Department of Economics

Group for Economic Analysis at Reading (GEAR)

Distributional Effects of Public Spending and Tax Shocks in Middle-Income Countries: A Panel VAR Approach

by Abdulaleem Isiaka, Alexander Mihailov and Giovanni Razzu

Discussion Paper No. 2022-09

Department of Economics
University of Reading
Whiteknights
Reading
RG6 6AA
United Kingdom

www.reading.ac.uk

Distributional Effects of Public Spending and Tax Shocks in Middle-Income Countries: A Panel VAR Approach

Abdulaleem Isiaka* Alexander Mihailov† Giovanni Razzu‡

August 2022§

Abstract

This paper is the first to employ the GMM Panel VAR approach in examining the distributional effects of public spending and tax shocks over different horizons in middle-income countries. The study also investigates the response of income distribution variables to shocks imposed on three key components of social expenditures: social protection, health expenditures and education spending. We find that: (i) shocks to government and education spending tend to exhibit the most pronounced distributional consequences; (ii) shocks to both these expenditures positively impact the low- and middle-income groups, with high-income groups benefiting from education spending shocks as well; (iii) social protection shocks often exhibit brief equalizing effects, while (iv) health spending and tax shocks generally have no apparent effects on the economic divide; (v) social protection and health spending shocks largely elevate the income share of the wealthy, whereas tax shocks generally do not benefit the income groups under study. Further inference from variance decompositions confirms that fiscal policy variables are crucial drivers of the income distribution. Our results are robust to alternative measures of inequality, different orderings of variables as well as the inclusion of inflation. As a final contribution, our study examines how the results for middle-income countries compare with high-income ones. We find that while the same fiscal policies could have different distributional effects across the middle- and high-income groups, we also reveal that the results for both groups often agree on some general trends. Interestingly, the equalizing impacts of health spending and tax shocks are witnessed only in high-income countries.

Keywords: distributional effects, public spending shocks, tax shocks, middle-income countries, income inequality, GMM Panel VAR

JEL codes: E62, H53, O15

*Department of Economics, University of Reading, Whiteknights, Reading, RG6 6AA, United Kingdom; a.m.isiaka@pgr.reading.ac.uk

†Department of Economics, University of Reading, Whiteknights, Reading, RG6 6AA, United Kingdom; a.mihailov@reading.ac.uk

‡Department of Economics, University of Reading, Whiteknights, Reading, RG6 6AA, United Kingdom; g.razzu@reading.ac.uk

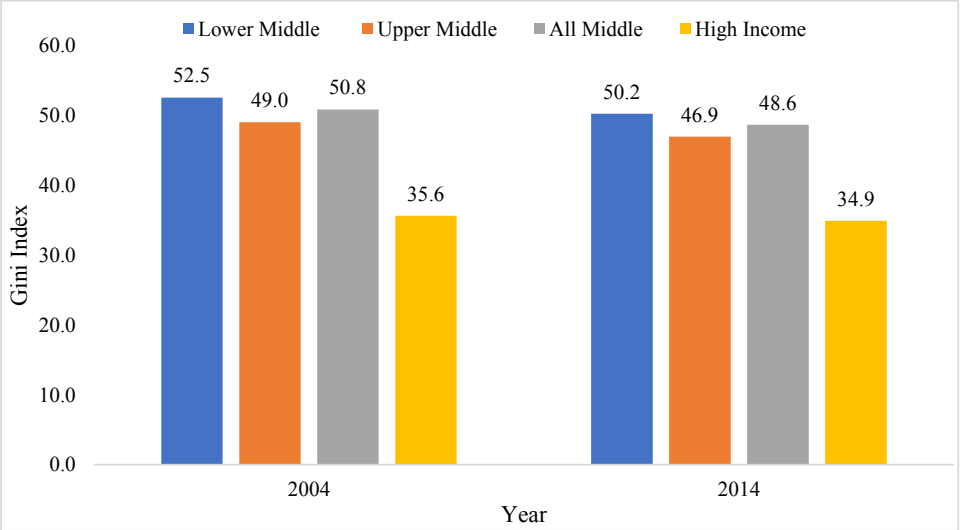
§Earlier drafts: March 2022 and October 2021. For valuable feedbacks, we are grateful to Carl Singleton, Hussein Hassan, Michael Clements, Ifeatu Uzodinma as well as seminar participants at Reading (November 2021). All remaining errors are ours.

1 Introduction

How do unexpected changes in public spending and taxes influence the income distribution in middle-income countries? The distributional implications of fiscal policy have been a long-standing topic of research, often with the aim to shed light on the growth-inequality nexus. Relatively more recently, the issue has gained increased interest as a result of two huge world-wide shocks, which have both prompted substantial fiscal stimulus and resulted in increased public-sector deficits and debt. First, the Global Financial Crisis (GFC) of 2007-2009 resulted in an unprecedented increase in public debt, and has been characterised by hotly debated arguments about the distributional and growth implications of fiscal consolidation approaches, which had been pursued particularly strongly by various European governments. More recently, the substantial government fiscal intervention to counteract the impact of the COVID-19 pandemic has just started to be questioned for its implications on growing public-sector deficits and debt (Bulow et al., 2020).

This paper examines the redistributive effects of tax and public spending *shocks*, the latter considered as unexpected changes in public-sector spending, as opposed to the more traditionally studied contemporaneous impact of government spending on inequality. Our study employs a panel of 56 middle-income countries over the 2004-2014 period. This is an extremely relevant set of countries, not just because of the relative paucity of evidence on the overall distributional incidence of fiscal policy in these countries, but also because they are characterised by relatively higher levels of income inequality, as shown in Figure 1

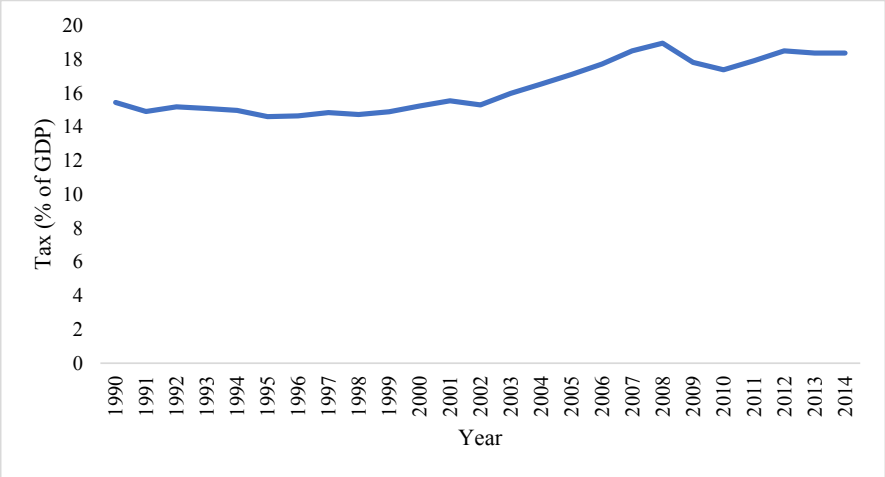
Figure (1) Income Inequality within Middle- and High-Income Countries in 2004 and 2014



Note: Figure 1 is computed using data from the Global Consumption and Income Project (GCIP) Database.

Fiscal policy has traditionally been considered an effective instrument through which to influence the distribution of income, even when the main direct target would have been economic growth, whether through impacting aggregate demand or the economy's productive capacity. The composition and combination of fiscal policies through spending and taxes is, therefore, critically important to understand the impact they may have on inequality. Middle-income countries are also characterised by relatively low levels of taxes and social spending, which limit the redistributive potential of their fiscal policies. Indeed, while the tax ratio for advanced economies exceeds 30% of GDP, for our set of countries, this share has been between 15% and 18% for most of the past three decades, as shown in Figure 2. As a result, resources available for social spending are more scarce in these countries than in advanced ones (see Figures 3 to 6).

Figure (2) Taxation within Middle-Income Countries



Note: Figure 2 is computed using data from the UNU WIDER Government Revenue Dataset.

Most distributional studies within the fiscal policy literature tend to examine the response of inequality to the contemporaneous effect of fiscal policy variables, while giving less attention to the dynamic response of inequality to unexpected changes in these variables. Meanwhile, policymakers are confronted with unforeseen circumstances, such as the GFC and the COVID-19 pandemic already mentioned, that prompted substantial fiscal policy intervention. As a result of the GFC, the share of government spending in GDP for the middle-income countries in our sample increased to 29.8% in 2009, about 4 percentage points greater than the average between 1990 and 2014. Moreover, data from the IMF indicates that in 2020, during the COVID-19 outbreak, public spending as a percentage of GDP in middle-income countries was 5 percentage points higher than the average between 2000 and 2020 (WEO, 2021). It is not hazardous to claim that sudden changes in fiscal policies are likely to become a recurring phenomenon when considering that countries will have to react to the consequences of climate-related disasters, let alone to those caused by the war of Russia in Ukraine and its huge consequences on energy and food prices worldwide.[1]

The now established link between inequality and growth means that it is relevant to have a better understanding of the impact of unexpected fiscal policy measures, and their composition, on inequality in middle-income countries in particular, as this will provide evidence as to the extent to which fiscal policies may hinder or facilitate their growth path and, consequently, their transition to a higher income status.

In this paper, we contribute as follows. First, unlike previous studies, which often analyse the contemporaneous impact of government spending on inequality, we examine the response of inequality to public spending shocks over different horizons. These shocks are identified as unexpected changes in public spending, using orthogonalized impulse response functions (IRFs) and forecast error variance decompositions (FEVDs). We employ a panel of 56 middle income countries over the period 2004–2014. To control for inequality persistence and reverse causality, we adopt a panel Vector Autoregressive (VAR) model implemented through the two-step difference Generalized Method of Moments (GMM) technique proposed by Arellano and Bond (1991). To our knowledge, the present study is the first to adopt the GMM Panel VAR approach in analysing the distributional effects of tax and public spending shocks in middle income countries.

[1] There is also evidence that the public might have changed the expectations on what is expected from government intervention, after the role that governments have assumed to deal with the consequences of the COVID-19 pandemic, which might have changed the way fiscal policy responses can be utilised.

Figure (3) Government Spending: MIC and HIC

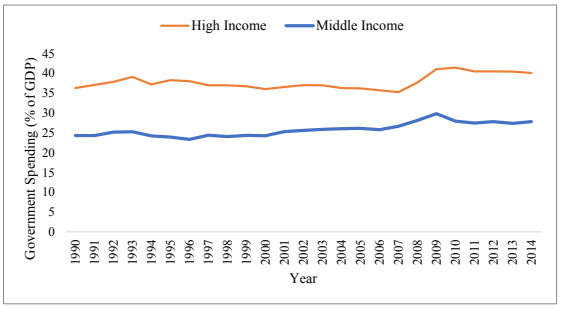


Figure (4) Social Protection: MIC and HIC

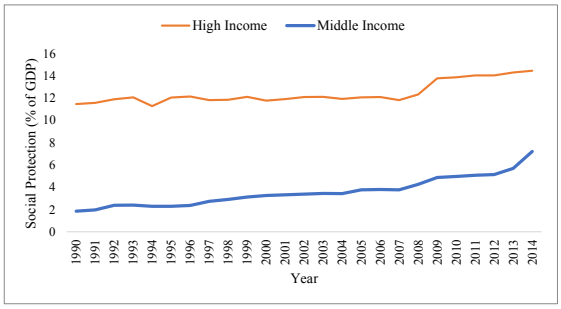


Figure (5) Health Spending: : MIC and HIC

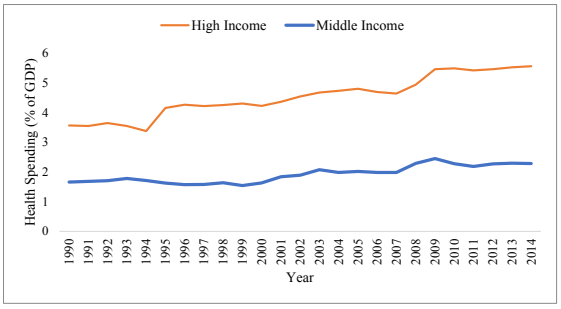
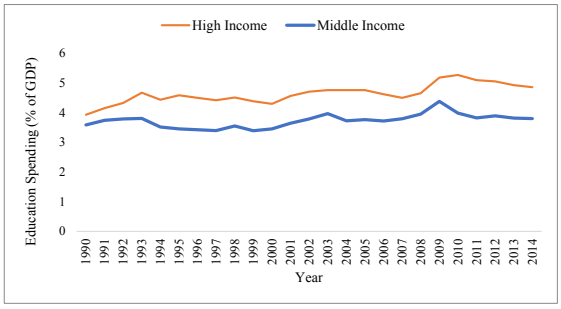


Figure (6) Education Spending: MIC and HIC



Note: Figures 3-6 are computed using data from the Statistics on Public Expenditures for Economic Development (SPEED) Database.

Second, we investigate the response of the key income distribution variables to shocks to taxes as well as three social expenditure variables. Following Oxfam/DFI (2017), we define our social expenditure variables as: social protection, health expenditures and education spending. Although there exists a variety of factors that determine the ultimate impact of these three categories of public-sector expenditures, Oxfam/DFI (2017) observes that they could also possess some equalizing prospects.

Third, we evaluate the effect of the examined fiscal shocks on different parts of the income distribution, namely the low-income group (the 10th percentile), the middle-income group (the 50th percentile) and the high-income group (the 90th percentile)[2]. By analysing the impact of the spending shocks on different income groups, we are, in effect, able to determine empirically in our panel whether the shocks are pro-rich, pro-middle class or pro-poor.

Overall, we find that, in our sample of middle-income countries, government and education spending shocks are associated with the most pronounced effects on the income distribution. Shocks imposed on both categories of public expenditures translate into a rise in the income share held by the low- and middle-income groups, with high-income groups benefiting from education spending shocks as well. Furthermore, social protection shocks often exhibit a brief equalizing effect, but health spending shocks generally have no detectable impact on the economic divide. Additionally, social protection and health spending shocks largely benefit the high-income group. As for tax shocks, they neither reduce inequality nor benefit the income groups under study. Our results are robust to alternative measures of inequality, different orderings of the variables as well as the inclusion of inflation. We also examine how the findings for middle-income countries compare with those for high-income countries. Remarkably, we detect equalizing effects of tax and health spending shocks in high-income countries. While we reveal that the same spending shocks could have different redistributive effects across middle- and high-income nations, the findings for both sets of countries tend to converge in some areas.

[2]We have also carried out analysis for further parts of the distribution, including the 20th, 40th and 80th percentiles. These results are in the Appendix

The rest of this paper is organized as follows: Section 2 reviews the related literature. Section 3 outlines the methodology adopted. Sections 4 and 5 present and discuss the results. Section 6 provides robustness tests. Section 7 summarizes and concludes. A comprehensive Appendix contains many details and further explorations.

2 Related Literature

The distributional effects of fiscal policy has been the topic of a vast literature now, most of it focusing on developed countries. In addition, studies tend to focus on the response of inequality to the contemporaneous effect of changes in taxes and public expenditures, while giving less attention to the dynamic distributional impact of such fiscal shocks. These studies can be grouped into three main types, depending on the approach they adopt. One type focuses on the redistributive consequences of taxes and transfers, mostly by assessing the difference between market income and disposable income inequality determined by the progressivity of the tax system. A review of this literature for developing countries is provided in Bastagli et al. (2015). Amongst the many studies with a single country focus, some that have a comparative approach for developed countries are from Brandolini and Smeeding (2009), Paulus et al. (2010) and Joumard et al. (2012) for OECD and five EU countries, respectively. The latter assesses the impact of in-kind benefits from public housing subsidies, education, and health care.

A second and similar type of studies aims to assess the determinants of net income distributions, typically based on regressions where the Gini coefficient is explained by government actions through taxes and spending. The findings from this type of regression-based studies suggest that greater reliance on income taxes and higher spending on social benefits reduces inequality. More specifically, direct taxes are found to be more redistributive than indirect taxes, and social protection spending reduces inequality (Afonso et al., 2010; Muinelo-Gallo and Roca-Sagalés, 2011; Martinez et al., 2012). For developing countries, the distribution of in-kind social spending has been found to be regressive, due to the relatively reduced access by low-income households to education and health. More specifically, the impact of spending varies across different categories: primary health care spending, for example, is progressive, while higher-level spending is regressive. Similarly, in education, primary education spending is progressive, while secondary and tertiary education spending are regressive (Van de Walle, 1995; Demery, 2000; Gregorio and Lee, 2002). Within this line of literature, more recent studies have focused on the impact of fiscal consolidation measures, which, as mentioned earlier, have been implemented by many countries as a response to the debt sustainability crisis that emerged from the substantial fiscal expansion adopted to address the consequences of the GFC (Woo et al., 2017).

Finally, a third type of studies is based on general equilibrium approaches, whereby the effects of all taxes and expenditures are estimated simultaneously, with no assumptions made or needed on how taxes affect different income groups. Most of these papers find weak redistributive effects of taxes, particularly in developing countries (Martinez et al., 2012). Within this line of research, there are also the popular dynamic stochastic general equilibrium (DSGE) models; the standard ones based on Smets and Wouters (2003) have a representative agent and, therefore, are not ideal to investigate distributional issues. More recent models have adopted heterogeneous agent types, mostly to assess the impact of monetary policy (Kaplan et al., 2018) while those on the impact of fiscal policy are recent (see, for example, Ferrara and Tirelli, 2017; Seidl and Seyrich, 2021).Overall, the results of existing studies on developed countries are mixed: while some suggest that the fiscal policy instruments tend to reduce inequality, others indicate the opposite.

In what follows, we concentrate on studies that have examined middle-income countries. Tables 1 and 2 report 14 such studies.

Table (1) Related Studies

Study	Geographical Coverage	Time Period	Methodology	Fiscal Policy	Findings	Critique
Ospina (2010)	19 Latin American countries	1980-2000	2SLS and GMM	Social Spending	Government spending on healthcare results in a more equal income distribution.	The time dimension is greater than the cross-sections, meanwhile, the GMM technique is more applicable to short panels.
Martinez et al. (2012)	150 Developed and Developing countries across the globe	1970-2009	Difference GMM	Taxes and social spending	The income distribution becomes more egalitarian due to progressive taxes and social spending	Does not evaluate the impact of the fiscal policy variables on different income percentiles.
Claus et al. (2012)	150 Developed, Developing and Transition economies	1970-2009	Difference GMM	Public spending and taxation	Inequality reduces with a rise in the share of government spending within the GDP (particularly social sectors).	Does not examine the impact of government spending on different income percentiles.
Anyanwu et al. (2016)	17 West African nations (Comprising Middle and Low-Income Countries)	1970-2011	System GMM	Government spending	Finds that inequality increases with an increase in total public expenditure on public goods and redistributive policies.	Use of the GMM technique is more suitable for short panels, rather than long ones, as employed in the study
Bergh et al. (2020)	140 Countries across varying income levels	1970-2010	Fixed Effect and system GMM estimator	Social spending	In the face of globalisation, all types of social security examined are ineffective at reducing inequality.	Does not consider the dynamic effect of public spending shocks on income inequality.
Furceri et al. (2022)	103 Developing countries across the world	1990-2015	Local Projection Method	Fiscal consolidation through public spending	The economic divide widens persistently following the implementation of austerity measures within developing countries	Inequality measures employed generally focus on the Gini index only. Also, local projection estimators tend to have a relatively high bias as well as variance, thereby leading to inaccurate confidence intervals (see, e.g., Kilian and Kim, 2009).
Howie and Atakhanova (2014)	Kazakhstan	1996-2009	Dynamic panel data model	Health spending	While public health programmes have no detectable effect on the lowest half of the distribution, they do reduce inequality in rural regions.	Does not consider the long-run effects of the health programmes on income inequality.
Lustig (2016)	28 Low and Middle-income countries	2010	Commitment to Equity (CEQ) methodology	Health spending	Public healthcare expenditure fails to close the income gap in the presence of low healthcare services as well as healthcare service which disproportionally benefit the wealthy.	Long-term redistributive effect of publicly sponsored health programmes are not adequately examined.

Table (2) Related Studies (Continued)

Study	Geographical Coverage	Time Period	Methodology	Fiscal Policy	Findings	Critique
Rudra (2004)	Developing (35) and industrialized countries (11)	1972-1996	Instrumental Variables methods	Health spending	In Less Developed Countries, government spending on healthcare encounters considerable bureaucratic bottle necks and thus fails to lower income inequality.	Largely focuses on the Gini index without examining alternative inequality measures.
Coady and Dizioli (2018)	103 Advanced and Emerging countries across several regions	1990–2005	OLS, SURE, Fixed Effects and GMM.	Education spending	Inequality declines in developing nations when the average number of years spent in education increases for adults aged 25.	Does not analyse the response of the income distribution to education expenditure shocks.
Battistón et al. (2014)	18 Latin American countries	1990-2009	Microsimulation using individual earnings equations.	Education spending	Expenditures raising school enrolment tend to exacerbate economic disparity. The disequalizing impact tends to endure unless the education sector's financing is well-targeted.	The effect of public education spending on the percentile income shares of various income categories is not examined in detail.
Castelló and Doménech (2014)	146 Countries across different income levels	1950–2010	OLS, Fixed Effects and some Instrumental Variables techniques.	Education spending	If having a higher education enhances the odds of earning a better pay, increasing the average number of years spent in school promotes inequality.	Does not adequately examine the impact of education spending on different income percentiles.
Sauer et al. (2020)	73 countries across the world	1981-2010	Fixed Effects	Taxation	Taxation as well as imports from low-income nations help offset the disequalizing impacts of falling labour income shares and rising importation from wealthy nations.	Largely focuses on Gini index and does not explore alternative inequality measures
Alavuotunki et al. (2019)	138 Developed and Developing Countries	1975–2010	Fixed Effects OLS Model	Taxation	Due to the tax programmes considered, income inequality has worsened.	Does not examine the impact of tax shocks on the economic divide.

Tables 1 and 2 report the findings of 14 empirical studies regarding the distributional impacts of a variety of fiscal policy variables including: public spending, social securities, health spending, education expenditures and taxation. The studies cover a period that spans from 1950 to 2015, overall. While some studies examine both developed and developing countries (Martinez et al., 2012; Coady and Dizioli, 2018), some concentrate on specific regions (Battistón et al., 2014; Anyanwu et al., 2016) meanwhile, a few others focus strictly on developing countries of varying income levels (Furceri et al., 2022). Also, GMM and panel fixed effects methods appear to be the most common techniques adopted, with 8 papers adopting the former, and 6 employing the latter. In terms of findings, the studies examined arrive at mixed results. While some studies show that the fiscal policy variables are equalizing, others find disequalizing impacts.

More importantly, the literature review provided above, reveals that existing studies generally give less attention to the redistributive impact of fiscal shocks as opposed to public sector expected spending and tax. We fill this gap by examining – within a sample of middle-income countries – the effect of tax and public expenditure shocks on a summary measure of inequality (the Gini index) as well on three sections of the income distribution over different forecast horizons. Also, we control for reverse causality by adopting a panel Vector Autoregressive (VAR) model implemented through the two-step difference GMM technique of Arellano and Bond (1991).

3 Method and Data

The measure of income inequality we start with is the Gini index, popularly used as it also satisfies most of the conditions that are widely accepted to be desirable in an inequality measure (Foster et al., 2013). Following the huge income inequality literature, our Gini index is measured on a scale of 0–100: as the index rises from 0 to 100, inequality increases. However, the Gini is well-known for being insensitive to changes in the tails of the income distribution, while we also aim to empirically uncover how different income groups respond to the tax and spending shocks. To do so, we employ three different percentile income shares: Consequently, we modify our VAR framework by replacing the Gini index with each of the percentile income shares, one after the other.

3.1 Model Specification

We employ a three-variable panel vector autoregressive (VAR) model following the seminal paper of Blanchard and Perotti (2002).[3] Our baseline panel VAR model is provided below:

$$Y_{it} = A_0 + A_1 Y_{it-1} + \mu_i + \theta_t + e_{it} \tag{1}$$

In equation (1), Y_{it} is a vector comprising the variables $Spending_{it}$, Tax_{it} and $Gini_{it}$. $Spending_{it}$ represents public spending in country i at time t, Tax_{it} is taxation revenue, and $Gini_{it}$ represents the Gini index, our initial measure of income inequality and principal variable of interest. Further, μ_i and θ_t denote the country and time fixed effects, respectively; and e_{it} represents the error term. Our choice of variables is underpinned by the theoretical proposition underlying the study published by the IMF in 2015 (Clements et al., 2015), wherein they observe that taxes, as well as spending decisions such as social security, education and health expenditures, are often designed to directly impact on households' welfare, as well as the income distribution of the society. Therefore, and similalry to the approach of Kabashi (2015), we also replace the public spending variable with three social expenditure variables, one at a time: social protection spending (SPS_{it}), health spending (HS_{it}), and education spending (ES_{it}). In examining the impact of the spending shocks on different income groups, we also subsequently replace the Gini index with three percentile income shares representing three very different income groups: the 10th percentile represents the low-income group; the 50th percentile denotes the middle-income group and the 90th percentile the high-income group.[4] Table 3 summarises these variables and their data source.

We include both public spending and taxes within the same VAR model since both variables are not independent of each other, as noted by Blanchard and Perotti (2002). Additionally, we use recursive VARs as they are relevant to situations in which the theoretical and empirical literature present mixed evidence about structural identification, as we consider to be the case in this research (see, e.g., Mihailov, 2009). Following existing studies (see, Anyanwu

[3] Blanchard and Perotti (2002) focused on the dynamic effects of fiscal shocks on output, by specifying a three-variable VAR comprising government spending, tax and GDP. They note that the use of a small-dimensional VAR arises from the fact that the VAR framework relies on multiple equations, implying that several parameter estimates would be obtained from only a few variables; a large VAR could grossly undermine degrees of freedom and, by implication, increase standard errors - except in the presence of an extremely large number of observations. Three-variable VARs are also employed by Love and Zicchino (2006), Saxegaard (2014) and IMF (2014).

[4] The Appendix contains further results for the 20th, 40th and 80th percentiles.

et al., 2016; Guzi and Kahanec, 2019), we measure tax as well as the expenditure variables as a percentage of GDP. In Appendix A, we provide further discussion concerning our panel VAR model.

Table (3) Variables Definition

Abbreviation	Description	Data Source
GS	Government spending represents the total expenditure incurred by a government in a given year. All spending variables are measured as a percentage of GDP.	Statistics on Public Expenditures for Economic Development (SPEED)
SPS	Social protection spending includes social securities such as provision of short- and long-term shelter to the poor, unemployment benefits and parental leave benefits.	Statistics on Public Expenditures for Economic Development (SPEED)
HS	Health spending comprises healthcare related expenses such as health insurance, drugs funds, ambulance acquisition, subsidies and grants channelled towards healthcare.	Statistics on Public Expenditures for Economic Development (SPEED)
ES	Education spending includes education expenditures such as grants, scholarships, allowances and loans in support of pupils; as well as construction of academic institutions.	Statistics on Public Expenditures for Economic Development (SPEED)
Tax	Taxation revenue comprises the total government revenue but excludes grants.	UNU WIDER Government Revenue Dataset for 2018
Gini	Gini index compares the average difference between pairs of incomes in a distribution with the distribution's mean.	Global Consumption and Income Project (GCIP) Database
Tenth, Fiftieth and Ninetieth Percentiles	The Tenth, Fifitieth and Ninetieth percentiles respectively reflect the income levels below which the incomes of the bottom 10%, bottom half and top 10% of the distribution fall. The 10th, 50th and 90th percentiles respectively denote the low, middle and high income groups.	Global Consumption and Income Project (GCIP) Database

Source: Authors' own computation.

Appendix Table B1 shows the results of the unit root and stability tests.

3.2 Panel VAR Identification

As is well-known, in orthogonalized impulse response analysis like ours here, the contemporaneous relationship among the endogenous variables is determined by the order in which variables are entered into the VAR system.

When a variable precedes another, the former is assumed to be capable of exhibiting a contemporaneous impact on the latter, while the reverse is not the case.

The order in which our variables enter the VAR system is based on a variety of theoretical and empirical findings. First, we assume that public spending impacts on the contemporaneous value of taxation revenue. The rationale behind this assumption is that government spending affects economic activities, which in turn determine taxation revenue (Blanchard and Perotti, 2002). Moreover, the usual delays in the implementation of tax rates implies that taxation revenue would likely impact on government expenditure with a time-lag (Narayan and Narayan, 2006; Ramos and Roca-Sagales, 2008). Second, the effect of taxation on the Gini index is likely to be contemporaneous. This assumption is based on the Jakobsson–Fellman theorem, which suggests that redistribution of income represents a core objective of taxation, and this in turn impacts the degree to which the income distribution is egalitarian (Jakobsson, 1976; Fellman, 1976). While the Gini index impacts on other variables with a time lag, the rest of the variables can exhibit a contemporaneous impact on the Gini index. Therefore, our variables enter the VAR system in the following order:

$$Y_{it} = [Spending, Tax, Gini,]' \tag{2}$$

We construct the impulse response functions using the VAR estimates and generate their standard errors and confidence intervals through 200 Monte Carlo simulations from the distribution of the panel VAR model. Likewise, we report the (forecast error) variance decompositions, which show the percentage of the variation in the respective dependent variable that arises from its own shocks as compared to shocks to the other variables in the system.

