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Trust in Government in a Changing World: Shocks, Tax Evasion, and Economic Growth

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Abstract

Governments are always dealing with unexpected shocks, like wars, terrorism, financial crises, natural disasters, and the like. A recent prominent example is the SARS-CoV-2 pandemic. Since early 2020, governments around the world have enacted a range of unprecedented measures in an attempt to protect their citizens, with quite mixed results. This varied record has in turn had dramatic effects on peoples' perceptions of their government, especially on their trust in government and so on their willingness to obey the many government mandates generated by the pandemic. This willingness to obey government mandates extends well beyond pandemic policies to all other dimensions of government laws and regulations. An important dimension of individual compliance with government mandates is tax evasion. What will be the effects of the pandemic and the associated government policies on post-pandemic tax evasion and economic growth, especially via the effects of government policies on "trust" in the government? In this paper we incorporate both tax evasion and trust in an endogenous growth model in order to examine the short and long run impacts on tax evasion of various shocks – a pandemic shock, a government policies shock, and a tax morale shock (and the resulting impact on trust in government). We then use real data on 11 representative economies to simulate these effects, economies representing developed and developing countries as well as economies representing governments that opted for various policy responses to COVID-19, modelled as a labor productivity shock. We find that varied public policy responses to the pandemic have immediate and persistent impacts on tax evasion in the short and long run, largely via their effects on trust in government. We also find that these evasion impacts vary in important and predictable ways that depend especially on whether government dealt effectively or not with the pandemic. Our methodology is readily adapted to examine the effects of other shocks and their respective policy responses on trust in government, tax evasion, and economic growth.

Keywords: COVID-19, tax evasion and tax compliance, trust, endogenous growth models
JEL codes: H26, H30, O40

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Trust in Government in a Changing World: Shocks, Tax Evasion, and Economic Growth

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Manuscript Highlights

- What will be the effects of the pandemic on post-pandemic tax evasion and economic growth, especially via the effects of government policies on "trust" in the government?
- We incorporate both tax evasion and trust in an endogenous growth model, and we examine the short and long run impacts on tax evasion of a pandemic shock, a government policies shock, and a tax morale shock (and the resulting impact on trust).
- We then simulate the effects of these shocks on 11 representative economies.
- We find that government responses to the pandemic have significant impacts on tax evasion in the short and long run, largely via their effects on how policies affected trust in government and especially via their effects on how government dealt effectively – or ineffectively – with the pandemic.
- Our methodology is readily adapted to examine the effects of other shocks and their respective policy responses on trust in government, tax evasion, and economic growth.

1. Introduction

Governments are always dealing with unexpected shocks, like wars, terrorism, financial crises, natural disasters, and the like. A recent prominent example is the SARS-CoV-2 pandemic. Since early 2020, governments around the world have enacted a range of unprecedented, extensive, and expensive measures in an attempt to protect their citizens' health, both physical and economic. Among other policies, governments have imposed lockdowns, required masks, limited personal interactions (indoors and outdoors), and closed schools and businesses, all designed to reduce the spread of the COVID-19 virus and thereby improving the *physical* health of individuals. Governments have also instituted many economic policies aimed mainly at providing various forms of *economic* relief to their citizens and businesses. These policies have often proved controversial. The lockdowns, masks, social distancing, and closures have been seen by many as infringements on their personal freedoms; the economic policies have been questioned on their cost and on their effectiveness.

The success of these many policies has varied considerably across countries, in both the physical and economic health dimensions. This varied success has in turn had dramatic effects on peoples' perceptions of their government, especially on their trust in government and so on their willingness to obey the many government mandates generated by the pandemic. As argued by Devine et al. (2020), Van Bavel et al. (2020), and Alm et al. (2021), the perceived effectiveness of these policies is likely to shape compliance with many aspects of government policies, including the pandemic-related policies but extending well beyond to many other dimensions of government regulations and laws.

An especially important aspect of government enforcement efforts is tax evasion. Individuals are required by law to pay their legally due taxes, and yet many individuals do not obey these government mandates. The failure to comply with the tax laws has effects that

are central to the most fundamental issues in public economics. The most obvious impact of tax evasion is that it reduces tax collections, thereby affecting taxes that compliant taxpayers face and public services that citizens receive. Beyond these revenue losses, evasion creates misallocations in resource use when individuals alter their behavior to cheat on their taxes, such as in their choices of hours to work, occupations to enter, and investments to undertake. Its presence requires that government expend resources to detect noncompliance, to measure its magnitude, and to penalize its practitioners. Noncompliance alters the distribution of income in arbitrary, unpredictable, and unfair ways. Evasion may contribute to feelings of unjust treatment and disrespect for the law. It even affects the accuracy of macroeconomic statistics. More broadly, it is not possible to understand the true impact of taxation without recognizing the existence and the effects of tax evasion.[1]

There is in fact a large and growing literature on the measurement, determinants, and effects of tax evasion, as discussed in detail later. However, the impact of government pandemic policies on post-pandemic tax evasion is, to our knowledge, unexamined and unknown.

This is our main immediate goal here. We examine the effects of the pandemic and the associated government policies on post-pandemic tax evasion and economic growth, especially via the effects of government policies on citizen "trust" in the government. There is some speculation on how government responses to COVID-19 might affect compliance both in the short run and the long run (Alm et al., 2020). However, to date there are to our

[1] Relatedly, there is emerging evidence on massive amounts of fraud committed by individuals and firms in an attempt to gain illegally pandemic-related government assistance. For example, see Congressional Testimony on pandemic-related fraud by the Office of Inspector General (U.S. Department of Labor, 2022) and a report on unemployment insurance fraud during the pandemic (U.S. Government Accountability Office, 2022). There are also numerous articles in the press about fraud in pandemic relief programs, such as those in *The Washington Post* ("'Immense fraud' creates immense task for Washington as it tries to tighten scrutiny of $6 trillion in emergency coronavirus spending", 2 February 2022, available online at https://www.washingtonpost.com/us-policy/2022/02/17/stimulus-aid-oversight-fraud/) and in *The New York Times* ("Prosecutors struggle to catch up to a tidal wave of pandemic fraud", 16 August 2022, available online at https://www.nytimes.com/2022/08/16/business/economy/covid-pandemic-fraud.html?smid=em-share), among many others.

knowledge no actual estimates of the likely magnitudes and even the direction of these effects.[2] A broader goal of our paper is to demonstrate a methodology in which public policy responses to other unexpected shocks can be usefully applied to examine their impact on trust in government, tax evasion, and economic growth.

We define, simulate, and compare the transitional dynamics of 11 developed and developing countries, including the United States. The models are calibrated using comparable data for initial conditions and coefficient values relative to the U.S. baseline. We start with the endogenous growth model developed by Barreto (2021), and we then extend it to incorporate the impacts of both the pandemic and the resulting government policies on trust in government and then on tax evasion and economic growth. These extensions allow us to consider the impact on tax evasion of the various shocks that countries have experienced in the last several years – starting with the pandemic shock, the response of government via its policies shock, and the resulting trust shock that stems from a shock to tax morale, defined as the intrinsic motivation of individuals to pay their taxes. We then simulate these short and long run dynamic effects using real data from the 11 representative economies that typify developed and developing countries as well as countries whose governments implemented policies that either increased or decreased trust in government. Our methodology allows us to forecast the short and long term implications of the pandemic shock and the subsequent policy responses of each of the 11 countries on the evolution of citizen trust in government, tax evasion, and economic growth.

We find that government responses to the pandemic had significant impacts on tax evasion in the short and long run, largely via their effects on trust in government. We also

[2] Recent work by Schneider (2022) provides estimates of the size of the so-called "shadow economy" for 36 OECD and European countries during the initial years of the pandemic (2020 and 2021), with projections to 2022. Note that these estimates are driven entirely by macroeconomic factors (e.g., recession, shutdowns). Note also that the shadow economy is different than, even if related to, tax evasion. To our knowledge, this is the only paper that attempts to estimate the compliance impact of COVID-19.

find that these evasion impacts varied in important and predictable ways that depend especially on how effective government dealt with the pandemic. Our methodology is readily adapted to examine the effects of other unexpected shocks on trust in government and the resulting impacts on tax evasion and economic growth in the short run and the long run.

2. Some Relevant Literatures

2.1. On the Pandemic and Government Responses

The response of governments to the COVID-19 pandemic has been unprecedented. These responses have been along two broad areas. First, governments have enacted a range of policies designed to limit the spread of the virus, mainly by closing down important parts of the economy, by requiring schools to teach online, by urging (and often mandating) people to wear masks, by limiting personal interactions, and by developing and distributing vaccines. All of these policies have the broad goal of improving the *physical* health of their citizens.

Second, governments have enacted many economic policies whose goal is to provide *economic* relief to their citizens and businesses. According to the Organisation for Economic Cooperation and Development (OECD), these include such policies as: increased business cost subsidies / nonrepayable grants and loans / tax credits; tax filing extensions / tax payment deferrals / tax waivers; extended tax refunds; claim back of preliminary tax payments; enhanced business loss offset provisions; wage subsidies; short-term work schedules; accelerated and bonus depreciation provisions; tax incentives for research and development; corporate income tax rate reductions / VAT tax rate reductions; reduced taxes on specific sectors (e.g., tourism, construction, finance); reduced business financing costs; direct cash transfers to households; enhanced / extended unemployment benefits for individuals; enhanced individual eligibility for sick-pay, tax refunds, special tax deductions, tax exemptions, and waivers for social security contributions; enhanced individual tax

refunds; special tax deductions / tax exemptions / tax credits / tax waivers for individuals; and tax waivers / tax credits for specific consumption items. As classified by the OECD, these policies fall into four main areas that depend on their main objective: policies to support firms' liquidity (e.g., tax deferrals and waivers), policies to support employment (e.g., wage subsidies), policies to support business investment (e.g., enhanced tax incentives, reduced business tax rates, expanded depreciation allowances), and policies to support household consumption (e.g., direct cash transfers to households, unemployment benefits).[3]

The amounts that governments have spent on economic relief programs have been staggering. Consider the United States as only one example. Since the start of the pandemic in early 2020, the federal government of the U.S. has enacted nearly $6 trillion in relief programs, including: the Coronavirus Preparedness and Response Supplemental Appropriations Act (March 2020, $8 billion); the Families First Coronavirus Response Act (March 2020, $192 billion); the Coronavirus Aid, Relief, and Economic Security (CARES) Act (March 2020, $2.2 trillion); the Paycheck Protection Program and Health Care Enhancement Act (April 2020, $483 billion); the Consolidated Appropriations Act (December 2020, $868 billion); the American Rescue Plan Act (March 2021, $1.9 trillion); and the Infrastructure Investment and Jobs Act (November 2021, $1.2 trillion). The U.S. experience is not an isolated one.

These health and economic relief policies have enjoyed widespread, but far from unanimous, support from the citizens of the countries. The lockdowns, masks, social distancing, and closures have been seen by many as infringements on their personal freedoms, and the economic policies have been questioned on their cost. These policies have had many effects, intended and unintended. Of most importance are the effects on the health

[3] See OECD, http://www.oecd.org/coronavirus/policy-responses/tax-administration-responses-to-covid-19-measures-taken-to-support-taxpayers-adc84188/ (update 29/06/2020). For a detailed discussion of these policies, especially tax-related policies, see Alm et al. (2020).

of individuals (e.g., death rates, hospitalization rates), as well as on the broad economic health of the countries (e.g., output, economic growth, unemployment, inflation). There have also been more indirect effects on such dimensions as educational attainment, job resignations, mental health, migration, urbanization, and so on.

Of most relevance for our paper are the effects on tax evasion. However, why should we expect any effects on tax evasion? One of our central arguments is that these policies will affect citizen trust in government and, through this channel, tax evasion. The next two sections discuss research that establishes these links.

2.2. On Trust[4]

It is useful to begin with the meaning of trust, before turning to its measurement and its trends. There are various ways to define "trust."[5] Consider "social trust", often referred to as "generalized trust" or "moralistic trust". This is trust in others – strangers, or people within your society with whom you have little personal familiarity. It is a belief in the honesty, integrity, and reliability of others. It is a belief that others share your fundamental values, that they will abide by recognized and shared social norms, that they should be treated by you as you would wish to be treated by them. It is a "faith in people", a belief that people can (usually) be trusted to "do the right thing".

Aside from social trust, we can also think about trust in specific institutions, such as government, the courts, the media, the military, the press, and the like. The basic notion of trust for these institutions mirrors the notion of social trust: it is the belief that these institutions can ultimately be trusted to "do the right thing". Especially important for our purposes is trust in government, or "political trust".

[4] For a general discussion of the role of trust in public policy, see Alm (2022).
[5] See Levi and Stoker (2000), Hardin (2002), and Uslaner (2002) for detailed discussions of the many definitions of trust. Also, see Organisation for Economic Co-operation and Development (OECD) (2017) for a useful summary of these definitions and the methods for the measurement of trust; the OECD website also provides links to its many studies of trust, along with its estimates of trust, available at https://www.oecd.org/gov/trust-in-government.htm.

There are two main approaches to measuring social trust: direct survey measures in which people are asked their opinions on trust,[6] and indirect measures in which underlying notions of trust are revealed indirectly by individual choices.[7] We do not go into the details of these two approaches, other than to mention that the relationship between direct and indirect measures is, surprisingly, not all that strong.

The dominant message from these surveys is simple: social trust has been in significant decline for most (if not all) countries over the last 50 years or so, and political trust has been falling over time by even greater amounts for most (if not all) countries. As only one among many possible examples, Gallup International survey evidence for the U.S. shows that social trust has fallen from 83 percent in 1974 to 55 percent in 2021 (where this percentage measures the percent of respondents who say that they have a "great deal/fair amount" of trust in others). Similarly, Gallup International survey evidence indicates that the percent of respondents with a "great deal/fair amount" of trust in government has fallen from 68 percent to 39 percent over the same period. These percentages have risen in specific periods (after 9/11) and fallen in other periods (after Watergate), but the overall trend is clearly and largely downward.[8] Again, the U.S. experience is not an isolated one.

The pandemic and the associated battery of government health and economic policies seem certain to have affected political trust. In principle, there could be varied impacts on

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[6] Direct measures of social trust are based on people reporting their trust levels on surveys and questionnaires, such as: General Social Survey (GSS), Pew Research Center surveys, Gallup polls, World Values Survey (WVS), European Values Study (EVS), European Social Survey (ESS), American National Election Studies (ANES), Eurobarometer, Latinbarometer, Asianbarometer, and so on. The typical question is something like the following, from the GSS:

> "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"

As for trust in government (and trust in other social institutions), a different set of questions asks individuals to report their level of trust in these institutions, like government (national and local), political parties, political officials, the courts, the media, the military, and the like.

[7] Indirect measures infer subjective trust expectations by observing actual individual decisions, most commonly in laboratory experiments, as pioneered by Berg et al. (1995) in what has become known as the "trust game". This game has generated a large experimental literature; for a recent survey, see Alos-Ferrer and Farolfi (2020).

[8] See https://news.gallup.com/poll/355124/americans-trust-government-remains-low.aspx. For other examples of estimates, see: https://www.pewresearch.org/politics/2021/05/17/public-trust-in-government-1958-2021/; and https://www.worldvaluessurvey.org/wvs.jsp . This is far from an exhaustive list.

trust. Citizens could "rally 'round the flag", especially if they saw the enactment of policies to bring some needed relief. However, they could also see the lockdowns, shutdowns, mandates, and other containment policies as an unacceptable infringement on their civil liberties and their economic freedoms.

Historical evidence suggests that major, catastrophic, and unexpected events like wars, terrorism, financial crises, and natural disasters have had large and persistent effects on trust in government and in societal institutions. For example, Grosjean (2014) finds that individual or family exposure to World War II violence had an enduring negative impact on levels of political trust throughout Europe and Central Asia, regardless of the actual outcome of the conflict in the relevant country. Similarly, work by De Bromhead et al. (2013), Armingeon and Guthmann (2014), Ananyev and Guriev (2015), Bermeo (2016), Quarantana and Martini (2017), and Guiso et al. (2019) have generally (although not always) found that trust in and support for governments around the world suffered during and after the Great Depression of the 1930s or the Great Recession of 2007-2008. Other research demonstrates that natural disasters (e.g., storms, floods, earthquakes, landslides, volcanic eruptions) can actually increase trust in government, at least when the disaster requires (and provides an opportunity for) societies to work together to meet the challenges (Carlin et al., 2014; Toya and Skidmore, 2014). In fact, there is work demonstrating that governments that ruled over long periods of time, sometimes for centuries, had enough time to build up formal and informal institutions that have lasted to the present day. As one example, Becker et al. (2016) provide evidence that the Habsburg Empire, with what is generally seen as better administrative institutions than the Ottoman Empire or the Russian Empire, was able to

generate greater trust in government than these other empires, trust that has persisted to this day, especially at the local government level.[9]

Of more direct relevance to the COVID-19 pandemic, Aassve et al. (2021) use information about attitudes of respondents from the General Social Survey to examine how the lethal influenza virus of 1918-1919, the so-called "Spanish Flu", affected individual attitudes toward government. They find that those who experienced and survived the pandemic exhibited permanent and long-run declines in trust, as reflected in the attitudes of their descendants who migrated to the U.S.

