories of fiscal policy: direct taxes, direct transfers, indirect taxes and subsidies.

II.b. Data

To undertake our empirical analysis, we use a novel data set housed in the Commitment to Equity Institute's Data Center on Fiscal Redistribution (CEQ Data Center)[14]. Our database includes the results of fiscal incidence analyses for 39 countries. For a subset of 8 countries, there are results for different years. In addition, as it is discussed later, given that social insurance old-age contributory pensions can be treated as deferred income (PDI) or a pure government transfer (PGT), there are a total of 50 PDI and 37 PGT scenarios for the covered country-years. Our empirical analysis requires availability of the three following indicators: the Kakwani index, the marginal contribution, and the size of each intervention that we analyze. This yields a total of 87 country studies (data points) shown in Table 1. Recall that the total number of country studies is constructed by adding the number of countries with a fiscal incidence study, the number of years there is a fiscal incidence analysis for the same country, and the number of country-years with a PDI and a PGT scenario. Thus, for example, for El Salvador there are 8 data points: 4 years times 2 scenarios. For Argentina, there are 3 data points: 2 years but only 1 of them has 2 scenarios. The table also includes the availability of indicators for disposable and consumable income whose definitions and use are described further below.

[12] In contrast, the Kakwani index is always calculated with respect to the prefiscal income and would have a different value when the prefiscal income is different.
[13] The dictum states, more generally, that increasing the progressivity (regressivity) of a fiscal component will make the system more equalizing (unequalizing). Regarding size, the dictum states that increasing the size of a progressive (regressive) fiscal component, will make the system more equalizing (unequalizing).
[14] https://commitmentoequity.org/datacenter/

Table 1. Data Availability

Country	Year	PDI		PGT	
		Disposable income	Consumable income	Disposable income	Consumable income
Argentina	2012	Yes	Yes	No	No
	2017	Yes	Yes	Yes	Yes
Armenia	2011	Yes	Yes	Yes	Yes
Bolivia	2009	No	Yes	Yes	Yes
	2015	No	Yes	Yes	Yes
Brazil	2009	Yes	Yes	Yes	Yes
Chile	2013	Yes	Yes	Yes	Yes
China	2014	Yes	Yes	Yes	Yes
Colombia	2010	Yes	Yes	Yes	Yes
	2014	Yes	Yes	Yes	Yes
Comoros	2014	Yes	Yes	No	No
Dominican Republic	2013	Yes	Yes	Yes	Yes
Ecuador	2011	Yes	Yes	Yes	Yes
El Salvador	2011	Yes	Yes	Yes	Yes
	2013	Yes	Yes	Yes	Yes
	2015	Yes	Yes	Yes	Yes
	2017	Yes	Yes	Yes	Yes
Eswatini	2017	Yes	Yes	Yes	Yes
Ghana	2012	Yes	Yes	No	No
Guatemala	2011	Yes	Yes	Yes	Yes
	2014	Yes	Yes	Yes	Yes
Honduras	2011	Yes	Yes	No	No
India	2011	Yes	Yes	Yes	Yes
Iran	2011	Yes	Yes	Yes	Yes
Ivory Coast	2015	Yes	Yes	No	No
Kenya	2015	Yes	Yes	No	No
Lesotho	2017	Yes	Yes	No	No
Mexico	2012	Yes	Yes	Yes	Yes
	2014	Yes	Yes	Yes	Yes
Namibia	2010	Yes	Yes	Yes	Yes
	2016	Yes	Yes	No	No
Nicaragua	2009	Yes	Yes	Yes	Yes
Panama	2016	Yes	Yes	Yes	Yes
Peru	2011	Yes	Yes	Yes	Yes
Russia	2010	Yes	Yes	Yes	Yes
South Africa	2010	Yes	Yes	No	No
	2015	Yes	Yes	No	No
Spain	2017	Yes	Yes	Yes	Yes
Sri Lanka	2009	Yes	Yes	No	No
Tajikistan	2015	Yes	Yes	Yes	Yes

Tanzania	2011	Yes	Yes	No	No
Togo	2015	Yes	Yes	Yes	Yes
Tunisia	2010	Yes	Yes	Yes	Yes
Turkey	2014	Yes	Yes	Yes	Yes
Uganda	2012	Yes	Yes	Yes	Yes
	2016	Yes	Yes	Yes	Yes
United States	2016	Yes	Yes	Yes	Yes
Uruguay	2009	Yes	Yes	Yes	Yes
Venezuela	2013	Yes	Yes	Yes	Yes
Zambia	2015	Yes	Yes	Yes	No

Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Spain 2017 (Bengoechea and Quan, 2019); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); United States 2016 (Carrera et al., 2019); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Note: PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1.

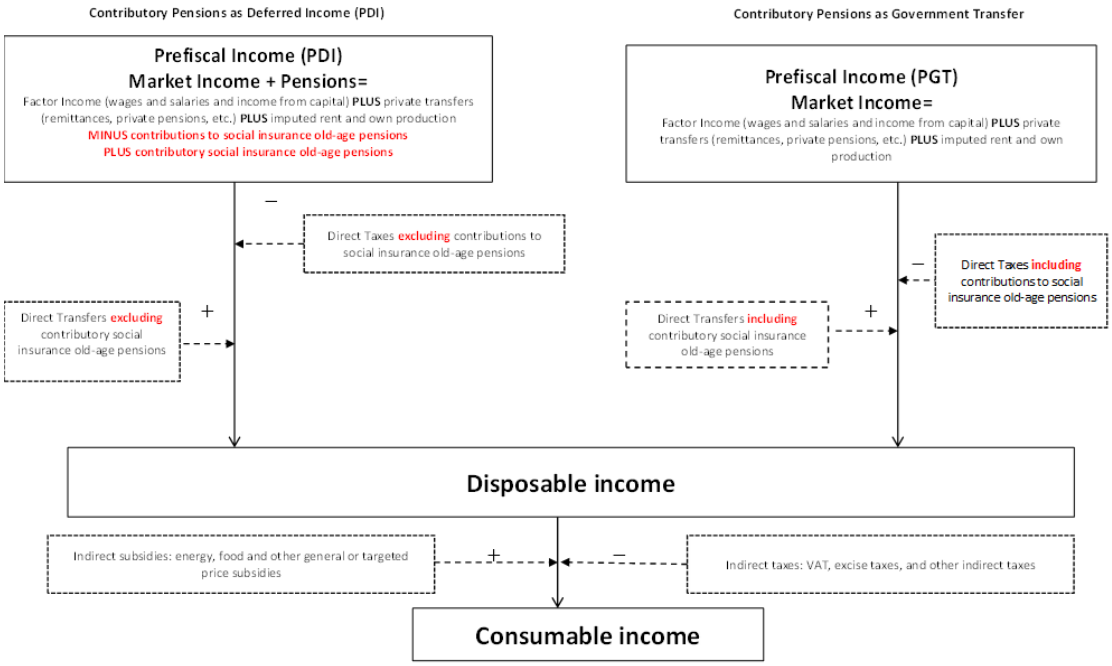
The advantages of using this database are twofold. First, the CEQ Data is one of the most comprehensive in terms of country coverage and the fiscal interventions included in the fiscal incidence analyses. The second advantage is that the country studies use a common methodological approach described in Lustig (2018) and are subject to the same protocol of quality control which makes the data quite comparable.

Fiscal incidence analysis is the method utilized to allocate taxes and public spending to households so that one can compare incomes before taxes and transfers with incomes after them, and calculate the relevant indicators for prefiscal and postfiscal incomes.[15] The building block of fiscal incidence analysis is the construction of income concepts. That is, starting from a concept of prefiscal income, each new income concept is constructed by adding (or subtracting) another element of the fiscal system. The prefiscal income is the income concept that is used to rank households before the effects of the fiscal system. Following the methodology in Lustig (2018), the studies housed in the CEQ Data Center use two prefiscal

[15] There are many references that describe what fiscal incidence analysis entails. For a synthesis see, for example, Lustig (2020).

income concepts and two postfiscal ones. The income concepts can be observed in Figure 1.

Figure 1. Income concepts



Source: Own elaboration based on Lustig (2018).

As can be observed, there are two pre-fiscal income concepts depending on the treatment of contributory pensions. In the first scenario, pensions are treated as pure deferred income (PDI) and in the second as pure government transfers (PGT).[16] When old-age pensions from social security are considered as pure deferred income from savings in the past, and current contributions are treated as a form of mandatory savings, the pre-fiscal income is equal to market income plus contributory pension minus contributions to social security old-age pensions.

The rationale for these two prefiscal income scenarios is the following. In actual situations, (and leaving aside the system of individualized accounts that are always deferred income), social insurance contributory pensions are partly deferred income and therefore should have a portion of them added to market income (and contributions subtracted from factor income); and partly government transfer and therefore a portion of them should be included with the rest of government transfers (and contributions treated as any other direct tax). However, since it is very difficult to determine which portion should be treated as deferred income and which portion should be treated as a transfer when the only information available is a cross-section household survey, it is advisable to calculate the impact of the net fiscal system under the two extreme scenarios. Lastly, the treatment of old-age pensions as deferred

[16] For details, see Chapter 1 in Lustig (2018).

income (the PDI scenario) or a government transfer (the PGT scenario) affects the value of Kakwani index for all fiscal interventions (by changing the prefiscal income distribution) and the marginal contribution of direct transfers. As a result, it is necessary to use both scenarios in the analysis. Ex ante there is no reason to think that the two scenarios would yield the same results in terms of consistent/inconsistent cases.

The fiscal incidence analyses include four broad categories of fiscal interventions: direct personal income taxes and contributions; direct transfers[17] and contributory pensions; indirect taxes; and, indirect subsidies.[18] These yield two postfiscal income concepts: *Disposable income* and *Consumable income*. The first one is equal to the sum of pre-fiscal income plus direct government transfers minus direct taxes[19]. The second one is the sum of disposable income plus indirect subsidies minus indirect taxes (e.g., value-added tax, sales tax, etc.). Again, see Figure 1 for details.

The fiscal incidence analyses in our database follow the so-called "accounting approach." This approach takes private income as given and allocates taxes and public spending to individuals and families in different economic circumstances based on what is reported in the household surveys used in the studies or, if not available, according to certain assumptions. However, they are not a mechanically applied accounting exercise. They analyze the incidence of taxes by their assumed economic rather than statutory incidence. The economic incidence, strictly speaking, depends on the elasticity of demand and supply of a factor or a good, and the ensuing general equilibrium effects. In essence, the accounting approach implicitly 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. Under these assumptions, individual income taxes and contributions (both by employee and employer) are borne by labor in the form of lower wages, taxes on incomes from capital are borne by the owners, and indirect taxes (on both final goods and inputs, using input-output tables for the latter) are fully shifted forward to consumers in the form of higher prices.[20] While ignoring behavioral responses and general

[17] Direct transfers include "conditional cash transfer programs, noncontributory 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),… the full value of wages paid in these programs [is included] as direct transfers...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 (Higgins and Lustig, 2018, p. 248)." In addition, in the PGT scenario, contributory pensions are treated as a direct transfer.

[18] The studies present results for these broad categories and the individual components that are included under each of them. They also calculate the fiscal incidence of transfers in-kind such as education and health. The latter are not used in this paper.

[19] Depending on the treatment of the pension system, pre-fiscal income will include contributory pensions and the same applies to direct taxes and contributions to pensions.

[20] In addition, the fiscal incidence studies take into account the lower incidence associated with consumption of own-production (quite common, especially in rural areas in developing countries), informality and other forms of tax evasion due to corruption or poor enforcement schemes.

equilibrium effects is a limitation of the accounting approach, the effects calculated with this method are considered a reasonable approximation of the short-run welfare impact.[21]

II.c. Consistency Analyses

We use three indicators available in the CEQ Data Center in our consistency analyses: the Kakwani index, the marginal contribution, and size of direct taxes, direct transfers, indirect taxes, and indirect subsidies. The Kakwani index and marginal contribution was described at the start of this section. Size is measured as the ratio between the total amount of the fiscal component observed in the fiscal incidence analysis divided by (the corresponding PDI or PGT) prefiscal income.[22] Since both the contributions and the benefits of old-age social security pensions are part of direct taxes and transfers (respectively) in the PGT scenario, we carry out the analysis with the former added to the latter and separately to assess whether our results are sensitive to their inclusion under the broader category. As shown in Figure 1, the fiscal incidence analyses that includes both direct taxes and transfers *and* indirect taxes and subisides, generates two postfiscal income concepts: disposable income (which covers only direct taxes and transfers) and consumable income (which includes direct taxes and transfers, and indirect taxes and subsidies). Thus, for direct taxes and transfers, there will be a marginal contribution associated with disposable income and another one associated with consumable income; that is, the sign and order of magnitude could be different, although usually the signs are the same. Table 2 shows the summary statistics for the variables we use in our empirical analysis.

[21] Coady et al. (2006), for instance, state "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." (Coady et al., 2006, p. 9).

[22] Note that this definition of size is different from the one calculated from administrative data which usually includes budget information in the numerator and GDP (or GNI) in the denominator.

Table 2. Summary statistics

Scenario		PDI				PGT			
Intervention	Variable	Mean	Standard deviation	Minimum	Maximum	Mean	Standard deviation	Minimum	Maximum
Direct taxes	Kakwani	0.249	0.133	0.059	0.605	0.138	0.099	-0.037	0.405
	Size	0.062	0.053	0.005	0.225	0.045	0.041	0.001	0.172
	MC to disposable income	0.014	0.012	0.001	0.046	0.005	0.007	-0.001	0.025
	MC to consumable income	0.015	0.013	0.002	0.051	0.006	0.008	-0.002	0.028
Contributions to social security	Kakwani	n.a	n.a	n.a	n.a	0.138	0.045	0.005	0.006
	Size	n.a	n.a	n.a	n.a	0.099	0.041	0.007	0.008
	MC to disposable income	n.a	n.a	n.a	n.a	-0.037	0.001	-0.001	-0.002
	MC to consumable income	n.a	n.a	n.a	n.a	0.405	0.172	0.025	0.028
Direct taxes+ contributions to social security	Kakwani	n.a	n.a	n.a	n.a	0.201	0.119	0.053	0.527
	Size	n.a	n.a	n.a	n.a	0.097	0.078	0.008	0.324
	MC to disposable income	n.a	n.a	n.a	n.a	0.016	0.014	0.003	0.063
	MC to consumable income	n.a	n.a	n.a	n.a	0.017	0.016	0.004	0.069
Direct transfers	Kakwani	0.743	0.166	0.294	1.101	0.743	0.137	0.532	1.095
	Size	0.027	0.027	0.001	0.119	0.026	0.026	0.001	0.119
	MC to disposable income	0.018	0.021	0.000	0.095	0.015	0.015	0.0005	0.078
	MC to consumable income	0.020	0.024	0.001	0.113	0.016	0.017	0.001	0.089
Contributory pensions	Kakwani	n.a	n.a	n.a	n.a	0.370	0.266	-0.195	0.861
	Size	n.a	n.a	n.a	n.a	0.061	0.058	0.001	0.234
	MC to disposable income	n.a	n.a	n.a	n.a	0.009	0.022	-0.008	0.098
	MC to consumable income	n.a	n.a	n.a	n.a	0.012	0.026	-0.008	0.111
Direct transfers + contributory pensions	Kakwani	n.a	n.a	n.a	n.a	0.492	0.202	0.096	0.996
	Size	n.a	n.a	n.a	n.a	0.086	0.078	0.004	0.298
	MC to disposable income	n.a	n.a	n.a	n.a	0.026	0.036	-0.002	0.142
	MC to consumable income	n.a	n.a	n.a	n.a	0.031	0.043	-0.002	0.177
Indirect taxes	Kakwani	-0.004	0.071	-0.175	0.146	-0.031	0.099	-0.268	0.119
	Size	0.085	0.034	0.023	0.197	0.084	0.030	0.027	0.163
	MC to disposable income	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
	MC to consumable income	0.003	0.005	-0.005	0.018	0.002	0.004	-0.005	0.014
Subsidies	Kakwani	0.223	0.256	-0.172	1.270	0.278	0.284	-0.067	1.325
	Size	0.020	0.024	0.000	0.127	0.021	0.027	0.0002	0.132
	MC to disposable income	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
	MC to consumable income	0.003	0.005	-0.002	0.022	0.003	0.005	-0.001	0.022

Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Spain 2017 (Bengoechea and Quan, 2019); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); United States 2016 (Carrera et al., 2019); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Note: PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5). Cells with n.a. means not applicable: that is, these coefficients cannot be calculated given our methodology. For example, disposable income does not include indirect taxes by definition, so the marginal contribution of indirect taxes to the inequality of disposable income is not defined. See the methodology section for more information.