In determining the order (or time lag) of our panel VAR model, we rely on the Model and Moment Selection Criteria (MMSC) proposed by Andrews and Lu (2001) for models estimated with the GMM method.[5] In all our regressions, we utilize a panel VAR model of order one as this yields the lowest MAIC, MBIC and MQIC. In constructing our instrument matrix, we employ the approach of Holtz-Eakin et al. (1988), which replaces missing values with zeros, and thus minimizes the loss of degrees of freedom as more instrument lags are added.[6]

3.3 Transformation of the Baseline Model Through Forward Orthogonal Deviations

The reverse-causality/contemporaneous feedback in structural VAR results in endogeneity bias. In time-series VAR, the feedback is eliminated by transforming the VAR and subsequently estimating same, equation by equation using OLS. However, in panel VAR – particularly given a short time-span (as is the case in this paper)[7] – we are unable to employ the OLS method due to the presence of country fixed effects which are correlated with the regressors (i.e., lagged explanatory variables) in the VAR system. In addressing this difficulty, we methodically transform our models using the forward orthogonal deviations transformation of Arellano and Bover (1995). This approach is computed in two steps. First, for each panel, we subtract the average of all available future observations (which will always be defined even in the presence of missing observations) from the observation available for the relevant period. Second, the resulting value is multiplied by a scale factor. Accordingly, every observation can be transformed through forward orthogonal deviations, except that of the last period. Mathematically, the forward orthogonal deviation for variable w is computed with the formula:

[5] The MMSC is similar to a number of model selection criteria, such as Akaike information criteria (AIC) (Akaike, 1969), Bayesian information criteria (BIC) (Schwarz, 1978) and the Hannan–Quinn information criteria (HQIC) (Hannan and Quinn, 1979).

[6] We do not adopt the Anderson-Hsiao approach (Anderson and Hsiao, 1982) because it reduces the observations available for regression with every additional instrument lag.

[7] As the timespan tends towards infinity, the endogeneity bias reduces, and the fixed effects estimator can be used (Nickell, 1981). Nonetheless, we do not experiment with the fixed effects estimator since we employ a relatively short time span.

$$c_{it}(w_{it} - \frac{1}{T}\sum w_{is}) \tag{3}$$

where w_{it} denotes the contemporaneous value of w for country i. Also, w_{is} captures all future observations ahead of w_{it}. Likewise, T_{it} represents the number of future observations from period t within country i. Similarly, c_{it} is a scale factor computed as:

$$c_{it} = \sqrt{\frac{T_{it}}{(T_{it}+1)}} \tag{4}$$

3.4 GMM Panel VAR Estimation Technique

We estimate the VAR equations using the two-step difference GMM estimator of Arellano and Bond (1991). We do not use the one-step difference GMM estimator since it employs an arbitrary approximation of the weighting matrix in the GMM estimator (see Roodman, 2009). Also, in addressing the downward bias in the standard errors of the two-step results, we adopt the Windmeijer (2005) finite-sample correction. The two-step difference GMM estimator is expressed as follows:

$$\beta_{GMM} = (X'Z(Z'\widehat{\Omega}Z)^{-1}Z'X)^{-1}X'Z(Z'\widehat{\Omega}Z)^{-1}Z'Y \tag{5}$$

where β_{GMM} is a column vector of coefficients, X is a column vector of k regressors, Y is the column vector representing the left-hand side variable, Z denotes the instrument matrix and $\widehat{\Omega}$ is a weighting matrix.

3.5 Descriptive Statistics

Table 4 shows descriptive statistics for our data: 56 middle-income countries over the period 2004–2014.[8] The countries are: Albania, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Bhutan, Botswana, Brazil, Bulgaria, Cabo Verde, Congo, Rep., Costa Rica, Ecuador, Egypt, El-Salvador, Eswatini, Fiji, Georgia, Ghana, Guatemala, India, Indonesia, Iran, Jamaica, Jordan, Kazakhstan, Kenya, Kyrgyz, Lesotho, Malaysia, Maldives, Mexico, Moldova, Mongolia, Morocco, Namibia, Nepal, Nigeria, Pakistan, Papua New Guinea, Peru, Philippines, Russia, Serbia, South Africa, Sri Lanka, Tanzania, Thailand, Tunisia, Turkey, Ukraine, Venezuela, Vietnam and Zambia.[9]

The table shows that the average Gini index for middle-income countries is about 49.7, with the maximum being 85.2. Also, the table reveals that, on average, the respective shares of taxation and government spending in GDP, in middle income countries are 17.9% and 27.3%. Unsurprisingly, the income share held increases as we move along the income distribution from bottom to top. Accordingly, the 90th percentile holds, on average, the highest income share.

[8] Our decision to use of a relatively short time span is justified by the fact that we employ the difference GMM method in implementing our panel VAR model. As noted by Arellano and Bond (1991), the difference GMM technique is suitable for short panels, rather than long ones. Moreover, existing studies that employ the GMM Panel VAR approach use it in analysing short panels, as in the seminal paper of Holtz-Eakin et al. (1988), which employs a dataset covering 7 years (1976–1982). Similarly, the analysis of Love and Zicchino (2006) spans over 11 years (1988-1998).

[9] We employ panel data analysis due to the fact that middle-income countries are relatively comparable vis-à-vis their public spending patterns (see IMF, 1995). Moreover, panel data analysis is chosen over time series data analysis because the latter requires separate regressions for each middle-income country. Hence, the use of panel data is a more efficient way of realising the objectives of this study.

Table (4) Summary Statistics

	Mean	SD	Min	Max
GS	27.339	10.355	5.000	67.000
SPS	4.559	4.991	0.000	26.476
HS	2.172	1.454	0.037	7.951
ES	3.874	2.294	0.079	14.727
Tax	17.913	7.829	4.975	60.946
Gini	49.748	7.889	32.919	85.165
Tenth	1.417	0.603	0.252	2.829
Fiftieth	5.529	1.074	2.568	8.136
Ninetieth	15.458	0.824	11.600	18.923

Source: Authors' own computation. GS denotes government spending, SPS - social protection spending, HS - health spending, ES - education spending, Tax - taxation revenue, Gini - the Gini index, and Tenth, Fiftieth and Ninetieth denote the income shares held by the 10th, 50th and 90th percentiles, respectively.

4 Analysis and Results

4.1 Impulse Response Analysis

To empirically uncover the dynamic behaviour of our panel VAR system, we present graphs of the impulse response functions at the 90% confidence interval (constructed by Monte Carlo simulations). Figure 7 reveals the orthogonalized impulse response of inequality to shocks imposed on the fiscal policy variables. A positive shock to government spending has a negative and almost immediate effect on inequality, with the Gini index reducing by as much as 0.243 percentage points in the first year after the shock. The effect peaks in the second year at 0.315 percentage points and remains statistically significant up until the fifth year. This result is similar to the findings of De Giorgi and Gambetti (2012) who use a VAR model in analysing the effect of public expenditure shocks on consumption distribution within the United States.

Also, a positive shock to government spending is associated with an increase in the income share held by the 10th and 50th percentiles (Figure 8), elevating both income shares one year after impact, (by 0.026 and 0.037 percentage points respectively). In both cases, the effect reaches a climax in the second year, and generally lasts till the fifth year. Meanwhile, a government spending shock has no significant impact on the 90th percentile.

Similarly, after a positive shock to education expenditure, the Gini index decreases by as much as 0.303 percentage points in the first year after the shock. Also, an education spending shock results in an increase in the income shares held by all percentiles under study, with each rising in the year of impact (Figure 8). In most cases, the effect peaks in the second year, lying within a range of 0.032 and 0.194 percentage points. While the shock's impact on the 10th and 90th percentiles vanishes by the third year; the 50th percentile continue to benefit from the shock until the fourth year.

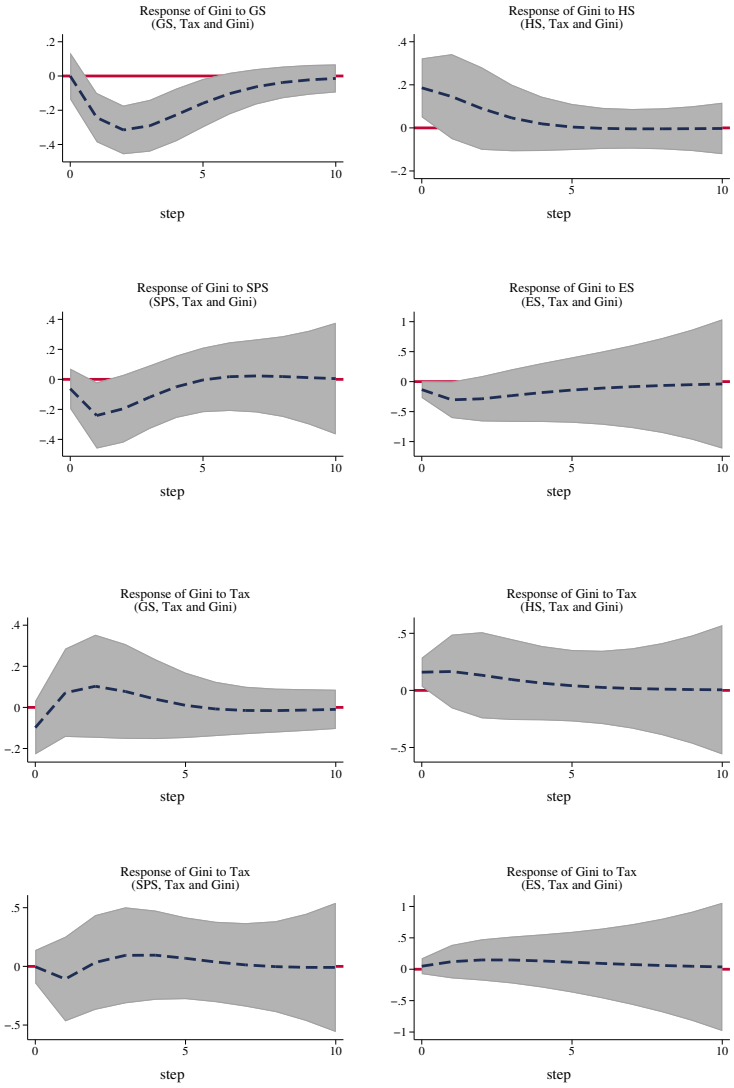
Likewise, the first year after a shock to social protection expenditure sees a drop in inequality by 0.241 percentage points. However, this result should be interpreted with caution as the negative impact is barely significant and short-lived; detected only in the year of the shock. Also, a social protection spending shock exhibits an ambiguous impact on the 10th percentile income share; reducing it on impact but later increasing the income share a year after the shock (Figure 8). Likewise, a shock to social protection spending exhibits a positive and instantaneous

impact on the 90th percentile, making them rise on impact by 0.03 percentage points. The impact however becomes statistically insignificant in subsequent years. Also, we find that a shock to social protection expenditure generally has no statistically significant impact on the 50th percentile.

Similarly, a health expenditure shock does not have a significant effect on income inequality as well as the percentiles representing poor and middle-income groups. Nonetheless, it takes just one year before the 90th percentile income share rises, following a positive health spending shock (Figure 8). The effect remains positive and statistically significant for an additional year before becoming statistically insignificant in the third year.

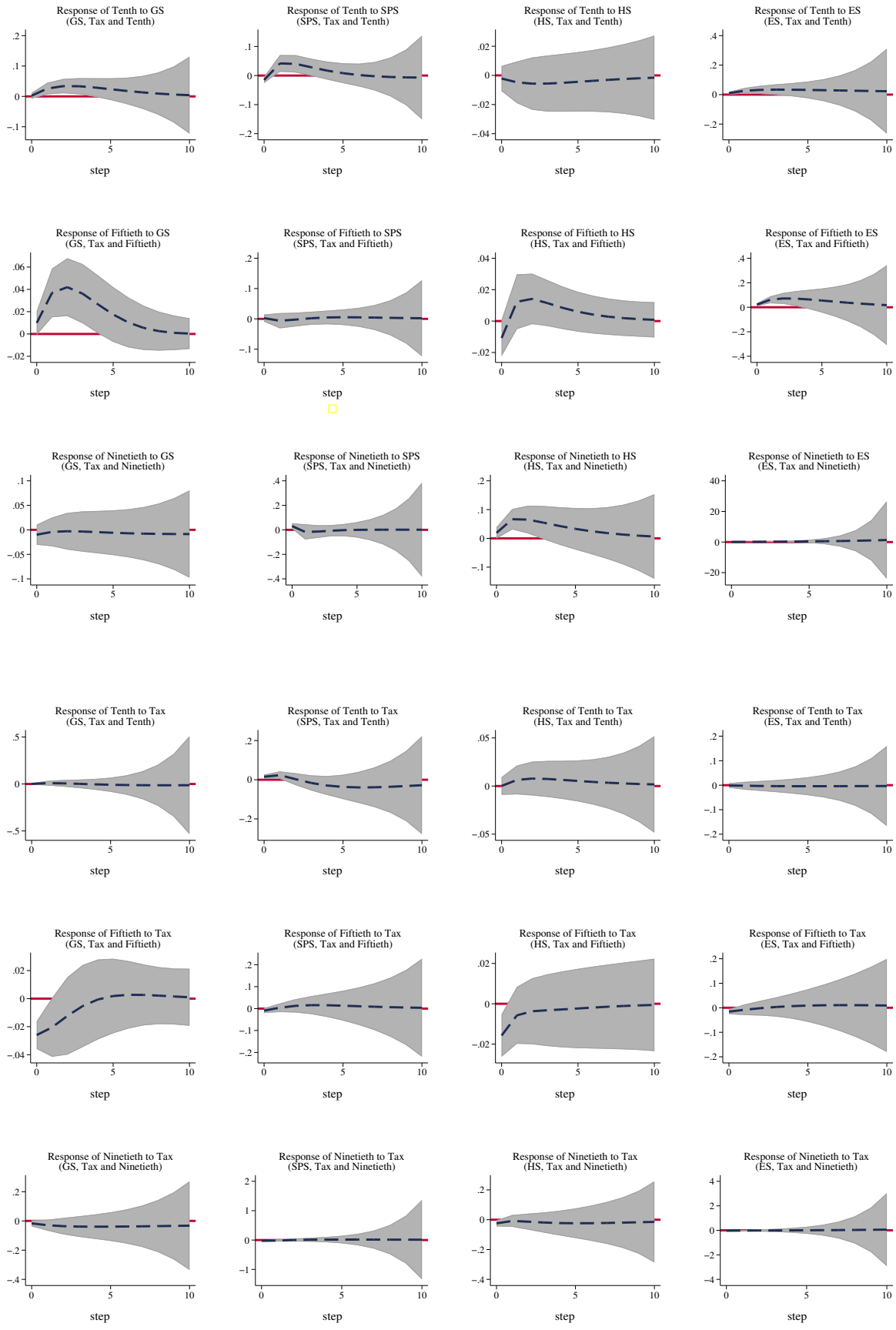
Also, Figure 7 reveals the orthogonalized impulse response of inequality to shocks imposed on tax. An unexpected change in tax largely exhibits no significant impact on inequality. Likewise, a positive shock to tax generally does not benefit the percentiles representing the low-, middle- and high-income groups (Figure 8). In many cases, a tax shock has a negative effect on the percentiles in the year of impact, which often fades away by the third year.

Figure (7) Impulse Responses: Spending and Tax Shocks on the Gini Index



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Figure (8) Impulse Responses: Spending and Tax Shocks on the Tenth, Fiftieth and Ninetieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Table (5) Variance Decomposition: Gini, Tenth, Fiftieth and Ninetieth Percentiles

Gini Index												
Response variable and periods ahead	Impulse variable											
	GS, Tax, and Gini			SPS, Tax, and Gini			HS, Tax, and Gini			ES, Tax, and Gini		
Gini	GS	Tax	Gini	SPS	Tax	Gini	HS	Tax	Gini	ES	Tax	Gini
1	0.000	0.004	0.996	0.001	0.000	0.999	0.012	0.009	0.979	0.006	0.001	0.993
2	0.016	0.004	0.981	0.017	0.003	0.979	0.017	0.016	0.967	0.031	0.005	0.965
3	0.037	0.006	0.957	0.027	0.003	0.970	0.019	0.021	0.960	0.049	0.010	0.941
4	0.055	0.007	0.938	0.030	0.006	0.964	0.020	0.024	0.957	0.060	0.015	0.925
5	0.066	0.007	0.927	0.031	0.008	0.961	0.020	0.025	0.955	0.067	0.019	0.915
Tenth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax, and Tenth			SPS, Tax, and Tenth			HS, Tax, and Tenth			ES, Tax, and Tenth		
Tenth	GS	Tax	Tenth	SPS	Tax	Tenth	HS	Tax	Tenth	ES	Tax	Tenth
1	0.000	0.000	1.000	0.014	0.015	0.971	0.000	0.000	1.000	0.008	0.000	0.992
2	0.035	0.004	0.962	0.087	0.034	0.879	0.002	0.002	0.996	0.045	0.000	0.955
3	0.081	0.005	0.914	0.139	0.031	0.830	0.003	0.005	0.992	0.089	0.001	0.910
4	0.124	0.005	0.871	0.161	0.039	0.800	0.005	0.008	0.987	0.131	0.001	0.868
5	0.154	0.005	0.840	0.164	0.068	0.768	0.006	0.010	0.984	0.166	0.002	0.832
Fiftieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax, and Fiftieth			SPS, Tax, and Fiftieth			HS, Tax, and Fiftieth			ES, Tax, and Fiftieth		
Fiftieth	GS	Tax	Fiftieth	SPS	Tax	Fiftieth	HS	Tax	Fiftieth	ES	Tax	Fiftieth
1	0.006	0.038	0.956	0.000	0.005	0.995	0.007	0.014	0.979	0.025	0.013	0.962
2	0.062	0.046	0.892	0.002	0.004	0.994	0.012	0.013	0.976	0.150	0.011	0.838
3	0.123	0.048	0.830	0.002	0.010	0.988	0.019	0.012	0.969	0.271	0.009	0.719
4	0.164	0.046	0.789	0.002	0.019	0.980	0.024	0.012	0.964	0.358	0.008	0.633
5	0.185	0.045	0.770	0.003	0.027	0.971	0.026	0.012	0.962	0.415	0.008	0.577
Ninetieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax, and Ninetieth			SPS, Tax, and Ninetieth			HS, Tax, and Ninetieth			ES, Tax, and Ninetieth		
Ninetieth	GS	Tax	Ninetieth	SPS	Tax	Ninetieth	HS	Tax	Ninetieth	ES	Tax	Ninetieth
1	0.002	0.005	0.994	0.016	0.012	0.973	0.006	0.010	0.984	0.082	0.013	0.904
2	0.001	0.013	0.986	0.017	0.013	0.970	0.058	0.008	0.934	0.196	0.011	0.793
3	0.001	0.024	0.975	0.019	0.013	0.968	0.097	0.009	0.895	0.323	0.008	0.669
4	0.001	0.037	0.962	0.019	0.015	0.966	0.120	0.012	0.868	0.436	0.005	0.559
5	0.001	0.051	0.948	0.019	0.018	0.963	0.133	0.016	0.850	0.524	0.003	0.473

4.2 Variance Decomposition Analysis

Table 5 provides the forecast error variance decompositions for the panel VAR model with the Gini index as the income distribution variable. From the first to the fifth year, the spending variables increase their influence on the variation in inequality, reaching up to 6.6% and 6.7% after 5 years for government and education spending shocks, respectively, which is the highest effect. The corresponding effects at this 5-year horizon of social protection and health expenditure are about half or third, respectively, of the reported magnitude. Taxes have the weakest influence on the variation in inequality, only 0.8% at the same 5-year horizon in the FEVDs. The inference from these empirical findings is that the fiscal variables, but mostly those on the public expenditure rather than the revenue side, are key drivers of income inequality within middle-income countries.

The variance decompositions for the income percentiles follow a similar pattern as inequality. As seen in Table 5; the fiscal policy variables contribute to the variations in each of the percentiles. Consequently, the results from the variance decompositions lend credence to those from the impulse response functions.

5 Comparison to High-Income Countries

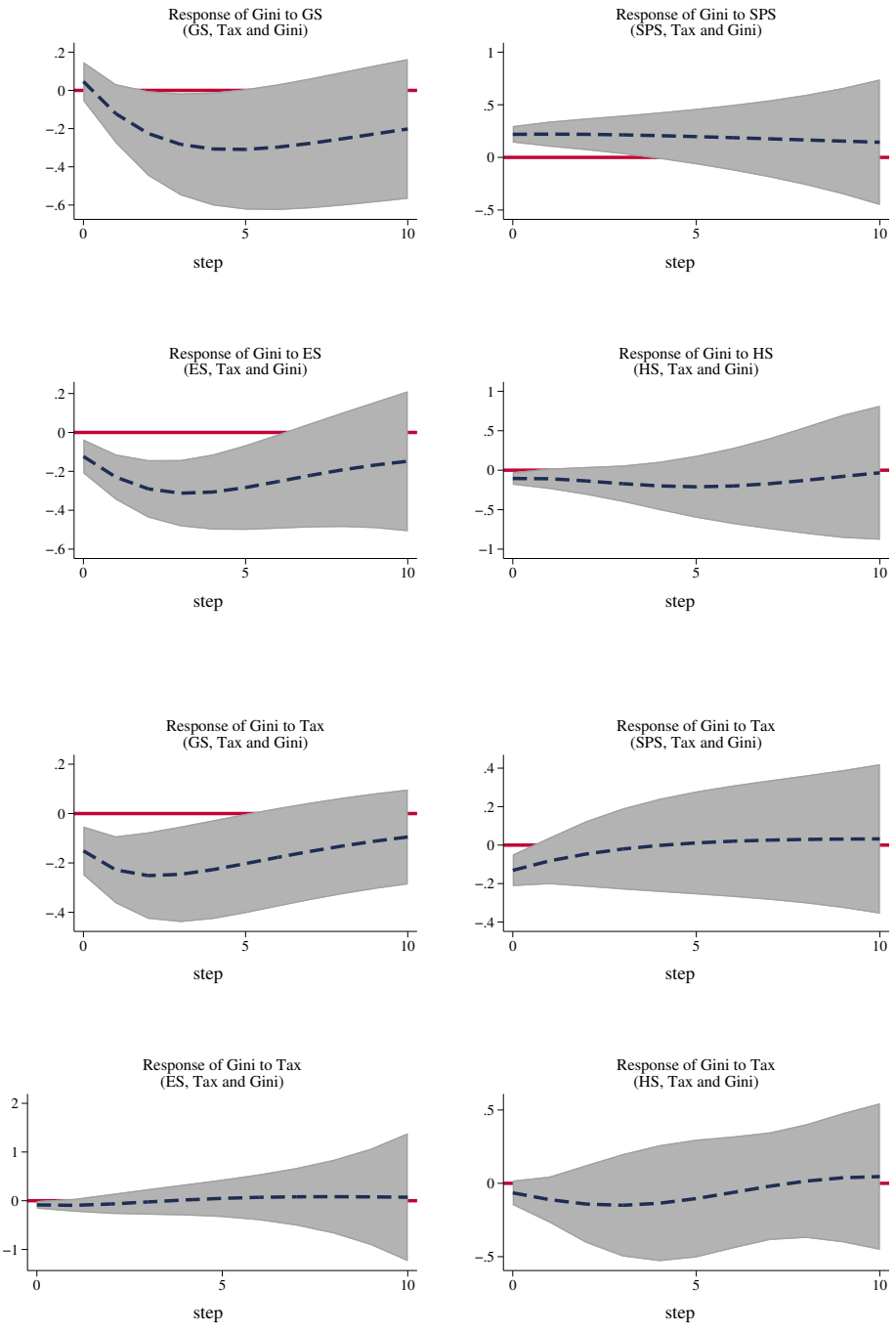
In this section, we examine how the results for middle-income countries compare with high-income countries.[10] The impulse responses, shown in Figure 9, reveal that the Gini index declines within two years of a government spending shock. Likewise, government spending shocks generally benefit the very low-income groups.[11] Following a government spending shock, the income share of the bottom 10th rises two years after and peaks in the fifth year but remains positive until the ninth year (Figure 10). Meanwhile, a positive shock to government spending does not exhibit a significantly positive impact on the other percentiles considered.

Similarly, a shock to education spending is associated with a decrease in inequality by 0.123 percentage points on impact. The effect peaks at 0.312 percentage points in the third year, and persists till the fifth year. Also, education spending shocks generally benefit the low-income group as well as the very high-income group. The shock is associated with an increase in the income share held by the 10th percentile in the year of impact, peaks in the fourth year but lasts till the fifth year. Likewise, a positive education spending shock has no immediate impact on the 90th percentile, but increases it by 0.040 percentage points in the first year after the shock. The effect subsequently becomes statistically insignificant in the third year. The education expenditure shock does not have a significant impact on the 50th percentile.

[10] Here, we consider a panel of 43 high income countries, as classified by the World Bank, over the period 2004-2014. The World Bank classification is based on estimates of gross national income (GNI) per capita in 2021. Countries classified as high income have a minimum GNI per capita of $13,205. Specifically, the high countries considered are: Australia, Austria, Bahamas, Barbados, Belgium, Canada, Chile, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea Rep., Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Seychelles, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States and Uruguay

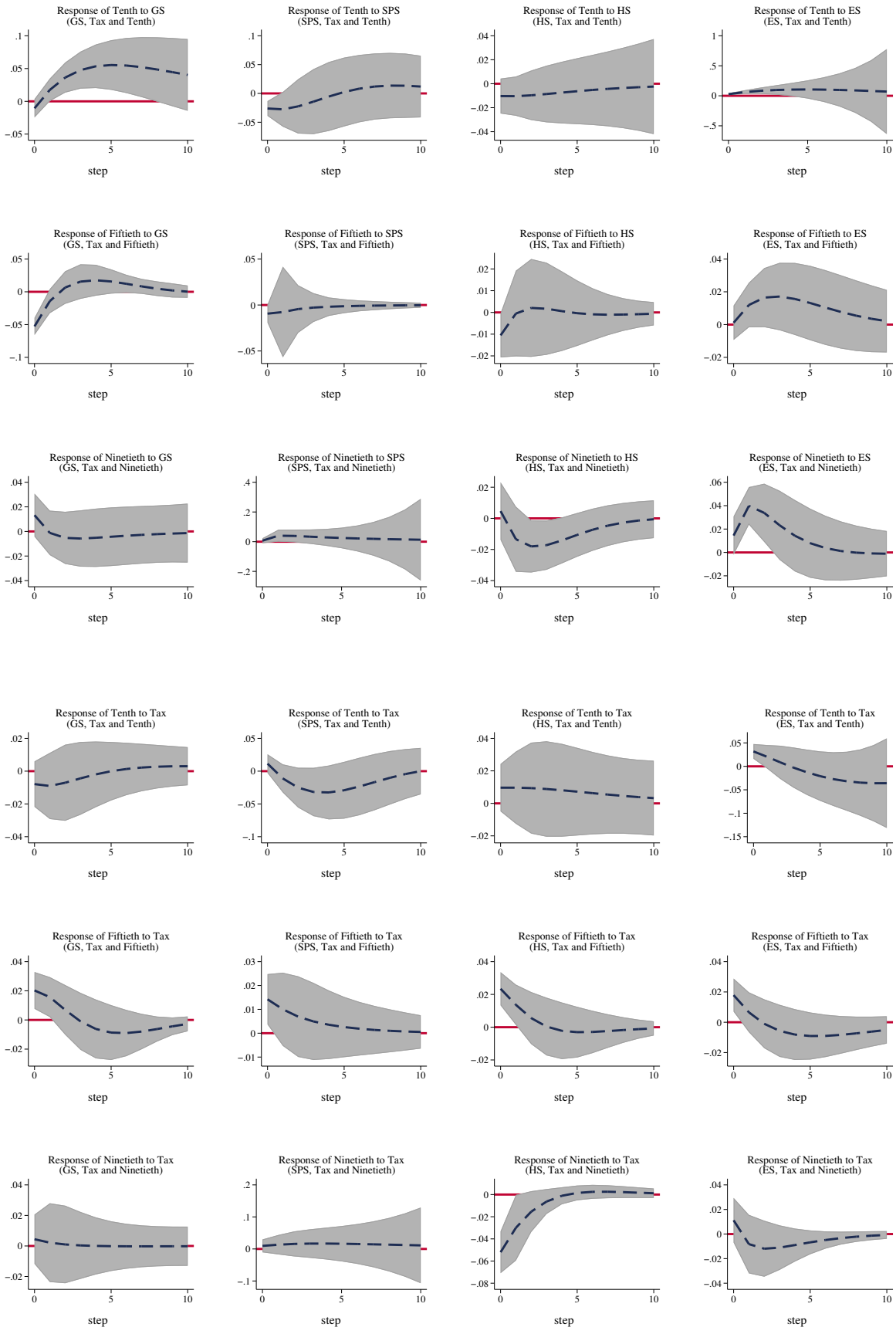
[11] Results in Appendix show that government spending shock also benefit the 80th percentile.