Evidence of the effects of the COVID-19 pandemic on trust in government is still emerging, but at present this evidence is somewhat tentative and largely suggestive. There is some evidence that the dominant effect in most countries has been to reduce trust. Daniele et al. (2020) use a large survey conducted during the initial stages of the pandemic and administered in Germany, Italy, the Netherlands, and Spain to find significant declines in institutional trust after the emergence of COVID-19. However, they also find that individuals seem likely to increase their trust in governments that implement effective pandemic policies. Becher et al. (2021) use a survey across 12 countries and 22,500 respondents to examine the impact of the pandemic on public attitudes about governments, and they find that the pandemic has generally increased dissatisfaction with the government and its actions, as equally driven by economic and health considerations (even though this decline is trust in government has not – at least as yet – translated into a desire for non-democratic regime types). In contrast, Leininger and Schaub (2020) using county-level data in Bavaria, Merkley et al. (2020) using social media data for Canada, and Harell (2020) using polling data for

[9] There is also theoretical work that demonstrates that trust in social institutions has important effects in many other dimensions. As only one recent example, Ferrara and Missios (2020) show that individuals' contributions to charitable organizations depends in part on their trust – or distrust – in the ways that the organizations will use the donations. See also Growiec and Growiec (2014) for analysis of how trust and social capital interact with each other to generate multiple equilibria in economic performance.

Canada all tend to find that the pandemic has increased political support for and trust in the existing government. Similarly, Bol et al. (2021) use a web-based survey conducted in March-April 2020 on representative samples of 15 Western European countries to find that the pandemic lockdowns largely increased political support for governments. They conclude that citizens accepted the necessity of these pandemic policies and rewarded those responsible for enacting the policies.

There is no firm consensus yet on the effect of the pandemic and the associated government policies on trust in government. The main factor driving the impact on trust in government seems to be the effectiveness of the overall government response, especially the success of the government in reducing pandemic mortality rates. In this regard, and of note for our own modelling efforts, Herrera et al. (2020) find that governments are "punished" in terms of political approval when COVID-19 infections and fatalities accelerate, particularly in the absence of effective lockdown measures. They do not find that approval rates are affected by declines in economic activity (e.g., lockdowns).[10]

2.3. On Tax Evasion

There is strong empirical support for a link between trust in government and tax evasion.[11] The major justification for this link is recent and still emerging research demonstrating that trust is a major factor – if not the only factor – in shaping why people pay

[10] Note that the COVID-19 pandemic itself has presented an unprecedented opportunity to examine via natural experiments the effects of various dimensions of trust on individual behavior. This research is expanding quite quickly, and much of it is still in working papers. For example, see the VoxEU webpage on COVID-19 research, available at https://voxeu.org/pages/covid-19-page, and also the CESifo webpage for all of their many studies, available at https://www.cesifo.org/en/cesifo/publications. Some studies are now being published in academic journals; for an especially timely and important of these published papers, see the recent (and ongoing) special issues of the *Journal of Public Economics*, available at https://www.sciencedirect.com/journal/journal-of-public-economics/special-issue/10JWB645FT5. Of particular relevance here are the papers by Bargain and Aminjonov (2020), Barrios et al. (2021), Durante et al. (2021), Egorov et al. (2021), Müller and Rau (2021), and Rafkin et al. (2021).

[11] Note that there is a large empirical literature that attempts to show the economic effects of trust, on such outcomes as: trade, financial development, productivity, institutional performance, personal happiness, educational attainment, preferences for redistribution, fertility, political participation, voting behavior, crime, savings, and the like. See Guiso et al. (2006) for discussion of much of this literature. One of the most investigated outcomes is economic growth; see Algan and Cahuc (2013) for a survey of this literature.

taxes. Indeed, the modern tax compliance literature shows the crucial effects of trust on individual compliance behavior and, by implication, on individual behavior more broadly. People who do not trust government will not obey government policies that require them to behave in particular and mandated ways, and, when this happens, government policies cannot achieve their goals.

There are of course many other reasons for why people pay taxes. Much of this analysis begins with the standard economics-of-crime model first applied to tax evasion by Allingham and Sandmo (1972). Here, a rational individual is viewed as maximizing the expected utility of the tax evasion gamble, weighing the benefits of successful cheating against the risk of detection and punishment. The main conclusion from this approach is that an individual pays taxes because of the fear of detection and punishment if he or she does not accurately report income and taxes. Indeed, the central point of this approach is that an individual pays taxes because – and *only* because – of the economic consequences of detection and punishment.

However, it is clear to most all analysts that individuals are not motivated strictly by financial considerations, given the low audit and penalty rates that are present in most countries. A purely economic analysis of the evasion gamble suggests that most rational individuals should either underreport income not subject to third-party information reporting or overclaim deductions not subject to independent verification. Yet even in the least compliant countries, evasion seldom rises to levels predicted by a strictly economic analysis, and in fact there are often substantial numbers of individuals who pay all (or most) of their taxes all (or most) of the time, regardless of the financial consequences of evasion.

In light of these concerns, researchers have sought other explanations for tax evasion. Researchers have introduced aspects of behavior considered explicitly by other social sciences, especially psychology via behavioral economics. One such factor introduces

motivations for individual behavior whose basis lies in the individual's social interactions with others (e.g., fairness, altruism, reciprocity, empathy, sympathy, guilt, shame, morality, alienation, patriotism, social customs, conformity, social capital, social networks, tax morale, intrinsic motivation, obedience to authority). Central to most all of these social interactions approaches is the broad notion of a *social norm* of behavior (Elster, 1989; Young, 2015). A social norm represents a pattern of behavior that is judged in a similar way by others and that is sustained in part by social approval or disapproval. Put differently, a social norm is a recognized, customary, and self-reinforcing pattern of behavior in which an individual participates, given the expectation that everyone else will also participate. Put still differently, a social norm is an informal rule of behavior that individuals follow for reasons largely distinct from the fear of legal or financial penalties. Consequently, if others behave according to some socially accepted norm of behavior, then the individual will behave appropriately; if others do not so behave, then the individual will respond in kind. It is hard to think of any type of social interaction that is not governed in some way or in some degree by a social norm, and these social interactions depend in some way upon the individual's interactions with – and trust in – the larger group, including the government.

There are many ways to introduce a social norm into models of tax evasion, as demonstrated by Feld and Frey (2007) and Kirchler et al. (2008), among others. All of these approaches conclude that citizens are more willing to declare income honestly as long as the political process is perceived to be fair and legitimate and as long as other individuals – and government – are seen as honest. When the political process is seen as unfair and illegitimate and when other individuals and government are seen as dishonest, individuals are more likely

to cheat on their taxes. Overall, then, the effectiveness of government policies depends intimately on trust in government.[12]

The central element in all of these approaches is the role of trust in others and, especially, of trust in government. These theoretical extensions have been the subject of extensive empirical research in recent years that has largely confirmed the role of trust (as well as of other additional motivations) for why people pay taxes.[13]

2.4. On Endogenous Models of Economic Growth

How can all of these elements – the pandemic and the associated government policy responses, the effects on trust in government, and individual tax evasion behavior – be combined in a formal analytical framework? We argue that one way of combining these elements is via endogenous growth models. We discuss our analytical framework in the next section, in which we begin with a standard model and then extend this model to incorporate the government policies stemming from COVID-19, their impacts on trust, and the resulting effects on tax evasion and economic growth in the short run and the long run.

3. Tax Evasion and Trust in an Endogenous Growth Model

3.1. Basic Elements

Our approach uses an endogenous growth framework to analyze dynamic economic effects as well as the dynamic effects of government responses to the pandemic especially via their effects on trust in government and on tax evasion. Our model is defined by a closed form solution, which implies that the transitional dynamics of the model are deterministic. As such, we can characterize the dynamic paths of every element within the model,

[12] There are additional and related approaches, as discussed by Hashimzade et al. (2013). For a recent and an especially novel approach, see Dufwenberg and Nordblom (2022), who use game theory that combines guilt, unawareness, and third-party audience effects to analyze how moral concerns affect tax evasion.
[13] Among many examples, see Alm et al. (1992), Feld and Frey (2002), Batrancea et al. (2019), and Prichard et al. (2019). For a comprehensive survey of the theoretical and empirical tax compliance literature, see Alm (2019).

distinguishing clearly between the short run and the long run impacts of the effects of the pandemic (modeled as a labor supply shock) and the possible government responses (modeled as deficit-financed increases in income transfers and public goods provision). We can further consider the possibility of the pandemic instigating secondary shocks to society as we observe very different death rates across countries likely attributable to the governments' responses.[14] Using comparable historical data from a cross section of countries, we then predict the relative impacts of the shock and its associated policy responses on economic growth, trust in government, and tax evasion, in both the short run and the long run.

Our model extends the government deficit, debt, and public goods model of Barreto (2021) to include the pandemic, trust, and tax evasion.[15] Consider a representative agent from country *i* who maximizes her welfare from consumption per capita (c_{it}) and aggregate public goods (M_{it}), as given by

$$\begin{aligned} Max\ W_i &= \int_{t=0}^{\infty} U\left(\frac{C_{it}}{L_{it}}, M_{it}\right) \cdot L_{it} e^{-\rho t} dt \\ &= \int_{t=0}^{\infty} \frac{\left(c_{it}^{\ \phi_i} \cdot M_{it}^{\ 1-\phi_i}\right)^{1-\theta}}{1-\theta} \cdot A_{i0}^{1-\theta} L_{i0} e^{\left[n_i + \phi(1-\theta)\chi_i - \rho\right]t} dt \end{aligned} \tag{1}$$

Note that lower case letters represent effective per capita terms such that $c_{it} = \frac{C_{it}}{A_{it} L_{it}}$, while upper case letters represent levels. Labor (L_{it}) and Harrod neutral technology (A_{it}) are assumed to grow at exogenous rates for country *i*, denoted by n_i and χ_i, respectively.

[14] For other work that combines tax evasion or corruption with social considerations (e.g., tax morale, social capital) in growth models, see Bethencourt and Kunze (2019) and Carmeci et al. (2021), both of whom use overlapping generations models. For work that examines the effects of the pandemic on growth, see Gori et al. (2022) and Davin et al. (2022).

[15] Complete analytical details of this model are provided and discussed in Barreto (2021). Also, see Argentiero and Cerqueti (2021) for an analysis of a tax evasion-based strategy for controlling the debt-to-GDP ratio, using a stochastic control problem.

Government expenditures simultaneously create both productive and unproductive public goods, and both are determined exogenously such that public revenues are independent of public expenditures. Government expenditures are determined by the product of the exogenous expenditure rate of country *i* (σ_i) and its gross output (Y_{it}). Productive public goods are defined as intermediate inputs in the production function for country *i* and are defined by the exogenous public expenditure rate, or

$$G_{it} = \sigma_i Y_{it} \ , \tag{2}$$

$$Y_{it} = K_{it}^{\alpha} G_{it}^{\beta} \left(A_{it} L_{it} \right)^{1-\alpha-\beta}, 0 < \alpha, \beta < 1 . \tag{3}$$

Unproductive public goods are the pure public goods that consumers enjoy. For country *i* in time *t*, unproductive public goods (M_{it}), enter the utility function of the representative agent subject to a congestion rate γ, according to

$$M_{it} = G_{it}^{\gamma} \left(\frac{G_{it}}{Y_{it}} \right)^{1-\gamma} \ , \ 0 \le \gamma \le 1 \ . \tag{4}$$

The aggregate resource constraint (ARC_i) for country *i* bounds economy-wide capital accumulation ($\dot{K}_{it}$), determined as

$$ARC_i\text{:} \ \dot{K}_{it} = Y_{it} - C_{it} - G_{it} \ . \tag{5}$$

Government debt (B_{it}) and deficits ($\dot{B}_{it}$) for country *i* in time *t* play accommodating roles to allow independence between public revenues and public expenditures. Government revenues for a country arise from income taxes on non-evaded income, the returns from tax enforcement, consumption taxes, and net bond income. The government budget constraint (GBC_i) is represented as

$$GBC_i\text{:} \ \sigma_i Y_{it} = \tau_i \left(Y_{it} + rB_{it} \right) \left(1 - \varepsilon_{it} \right) + p_i f_i \varepsilon_{it} \left(Y_{it} + rB_{it} \right) + \omega_i C_{it} + \dot{B}_{it} - rB_{it} \ . \tag{6}$$

The income tax rate (τ_i), consumption tax rate (ω_i), the probability of detection (p_i), and the fine rate (f_i) for country *i* are constant across time. The evasion rate (ε_{it}) is endogenous and so varies over time.

Although this model (including the extensions discussed later) is somewhat analytically cumbersome, the model remains intuitively an extension of Lucas (1988) in that it is represented by a modified Golden Rule across three dimensions – consumption, capital and bonds – instead of just two dimensions (or consumption and capital). Growth in effective per capita consumption only occurs during the transition to the steady state. The long run is defined by steady states as well as by Ricardian equivalence of debt. The implicit assumption underlying our analysis is that no country is at or necessarily even close to its respective steady state. Economic growth and the real impacts of deficits are mainly observed within the transitional dynamics. Following this key assumption, we analyze the model by the application of specialized continuous time dynamic modelling software that is more common to engineering and fluid dynamics than economics. Specifically, we follow the modelling and computational methodology proposed by Barreto (2018), and we extend the model in several important dimensions. Even though these extensions are admittedly somewhat ad hoc, they are intended to be both plausible in their basic motivation and tractable in their numerical solution.

3.2. Extension (1): Incorporating Tax Evasion

An important extension of Barreto (2021) is our incorporating tax evasion in the model. Tax evasion reduces government revenues and so enters the model through the GBC_i, as defined in equation (6); evasion also affects the representative agent's budget and so enters the model via the private resource constraint (PRC_i), as defined in equation (7). The PRC_i may be rearranged such that total saving in bonds and capital accumulation is defined as

PRC$_i$:

$$\dot{K}_{it}+\dot{B}_{it}=\left.\begin{Bmatrix}\Big[\big(Y_{it}+rB_{it}\big)\big(1-\tau_i\big)\big(1-\varepsilon_{it}\big)+\big(Y_{it}+rB_{it}\big)\varepsilon_{it}\Big]\big(1-p_i\big)\\ +\Big[\big(Y_{it}+rB_{it}\big)\big(1-\tau_i\big)\big(1-\varepsilon_{it}\big)+\big(Y_{it}+rB_{it}\big)\varepsilon_{it}-f_i\big(Y_{it}+rB_{it}\big)\varepsilon_{it}\Big]p_i\end{Bmatrix}\right.-C_{it}\big(1+\omega_i\big) \quad (7)$$
$$=\big(Y_{it}+rB_{it}\big)\Big[1-\tau_i\big(1-e_{it}\big)-p_i f_i\varepsilon_{it}\Big]-C_{it}\big(1+\omega_i\big)$$

The representative agent's total income equals received income production plus bond holdings $\big(Y_{it}+rB_{it}\big)$. This income is subject to income taxation at rate τ_i, but may be *illegally* evaded at some endogenous rate ε_{it}, with a probability of detection p_i and a penalty rate f_i if detected. Income may also be *legally* avoided at a rate ($avoid_i$) that is assumed to be constant over time for country *i*. The decision to evade is assumed to be determined by a constant elasticity of substitution structure based in part on the financial costs versus the financial benefits of illegal tax evasion, as in the standard Allingham and Sandmo (1972). These financial incentives are summarized by the effective tax rate for country *i*, $\big(\tau_i-p_i f_i\big)$, such that evasion is greater the greater is the tax rate and the lower are the audit and penalty rates. The decision to evade is also assumed to be inversely related to the amount of legal tax avoidance ($avoid_i$). Importantly, the decision to evade is affected by the agent's trust in the government of country *i*, denoted by $trust_{it}$, such that greater trust reduces the amount of evasion; the ways in which trust enters the model is discussed later.