The sign-consistency check consists of counting the frequency of the cases in which the Kakwani index and the marginal contribution coincide in sign. That is, we calculate the following ratio:

$$\frac{\sum_{i,j,c,s} I\{1=[(K>0 \wedge MC<0) \vee (K<0 \wedge MC>0)]\}_{i,j,c,s}}{N_{i,j,c,s}} \quad \textbf{(6)}$$

Where $\sum_{i,j,c,s} I\{1 = [(K > 0 \wedge MC < 0) \vee (K < 0 \wedge MC > 0)]\}_{i,j,c,s}$ is an indicator function equal to one if the observation is a sign-inconsistent case; the subscripts i, j, c and s refer to the fiscal policy or intervention (direct taxes, direct transfers, etc.), income concept (disposable or consumable income), country-year, and scenario (PDI or PGT), respectively. This summation covers all countries, income concepts, interventions, and scenarios. $N_{i,j,c,s}$ is the total number of country-study-scenario by intervention. The above formula is calculated for all the interventions together and by intervention.

For the magnitude-consistency test, we count the cases in which there is no sign-inconsistency but taxes and transfers with relatively similar size and progressivity (regressivity) have significantly different marginal contributions. Specifically, we count the cases in which the size and Kakwani index of interventions are very similar, but the value of the marginal contributions is in the top or bottom 25% of all marginal contributions for that component of fiscal policy in our sample (for a given scenario-income concept combination).

As stated, we test the fiscal redistribution dictum-consistency using regression analysis. Since we have different postfisal income concepts (disposable and consumable income) and different prefiscal income (PDI and PGT scenarios), we have a separate set of marginal contributions, Kakwani indices, and sizes depending on the choice of pre and postfical income concepts and therefore a series of regression models. The general formula for the regressions is as follows:

$$\boldsymbol{MC^s_{i,j,c} = \beta_0 + \beta_1 K^s_{i,c} + \beta_2 S^s_{i,c} + \varepsilon^s_{i,j,c}} \quad \textbf{(7)}$$

Where $MC^s_{i,j,c}$ is the marginal contribution of the intervention i, for the income concept j, in the country c, and in the scenario s. K is the Kakwani index with respect to the prefiscal income, S is the relative size of the intervention with respect to the prefiscal income, and ε is the error term. If the dictum holds, β_1 and β_2 should be positive and statistically significant.

There are two clarifications to be made about these regressions. First, when we use marginal contributions to disposable income, we run the regression only for direct transfers and direct taxes because indirect taxes and indirect subsidies come after disposable income (see Figure 1). Thus, there is no marginal contribution to the change in inequality from prefiscal to disposable income for these two items. Second, in the PGT scenario, we add the contributions to social security to direct taxes, and the contributory pensions are added to direct transfers. For comparability reasons, in the PGT scenario, we show the results with

direct taxes and contributions summed up as one category (likewise for direct transfers and contributory pensions) and each item separately (i.e., separate regressions for direct taxes, contributions to social security, direct transfers, and contributory pensions). Hence, we run a total of twenty regressions.

III. Results and Discussion

As mentioned in the Introduction, we want to assess the extent to which there is sign-inconsistency, magnitude-inconsistency, or fiscal redistribution dictum- inconsistency in actual country studies. As it was mentioned before, if there is reranking or the Lambert's conundrum occurs, it is possible to have taxes and transfers that are regressive (progressive) but equalizing (unequalizing). Thus, we first analyze the cases in which the sign of the Kakwani index and the marginal contribution of components of fiscal policy (i.e., direct and indirect taxes, direct transfers, and indirect subsidies) do not match (i.e., sign-inconsistency). Table 3 shows the list of country cases with a sign-inconsistency. Our results show that for everything but indirect taxes, the sign-inconsistency is limited to only three cases for direct transfers and contributory pensions in the PGT scenario. These three cases display a progressive but unequalizing examples of sign-inconsistency. For indirect taxes, however, there are 22 cases out of 87 country cases (about 25% of our sample) that are regressive but eqaulizing.

As observed in Table 3, there are two cases of sign-inconsistency: progressive but unequalizing and regressive but equalizing. The former implies that, for example, if the progressive transfer in Tunisia is removed, the fiscal system would be more equalizing. Similarly, if the regressive tax in Argentina is removed, the fiscal system would be less equalizing. The Lambert's conundrum contributes differently to these two types of sign-inconsistencies (i.e., regressive but equalizing vs. progressive but unequalizing). Kakwani index defines progressivity/regressivity with respect to prefiscal income and therefore ignores other components of the fiscal system. In the regressive but equalizing cases, a regressive tax becomes effectively progressive when all other elements of the fiscal system are taken into account. In the progressive but unequalizing cases, a progressive transfer becomes effectively regressive when all other elements of the fiscal system are accounted for.

Table 3. List of cases with sign-inconsistency between the Kakwani index and marginal contribution

Panel A: Regressive but equalizing

Scenario	Intervention	Income concept	Country study	Kakwani	Marginal contribution
PDI	Indirect taxes	Consumable Income	Argentina (2017)	-0.088	0.001
PDI	Indirect taxes	Consumable Income	Bolivia (2015)	-0.005	0.001

PDI	Indirect taxes	Consumable Income	Brazil (2009)	-0.025	0.002
PDI	Indirect taxes	Consumable Income	Chile (2013)	-0.027	0.000
PDI	Indirect taxes	Consumable Income	Ivory Coast (2015)	-0.070	0.018
PDI	Indirect taxes	Consumable Income	Lesotho (2017)	-0.052	0.003
PDI	Indirect taxes	Consumable Income	Mexico (2014)	-0.005	0.002
PDI	Indirect taxes	Consumable Income	Namibia (2010)	-0.037	0.001
PDI	Indirect taxes	Consumable Income	Nicaragua (2009)	-0.014	0.001
PDI	Indirect taxes	Consumable Income	South Africa (2010)	-0.065	0.009
PDI	Indirect taxes	Consumable Income	Spain (2017)	-0.137	0.000
PGT	Indirect taxes	Consumable Income	Argentina (2017)	-0.207	0.001
PGT	Indirect taxes	Consumable Income	Bolivia (2009)	-0.002	0.001
PGT	Indirect taxes	Consumable Income	Bolivia (2015)	-0.010	0.001
PGT	Indirect taxes	Consumable Income	Brazil (2009)	-0.097	0.002
PGT	Indirect taxes	Consumable Income	Chile (2013)	-0.042	0.000
PGT	Indirect taxes	Consumable Income	Mexico (2012)	0.000	0.002
PGT	Indirect taxes	Consumable Income	Mexico (2014)	-0.024	0.002
PGT	Indirect taxes	Consumable Income	Namibia (2010)	-0.042	0.001
PGT	Indirect taxes	Consumable Income	Nicaragua (2009)	-0.022	0.001
PGT	Indirect taxes	Consumable Income	Spain (2017)	-0.268	0.000
PGT	Indirect taxes	Consumable Income	Tajikistan (2015)	-0.022	0.000

Panel B: Progressive but unequalizing

Scenario	Intervention	Income concept	Country study	Kakwani	Marginal contribution
PGT	Direct transfers and contributory pensions	Disposable income	Tunisia (2010)	0.096	-0.002
PGT	Direct transfers and contributory pensions	Consumable Income	Togo (2015)	0.347	-0.0001
PGT	Direct transfers and contributory pensions	Consumable Income	Tunisia (2010)	0.097	-0.002

Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Spain 2017 (Bengoechea and Quan, 2019); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); United States 2016 (Carrera et al., 2019); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Notes: PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5).

It is worth noting that with the exception of a few cases of regressive indirect subsidies, indirect taxes are the only components of the fiscal system in our database that are regressive. One of the reasons was pointed out above. The randomness component in indirect taxes is relatively higher (due to tastes, for instance) and, therefore, the frequency of reranking is likely higher. A second reason is related to the Lambert's conundrum: it is possible that other progressive components of the fiscal system (e.g., direct taxes, direct transfers, subsidies, and spending on education and health) have a higher power to create an income distribution in which regressive indirect taxes become effectively progressive when these other components are taken into account.[23]

Given the prevalence of sign-inconsistent cases for indirect taxes, we take an additional step to compare the incidence of indirect taxes in the group of countries that are sign-consistent

[23] In fact, if the Kakwani index is calculated with respect to the disposable income as opposed to the prefiscal income, the majority of sign-inconsistent cases would disappear because the indirect taxes would be categorized as progressive (and equalizing).

to those that are sign-inconsistent. The goal of this analysis is to determine whether one can identify the potential for sign-inconsistency by simply computing the incidence of indirect taxes. Table 4 presents this analysis and shows the share of indirect taxes paid by each decile (on average) in sign-consistent vs. inconsistent cases. The tax incidence is very similar in the two groups. This analysis highlights that the sign-consistency/inconsistency is a result of the interaction between components of a fiscal system and focusing on only one component would not allow us to distinguish these cases.

Table 4. Incidence of indirect taxes in sign-consistent vs. inconsistent cases

Decile	PDI scenario		PGT scenario	
	Sign-Consistent	Sign-Inconsistent	Sign-Consistent	Sign-Inconsistent
1	1.77%	2.21%	2.33%	2.96%
2	2.78%	2.63%	3.05%	2.68%
3	3.73%	3.67%	3.95%	3.67%
4	4.69%	4.23%	4.86%	4.63%
5	5.80%	5.39%	5.93%	5.60%
6	7.09%	6.83%	7.18%	6.98%
7	8.88%	8.30%	8.80%	8.56%
8	11.41%	11.11%	11.29%	11.16%
9	15.95%	16.40%	15.74%	15.55%
10	37.89%	39.23%	36.87%	38.22%
Sum	**100%**	**100%**	**100%**	**100%**

Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Spain 2017 (Bengoechea and Quan, 2019); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); United States 2016 (Carrera et al., 2019); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Notes: PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. The values in the table represent the share of indirect taxes paid by each decile (on-average) in sign-consistent vs.

inconsistent countries. Sign-consistent countries are the ones in which the signs of Kakwani index and marginal contribution (for indirect taxes) are the same. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5).

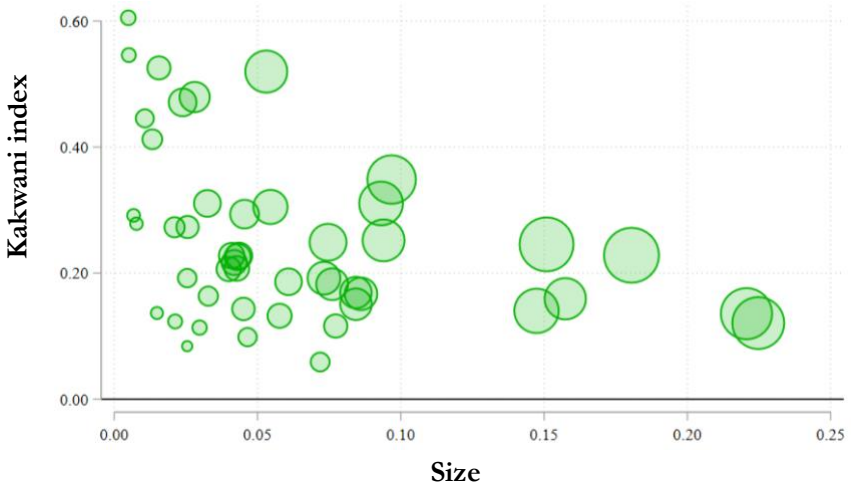
A plausible explanation of why sign-inconsistent cases appear more frequently with indirect taxes is that randomness (due to tastes, for example) in the connection between the burden of taxes and pretax income is likely to be higher in the case of indirect taxes (compared to direct taxes or transfers, for example). Randomness is likely to introduce instances of switches from local regressivity to local progressivity but with the tax being globally regressive (progressive) but equalizing. Randomness could, in turn, introduce more instances of reranking. Finally, given that the final impact on inequality depends on the incidence of the other components of the fiscal system, it is possible that in some countries transfers are so generous at the bottom that the indirect taxes are no longer regressive vis-à-vis the income concept that incorporates transfers. This last case is the Lambert conundrum.

Our second indicator to point out inconsistencies refers to what we called magnitude-inconsistency. That is, even among the cases in which there is no sign-inconsistency, taxes and transfers with relatively similar size and progressivity (regressivity) may have significantly different marginal contributions. To highlight this matter, first we use a set of bubble charts to display the relationship between the size of interventions, their Kakwani index, and their marginal contribution in our sample. Figure 2 displays this relationship for various components of fiscal policy and for the two scenarios regarding contributory pensions (PDI and PGT scenarios) and with respect to the two main income concepts: Disposable and Consumable Income.

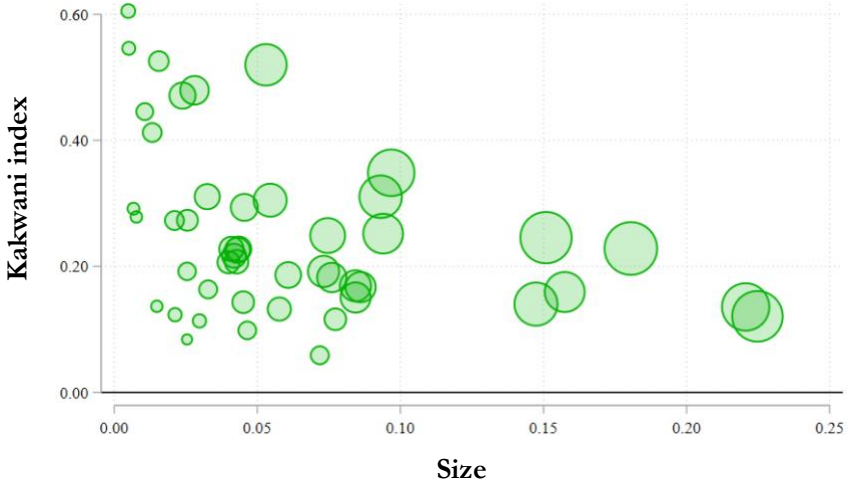
Figure 2. Kakwani index, size, and marginal contribution of components of the fiscal system: Bubble plots.

Section I. PDI scenario

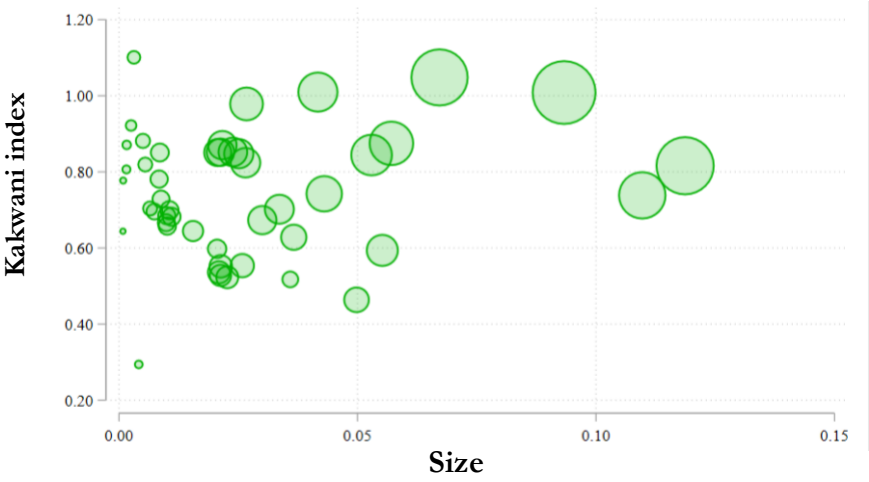
Panel A1. Marginal contribution of direct taxes to the inequality of Disposable income



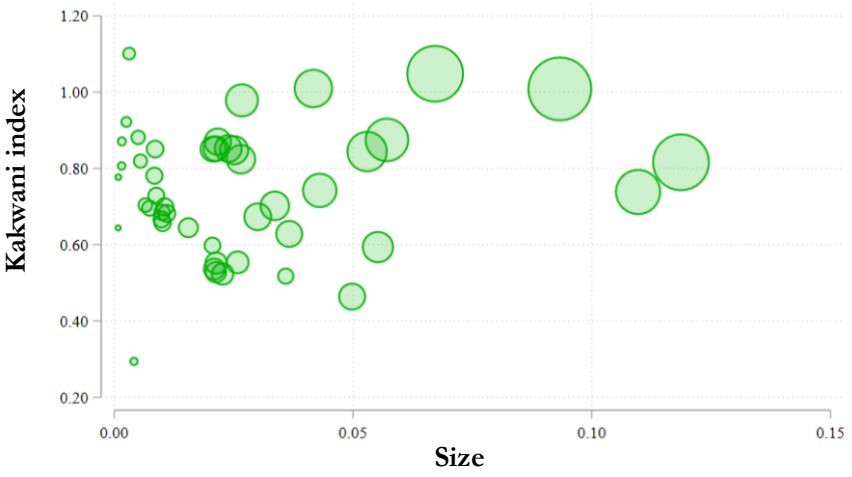
Panel A2. Marginal contribution of direct taxes to the inequality of Consumable income