Figure (9) Impulse Responses: Spending and Tax Shocks on the Gini Index



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Figure (10) Impulse Responses: Spending and Tax Shocks on the Tenth, Fiftieth and Ninetieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Table (6) Variance Decomposition: Gini, Tenth, Fiftieth and Ninetieth Percentiles

Gini Index												
Response variable and periods ahead	Impulse variable											
	GS, Tax and Gini			SPS, Tax and Gini			HS, Tax and Gini			ES, Tax and Gini		
Gini	GS	Tax	Gini	SPS	Tax	Gini	HS	Tax	Gini	ES	Tax	Gini
1	0.002	0.017	0.982	0.050	0.018	0.932	0.012	0.005	0.983	0.017	0.008	0.975
2	0.007	0.032	0.961	0.054	0.013	0.932	0.015	0.011	0.974	0.045	0.011	0.945
3	0.021	0.043	0.935	0.058	0.010	0.931	0.022	0.019	0.959	0.076	0.010	0.913
4	0.039	0.052	0.910	0.062	0.009	0.930	0.032	0.027	0.941	0.104	0.009	0.887
5	0.056	0.058	0.887	0.065	0.007	0.928	0.046	0.032	0.922	0.125	0.008	0.868
Tenth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax and Tenth			SPS, Tax and Tenth			HS, Tax and Tenth			ES, Tax and Tenth		
Tenth	GS	Tax	Tenth	SPS	Tax	Tenth	HS	Tax	Tenth	ES	Tax	Tenth
1	0.004	0.002	0.994	0.025	0.005	0.970	0.004	0.003	0.993	0.025	0.034	0.941
2	0.009	0.003	0.988	0.035	0.006	0.959	0.004	0.004	0.992	0.084	0.027	0.889
3	0.029	0.003	0.968	0.040	0.018	0.942	0.005	0.005	0.990	0.154	0.021	0.826
4	0.058	0.003	0.939	0.041	0.036	0.923	0.005	0.005	0.989	0.222	0.016	0.762
5	0.090	0.003	0.907	0.040	0.054	0.906	0.006	0.006	0.989	0.280	0.015	0.705
Fiftieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax and Fiftieth			SPS, Tax and Fiftieth			HS, Tax and Fiftieth			ES, Tax and Fiftieth		
Fiftieth	**GS**	Tax	Fiftieth	SPS	Tax	Fiftieth	HS	Tax	Fiftieth	ES	Tax	Fiftieth
1	0.113	0.017	0.870	0.006	0.015	0.979	0.007	0.037	0.956	0.000	0.021	0.979
2	0.077	0.017	0.906	0.009	0.019	0.972	0.005	0.032	0.963	0.006	0.015	0.979
3	0.067	0.016	0.917	0.010	0.021	0.969	0.004	0.029	0.967	0.014	0.012	0.974
4	0.070	0.015	0.916	0.010	0.023	0.967	0.004	0.027	0.968	0.021	0.012	0.967
5	0.075	0.016	0.909	0.011	0.023	0.966	0.004	0.027	0.969	0.027	0.013	0.961
Ninetieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax and Ninetieth			SPS, Tax and Ninetieth			HS, Tax and Ninetieth			ES, Tax and Ninetieth		
Ninetieth	**GS**	Tax	Ninetieth	SPS	Tax	Ninetieth	HS	Tax	Ninetieth	ES	Tax	Ninetieth
1	0.004	0.000	0.995	0.001	0.002	0.997	0.000	0.056	0.944	0.005	0.003	0.992
2	0.004	0.001	0.996	0.031	0.005	0.964	0.004	0.072	0.923	0.036	0.004	0.960
3	0.004	0.001	0.995	0.053	0.008	0.939	0.010	0.076	0.914	0.057	0.007	0.936
4	0.005	0.001	0.995	0.067	0.012	0.921	0.016	0.076	0.908	0.067	0.009	0.925
5	0.006	0.001	0.994	0.076	0.016	0.908	0.020	0.076	0.904	0.070	0.010	0.920

Source: Author's own computation.

A positive shock to social protection spending neither reduces inequality nor exhibits a significantly positive impact on any of the percentiles considered. In contrast to the results obtained for the middle-income countries, here we find that a positive shock to health spending has a negative and immediate effect on inequality, with the Gini index declining by 0.105 percentage points in the year of the shock. [12]

Now, contrary to the results obtained for middle-income countries, an unexpected rise in taxation largely reduces income inequality. The reduction often occurs in the year of impact and persists for at least one additional year. Interestingly, in the model in which our spending variable is represented by government expenditure, the effect persists till the fifth year. Meanwhile, a shock to taxation benefits the 50th percentile, with the positive effect being often immediate and then fading away by the second year.

The results from the variance decomposition validate those from the impulse responses, showing that the fiscal policy variables we examined contribute significantly to the variations in all the income percentiles considered (see Table 6).

6 Sensitivity Analysis

6.1 Employing Different Measures of Inequality in the Panel VAR

We test the robustness of our results to alternative measures of inequality and to three additional income percentiles.[13] Specifically, we replace the Gini index with the Atkinson inequality measure and the Theil index and also use the 20th, 40th and 80th percentiles, which are alternative proxies for the bottom, middle and top income percentiles previously discussed. This allows us to examine the degree to which our findings potentially depend on the measure of inequality used.[14]

Replacing the Gini coefficient and the income percentiles with these other measures does not change the essence of the results we analyzed as a benchmark specification. Similarly, shocks to government expenditure retain their negative impact on inequality: both the Theil index and the Atkinson inequality measure exhibit negative responses. A positive shock to education spending has a negative and immediate effect on the Theil index and the Atkinson measure of inequality, while a health spending shock, and a positive tax shock, have no statistically significant impact on the Theil index and the Atkinson measure of inequality.

The findings obtained for the 20th, 40th and 80th percentiles generally corroborate the baseline results. Similar to our previous findings, government and education spending shocks tend to benefit the 20th and 40th percentiles, with the 80th percentile benefiting from education spending shocks as well. Also, social protection and health spending shocks exhibit a positive impact on the 80th percentile. Meanwhile, tax shocks generally do not benefit any of the income shares.[15]

6.2 Re-ordering the Variables in the Panel VAR

6.2.1 Inclusion of Taxation Before Government Spending

We re-order our panel VAR by including taxation before the public spending variables. This ordering is based on Wagner's law of government expenditure, which suggests that an increase in tax receipts enhances the government's

[12] As shown in Appendix Figure G4, the health spending shock is associated with a sharp decrease in the share of income held by the 80th percentile, by 0.033 percentage points on impact. The effect reaches a climax in the immediate year after the shock at 0.054 percentage points and persists for four additional years. Health spending shocks do not exhibit a significantly positive impact on the remaining percentiles considered.

[13] The related Tables and Figures with full results are available in the Online Appendix D

[14] For a detailed discussion of the properties of these inequality measures, amongst others, see Cowell (2000). Data on both the Atkinson index and the Theil index are sourced from the Global Consumption and Income Project Database.

[15] We provided in Appendix C, further details regarding the results obtained for the 20th, 40th and 80th percentiles.

capacity to spend on public goods (Wagner, 1890). Moreover, there exist some middle-income countries which on average, have recorded budget surpluses, over time. For example, the IMF World Economic Outlook Database (October 2020 Vintage) reveals that between 2004 and 2014, Azerbaijan recorded, on average, a budget surplus of 5.76%. For some countries, a budget surplus may be necessary to realize some savings to pay off debts or foot the bills of a capital project; as such, taxation revenue is seen as a benchmark, determining how much the government spends annually (ECLAC/UNESCO, 2005).

We find that the ordering of variables has no impact on the panel VAR estimates, although it does affect somewhat the impulse responses and the variance decompositions (Abrigo and Love, 2016). [16] More specifically, the results show that income inequality declines in response to a positive shock to government spending as well as education expenditure. While a government expenditure shock has a positive effect on the percentiles representing the low- and middle-income groups, a shock to education expenditure exhibits a positive effect on all percentiles under study. In most cases, the impact persists for at least two years.

Also, a positive shock to social protection expenditure elevates the income share of the 90th percentile, based on the impulse responses. Likewise, a social protection expenditure shock initially has a negative effect on the 10th percentile, but the shock eventually has a positive influence on the percentile's share of income in the years following the shock. Consistent with earlier results, a positive health spending shock has no significant impact on inequality, but it exhibits a positive effect on the 90th percentile. In general, a positive tax shock does not contribute towards closing the income gap. Also, the income shares generally do not benefit from a tax shock, as shown previously.

Finally, regarding the variance decomposition, the analysis reveals that the fiscal policy variables still contribute to the variations in inequality as well as the income percentiles in a range similar to the benchmark case with the Gini index.

6.2.2 Employing the Reverse of the Baseline Ordering

As is well-known, the results obtained for the impulse responses and variance decompositions in (panel) VARs depend on the ordering of the VAR. For instance, Brooks (2014) recommends the very extreme case of an ordering, which, in our analysis, would correspond to the exact opposite of the one we have used for the baseline. Specifically, the Gini index and government spending are respectively entered as the first and last variables in the panel VAR.[17]

In terms of impulse responses, we find that the inequality impact of government spending and education expenditure is comparable to the baseline results.[18] A shock to social protection spending exhibits a weak and brief negative impact on inequality. As before, a government expenditure shock has a positive effect on the bottom half of the income distribution while a shock to education expenditure exhibits a positive effect on all percentiles considered, with the impact often persisting beyond the second year. Similar to previous findings, a positive health spending shock benefits the top percentiles but has no significant impact on inequality as well as the low and middle-income groups.

Moving on to the distributive effect of tax shocks, we find that an unexpected rise in tax often exhibits a statistically insignificant effect on inequality and, also, across the income distribution. Consistent with the baseline findings, the spending variables, along with tax, contribute to the variations in the income distribution variables.[19]

[16] Our results for the impulse responses are presented in Appendix Figures E1 - E3

[17] As a fallout of the new ordering, the response of inequality to government spending becomes constrained to zero in the first period.

[18] All results are in in Appendix Figures E4 - E6

[19] See detailed results for the variance decomposition in Appendix Tables E1 - E4.

6.3 Inclusion of Inflation in the VAR Model

In this section we include inflation in our VAR model based on the insider-outsider theory which predicts that inflation may exhibit a contemporaneous impact on the Gini index. Specifically, the theory suggests that some workers are granted a pay rise (insiders) during periods of high inflation, while many others are not (outsiders); and this increases income inequality (see, e.g., Fischer, 1993; Braun, 1994; Davtyan, 2017). Similar to Gunasinghe et al. (2020), we assume that inflation is conditioned on the fiscal policy variables and any feedback impact will likely be with a time-lag. While the precise impact of taxation on inflation may be unclear, the literature generally indicates that inflation is conditioned on taxation. For example, Pitchford and Turnovsky (1976) observe that conventional macroeconomic theory predicts that a tax increase could decrease demand thereby lowering inflation. Nonetheless, Smith (1952) suggests a less straightforward outcome, since inflation could also rise as a consequence of tax hikes.

When looking at the impulse responses, we find that Government spending shock still reduces the income gap between the rich and the poor, and also impact positively on the percentiles representing the low- and middle-income groups. Also, an education spending shock continues to benefit all income groups while shocks to social protection and to health spending generally benefits the wealthy, with no detectable effect on the low- and middle-income groups. A tax shock mostly has no significant effect on inequality nor exhibits any positive impact on the percentiles under study. The results for the variance decomposition are comparable to baseline findings.[20]

7 Concluding Discussion

We employed a panel VAR framework estimated by the GMM to assess the distributional effects of government spending and tax shocks within a sample of 56 middle-income countries for the period ranging from 2004 to 2014. We also compared these results to the corresponding ones for a sample of 43 high-income countries for the same period. In particular, we investigated the response of three alternative income distribution variables, namely the Gini index, the Theil index and the Atkinson measure of income inequality, to shocks imposed on three social expenditure components, namely, social protection, health and education expenditures, as well as on government expenditure as a whole and on taxes.

We found that shocks to government and education spending tend to exhibit the most pronounced distributional effects, while social protection shocks often exhibit brief equalizing impacts and health spending shocks generally have no apparent effects on inequality. Moreover, shocks to government and education expenditures positively impact the low- and middle-income groups, but high-income groups benefit from education spending shocks as well. Generally, the impact of the shock on the various income groups remains significant for at least 3 years. Likewise, social protection and health spending shocks often elevate the income share of the wealthy. Meanwhile, an unexpected rise in taxes largely exhibits no significant impact on inequality, and fails to benefit any particular income group. Our findings bear some similarities to those of De Giorgi and Gambetti (2012) and Gunasinghe et al. (2020), who report related estimates on US and Australian data, respectively. Our results were shown to be robust to alternative measures of inequality, different orderings of variables, and the inclusion of inflation.

An additional contribution of this paper was our investigation regarding how results change when the countries under study have higher incomes. For this purpose, we examined how the results for middle-income countries compare with those for high-income ones. Generally, we found that shocks to government and education spending continue to exhibit the most pronounced distributional effects. In contrast to the findings for middle-income countries, however, tax and health spending shocks tend to exhibit a negative, albeit less evident impact on inequality in high-income countries. Meanwhile, social protection shocks have no noticeable inequality reducing

[20] Detailed results are in Appendix F

effects in high-income countries. As discussed previously, government and education spending shocks support the middle-income group in middle-income countries; however, in high-income countries, both types of spending shocks do not benefit the middle–income group, but generally enhance the income shares held by the low- and high-income groups. Again, contrary to the results for middle-income countries, we find that, in high-income countries, tax shocks benefit the low-income group (specifically, the 20th percentile) and the middle-income group, while health spending shocks reduce the income share of the high-income group (specifically, the 80th percentile). Nonetheless, social protection shocks do not exhibit any detectable impact on the income groups.

Taking the empirical results as a guide for macroeconomic policies, the most vital implication of this study for middle-income countries is that unexpected changes in government spending, (such as witnessed during the COVID-19 pandemic) may contribute towards making a dent in income inequality. Nonetheless, the income distribution does not respond homogenously to shocks in the various social expenditures under study – hence, the specific expenditure under consideration matters for the precision of details. Education spending shocks appear to be most effective in achieving better distributional outcomes, while social protection shocks often exhibit negative but short-lived inequality reducing effects; interestingly, the equalizing impacts of health spending shocks are witnessed only in high-income countries.

It is noteworthy that data availability issues posed a constraint to the time-span covered in this paper. Hence, the redistributive impact of the spending shocks over a longer time-frame may be examined in future research as the required data become available. In addition, this paper focused on the social spending sectors, and hence, future extensions could examine the distributional impacts of shocks imposed on other sectoral expenditures. Finally, further theoretical research may aid in better disentangling and interpreting the patterns presented in the data.

References

Abrigo, M. R. and Love, I. (2016), "Estimation of Panel Vector Autoregression in Stata", *The Stata Journal* **16**(3), 778–804.

Afonso, A., Schuknecht, L. and Tanzi, V. (2010), "Income Distribution Determinants and Public Spending Efficiency", *The Journal of Economic Inequality* **8**(3), 367–389.

Akaike, H. (1969), "Fitting Autoregressive Models for Prediction", *Annals of the Institute of Statistical Mathematics* **21**(1), 243–247.

Alavuotunki, K., Haapanen, M. and Pirttilä, J. (2019), "The Effects of the Value-Added Tax on Revenue and Inequality", *The Journal of Development Studies* **55**(4), 490–508.

Anderson, T. W. and Hsiao, C. (1982), "Formulation and Estimation of Dynamic Models Using Panel Data", *Journal of Econometrics* **18**(1), 47–82.

Andrews, D. W. and Lu, B. (2001), "Consistent Model and Moment Selection Procedures for Gmm Estimation With Application to Dynamic Panel Data Models", *Journal of Econometrics* **101**(1), 123–164.

Anyanwu, J. C., Erhijakpor, A. E. and Obi, E. (2016), "Empirical Analysis of The Key Drivers of Income Inequality in West Africa", *African Development Review* **28**(1), 18–38.

Arellano, M. and Bond, S. (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and An Application to Employment Equations", *The Review of Economic Studies* **58**(2), 277–297.

Arellano, M. and Bover, O. (1995), "Another Look at the Instrumental Variable Estimation of Error-Components Models", *Journal of Econometrics* **68**(1), 29–51.

Bastagli, F., Coady, D. and Gupta, S. (2015), "Fiscal Redistribution in Developing Countries: Overview of Policy Issues and Options", *Inequality and fiscal policy* pp. 57–76.

Battistón, D., García-Domench, C. and Gasparini, L. (2014), "Could an Increase in Education Raise Income Inequality?: Evidence for Latin America", *Latin American Journal of Economics* **51**(1), 1–39.

Bergh, A., Mirkina, I. and Nilsson, T. (2020), "Can Social Spending Cushion the Inequality Effect of Globalization?", *Economics & Politics* **32**(1), 104–142.

Blanchard, O. and Perotti, R. (2002), "An Empirical Characterization of The Dynamic Effects of Changes in Government Spending and Taxes on Output", *The Quarterly Journal of economics* **117**(4), 1329–1368.

Blundell, R. and Bond, S. (1998), "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models", *Journal of Econometrics* **87**(1), 115–143.

Brandolini, A. and Smeeding, T. M. (2009), "Income Inequality in Richer and OECD Countries", *The Oxford handbook of economic inequality* pp. 71–100.

Braun, R. A. (1994), "Another Attempt to Quantify the Benefits of Reducing Inflation", *Federal Reserve Bank of Minneapolis Quarterly Review* **18**(4), 17–25.

Brooks, C. (2014), *Introductory Econometrics for Finance*, New York: Cambridge University Press.

Bulow, J., Reinhart, C., Rogoff, K. and Trebesch, C. (2020), "The Debt Pandemic", *Finance & Development* **57**(003).

Castelló, A. and Doménech, R. (2014), "Human Capital and Income Inequality: Some Facts and Some Puzzles", *BBVA Research Working Paper No. 12/28* .

Claus, I., Martinez-Vazquez, J. and Vulovic, V. (2012), "Government Fiscal Policies and Redistribution in Asian Countries", *ADB Working Paper No. 310* .

Clements, B. J., De Mooij, R. A., Gupta, S. and Keen, M. (2015), *Inequality and Fiscal Policy*, Washington, DC: International Monetary Fund.

Coady, D. and Dizioli, A. (2018), "Income Inequality and Education Revisited: Persistence, Endogeneity and Heterogeneity", *Applied Economics* **50**(25), 2747–2761.

Cowell, F. A. (2000), "Measurement of Inequality", *Handbook of income distribution* **1**, 87–166.

Davtyan, K. (2017), "The Distributive Effect of Monetary Policy: The Top One Percent Makes the Difference", *Economic Modelling* **65**, 106–118.

De Giorgi, G. and Gambetti, L. (2012), *The Effects of Government Spending on the Distribution of Consumption*, Mimeo: Stanford and Autonoma de Barcelona.

Demery, L. (2000), "Benefit Incidence: A Practitioner's Guide", *Poverty and Social Development Group Africa Region Working Paper* .

ECLAC/UNESCO (2005), *Investing Better in Order to Invest More. Finance and Management of Education in Latin America and the Caribbean*, Chile: Economic Commission for Latin America and the Caribbean/ Paris, France: The United Nations Educational, Scientific and Cultural Organization.

Fellman, J. (1976), "The Effect of Transformations on Lorenz Curves", *Econometrica* **44**(4), 823.

Ferrara, M. and Tirelli, P. (2017), "Equitable fiscal consolidations", *Economic Modelling* **61**, 207–223.

Fischer, S. (1993), "The Role of Macroeconomic Factors in Growth", *Journal of Monetary Economics* **32**(3), 485–512.

Foster, J., Seth, S. and Lokshin, M. (2013), *A Unified Approach to Measuring Poverty and Inequality: Theory and Practice*, Washington, DC: World Bank.

Furceri, D., Ge, J., Loungani, P. and Melina, G. (2022), "The distributional effects of government spending shocks in developing economies", *Review of Development Economics* **26**(3), 1574–1599.

Gregorio, J. D. and Lee, J.-W. (2002), "Education and Income Inequality: New Evidence From Cross-Country Data", *Review of income and wealth* **48**(3), 395–416.

Gunasinghe, C., Selvanathan, E., Naranpanawa, A. and Forster, J. (2020), "The Impact of Fiscal Shocks on Real GDP And Income Inequality: What Do Australian Data Say?", *Journal of Policy Modeling* **42**(2), 250–270.

Guzi, M. and Kahanec, M. (2019), "Income Inequality and the Size of Government: A Causal Analysis", *IZA Discussion Paper No. 12015* .

Hamilton, J. D. (2020), *Time Series Analysis*, Princeton, NJ: Princeton University Press.

Hannan, E. J. and Quinn, B. G. (1979), "The Determination of the Order of an Autoregression", *Journal of the Royal Statistical Society: Series B (Methodological)* **41**(2), 190–195.

Holtz-Eakin, D., Newey, W. and Rosen, H. S. (1988), "Estimating Vector Autoregressions With Panel Data", *Econometrica: Journal of the Econometric Society* pp. 1371–1395.

Howie, P. and Atakhanova, Z. (2014), "Resource Boom and Inequality: Kazakhstan as a Case Study", *Resources Policy* **39**, 71–79.

IMF (1995), *Unproductive Public Expenditures: A Pragmatic Approach to Policy Analysis*, Washington, DC: International Monetary Fund.

IMF (2014), *Paraguay: Selected Issues*, Washington, DC: International Monetary Fund.

Jakobsson, U. (1976), "On the Measurement of the Degree of Progression", *Journal of Public Economics* **5**(1-2), 161–168.

Joumard, I., Pisu, M. and Bloch, D. (2012), "Less Income Inequality and More Growth–Are They Compatible? Part 3. Income Redistribution via Taxes and Transfers Across OECD Countries".

Kabashi, R. (2015), Cyclicality, Determinants and Macroeconomic Effects of Fiscal Policy in European Countries, With Particular Reference to Transition Countries, PhD thesis, Staffordshire University.

Kaplan, G., Moll, B. and Violante, G. L. (2018), "Monetary Policy According to HANK", *American Economic Review* **108**(3), 697–743.

Kilian, L. and Kim, Y. J. (2009), "Do local projections solve the bias problem in impulse response inference?".

Levin, A., Lin, C.-F. and Chu, C.-S. J. (2002), "Unit Root Tests in Panel Data: Asymptotic And Finite-Sample Properties", *Journal of Econometrics* **108**(1), 1–24.

Love, I. and Zicchino, L. (2006), "Financial Development and Dynamic Investment Behavior: Evidence From Panel VAR", *The Quarterly Review of Economics and Finance* **46**(2), 190–210.

Lustig, N. (2016), Fiscal Policy, Income Redistribution and Poverty Reduction in Low- and Middle-Income Countries, *in* N. Lustig, ed., "Commitment to Equity Handbook. A Guide to Estimating the Impact of Fiscal Policy on Inequality and Poverty", New Orleans, Louisiana: Tulane University., pp. 461–503.

Lütkepohl, H. (2005), *New Introduction to Multiple Time Series Analysis*, Heidelberg: Springer.

Martinez, V. J., Moreno-Dodson, B. and Vulovic, V. (2012), "The Impact of Tax and Expenditure Policies on Income Distribution: Evidence From a Large Panel of Countries", *Andrew Young School of Policy Studies Research Paper Series* (12-30).

Mihailov, A. (2009), "Exchange Rate Pass-Through to Prices in Macrodata: A Comparative Sensitivity Analysis", *International Journal of Finance & Economics* **14**(4), 346–377.

Muinelo-Gallo, L. and Roca-Sagalés, O. (2011), "Economic Growth and Inequality: The Role of Fiscal Policies", *Australian Economic Papers* **50**(2-3), 74–97.

Narayan, P. K. and Narayan, S. (2006), "Government Revenue and Government Expenditure Nexus: Evidence From Developing Countries", *Applied Economics* **38**(3), 285–291.

Nickell, S. (1981), "Biases in Dynamic Models With Fixed Effects", *Econometrica: Journal of the Econometric Society* pp. 1417–1426.

Ospina, M. (2010), "The Effect of Social Spending on Income Inequality: An Analysis for Latin American Countries", *Center for Research in Economics and Finance Working Paper No. 10-03.* .

Oxfam/DFI (2017), *The Commitment to Reducing Inequality Index: A New Global Ranking of Governments Based on What They Are Doing to Tackle the Gap Between Rich and Poor*, Nairobi: Oxfam/Washington, DC: Development Finance International.

Paulus, A., Sutherland, H. and Tsakloglou, P. (2010), "The Distributional Impact of In-Kind Public Benefits in European Countries", *Journal of Policy Analysis and Management* **29**(2), 243–266.

Pitchford, J. and Turnovsky, S. J. (1976), "Some Effects of Taxes on Inflation", *The Quarterly Journal of Economics* **90**(4), 523–539.

Ramos, X. and Roca-Sagales, O. (2008), "Long-Term Effects of Fiscal Policy on the Size and Distribution of the Pie in the UK", *Fiscal Studies* **29**(3), 387–411.

Roodman, D. (2009), "How to Do Xtabond2: An Introduction to Difference and System Gmm in Stata", *The Stata Journal* **9**(1), 86–136.

Rudra, N. (2004), "Openness, Welfare Spending, and Inequality in the Developing World", *International Studies Quarterly* **48**(3), 683–709.

Sauer, P., Rao, N. D. and Pachauri, S. (2020), "Explaining Income Inequality Trends: An Integrated Approach", *WIDER Working Paper No. 2020/65* .

Saxegaard, M. (2014), *Safe Debt and Uncertainty in Emerging Markets: An Application to South Africa*, Washington, DC: International Monetary Fund.

Schwarz, G. (1978), "Estimating the Dimension of a Model", *The Annals of Statistics* pp. 461–464.

Seidl, H. and Seyrich, F. (2021), *Unconventional Fiscal Policy in HANK*, DIW Berlin Discussion Paper.

Smets, F. and Wouters, R. (2003), "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area", *Journal of the European economic association* **1**(5), 1123–1175.

Smith, D. T. (1952), "Note on Inflationary Consequences of High Taxation", *The Review of Economics and Statistics* **34**(3), 243–247.

Van de Walle, D. (1995), "Incidence and Targeting: An Overview of Implications for Research and Policy".

Wagner, A. (1890), *Finanzwissenschaft*, Leipzig.

WEO (2021), *IMF World Economic Outlook Database: October 2021*, Washington, DC: International Monetary Fund.

Windmeijer, F. (2005), "A Finite Sample Correction for the Variance of Linear Efficient Two-Step Gmm Estimators", *Journal of Econometrics* **126**(1), 25–51.

Woo, J., Bova, E., Kinda, T. and Sophia Zhang, Y. (2017), "Distributional Consequences of Fiscal Adjustments: What Do the Data Say?", *IMF Economic Review* **65**(2), 273–307.

Supplementary Appendix
(for online publication)

Distributional Effects of Public Spending and Tax Shocks in Middle-Income Countries: A Panel VAR Approach

Abdulaleem Isiaka Alexander Mihailov Giovanni Razzu

August 2022

Appendix A. Additional Technical Information

In arriving at equation (1), we begin with the structural VAR models in equations (6) to (8) below:

$$GS_{it} = \beta_{10} + \beta_{12}Tax_{it} + \beta_{13}Gini_{it} + \gamma_{11}GS_{it-1} + \gamma_{12}Tax_{it-1} + \gamma_{13}Gini_{it-1} + U_{GSit} \tag{6}$$
$$Tax_{it} = \beta_{20} + \beta_{22}GS_{it} + \beta_{23}Gini_{it} + \gamma_{21}GS_{it-1} + \gamma_{22}Tax_{it-1} + \gamma_{23}Gini_{it-1} + U_{Taxit} \tag{7}$$
$$Gini_{it} = \beta_{30} + \beta_{32}GS_{it} + \beta_{33}Tax_{it} + \gamma_{31}GS_{it-1} + \gamma_{32}Tax_{it-1} + \gamma_{33}Gini_{it-1} + U_{Giniit} \tag{8}$$

Equations (6) to (8) represent the structural VAR equations. The reverse-causality/contemporaneous feedback in the structural VAR models above results in endogeneity bias; and as such we transform the structural VAR in order to eliminate the feedback. For this purpose, we move the contemporaneous variables in equations (6) to (8) to the left-hand side of each equation and thus obtain equations (9) to (11) below:

$$GS_{it} - \beta_{12}Tax_{it} - \beta_{13}Gini_{it} = \beta_{10} + \gamma_{11}GS_{it-1} + \gamma_{12}Tax_{it-1} + \gamma_{13}Gini_{it-1} + U_{GSit} \tag{9}$$
$$-\beta_{22}GS_{it} + Tax_{it} - \beta_{23}Gini_{it} = \beta_{20} + \gamma_{21}GS_{it-1} + \gamma_{22}Tax_{it-1} + \gamma_{23}Gini_{it-1} + U_{Taxit} \tag{10}$$
$$-\beta_{32}GS_{it} - \beta_{33}Tax_{it} + Gini_{it} = \beta_{30} + \gamma_{31}GS_{it-1} + \gamma_{32}Tax_{it-1} + \gamma_{33}Gini_{it-1} + U_{Giniit} \tag{11}$$

Using matrices, equations (9) to (11) can be denoted as:

$$\begin{pmatrix} 1 & -\beta_{12} & -\beta_{13} \\ -\beta_{22} & 1 & -\beta_{23} \\ -\beta_{32} & -\beta_{33} & 1 \end{pmatrix} \begin{pmatrix} GS_{it} \\ Tax_{it} \\ Gini_{it} \end{pmatrix} = \begin{pmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \end{pmatrix} + \begin{pmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} \end{pmatrix} \begin{pmatrix} GS_{it-1} \\ Tax_{it-1} \\ Gini_{it-1} \end{pmatrix} + \begin{pmatrix} U_{GSit} \\ U_{Taxit} \\ U_{Giniit} \end{pmatrix} \tag{12}$$

and with matrix algebra, equation (12) can be simplified as:

$$BY_{it} = \Gamma_0 + \Gamma_1 Y_{t-1} + U_t \tag{13}$$

$$where\ \ B = \begin{pmatrix} 1 & -\beta_{12} & -\beta_{13} \\ -\beta_{22} & 1 & -\beta_{23} \\ -\beta_{32} & -\beta_{33} & 1 \end{pmatrix}, Y_{it} = \begin{pmatrix} GS_{it} \\ Tax_{it} \\ Gini_{it} \end{pmatrix}, \Gamma_0 = \begin{pmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \end{pmatrix}, \Gamma_1 = \begin{pmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} \end{pmatrix}, U_t = \begin{pmatrix} U_{GSit} \\ U_{Taxit} \\ U_{Giniit} \end{pmatrix} \tag{14}$$

To solve for Y_{it} in equation (13) above, we multiply both sides by B^{-1}, and this gives:

$$Y_{it} = A_0 + A_1 Y_{it-1} + e_{it} \tag{15}$$
$$where\ \ A_0 = B^{-1}\Gamma_0, A_1 = B^{-1}\Gamma_1\ and\ e_{it} = B^{-1}U_t \tag{16}$$

Equation (15) can be further simplified as follows:

$$GS_{it} = \alpha_{10} + \alpha_{11}GS_{it-1} + \alpha_{12}Tax_{it-1} + \alpha_{13}Gini_{it-1} + e_{GSit} \tag{17}$$
$$Tax_{it} = \alpha_{20} + \alpha_{21}GS_{it-1} + \alpha_{22}Tax_{it-1} + \alpha_{23}Gini_{it-1} + e_{Taxit} \tag{18}$$
$$Gini_{it} = \alpha_{30} + \alpha_{31}GS_{it-1} + \alpha_{32}Tax_{it-1} + \alpha_{33}Gini_{it-1} + e_{Giniit} \tag{19}$$

It is noteworthy that we do not report the constant term in our results for brevity. Also, in each equation, we account for the country and time fixed effects by including country and time specific dummies (denoted as μ_i and θ_t respectively in our baseline equation).