The evasion rate ($evasion_{it}$) is therefore determined by the effective tax rate $\big(\tau_i-p_i f_i\big)$, by the inverse of tax avoidance ($avoid_i$), and by the inverse of societal trust in government ($trust_{it}$), as summarized in equation (8):

$$\begin{aligned}evasion_{it}&=\varepsilon_{it}\big(\tau_i-p_i f_i, avoid_i, trust_{it}\big)\\&=\big(\tau_i-p_i f_i\big)^{v_1}\left(\frac{1}{avoid_i}\right)^{v_2}\left(\frac{1}{trust_{it}}\right)^{1-v_1-v_2},\ 0\le\{v_1,v_2\}\le 1\ .\end{aligned} \quad (8)$$

Only trust varies across time, while the effective tax rate and the tax avoidance rate are constant. We arbitrarily assume common coefficient values across countries to reflect decision weights such that $\nu_1 = 0.5$, $\nu_2 = 0.1$ and $1 - \nu_1 - \nu_2 = 0.4$. While the decision weights to evade are likely idiosyncratic to each country, we lack sufficient information to determine these differences. We assume that the decision to evade is mostly financial in nature but that is also heavily influenced by one's trust in the receiving government. The addition of comparable avoidance rates creates greater variability in the relationship between trust and evasion without fundamentally changing the nature of that relationship.

3.3. Extension (2): Incorporating Trust

We conjecture that the public's trust in the government of country *i* is represented by a multi-faceted dynamic preference structure with both subjective and objective components. The *subjective* portion of trust reflects the representative agent's belief in the government. We assume that subjective trust in government has a level effect on the overall level of trust in government. The *objective* portion of trust captures reciprocity between the agent and the government. It is based both on the agent's effective per capita consumption and on the government's provision of public goods; that is, objective trust will increase if there is greater effective per capita consumption and/or if there is greater government provision of public goods, as the consumer attributes some part of the good fortune to the government.

We assume that trust in government results from the perceptions that are influenced by what the representative agent consumes in the presence of the public sector as well as by what the agent receives directly from the public sector. The representative agent's perception of trust in government may wax and wane as consumption interacts with the government's decisions on expenditures. In the short run, we assume that the impact of consumption and the immediate provision of public goods on the agent's trust in government is positive and decreasing. As the agent transitions to the long run, we assume that the weight the agent

places on public goods (as represented by the elasticity of substitution between private and public goods) and the long term provision of public goods (as represented by the congestion coefficient) define the effective baseline by which the agent's trust in government is formed.

Trust in government *i* in year *t* ($trust_{it}$) is therefore defined as

$$trust_{it} = \Upsilon_{it} \mathrm{T}_i c_{i,t-1}^{\mu_1} (1-\phi)^{\mu_2} \left(\frac{M_{it}}{Y_{it}} \right)^{\mu_3} (1-\gamma)^{1-\mu_1-\mu_2-\mu_3},\ 0 < \{\mu_1, \mu_2, \mu_3\} < 1, \qquad (9)$$

where Υ_{it} is the country specific tax morale shock at time *t*, as discussed later. The representative agent's trust in their respective government is defined by *subjective* components that are idiosyncratic to the country and by *objective* components that are common to all countries. The country *i* specific *subjective* component T_i has a strictly level static effect on overall trust. The *objective* component is a function of lagged effective per capita consumption and of government provision of public goods. The short run impact of consumption on trust implies that trust in government will immediately improve when government policy immediately increases consumption. Underlying the relationship between trust and public goods provision in the long run is the degree to which society relies on public goods, represented by the elasticity of substitution between private and public goods (ϕ). Together, these two components represent the short and long run influences of consumption on objective trust.

The impacts of public goods on trust in government, similar to consumption, are observed in the short run and long run. In the short run, the relative scale of unproductive public services in country *i* in year *t* relative to output ($\frac{M_{it}}{Y_{it}}$) improves trust in government. As with the other endogenous variables, relative public services are decreasing at a decreasing rate to a steady state, which captures the short run dynamic effect of public goods

on trust.[16] The short run impact of public services on trust is underpinned in the long run by the congestion rate $(1-\gamma)$, which tempers the amount of realizable unproductive public goods that the government can provide to consumers. While the congestion rate and the elasticity of substitution between private and public goods ought to be country-specific to reflect institutionally ingrained national idiosyncrasies, we assume common values across all countries given the lack internationally comparable values for these parameters.

Importantly, we assume that the government's effectiveness in dealing with the pandemic affects the representative agent's trust in government. This modification is discussed in detail later. Similar to the trust function, we chose the coefficient values ($\mu_1 = 0.5$, $\mu_2 = 0.2$, $\mu_3 = 0.2$ and $1-\mu_1-\mu_2-\mu_3 = 0.1$) somewhat arbitrarily. While the weights on trust's components are likely idiosyncratic to each country, again we lack sufficient information to determine these differences. We assume that trust is most heavily influenced by short run welfare, accounting for 60 percent weight in the trust function. The remaining 40 percent is equally shared by the static impacts of the elasticity of substitution and the congestion rate on consumption.[17]

3.4. Extension (3): Incorporating Shocks – Pandemic Shock, Government Policies Shock, and Trust Shock

We assume that this endogenous growth model is subject to various shocks, representing the impact of COVID-19, the impact of government policy responses, and the effects of the agent's perceptions of trust in government via a shock to tax morale. While the shocks are linked to COVID-19, our goal is not to model the pandemic per se. Instead, we use

[16] M/Y is assumed to be a concave limit function such that $\partial\left(\frac{M_{it}}{Y_{it}}\right)/\partial t < 0$ and $\lim_{t\to\infty}\frac{M_{it}}{Y_{it}} = \sigma Y_{it}^{\gamma-1} = \bar{m}_i$.

[17] Note that the elasticity of substitution between private and public goods in the utility function is set at $\phi = 0.9$, as is the congestion rate ($\gamma = 0.9$). We assume these values as intuitively plausible, and, within the trust function, their equal weights make the simulations more tractable.

the pandemic as a stylized fact to justify the large economy wide productivity shock observed in 2020.

Pandemic Shock. There is a long literature regarding the dynamics surrounding the epidemiology of infectious disease.[18] Within the growth literature, and in the context of the partial equilibrium Solow (1956) growth framework, Gori et al. (2022b) introduce a generalized dynamic epidemiological model of susceptible, infected, and recovered individuals within the labor force. They model the supply side impact of the pandemic as the combined effect of COVID-19 excess mortality on population growth and a productivity shock, depicted as the inability of infected people to work, where the infected group size is a function of the population's susceptibility. As such, the productivity impact of the pandemic is a function of each country's heterogenous policy response to the pandemic. Furthermore, as the disease effectively runs its course within the year (barring renewed outbreaks in following years), there is no persistence of the pandemic's impact on productivity.

New empirical evidence suggests the pandemic resulted in a more homogenous productivity shock with some persistence that is independent of health policy responses. Behera et al. (2021) estimate a fall of 10 percent in gross value added by labor in India. Baqaee and Farhi (2022) estimate a 10 percent decline in United States output considering both the demand and supply implications of the pandemic. In the Eurozone, Beck (2023) suggests a somewhat greater than 10 percent fall in real GDP, while Bighelli et al. (2023) estimate a 4.6 percent productivity drop in five EU countries and Konings et al. (2023) estimate a fall in full time equivalent employment in Flanders to be approximately 7.5 percent. Evidence of spillovers suggests some persistence is to be expected as lower investments (Apergis and Apergis, 2021; Demmou et al., 2021) and/or declines in aggregate productivity (Fornaro and Wolf, 2020) may affect growth. While we recognize the correlation

[18] See Gori et al. (2022a) for a review of this literature.

between infection rates, death rates, and adopted health policies, we nevertheless assume that all countries suffered the same fundamental productivity shock in the sense that countries' economies shut down irrespective of their health policy initiatives.

We assume that the COVID-19 pandemic enters via a homogenous worldwide productivity shock ψ_t to labor at time $t = t_{Covid}$,[19] such that post-pandemic production for country *i* is now determined by

$$Y_{it} = a_i K_{it}^{\alpha} G_{it}^{\beta} \left(\psi_t A_{it} L_{it}\right)^{1-\alpha-\beta} \begin{vmatrix} \psi_t \leq 1 \ \forall \ t \geq t_{Covid} \\ \psi_t = 1 \ \forall \ t < t_{Covid} \end{vmatrix}, \ 0 < \{\alpha, \beta\} < 1 \ , \tag{10}$$

where total factor productivity a_i is assumed to be country-specific and static. We assume an exogenous recovery rate δ, such that the scale of the shock ψ_t evolves from $t \geq t_{Covid}$ according to $\frac{\partial \psi_t}{\partial t} > 0$ and $\frac{\partial \dot{\psi}_t}{\partial t} < 0$ up to its limit of $\psi_\infty = 1$. The depth of the shock is assumed to dissipate at some rate δ by the rule

$$\psi_{t+1} = (1-\delta)\psi_t + \delta \ \forall \ t > t_{Covid} \ . \tag{11}$$

Our analytical focus is not on the COVID-19 health shock *per se* but rather on the secondary effects of the productivity shock wrought by the pandemic. Equations (10) and (11) propose a simple mechanism and functional form to model a temporary productivity shock and its impacts both on trust in government and on tax evasion. Analytically, our approach is similar to Gori et al. (2022b), except that we assume that the productivity shock is homogeneous and persistent within a general equilibrium framework.[20]

[19] We ignore the labor impacts of excess mortality due to the pandemic because the marginal effect on the labor force remains relatively inconsequential. For example, the highest death rate country (USA) suffered 1333 deaths per million, representing 0.13 percent of the population. Cost estimates suggest that at their highest the cost of excess mortality as a proportion of GDP was below 0.11 percent (Hanley et al., 2022).

[20] The effects of the pandemic on demand versus supply are explicitly considered by Baqaee and Farhi (2022), among others. Within our general equilibrium model, it is possible to temporarily alter preferences to represent the policy impacts on demand that many economies underwent. We nevertheless leave this for future research.

Government Policies Shock. We assume that country *i* can respond to the crisis immediately with income support (IC_{it}), whose scale is defined exogenously as a percentage of the country's total output, which is determined annually. The support is freely given to consumers by the government and is paid entirely by debt. We also assume in the year following the shock that a government can provide a costly vaccine (IM_{it}) to their respective populations as a public service. We represent this as a temporary increase in the provision of unproductive public goods, subject to congestion, within the utility function as given by

$$M_{it} = \sigma_i Y_{it}^{\gamma_i} + IM_{it} \ . \tag{12}$$

The extra government expenditure is accounted for through the government budget constraint and appears analytically in the evolution of bonds in equation (13),

$$\dot{B}_{it} = r_i B_{it}\left[1-\tau_i\left(1-\varepsilon_{it}\right)-p_i f_i \varepsilon_{it}\right]+\left[\sigma_i-\tau_i\left(1-\varepsilon_{it}\right)-p_i f_i \varepsilon_{it}\right]Y_{it}-\omega_i C_{it}+IM_{it}+IC_{it} \ . \tag{13}$$

Tax Morale Shock. Finally, we assume that trust is subject to a "tax morale" shock, $\left(\Upsilon_{it}=1 \forall t \neq t_{Shock}\right)$. Tax morale is typically defined as the intrinsic motivation to pay taxes (Torgler, 2007). In the context of the COVID-19 pandemic, we view tax morale as a proxy for the idiosyncratic impact of the pandemic on country *i* in year *t*, given whatever policy responses the respective governments undertook. Consistent with Herrera et al. (2020), we assume that the tax morale shock is a direct function of the death rate from COVID-19 in the country, relative to some baseline, and we also assume that the shock may demonstrate persistence. A country that suffers deaths per capita greater than the baseline experiences a negative tax morale shock to government trust, while a country that suffers a death rate below the baseline experiences a positive tax morale shock.

The tax morale shock (Υ_{it}) is defined as

$$\Upsilon_{i\bar{t}} = \Upsilon\left(Covid\_death\_rate\_per\_million_{it}\right) = \left(\frac{Baseline\_death\_rate}{Death\_rate_{it}}\right)^{\frac{1}{2}}$$
$$= \frac{10}{\sqrt{Death\_rate_{it}}} \tag{14}$$

The average worldwide excess mortality rate of COVID-19 was 1203 deaths per million (The Lancet, 2022). We note that among the countries surveyed the distribution of deaths per million is bimodal. As such, we arbitrarily assume that the baseline death rate per million inhabitants is 100 per million. A country that observes a death rate of 100 per million therefore experiences no tax morale shock, such that $\Upsilon(100) = 1$.[21] Note that this idiosyncratic shock is increasing in the death rate at an increasing rate. Although Υ_{it} has a strictly level effect, we need to consider the likely persistence of the death rate on trust. For example, the tax morale shock could be permanent if one believes that lives lost permanently taints the agent's view of the government. Alternatively, the tax morale shock could dissipate at some decreasing rate. We assume a simple algorithm for the persistence of the tax morale shock that defines the evolution of the death rate after it is first perceived at t_{shock} and that then dissipates as the memory of the COVID-19 deaths recedes. This algorithm is defined for all $t > t_{shock}$ as

$$Death\_rate_{i,t} = \frac{\ln(100)}{\ln\left(Death\_rate_{i,t-1}\right)} \cdot Death\_rate_{i,t-1} \ . \tag{15}$$

Equation (15) decreases (increases) at a decreasing rate around $Death\_rate = 100$ such that the magnitude of the shock is greater the higher (lower) the initial death rate is above (below) 100 deaths per million. Importantly, the duration of the shock and its dissipation rate are equal for all countries irrespective of the shock's magnitude. While the magnitude of initial

[21] Higher baselines rates necessarily weaken the impact of the tax morale shock on trust and evasion on the right tale countries like USA while amplifying the impact of the left tale countries like AUS.

shock is positively correlated with the number of initial COVID-19 deaths, the duration of its impact is the same across countries, approximately 30 years, irrespective of the initial shock's magnitude.

2.5. Solution via Parameterization and Numerical Simulation

The underlying premise of our modelling methodology is similar to Barreto (2018). Our approach assumes that all countries exist somewhere along their respective transitional saddles path and that they are effectively nowhere near their respective long run steady state. The growth patterns that we observe are the transitional dynamics that are idiosyncratic to country *i* and that are largely based on the initial endowments of capital, labor, and Harrod neutral technology, along with the time invariant parameters such as the growth rates of labor and technology, the tax rates, the public expenditure rate, and the various evasion coefficients.

We include 11 countries in our analysis: Australia (AUS), India (IND), Japan (JPN), Malaysia (MYS), Mexico (MEX), South Korea (KOR), Singapore (SGP), South Africa (ZAF), Spain (ESP), Switzerland (CHE), and the United States (USA). We chose these 11 countries for several reasons. First, these countries exhibit a broad range of economic development, ranging from developed high-income countries (e.g., AUS, JPN, KOR, SCP, ESP, CHE, USA) to developing low- to middle-income countries (IND, MYS, MEX, ZAF), according to World Bank classifications. Second, these countries differ widely in the degree to which their governments enacted COVID-19 relief policies. Third, these countries also differ widely in the effectiveness of these pandemic policies. Finally and notably, it was possible to collect the required internationally comparable indices for tax enforcement and tax avoidance for all of these countries, something that constrained somewhat our choices. Overall, we believe that these 11 countries are a representative cross-section of countries,

while recognizing that it would be desirable eventually to extend our analysis to other countries, depending largely on data availability.

We impose comparable initial conditions for all countries. The differences in stage of development are reflected in the initial condition of the state variables, A_{i0}, K_{i0}, and L_{i0}, as presented in Table 1A. The capital per effective labor ratio broadly represents each country's relative stage of development in 1950. The remaining country-specific static variables necessarily result in the idiosyncratic path of consumption for each country.

Tables 1A and 1B summarize the country-specific static variables. These variables include, in addition to endowment levels, the average total factor productivity, the average observed growth rates of population and human capital from 1950 to 2010, and the average tax and public expenditure rates from 1990 to 2015.[22] Table 1A also includes the probability of detection (p_i), a tax avoidance index ($avoid_i$), and the share of the population who report trust in their national government which we assume to be a proxy for the subjective level of trust in government (T_i). The probabilities of detection are derived from the tax enforcement index ($TaxEnf_i$) reported in Atwood et al. (2012), such that $p_i = 0.005\left(TaxEnf_i\right)$.[23] The fine rate is assumed constant across all countries at $f_i = 2.0$.

The simulations assume that some coefficient values are common across countries. We choose values that are both analytically and intuitively plausible. For example, we assume the discount rate (ρ) is 3 percent, the coefficient of relative risk aversion (θ) is 0.99, the elasticity of substitution between consumption and public goods (ϕ) is 0.9, the congestion rate (γ) is 10 percent, the elasticity of capital in production (α) is 0.33, and the elasticity of

[22] Although tax and expenditures rates have changed in the countries sampled between 1950 and 2015, our overriding concern is that the data be internationally comparable.