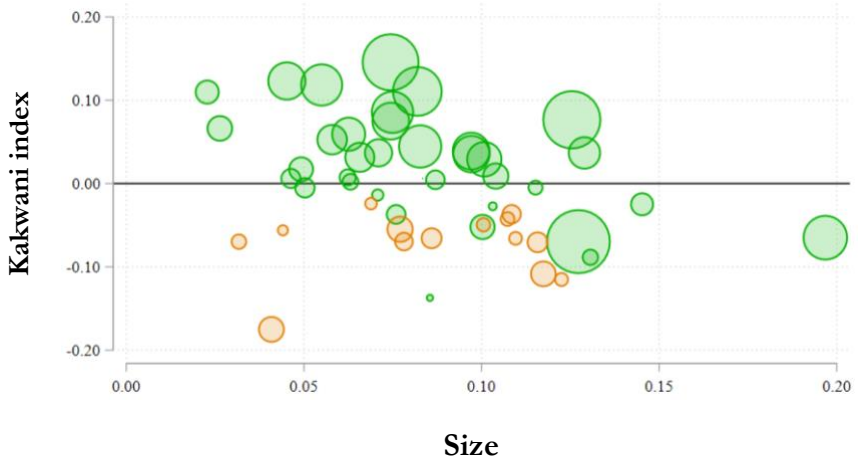
Panel B1. Marginal contribution of direct transfers to the inequality of Disposable income



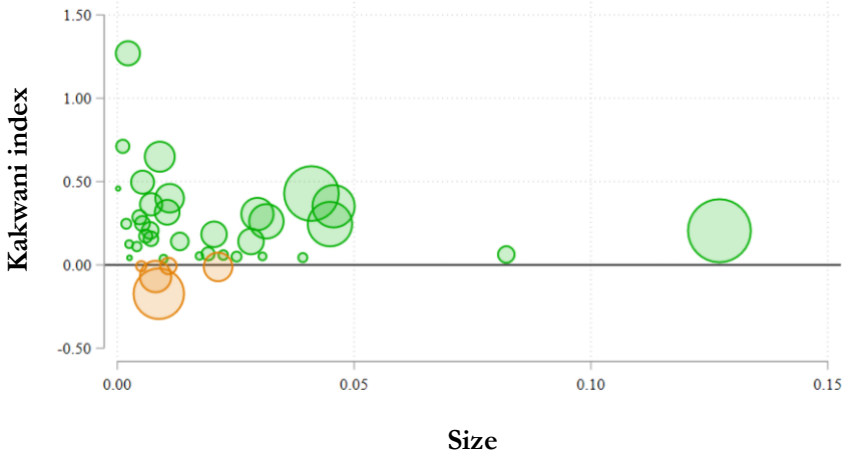
Panel B2. Marginal contribution of direct transfers to the inequality of Consumable income



Panel C. Marginal contribution of indirect taxes to the inequality of Consumable income

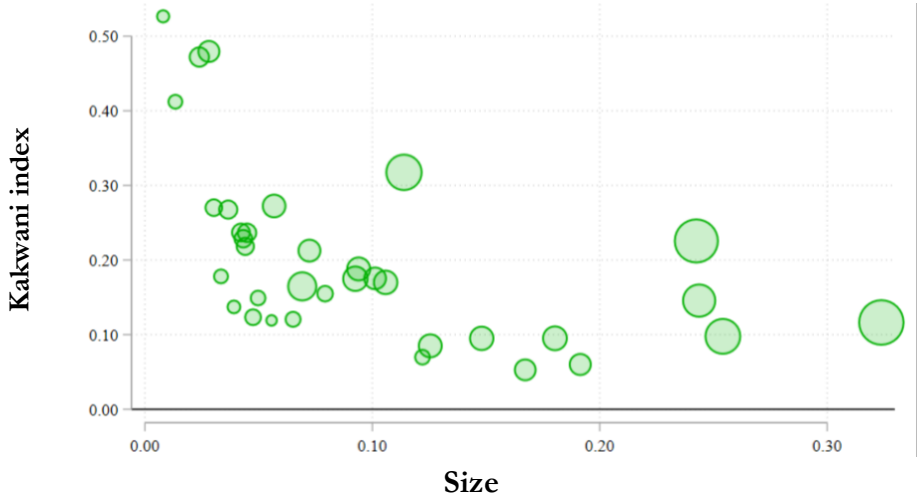


Panel D. Marginal contribution of indirect subsidies to the inequality of Consumable income

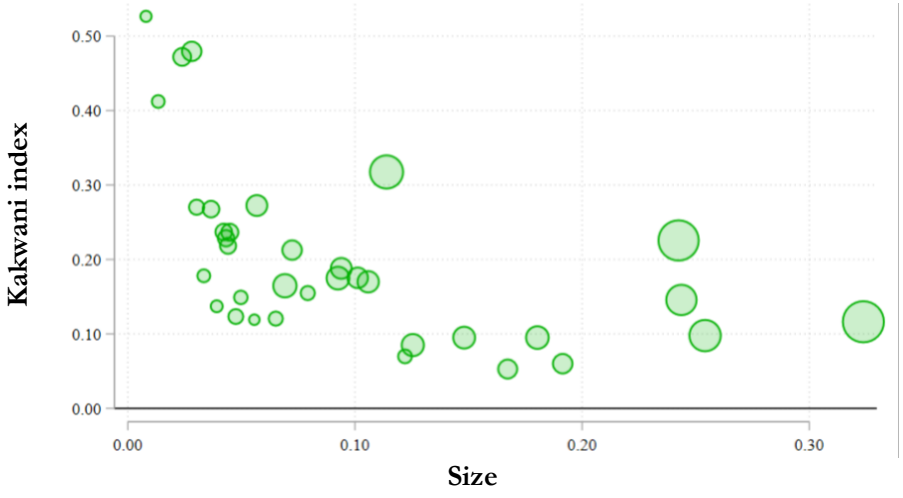


Section II. PGT scenario

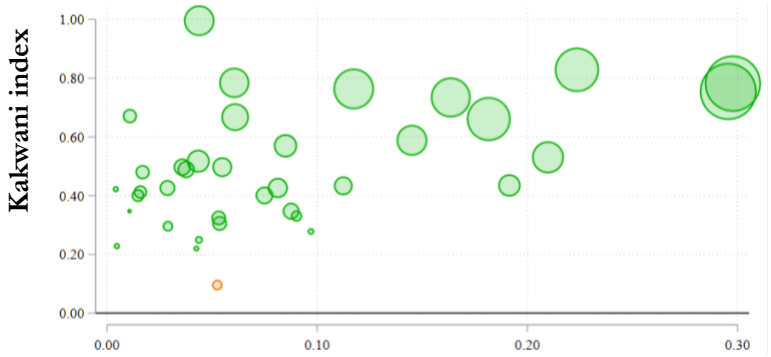
Panel E1. Marginal contribution of direct taxes to the inequality of Disposable income



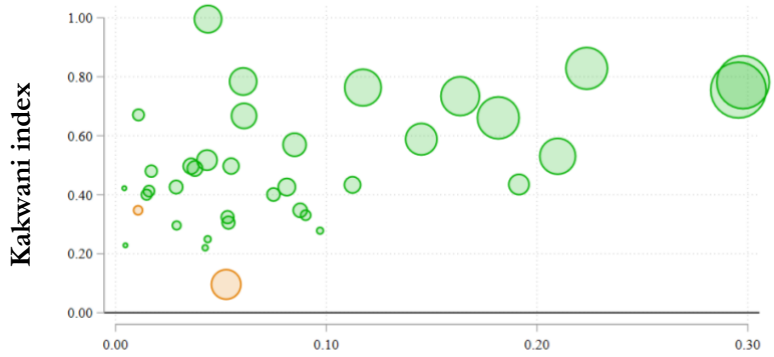
Panel E2. Marginal contribution of direct taxes to the inequality of Consumable income



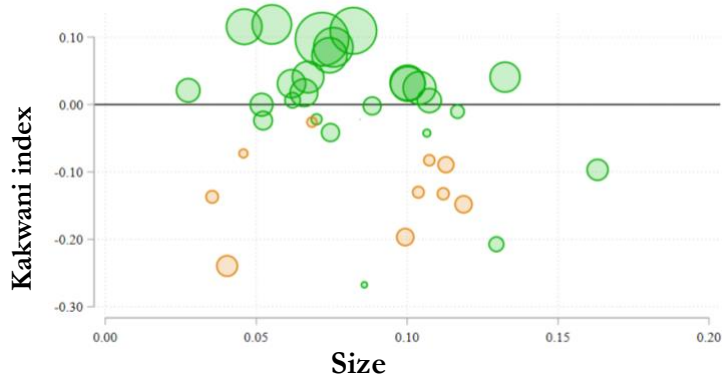
Panel F1. Marginal contribution of direct transfers to the inequality of Disposable income



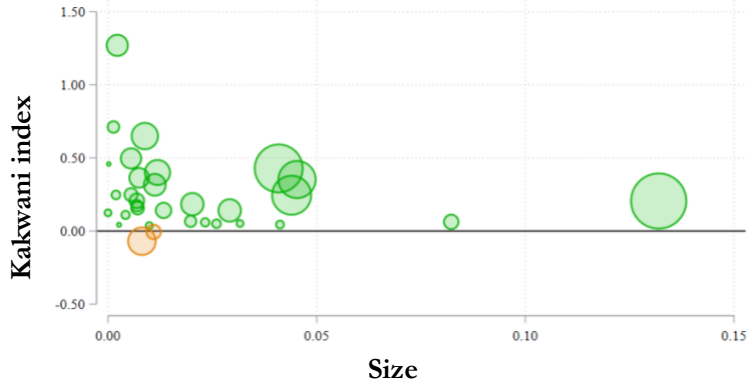
Panel F2. Marginal contribution of direct transfers to the inequality of Consumable income



Panel G. Marginal contribution of indirect taxes to the inequality of Consumable income



Panel H. Marginal contribution of indirect subsidies to the inequality of Consumable income



Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Spain 2017 (Bengoechea and Quan, 2019); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); United States 2016 (Carrera et al., 2019); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Notes: PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5). Size of each component of fiscal policy is measured with respect to the prefiscal income of a given scenario.

Green bubbles represent equalizing effects (positive marginal contribution) and red bubbles represent unequalizing effects (negative marginal contribution). The size of bubbles represents the size of marginal contribution. For the full-size graphs with country names see online Appendix D.

As observed, there are a number of cases in which taxes or transfers with similar values for the Kakwani index and size have drastically different marginal contributions. We summarize these cases in Table 5 below. Specifically, this table includes only the cases in which the size and Kakwani index of interventions are very similar, but the values of the marginal contributions are in the top or bottom 25% of all marginal contributions for that component of fiscal policy in our sample (for a given scenario-income concept combination). There are 5 pairs of cases that fall under the latter for the PDI scenario and 4 pairs for the PGT scenario. In all 9 pairs of cases (about 6% of the possible pairs), the size and progressivity of an intervention are inaccurate predictors of the marginal contribution of a component of fiscal policy to the change in inequality. For example, Peru (2011) and Namibia (2016) are two countries with a relatively similar Kakwani index and size for their direct taxes (in the PDI scenario), but the marginal contribution of direct taxes (with respect to the Disposable Income) is relatively small (bottom 25%) in Peru and relatively large (top 25%) in Namibia. Had we not measured their impact correctly by using the size of the marginal contribution, we would have concluded that direct taxes in these two countries have similar equalizing impacts.

Table 5. List of cases with magnitude-inconsistency

Scenario	Intervention	Income concept	Size	Kakwani	Marginal contribution	Country
PDI	Direct taxes	Disposable Income	Medium size	Medium Kakwani	Small MC	Peru (2011)
PDI	Direct taxes	Disposable Income	Medium size	Medium Kakwani	Large MC	Namibia (2016),
PDI	Direct taxes	Consumable Income	Medium size	Medium Kakwani	Small MC	Peru (2011)
PDI	Direct taxes	Consumable Income	Medium size	Medium Kakwani	Large MC	Namibia (2016),
PDI	Direct transfers	Disposable Income	Medium size	Medium Kakwani	Small MC	Colombia (2010), Venezuela (2013), Iran (2011)
PDI	Direct transfers	Disposable Income	Medium size	Medium Kakwani	Large MC	Chile (2013),
PDI	Direct transfers	Consumable Income	Medium size	Medium Kakwani	Small MC	Tunisia (2010)
PDI	Direct transfers	Consumable Income	Medium size	Medium Kakwani	Large MC	Togo (2015), Namibia (2010)
PDI	Indirect taxes	Consumable Income	Medium size	Medium Kakwani	Small MC	Uruguay (2009)
PDI	Indirect taxes	Consumable Income	Medium size	Medium Kakwani	Large MC	El Salvador (2011), Kenya (2015),
PGT	Direct taxes and contributions	Disposable Income	Medium size	Medium Kakwani	Small MC	Colombia (2010), Venezuela (2013), Iran (2011)
PGT	Direct taxes and contributions	Disposable Income	Medium size	Medium Kakwani	Large MC	Togo (2015), Namibia (2010)
PGT	Direct taxes and contributions	Consumable Income	Medium size	Medium Kakwani	Small MC	Iran (2011), Colombia (2014), Colombia (2010), Venezuela (2013)
PGT	Direct taxes and contributions	Consumable Income	Medium size	Medium Kakwani	Large MC	Namibia (2010), Togo (2015)
PGT	Direct transfers and contributory pensions	Disposable Income	Medium size	Medium Kakwani	Small MC	Peru (2011)
PGT	Direct transfers and contributory pensions	Disposable Income	Medium size	Medium Kakwani	Large MC	Namibia (2016)
PGT	Subsidies	Consumable Income	Medium size	Large Kakwani	Small MC	Spain (2017)
PGT	Subsidies	Consumable Income	Medium size	Large Kakwani	Large MC	Namibia (2010)

Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Spain 2017 (Bengoechea and Quan, 2019); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); United States 2016 (Carrera et al., 2019); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Notes: PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5). Size of each component of fiscal policy is measured with respect to the prefiscal income of a given scenario. With regard to the magnitude of Kakwani index, size, and marginal contribution of components of the fiscal system, Small, Medium and Large are defined relative to the range of these variables. A given value is classified as "Small" if the value of the indicator is lower than the 25th percentile of the distribution of this variable. "Medium" if the value is between the 25th and 75th percentiles, and "Large" if the value is higher than the 75th percentile.

Given the above results, we can conclude that the frequency of both sign-inconsistency and magnitude-inconsistency are relatively small, but they exist. Sign-inconsistency is more common only in the case of indirect taxes which means that one should be cautions to use a partial analysis (i.e., the Kakwani index) when assessing their impact on inequality.

It is important to note that one is not able to disentangle whether sign- or magnitude-inconsistency are due to reranking or the presence of Lambert's conundrum. All the countries included in our sample present some extent of reranking.[24] However, for the purposes of our paper it is not important to disentangle the source of the inconsistencies.

Additionally, it is worth noting that the relationship between the Kakwani index and size of a fiscal intervention and its marginal contribution is complicated in the presence of reranking and Lambert's conundrum and specially when a fiscal system has many other components. Enami (2018) derives the mathematical relationship between these indicators, but the complexity of these equations indicates that any proper policy evaluation of the potential effect of alternative policies on inequality requires microsimulation. In other words, the information about the progressivity or size of a fiscal intervention is far from enough to predict its impact on income inequality.

Finally, to analyze the validity of the fiscal redistribution dictum and to quantify it, we regress the marginal contribution of components of the fiscal system on their respective Kakwani index and size. It is important to note that we do not make any claims about causality as the changes in Kakwani index and size are not random.

Table 6 presents the results of our regression analysis. To provide a more straightforward interpretation of the relative impact of the change in the size and Kakwani index on the marginal contribution of a component of the fiscal system, we have calculated elasticities based on the average value of the Kakwani index and size of components in the relevant sub-sample used for each regression model displayed in Table 6. Note that the sign of elasticities follows the sign of the coefficients (i.e., they are always positive). This is because our elasticities simply express the coefficients of our regressions in an easier to comprehend form.

Our results show that, in general, increasing the size or progressivity (regressivity) of a progressive (regressive) tax or transfer will be equalizing (unequalizing). The elasticity of the marginal contribution with respect to progressivity of a component of fiscal policy ranges from 0.4 for direct taxes to 1.6 for direct transfers while the elasticity of the marginal contribution with respect to size ranges from 0.4 to 2 (both are for indirect taxes, but in different scenarios). Thus, although reranking and the presence of Lambert's conundrum can potentially yield cases in which raising the progressivity or size of a progressive intervention increases inequality, in general this is empirically unlikely. To what extent does the assumption about contributory pensions make a difference? We find that our elasticities

[24] See the Reranking sheet in the Standard Indicators housed in the CEQ Institute Data Center. https://commitmentoequity.org/datacenter/

are generally similar for the same components of fiscal policy in the PDI and PGT scenarios (i.e., direct taxes, direct transfers, and indirect subsidies). The only exception is indirect taxes: the elasticity with respect to progressivity (size) is noticeably lower in the PDI (PGT) scenario. As Appendix B shows the results discussed above remain remarkably unchanged when we exclude the two rich countries in our database, i.e., USA and Spain.

A caveat is in order. The regression assumes that countries are comparable when it comes to the issue of how changes in size and progressivity affect reranking or the occurrence of Lambert's conundrum (or both). In other words, the estimated coefficients for progressivity, for example, assume that whenever one is comparing country A to country B where B has a more progressive system, and one makes the system in A more like B (more progressive), the additional reranking would look like the reranking observed in country B. In practice there is no reason why this assumption would hold. It is empirically possible that the reranking induced by changes in progressivity in country A is not similar to the one observed in country B. Thus, the dictum could be violated more, or less, frequently than the regression results imply.