Appendix B. Panel Unit Root and Stability Tests

As part of our analysis, we conduct unit root tests. As observed by Blundell and Bond (1998), the instruments employed by the GMM estimator tend to be weak if the variables being modelled suffer from unit root. We thus conduct the Levin-Lin-Chu test (Levin et al., 2002). The null hypothesis of the test assumes the panels contain unit roots. We do not employ Fisher-type tests (i.e., Augmented Dickey-Fuller and Phillips-Perron tests) since they are designed for panels with long time-spans, whereas we utilize a short panel of ten years from 2004 to 2014 in our present research. Our test results below suggest that we can reject the null hypothesis of unit root for all the variables.

Table (B1) Panel VAR Results: Gini Index

	Levin-Lin-Chu test	
	Adjusted t*	p-value
GS	-4.956	0.000
Tax	-8.050	0.000
SPS	-1.795	0.036
HS	-12.723	0.000
ES	-6.309	0.000
Inflation	-9.628	0.000
Gini	-14.099	0.000
Tenth	-9.151	0.000
Twentieth	-7.764	0.000
Fortieth	-8.402	0.000
Fiftieth	-15.658	0.000
Eightieth	-10.890	0.000
Ninetieth	-8.948	0.000
Theil	-12.146	0.000
Atkinson	-7.070	0.000
	H0: Panels contain unit roots Ha: Panels are stationary	

Likewise, we evaluate the stability condition of our panel VAR model. As noted by Lütkepohl (2005) and Hamilton (2020) , all the moduli of the companion matrix have to be less than one for the fitted VAR model to be considered stable. Graphically, this implies that the roots of the companion matrix must lie within the unit circle. When a panel VAR model is not stable, no known interpretation can be given to its impulse response functions and variance decompositions.

Appendix C. Baseline Results

Table (C1) Panel VAR Results: Gini Index

Regressors	Regressands											
	GS, Tax and Gini			SPS, Tax and Gini			HS, Tax and Gini			ES, Tax and Gini		
	GS	Tax	Gini	SPS	Tax	Gini	HS	Tax	Gini	ES	Tax	Gini
L.GS	0.565***	-0.127**	-0.100***									
	(0.080)	(0.051)	(0.029)									
L.SPS				0.188	0.413	-0.187*						
				(0.224)	(0.560)	(0.112)						
L.HS							0.555***	-0.281	0.051			
							(0.142)	(0.754)	(0.163)			
L.ES										0.450**	-0.761	-0.384
										(0.177)	(0.775)	(0.277)
L.Tax	0.151	0.641***	0.065	-0.172***	0.539**	-0.024	-0.018	0.786***	0.026	-0.033	0.637**	0.052
	(0.147)	(0.123)	(0.058)	(0.066)	(0.229)	(0.053)	(0.021)	(0.197)	(0.049)	(0.051)	(0.248)	(0.081)
L.Gini	0.008	-0.663***	0.625***	0.138	-2.200***	0.480***	-0.158***	-2.014***	0.396***	-0.064	-0.011	0.518***
	(0.221)	(0.159)	(0.122)	(0.104)	(0.353)	(0.125)	(0.045)	(0.330)	(0.121)	(0.112)	(0.326)	(0.198)
Observations	437	437	437	387	387	387	404	404	404	404	404	404
Countries	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (C2) Panel VAR Results: Tenth Percentile

Regressors	Regressands											
	GS, Tax and Tenth			SPS, Tax and Tenth			HS, Tax and Tenth			ES, Tax and Tenth		
	GS	Tax	Tenth	SPS	Tax	Tenth	HS	Tax	Tenth	ES	Tax	Tenth
L.GS	0.800***	-0.172**	0.008**									
	(0.161)	(0.083)	(0.004)									
L.SPS				0.235	0.356	0.041***						
				(0.228)	(0.386)	(0.014)						
L.HS							0.651***	-0.288	-0.005			
							(0.155)	(0.333)	(0.014)			
L.ES										0.779***	-0.753	0.029*
										(0.271)	(0.513)	(0.017)
L.Tax	-0.293	0.749***	0.004	-0.289***	1.056***	0.007	-0.077***	0.539***	0.003	-0.017	0.567***	-0.001
	(0.279)	(0.225)	(0.007)	(0.076)	(0.198)	(0.005)	(0.024)	(0.177)	(0.005)	(0.081)	(0.156)	(0.005)
L.Tenth	-10.736	4.851	0.642***	0.020	2.417	0.538***	-0.244	1.838	0.589***	1.240	-0.004	0.602***
	(7.091)	(3.233)	(0.193)	(1.761)	(3.173)	(0.143)	(0.619)	(2.123)	(0.132)	(1.821)	(3.239)	(0.133)
Observations	437	437	437	387	387	387	404	404	404	404	404	404
Countries	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (C3) Panel VAR Results: Fiftieth Percentile

Regressors	Regressands											
	GS, Tax and Fiftieth			SPS, Tax and Fiftieth			HS, Tax and Fiftieth			ES, Tax and Fiftieth		
	GS	Tax	Fiftieth	SPS	Tax	Fiftieth	HS	Tax	Fiftieth	ES	Tax	Fiftieth
L.GS	0.691***	-0.199**	0.011**									
	(0.114)	(0.093)	(0.005)									
L.SPS				0.166	0.809	-0.005						
				(0.255)	(0.507)	(0.013)						
L.HS							0.454***	0.036	0.033*			
							(0.136)	(0.323)	(0.018)			
L.ES										0.795***	-0.536	0.072***
										(0.221)	(0.491)	(0.025)
L.Tax	0.067	0.699***	-0.004	-0.154**	0.892***	0.004	-0.026	0.611***	0.001	0.019	0.801***	0.000
	(0.215)	(0.171)	(0.006)	(0.077)	(0.243)	(0.005)	(0.026)	(0.183)	(0.005)	(0.055)	(0.155)	(0.007)
L.Fiftieth	-2.702	7.952***	0.502***	1.181	0.659	0.608***	1.133*	4.633*	0.522**	0.224	-0.756	0.541***
	(3.464)	(2.720)	(0.156)	(1.539)	(3.806)	(0.199)	(0.635)	(2.732)	(0.204)	(1.020)	(2.463)	(0.180)
Observations	437	437	437	387	387	387	404	404	404	404	404	404
Countries	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (C4) Panel VAR Results: Ninetieth Percentile

Regressors	Regressands											
	GS, Tax and Ninetieth			SPS, Tax and Ninetieth			HS, Tax and Ninetieth			ES, Tax and Ninetieth		
	GS	Tax	Ninetieth	SPS	Tax	Ninetieth	HS	Tax	Ninetieth	ES	Tax	Ninetieth
L.GS	0.588***	-0.011	0.003									
	(0.074)	(0.050)	(0.006)									
L.SPS				0.113	0.439	-0.024						
				(0.224)	(0.602)	(0.028)						
L.HS							0.511***	-0.225	0.101***			
							(0.142)	(0.559)	(0.037)			
L.ES										1.044***	-0.839	0.093**
										(0.170)	(0.591)	(0.040)
L.Tax	0.234	0.997***	-0.009	-0.252***	1.048***	-0.002	-0.055**	0.775***	0.002	0.027	0.798***	0.001
	(0.181)	(0.165)	(0.010)	(0.058)	(0.192)	(0.010)	(0.024)	(0.234)	(0.011)	(0.044)	(0.191)	(0.012)
L.Ninetieth	-1.108	1.347	0.649***	-0.174	1.478	0.453***	0.520***	1.639	0.526***	1.318**	0.658	0.774***
	(1.311)	(0.861)	(0.170)	(0.522)	(2.214)	(0.117)	(0.163)	(1.541)	(0.192)	(0.547)	(1.438)	(0.203)
Observations	437	437	437	387	387	387	404	404	404	404	404	404
Countries	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (C5) Panel VAR Results: Twentieth Percentile

Regressors	Regressands											
	GS, Tax and Twentieth			SPS, Tax and Twentieth			HS, Tax and Twentieth			ES, Tax and Twentieth		
	GS	Tax	Twentieth	SPS	Tax	Twentieth	HS	Tax	Twentieth	ES	Tax	Twentieth
L.GS	0.714***	-0.254**	0.013***									
	(0.136)	(0.112)	(0.003)									
L.Tax	0.034	0.936***	-0.002	-0.157**	0.901***	0.002	-0.049	0.623***	0.002	-0.019	0.733***	-0.001
	(0.225)	(0.231)	(0.007)	(0.075)	(0.213)	(0.006)	(0.031)	(0.178)	(0.005)	(0.067)	(0.154)	(0.006)
L.SPS				0.049	0.694	0.023*						
				(0.251)	(0.461)	(0.013)						
L.HS							0.559***	-0.163	0.005			
							(0.149)	(0.338)	(0.015)			
L.ES										0.684***	-0.964**	0.041*
										(0.235)	(0.476)	(0.021)
L.Twentieth	-5.073	8.236**	0.485***	3.509*	1.193	0.561***	0.524	1.363	0.753***	1.139	-0.192	0.632***
	(4.888)	(3.753)	(0.141)	(1.852)	(3.798)	(0.198)	(0.807)	(3.363)	(0.167)	(1.350)	(2.629)	(0.160)
Observations	437	437	437	387	387	387	404	404	404	404	404	404
Countries	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (C6) Panel VAR Results: Fortieth Percentile

Regressors	Regressands											
	GS, Tax and Fortieth			SPS, Tax and Fortieth			HS, Tax and Fortieth			ES, Tax and Fortieth		
	GS	Tax	Fortieth	SPS	Tax	Fortieth	HS	Tax	Fortieth	ES	Tax	Fortieth
L.GS	0.737***	-0.221**	0.013***									
	(0.124)	(0.099)	(0.005)									
L.SPS				0.325	0.489	0.007						
				(0.201)	(0.507)	(0.010)						
L.HS							0.516***	0.052	0.014			
							(0.129)	(0.304)	(0.015)			
L.ES										0.724***	-0.595	0.061**
										(0.219)	(0.475)	(0.024)
L.Tax	0.025	0.720***	-0.004	-0.196***	0.867***	0.006	-0.018	0.629***	0.002	0.011	0.775***	-0.001
	(0.216)	(0.172)	(0.006)	(0.059)	(0.154)	(0.005)	(0.026)	(0.151)	(0.004)	(0.056)	(0.153)	(0.007)
L.Fortieth	-3.976	8.605***	0.503***	1.964	-1.344	0.692***	1.082*	-0.014	0.517**	0.636	-1.378	0.573***
	(3.904)	(3.019)	(0.160)	(1.625)	(3.688)	(0.142)	(0.650)	(3.079)	(0.206)	(1.096)	(2.586)	(0.178)
Observations	437	437	437	387	387	387	404	404	404	404	404	404
Countries	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (C7) Panel VAR Results: Eightieth Percentile

Regressors	Regressands											
	GS, Tax and Eightieth			SPS, Tax and Eightieth			HS, Tax and Eightieth			ES, Tax and Eightieth		
	GS	Tax	Eightieth	SPS	Tax	Eightieth	HS	Tax	Eightieth	ES	Tax	Eightieth
L.GS	0.586***	-0.023	0.002									
	(0.080)	(0.057)	(0.004)									
L.SPS				0.003	0.907	-0.027						
				(0.296)	(0.648)	(0.026)						
L.HS							0.479***	-0.397	0.059**			
							(0.145)	(0.514)	(0.025)			
L.ES										0.755***	-0.739	0.073***
										(0.195)	(0.538)	(0.027)
L.Tax	0.241	0.871***	-0.007	-0.232**	0.929***	0.002	-0.033	0.705***	-0.003	-0.027	0.725***	-0.005
	(0.205)	(0.184)	(0.007)	(0.095)	(0.282)	(0.009)	(0.023)	(0.235)	(0.007)	(0.052)	(0.173)	(0.009)
L.Eightieth	-0.517	2.167*	0.669***	-1.081	1.003	0.468***	0.791**	5.557**	0.475***	0.454	0.238	0.681***
	(2.115)	(1.296)	(0.172)	(1.023)	(3.681)	(0.152)	(0.311)	(2.351)	(0.183)	(0.758)	(1.424)	(0.217)
Observations	437	437	437	387	387	387	404	404	404	404	404	404
Countries	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Figure (C1) Stability Condition: Gini Index

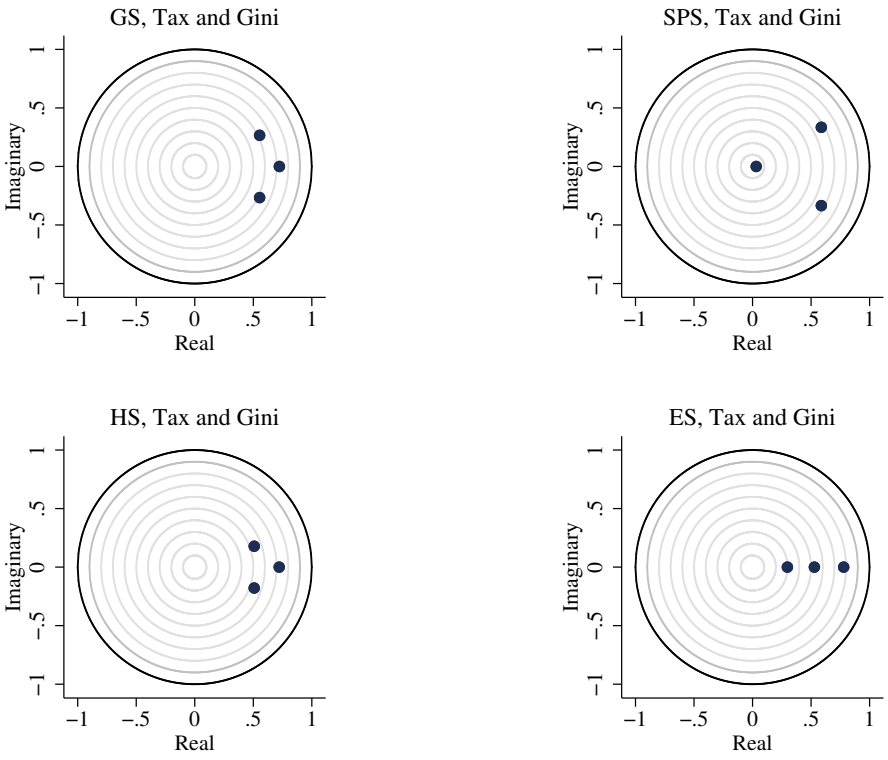


Figure (C2) Stability Condition: Tenth, Fiftieth and Ninetieth Percentiles

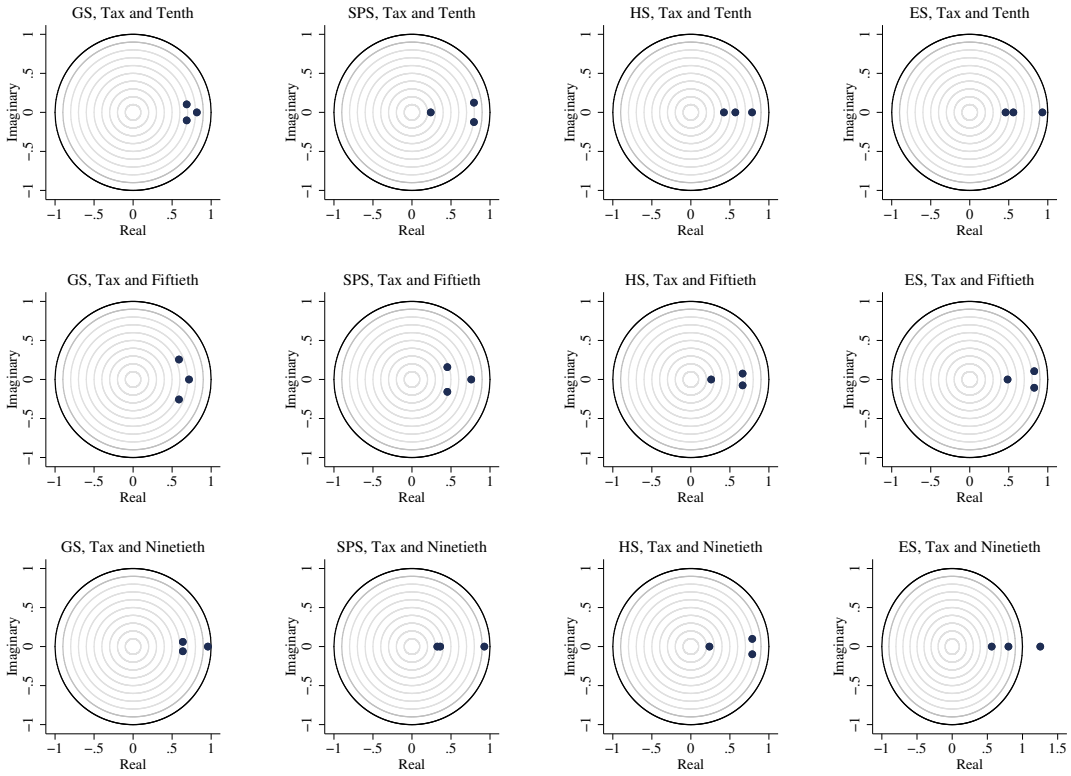


Figure (C3) Stability Condition: Twentieth, Fortieth and Eightieth Percentiles

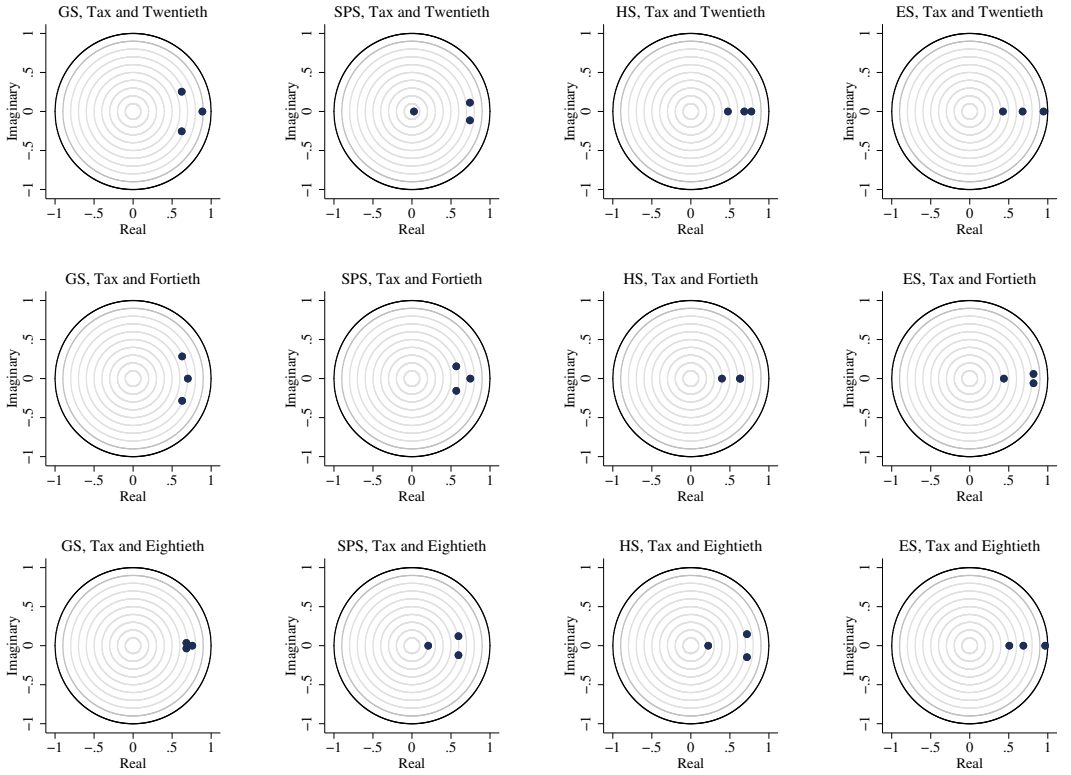
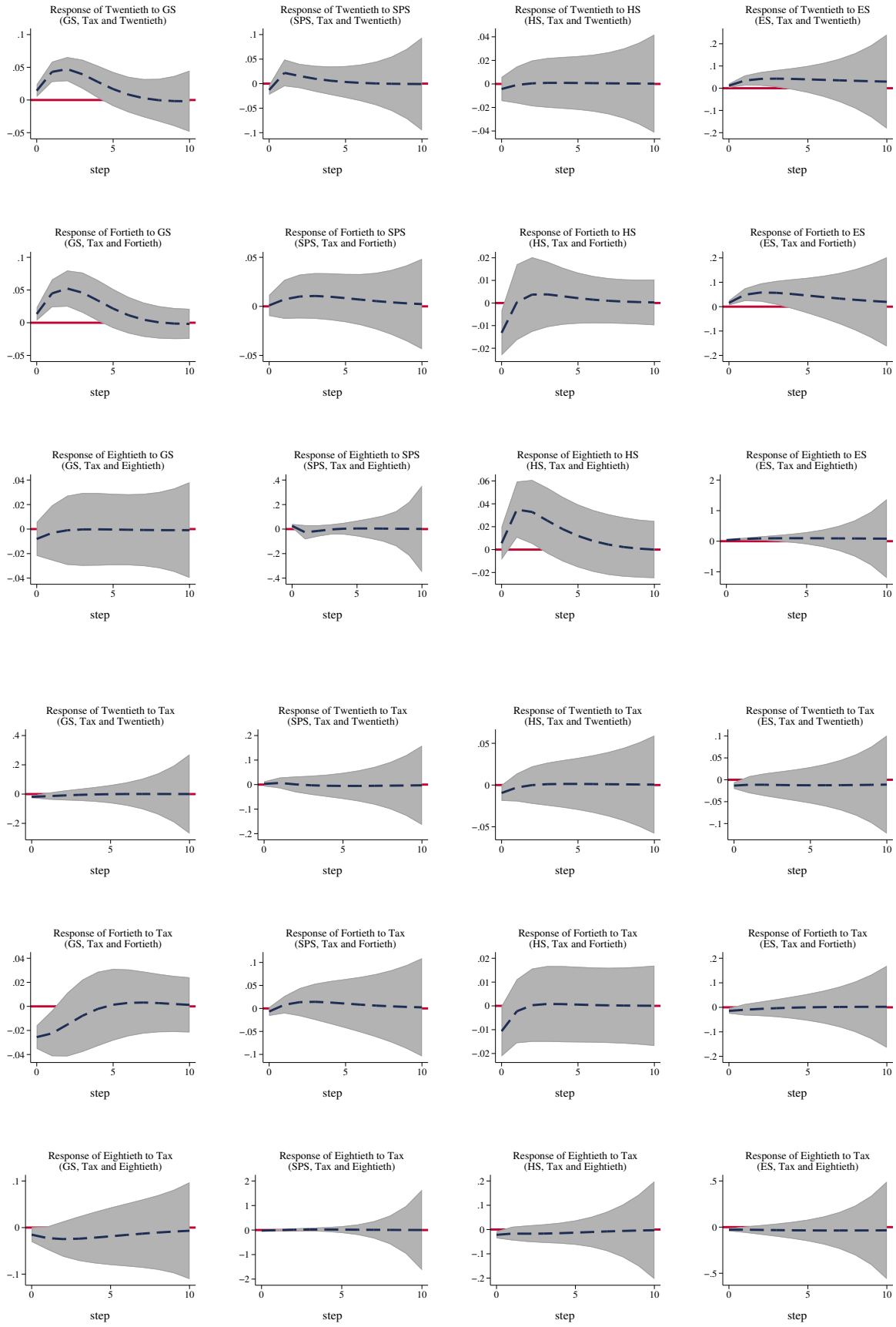


Figure (C4) Impulse Responses: Spending and Tax Shocks on the Twentieth, Fortieth and Eightieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Table (C8) Variance Decomposition: Twentieth, Fortieth and Eightieth Percentiles

Twentieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax, and Twentieth			SPS, Tax, and Twentieth			HS, Tax, and Twentieth			ES, Tax, and Twentieth		
Twentieth	GS	Tax	Twentieth	SPS	Tax	Twentieth	HS	Tax	Twentieth	ES	Tax	Twentieth
1	0.015	0.026	0.959	0.012	0.001	0.987	0.001	0.007	0.991	0.011	0.014	0.975
2	0.111	0.030	0.859	0.036	0.003	0.961	0.001	0.005	0.994	0.073	0.017	0.911
3	0.203	0.031	0.766	0.043	0.003	0.954	0.001	0.004	0.995	0.137	0.019	0.844
4	0.257	0.030	0.713	0.045	0.003	0.952	0.001	0.004	0.995	0.191	0.022	0.787
5	0.279	0.029	0.692	0.046	0.004	0.950	0.001	0.004	0.996	0.233	0.025	0.742
Fortieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax, and Fortieth			SPS, Tax, and Fortieth			HS, Tax, and Fortieth			ES, Tax, and Fortieth		
Fortieth	GS	Tax	Fortieth	SPS	Tax	Fortieth	HS	Tax	Fortieth	ES	Tax	Fortieth
1	0.011	0.041	0.948	0.000	0.003	0.997	0.011	0.007	0.981	0.015	0.013	0.972
2	0.098	0.052	0.850	0.002	0.005	0.993	0.009	0.006	0.985	0.113	0.013	0.874
3	0.192	0.054	0.754	0.006	0.011	0.983	0.009	0.006	0.985	0.208	0.012	0.780
4	0.252	0.052	0.696	0.009	0.017	0.974	0.010	0.006	0.985	0.279	0.011	0.710
5	0.280	0.050	0.670	0.012	0.022	0.966	0.010	0.006	0.984	0.327	0.010	0.663
Eightieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax, and Eightieth			SPS, Tax, and Eightieth			HS, Tax, and Eightieth			ES, Tax, and Eightieth		
Eightieth	GS	Tax	Eightieth	SPS	Tax	Eightieth	HS	Tax	Eightieth	ES	Tax	Eightieth
1	0.002	0.007	0.991	0.022	0.015	0.963	0.001	0.015	0.984	0.038	0.024	0.938
2	0.001	0.015	0.984	0.035	0.014	0.952	0.031	0.019	0.950	0.122	0.029	0.849
3	0.001	0.024	0.975	0.038	0.018	0.945	0.054	0.024	0.923	0.207	0.035	0.758
4	0.001	0.032	0.967	0.037	0.028	0.934	0.066	0.029	0.905	0.279	0.041	0.680
5	0.001	0.039	0.960	0.037	0.039	0.924	0.072	0.034	0.894	0.336	0.047	0.617

C.1 Further Discussions on Baseline Results

The parameter estimates from our VAR models provide information about how the income distribution variables are affected by changes in the fiscal policy variables, meanwhile, the impulse responses show the dynamic response of the income distribution variables to a shock imposed on the fiscal policy variables. As a corollary, the impulse responses and estimated coefficients do not generally capture the same information. Interestingly however, our Panel VAR results largely follow the same pattern as our impulse responses (see Appendix Table C1 - Appendix Table C7). As such, in situations in which we observe a negative (positive) impulse response for our income distribution variables, we generally observe a similar response for our estimated coefficients obtained from the Panel VAR. Further, Appendix Figures C1 - C3 show that the roots of the companion matrix often lie within the unit circle, for the VAR models. Consequently, our VAR models generally satisfy the stability condition.

C.2 Further Discussions on the 20th, 40th and 80th Percentiles

Appendix Figure C4 reveals that the income shares held by the 20th and 40th percentiles increase in the year of impact (by 0.014 and 0.013 percentage points respectively) when there is a positive shock to public expenditure. The greatest increase in the 40th percentile occurs in the second year for both scenarios (0.052 percentage points). For the 80th percentile, however, a government expenditure shock has little effect. The impact is greatest in the second year, with a rise of 0.052 percentage points in the 40th percentile being the highest. Meanwhile, the 80th percentile are not significantly impacted by a public expenditure shock.

As before, the income share held by the 20th, 40th, and 80th percentiles rises instantaneously when there is a shock to education expenditure (Appendix C4). In most cases, the effects peaks in the second year. The shock's effect on the 80th and 20th percentiles fades in the third and fourth years respectively.

Also, a social protection shock raises the 80th percentile by 0.026 percentage points in the year of impact. Nonetheless, a shock to social protection expenditure generally has no statistically significant impact on 20th and 40th percentiles.