[23] The original tax enforcement index from Atwood et al. (2012) is a number, $0 < TaxEnf_i < 10$, that we scaled down such that $0 < p_i < 0.05$ and $0 < p_i f_i < 0.1$.

productive public goods in production (β) is 0.25. As such, the elasticity of effective labor in production ($1-\alpha-\beta$) is 0.42. If we had internationally comparable values, these variables could also vary across countries, thereby theoretically improving the simulation's fit to the actual data. As discussed earlier, the elasticity of substitution on the financial incentive to evade $\left(\tau_i - p_i f_i\right)$ is $v_1 = 0.5$, while the elasticities of substitution on tax avoidance and government trust are $v_2 = 0.1$ and $1 - v_1 - v_2 = 0.4$, respectively. The four elasticities within the trust function are: the coefficient on current consumption, $\mu_{1,i} = 0.5$; the coefficient on the substitution elasticity of consumption from the welfare function, $\mu_{2,i} = 0.2$; the coefficient on the congestion rate, $\mu_{3,i} = 0.2$; and the coefficient on current relative public goods, $1 - \mu_{1,i} - \mu_{2,i} - \mu_{3,i} = 0.1$.

Our model is a continuous time dynamic general equilibrium of a closed economy that defines a multidimensional modified Golden Rule. We simulate this model using advanced computing in order to observe the transitional dynamics of its component parts. Unlike discrete time models, there is no calibration of coefficients. The differing initial conditions and parameter values representative of each country ultimately define 11 comparable closed form solutions for the paths of the three state variables – consumption, capital, and debt.

As noted earlier, our model is effectively an extension of the Lucas (1988) endogenous growth model. Incorporating tax evasion and trust does not substantively change the analytical methodology. The rates of tax evasion and trust in government both converge to their respective long run equilibrium values. The equilibria can be depicted with respect to effective per capita, as traditionally done in this class of models, or with respect to time. Although the steady state rates of evasion and trust are certainly interesting, we are more interested in the transitional dynamics. Furthermore, we impose baseline starting values

representing 1950 and average coefficient values representing 1950 to 2015 with our stated goal of considering the impact of COVID-19 in 2020. We assess the fit of simulations to the real data by comparing the predicted 2015 consumption to the actual 2015 consumption in Table 2. Note that in 6 of the 10 countries other than the United States, the predicted consumption in 2015 is within 12 percent of actuality. Given the fit of each simulation to actual country data, we are interested in what happens to each country sampled from exactly 70 periods (or years) from the model's commencement at $t_0 = t_{1950}$.

4. Numerical Simulations and Results

We are interested in examining the dynamic impacts on consumption, trust, and tax evasion of the pandemic shock, the government policies shock, and the tax morale shock (with the resulting effects on trust). To do so, we proceed in steps, analyzing these impacts in several preliminary stages before examining all aspects. We first present some simple simulations on consumption, trust, and tax evasion in which only the pandemic shock is introduced and in which there are no government responses. We then include both the pandemic shock and the tax morale shock, but again with no government responses, again examining the effects on evasion and trust. Next, we examine the effects on evasion and trust of government responses (e.g., the provision of income support, the delivery of vaccines), but with only the pandemic shock. Finally, we present our main results of interest, when there are both the pandemic and the tax morale shocks and when both government responses are allowed.

4.1. Some Preliminaries (1): The Pandemic Shock Only with No Government Responses

To demonstrate the basic workings of the model for the 11 countries, we start with a simple scenario. We assume that there is only a pandemic shock, which occurs in period 70 (e.g., year 2020), and that there is no government response. Figure 1 depicts the saddle paths

of effective consumption for the 11 countries with respect to effective capital, and Figure 2 depicts the growth paths with respect to time. The pandemic shock is modeled as a productivity shock to labor, as shown in equation (10). We assume that labor productivity falls by 10 percent in 2020 from the pandemic shock, such that $\psi_{2020} = 0.9$.[24] We further assume the economy recovers on its own volition at a rate of 15 percent per year from 2021 such that within 5 years, by 2025, labor productivity has returned to 99 percent of what it had been prior to the pandemic.[25] Note the predicted increased growth rate of consumption immediately following the initial negative shock. Although the limit to the shock's impact is zero in the steady state, by construction the shock shows significant persistence.

In Figure 1, the steady states occur when the growth in capital, represented by $\dot{k}_i = 0$ loci, and the growth in consumption, represented by the saddle path, are simultaneously zero. To aid in exposition, only the $\dot{k}_{US} = 0$ loci for the United States is shown. Each country's saddle path of consumption necessarily terminates at the modified Golden Rule where consumption convergence with its respective $\dot{k}_i = 0$ loci, which have been suppressed for clarity. Note that the pandemic/productivity shock in period 70, although proportionally identical at 10 percent, is discernably different given the relative differences among the countries.

Figures 3 and 4 depict the evolution of government trust and the tax evasion rate, respectively, for the country group; as with Figures 1 and 2, we assume that there is only a pandemic/productivity shock and that there is no government response. The impact of the 10 percent pandemic/productivity shock, although slightly different given each country's unique saddle path, is relatively the same in scale for most of the countries. Evasion increases less

[24] The magnitude of the shock is arbitrary. We impose a discernible productivity shock to labor that is independent of any fiscal response.
[25] The recovery rate is arbitrary, expanding or contracting the natural duration of the shock. Nevertheless, the policy response remains the same.

than 0.1 percent, and trust falls by between 0.4 and 0.5 percent in the first year of the shock. The differences across countries, although small, are the consequence of variation in initial conditions. Nevertheless, our assumption that all countries share the same coefficients with respect to the financial cost of tax evasion implies that the effect of COVID-19 on tax evasion is almost entirely due to changes in trust, as primarily determined by changes to consumption, the public good, and shocks.

4.2. Some Preliminaries (2): The Pandemic and the Tax Morale Shocks with No Government Responses

We now add a "tax morale" shock to government trust, in addition to the pandemic/productivity shock, while continuing to assume that there are no government responses. We hypothesize that public trust in government is temporarily eroded by the observed death rate above some baseline within the economy. For example, consider the United States. If we assume that the baseline death rate from COVID-19 is 100 deaths per million people (or 0.01 percent), then the effect on government trust and subsequently tax evasion in the U.S. is quite significant, given that the U.S. sustained a high death rate of 1333 deaths per million as of 31 January 2021. Under such a scenario, trust in the U.S. government falls from the 14.45 baseline to 4.57, a 68 percent decrease, while tax evasion subsequently increases from the 12 percent baseline to 19 percent, a 58 percent increase.

Table 2, rows 8 through 13, summarize the tax morale shock for all 11 countries, and the effects are shown for each set of countries in Figures 5A, 5B, 6A, and 6B, which divide the countries by death rates above or below the baseline. Recall that the figures depict the evolution of government trust and tax evasion in response to the pandemic shock and the tax morale shock but still assuming for the moment no government responses. Note the impact of tax morale on trust and evasion. The model demonstrates a mechanism by which perceptions of the government's ability to fulfill its social contract, via of the provision of public goods, can either positively or negatively affect peoples' trust in government and their subsequent

willingness to pay taxes. The effects on consumption are not presented but are available upon request.

4.3. Some Preliminaries (3): Introducing Government Responses to the Pandemic Shock Only

To mitigate the economic impact of the pandemic, we allow the hypothetical government two policies: government can provide direct income support funded entirely by public debt in the year 2020; or government can provide a costly vaccine, again paid for through public borrowing from the year 2021. For example, from Table 2, row 15, the United States direct income support in 2020 amounted to approximately 10 percent of GDP, as compared to India and South Africa who each provided less than 1 percent. The cost of the vaccine in the USA was approximately 2 percent of GDP. We assume this latter figure across all countries.[26]

Figures 7A (trust) and 8A (tax evasion) isolate the COVID-19 shock and the subsequent government responses by high income support countries by assuming no tax morale shock; Figures 7B and 8B isolate the government responses in low income support countries. These figures coincide with the numeric results in Table 2, rows 14 through 19. Note that the USA government policy response, in isolation, raised trust by 67.0 percent in 2020 (Table 2, row 17) and lowered evasion by 18.6 percent (Table 2, row 19), largely offsetting the tax morale shock on government trust while only partially offsetting the tax morale shock on the evasion rate. Note also that the government response in rows 14 through 19 of Table 2 completely mitigates the negative impact of COVID-19 on trust and evasion, in every case except India. In fact, comparing rows 3 through 7 and rows 8 through 13 of Table 2, note the tax morale shock has a far greater impact on trust and evasion than did the pandemic. Our model suggests that government direct income support in response to a

[26] See Ortiz-Ospina Roser (2016).

productivity shock can entirely mitigate the direct negative impact on trust and evasion but only partially mitigates the secondary tax morale shock.

4.4. Main Results: Government Responses to the Pandemic and the Tax Morale Shocks

The main results are presented in Figures 9, 10, and 11, where we examine the effects on trust, evasion, and consumption of government responses to both the pandemic shock and the tax morale shock.

Numerical solutions for all 11 countries indicate that these countries fall into three broad categories. In wealthy countries that suffer a relatively large tax morale shock coupled with a relatively large public government response (the United States, Spain, and Switzerland), the two outcomes offset one another in their impacts on government trust and evasion as depicted in Figures 9A (trust) and 10A (evasion). Government trust falls in Spain, the U.S., and Switzerland in response to high deaths, but trust rises because of income support. Secondly, in countries such as Australia, Japan, Korea, Malaysia, and Singapore where deaths are relatively few, the tax morale shock and the government response re-enforce one another, as shown in Figures 9B (trust) and 10B (evasion). Finally, Figures 9C and 10C depict Mexico and South Africa. In these countries that suffer a large negative tax morale shock coupled with relatively low government income support, the effects of COVID-19 are the most profound. Table 2, rows 20 through 36, summarize all these results across the short, medium, and long run.

Figures 9 and 10 show that the short-term impact of the COVID-19 shock and the subsequent tax morale shock can be largely mitigated by government policy.[27] In wealthy countries like the United States and Switzerland, although trust initially drops significantly, it is followed by an offsetting increase in trust as the short run positive impacts of the income support and vaccine are felt throughout society. However, the transitional dynamic costs of

[27] Graphical results for all countries are available upon request.

the income support in terms of consumption in the medium term effectively catch up to the U.S. economy to erode net trust in government. Consequently, evasion displays an inverse but similar dynamic effect. For example, tax evasion in the United States increases dramatically in 2021, and then falls below the baseline rate for approximately twenty years after the pandemic only to again increase to an effectively higher transitional evasion rate for the remainder of the century. The countries in Table 10B are saved from a negative morale shock, so they do not experience the initial spike in evasion. Instead, we predict that tax evasion in Australia and other similar countries will fall initially in 2021 and then gradually rise back to their respective baseline across about 40 years. The evasion rate in countries like Mexico, with less income support and higher COVID-19 death rates, will initially spike and then gradually fall back to the baseline within 20 years.

Figures 9 and 10 depict the short-term impacts of Ricardian equivalence on trust in government and tax evasion. To illustrate the consumption smoothing that results from deficit spending, compare the consumption paths for the different sets of countries from the high income support countries in Figure 11 to the resulting trust and evasion paths in Figures 9 and 10. The modelling in Barreto (2021) suggests that even 1 percent income support coupled with a free vaccine would have been sufficient to offset the short-term economic impact of the pandemic. The policy in, say, the United States to devote 10 percent of GDP to income support paid for by debt therefore creates an enormous spike in consumption followed by lower near-term consumption as society pays off the cost of 2020 across the infinite horizon.

Figure 11B demonstrates that, barring income support, spending 2 percent of GDP even on unproductive public goods as representing the public health response to COVID-19 will offset the negative growth effects of the supply shock. Indeed, our model predicts a spike in consumption followed by declining economic growth from 2021 until 2050 in those countries that provided the most income support, such as the United States, Australia,

Switzerland, Japan, Singapore, and Spain. Furthermore, while growth will rebound in these countries by 2050, it will do so from a significantly lower level than otherwise, if not for the initial 2020 aggressive income support policies. In countries that provided the least income support, the pattern is the same although far less dramatic. Growth will decline through 2040 and rebound thereafter, but from not so deep a trough.

Figures 9 and 10, along with Table 2, highlight the impacts of differing policy choices that countries undertook in 2020 compared to the United States. While Mexico suffered a similar death rate as the U.S. and South Africa experienced a somewhat smaller death rate, neither provided as much debt-financed income support. As a result, within our model Mexico and South Africa experience a fall in government trust and an increase in evasion, both of which return to baseline within approximately 20 years. Among the countries that experience a positive tax morale shock, Korea provided relatively the least income support while Singapore provided the most. Malaysia also offered less limited income support but enjoyed a positive tax morale shock due to the low death rate, and so Malaysia experienced an immediate increase in trust and a decrease in tax evasion that dissipates over time. The effects on Switzerland are the most dramatic given their extensive income support and relatively high death rate coupled with subjectively high government trust. The Australian experience is closer to that of Malaysia, even though Australia provided somewhat greater income support.

In general, Table 2 suggests that our three country categories follow a broadly similar pattern immediately following the pandemic. Countries with high death rates lose government trust and experience higher evasion, and income support only partially mitigates the effects. Those countries with low death rates tend to experience an increase in trust, and so these countries exhibit immediately lower evasion. As countries enter the medium term, approximately 20 years post-pandemic, variation among these country categories becomes

evident as the dynamic impact of income support reveals itself. Those countries that provided the greatest income support (e.g., Japan, Singapore, Switzerland) suffer the most loss in government trust and the highest evasion rate after 20 years. Those countries that provided income support below 10 percent of GDP experience higher trust and marginally lower evasion. In the long run (or 40 years after the pandemic), government trust remains low and the evasion rate remains higher in those countries that provided the most extensive income support. In contrast, countries that did not provide as much income support generally return to pre-pandemic levels.

5. Conclusions

What will be the effects of the COVID-19 pandemic and the associated government policy responses on post-pandemic trust in the government, tax evasion, and economic growth? We consider this question by adding government trust and tax evasion to an endogenous growth model with public goods and public debt to examine the short and long run impacts of various shocks – a productivity shock as a proxy for the direct impact of the pandemic, a government policy response shock, and a tax morale shock reflecting each government's idiosyncratic policy effectiveness.

We utilize an analytical framework to characterize the dynamic evolution of the complex observed economic behavior of tax evasion, which we assume is based on the combination of directly observable financial incentives, such as detection probabilities and fine rates, with unobservable internalized incentives, such as trust in government. We further assume that trust in public institutions stems from the portion of agents' perceived wellbeing that is attributed directly and indirectly to government policies.

The deterministic nature of the endogenous growth framework implies that the dynamic general equilibrium may be represented by a closed form solution. The introduction

of additional state dimensions, such as debt, additional cost structures (e.g., tax evasion), or additional dynamic preference structures (e.g., trust in government), change neither the fundamental deterministic nature of the model nor its intuitive representation by a modified Golden Rule (Lucas, 1988). Using modern simulation software, common to engineering and fluid dynamics, we simulate the complex general equilibria, and we demonstrate the results graphically.

Our model assumes a mechanism by which the pandemic affects trust in government and tax evasion via the direct and indirect effects of policy. Our framework identifies the policy channel between the representative agent's welfare – as defined by consumption of final goods per capita and aggregate consumption of public goods – and public trust and tax evasion. For example, we model the public health response as a positive shock to public goods worth 2 percent of GDP. As such, any policy that increases the level or improves the distribution of public goods will have a discernable dynamic impact on trust in government, tax evasion, and economic growth. If the policy is funded by public debt, our model also captures the secondary transitional dynamic effects of consumption smoothing and Ricardian equivalence on both trust and evasion.

Numerical simulations of 11 representative economies demonstrate that government responses to the pandemic have significant impacts on tax evasion in the short and the long run, largely via their effects on public trust in government. Assuming a systemic correlation between tax morale (as reflective of trust in government) and the mortality rate (as a proxy for the effectiveness of the public policy response), we find that governments that enacted policies that minimized COVID-19 mortality rates experience an increase in trust that reduces tax evasion; in sharp contrast, countries whose public policies did not contain the pandemic suffer a loss in trust and a corresponding increase in tax evasion. Government relief based on debt financed income support also has short and long run effects on trust and tax evasion.

Perhaps surprisingly, more generous economic relief programs generate greater transitional dynamic costs in terms of consumption in the medium term of 20 years, which ultimately erodes trust in government and increases tax evasion. In short, the many and varied ways by which governments dealt with the pandemic have important and predictable impacts on tax evasion, largely determined by their effects on trust in government.