Table 6. Fiscal redistribution dictum-consistency: regression results

Panel A. PDI scenario

Income Concept	Disposable Income		Consumable Income			
Marginal contribution of	Direct taxes	Direct transfers	Direct taxes	Direct transfers	Indirect taxes	Indirect subsidies
Kakwani Index	0.030***	0.036***	0.033***	0.041***	0.053***	0.007***
	(0.006)	(0.012)	(0.007)	(0.014)	(0.008)	(0.002)
Size	0.227***	0.656***	0.252***	0.759***	0.059***	0.151***
	(0.018)	(0.088)	(0.021)	(0.115)	(0.017)	(0.034)
Observations	48	47	48	47	50	39
Adj. R-Squared	0.886	0.885	0.878	0.870	0.535	0.666
Average MC	0.013	0.017	0.015	0.020	0.003	0.003
Average Kakwani	0.249	0.743	0.249	0.743	-0.004	0.223
Average size	0.059	0.025	0.059	0.025	0.085	0.015
Elasticity of MC w.r.t. the Kakwani index	0.6%	1.6%	0.5%	1.5%	0.1%	0.6%
Elasticity of MC w.r.t. the size	1.0%	1.0%	1.0%	1.0%	2.0%	0.8%

Panel B. PGT scenario

Income Concept	Disposable Income						Consumable Income							
Marginal contribution of	Direct taxes + contributions to pension	Direct taxes	Contributions to social security	Direct transfers + contributory pensions	Direct transfers	Contributory pensions	Direct taxes + contributions to pensions	Direct taxes	Contributions to social security	Direct transfers + contributory pensions	Direct transfers	Contributory pensions	Indirect taxes	Indirect subsidies
Kakwani Index	0.050***	0.022**	0.043***	0.070***	0.027***	0.032***	0.055***	0.024**	0.046***	0.078***	0.029***	0.036***	0.034***	0.006**
	(0.015)	(0.009)	(0.014)	(0.012)	(0.009)	(0.010)	(0.017)	(0.009)	(0.015)	(0.015)	(0.009)	(0.012)	(0.006)	(0.002)
Size	0.188***	0.216***	0.137***	0.309***	0.499***	0.200**	0.207***	0.236***	0.150***	0.397***	0.567***	0.262***	0.012	0.146***
	(0.024)	(0.028)	(0.023)	(0.055)	(0.058)	(0.073)	(0.026)	(0.032)	(0.026)	(0.062)	(0.069)	(0.074)	(0.009)	(0.034)
Observations	35	35	28	37	36	37	35	35	28	37	36	37	37	31
Adj. R-Squared	0.778	0.835	0.678	0.865	0.906	0.664	0.792	0.835	0.695	0.881	0.915	0.720	0.662	0.629
Average MC	0.015	0.011	0.004	0.025	0.014	0.009	0.017	0.013	0.006	0.031	0.016	0.012	0.002	0.003
Average Kakwani	0.201	0.212	0.138	0.492	0.743	0.370	0.201	0.212	0.138	0.492	0.743	0.370	-0.031	0.278
Average size	0.089	0.056	0.033	0.083	0.025	0.059	0.089	0.056	0.033	0.083	0.025	0.059	0.082	0.017
Elasticity of MC w.r.t. the Kakwani index	0.7%	0.4%	1.6%	1.4%	1.4%	1.3%	0.6%	0.4%	1.2%	1.2%	1.3%	1.1%	0.5%	0.5%
Elasticity of MC w.r.t. the size	1.1%	1.1%	1.2%	1.0%	0.9%	1.3%	1.1%	1.0%	0.9%	1.1%	0.8%	1.3%	0.4%	0.8%

Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Spain 2017 (Bengoechea and Quan, 2019); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); United States 2016 (Carrera et al., 2019); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Notes: Clustered standard errors at the country level are in parentheses. Stars represent statistical significance: *** p<0.01, ** p<0.05, * p<0.1. PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5). Size of each component of fiscal policy is measured with respect to the prefiscal income of a given scenario.

Given the existence of a number of sign-inconsistent indirect taxes in our sample (about 25% of the sample), it is important to repeat the above-mentioned analysis and allow for the coefficients of the Kakwani index and size to change depending on whether an observation is sign-consistent or not. Table 7 presents the results of this analysis. An increase in the Kakwani index (i.e., making indirect taxes more progressive) has a much higher and statistically significant impact on reducing inequality when the case is sign-consistent to begin with. In fact, the effect of changing Kakwani index on the marginal contribution is statistically insignificant for sign-inconsistent cases in both scenarios. The effect of increasing the size of indirect taxes on reducing inequality is scenario-dependent with a much stronger effect observed in the PDI scenario while the effect is small and statistically insignificant in the PGT scenario. However, the difference between the sign-consistent and inconsistent cases is statistically insignificant in both scenarios. Therefore, separating these cases is more important when we analyze the relationship between the Kakwani index and the marginal contribution. Focusing on the sign-consistent cases, 1% increase in the progressivity of indirect taxes leads to 0.2% increase in the effect of these taxes on reducing inequality. Regarding the size of indirect taxes of consistent cases, 1% increase in the size leads to 1.5% increase in the marginal contribution in the PDI scenario and 0.2% increase in the PGT scenario. As appendix B shows, our results remain relatively unchanged when we exclude USA and Spain, i.e., the two rich countries, from our database. The only noticeable difference is in the PDI scenario in which the coefficients become statistically insignificant.

Table 7. Fiscal redistribution dictum-consistency: sign-consistent vs. inconsistent cases

Scenario	PDI	PGT
Component of the fiscal system (Dep. var.: Marginal cont. to the Consumable income)	Indirect taxes	Indirect taxes
Kakwani Index	-0.012	0.003
	(0.030)	(0.002)
Kakwani Index * Consistent	0.074**	0.040***
	(0.030)	(0.005)
Size	0.057***	0.002
	(0.019)	(0.010)
Size * Consistent	-0.019	0.004
	(0.028)	(0.015)
Observations	50	37
Adj. R-Squared	0.595	0.790
Average MC for consistent cases	0.002	0.003
Average Kakwani for consistent cases	0.008	-0.016
Average size for consistent cases	0.077	0.080
Elasticity of MC w.r.t. the Kakwani index	0.2%	0.2%
Elasticity of MC w.r.t. the Kakwani index	1.5%	0.2%

Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil

2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Spain 2017 (Bengoechea and Quan, 2019); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); United States 2016 (Carrera et al., 2019); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Notes: Clustered standard errors at the country level are in parentheses. Stars represent statistical significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5). Size of each component of fiscal policy is measured with respect to the prefiscal income of a given scenario. "Consistent" is an indicator variable identifying sign-consistent country cases, i.e., countries where the sign of the Kakwani index and marginal contribution are the same.

IV. Concluding Remarks

Progressivity indexes have been classified in two broad categories: the tax redistribution progressivity indicators also known as structural indices and the income redistribution progressivity indicators also known as distributional indices.[25] However, for our purposes, the relevant distinction is whether the index relies on indicators that use the prefiscal income as a classifier (i.e., the income by which individuals are ranked). If there is reranking, such indices can mathematically result in inconsistent results. When there is more than one intervention and the index relies on indicators that use the prefiscal income as a classifier, sign-inconsistency can occur even in the absence of reranking as demonstrated by Lambert (2001). The Kakwani and Suits indices, two commonly used tax redistribution progressivity indicators, and the Reynolds-Smolensky (as a measure of vertical inequity as in Lambert, 2001), a common indicator of redistribution progressivity or vertical equity, all suffer from this limitation. Mathematically, the Kakwani or the Suits index can estimate a tax to be regressive while its impact is equalizing (or the converse). Similarly, the Reynolds-Smolensky index can estimate a tax or an entire fiscal system to be regressive while their impact is equalizing (or the converse).[26]

In contrast, indices that rely on indicators that change the income used as classifier to the relevant postfiscal income, mathematically will not produce sign-inconsistent results by construction. This is the case of indices that include the pre and postfiscal Gini coefficient in their formulae such as the effective progression index proposed by Musgrave and Thin (1948) and the Pechman-Ockner index (Ockner and Pechman, 1974). This is also the case of the marginal contribution, the indicator used in this paper.

In sum, indices that rely on concentration measures that use pre-tax income as a classifier can mathematically produce sign-inconsistent cases in the presence of reranking and/or the Lambert conundrum. Using information on Kakwani indexes, marginal contributions, and size of taxes and transfers for 87 country studies housed in the CEQ Data Center on Fiscal Redistribution, we assessed the extent to which counterintuitive results occur in actual systems.

Our results show that for everything but indirect taxes, the risk of a Kakwani index yielding a sign-inconsistent result is small. In the case of indirect taxes, however, we find that in roughly 25 percent of our sample there is sign-inconsistency: regressive indirect taxes are *equalizing*. As discussed in the paper, the higher frequency of sign-inconsistent cases with indirect taxes could be a consequence of the higher presence of randomness in the relationship between income and taxes (due to tastes, for example); a higher degree of randomness, in turn, is likely to produce more instances of reranking. Are other indexes of progressivity likely to yield different results? Based on what was said above, the sign-inconsistent cases found in our sample using the Kakwani index are likely to show as sign-

[25] See, for example, Kiefer (1984) and Duclos and Araar (2006), chapter 7.

[26] In practice, while "strong" sign-inconsistency is unlikely, "weak" inconsistency is possible: that is, while the Reynolds-Smolensky may show a reduction in vertical inequality, the postfiscal Gini index could remain relatively unchanged. In our sample of countries, this was the case, for example, in Bolivia.

inconsistent with the Suits and the Reynolds-Smolensky index (applied to the same single fiscal intervention, that is).

For the cases in which there is sign-consistency, we find that only in about 6 percent of the possible pairs there is magnitude inconsistency: that is, the magnitude of the Kakwani index and the magnitude of the size of the tax or the transfer do not map into a similar magnitude for the marginal contribution. Using regression analysis, we also find that the dictum that increasing the size or progressivity of a progressive tax (transfer) is equalizing is statistically robust for sign-consistent cases. However, the coefficient for the Kakwani index is not statistically and/or economically significant for the sign-inconsistent cases. The latter means that making the tax or transfer more progressive, will not necessarily make the equalizing effect higher.

While it is mathematically possible for the Kakwani index of progressivity to yield the wrong conclusions about the impact of taxes or transfers on postfiscal inequality, our results suggest that the Kakwani index of progressivity is an empirically robust indicator of the impact of taxes or transfers on inequality except for indirect taxes. Thus, researchers and policymakers can rely on the Kakwani index in general. For indirect taxes, an alternative to producing a full-fledged fiscal incidence study is to calculate the marginal contribution with respect to consumable income. One would just have to calculate consumable income by adding subsidies and subtracting indirect taxes from disposable income. With this step, one can then easily calculate the marginal contribution for indirect taxes.

References

Coady, David, Moataz El-Said, Robert Gillingham, Kangni Kpodar, Paulo Medas, and David Newhouse. 2006. "The Magnitude and Distribution of Fuel Subsidies: Evidence from Bolivia, Ghana, Jordan, Mali, and Sri Lanka," International Monetary Fund Working Paper 06/247.

Duclos, Jean-Yves, and Abdelkrim Araar, 2006. Poverty and Equity: Measurement, Policy and Estimation with DAD. Economic Studies in Inequality, Social Exclusion and Well-Being 2 (New York: Springer, IDRC).

Enami, Ali. 2018. "Measuring the Redistributive Impact of Taxes and Transfers in the Presence of Reranking," chap. 3 in Commitment to Equity Handbook: Estimating the Impact of Fiscal Policy on Inequality and Poverty, edited by Nora Lustig (Brookings Institution Press and CEQ Institute, Tulane University). Free online version available at www.commitmentoequity.org.

Enami, Ali, Nora Lustig, and Rodrigo Aranda. 2018. "Analytic Foundations: Measuring the Redistributive Impact of Taxes and Transfers," chap. 2 in Commitment to Equity Handbook: Estimating the Impact of Fiscal Policy on Inequality and Poverty, edited by Nora Lustig (Brookings Institution Press and CEQ Institute, Tulane University). Free online version available at www.commitmentoequity.org.

Higgins, Sean, and Nora Lustig 2018. "Allocating Taxes and Transfers and Constructing Income Concepts: Completing Sections A, B, and C of the CEQ Master Workbook," chap. 6 in Commitment to Equity Handbook: Estimating the Impact of Fiscal Policy on Inequality and Poverty, edited by Nora Lustig (Brookings Institution Press and CEQ Institute, Tulane University). Free online version available at www.commitmentoequity.org.

Kakwani, Nanak C. 1977. "Measurement of Tax Progressivity: An International Comparison." Economic Journal 87, no. 345, pp. 71–80.

Kiefer, Donald W. "Distributional tax progressivity indexes." National Tax Journal 37, no. 4 (1984): 497-513.

Lambert, Peter. 1985. "On the Redistributive Effect of Taxes and Benefits." Scottish Journal of Political Economy 32, no. 1, pp. 39–54.

Lambert, Peter. 2001. The Distribution and Redistribution of Income, 3rd ed. (Manchester University Press).

Lustig, Nora (Editor). 2018. Commitment to equity handbook: Estimating the impact of fiscal policy on inequality and poverty. Brookings Institution Press.

Lustig, Nora. 2020. "Measuring the distributional impact of taxation and public spending: The practice of fiscal incidence analysis." Oxford Research Encyclopedia of Economics and Finance, April.

Musgrave, Richard A., and Tun Thin. "Income tax progression, 1929-48." Journal of political Economy 56, no. 6 (1948): 498-514.

Ockner, Benjamin A. and Joseph A. Pechman, 1974. *Who Bears the Tax Burden.* The Brookings Institution, Washington.

Appendix A: Lambert's Counterintuitive Result

Lambert showed that –even in the absence of reranking– it is mathematically possible that a Kakwani index classifies a tax as regressive, but the tax is equalizing.[27] Lambert showed that this result is a consequence of the fact that the redistributive effect (measured by the difference between pre-fiscal and post-fiscal Gini coefficients) is a weighted sum, *and not a weighted average*, of the progressivity of taxes and transfers.[28] In particular, Lambert showed that the redistributive effect equals:

$$\boldsymbol{\Pi_N^{RE}} = \frac{(\boldsymbol{g\Pi_T^K} + \mathbf{b}\,\boldsymbol{\rho_B^K})}{(1 - \mathbf{g} + \mathbf{b})}$$

where $\boldsymbol{\Pi_N^{RE}}$ is the Redistributive Effect (that is, the difference between the prefiscal and postfiscal Gini coefficients). **g** and **b** are the ratio of taxes and transfers to pre-fiscal income, respectively; and $\boldsymbol{\Pi_T^K}$ and $\boldsymbol{\rho_B^K}$ are the Kakwani indexes for total taxes and total transfers, respectively. The condition for the system that includes the tax to be more equalizing than a system without the tax is the following:

$$\boldsymbol{\Pi_T^K} \;>\; -\frac{(b)}{(1+b)}\boldsymbol{\rho_B^K}$$

A regressive tax implies that the Kakwani index on the left hand side is negative and the equation tells us that as long as the absolute size of the Kakwani is smaller than the figure on the right side of the equation, the system that includes the regressive tax would be more equalizing than the system with just the benefit (and with the revenues coming as "manna from heaven").

The example shown below is used by Lambert to illustrate 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 (Lambert, 2001, p. 278). There are four individuals and one tax and one transfer in this example. The distribution of prefiscal income is clearly unequal and taxes are regressive. The Kakwani index for taxes equals -0.0714. Yet, the redistributive effect for the net fiscal system is 0.25, higher than 0.1972, the redistributive effect if we just kept transfers and removed the regressive tax. How is this possible? Because while the tax is regressive vis-à-vis the prefiscal (original) distribution of income, it is progressive vis-à-vis the post-transfers income. Lambert cited O'Higgins and Ruggles (1981) for the United Kingdom and Ruggles and O'Higgins (1981) for the United States as examples of systems in which a regressive tax exercised an equalizing force.

[27] Lambert (2001). Enami, Lustig and Aranda (2018) show that, in fact, it is also possible to have the opposite: a Kakwani-progressive tax could be unequalizing. Same is true for transfers.

[28] It is actually equal to the weighted sum of the Reynolds-Smolensky indexes but in the absence of reranking, the latter is equal to the redistributive effect.

Table A1. Lambert's conundrum

Individual	1	2	3	4	Total
Original income x	10	20	30	40	100
Tax liability (T)	6	9	12	15	42
Benefit level (B)	21	14	7	0	42
Post-benefit income	31	34	37	40	142
Final income	25	25	25	25	100

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

Appendix B: Regression Reuslts Robustness Check

This appendix provides the results of the same regression analyses presented in the main text but excludes USA and Spain. Our results remain largely unchanged indicating that these countries—the only advanced countries in our sample—are not driving our results.