In line with previous results, the 20th and 40th percentiles are not significantly impacted by health expenditure shock. Nonetheless, after a positive health spending shock, the 80th percentile income share rises only after a year (Appendix Figure C4). The impact however ceases to be statistically insignificant by the third year. Consistent with earlier results, a positive shock to tax generally does not benefit the 20th, 40th and 80th percentiles (Appendix Figure C4). In many cases, a tax shock has a negative effect on the percentiles in the year of impact, which often fades away by the third year.

Appendix D. Robustness Test: Replacing the Gini Index with Alternative Inequality Measures

Table (D1) Panel VAR Results: Atkinson Index

Regressors	Regressands											
	GS, Tax and Atkinson			SPS, Tax and Atkinson			HS, Tax and Atkinson			ES, Tax and Atkinson		
	GS	Tax	Atkinson	SPS	Tax	Atkinson	HS	Tax	Atkinson	ES	Tax	Atkinson
L.GS	0.678***	-0.206***	-0.166***									
	(0.104)	(0.068)	(0.044)									
L.SPS				0.277	0.036	-0.502**						
				(0.278)	(0.649)	(0.228)						
L.HS							0.574***	0.041	-0.160			
							(0.172)	(0.457)	(0.239)			
L.ES										0.573***	0.308	-0.365
										(0.178)	(0.630)	(0.292)
L.Tax	0.076	0.764***	0.071	-0.227**	0.745**	-0.093	-0.055*	0.573**	-0.018	-0.042	0.633***	-0.051
	(0.147)	(0.130)	(0.067)	(0.101)	(0.325)	(0.093)	(0.033)	(0.248)	(0.079)	(0.041)	(0.220)	(0.095)
L.Atkinson	0.302	-0.563***	0.530***	0.141	-0.547	0.535***	0.011	-0.163	0.714***	-0.073	0.203	0.826***
	(0.240)	(0.163)	(0.125)	(0.146)	(0.458)	(0.164)	(0.057)	(0.200)	(0.153)	(0.063)	(0.187)	(0.153)
Observations	437	437	437	387	387	387	404	404	404	404	404	404
Countries	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (D2) Panel VAR Results: Theil Index

Regressors	Regressands											
	GS, Tax and Theil			SPS, Tax and Theil			HS, Tax and Theil			ES, Tax and Theil		
	GS	Tax	Theil	SPS	Tax	Theil	HS	Tax	Theil	ES	Tax	Theil
L.GS	0.669***	-0.164**	-0.001*									
	(0.122)	(0.075)	(0.001)									
L.SPS				0.172	0.318	-0.002						
				(0.204)	(0.300)	(0.002)						
L.HS							0.501***	-0.003	-0.006**			
							(0.134)	(0.290)	(0.002)			
L.ES										0.675***	-1.407***	-0.007***
										(0.182)	(0.373)	(0.002)
L.Tax	-0.127	0.549***	0.001	-0.186***	0.421***	0.001**	-0.038	0.527***	-0.000	0.070	0.487***	0.001
	(0.267)	(0.173)	(0.002)	(0.058)	(0.124)	(0.001)	(0.027)	(0.167)	(0.001)	(0.047)	(0.106)	(0.001)
L.Theil	39.090	-32.128**	0.775***	-8.966	-55.125***	0.908***	-3.517	-9.255	0.728***	-20.051***	5.205	0.706***
	(25.928)	(13.849)	(0.197)	(6.932)	(12.291)	(0.109)	(3.099)	(10.302)	(0.198)	(4.636)	(8.585)	(0.102)
Observations	437	437	437	387	387	387	404	404	404	404	404	404
Countries	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Figure (D1) Stability Condition: Atkinson Index

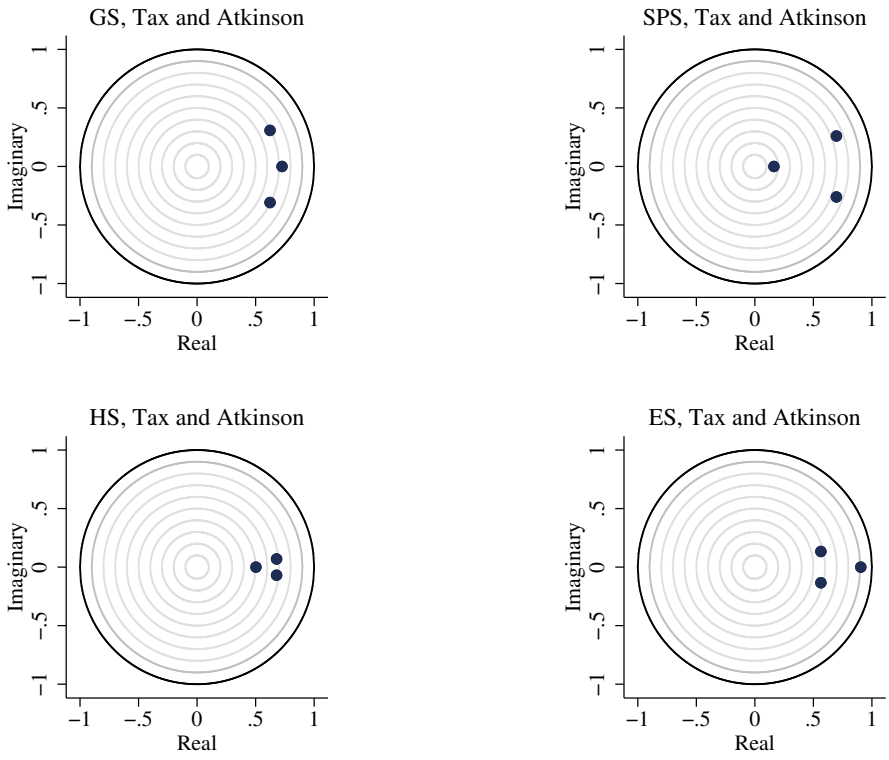


Figure (D2) Stability Condition: Theil Index

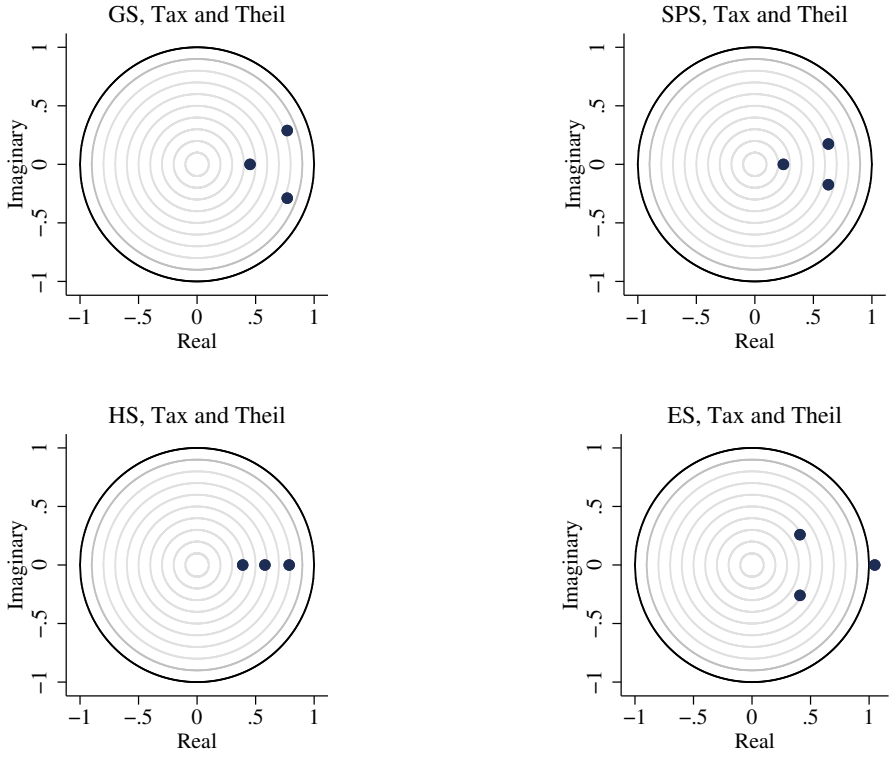
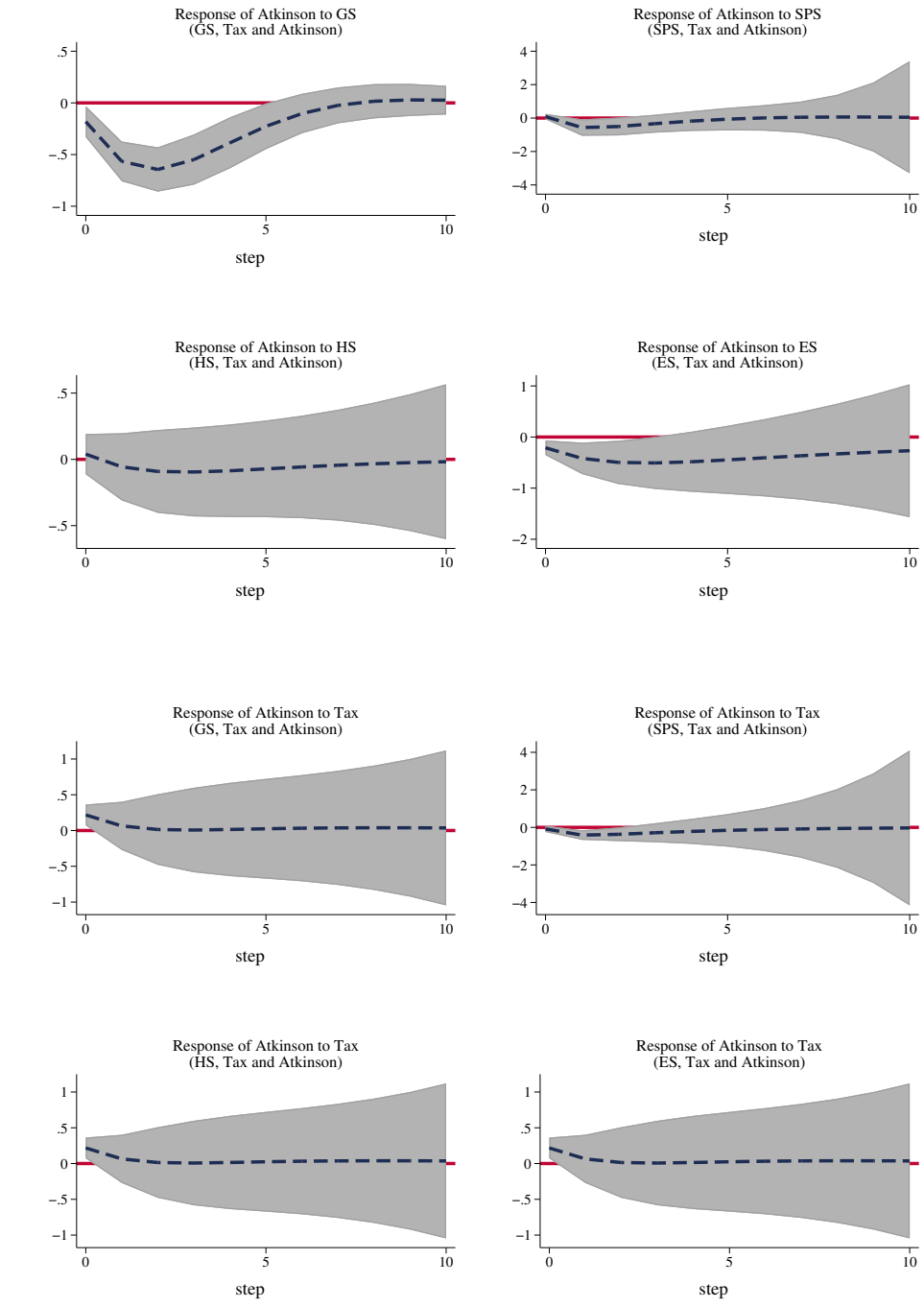
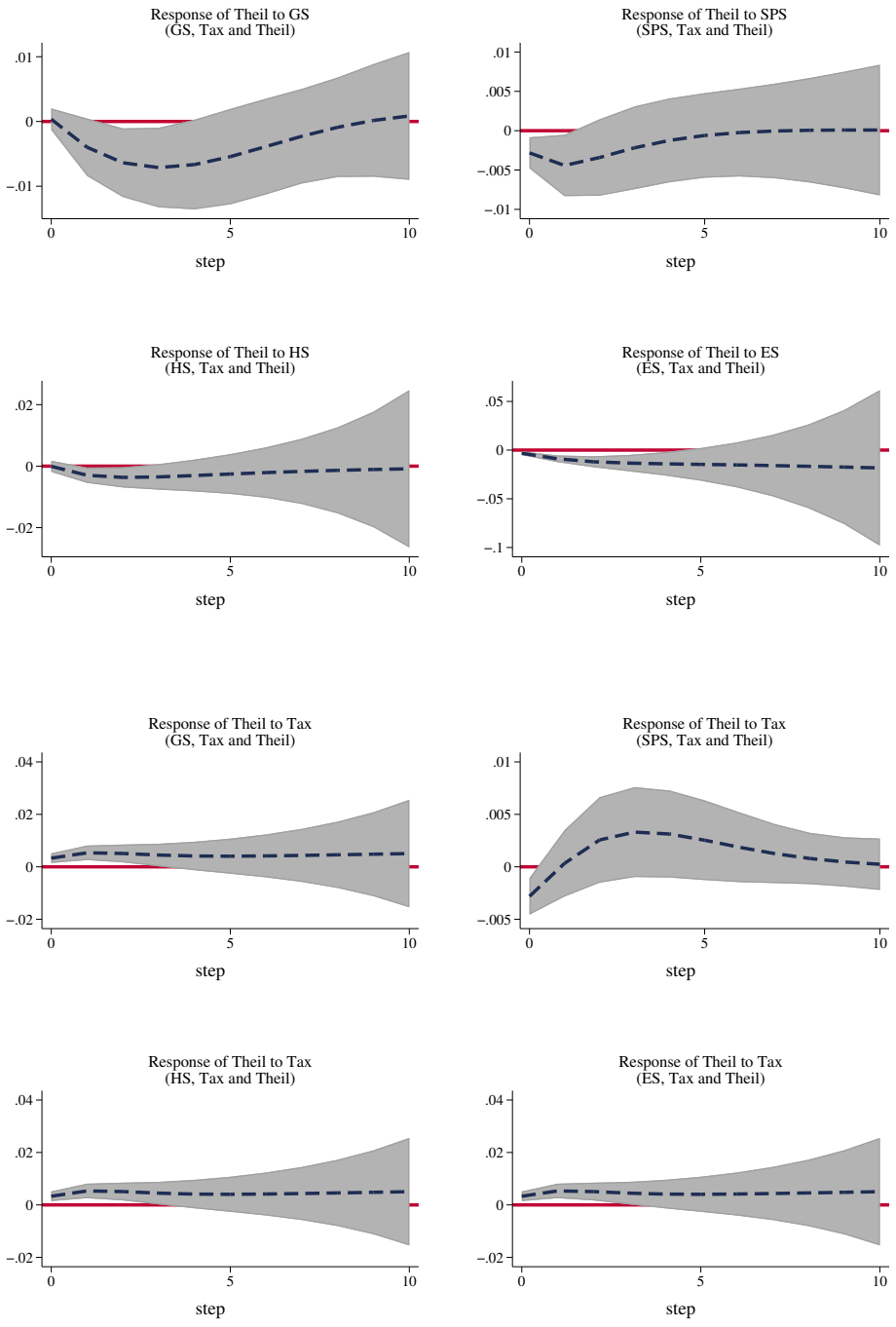


Figure (D3) Impulse Responses: Spending and Tax Shocks on the Atkinson Index



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Figure (D4) Impulse Responses: Spending and Tax Shocks on the Theil Index



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Table (D3) Variance Decomposition: Atkinson Index

Response variable and periods ahead	Impulse variable											
	GS, Tax and Atkinson			SPS, Tax and Atkinson			HS, Tax and Atkinson			ES, Tax and Atkinson		
Atkinson	GS	Tax	Atkinson	SPS	Tax	Atkinson	HS	Tax	Atkinson	ES	Tax	Atkinson
1	0.009	0.022	0.969	0.002	0.005	0.993	0.000	0.003	0.996	0.013	0.016	0.971
2	0.070	0.033	0.897	0.062	0.007	0.931	0.001	0.002	0.997	0.038	0.011	0.951
3	0.136	0.039	0.825	0.101	0.006	0.893	0.002	0.002	0.996	0.061	0.009	0.930
4	0.179	0.039	0.782	0.117	0.010	0.873	0.004	0.002	0.994	0.080	0.007	0.912
5	0.198	0.038	0.764	0.121	0.017	0.862	0.005	0.002	0.993	0.094	0.007	0.899

Table (D4) Variance Decomposition: Theil Index

Response variable and periods ahead	Impulse variable											
	GS, Tax, and Theil			SPS, Tax, and Theil			HS, Tax, and Theil			ES, Tax, and Theil		
Theil	GS	Tax	Theil	SPS	Tax	Theil	HS	Tax	Theil	ES	Tax	Theil
1	0.000	0.005	0.995	0.014	0.011	0.974	0.000	0.010	0.990	0.022	0.015	0.963
2	0.021	0.013	0.966	0.027	0.007	0.966	0.012	0.007	0.981	0.112	0.025	0.863
3	0.061	0.022	0.918	0.029	0.012	0.959	0.025	0.006	0.969	0.202	0.024	0.774
4	0.104	0.029	0.866	0.028	0.019	0.953	0.035	0.006	0.959	0.265	0.020	0.715
5	0.140	0.034	0.826	0.027	0.024	0.949	0.042	0.006	0.952	0.303	0.016	0.681

D.1 Further Details on the Atkinson Measure of Inequality and the Theil Index

The Atkinson index has a lower bound of zero, reflecting an equal distribution, and an upper bound of one. An important features of this measure of inequality is that it is the only one to explicitly (and not implicitly, as in all other standard measures of inequality) incorporate society's avertion to inequality and, therefore, the sensitivity of the implied social welfare losses arising from inequality.[2]

Also, the lower bound of the Theil index is zero, representing a society wherein the total income is equally distributed across the citizenry. Unlike the Gini coefficient and the Atkinson index which have an upper bound of one, the Theil index has no upper bound (Foster et al., 2013). Data on the Theil index is also sourced from the Global Consumption and Income Project Database. The database reports Theil's first and second measures of inequality (i.e., such that the orders of the generalized entropy measure are 1 and 0). We begin by conducting a panel unit root test on both the Theil index and the Atkinson inequality measure. Appendix Table B1 suggests that we can reject the null hypothesis of unit root for both inequality measures.

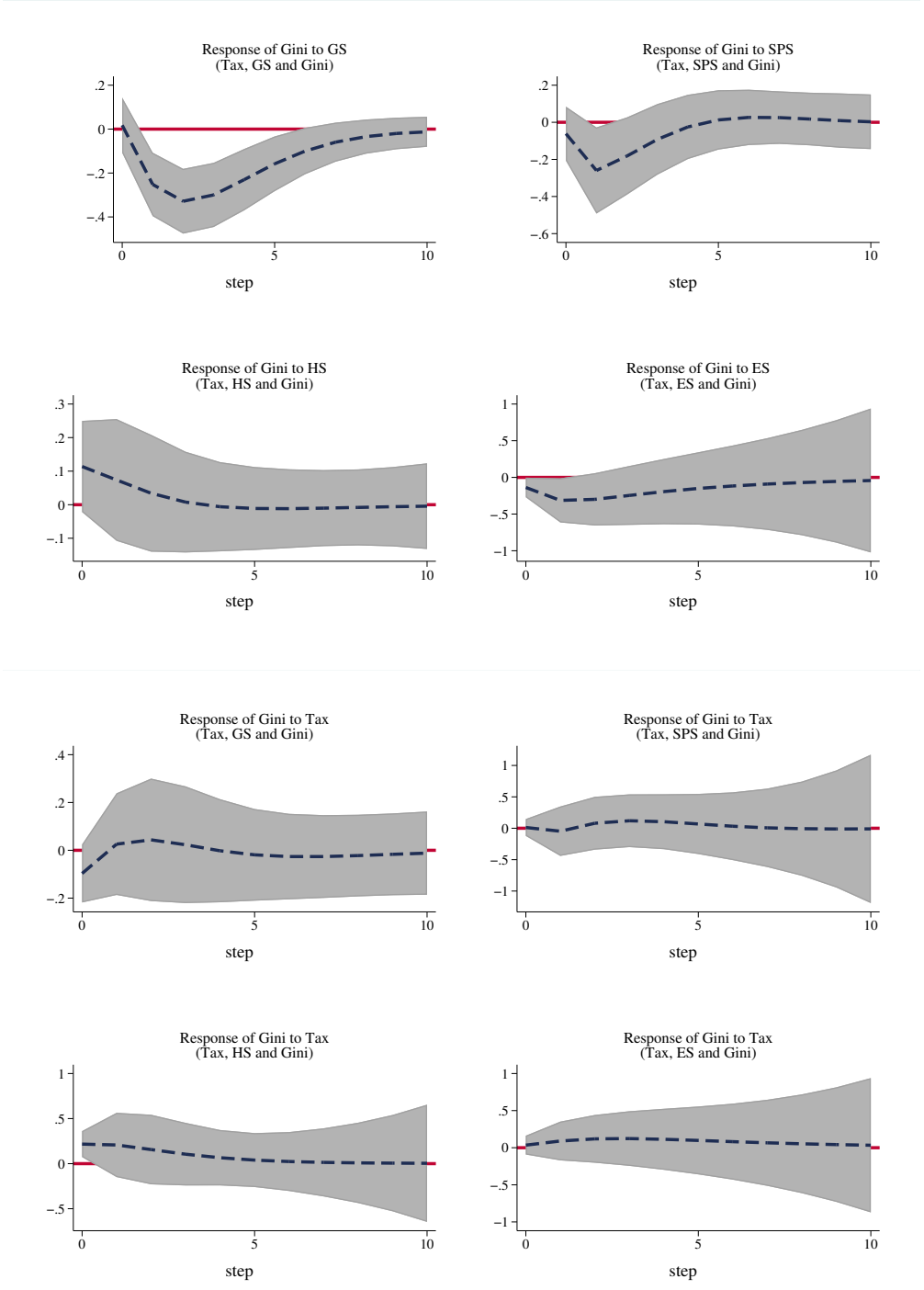
As seen in Appendix Tables D3 - D4, between the first and fifth years, the spending and tax variables account for a reasonable portion of the variations in both the Theil index and the Atkinson inequality measure (excluding their own shocks). As a result, the variance decomposition results are comparable to the baseline findings.

Further, Appendix Figures D1 and D2 reveals that for all VAR equations, the roots of the companion matrix are contained within the unit circle. Hence, our panel VAR models meet the criteria of stability.

[2] An aversion parameter of zero suggests a society has no aversion to inequality. Meanwhile, a society with an infinite aversion to inequality is assigned a parameter of infinity (∞). Data on the Atkinson index are sourced from the Global Consumption and Income Project Database. The database computes the Atkinson index with an aversion parameter of 2.

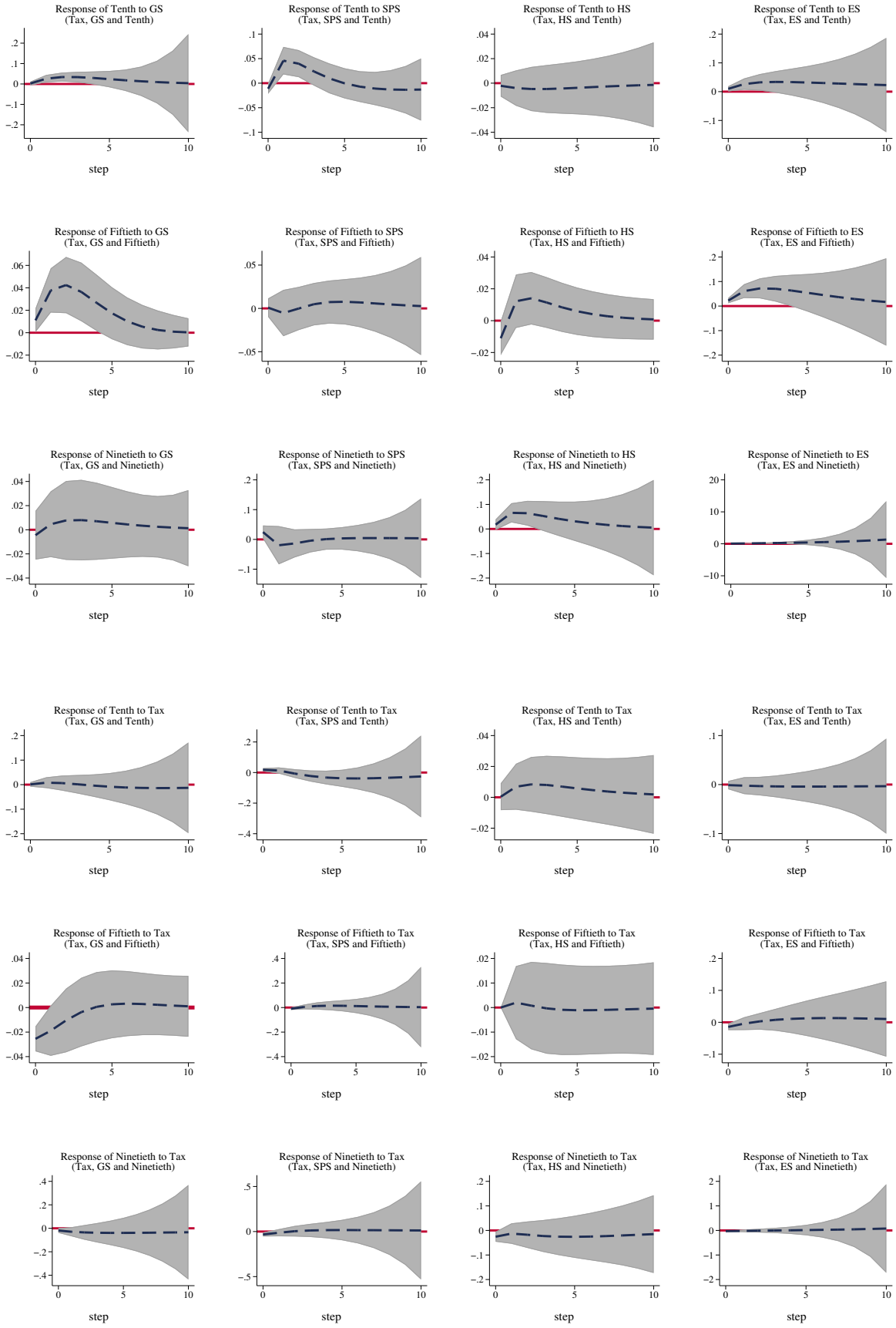
Appendix E. Robustness Test: Re-ordering the Panel VAR Framework

Figure (E1) Impulse Responses: Spending and Tax Shocks - Tax Before Spending Variables - Gini Index



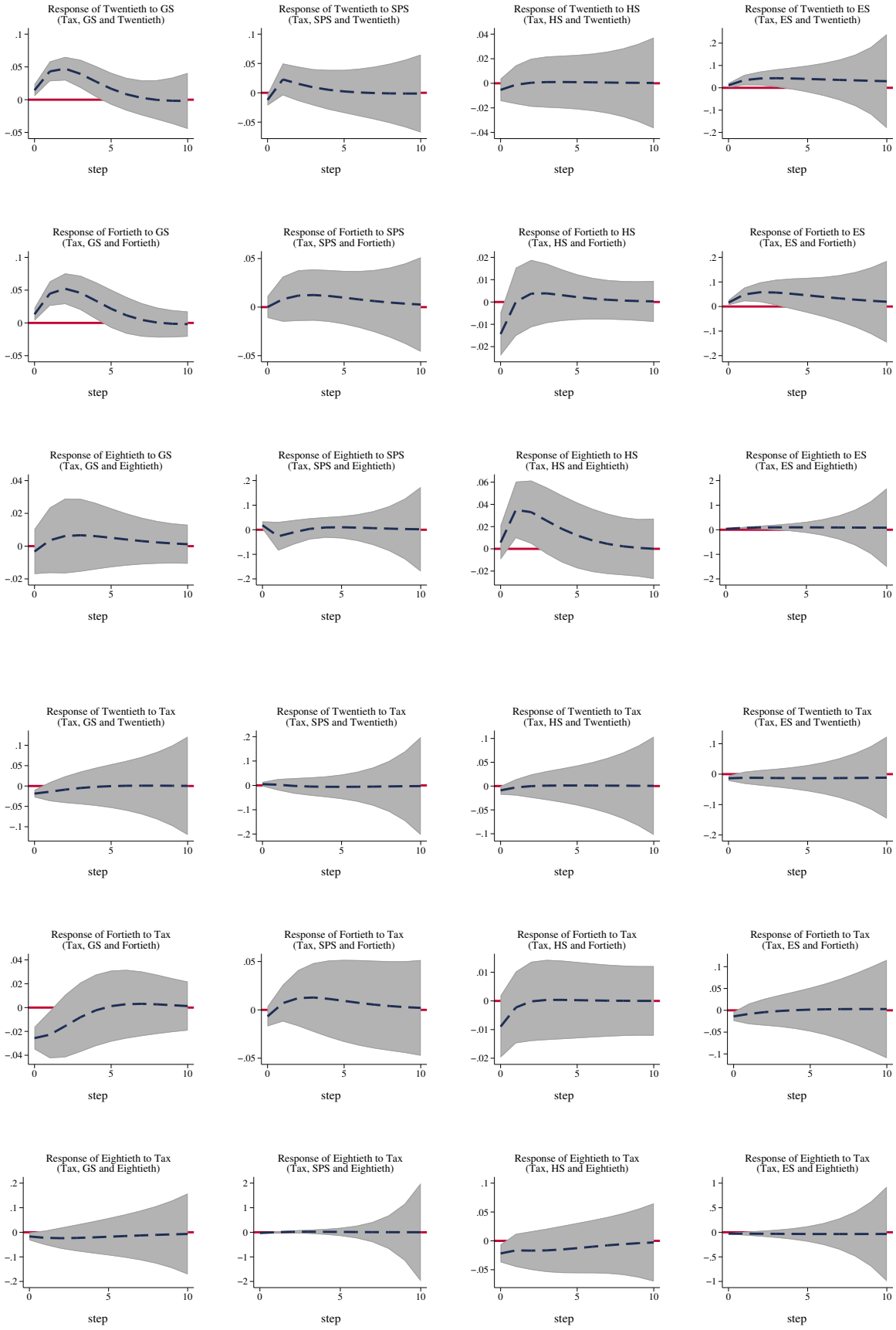
Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Figure (E2) Impulse Responses: Spending and Tax Shocks - Tax Before Spending Variables - Tenth, Fiftieth and Ninetieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Figure (E3) Impulse Responses: Spending and Tax Shocks - Tax Before Spending Variables - Twentieth, Fortieth and Eightieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