Our simulations provide directly comparable predictions for the 11 countries that we examine. For example, we predict a relative spike in 2021 and 2022 consumption in the United States, a high support country, that will be far greater than in India, a low support country. While the subsequent post-pandemic period of lower growth will be felt worldwide, it will be most dramatic in high income support countries such as United States and Switzerland. We also analyze the possible paths that trust in government and tax evasion will follow as result of the combined pandemic productivity shock, the income support shock, and the tax morale shock. Our simulations provide insights into the dynamic nature of tax compliance in the face of exogenous productivity shocks and distortionary public policy responses. We make directly comparable cross-country predictions of the impact of COVID-19 and the subsequent idiosyncratic public policy responses on trust in government and tax evasion in 11 countries. Indeed, our simulations are broadly representative of many countries' immediate experiences, and in fact we are hopeful that our results provide useful indicators of what might be expected to happen to trust in government and, especially, to tax evasion over the next 40 post-pandemic years as a consequence of the pandemic and government responses to the pandemic.

Whether the pandemic's actual effects on trust in government – and on tax evasion – will persist over time is unclear. As noted earlier, historical evidence sometimes suggests that unexpected events have often had persistent effects on trust in government, although this evidence is more suggestive than definitive. Regardless, as also noted earlier, there is no firm

consensus yet on the effect of the pandemic and the associated government policies on trust in government. What is clear is that trust is not fixed, given, or immutable, determined mainly by a country's culture, institutions, and history. Instead, as argued by Alm (2022), trust can vary significantly, even over short periods of time, as demonstrated by recent research showing that trust in government can be affected in systematic ways by systematic policy interventions, even though these levers are unlikely to be either quick-acting or easy to implement.[28] Increasing trust in government requires that individuals see that government is contributing in tangible ways to the "greater good", that it delivers on its promises, that it is transparent, and that it supports people in their desire to live better, more fulfilling, and healthier lives. Implementing policies to effectively address the pandemic certainly qualifies as a way that should increase trust in government, both now and over time.

Our results are of course specific to the selection of countries examined, along with the many parameter values and modelling assumptions made. Nevertheless, these countries represent a broad range of country economic settings along with a similarly broad range of pandemic responses, making our predictions timely and relevant to the current environment. Even so, we acknowledge that it is important to expand our analyses beyond these 11 countries, dependent of course on the availability of internationally comparable data.

More broadly, our modelling framework can be usefully applied to other unexpected shocks such as wars, terrorism, financial crises, natural disasters, and the like. Economic shocks will generate government policy responses. These policies will in turn have significant effects on the ways in which citizens perceive their governments, affecting citizen trust in government, both positively and negatively and generating dynamic repercussions that will spill over into many other dimensions. The tractability inherent to our methodology explicitly captures the many effects of these shocks, as well as the policy responses, on the

[28] See especially Uslaner (2002, 2008, 2012).

evolution of public trust in government and its effect on tax evasion and economic growth, both now and in the future. This methodology is flexible enough to consider alternative policy representations as well as any number of alternative specifications or functional forms. The many dimensions of unexpected shocks and the resulting multiple policy responses that our methodology can accommodate remains an important area for future research.

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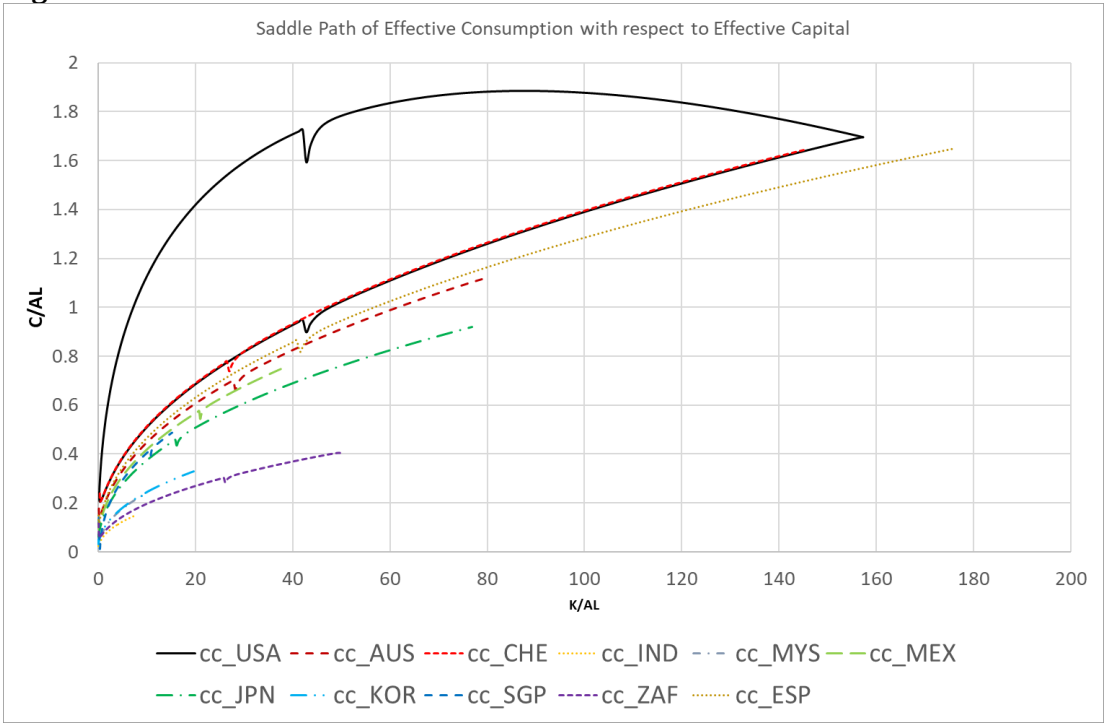
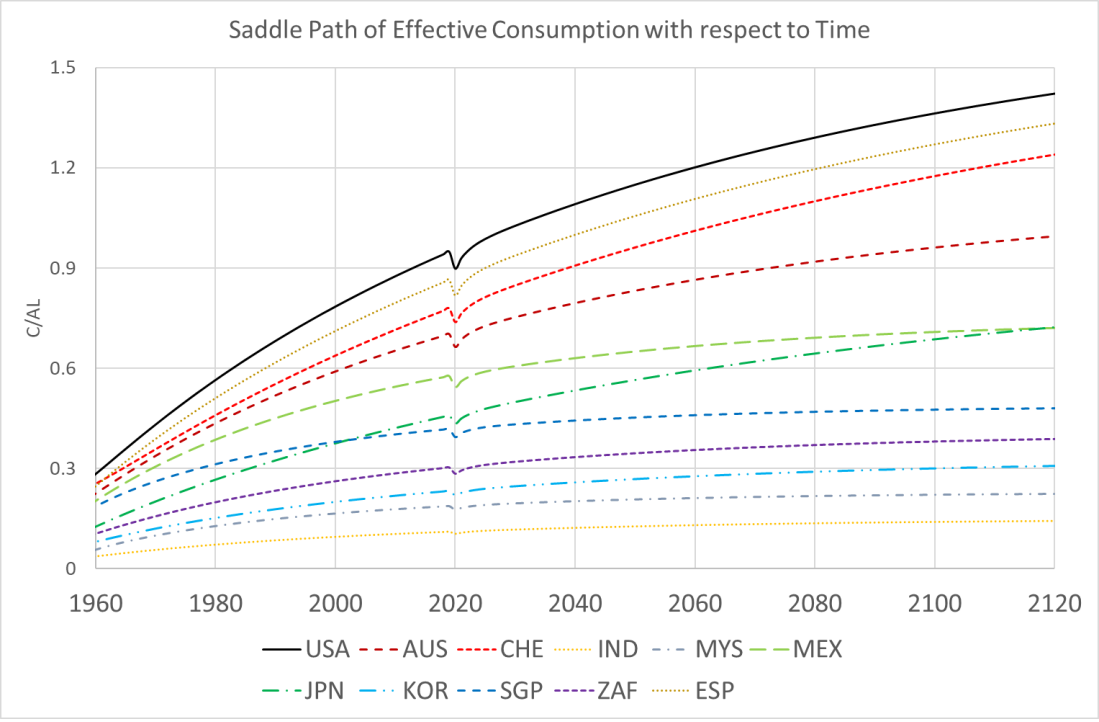
Figure 1



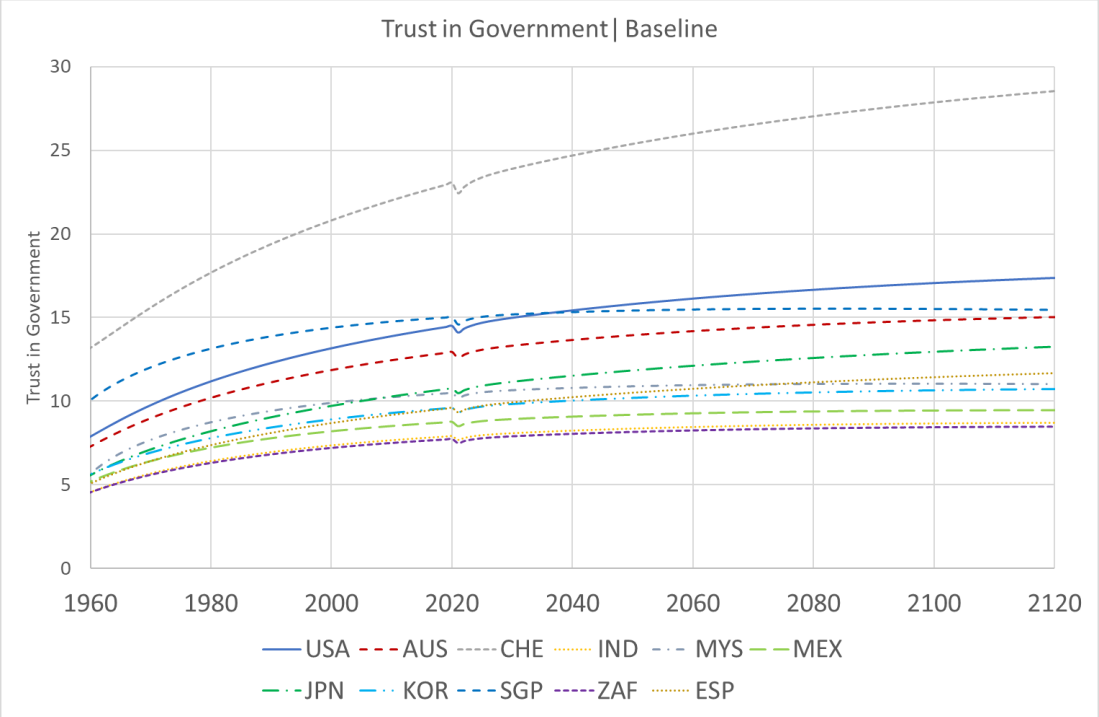
This figure shows equilibrium saddles paths of consumption per effective capita with respect to effective per capita capital, in response to the COVID-19 productivity shock, assuming no government responses. Simulations are based on country-specific static variables and common values, α=0.33, β=0.25, γ=0.9, ρ=0.03 and θ=0.99.

Figure 2



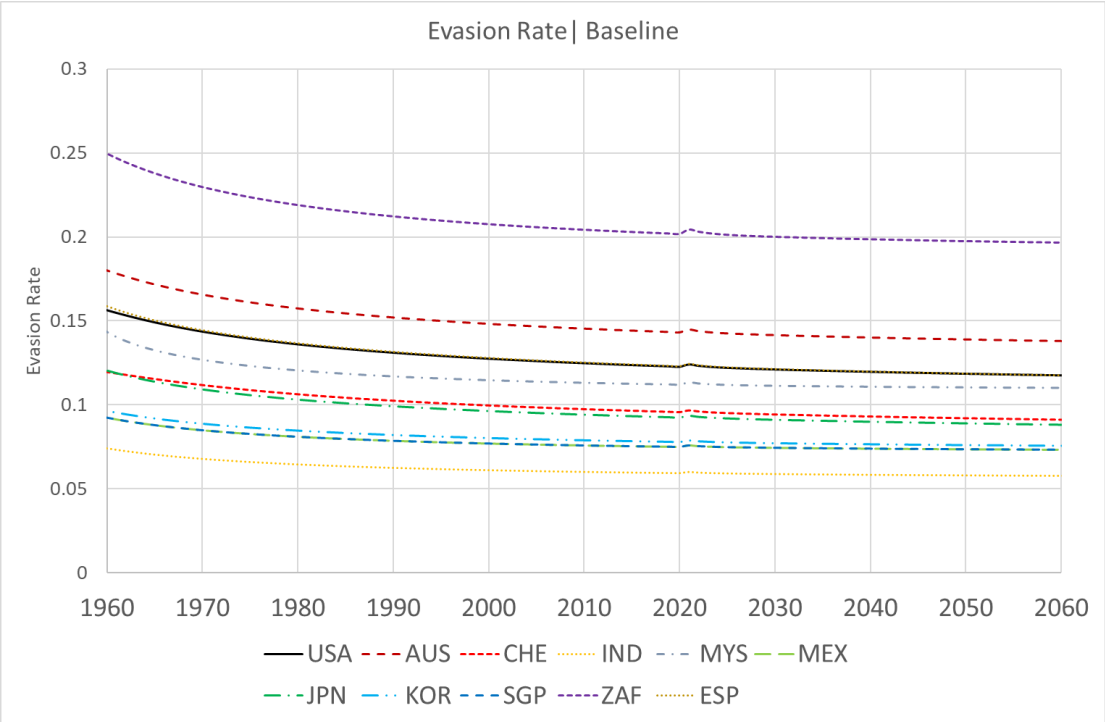
This figure shows equilibrium saddles paths of consumption per effective capita with respect to time, in response to the COVID-19 productivity shock, assuming no government responses. Simulations are based on country-specific static variables and common values, α=0.33, β=0.25, γ=0.9, ρ=0.03 and θ=0.99.

Figure 3



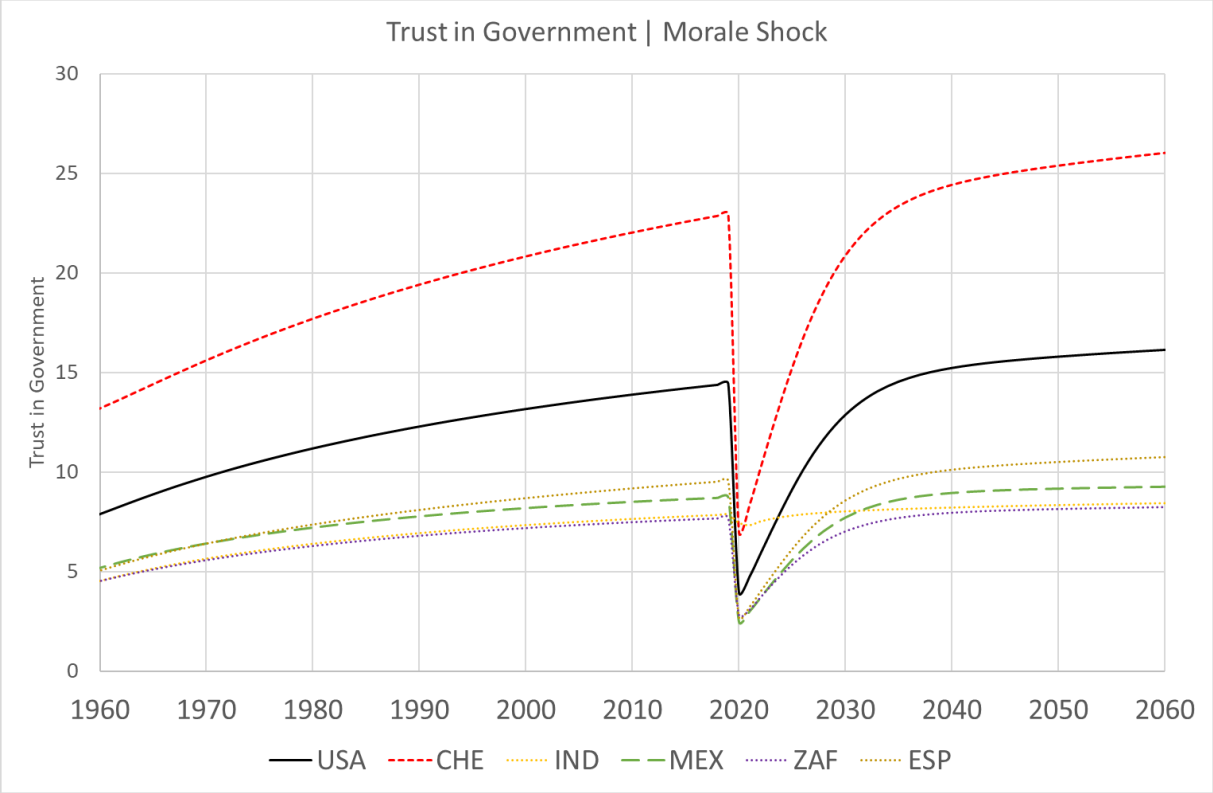
This figure shows equilibrium transitional paths of the trust in government index in response to the COVID-19 productivity shock, assuming no government responses.