Table B1. Fiscal redistribution dictum-consistency: regression results (excluding USA and Spain)

Panel A. PDI scenario

Income Concept	Disposable Income		Consumable Income			
Marginal contribution of	Direct taxes	Direct transfers	Direct taxes	Direct transfers	Indirect taxes	Indirect subsidies
Kakwani Index	0.029***	0.036***	0.032***	0.041***	0.062***	0.011***
	(0.006)	(0.011)	(0.007)	(0.014)	(0.008)	(0.003)
Size	0.229***	0.665***	0.260***	0.773***	0.070***	0.148***
	(0.019)	(0.127)	(0.020)	(0.165)	(0.017)	(0.033)
Observations	46	45	46	45	48	37
Adj. R-Squared	0.879	0.858	0.879	0.841	0.554	0.719
Average MC	0.012	0.015	0.014	0.018	0.003	0.003
Average Kakwani	0.251	0.742	0.251	0.742	0.002	0.188
Average size	0.054	0.023	0.054	0.023	0.086	0.016
Elasticity of MC w.r.t. the Kakwani index	0.6%	1.8%	0.6%	1.7%	0.1%	0.7%
Elasticity of MC w.r.t. the size	1.0%	1.0%	1.0%	1.0%	2.2%	0.8%

Panel B. PGT scenario

Income Concept	Disposable Income						Consumable Income							
Marginal contribution of	Direct taxes + contributions to pension	Direct taxes	Contributions to social security	Direct transfers + contributory pensions	Direct transfers	Contributory pensions	Direct taxes + contributions to pensions	Direct taxes	Contributions to social security	Direct transfers + contributory pensions	Direct transfers	Contributory pensions	Indirect taxes	Indirect subsidies
Kakwani Index	0.046**	0.021**	0.044**	0.067***	0.023**	0.029***	0.052***	0.024**	0.046**	0.074***	0.024**	0.034**	0.041***	0.010**
	(0.017)	(0.009)	(0.017)	(0.011)	(0.009)	(0.010)	(0.018)	(0.009)	(0.019)	(0.013)	(0.009)	(0.012)	(0.006)	(0.004)
Size	0.172***	0.199***	0.115***	0.270***	0.426***	0.215**	0.194***	0.225***	0.125***	0.346***	0.478***	0.274***	0.021**	0.145***
	(0.038)	(0.038)	(0.026)	(0.061)	(0.041)	(0.082)	(0.042)	(0.041)	(0.029)	(0.061)	(0.039)	(0.084)	(0.010)	(0.033)
Observations	33	33	26	35	34	35	33	33	26	35	34	35	35	29
Adj. R-Squared	0.649	0.793	0.573	0.848	0.853	0.654	0.680	0.808	0.588	0.872	0.876	0.705	0.716	0.674
Average MC	0.013	0.010	0.003	0.021	0.012	0.007	0.015	0.011	0.005	0.026	0.014	0.010	0.002	0.003
Average Kakwani	0.207	0.216	0.147	0.476	0.735	0.352	0.207	0.216	0.147	0.476	0.735	0.352	-0.018	0.234
Average size	0.078	0.049	0.029	0.077	0.021	0.055	0.078	0.049	0.029	0.077	0.021	0.055	0.083	0.018
Elasticity of MC w.r.t. the Kakwani index	0.7%	0.5%	2.0%	1.5%	1.4%	1.4%	0.7%	0.5%	1.4%	1.4%	1.3%	1.2%	-0.3%	0.7%
Elasticity of MC w.r.t. the size	1.0%	1.0%	1.0%	1.0%	0.8%	1.6%	1.0%	1.0%	0.7%	1.0%	0.7%	1.5%	0.7%	0.8%

Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Notes: Clustered standard errors at the country level are in parentheses. Stars represent statistical significance: *** p<0.01, ** p<0.05, * p<0.1. PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5). Size of each component of fiscal policy is measured with respect to the prefiscal income of a given scenario.

Table B2. Fiscal redistribution dictum-consistency: sign-consistent vs. inconsistent cases (excluding USA and Spain)

Scenario	PDI	PGT
Component of the fiscal system (Dep. var.: Marginal cont. to the Consumable income)	Indirect taxes	Indirect taxes
Kakwani Index	-0.075	-0.001
	(0.087)	(0.002)
Kakwani Index * Consistent	0.144	0.047***
	(0.086)	(0.006)
Size	0.027	-0.002
	(0.022)	(0.011)
Size * Consistent	0.024	0.017
	(0.030)	(0.017)
Observations	48	35
Adj. R-Squared	0.656	0.784
Average MC for consistent cases	0.003	0.003
Average Kakwani for consistent cases	0.013	-0.007
Average size for consistent cases	0.079	0.082
Elasticity of MC w.r.t. the Kakwani index	0.4%	-0.1%
Elasticity of MC w.r.t. the Kakwani index	1.6%	0.5%

Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Notes: Clustered standard errors at the country level are in parentheses. Stars represent statistical significance: *** p<0.01, ** p<0.05, * p<0.1. PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5). Size of each component of fiscal policy is measured with respect to the prefiscal income of a given scenario. "Consistent" is an indicator variable identifying sign-consistent country cases, i.e., countries where the sign of the Kakwani index and marginal contribution are the same.

Appendix C: Country studies references

Argentina (2012): Rossignolo, Dario. 2018. "Argentina: Taxes, Expenditures, Poverty, and Income Distribution," chap. 11 in Commitment to Equity Handbook. Estimating the Impact of Fiscal Policy on Inequality and Poverty, edited by Nora Lustig (Brookings Institution Press and CEQ Institute, Tulane University)

Argentina (2017): Lopez Del Valle, Juan Cruz, Caterina Brest López, Joaquín Campabadal, Julieta Ladronis, Nora Lustig, Valentina Martínez Pabón, Mariano Tommasi. 2021. "Fiscal Policy, Income Redistribution and Poverty Reduction in Argentina." CEQ Working Paper 111, Commitment to Equity Institute, Tulane University, August.

Armenia (2011): Younger, Stephen D., and Artsvi Khachatryan. 2017. "Fiscal Incidence in Armenia," chap. 2 in The Distributional Impact of Taxes and Transfers. Evidence from Eight Low- and Middle-Income Countries, edited by Gabriela Inchauste and Nora Lustig (Washington: World Bank)

Bolivia (2009): Paz Arauco, Veronica, George Gray-Molina, Ernesto Yañez Aguilar and Wilson Jimenez Pozo. 2014a. "Explaining Low Redistributive Impact in Bolivia," in Analyzing the Redistributive Impact of Taxes and Transfers in Latin America, edited by Nora Lustig, Carola Pessino and John Scott, Special Issue, Public Finance Review 42, no. 3, pp. 326-345. DOI: 10.1177/1091142113496133

Bolivia (2015): Paz Arauco, Veronica, Wilson Jimenez and Ernesto Yañez. 2020. "CEQ Master Workbook: Bolivia (2015)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University). December, 2020.

Brazil (2009): Higgins, Sean and Claudiney Pereira. 2014. "The Effects of Brazil's Taxation and Social Spending on the Distribution of Household Income," in Analyzing the Redistributive Impact of Taxes and Transfers in Latin America, edited by Nora Lustig and Carola Pessino

Chile (2013): Martinez- Aguilar, Sandra, Alan Fuchs, Eduardo Ortiz-Juarez and Giselle del Carmen. 2018. "Chile: The Impact of Fiscal Policy on Inequality and Poverty," chap. 13 in Commitment to Equity Handbook. Estimating the Impact of Fiscal Policy on Inequality and Poverty, edited by Nora Lustig (Brookings Institution Press and CEQ Institute, Tulane University)

China (2014): Lustig, Nora and Yang Wang. 2020. "The Impact of Taxes and Transfers on Income Inequality, Poverty, and the Urban-Rural and Regional Income Gaps in China." CEQ Working Paper 93, Commitment to Equity Institute, Tulane University, July.

Colombia (2010, 2014): Meléndez, Marcela, Valentina Martínez Pabón, and Nicolás Peña-Tenjo. 2021. "El papel de la política fiscal en la reducción de la desigualdad y la pobreza en Colombia: un análisis de incidencia del gasto social y los impuestos." CEQ Working Paper 107, Commitment to Equity Institute, Tulane University, February.

Dominican Republic (2013): Aristy-Escuder, Jaime, Maynor Cabrera, Blanca Moreno-Dodson and Miguel E. Sanchez-Martin. 2018. "Dominican Republic: Fiscal Policy and Redistribution," chap. 14 in Commitment to Equity Handbook. Estimating the Impact of Fiscal Policy on Inequality and Poverty, edited by Nora Lustig (Brookings Institution Press and CEQ Institute, Tulane University)

Ecuador (2011): Llerena Pinto, Freddy Paul, Maria Cristhina Llerena Pinto, Maria Andrea Llerena Pinto and Roberto Carlos Saa Daza. 2015. "Social Spending, Taxes and Income Redistribution in Ecuador," CEQ Working Paper 28 (Center for Inter-American Policy and Research and Department of Economics, Tulane University and Inter-American Dialogue).

El Salvador (2011): Beneke, Margarita, Nora Lustig and Jose Andres Oliva. 2018. "El Salvador: The Impact of Taxes and Social Spending on Inequality and Poverty," chap. 15 in Commitment to Equity Handbook. Estimating the Impact of Fiscal Policy on Inequality and Poverty, edited by Nora Lustig (Brookings Institution Press and CEQ Institute, Tulane University)

El Salvador (2013): Oliva, Jose Andres. 2020. "CEQ Master Workbook: El Salvador (2013)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University and Inter-American Development Bank). June, 2020.

El Salvador (2015): Oliva, Jose Andres. 2020. "CEQ Master Workbook: El Salvador (2015)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University and Inter-American Development Bank). June, 2020.

El Salvador (2017): Oliva, Jose Andres. 2020. "CEQ Master Workbook: El Salvador (2017)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University and Inter-American Development Bank). June, 2020.

eSwatini (2017): International Monetary Fund: African Department. 2020. "Kingdom of Eswatini: 2019 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Director for the Kingdom of Eswatini."

Ghana (2012): Younger, Stephen, Eric Osei-Assibey and Felix Oppong. 2017. "Fiscal Incidence in Ghana." Review of Development Economics 21, no 4, pp. 47-66. DOI: 10.1111/rode.12299.

Guatemala (2011): Cabrera, Maynor, Nora Lustig and Hilcias E. Moran. 2015. "Fiscal Policy, Inequality and the Ethnic Divide in Guatemala." World Development 76: 263-279. DOI: https://doi.org/10.1016/j.worlddev.2015.07.008

Guatemala (2014): Cabrera, Maynor, Martinez and Moran. 2020. "CEQ Master Workbook: Guatemala (2014)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University, Instituto Centroamericano de Estudios Fiscales (ICEFI) and International Fund for Agricultural Development (IFAD)). November 2020.

Honduras (2011): Icefi. 2017b. "Incidencia de la politica fiscal en la desigualdad y la pobreza en Honduras," CEQ Working Paper 51 (CEQ Institute, Tulane University, IFAD and Instituto Centroamericano de Estudios Fiscales), April.

India (2011): Khundu, Sridhar and Maynor Cabrera. 2020. "CEQ Master Workbook: India (2011)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University and Centre for Budget and Governance Accountability). June 22, 2020.

Iran (2011): Enami, Ali, Nora Lustig and Alireza Taqdiri. 2019. "Fiscal Policy, Inequality and Poverty in Iran: Assessing the Impact and Effectiveness of Taxes and Transfers." Middle East Development Journal. March. DOI: https://doi.org/10.1080/17938120.2019.1583510

Ivory Coast (2015): Jellema, Jon. 2020. "CEQ Master Workbook: Ivory Coast (2015)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University and the World Bank). November 16, 2020.

Kenya (2015): Pape, Utz Johann and Simon Lange. 2018. "Fiscal incidence analysis for Kenya : using the Kenya integrated household budget survey 2015-16." (Washington: World Bank Group).

Lesotho (2017): Houts, Ian and Alexander Massara. 2020. "CEQ Master Workbook: Lesotho (2016)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University and the World Bank). August 19, 2020.

Mexico (2012, 2014): Scott, John, Enrique de la Rosa, and Rodrigo Aranda. 2017. "Inequality and fiscal redistribution in Mexico: 1992-2015." CEQ Working Paper 65, CEQ Institute, Tulane University, November.

Namibia (2010): Sulla, Victor, Precious Zikhali, Philip M. Schuler, and Jon Jellema. 2017, June. Does Fiscal Policy Benefit the Poor and Reduce Inequality in Namibia? The Distributional Impact of Fiscal Policy in Namibia (Washington, World Bank Working Paper No. 116029)

Namibia (2016): Jellema, Jon and Maya Goldman. 2020. "CEQ Master Workbook: Namibia (2015-16)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University). June, 2020.

Nicaragua (2009): Icefi. 2017c. "Incidencia de la politica fiscal en la desigualdad y la pobreza en Nicaragua," CEQ Working Paper 52 (CEQ Institute, Tulane University, IFAD and Instituto Centroamericano de Estudios Fiscales), May.

Panama (2016): Martinez-Aguilar, Sandra. 2019. "CEQ Master Workbook: Panama (2016)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University and the Economic Co-operation and Development). January 16, 2019.

Peru (2011): Jaramillo, Miguel. 2020. "CEQ Master Workbook: Peru (2011)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University). July 28, 2020.

Russia (2010): Lopez-Calva, Luis Felipe, Nora Lustig, Mikhail Matytsin, and Daria Popova. 2017. "Who Benefits from Fiscal Redistribution in the Russian Federation?," chap. 7 in The Distributional Impact of Taxes and Transfers. Evidence from Eight Low- and Middle-Income Countries, edited by Gabriela Inchauste and Nora Lustig (Washington: World Bank)

South Africa (2010): Inchauste, Gabriela, Nora Lustig, Mashekwa Maboshe, Catriona Purfield, and Ingrid Woolard. 2017. "The Distributional Impact of Fiscal Policy in South Africa." chap. 8 in The Distributional Impact of Taxes and Transfers. Evidence from Eight Low- and Middle-Income Countries, edited by Gabriela Inchauste and Nora Lustig (Washington: World Bank).

South Africa (2015): Goldman, Maya, Woolard, Ingrid, and Jellema, Jon. (2021, January). The Impact of Taxes and Transfers on Poverty and Income Distribution in South Africa 2014/15. (CEQ Institute Working Paper 106).

Spain (2017): Gómez Bengoechea, Gonzalo and Siyu Quan. 2020. "Fiscal Incidence in Spain in 2016," CEQ Working Paper 95 (CEQ Institute, Tulane University).

Sri Lanka (2009): Arunatilake, Nisha, Gabriela Inchauste, and Nora Lustig. 2017. "The Incidence of Taxes and Spending in Sri Lanka," in The Distributional Impact of Taxes and Transfers. Evidence from Eight Low- and Middle-Income Countries, edited by Gabriela Inchauste and Nora Lustig (Washington: World Bank).

Tajikistan (2015): Dalmacio F., Benicio, Jon Jellema, Maya Goldman and William Seitz. 2021. "The Effects of Fiscal Policy on Poverty and Inequality in Tajikistan." CEQ Working Paper 108, Commitment to Equity Institute, Tulane University, February.

Tanzania (2011): Younger, Stephen, Flora Myamba and Kenneth Mdadila. 2016. "Fiscal Incidence in Tanzania." African Development Review 28, no. 3, pp. 264-276. DOI: 10.1111/1467-8268.12204.

Togo (2015): Jellema, Jon and Caroline Tassot. 2020. "CEQ Master Workbook: Togo (2015)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University). October 19, 2020.

Tunisia (2010): Jouini, Nizar, Nora Lustig, Ahmed Moummi, and Abebe Shimeles. 2018. "Tunisia: Fiscal Policy, Income Redistribution and Poverty Reduction," chap. 18 in Commitment to Equity Handbook. Estimating the Impact of Fiscal Policy on Inequality and Poverty, edited by Nora Lustig (Brookings Institution Press and CEQ Institute, Tulane University)

Turkey (2014): Cuevas, P. Facundo, Leonardo Lucchetti and Metin Nebiler. 2020. "What are the Poverty and Inequality Impacts of Fiscal Policy in Turkey?" CEQ Working Paper 100, Commitment to Equity Institute, Tulane University, May.

Uganda (2012): Jellema, Jon, Astrid Haas, Nora Lustig, and Sebastian Wolf. 2018. "Uganda: The Impact of Taxes, Transfers, and Subsidies on Inequality and Poverty," chap. 19 in Commitment to Equity Handbook. Estimating the Impact of Fiscal Policy on Inequality and Poverty, edited by Nora Lustig (Brookings Institution Press and CEQ Institute, Tulane University).

Uganda (2016): Deisy, G., Mejia-Mantilla, C., Fajardo, J., Goldman, M., Jellema, J., Renda, H.. 2020. "CEQ Master Workbook: Uganda (2016-17)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University). August 19, 2020.

United States (2016): Carrera, Cristina, Ruoxi Rosie Li and Haley Renda. 2019. "CEQ Master Workbook: United States (2016)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University). December 23th, 2019.