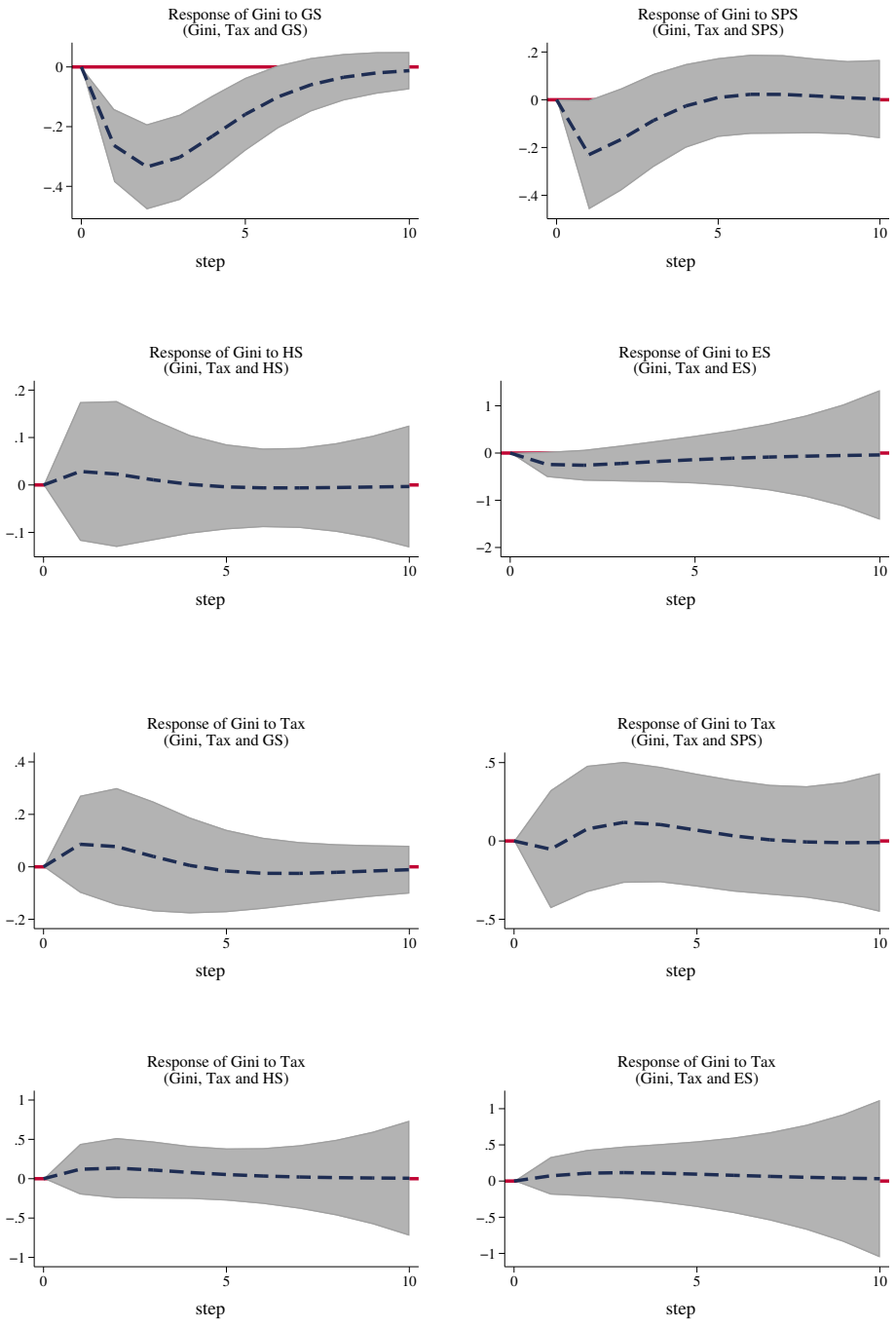
Table (E1) Variance Decomposition: Tax Before Spending Variables - Gini, Tenth, Fiftieth and Ninetieth Percentiles

Gini Index												
Response variable and periods ahead	Impulse variable											
	Tax, GS and Gini			Tax, SPS and Gini			Tax, HS and Gini			Tax, ES and Gini		
Gini	Tax	GS	Gini	Tax	SPS	Gini	Tax	HS	Gini	Tax	ES	Gini
1	0.003	0.000	0.996	0.000	0.001	0.999	0.017	0.005	0.979	0.000	0.007	0.993
2	0.003	0.017	0.981	0.001	0.020	0.979	0.027	0.006	0.967	0.003	0.033	0.965
3	0.003	0.041	0.957	0.002	0.028	0.970	0.034	0.006	0.960	0.006	0.053	0.941
4	0.003	0.059	0.938	0.006	0.030	0.964	0.038	0.006	0.957	0.010	0.065	0.925
5	0.003	0.070	0.927	0.009	0.030	0.961	0.039	0.006	0.955	0.012	0.073	0.915
Tenth Percentile												
Response variable and periods ahead	Impulse variable											
	Tax, GS and Tenth			Tax, SPS and Tenth			Tax, HS and Tenth			Tax, ES and Tenth		
Tenth	Tax	GS	Tenth	Tax	SPS	Tenth	Tax	HS	Tenth	Tax	ES	Tenth
1	0.000	0.000	1.000	0.021	0.008	0.971	0.000	0.000	1.000	0.000	0.008	0.992
2	0.003	0.035	0.962	0.023	0.099	0.879	0.003	0.001	0.996	0.000	0.045	0.955
3	0.005	0.082	0.914	0.022	0.148	0.830	0.006	0.002	0.992	0.001	0.089	0.910
4	0.005	0.124	0.871	0.039	0.161	0.800	0.009	0.003	0.987	0.001	0.131	0.868
5	0.005	0.155	0.840	0.075	0.158	0.768	0.011	0.004	0.984	0.002	0.166	0.832
Fiftieth Percentile												
Response variable and periods ahead	Impulse variable											
	Tax, GS and Fiftieth			Tax, SPS and Fiftieth			Tax, HS and Fiftieth			Tax, ES and Fiftieth		
Fiftieth	Tax	GS	Fiftieth	Tax	SPS	Fiftieth	Tax	HS	Fiftieth	Tax	ES	Fiftieth
1	0.037	0.007	0.956	0.005	0.000	0.995	0.014	0.007	0.979	0.011	0.027	0.962
2	0.043	0.065	0.892	0.005	0.001	0.994	0.012	0.012	0.976	0.008	0.154	0.838
3	0.043	0.128	0.830	0.011	0.001	0.988	0.012	0.019	0.969	0.007	0.274	0.719
4	0.041	0.169	0.789	0.019	0.002	0.980	0.012	0.024	0.964	0.007	0.359	0.633
5	0.040	0.190	0.770	0.025	0.004	0.971	0.012	0.026	0.962	0.009	0.414	0.577
Ninetieth Percentile												
Response variable and periods ahead	Impulse variable											
	Tax, GS and Ninetieth			Tax, SPS and Ninetieth			Tax, HS and Ninetieth			Tax, ES and Ninetieth		
Ninetieth	Tax	GS	Ninetieth	Tax	SPS	Ninetieth	Tax	HS	Ninetieth	Tax	ES	Ninetieth
1	0.006	0.000	0.994	0.017	0.010	0.973	0.011	0.005	0.984	0.012	0.083	0.904
2	0.014	0.000	0.986	0.017	0.014	0.970	0.010	0.056	0.934	0.010	0.197	0.793
3	0.024	0.001	0.975	0.016	0.015	0.968	0.012	0.093	0.895	0.007	0.324	0.669
4	0.037	0.002	0.962	0.018	0.016	0.966	0.016	0.115	0.868	0.004	0.437	0.559
5	0.050	0.002	0.948	0.021	0.016	0.963	0.022	0.128	0.850	0.003	0.524	0.473

Table (E2) Variance Decomposition: Tax Before Spending Variables - Twentieth, Fortieth and Eightieth Percentiles

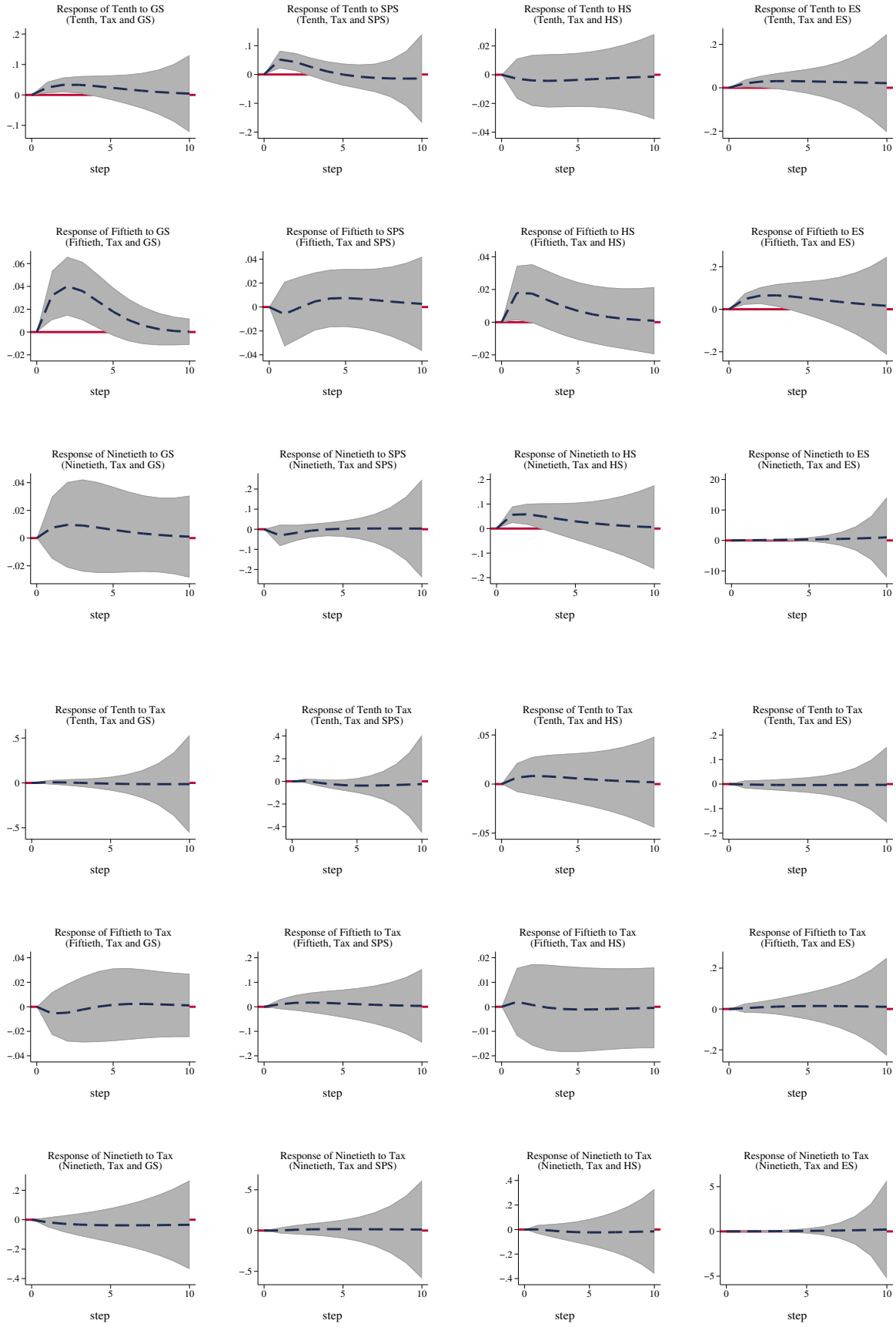
Twentieth Percentile												
Response variable and periods ahead	Impulse variable											
	Tax, GS and Twentieth			Tax, SPS and Twentieth			Tax, HS and Twentieth			Tax, ES and Twentieth		
Twentieth	Tax	GS	Twentieth	Tax	SPS	Twentieth	Tax	HS	Twentieth	Tax	ES	Twentieth
1	0.026	0.016	0.959	0.002	0.011	0.987	0.006	0.002	0.991	0.015	0.011	0.975
2	0.029	0.112	0.859	0.002	0.037	0.961	0.005	0.002	0.994	0.018	0.072	0.911
3	0.029	0.204	0.766	0.002	0.044	0.954	0.004	0.001	0.995	0.021	0.136	0.844
4	0.028	0.258	0.713	0.003	0.046	0.952	0.003	0.001	0.995	0.024	0.189	0.787
5	0.027	0.281	0.692	0.004	0.046	0.950	0.003	0.001	0.996	0.028	0.230	0.742
Fortieth Percentile												
Response variable and periods ahead	Impulse variable											
	Tax, GS and Fortieth			Tax, SPS and Fortieth			Tax, HS and Fortieth			Tax, ES and Fortieth		
Fortieth	Tax	GS	Fortieth	Tax	SPS	Fortieth	Tax	HS	Fortieth	Tax	ES	Fortieth
1	0.041	0.011	0.948	0.003	0.000	0.997	0.000	0.000	0.000	0.012	0.016	0.972
2	0.053	0.097	0.850	0.004	0.003	0.993	0.005	0.013	0.981	0.011	0.115	0.874
3	0.055	0.191	0.754	0.009	0.008	0.983	0.004	0.011	0.985	0.010	0.210	0.780
4	0.053	0.251	0.696	0.014	0.012	0.974	0.004	0.011	0.985	0.008	0.281	0.710
5	0.051	0.279	0.670	0.018	0.016	0.966	0.004	0.011	0.985	0.008	0.329	0.663
Eightieth Percentile												
Response variable and periods ahead	Impulse variable											
	Tax, GS and Eightieth			Tax, SPS and Eightieth			Tax, HS and Eightieth			Tax, ES and Eightieth		
Eightieth	Tax	GS	Eightieth	Tax	SPS	Eightieth	Tax	HS	Eightieth	Tax	ES	Eightieth
1	0.008	0.000	0.991	0.026	0.011	0.963	0.015	0.001	0.984	0.023	0.039	0.938
2	0.016	0.000	0.984	0.021	0.027	0.952	0.018	0.031	0.950	0.027	0.124	0.849
3	0.024	0.001	0.975	0.028	0.028	0.945	0.024	0.054	0.923	0.032	0.209	0.758
4	0.032	0.002	0.967	0.038	0.027	0.934	0.029	0.066	0.905	0.038	0.282	0.680
5	0.038	0.002	0.960	0.046	0.029	0.924	0.033	0.072	0.894	0.043	0.340	0.617

Figure (E4) Impulse Responses: Spending and Tax Shocks - Reverse of Baseline Ordering - Gini Index



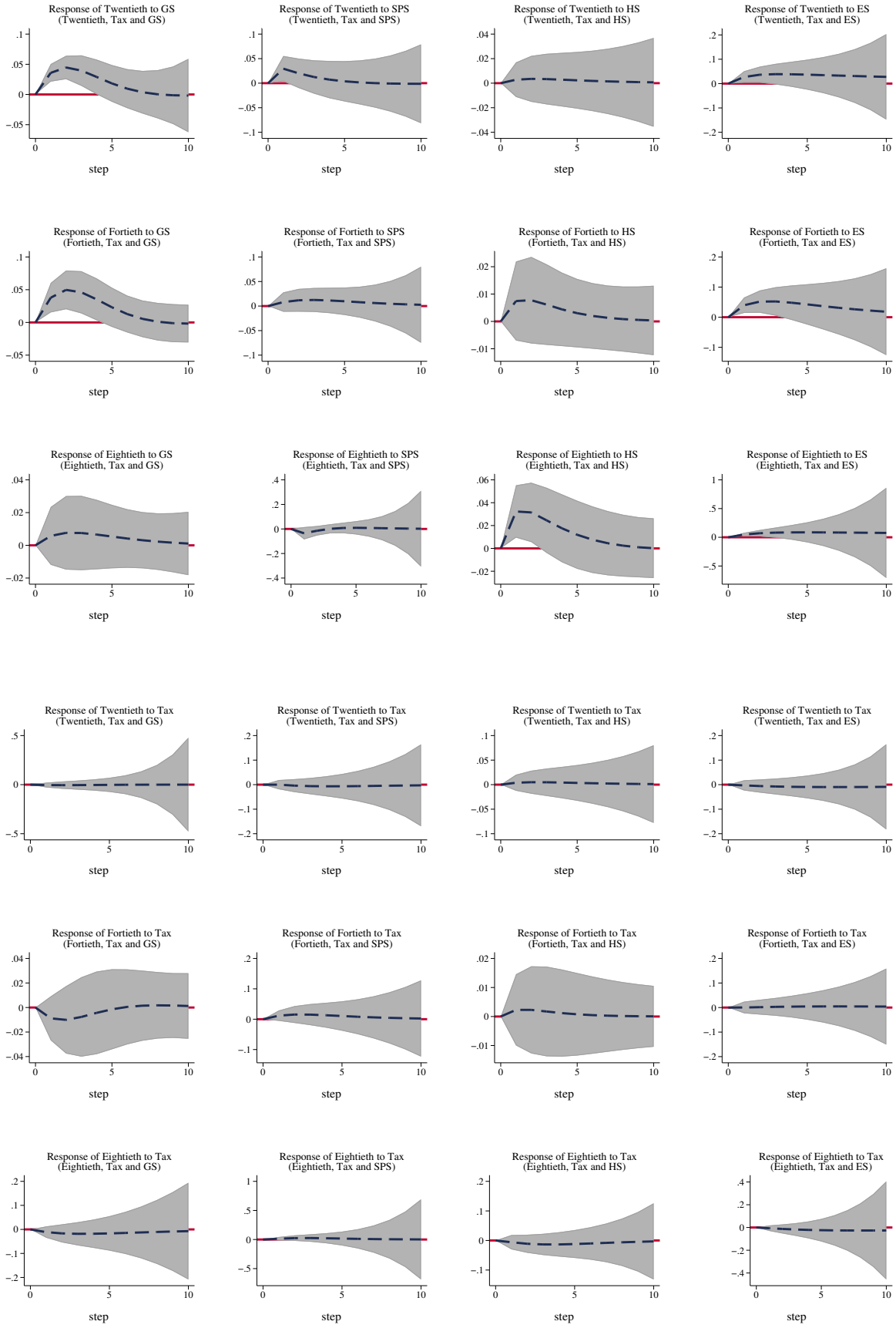
Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Figure (E5) Impulse Responses: Spending and Tax Shocks - Reverse of Baseline Ordering - Tenth, Fiftieth and Ninetieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Figure (E6) Impulse Responses: Spending and Tax Shocks - Reverse of Baseline Ordering - Twentieth, Fortieth and Eightieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Table (E3) Variance Decomposition: Reverse of Baseline Ordering - Gini, Tenth, Fiftieth and Ninetieth Percentiles

Gini Index												
Response variable and periods ahead	Impulse variable											
	Gini, Tax and GS			Gini, Tax and SPS			Gini, Tax and HS			Gini, Tax and ES		
Gini	Gini	Tax	GS	Gini	Tax	SPS	Gini	Tax	HS	Gini	Tax	ES
1	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000
2	0.980	0.002	0.018	0.984	0.001	0.015	0.995	0.004	0.000	0.982	0.001	0.016
3	0.954	0.003	0.043	0.976	0.002	0.021	0.990	0.010	0.000	0.964	0.004	0.032
4	0.935	0.003	0.062	0.971	0.006	0.023	0.986	0.013	0.000	0.950	0.008	0.043
5	0.924	0.003	0.073	0.968	0.009	0.023	0.984	0.015	0.000	0.941	0.010	0.049
Tenth Percentile												
Response variable and periods ahead	Impulse variable											
	Tenth, Tax and GS			Tenth, Tax and SPS			Tenth, Tax and HS			Tenth, Tax and ES		
Tenth	Tenth	Tax	GS	Tenth	Tax	SPS	Tenth	Tax	HS	Tenth	Tax	ES
1	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000
2	0.967	0.003	0.031	0.881	0.001	0.118	0.997	0.003	0.000	0.977	0.000	0.023
3	0.920	0.004	0.075	0.818	0.006	0.176	0.993	0.006	0.001	0.941	0.000	0.059
4	0.879	0.004	0.118	0.781	0.028	0.191	0.989	0.009	0.002	0.904	0.001	0.095
5	0.847	0.004	0.148	0.748	0.066	0.186	0.986	0.011	0.003	0.872	0.001	0.126
Fiftieth Percentile												
Response variable and periods ahead	Impulse variable											
	Fiftieth, Tax and GS			Fiftieth, Tax and SPS			Fiftieth, Tax and HS			Fiftieth, Tax and ES		
Fiftieth	Fiftieth	Tax	GS	Fiftieth	Tax	SPS	Fiftieth	Tax	HS	Fiftieth	Tax	ES
1	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000
2	0.955	0.001	0.043	0.994	0.005	0.001	0.986	0.000	0.014	0.915	0.001	0.084
3	0.897	0.002	0.101	0.984	0.014	0.001	0.974	0.000	0.026	0.810	0.003	0.188
4	0.855	0.002	0.143	0.973	0.025	0.002	0.968	0.000	0.032	0.727	0.006	0.268
5	0.833	0.002	0.165	0.963	0.033	0.004	0.964	0.000	0.035	0.669	0.009	0.322
Ninetieth Percentile												
Response variable and periods ahead	Impulse variable											
	Ninetieth, Tax and GS			Ninetieth, Tax and GS			Ninetieth, Tax and GS			Ninetieth, Tax and GS		
Ninetieth	Ninetieth	Tax	GS	Ninetieth	Tax	SPS	Ninetieth	Tax	HS	Ninetieth	Tax	ES
1	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000
2	0.996	0.003	0.001	0.987	0.000	0.013	0.961	0.000	0.039	0.954	0.000	0.046
3	0.988	0.010	0.001	0.982	0.001	0.017	0.929	0.001	0.070	0.874	0.001	0.125
4	0.978	0.020	0.002	0.978	0.004	0.017	0.907	0.003	0.090	0.791	0.003	0.205
5	0.965	0.032	0.003	0.974	0.008	0.017	0.892	0.008	0.101	0.722	0.006	0.272

Source: Author's own computation.

Table (E4) Variance Decomposition: Reverse of Baseline Ordering - Twentieth, Fortieth and Eightieth Percentiles

Twentieth Percentile												
Response variable and periods ahead	Impulse variable											
	Twentieth, Tax and GS			Twentieth, Tax and SPS			Twentieth, Tax and HS			Twentieth, Tax and ES		
Twentieth	Twentieth	Tax	GS	Twentieth	Tax	SPS	Twentieth	Tax	HS	Twentieth	Tax	ES
1	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000
2	0.929	0.001	0.070	0.952	0.000	0.048	0.999	0.001	0.000	0.960	0.000	0.040
3	0.842	0.002	0.156	0.937	0.001	0.062	0.997	0.002	0.001	0.907	0.002	0.091
4	0.783	0.003	0.214	0.932	0.002	0.066	0.996	0.002	0.001	0.859	0.004	0.137
5	0.756	0.003	0.241	0.929	0.004	0.067	0.996	0.003	0.001	0.820	0.006	0.174
Fortieth Percentile												
Response variable and periods ahead	Impulse variable											
	Fortieth, Tax and GS			Fortieth, Tax and SPS			Fortieth, Tax and HS			Fortieth, Tax and ES		
Fortieth	Fortieth	Tax	GS	Fortieth	Tax	SPS	Fortieth	Tax	HS	Fortieth	Tax	ES
1	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000
2	0.932	0.004	0.064	0.991	0.006	0.003	0.997	0.000	0.003	0.932	0.000	0.068
3	0.841	0.007	0.152	0.979	0.014	0.008	0.994	0.001	0.006	0.852	0.000	0.148
4	0.775	0.009	0.216	0.967	0.021	0.012	0.992	0.001	0.007	0.788	0.000	0.212
5	0.742	0.009	0.249	0.958	0.025	0.016	0.991	0.001	0.008	0.743	0.001	0.257
Eightieth Percentile												
Response variable and periods ahead	Impulse variable											
	Eightieth, Tax and GS			Eightieth, Tax and SPS			Eightieth, Tax and HS			Eightieth, Tax and ES		
Eightieth	Eightieth	Tax	GS	Eightieth	Tax	SPS	Eightieth	Tax	HS	Eightieth	Tax	ES
1	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000
2	0.997	0.003	0.001	0.964	0.005	0.032	0.973	0.001	0.026	0.957	0.001	0.042
3	0.991	0.007	0.002	0.946	0.019	0.035	0.950	0.004	0.047	0.894	0.003	0.103
4	0.985	0.012	0.002	0.932	0.034	0.034	0.934	0.007	0.059	0.832	0.006	0.162
5	0.980	0.017	0.003	0.921	0.044	0.035	0.924	0.011	0.064	0.779	0.010	0.212

Appendix F. Robustness Test: Inclusion of Inflation

Table (F1) Panel VAR Results: Gini Index

Regressors	Regressands															
	GS, Tax, Inflation and Gini				SPS, Tax, Inflation and Gini				HS, Tax, Inflation and Gini				ES, Tax, Inflation and Gini			
	GS	Tax	Inflation	Gini	SPS	Tax	Inflation	Gini	HS	Tax	Inflation	Gini	ES	Tax	Inflation	Gini
L.GS	0.581***	-0.136*	-0.026	-0.105***												
	(0.101)	(0.075)	(0.093)	(0.039)												
L.SPS					-0.025	1.038	0.593	-0.009								
					(0.220)	(0.676)	(0.472)	(0.181)								
L.HS									0.392***	0.105	-0.407	-0.037				
									(0.139)	(0.569)	(0.512)	(0.171)				
L.ES													0.795***	-1.068	-0.517	-0.522**
													(0.131)	(0.866)	(0.487)	(0.223)
L.Tax	0.019	0.596***	-0.332	0.078	-0.254***	0.895***	-0.225	0.068	-0.042	0.643**	-0.290	0.006	0.005	0.733***	-0.139	0.054
	(0.260)	(0.214)	(0.237)	(0.076)	(0.084)	(0.268)	(0.229)	(0.072)	(0.031)	(0.277)	(0.221)	(0.074)	(0.036)	(0.237)	(0.165)	(0.060)
L.Inflation	-0.024	-0.028	0.215	-0.023	-0.036	0.028	0.225*	0.005	0.002	-0.036	0.182	0.016	-0.003	-0.100	0.358***	-0.014
	(0.065)	(0.040)	(0.139)	(0.023)	(0.035)	(0.083)	(0.122)	(0.026)	(0.010)	(0.074)	(0.139)	(0.023)	(0.012)	(0.096)	(0.126)	(0.021)
L.Gini	0.057	-0.677***	-0.096	0.704***	0.186	-0.835*	-0.081	0.973***	-0.025	-1.145**	-0.237	1.120***	-0.026	-0.793	-0.206	0.769***
	(0.328)	(0.248)	(0.246)	(0.138)	(0.143)	(0.478)	(0.236)	(0.136)	(0.065)	(0.517)	(0.222)	(0.150)	(0.057)	(0.498)	(0.198)	(0.130)
Observations	436	436	436	436	386	386	386	386	403	403	403	403	403	403	403	403
Countries	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (F2) Panel VAR Results: Tenth

Regressors	Regressands															
	GS, Tax, Inflation and Tenth				SPS, Tax, Inflation and Tenth				HS, Tax, Inflation and Tenth				ES, Tax, Inflation and Tenth			
	GS	Tax	Inflation	Tenth	SPS	Tax	Inflation	Tenth	HS	Tax	Inflation	Tenth	ES	Tax	Inflation	Tenth
L.GS	0.837***	-0.069	-0.060	0.010***												
	(0.117)	(0.043)	(0.092)	(0.002)												
L.SPS					0.181	-0.351	0.237	0.015								
					(0.175)	(0.412)	(0.464)	(0.012)								
L.HS									0.608***	-0.017	-0.349	-0.001				
									(0.143)	(0.345)	(0.587)	(0.015)				
L.ES													0.953***	-1.093**	0.147	0.011
													(0.243)	(0.499)	(0.615)	(0.017)
L.Tax	0.570***	0.167**	-0.003	-0.009***	-0.216***	0.964***	-0.584**	0.001	-0.046**	0.569***	-0.459**	0.003	-0.014	0.511***	-0.294	0.001
	(0.160)	(0.069)	(0.133)	(0.003)	(0.062)	(0.250)	(0.248)	(0.005)	(0.023)	(0.155)	(0.234)	(0.005)	(0.072)	(0.147)	(0.221)	(0.005)
L.Inflation	0.132**	-0.039	0.300***	0.003	-0.025	0.013	0.065	0.002	-0.004	0.054	0.084	0.000	0.018	-0.003	0.257*	0.000
	(0.055)	(0.031)	(0.112)	(0.002)	(0.028)	(0.051)	(0.144)	(0.002)	(0.006)	(0.044)	(0.156)	(0.002)	(0.018)	(0.050)	(0.136)	(0.002)
L.Tenth	-6.979	3.787*	3.347	0.573***	0.190	6.331	-4.839	0.543***	-0.142	1.427	0.505	0.701***	0.959	0.561	-4.094	0.654***
	(4.479)	(2.037)	(3.927)	(0.111)	(1.103)	(4.972)	(3.318)	(0.148)	(0.580)	(2.561)	(3.865)	(0.131)	(1.575)	(3.610)	(3.291)	(0.138)
Observations	436	436	436	436	386	386	386	386	403	403	403	403	403	403	403	403
Countries	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (F3) Panel VAR Results: Fiftieth