Figure 4



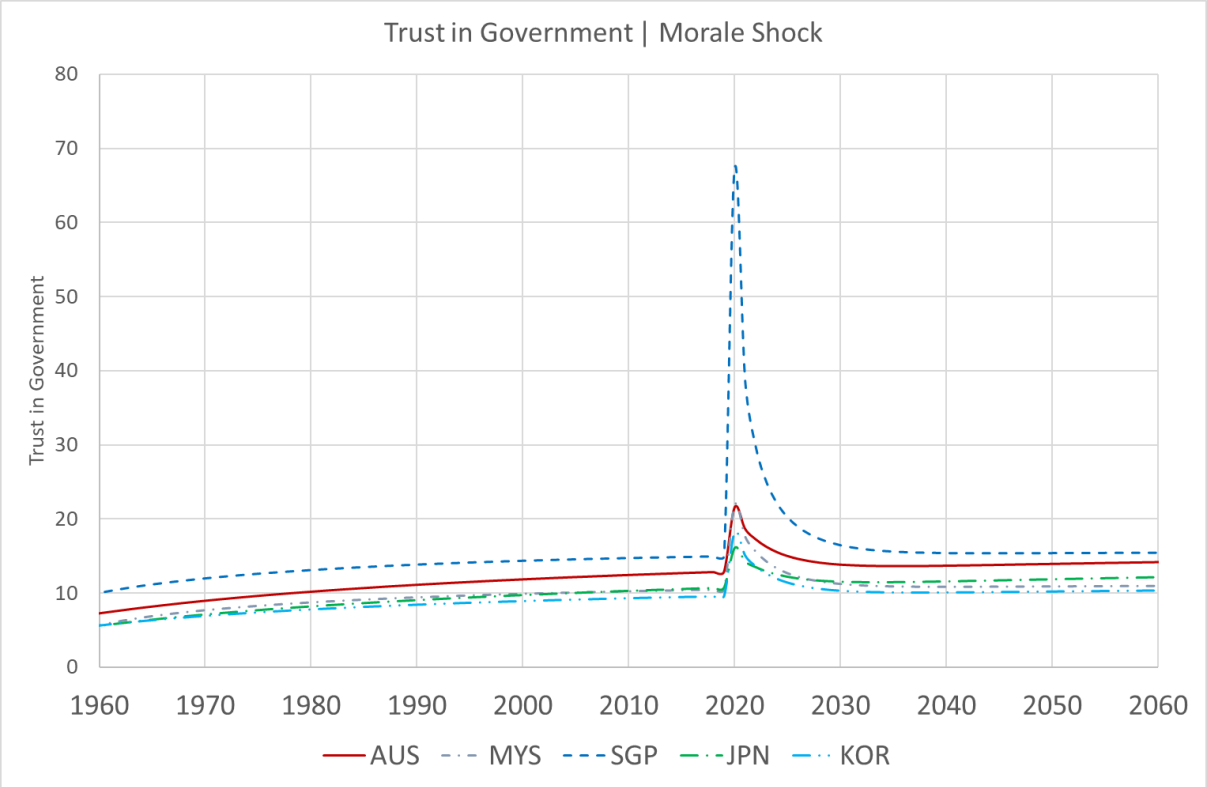
This figure shows equilibrium transitional paths of the evasion rate in response to the COVID-19 productivity shock, assuming no government responses.

Figure 5A – High Mortality Countries



This figure shows equilibrium transitional paths of the trust in government index, in response to the COVID-19 productivity shock and the tax morale shock, assuming no government responses.

Figure 5B– Low Mortality Countries



This figure shows equilibrium transitional paths of the trust in government index, in response to the COVID-19 productivity shock and the tax morale shock, assuming no government responses.

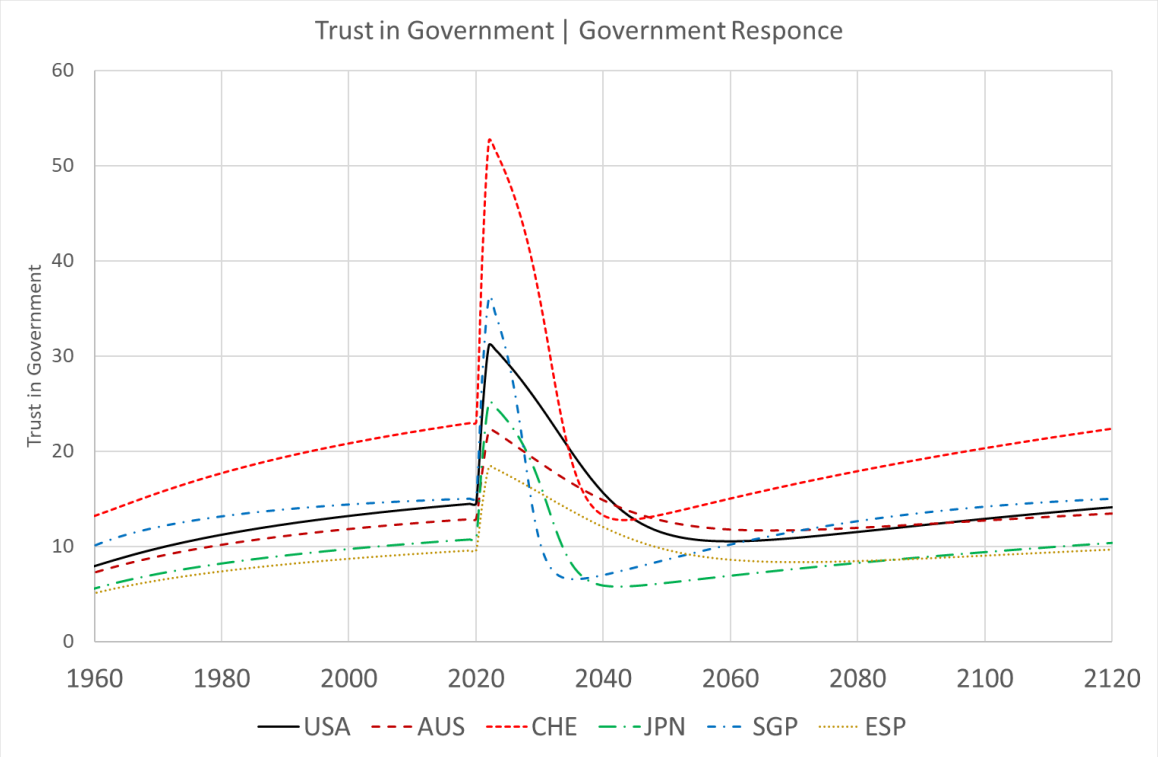
Figure 6A– High Mortality Countries

This figure shows equilibrium transitional paths of the evasion rate in response to the COVID-19 productivity shock and the tax morale shock, assuming no government responses.

Figure 6B– Low Mortality Countries

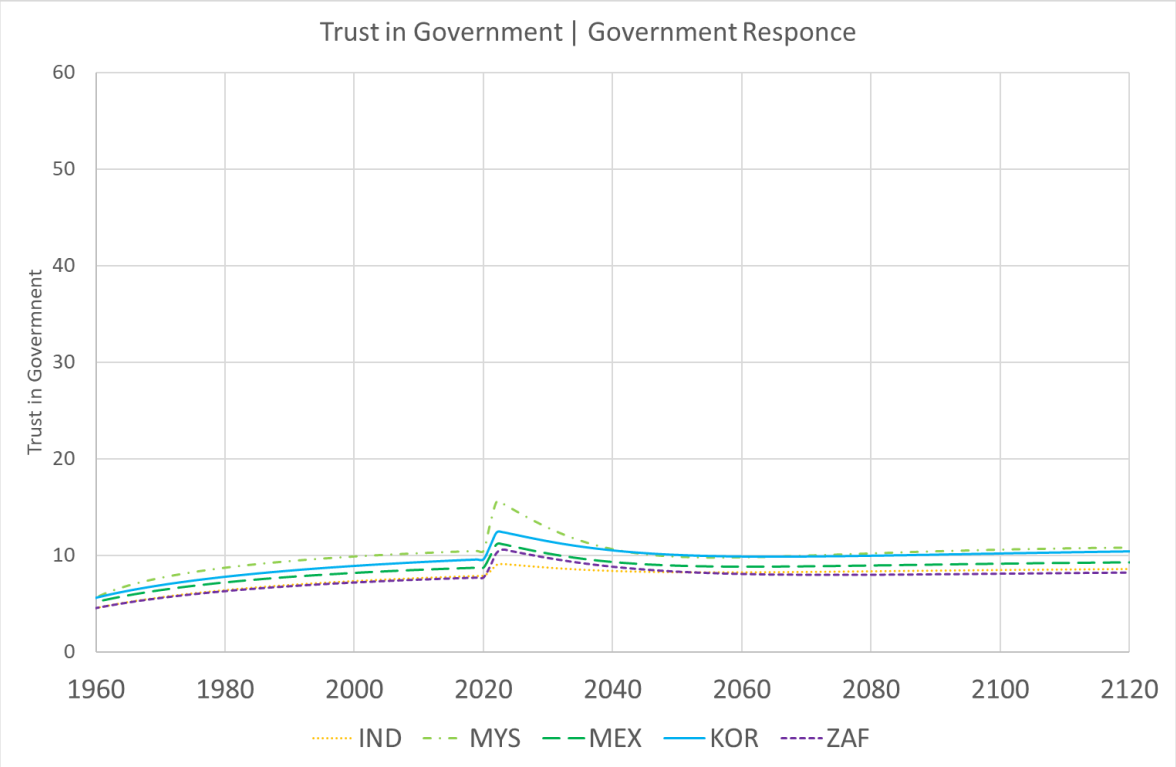
This figure shows equilibrium transitional paths of the evasion rate in response to the COVID-19 productivity shock and the tax morale shock, assuming no government responses.

Figure 7A – High Income Support Countries



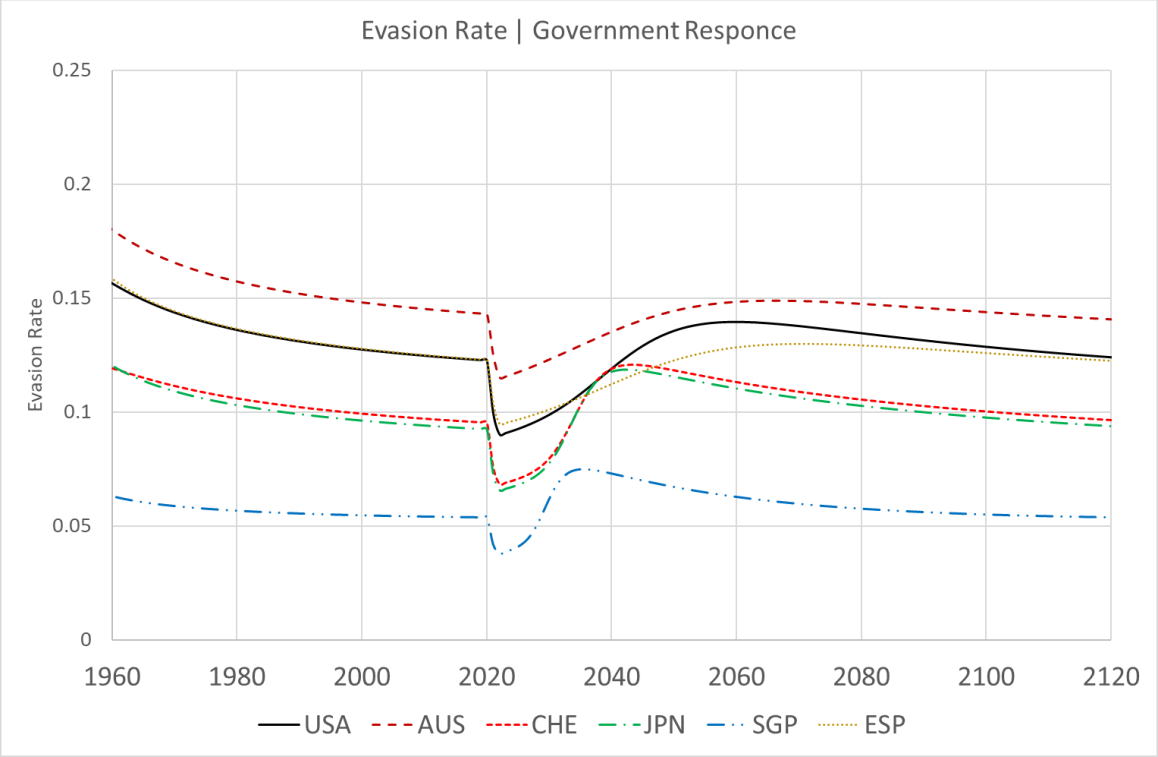
This figure shows equilibrium transitional paths of the trust in government index in response to the COVID-19 productivity shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 7B – Low Income Support Countries



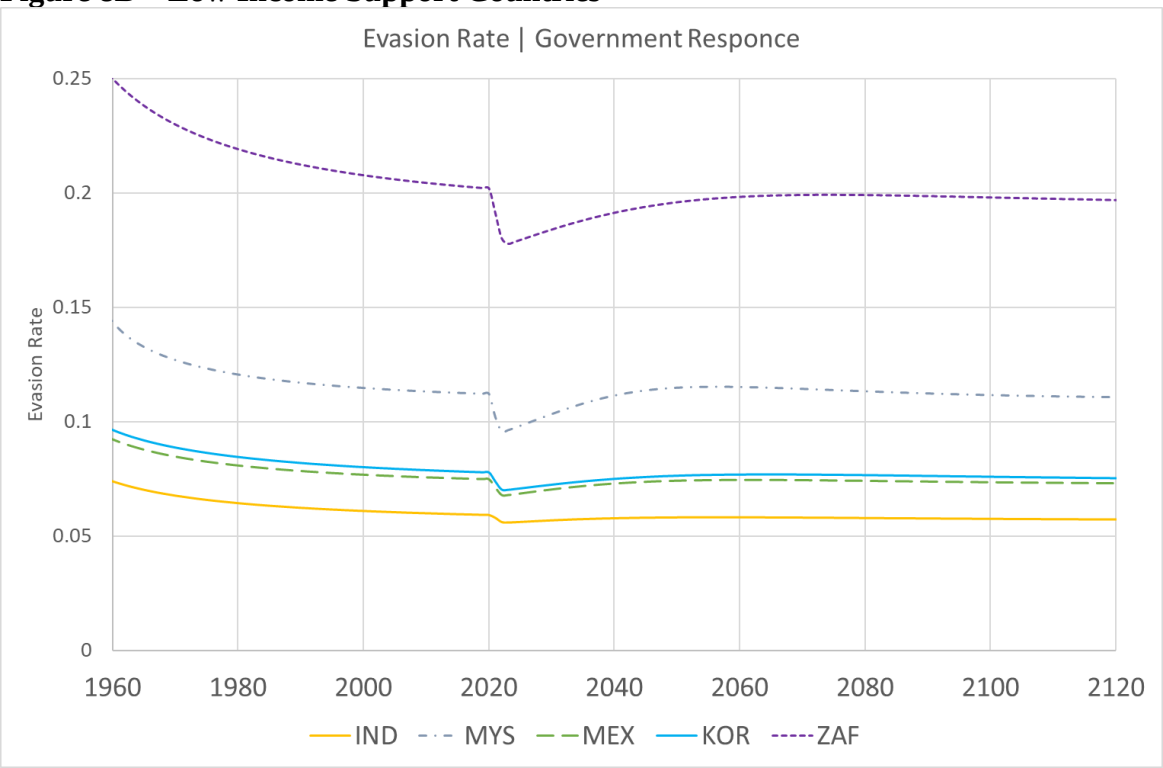
This figure shows equilibrium transitional paths of the trust in government index in response to the COVID-19 productivity shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 8A – High Income Support Countries