Uruguay (2009): Bucheli, Marisa, Nora Lustig, Maximo Rossi and Florencia Amabile. 2014. "Social Spending, Taxes, and Income Redistribution in Uruguay," in Analyzing the Redistributive Impact of Taxes and Transfers in Latin America, edited by Nora Lustig, Carola Pessino and John Scott, Special Issue, Public Finance Review 42, no. 3, pp. 413-433. DOI: 10.1177/1091142113493493

Venezuela (2013): Molina, Emiro. 2020. "CEQ Master Workbook: Venezuela (2013)," CEQ Data Center on Fiscal Redistribution (CEQ Institute, Tulane University). November 10, 2020.

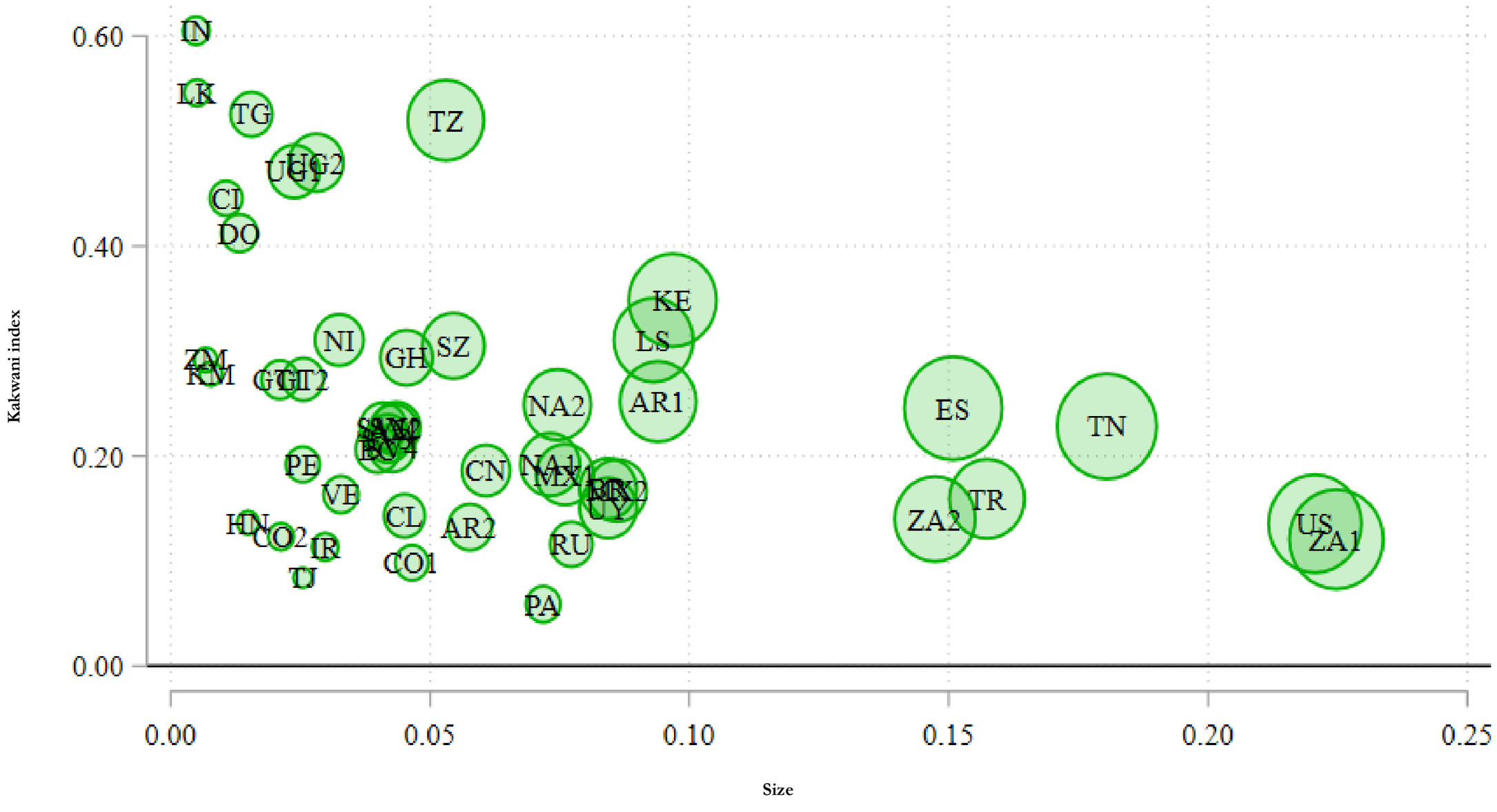
Zambia (2015): International Monetary Fund: African Department. 2017. "Zambia: Selected Issues," International Monetary Fund Country Report No. 17/328.

Appendix D. Bubble plots with country indicators

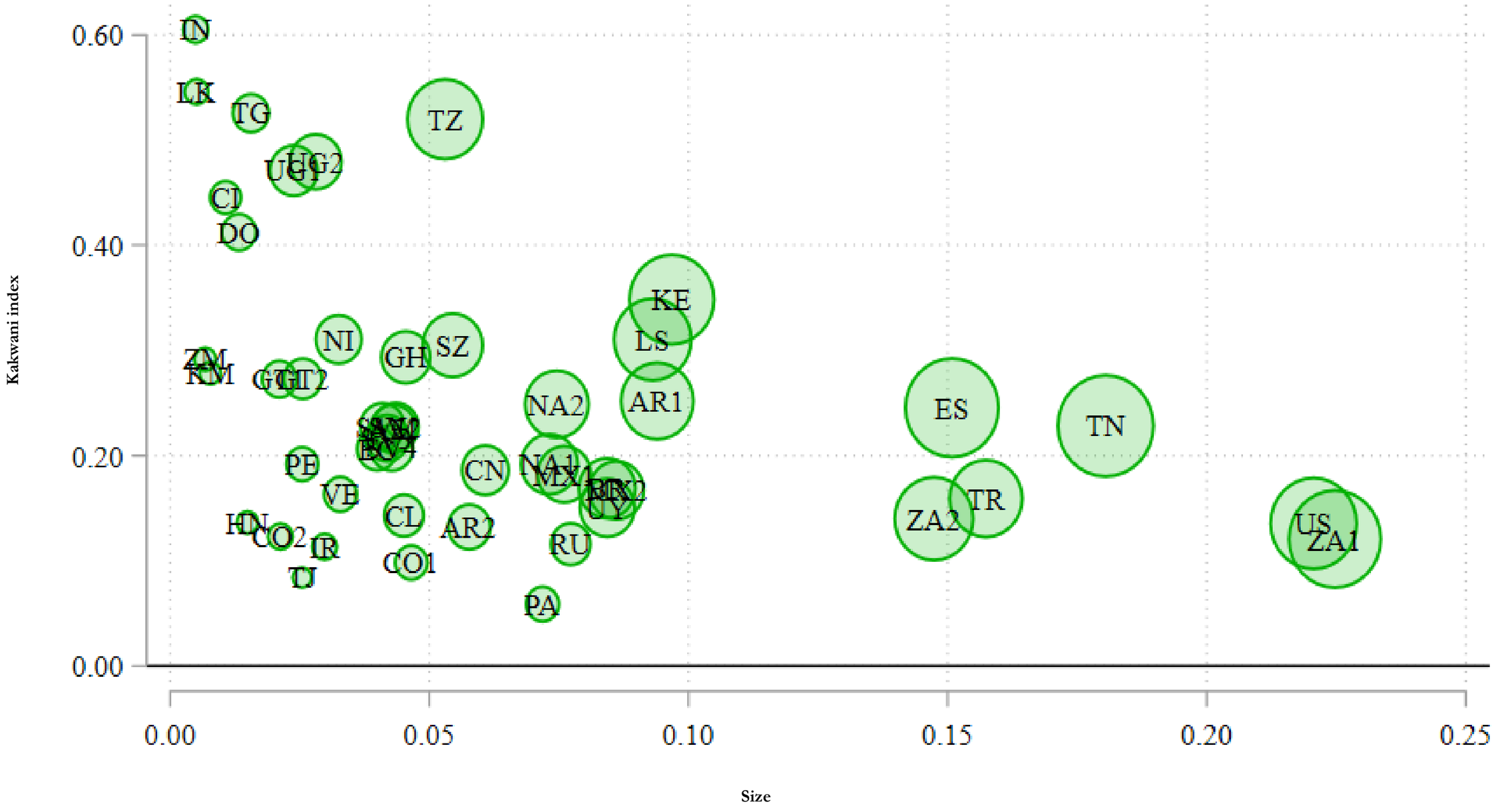
Figure D1. Kakwani index, size, and marginal contribution of components of the fiscal system: Bubble plots (with country indicators).

Section I. PDI scenario

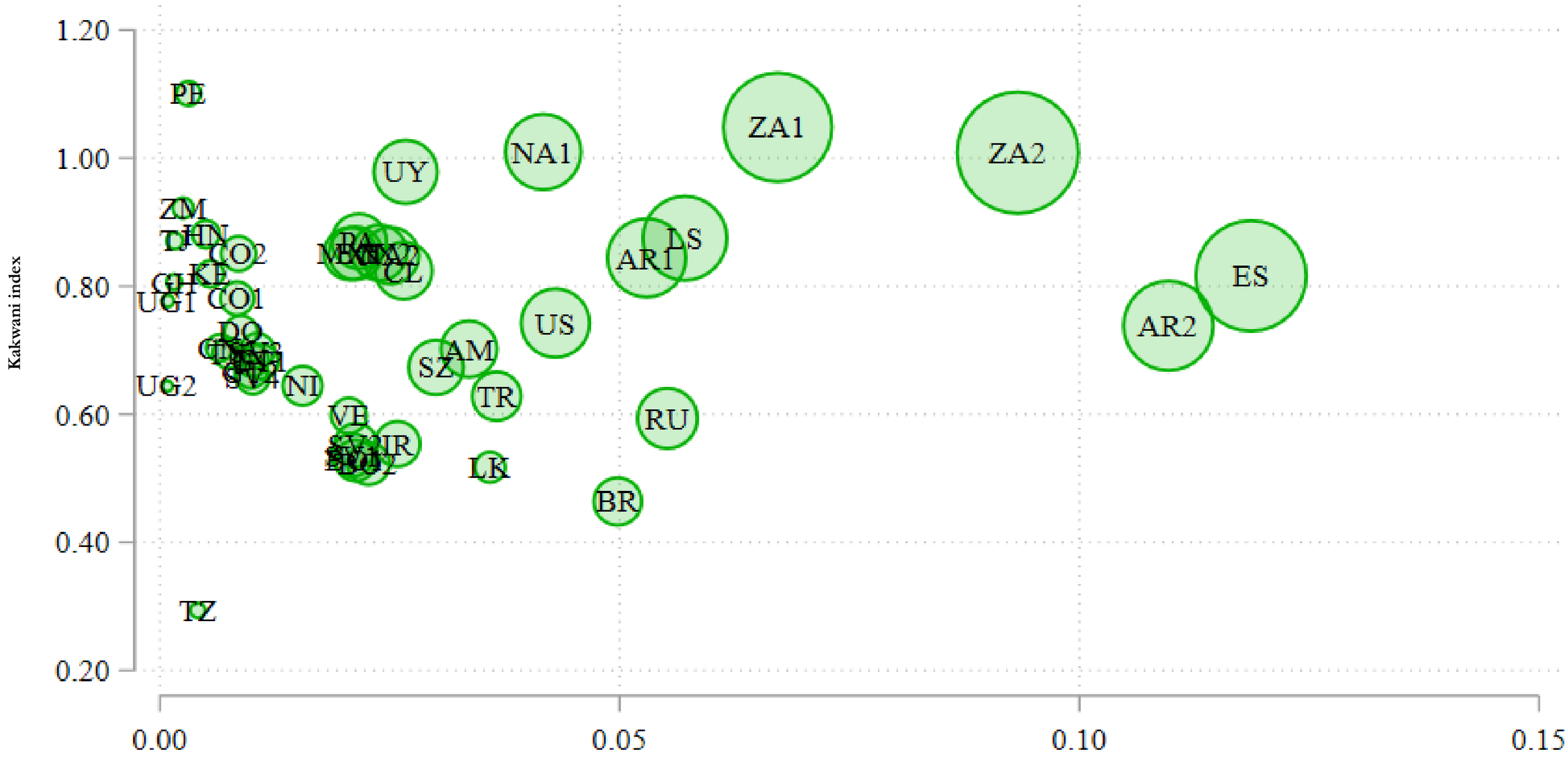
Panel A1. Marginal contribution of direct taxes to the inequality of Disposable income



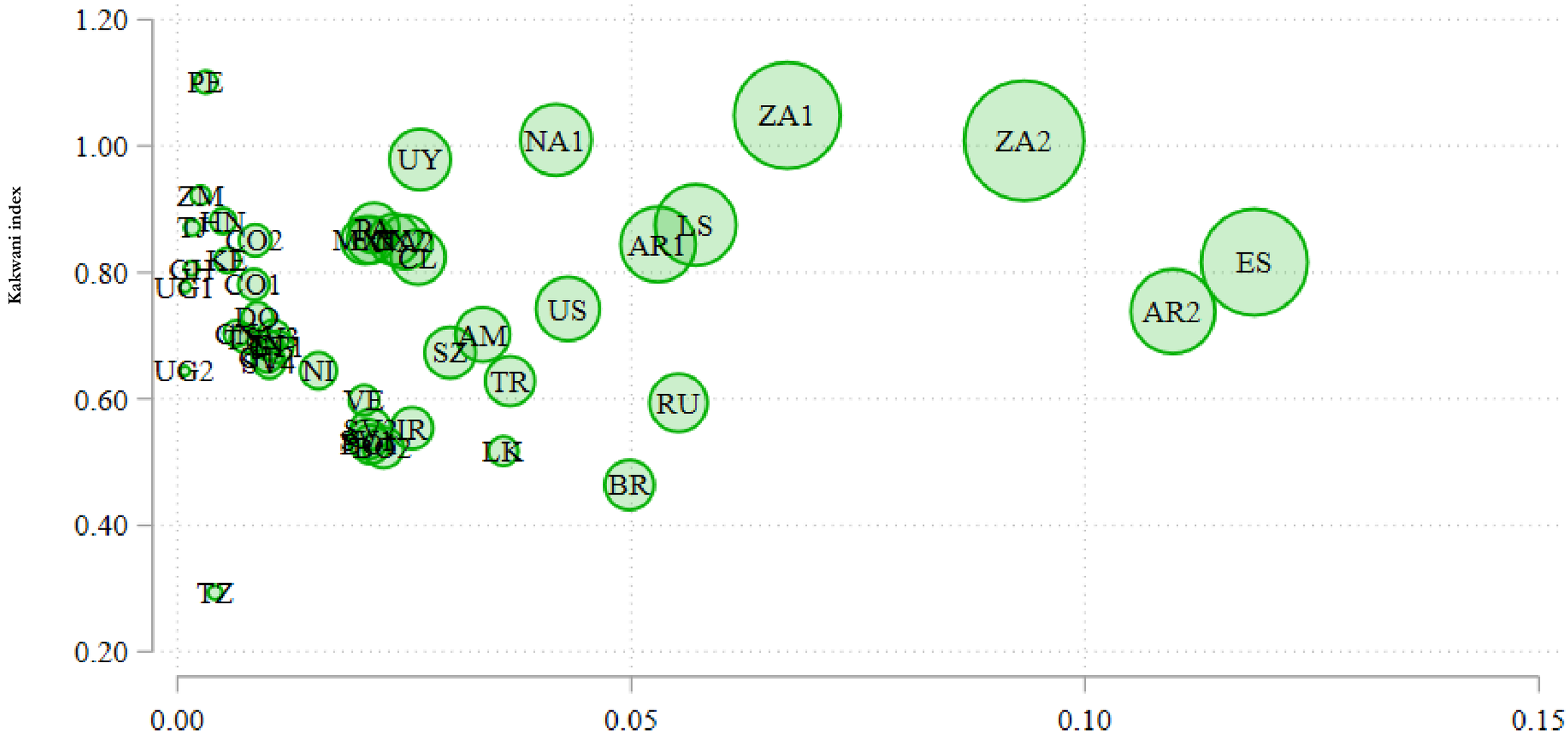
Panel A2. Marginal contribution of direct taxes to the inequality of Consumable income