Regressors	Regressands															
	GS, Tax, Inflation and Fiftieth				SPS, Tax, Inflation and Fiftieth				HS, Tax, Inflation and Fiftieth				ES, Tax, Inflation and Fiftieth			
	GS	Tax	Inflation	Fiftieth	SPS	Tax	Inflation	Fiftieth	HS	Tax	Inflation	Fiftieth	ES	Tax	Inflation	Fiftieth
L.GS	0.591***	-0.226***	-0.048	0.009**												
	(0.105)	(0.073)	(0.093)	(0.003)												
L.SPS					0.202	0.525	0.578	-0.016								
					(0.180)	(0.351)	(0.421)	(0.017)								
L.HS									0.453***	-0.134	-0.354	0.018				
									(0.131)	(0.306)	(0.508)	(0.018)				
L.ES													0.974***	-1.190***	-0.723	0.048*
													(0.193)	(0.424)	(0.558)	(0.026)
L.Tax	0.282	0.776***	-0.138	0.001	-0.166**	1.066***	-0.284	0.001	-0.031	0.592***	-0.362	0.004	0.031	0.732***	-0.039	0.005
	(0.200)	(0.160)	(0.196)	(0.005)	(0.071)	(0.212)	(0.269)	(0.006)	(0.027)	(0.164)	(0.243)	(0.006)	(0.047)	(0.129)	(0.186)	(0.006)
L.Inflation	0.018	-0.029	0.333***	0.002	-0.039	0.071	0.182	0.000	-0.003	0.023	0.126	-0.000	-0.003	0.035	0.323**	0.000
	(0.065)	(0.030)	(0.120)	(0.002)	(0.032)	(0.046)	(0.143)	(0.003)	(0.006)	(0.028)	(0.143)	(0.003)	(0.016)	(0.027)	(0.128)	(0.003)
L.Fiftieth	-1.204	9.439***	3.514	0.680***	0.841	6.471*	2.432	0.788***	0.982	7.161***	2.603	0.846***	-0.422	2.787	4.046	0.712***
	(3.377)	(1.902)	(2.961)	(0.114)	(1.248)	(3.457)	(3.920)	(0.182)	(0.633)	(2.556)	(3.642)	(0.173)	(0.945)	(1.784)	(2.938)	(0.158)
Observations	436	436	436	436	386	386	386	386	403	403	403	403	403	403	403	403
Countries	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (F4) Panel VAR Results: Ninetieth

Regressors	Regressands															
	GS, Tax, Inflation and Ninetieth				SPS, Tax, Inflation and Ninetieth				HS, Tax, Inflation and Ninetieth				ES, Tax, Inflation and Ninetieth			
	GS	Tax	Inflation	Ninetieth	SPS	Tax	Inflation	Ninetieth	HS	Tax	Inflation	Ninetieth	ES	Tax	Inflation	Ninetieth
L.GS	0.589***	0.043	0.010	0.005												
	(0.072)	(0.041)	(0.073)	(0.005)												
L.SPS					-0.101	-0.166	0.868**	-0.006								
					(0.149)	(0.252)	(0.376)	(0.019)								
L.HS									0.450***	-0.522	-0.520	0.115***				
									(0.115)	(0.400)	(0.520)	(0.037)				
L.ES													1.021***	0.051	-1.031*	0.102**
													(0.147)	(0.317)	(0.583)	(0.040)
L.Tax	0.329**	1.019***	-0.257	-0.003	-0.223***	0.850***	-0.100	0.003	-0.060***	0.645***	-0.252	0.003	0.054	0.660***	-0.199	-0.003
	(0.168)	(0.144)	(0.192)	(0.009)	(0.039)	(0.126)	(0.153)	(0.008)	(0.018)	(0.136)	(0.179)	(0.009)	(0.033)	(0.131)	(0.170)	(0.012)
L.Inflation	0.005	-0.006	0.169	-0.006**	-0.064**	0.026	0.240*	-0.007**	-0.005	0.050	0.188	-0.008***	0.009	0.023	0.146	-0.006*
	(0.069)	(0.024)	(0.135)	(0.003)	(0.028)	(0.034)	(0.127)	(0.003)	(0.006)	(0.030)	(0.152)	(0.003)	(0.011)	(0.028)	(0.152)	(0.003)
L.Ninetieth	2.047	1.842**	2.040	0.417***	1.070**	2.232**	0.056	0.446***	0.498***	1.386**	0.865	0.396***	1.367***	-0.600	1.288	0.404***
	(1.314)	(0.802)	(1.255)	(0.109)	(0.467)	(0.936)	(1.301)	(0.092)	(0.154)	(0.643)	(1.139)	(0.106)	(0.425)	(0.650)	(1.375)	(0.122)
Observations	436	436	436	436	386	386	386	386	403	403	403	403	403	403	403	403
Countries	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (F5) Panel VAR Results: Twentieth

Regressors	Regressands															
	GS, Tax, Inflation and Twentieth				SPS, Tax, Inflation and Twentieth				HS, Tax, Inflation and Twentieth				ES, Tax, Inflation and Twentieth			
	GS	Tax	Inflation	Twentieth	SPS	Tax	Inflation	Twentieth	HS	Tax	Inflation	Twentieth	ES	Tax	Inflation	Twentieth
L.GS	0.819***	-0.168**	-0.125	0.010***												
	(0.151)	(0.066)	(0.136)	(0.003)												
L.SPS					0.144	0.106	0.463	0.003								
					(0.166)	(0.410)	(0.440)	(0.012)								
L.HS									0.548***	-0.041	-0.310	0.007				
									(0.132)	(0.328)	(0.546)	(0.016)				
L.ES													0.739***	-1.111***	0.265	0.027
													(0.215)	(0.398)	(0.621)	(0.019)
L.Tax	-0.084	0.559***	-0.200	-0.004	-0.178***	0.947***	-0.464*	0.002	-0.027	0.675***	-0.537**	0.005	-0.011	0.628***	-0.321	0.003
	(0.307)	(0.160)	(0.265)	(0.006)	(0.067)	(0.230)	(0.268)	(0.006)	(0.028)	(0.159)	(0.257)	(0.005)	(0.063)	(0.126)	(0.228)	(0.006)
L.Inflation	0.009	-0.018	0.236*	0.003	-0.036	0.040	0.115	0.002	-0.004	0.041	0.080	-0.000	0.001	0.016	0.270**	0.001
	(0.074)	(0.028)	(0.123)	(0.002)	(0.030)	(0.048)	(0.147)	(0.002)	(0.006)	(0.046)	(0.155)	(0.002)	(0.017)	(0.034)	(0.129)	(0.002)
L.Twentieth	-6.842	7.270***	4.552	0.606***	1.748	4.136	-3.738	0.731***	0.583	2.655	-1.479	0.875***	1.154	2.042	-4.316	0.664***
	(5.445)	(2.347)	(4.744)	(0.129)	(1.249)	(5.096)	(4.212)	(0.186)	(0.772)	(3.202)	(4.236)	(0.135)	(1.293)	(2.300)	(3.682)	(0.143)
Observations	436	436	436	436	386	386	386	386	403	403	403	403	403	403	403	403
Countries	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (F6) Panel VAR Results: Fortieth

Regressors	Regressands															
	GS, Tax, Inflation and Fortieth				SPS, Tax, Inflation and Fortieth				HS, Tax, Inflation and Fortieth				ES, Tax, Inflation and Fortieth			
	GS	Tax	Inflation	Fortieth	SPS	Tax	Inflation	Fortieth	HS	Tax	Inflation	Fortieth	ES	Tax	Inflation	Fortieth
L.GS	0.620***	-0.195***	-0.033	0.012***												
	(0.111)	(0.066)	(0.097)	(0.003)												
L.SPS					0.213	0.346	0.479	-0.009								
					(0.174)	(0.335)	(0.412)	(0.015)								
L.HS									0.440***	-0.157	-0.127	0.012				
									(0.120)	(0.287)	(0.487)	(0.017)				
L.ES													0.778***	-0.782*	-0.104	0.035
													(0.209)	(0.425)	(0.610)	(0.022)
L.Tax	0.300	0.785***	-0.097	0.000	-0.160**	0.968***	-0.353	0.002	-0.044*	0.590***	-0.150	0.009*	0.007	0.629***	-0.217	0.002
	(0.198)	(0.146)	(0.197)	(0.005)	(0.070)	(0.206)	(0.268)	(0.006)	(0.024)	(0.162)	(0.211)	(0.005)	(0.055)	(0.133)	(0.234)	(0.006)
L.Inflation	0.036	-0.024	0.295**	0.002	-0.034	0.059	0.146	0.001	-0.005	0.060**	0.332***	0.004	0.010	0.000	0.284**	-0.000
	(0.068)	(0.025)	(0.116)	(0.002)	(0.032)	(0.041)	(0.143)	(0.003)	(0.005)	(0.028)	(0.128)	(0.003)	(0.016)	(0.032)	(0.127)	(0.003)
L.Fortieth	-2.158	8.793***	3.781	0.599***	1.587	3.908	0.829	0.838***	0.732	5.968***	2.880	0.631***	0.432	1.506	0.842	0.798***
	(3.741)	(1.853)	(3.133)	(0.120)	(1.293)	(3.701)	(4.256)	(0.192)	(0.647)	(2.293)	(3.600)	(0.169)	(1.041)	(2.150)	(3.608)	(0.162)
Observations	436	436	436	436	386	386	386	386	403	403	403	403	403	403	403	403
Countries	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (F7) Panel VAR Results: Eightieth

Regressors	Regressands															
	GS, Tax, Inflation and Eightieth				SPS, Tax, Inflation and Eightieth				HS, Tax, Inflation and Eightieth				ES, Tax, Inflation and Eightieth			
	GS	Tax	Inflation	Eightieth	SPS	Tax	Inflation	Eightieth	HS	Tax	Inflation	Eightieth	ES	Tax	Inflation	Eightieth
L.GS	0.557***	-0.085	-0.024	0.004												
	(0.076)	(0.060)	(0.078)	(0.003)												
L.SPS					0.166	0.760**	0.896*	-0.055**								
					(0.189)	(0.386)	(0.517)	(0.025)								
L.HS									0.444***	-0.987*	-0.634	0.056**				
									(0.126)	(0.547)	(0.507)	(0.022)				
L.ES													0.669***	-0.514	-0.483	0.076***
													(0.182)	(0.491)	(0.596)	(0.029)
L.Tax	0.467**	1.074***	-0.235	-0.003	-0.232***	1.182***	-0.248	-0.005	-0.037*	0.600***	-0.287	0.001	0.003	0.670***	-0.213	-0.009
	(0.187)	(0.189)	(0.192)	(0.006)	(0.074)	(0.228)	(0.243)	(0.009)	(0.020)	(0.169)	(0.181)	(0.006)	(0.049)	(0.159)	(0.216)	(0.008)
L.Inflation	0.024	-0.030	0.299**	-0.003	-0.043	0.104**	0.219	-0.005	-0.005	0.034	0.281**	-0.001	0.006	0.009	0.185	-0.005
	(0.061)	(0.029)	(0.132)	(0.002)	(0.031)	(0.046)	(0.148)	(0.004)	(0.006)	(0.027)	(0.143)	(0.003)	(0.013)	(0.039)	(0.131)	(0.003)
L.Eightieth	-0.131	6.165***	1.076	0.781***	-0.236	7.851***	2.796	0.364***	0.578**	9.069***	-0.841	0.509***	0.864	1.467	1.870	0.832***
	(1.812)	(1.245)	(1.805)	(0.124)	(0.828)	(2.428)	(1.882)	(0.129)	(0.259)	(2.001)	(1.646)	(0.129)	(0.577)	(1.451)	(1.857)	(0.192)
Observations	436	436	436	436	386	386	386	386	403	403	403	403	403	403	403	403
Countries	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Figure (F1) Stability Condition: Gini Index

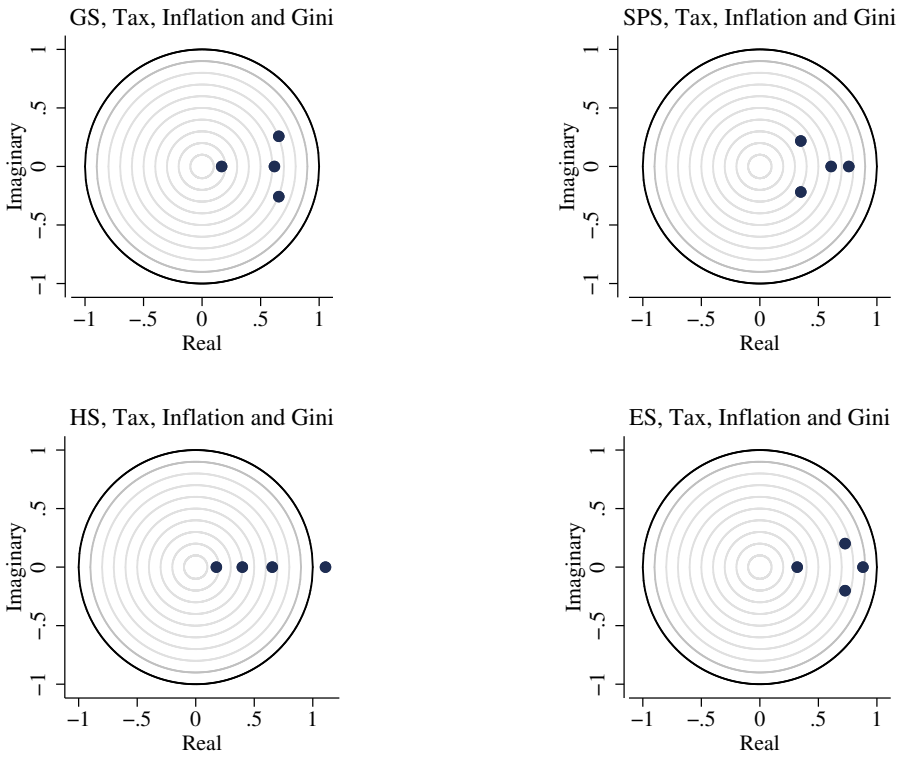


Figure (F2) Stability Condition: Tenth, Fiftieth and Ninetieth Percentiles

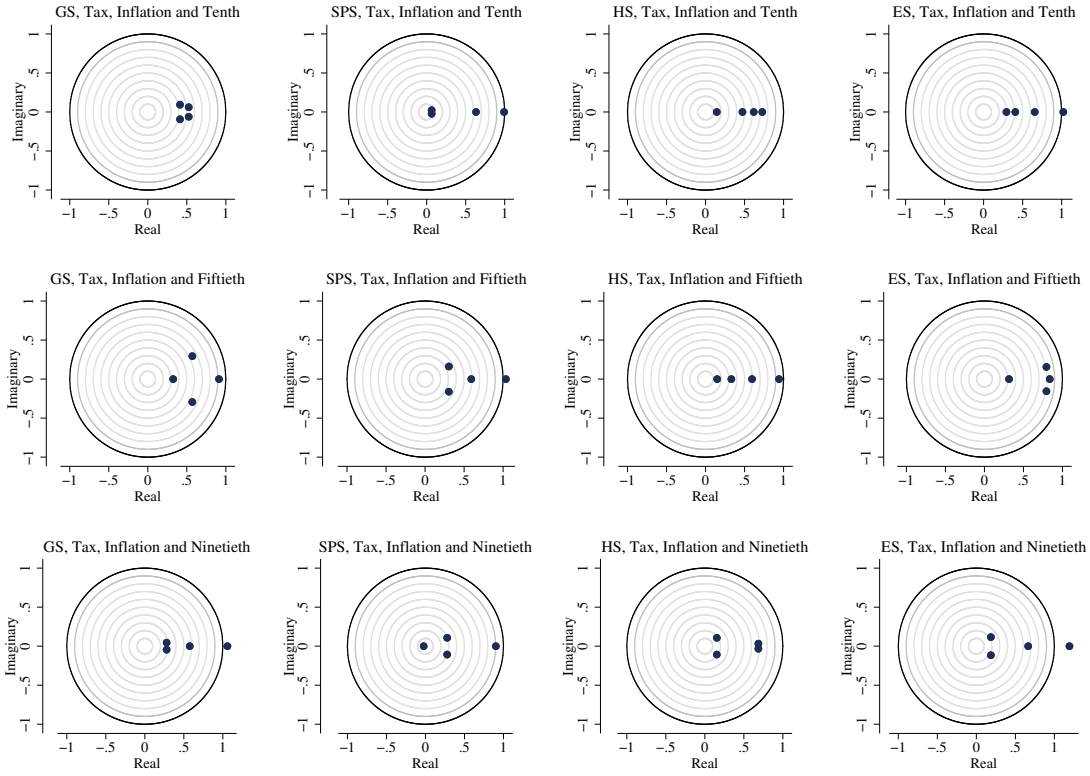


Figure (F3) Stability Condition: Twentieth, Fortieth and Eightieth Percentiles

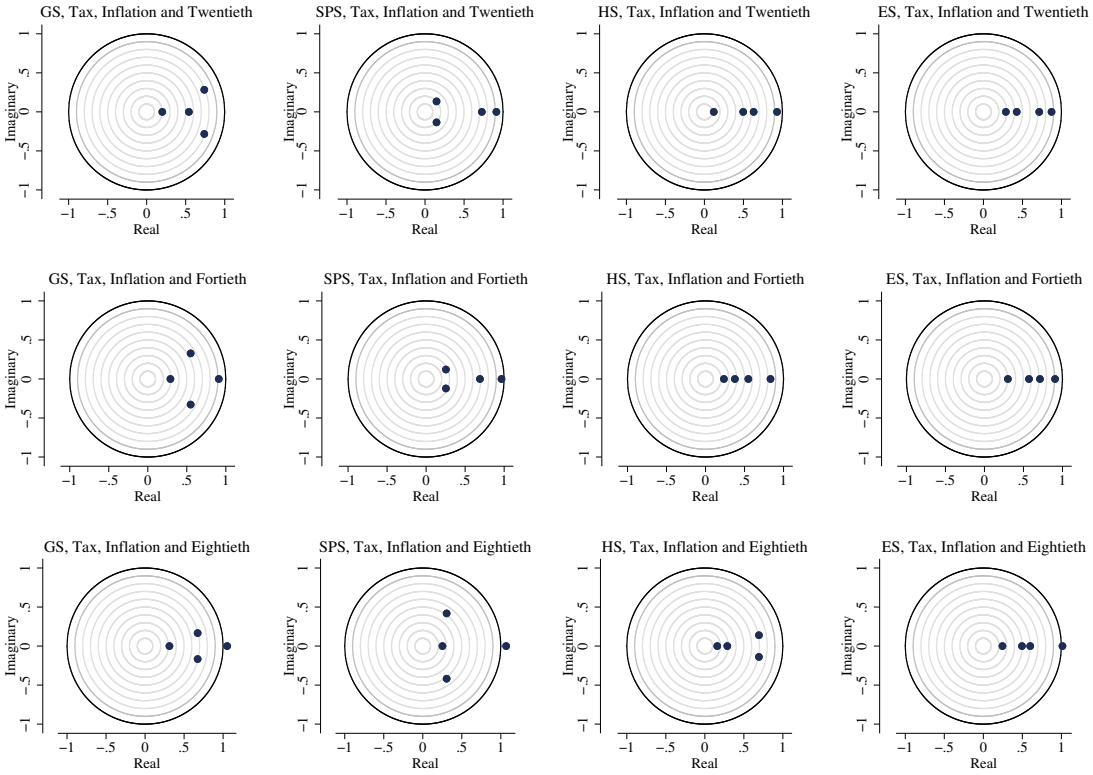
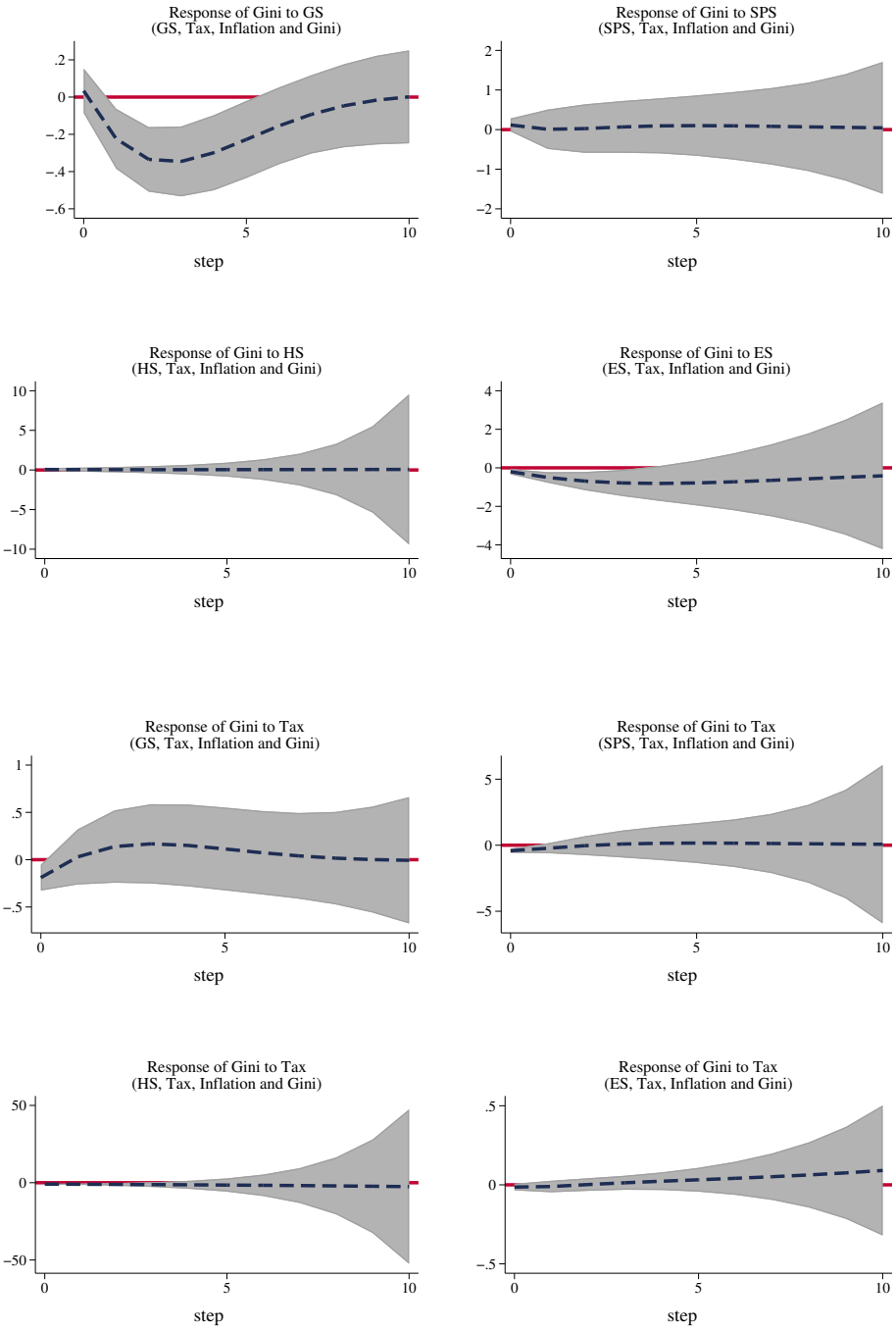
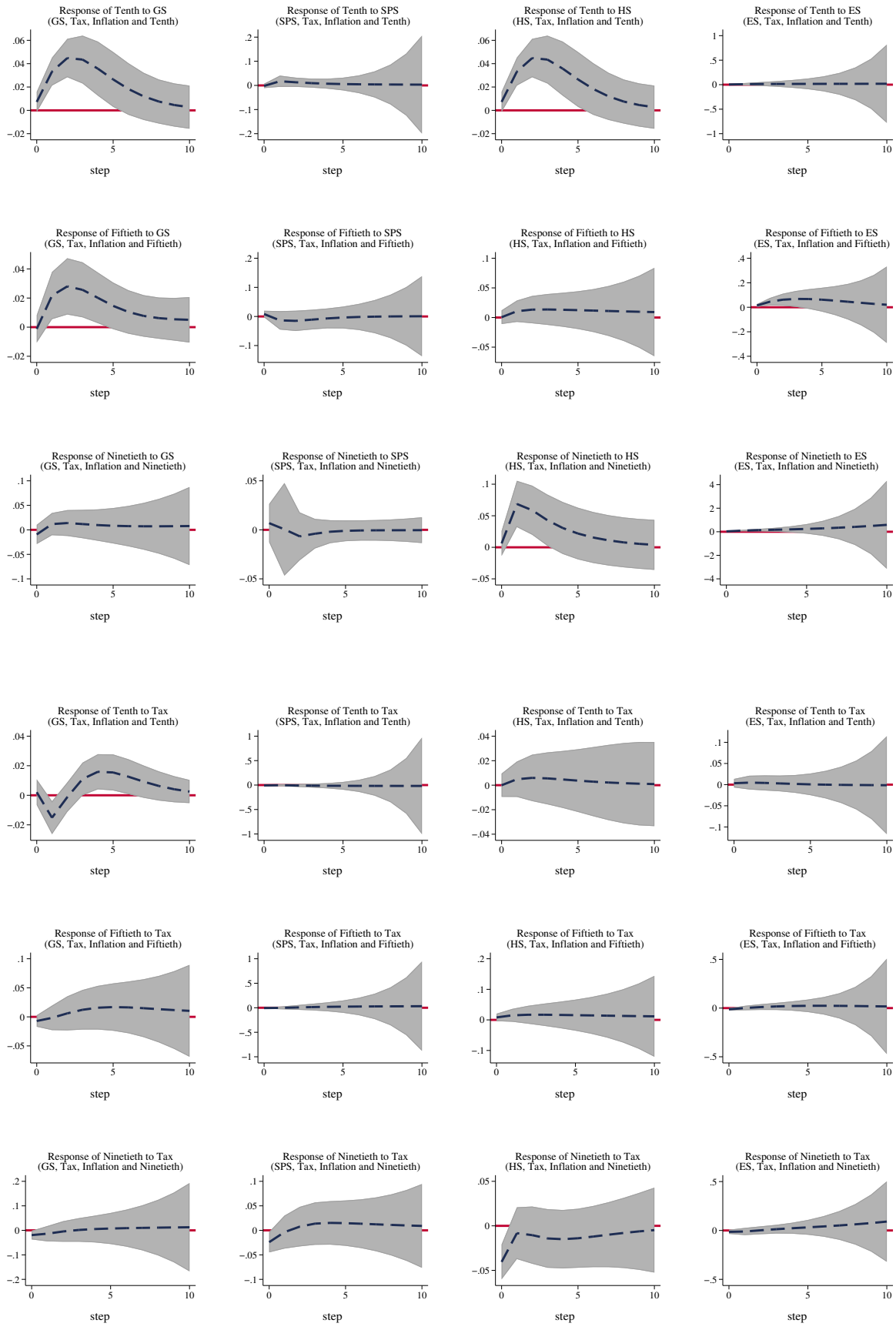