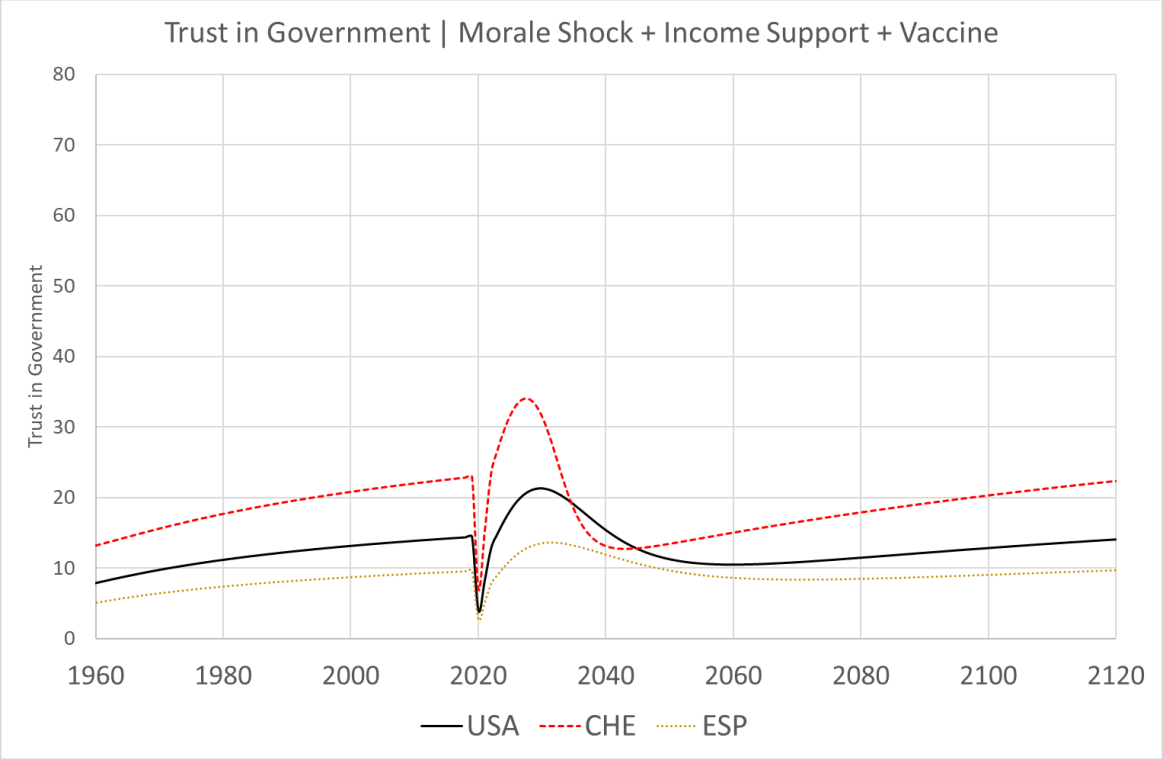
This figure shows equilibrium transitional paths of the evasion rate in response to the COVID-19 productivity shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 8B – Low Income Support Countries



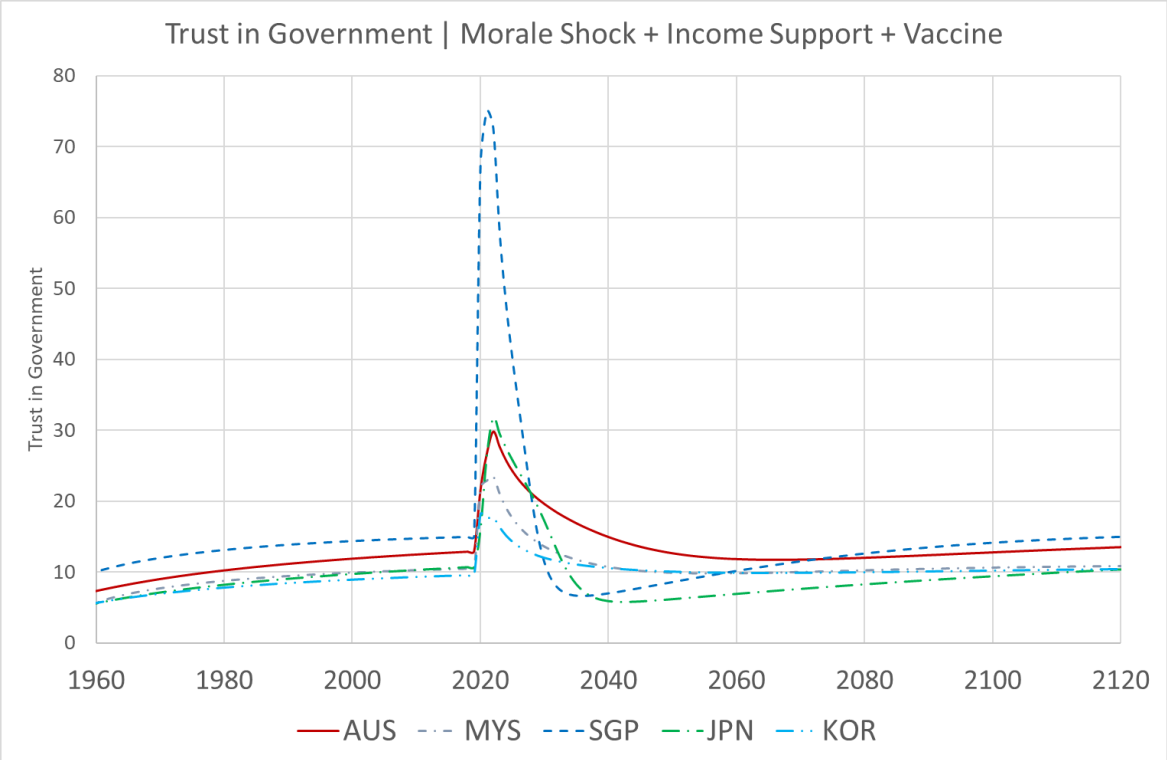
This figure shows equilibrium transitional paths of the evasion rate in response to the COVID-19 productivity shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 9A – High Income Support Countries + High Mortality Countries



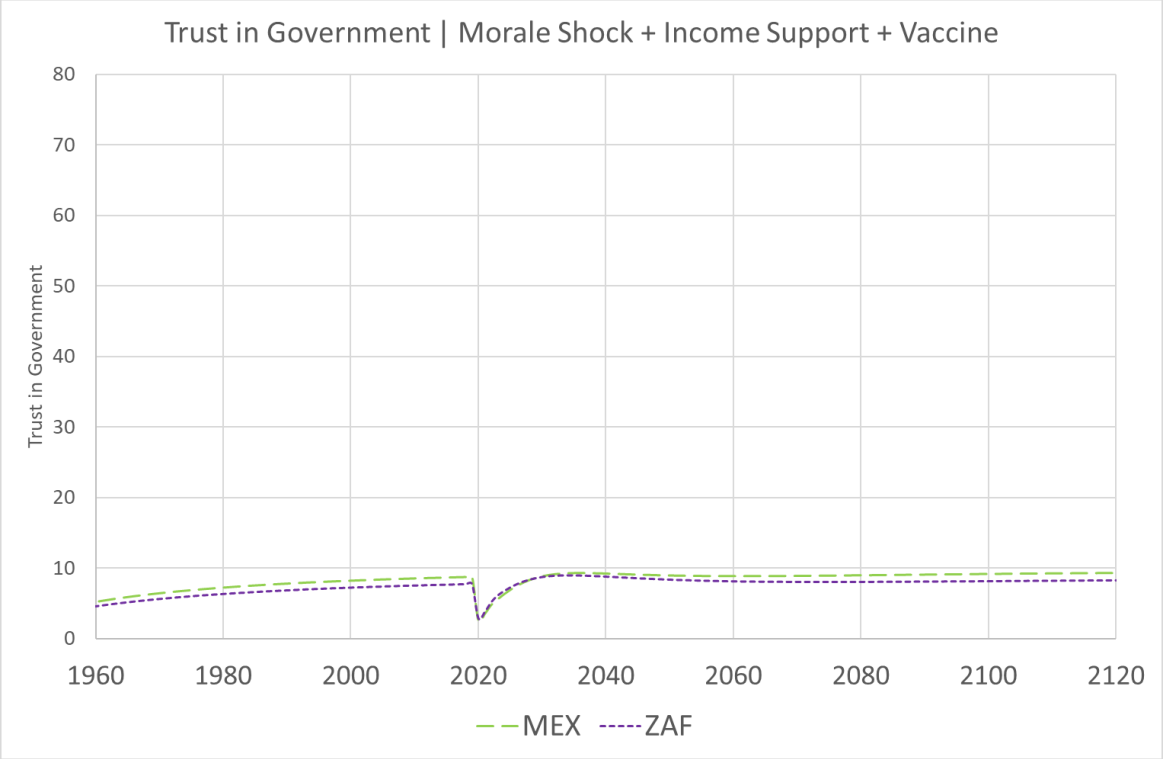
This figure shows equilibrium transitional paths of the trust in government index in response to the COVID-19 productivity shock and the tax morale shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 9B – High Income Support Countries + Low Mortality Countries



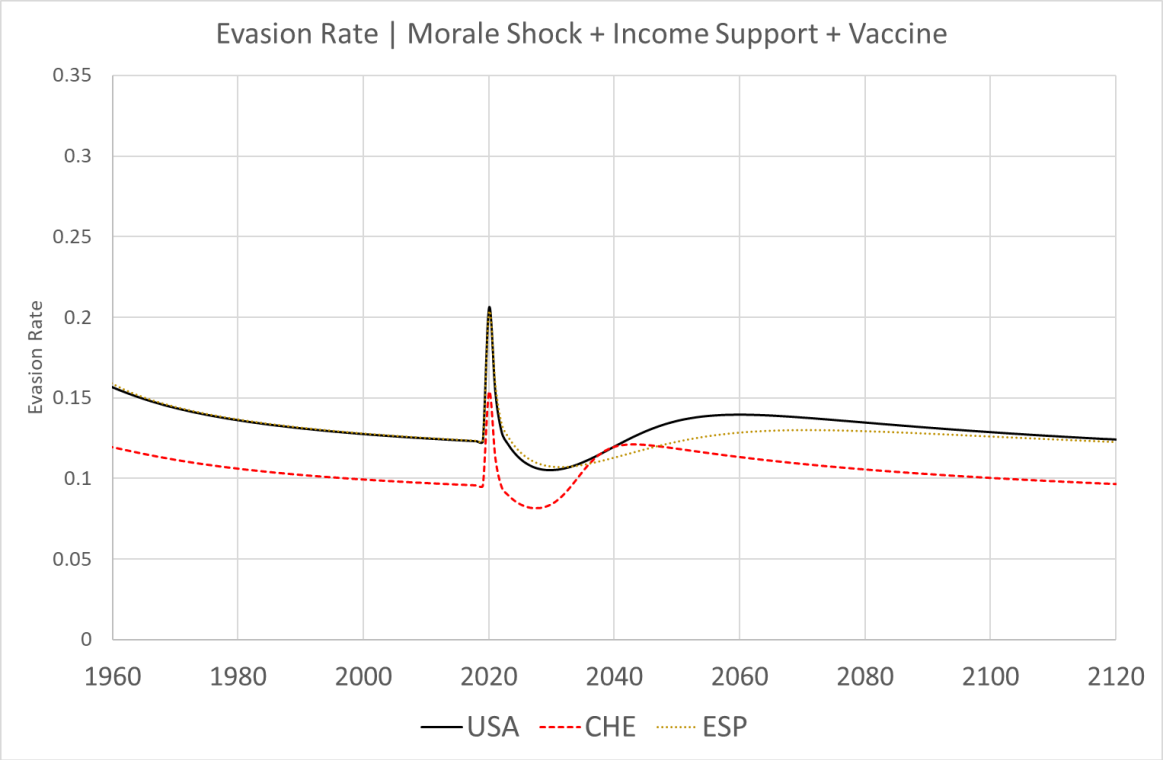
This figure shows equilibrium transitional paths of the trust in government index in response to the COVID-19 productivity shock and the tax morale shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 9C – Low Income Support Countries + High Mortality Countries



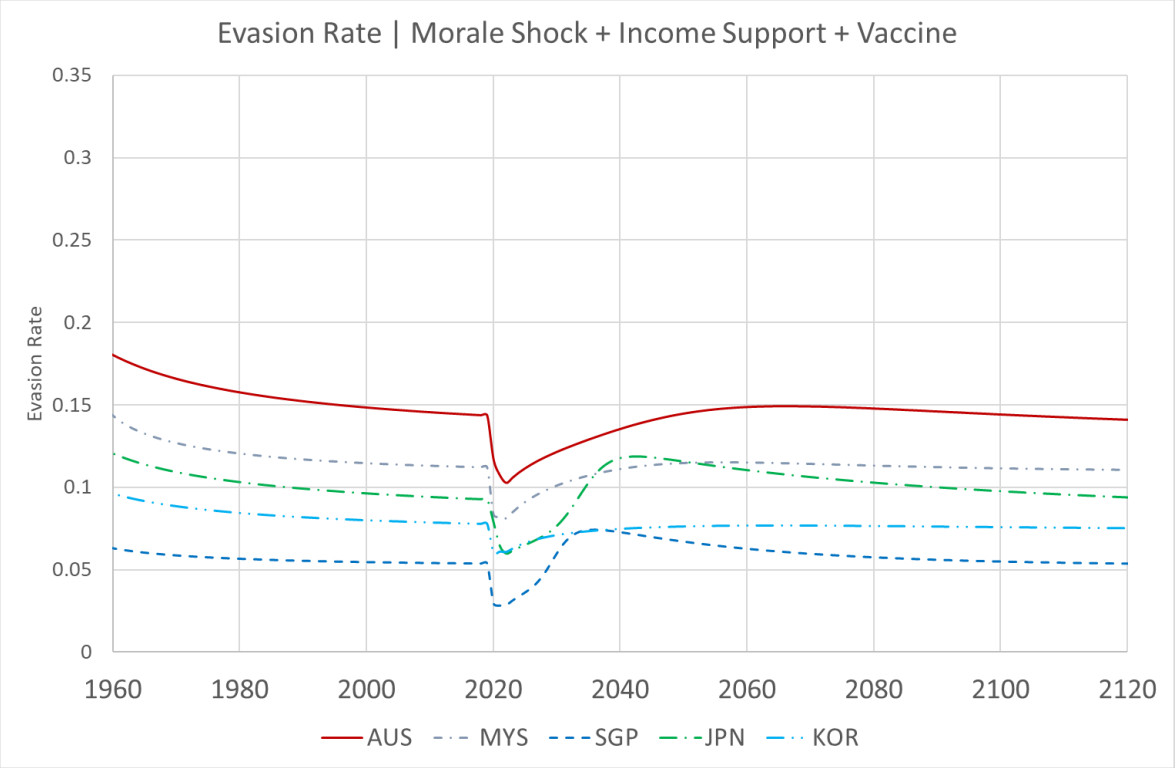
This figure shows equilibrium transitional paths of the trust in government index in response to the COVID-19 productivity shock and the tax morale shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 10A – High Income Support Countries + High Mortality Countries



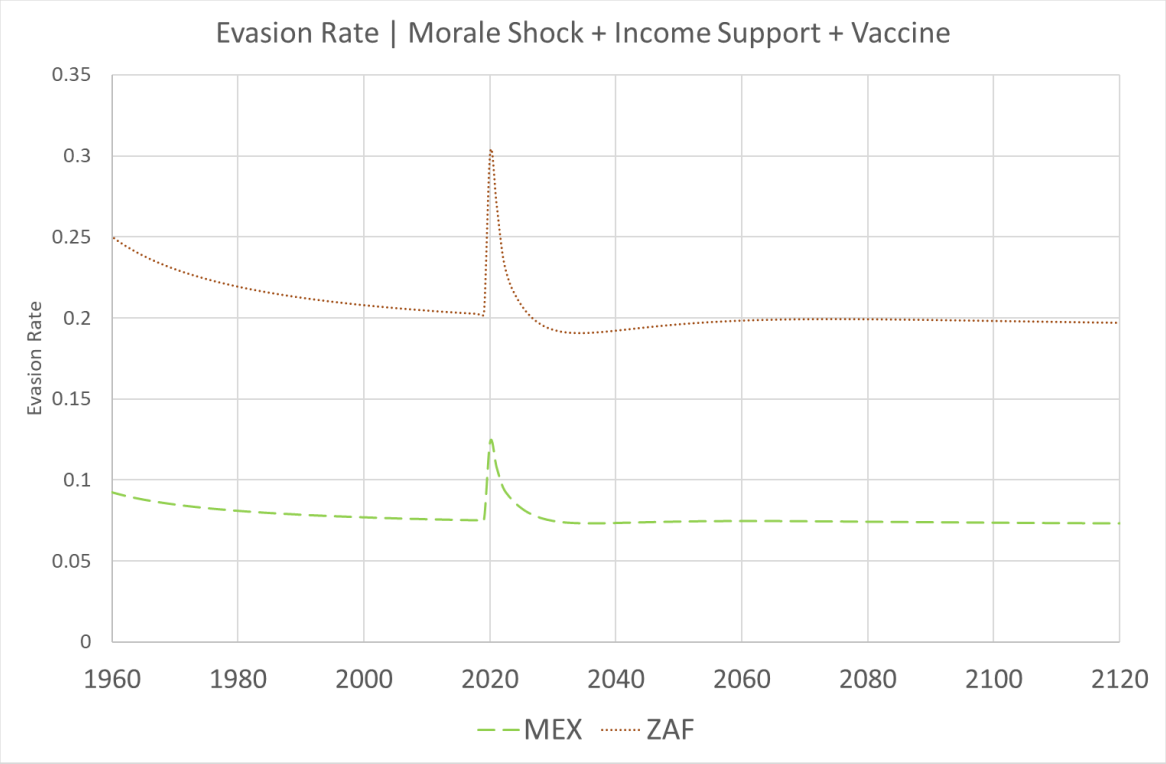
This figure shows equilibrium transitional paths of the evasion rate in response to the COVID-19 productivity shock and the tax morale shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 10B– High Income Support Countries + Low Mortality Countries