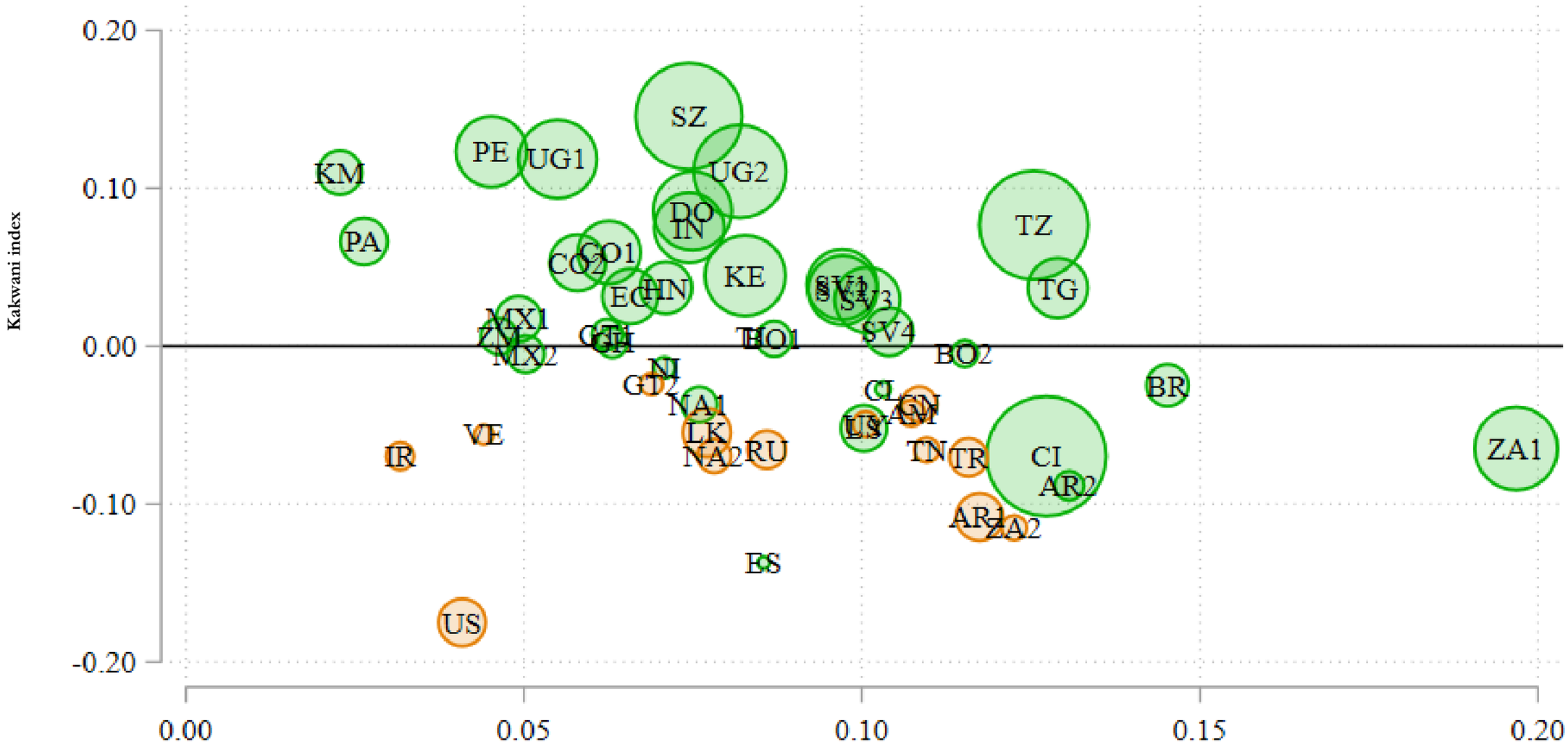
Panel B1. Marginal contribution of direct transfers to the inequality of Disposable income



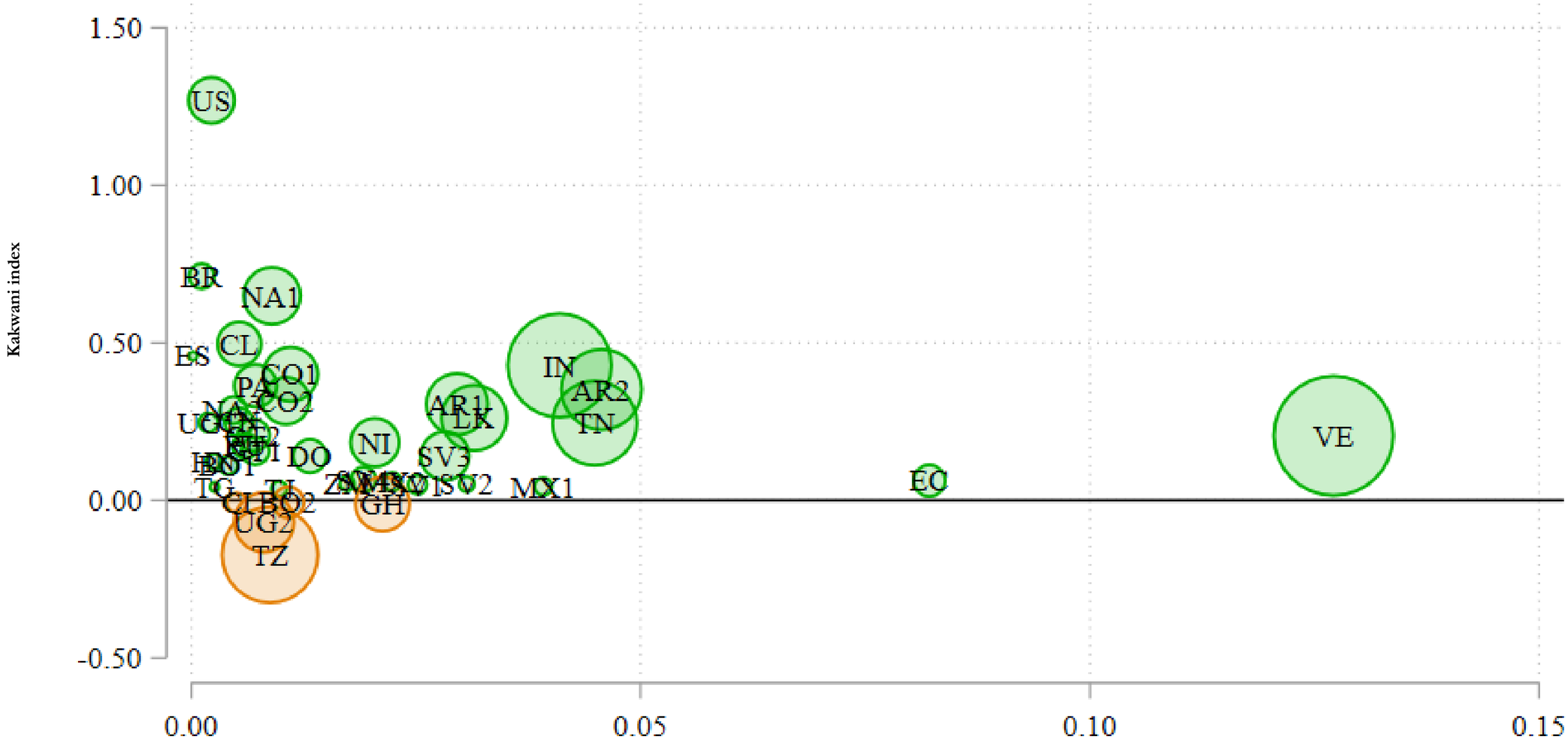
Panel B2. Marginal contribution of direct transfers to the inequality of Consumable income



Panel C. Marginal contribution of indirect taxes to the inequality of Consumable income

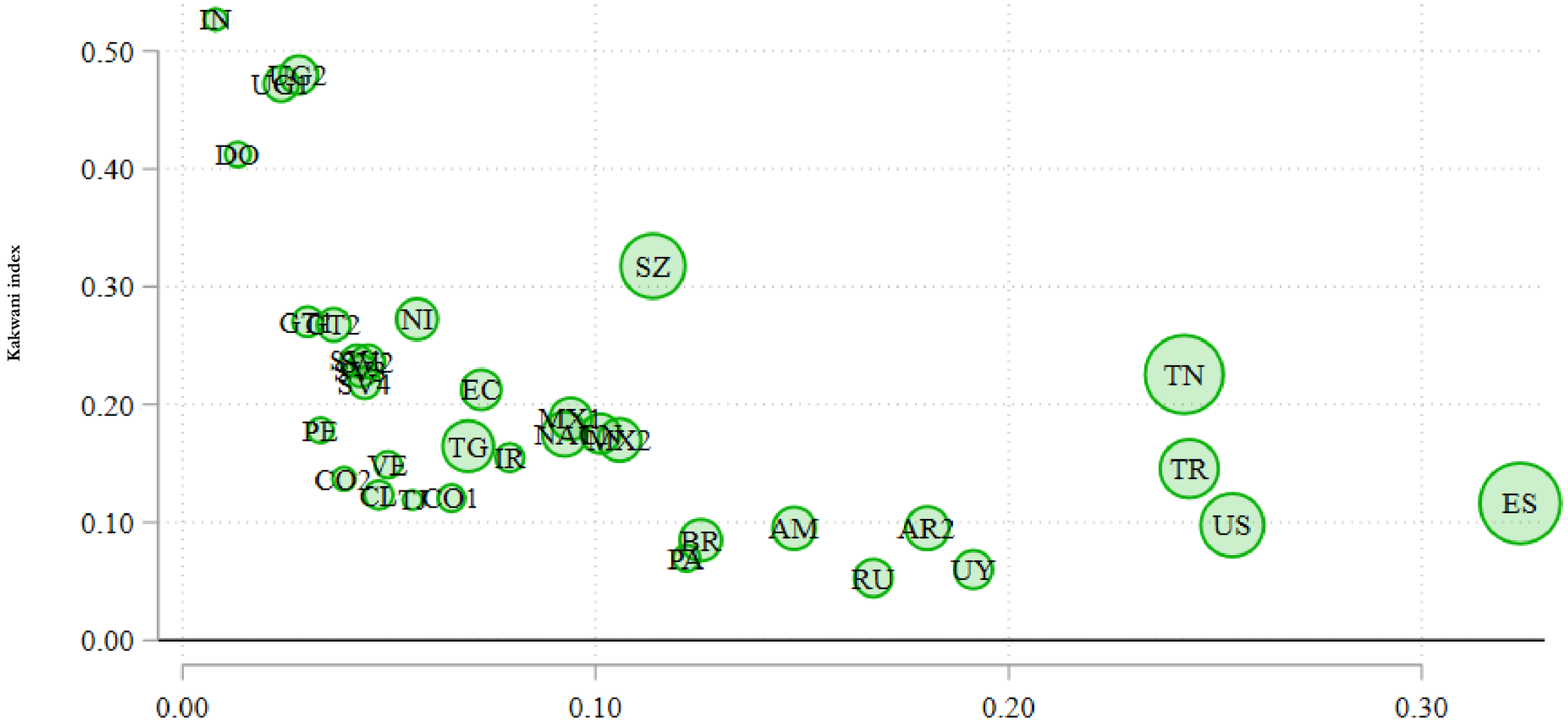


Panel D. Marginal contribution of indirect subsidies to the inequality of Consumable income

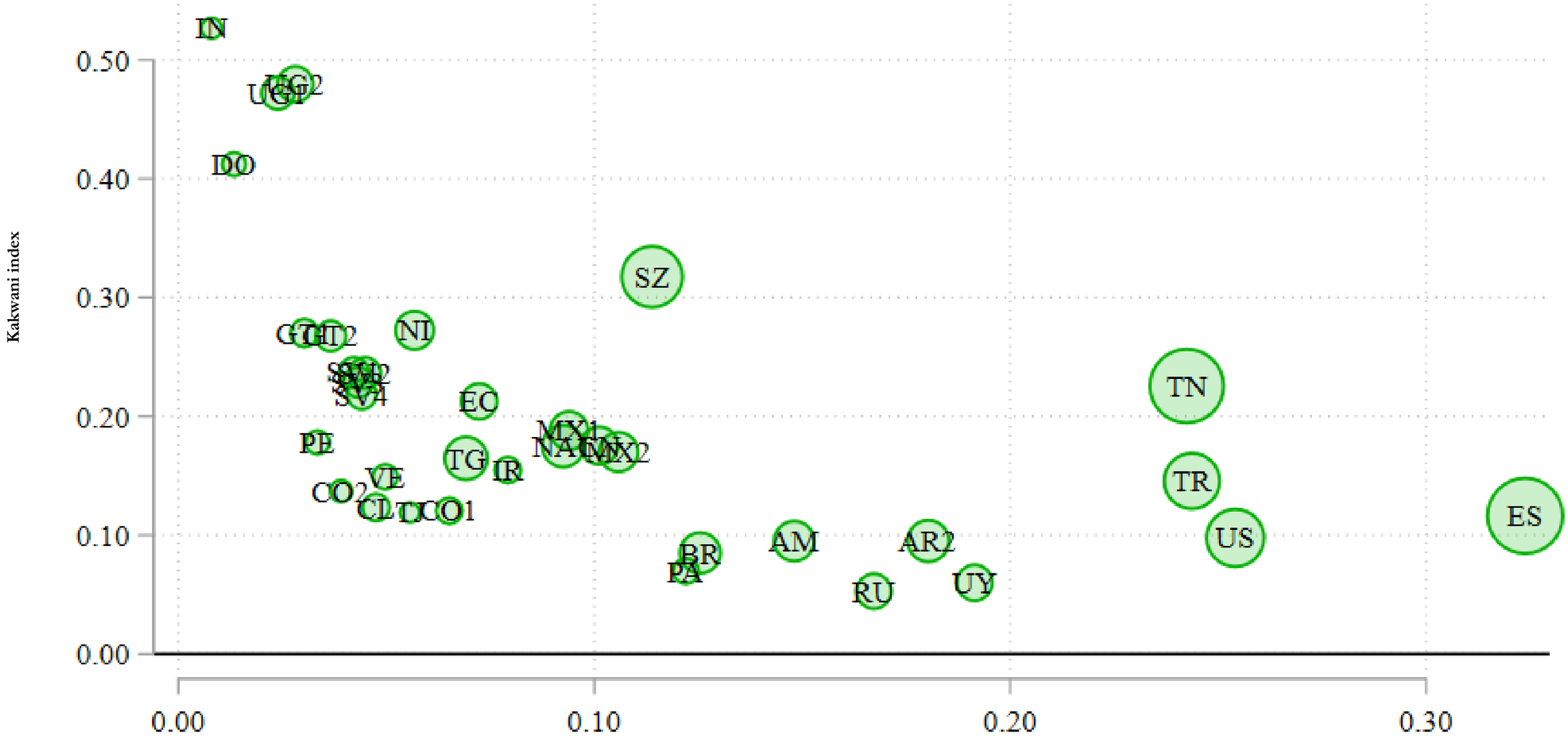


Section II. PGT scenario

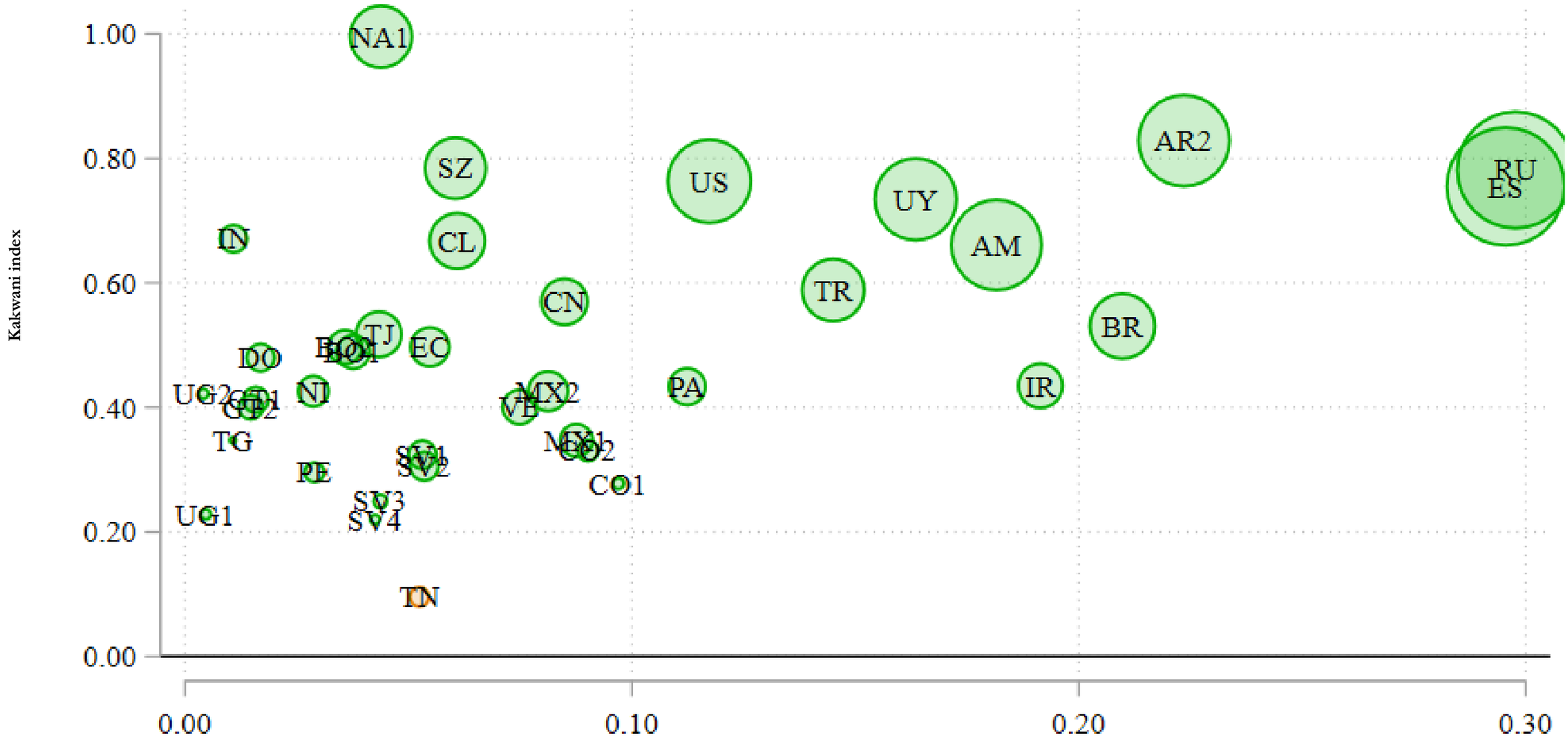
Panel E1. Marginal contribution of direct taxes to the inequality of Disposable income



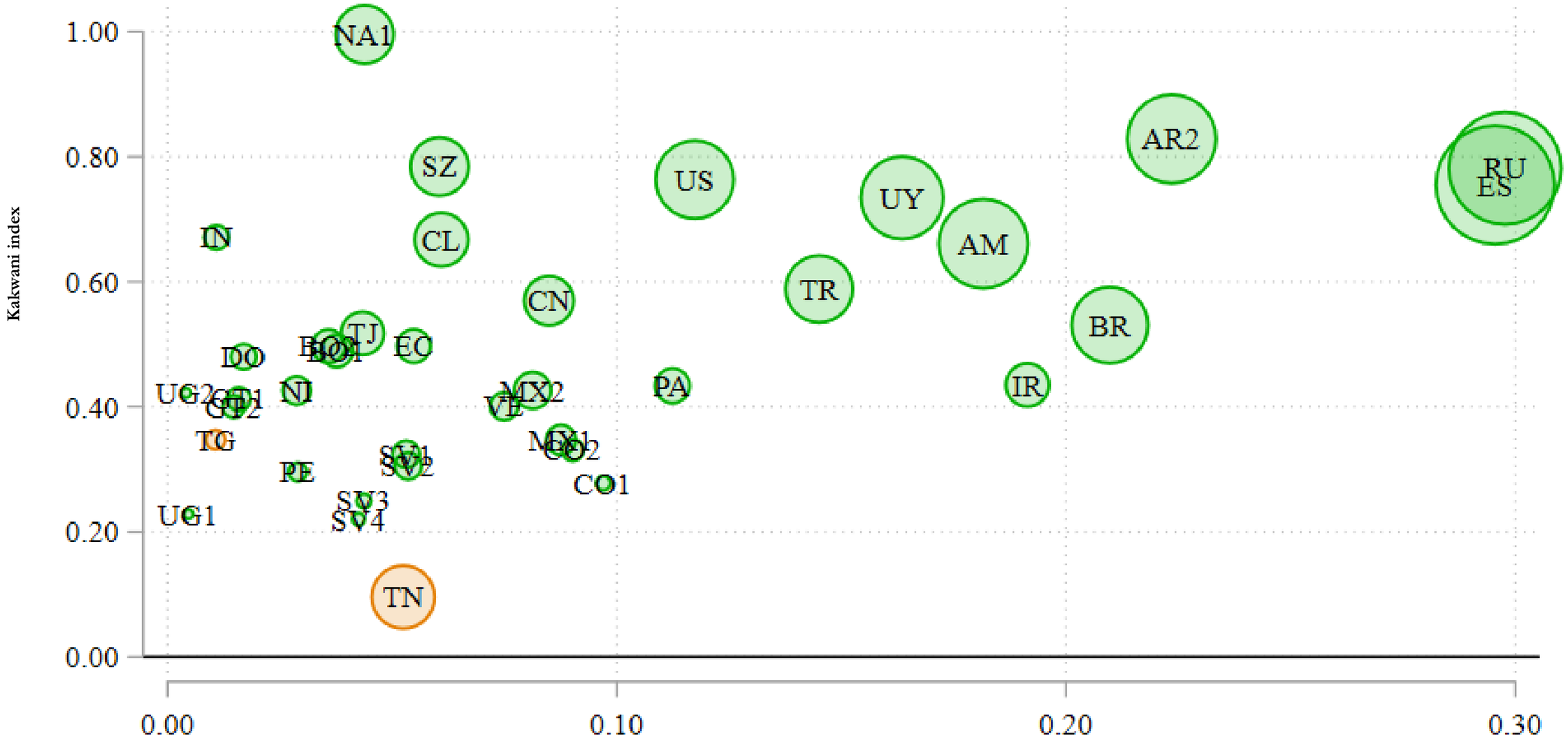
Panel E2. Marginal contribution of direct taxes to the inequality of Consumable income



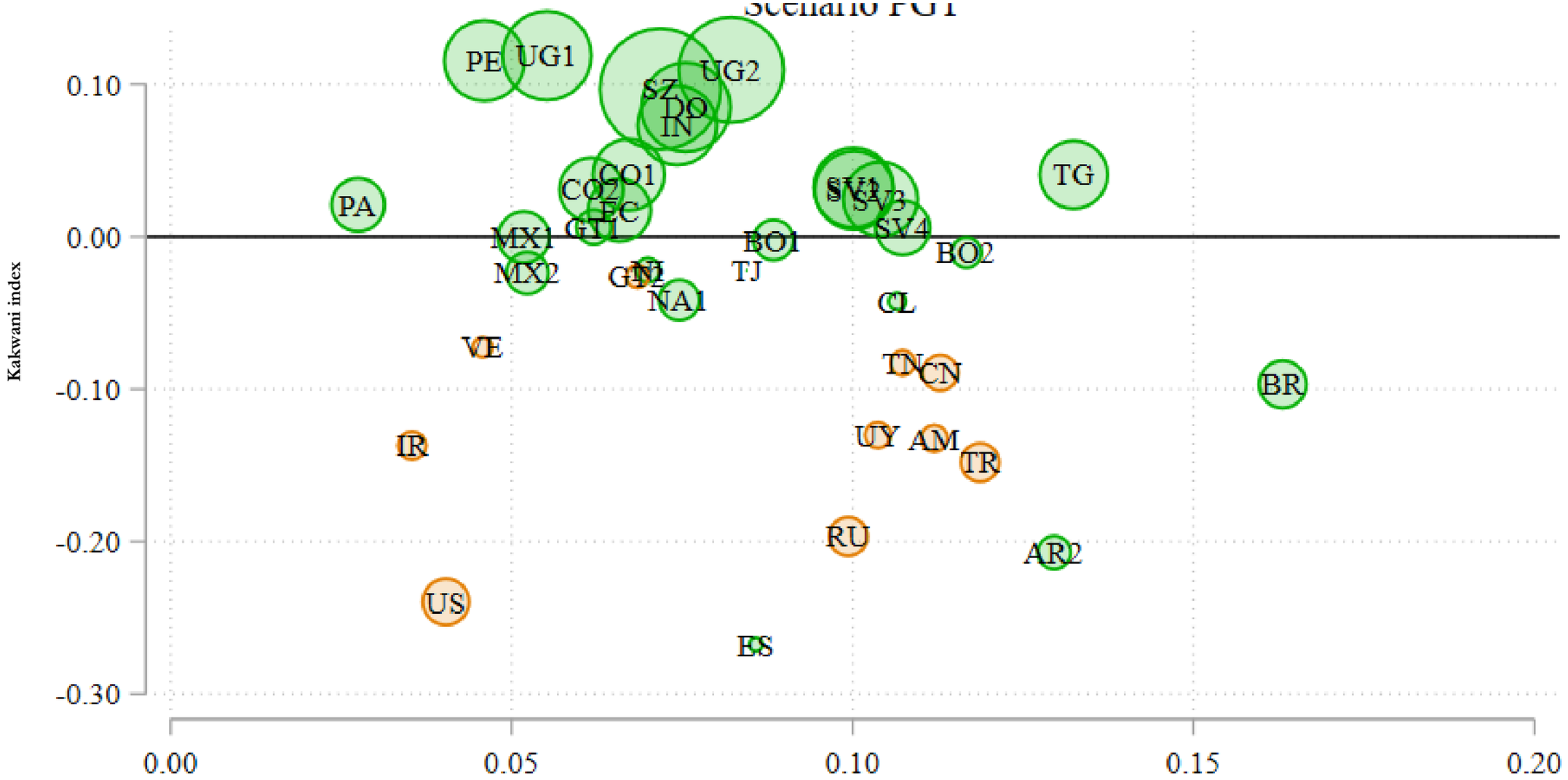
Panel F1. Marginal contribution of direct transfers to the inequality of Disposable income



Panel F2. Marginal contribution of direct transfers to the inequality of Consumable income

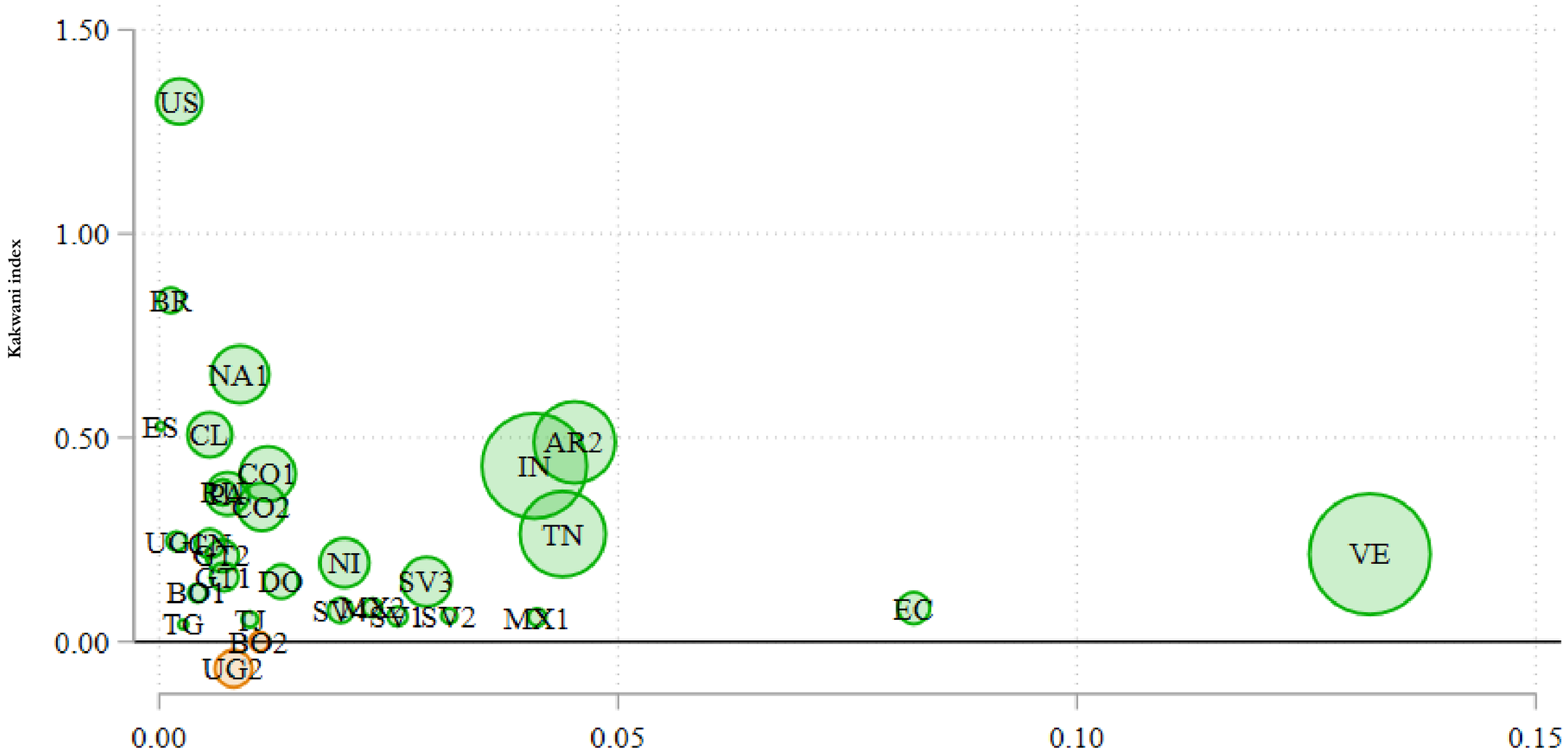


Panel G. Marginal contribution of indirect taxes to the inequality of Consumable income



Size

Panel H. Marginal contribution of Subsidies to the inequality of Consumable income



Source: Argentina 2012 (Rossignolo, 2020); Argentina 2017 (Lopez del Valle et al., 2021); Armenia 2011 (Younger et al., 2019); Bolivia 2009 (Paz Arauco et al., 2014); Bolivia 2015 (Paz Arauco et al., 2020); Brazil 2009 (Higgins, Pereira and Cabrera, 2020); Chile 2013 (Martinez-Aguilar, 2020); China 2014 (Yang, 2020); Colombia 2010 (Melendez and Martinez, 2019); Colombia 2014 (Melendez and Martinez, 2019); Comoros 2014 (Jellema 2020); Dominican Republic 2013 (Aristy-Escuder, 2019); Ecuador 2011 (Llerena et al., 2020); El Salvador 2011 (Oliva, 2020); El Salvador 2013 (Oliva, 2020); El Salvador 2015 (Oliva, 2020); El Salvador 2017 (Oliva, 2020); Eswatini 2017 (Habib et al., 2020); Ghana 2012 (Younger et al., 2018); Guatemala 2011 (Cabrera, 2019); Guatemala 2014 (Cabrera et al., 2020); Honduras 2011 (Espino, 2020); India 2011 (Khundu and Cabrera, 2020); Iran 2011 (Enami, Lustig, and Taqdiri, 2017); Ivory Coast 2015 (Jellema, 2020); Kenya 2015 (Kulundu et al., 2019); Lesotho 2017 (Massara and Houts, 2020); Mexico 2012 (Scott et al., 2020); Mexico 2014 (Scott et al., 2020); Namibia 2010 (Jellema and Renda, 2020); Namibia 2016 (Jellema and Goldman, 2020); Nicaragua 2009 (Cabrera and Moran, 2020); Panama 2016 (Martinez-Aguilar, 2020); Paraguay 2014 (Gimenez et al., 2017); Peru 2011 (Jaramillo, 2020); Russia 2010 (Popova Et.Al, 2019); South Africa 2010 (Inchauste et al., 2016); South Africa 2015 (Goldman and Woolard, 2020); Spain 2017 (Bengoechea and Quan, 2019); Sri Lanka 2009 (Arunatilake et al., 2019); Tajikistan 2015 (Benicio et al., 2017); Tanzania 2011 (Younger, Myamba, and Mdadila, 2019); Togo 2015 (Jellema and Tassot, 2020); Tunisia 2010 (Jouini, 2020); Turkey 2014 (Caglayan, 2020); Uganda 2012(Jellema and Renda, 2020); Uganda 2016 (Deisy et al., 2020); United States 2016 (Carrera et al., 2019); Uruguay2009 (Bucheli, 2019); Venezuela 2013 (Molina, 2020) and Zambia 2015 (Jellema et al., 2020). For the references see online Appendix C.

Notes: PDI: old-age pensions as deferred income; PGT: old-age pensions as government transfer. For definitions of disposable and consumable income see Figure 1 in the paper. For the definition of Kakwani index and marginal contribution see equations (1), (2), and (5). Size of each component of fiscal policy is measured with respect to the prefiscal income of a given scenario. Green bubbles represent equalizing effects (positive marginal contribution) and red bubbles represent unequalizing effects (negative marginal contribution). The size of bubbles represents the size of marginal contribution. The list of labels used for the countries is below.

List of countries:

Country Study	Label
Argentina (2012)	AR1
Argentina (2017)	AR2
Armenia (2011)	AM
Bolivia (2009)	BO1
Bolivia (2015)	BO2
Brazil (2009)	BR
Chile (2013)	CL
China (2014)	CN
Colombia (2010)	CO1
Colombia (2014)	CO2
Comoros (2014)	KM
Dominican Republic (2013)	DO
Ecuador (2011)	EC
El Salvador (2011)	SV1
El Salvador (2013)	SV2
El Salvador (2015)	SV3
El Salvador (2017)	SV4
Ghana (2012)	GH
Guatemala (2011)	GT1
Guatemala (2014)	GT2
Honduras (2011)	HN
India (2011)	IN
Iran (2011)	IR
Ivory Coast (2015)	CI
Kenya (2015)	KE

Country Study	Label
Lesotho (2017)	LS
Mexico (2012)	MX1
Mexico (2014)	MX2
Namibia (2010)	NA1
Namibia (2016)	NA2
Nicaragua (2009)	NI
Panama (2016)	PA
Peru (2011)	PE
Russia (2010)	RU
South Africa (2010)	ZA1
South Africa (2015)	ZA2
Spain (2017)	ES
Sri Lanka (2009)	LK
Tajikistan (2015)	TJ
Tanzania (2011)	TZ
Togo (2015)	TG
Tunisia (2010)	TN
Turkey (2014)	TR
Uganda (2012)	UG1
Uganda (2016)	UG2
United States (2016)	US
Uruguay (2009)	UY
Venezuela (2013)	VE
Zambia (2015)	ZM
eSwatini (2017)	SZ