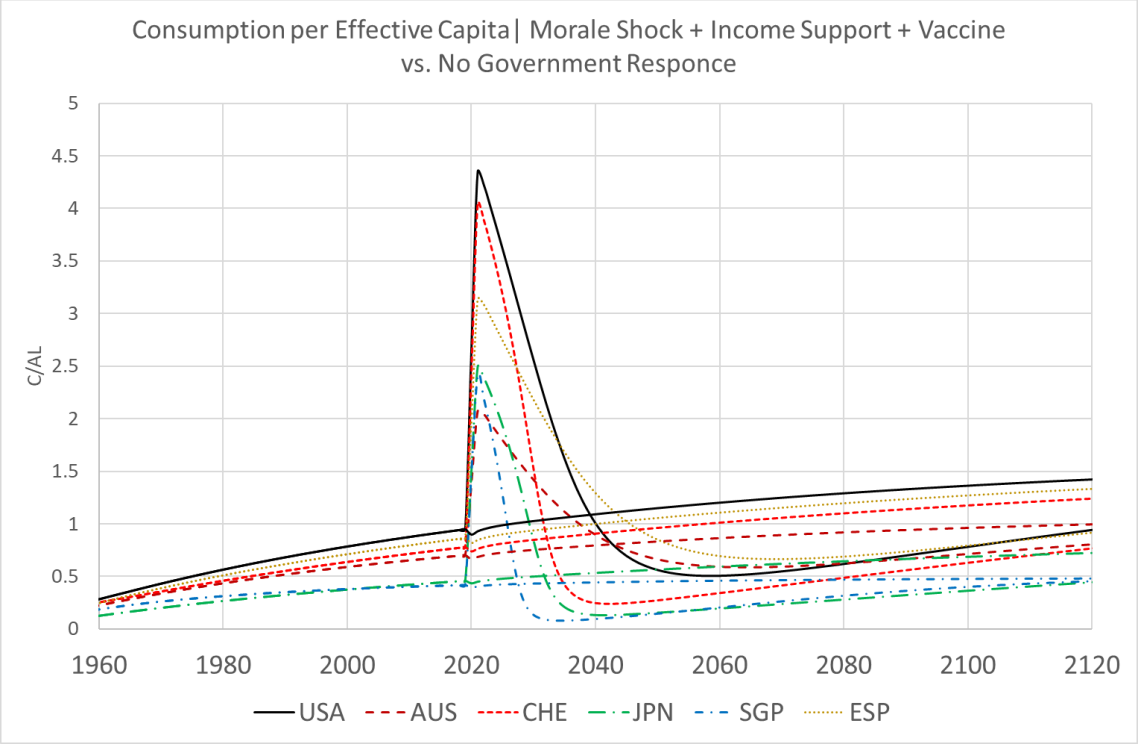
This figure shows equilibrium transitional paths of the evasion rate in response to the COVID-19 productivity shock and the tax morale shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 10C– Low Income Support Countries + High Mortality Countries



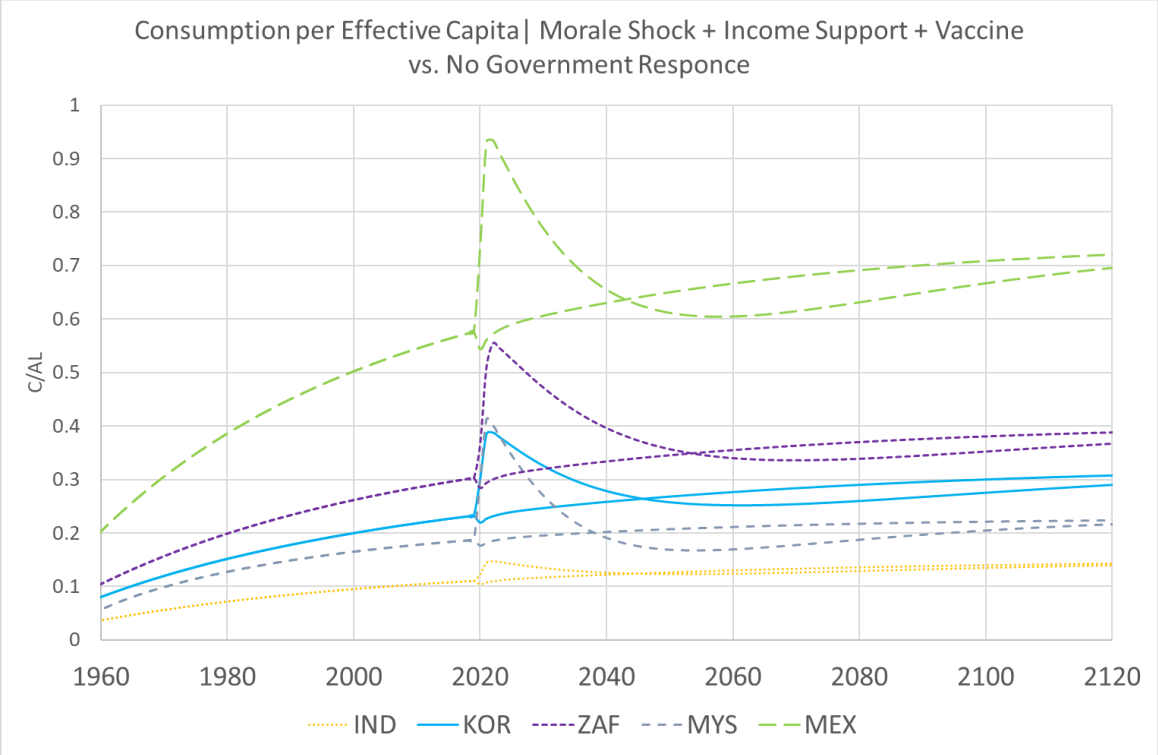
This figure shows equilibrium transitional paths of the evasion rate in response to the COVID-19 productivity shock and the tax morale shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 11A – High Income Support Countries



This figure shows equilibrium saddle paths of effective consumption in response to the COVID-19 productivity shock and the tax morale shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Figure 11B – Low Income Support Countries



This figure shows equilibrium saddle paths of effective consumption in response to the COVID-19 productivity shock and the tax morale shock, assuming that public goods (e.g., vaccines) increase by 2 percent of GDP and that country-specific levels of income support are provided.

Table 1A

Country specific time invariant tax rates, public expenditure rates, state variable growth rates and tax complainace statistics

	Public Finances			*Total Factor Productivity*	*Technology Growth (yrly.avg.)*	*Population Growth (yrly.avg.)*	*Probability of Detection^*	*Tax Avoidance Index^^*	*Share of Popular Trust in Govt.^^^*
Country	τ *	ω *	σ **	*a*	χ	*n*	*p*	*avoid*	*T*
Australia	0.16	0.09	0.25	0.85	0.42%	1.62%	0.02	0.23	46.98
India	0.03	0.09	0.15	0.34	0.94%	1.96%	0.01	0.19	77.15
Japan	0.10	0.05	0.17	0.64	0.68%	0.65%	0.02	-0.01	50.95
Malaysia	0.09	0.04	0.19	0.47	1.38%	2.44%	0.02	0.06	75.17
Mexico	0.05	0.05	0.16	0.87	0.88%	2.34%	0.01	0.14	37.08
Rep. of Korea	0.06	0.08	0.18	0.49	1.13%	1.44%	0.02	0.22	62.71
Singapore	0.07	0.04	0.14	0.73	1.70%	2.23%	0.03	0.11	73.58
South Africa	0.14	0.08	0.30	0.72	0.77%	2.18%	0.01	0.05	42.21
Spain	0.09	0.09	0.20	0.93	0.68%	0.77%	0.01	0.24	32.32
Switzerland	0.11	0.06	0.17	0.84	0.35%	0.91%	0.02	0.07	81.47
United States	0.12	0.04	0.21	1.00	0.57%	1.12%	0.02	0.06	47.43

* 1980-2019 avg., So. ICTD (2017); ** 1990-2015 avg., So. World Development Indicators (2017); ^ 1950-2015 avg., a=cwtfp, χ=hc & n=pop from PWT 9.0, Feenstra, et.al. (2017); ^^ Atwood, et.al. (2012); ^^^ Ortiz-Ospina and Roser (2016)

Table 1B

	Starting values of capital, labour and Harrod neutral techology^			Predicted relative consumption	Actual relative consumption^^	Predicted versus actual
Country	*K(1950)*	*L(1950)*	*A(1950)*	*c/c(USA)*	*c/c(USA)*	*difference*
Australia	3.51	8.39	2.67	0.90	0.90	0.01 ***
India	6.34	369.67	1.13	0.14	0.05	-0.09 ***
Japan	7.63	84.27	2.29	0.55	0.57	0.02 ***
Malaysia (55)	0.51	7.24	1.31	0.25	0.19	-0.06 ***
Mexico	3.12	28.08	1.53	0.47	0.20	-0.27 *
Rep. of Korea (54)	1.34	21.24	1.84	0.30	0.42	0.12 **
Singapore (60)	0.35	1.64	1.46	0.48	0.59	0.11 **
South Africa	2.11	13.66	1.65	0.44	0.14	-0.30 *
Spain	4.53	28.15	1.87	0.99	0.51	-0.48
Switzerland	4.50	4.62	2.94	0.82	1.07	0.25 *
United States	88.92	155.64	2.58	1.00	1.00	0.00

^ So. Penn World Tables, Feenstra, et.al. (2017); ^^ Barreto (2022); *** |Difference|<0.1, ** |Difference|<0.2, *|Difference3|<0.3; Numbers in brackets next to country names represent model inception year if other than 1950

Table 2

Row		AUS	JPN	KOR	MYS	SGP	MEX	ZAF	ESP	CHE	USA	IND
1	Trust in Government 2019 | **Baseline**	12.9	10.7	9.6	10.5	15.0	8.7	7.7	9.6	23.0	14.5	7.9
2	Evasion Rate 2019 | **Baseline**	14.3%	9.3%	7.8%	11.2%	5.4%	7.5%	20.2%	12.3%	9.6%	12.3%	5.9%
3	**Covid-19 Shock Only**											
4	Trust on Govt. 2021 | Covid-19 Shock Only	12.6	10.5	9.3	10.2	14.6	8.5	7.5	9.3	22.4	14.1	7.7
5	**%Δ from Baseline**	**-2.4%**	**-2.2%**	**-2.5%**	**-2.7%**	**-2.8%**	**-2.6%**	**-2.9%**	**-2.3%**	**-2.2%**	**-2.3%**	**-2.6%**
6	Evasion Rate 2021 | Covid-19 Shock Only	14.5%	9.3%	7.9%	11.3%	7.6%	7.6%	20.5%	12.4%	9.6%	12.4%	6.0%
7	**%Δ from Baseline**	**1.0%**	**0.9%**	**1.0%**	**1.1%**	**41.1%**	**1.1%**	**1.2%**	**0.9%**	**0.9%**	**0.9%**	**1.0%**
8	**Covid-19 Shock + Morale Shock**											
9	Deaths per Million as of 31 Jan. 2021*	36	45	28	23	5	1230	745	1247	1084	1333	112
10	Trust on Government 2021 | Morale Shock	18.6	14.2	15.0	17.6	38.6	3.0	3.1	3.2	8.3	4.8	7.3
11	**%Δ from Baseline**	**44.6%**	**32.7%**	**56.9%**	**67.9%**	**157.3%**	**-65.6%**	**-59.8%**	**-66.0%**	**-63.7%**	**-67.0%**	**-6.8%**
12	Evasion Rate 2021 | Morale Shock	12.4%	8.3%	6.5%	9.1%	3.7%	11.5%	29.1%	19.0%	14.3%	19.2%	6.1%
13	**%Δ from Baseline**	**-13.7%**	**-10.7%**	**-16.5%**	**-18.7%**	**-31.5%**	**53.2%**	**44.0%**	**54.0%**	**50.0%**	**55.9%**	**2.9%**
14	**Covid-19 Shock + Government Response (ie. Income Support + Vaccination)**											
15	% of GDP as Income Support in 2020**	5.4%	15.8%	2.0%	3.8%	18.0%	1.9%	1.0%	7.4%	15.0%	10.0%	1.0%
16	Trust on Government 2021 | Public Reponse	18.1	28.4	8.9	13.3	19.5	9.9	10.9	14.6	41.0	24.5	8.3
17	**%Δ from Baseline**	**40.5%**	**165.0%**	**-7.4%**	**26.7%**	**30.2%**	**13.5%**	**42.0%**	**53.1%**	**78.8%**	**69.2%**	**5.9%**
18	Evasion Rate 2021 | Public Response	12.5%	4.2%	19.1%	10.2%	7.3%	7.1%	7.4%	10.4%	7.6%	10.0%	5.8%
19	**%Δ from Baseline**	**-12.7%**	**-55.1%**	**145.5%**	**-9.0%**	**35.7%**	**-4.9%**	**-63.5%**	**-15.7%**	**-20.7%**	**-19.0%**	**-2.3%**
20	**Covid-19 Shock + Morale Shock + Government Response (ie. Income Support + Vaccination)**											
21	Trust on Govt. **2021** | Morale Shock + Response	26.7	26.5	17.6	22.9	75.1	3.5	3.7	5.1	15.3	8.3	8.0
22	**%Δ from Baseline**	**107.4%**	**147.2%**	**83.7%**	**118.4%**	**400.4%**	**-59.8%**	**-51.5%**	**-46.3%**	**-33.3%**	**-42.3%**	**1.3%**
23	Evasion Rate **2021** | Morale Shock + Response	10.7%	6.4%	6.1%	8.2%	2.8%	10.8%	27.0%	15.8%	11.2%	15.3%	5.9%
24	**%Δ from Baseline**	**-25.3%**	**-30.4%**	**-21.6%**	**-26.8%**	**-47.5%**	**44.0%**	**33.6%**	**28.3%**	**17.6%**	**24.6%**	**-0.5%**
25	Trust on Govt. **2040** | Morale Shock + Response	14.6	5.8	10.5	10.6	7.2	9.2	8.7	11.6	12.9	14.8	8.4
26	**%Δ from Baseline**	**13.3%**	**-45.8%**	**9.5%**	**0.8%**	**-52.2%**	**5.1%**	**13.0%**	**21.4%**	**-43.9%**	**2.2%**	**6.3%**
27	Evasion Rate **2040** | Morale Shock + Response	13.6%	11.8%	7.5%	11.2%	7.2%	7.4%	19.3%	11.4%	12.1%	12.2%	5.8%
28	**%Δ from Baseline**	**-4.9%**	**27.8%**	**-3.5%**	**-0.3%**	**34.4%**	**-2.0%**	**-4.8%**	**-7.5%**	**26.1%**	**-0.9%**	**-2.4%**
29	Trust on Govt. **2060** | Morale Shock + Response	11.8	7.0	9.9	9.8	10.3	8.8	8.1	8.5	15.2	10.5	8.2
30	**%Δ from Baseline**	**-8.7%**	**-34.8%**	**3.1%**	**-6.2%**	**-31.1%**	**1.2%**	**4.8%**	**-10.6%**	**-33.8%**	**-27.2%**	**4.8%**
31	Evasion Rate **2060** | Morale Shock + Response	14.9%	11.0%	7.7%	11.5%	6.2%	7.5%	19.8%	12.9%	11.3%	13.9%	5.8%
32	**%Δ from Baseline**	**3.7%**	**18.7%**	**-1.2%**	**2.6%**	**16.1%**	**-0.5%**	**-1.9%**	**4.6%**	**18.0%**	**13.5%**	**-1.9%**
33	Trust on Govt. **2120** | Morale Shock + Response	13.5	10.4	10.4	10.8	15.0	9.3	8.2	9.7	22.5	14.2	8.6
34	**%Δ from Baseline**	**4.9%**	**-2.9%**	**8.8%**	**3.5%**	**0.1%**	**6.4%**	**6.9%**	**1.5%**	**-2.1%**	**-2.1%**	**9.1%**
35	Evasion Rate **2120** | Morale Shock + Response	14.1%	9.4%	7.5%	11.1%	5.4%	7.3%	19.7%	12.2%	9.6%	12.4%	5.7%
36	**%Δ from Baseline**	**-1.9%**	**1.2%**	**-3.3%**	**-1.3%**	**0.0%**	**-2.4%**	**-2.6%**	**-0.6%**	**0.9%**	**0.8%**	**-3.4%**

* So. ourworldindata.org (2021); ** So. The World Bank (2021)