Figure (F4) Impulse Responses: Spending and Tax Shocks on the Gini Index



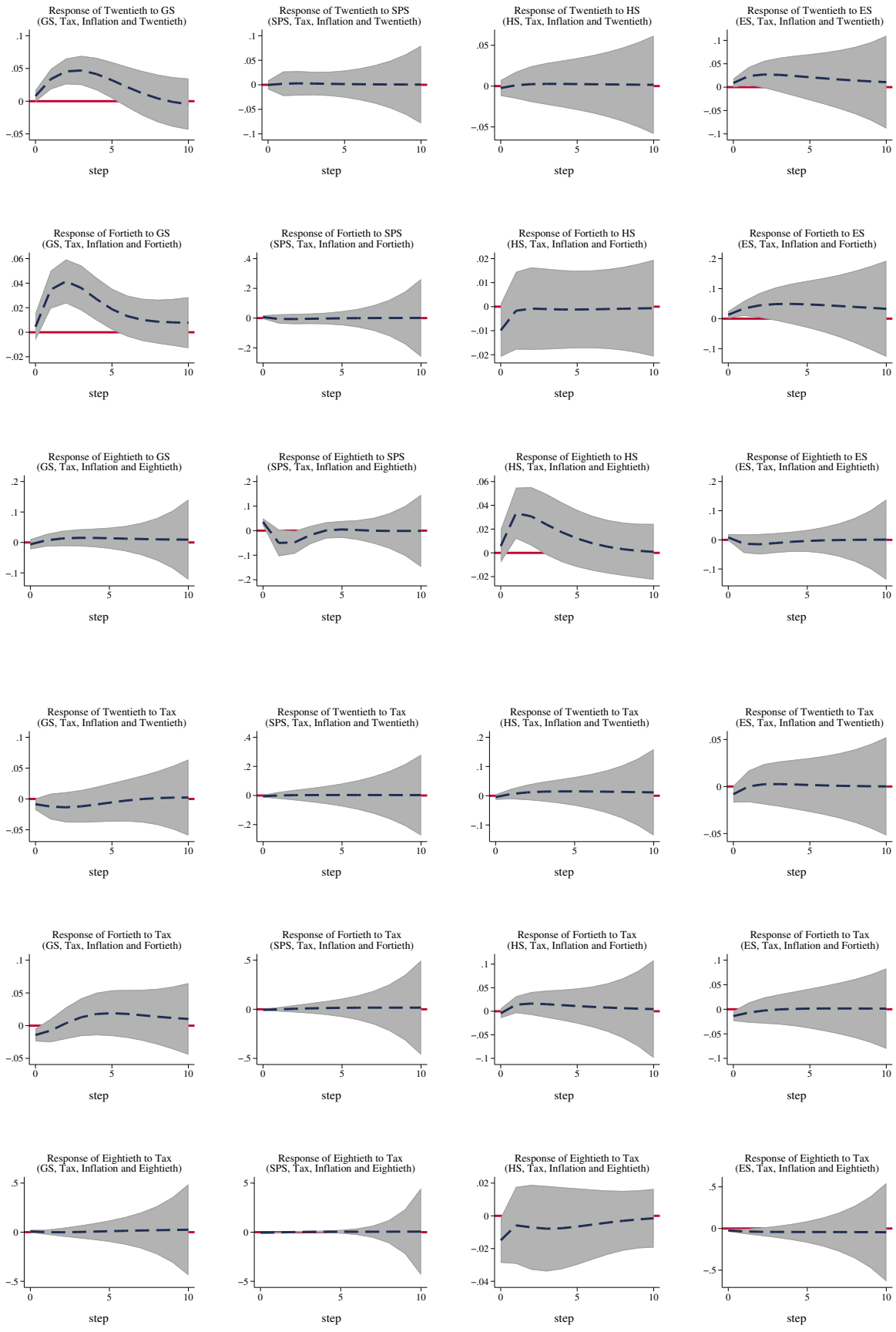
Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Figure (F5) Impulse Responses: Spending and Tax Shocks on the Tenth, Fiftieth and Ninetieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Figure (F6) Impulse Responses: Spending and Tax Shocks on the Twentieth, Fortieth and Eightieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Table (F8) Variance Decomposition: Gini, Tenth, Fiftieth and Ninetieth Percentiles

Gini Index																
Response variable and periods ahead	Impulse variable															
	GS, Tax, Inflation and Gini				SPS, Tax, Inflation and Gini				HS, Tax, Inflation and Gini				ES, Tax, Inflation and Gini			
Gini	GS	Tax	Inf	Gini	SPS	Tax	Inf	Gini	HS	Tax	Inf	Gini	ES	Tax	Inf	Gini
1	0.000	0.013	0.004	0.983	0.004	0.049	0.004	0.944	0.001	0.197	0.007	0.795	0.013	0.013	0.006	0.969
2	0.012	0.009	0.008	0.971	0.002	0.033	0.003	0.962	0.001	0.194	0.005	0.800	0.056	0.008	0.008	0.928
3	0.033	0.011	0.010	0.946	0.002	0.024	0.003	0.972	0.000	0.193	0.004	0.802	0.115	0.007	0.010	0.868
4	0.053	0.016	0.011	0.920	0.002	0.021	0.002	0.975	0.000	0.193	0.004	0.803	0.178	0.008	0.011	0.803
5	0.069	0.020	0.011	0.901	0.002	0.020	0.002	0.975	0.000	0.192	0.004	0.804	0.235	0.009	0.011	0.744
Tenth Percentile																
Response variable and periods ahead	Impulse variable															
	GS, Tax, Inflation and Tenth				SPS, Tax, Inflation and Tenth				HS, Tax, Inflation and Tenth				ES, Tax, Inflation and Tenth			
Tenth	GS	Tax	Inf	Tenth	SPS	Tax	Inf	Tenth	HS	Tax	Inf	Tenth	ES	Tax	Inf	Tenth
1	0.004	0.000	0.000	0.996	0.000	0.003	0.000	0.996	0.000	0.000	0.000	1.000	0.001	0.001	0.000	0.998
2	0.059	0.012	0.005	0.924	0.017	0.003	0.002	0.978	0.000	0.001	0.000	0.998	0.007	0.002	0.000	0.991
3	0.140	0.010	0.013	0.836	0.025	0.006	0.002	0.967	0.001	0.003	0.000	0.997	0.015	0.002	0.000	0.982
4	0.204	0.014	0.020	0.762	0.029	0.013	0.002	0.956	0.001	0.004	0.000	0.995	0.024	0.003	0.000	0.973
5	0.239	0.023	0.023	0.715	0.031	0.022	0.002	0.944	0.001	0.004	0.000	0.994	0.035	0.003	0.000	0.962
Fiftieth Percentile																
Response variable and periods ahead	Impulse variable															
	GS, Tax, Inflation and Fiftieth				SPS, Tax, Inflation and Fiftieth				HS, Tax, Inflation and Fiftieth				ES, Tax, Inflation and Fiftieth			
Fiftieth	GS	Tax	Inf	Fiftieth	SPS	Tax	Inf	Fiftieth	HS	Tax	Inf	Fiftieth	ES	Tax	Inf	Fiftieth
1	0.000	0.003	0.001	0.996	0.004	0.002	0.001	0.994	0.000	0.003	0.002	0.995	0.012	0.009	0.002	0.977
2	0.018	0.002	0.004	0.975	0.008	0.001	0.001	0.989	0.003	0.009	0.001	0.986	0.078	0.005	0.003	0.914
3	0.042	0.003	0.006	0.949	0.013	0.002	0.002	0.983	0.007	0.013	0.001	0.979	0.161	0.007	0.003	0.829
4	0.058	0.007	0.007	0.928	0.014	0.006	0.003	0.977	0.009	0.016	0.001	0.974	0.238	0.012	0.003	0.747
5	0.066	0.014	0.007	0.913	0.014	0.014	0.004	0.969	0.010	0.018	0.001	0.970	0.298	0.020	0.003	0.680
Ninetieth Percentile																
Response variable and periods ahead	Impulse variable															
	GS, Tax, Inflation and Ninetieth				SPS, Tax, Inflation and Ninetieth				HS, Tax, Inflation and Ninetieth				ES, Tax, Inflation and Ninetieth			
Ninetieth	GS	Tax	Inf	Ninetieth	SPS	Tax	Inf	Ninetieth	HS	Tax	Inf	Ninetieth	ES	Tax	Inf	Ninetieth
1	0.001	0.006	0.000	0.992	0.001	0.010	0.000	0.989	0.001	0.026	0.001	0.973	0.017	0.003	0.003	0.977
2	0.003	0.008	0.008	0.981	0.001	0.008	0.009	0.981	0.060	0.021	0.015	0.904	0.128	0.004	0.011	0.857
3	0.006	0.008	0.010	0.976	0.001	0.009	0.013	0.977	0.095	0.021	0.020	0.865	0.269	0.003	0.011	0.718
4	0.007	0.008	0.011	0.974	0.001	0.011	0.013	0.974	0.112	0.022	0.021	0.845	0.397	0.003	0.008	0.591
5	0.009	0.008	0.011	0.972	0.001	0.014	0.013	0.971	0.120	0.025	0.022	0.834	0.503	0.005	0.006	0.485

Table (F9) Variance Decomposition: Twentieth, Fortieth and Eightieth Percentiles

Twentieth Percentile																
Response variable and periods ahead	Impulse variable															
	GS, Tax, Inflation and Twentieth				SPS, Tax, Inflation and Twentieth				HS, Tax, Inflation and Twentieth				ES, Tax, Inflation and Twentieth			
Twentieth	GS	Tax	Inf	Twentieth	SPS	Tax	Inf	Twentieth	HS	Tax	Inf	Twentieth	ES	Tax	Inf	Twentieth
1	0.005	0.006	0.002	0.988	0.000	0.002	0.001	0.998	0.000	0.002	0.000	0.998	0.006	0.006	0.002	0.986
2	0.061	0.012	0.010	0.917	0.000	0.001	0.004	0.995	0.000	0.002	0.000	0.997	0.035	0.004	0.003	0.958
3	0.143	0.018	0.013	0.826	0.001	0.001	0.005	0.993	0.000	0.006	0.000	0.994	0.064	0.003	0.003	0.929
4	0.218	0.022	0.013	0.747	0.001	0.001	0.006	0.992	0.001	0.010	0.000	0.989	0.087	0.003	0.004	0.906
5	0.265	0.023	0.012	0.700	0.001	0.002	0.006	0.992	0.001	0.013	0.000	0.986	0.104	0.003	0.004	0.889
Fortieth Percentile																
Response variable and periods ahead	Impulse variable															
	GS, Tax, Inflation and Fortieth				SPS, Tax, Inflation and Fortieth				HS, Tax, Inflation and Fortieth				ES, Tax, Inflation and Fortieth			
Fortieth	GS	Tax	Inf	Fortieth	SPS	Tax	Inf	Fortieth	HS	Tax	Inf	Fortieth	ES	Tax	Inf	Fortieth
1	0.001	0.013	0.001	0.984	0.003	0.002	0.001	0.995	0.006	0.001	0.001	0.991	0.010	0.012	0.001	0.976
2	0.054	0.011	0.007	0.928	0.003	0.001	0.002	0.994	0.004	0.010	0.015	0.971	0.049	0.009	0.001	0.942
3	0.111	0.010	0.011	0.868	0.003	0.002	0.003	0.992	0.004	0.018	0.025	0.952	0.092	0.007	0.001	0.900
4	0.148	0.015	0.012	0.824	0.003	0.004	0.004	0.989	0.004	0.025	0.032	0.940	0.131	0.006	0.002	0.861
5	0.165	0.025	0.013	0.797	0.003	0.007	0.005	0.985	0.003	0.029	0.036	0.932	0.165	0.005	0.002	0.828
Eightieth Percentile																
Response variable and periods ahead	Impulse variable															
	GS, Tax, Inflation and Eightieth				SPS, Tax, Inflation and Eightieth				HS, Tax, Inflation and Eightieth				ES, Tax, Inflation and Eightieth			
Eightieth	GS	Tax	Inf	Eightieth	SPS	Tax	Inf	Eightieth	HS	Tax	Inf	Eightieth	ES	Tax	Inf	Eightieth
1	0.001	0.002	0.000	0.997	0.035	0.069	0.001	0.896	0.001	0.007	0.000	0.991	0.053	0.014	0.001	0.932
2	0.001	0.001	0.001	0.996	0.084	0.080	0.012	0.824	0.029	0.006	0.000	0.965	0.135	0.025	0.003	0.836
3	0.004	0.001	0.002	0.993	0.128	0.079	0.012	0.782	0.048	0.007	0.001	0.945	0.213	0.032	0.004	0.751
4	0.006	0.001	0.003	0.990	0.128	0.109	0.012	0.751	0.058	0.008	0.001	0.933	0.275	0.036	0.004	0.686
5	0.009	0.001	0.003	0.987	0.121	0.146	0.012	0.721	0.064	0.009	0.001	0.926	0.321	0.039	0.003	0.637

Appendix G. Brief Comparison between Middle- and High-Income Countries

Table (G1) Panel VAR Results: Gini Index

Regressors	Regressands											
	GS, Tax, and Gini			SPS, Tax, and Gini			HS, Tax, and Gini			ES, Tax, and Gini		
	GS	Tax	Gini	SPS	Tax	Gini	HS	Tax	Gini	ES	Tax	Gini
L.GS	0.678***	0.041	-0.055**									
	(0.088)	(0.026)	(0.026)									
L.SPS				0.380***	0.228	0.022						
				(0.116)	(0.165)	(0.076)						
L.HS							0.645***	1.551***	-0.050			
							(0.134)	(0.440)	(0.138)			
L.ES										0.683***	0.909***	-0.250**
										(0.083)	(0.199)	(0.098)
L.Tax	-0.120	0.631***	-0.112	0.054	0.722***	0.043	-0.131***	1.035***	-0.044	-0.109*	0.833***	-0.022
	(0.186)	(0.099)	(0.080)	(0.087)	(0.098)	(0.067)	(0.050)	(0.205)	(0.067)	(0.058)	(0.185)	(0.063)
L.Gini	0.037	-0.066	0.846***	0.361**	-0.239	0.926***	-0.109*	0.377	0.812***	-0.173**	0.423	0.792***
	(0.257)	(0.139)	(0.080)	(0.168)	(0.184)	(0.134)	(0.061)	(0.277)	(0.093)	(0.072)	(0.268)	(0.081)
Observations	379	379	379	362	362	362	362	362	362	362	362	362
Countries	43	43	43	43	43	43	43	43	43	43	43	43
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (G2) Panel VAR Results: Tenth Percentile

Regressors	Regressands											
	GS, Tax, and Tenth			SPS, Tax, and Tenth			HS, Tax, and Tenth			ES, Tax, and Tenth		
	GS	Tax	Tenth	SPS	Tax	Tenth	HS	Tax	Tenth	ES	Tax	Tenth
L.GS	0.869***	-0.095***	0.008***									
	(0.065)	(0.026)	(0.003)									
L.SPS				0.822***	-0.185*	-0.009						
				(0.129)	(0.097)	(0.019)						
L.HS							0.690***	0.188	-0.004			
							(0.193)	(0.130)	(0.016)			
L.ES										0.890***	0.344**	0.073**
										(0.159)	(0.175)	(0.031)
L.Tax	0.158	0.460***	-0.003	0.263**	0.760***	-0.021*	-0.132**	0.573***	0.002	-0.079*	0.672***	-0.006
	(0.160)	(0.091)	(0.011)	(0.104)	(0.083)	(0.012)	(0.056)	(0.072)	(0.012)	(0.042)	(0.087)	(0.015)
L.Tenth	0.250	-0.158	0.767***	0.263	0.995	0.720***	-0.396	0.316	0.821***	0.517	2.009***	0.821***
	(1.197)	(0.535)	(0.083)	(0.855)	(0.644)	(0.129)	(0.289)	(0.510)	(0.093)	(0.360)	(0.717)	(0.124)
Observations	379	379	379	362	362	362	362	362	362	362	362	362
Countries	43	43	43	43	43	43	43	43	43	43	43	43
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (G3) Panel VAR Results: Fiftieth Percentile

Regressors	Regressands											
	GS, Tax, and Fiftieth			SPS, Tax, and Fiftieth			HS, Tax, and Fiftieth			ES, Tax, and Fiftieth		
	GS	Tax	Fiftieth	SPS	Tax	Fiftieth	HS	Tax	Fiftieth	ES	Tax	Fiftieth
L.GS	0.427***	-0.020	0.007***									
	(0.087)	(0.022)	(0.003)									
L.SPS				-0.079	-0.397	-0.004						
				(0.322)	(0.247)	(0.026)						
L.HS							0.410**	0.403**	0.014			
							(0.194)	(0.187)	(0.022)			
L.ES										0.811***	0.408***	0.023
										(0.091)	(0.132)	(0.015)
L.Tax	-0.491**	0.689***	-0.000	0.214	0.808***	0.005	-0.132***	0.678***	-0.004	-0.063**	0.662***	-0.008
	(0.244)	(0.077)	(0.008)	(0.131)	(0.118)	(0.011)	(0.043)	(0.064)	(0.008)	(0.027)	(0.064)	(0.007)
L.Fiftieth	-12.738***	3.041***	0.793***	-3.104	1.037	0.391**	-0.940**	1.365***	0.725***	0.087	0.255	0.767***
	(1.583)	(0.478)	(0.057)	(1.897)	(1.593)	(0.160)	(0.368)	(0.487)	(0.077)	(0.188)	(0.604)	(0.056)
Observations	379	379	379	362	362	362	362	362	362	362	362	362
Countries	43	43	43	43	43	43	43	43	43	43	43	43
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (G4) Panel VAR Results: Ninetieth Percentile

Regressors	Regressands											
	GS, Tax, and Ninetieth			SPS, Tax, and Ninetieth			HS, Tax, and Ninetieth			ES, Tax, and Ninetieth		
	GS	Tax	Ninetieth	SPS	Tax	Ninetieth	HS	Tax	Ninetieth	ES	Tax	Ninetieth
L.GS	0.793***	-0.045*	-0.002									
	(0.128)	(0.026)	(0.004)									
L.SPS				0.503***	0.080	0.031						
				(0.180)	(0.111)	(0.021)						
L.HS							0.723***	0.602***	-0.029			
							(0.130)	(0.176)	(0.024)			
L.ES										0.693***	0.647***	0.074***
										(0.075)	(0.083)	(0.014)
L.Tax	0.094	0.631***	0.001	0.065	0.767***	0.010	-0.079*	0.732***	-0.028*	-0.031	0.600***	-0.012
	(0.140)	(0.098)	(0.016)	(0.160)	(0.090)	(0.019)	(0.048)	(0.108)	(0.016)	(0.022)	(0.065)	(0.013)
L.Ninetieth	-1.346	0.866	0.366**	3.518**	0.605	0.451***	-0.273	3.176***	-0.033	0.473*	0.844	0.340***
	(1.845)	(0.984)	(0.160)	(1.370)	(0.779)	(0.147)	(0.486)	(1.136)	(0.138)	(0.244)	(0.640)	(0.111)
Observations	379	379	379	362	362	362	362	362	362	362	362	362
Countries	43	43	43	43	43	43	43	43	43	43	43	43
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (G5) Panel VAR Results: Twentieth Percentile

Regressors	Regressands											
	GS, Tax, and Twentieth			SPS, Tax, and Twentieth			HS, Tax, and Twentieth			ES, Tax, and Twentieth		
	GS	Tax	Twentieth	SPS	Tax	Twentieth	HS	Twentieth	Twentieth	ES	Tax	Twentieth
L.GS	0.889***	-0.052***	0.000									
	(0.073)	(0.020)	(0.003)									
L.SPS				0.595***	-0.057	-0.020						
				(0.117)	(0.102)	(0.013)						
L.HS							0.860***	0.236**	-0.016			
							(0.154)	(0.100)	(0.015)			
L.ES										0.887***	0.357***	0.040***
										(0.096)	(0.099)	(0.015)
L.Tax	0.043	0.625***	-0.007	0.131	0.739***	-0.007	-0.097**	0.588***	-0.018*	-0.022	0.609***	-0.023**
	(0.162)	(0.072)	(0.013)	(0.082)	(0.093)	(0.009)	(0.045)	(0.072)	(0.010)	(0.033)	(0.081)	(0.011)
L.Twentieth	0.058	0.058	0.695***	-0.542	2.537**	0.714***	-0.444	0.473	0.919***	-0.195	0.254	0.916***
	(1.681)	(0.670)	(0.105)	(0.963)	(1.108)	(0.148)	(0.404)	(0.680)	(0.105)	(0.365)	(0.846)	(0.119)
Observations	379	379	379	362	362	362	362	362	362	362	362	362
Countries	43	43	43	43	43	43	43	43	43	43	43	43
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (G6) Panel VAR Results: Fortieth Percentile

Regressors	Regressands											
	GS, Tax, and Fortieth				SPS, Tax, and Fortieth				HS, Tax, and Fortieth				ES, Tax, and Fortieth			
	GS	Tax	Fortieth		SPS	Tax	Fortieth		HS	Tax	Fortieth		ES	Tax	Fortieth	
L.GS	0.418***	-0.016	0.003													
	(0.081)	(0.020)	(0.003)													
L.SPS					0.213	-0.131	-0.030									
					(0.192)	(0.175)	(0.020)									
L.HS									0.742***	0.383***	-0.007					
									(0.167)	(0.135)	(0.015)					
L.ES													0.884***	0.366***	0.021	
													(0.090)	(0.119)	(0.014)	
L.Tax	-0.421*	0.727***	-0.014		0.175*	0.738***	0.009		-0.104**	0.641***	-0.010		-0.054*	0.671***	-0.012	
	(0.249)	(0.077)	(0.008)		(0.094)	(0.104)	(0.011)		(0.042)	(0.061)	(0.007)		(0.028)	(0.069)	(0.008)	
L.Fortieth	-12.276***	2.604***	0.790***		-2.872**	2.042	0.311*		-0.798**	1.266**	0.840***		-0.070	-0.308	0.837***	
	(1.667)	(0.525)	(0.063)		(1.402)	(1.526)	(0.177)		(0.372)	(0.538)	(0.079)		(0.247)	(0.682)	(0.069)	
Observations	379	379		362	362	362		362	362	362		362	362	362	362	
Countries	43	43	43		43	43	43		43	43	43		43	43	43	
Time FE	Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes	

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table (G7) Panel VAR Results: Eightieth Percentile

Regressors	Regressands											
	GS, Tax, and Eightieth			SPS, Tax, and Eightieth			HS, Tax, and Eightieth			ES, Tax, and Eightieth		
	GS	Tax	Eightieth	SPS	Tax	Eightieth	HS	Tax	Eightieth	ES	Tax	Eightieth
L.GS	0.796***	-0.093**	0.004									
	(0.100)	(0.041)	(0.003)									
L.SPS				0.791***	0.211	0.041						
				(0.221)	(0.237)	(0.037)						
L.HS							0.895***	0.583***	-0.103***			
							(0.087)	(0.213)	(0.027)			
L.ES										0.944***	0.629***	0.016
										(0.148)	(0.227)	(0.028)
L.Tax	0.005	0.734***	-0.019	-0.062	0.782***	-0.018	-0.021	0.620***	-0.015	-0.008	0.748***	-0.016
	(0.140)	(0.142)	(0.015)	(0.103)	(0.122)	(0.018)	(0.027)	(0.071)	(0.010)	(0.036)	(0.094)	(0.011)
L.Eightieth	-1.019	0.472	-0.244	1.032	1.662	0.059	0.243	2.193**	-0.053	0.941*	1.718	0.035
	(2.800)	(2.104)	(0.235)	(1.304)	(1.684)	(0.285)	(0.385)	(1.031)	(0.145)	(0.544)	(1.388)	(0.183)
Observations	379	379	379	362	362	362	362	362	362	362	362	362
Countries	43	43	43	43	43	43	43	43	43	43	43	43
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The Table provides the parameter estimates obtained from regressing the column variables on the row variables. The parentheses contain the standard errors. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Figure (G1) Stability Condition: Gini Index

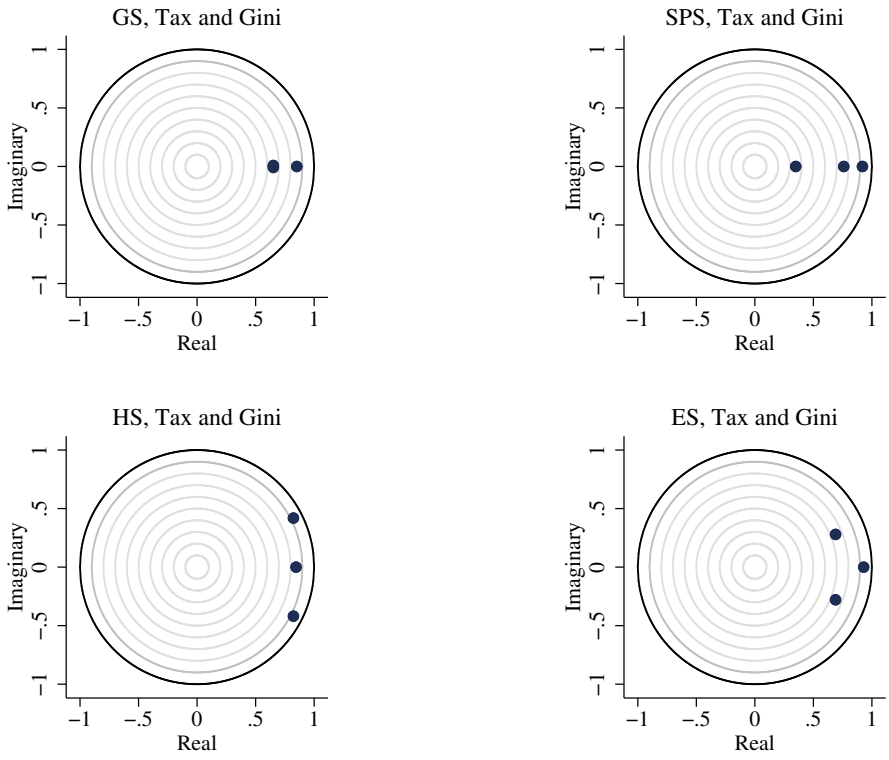


Figure (G2) Stability Condition: Tenth, Fiftieth and Ninetieth Percentiles

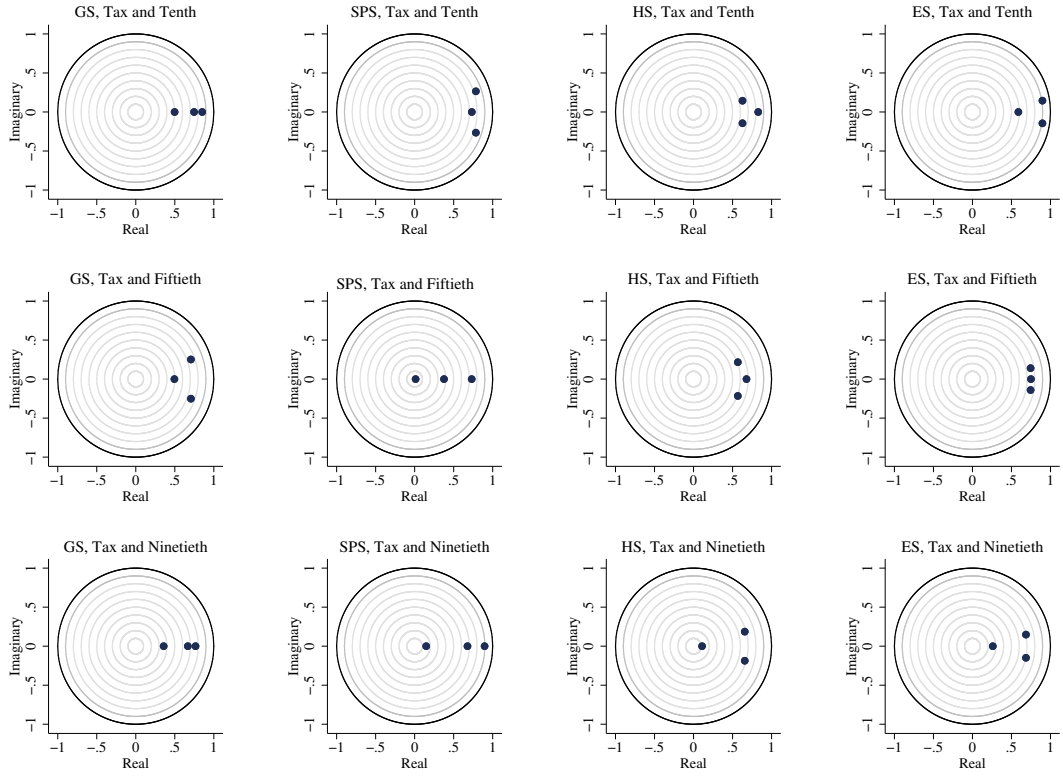


Figure (G3) Stability Condition: Twentieth, Fortieth and Eightieth Percentiles

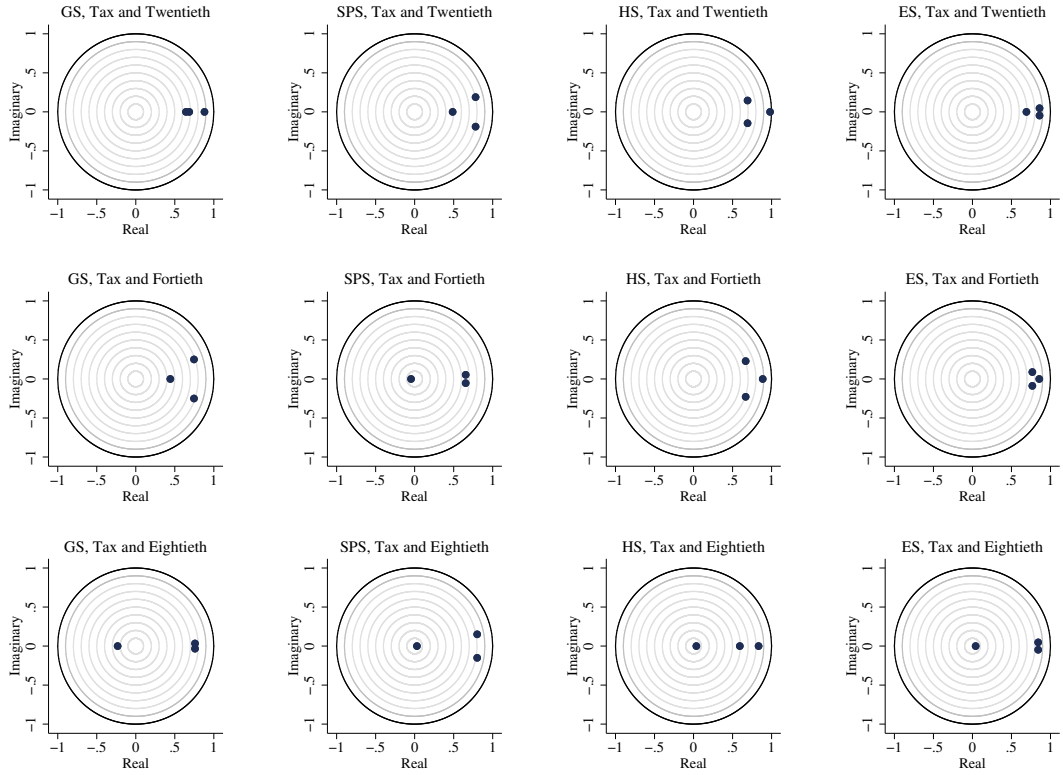
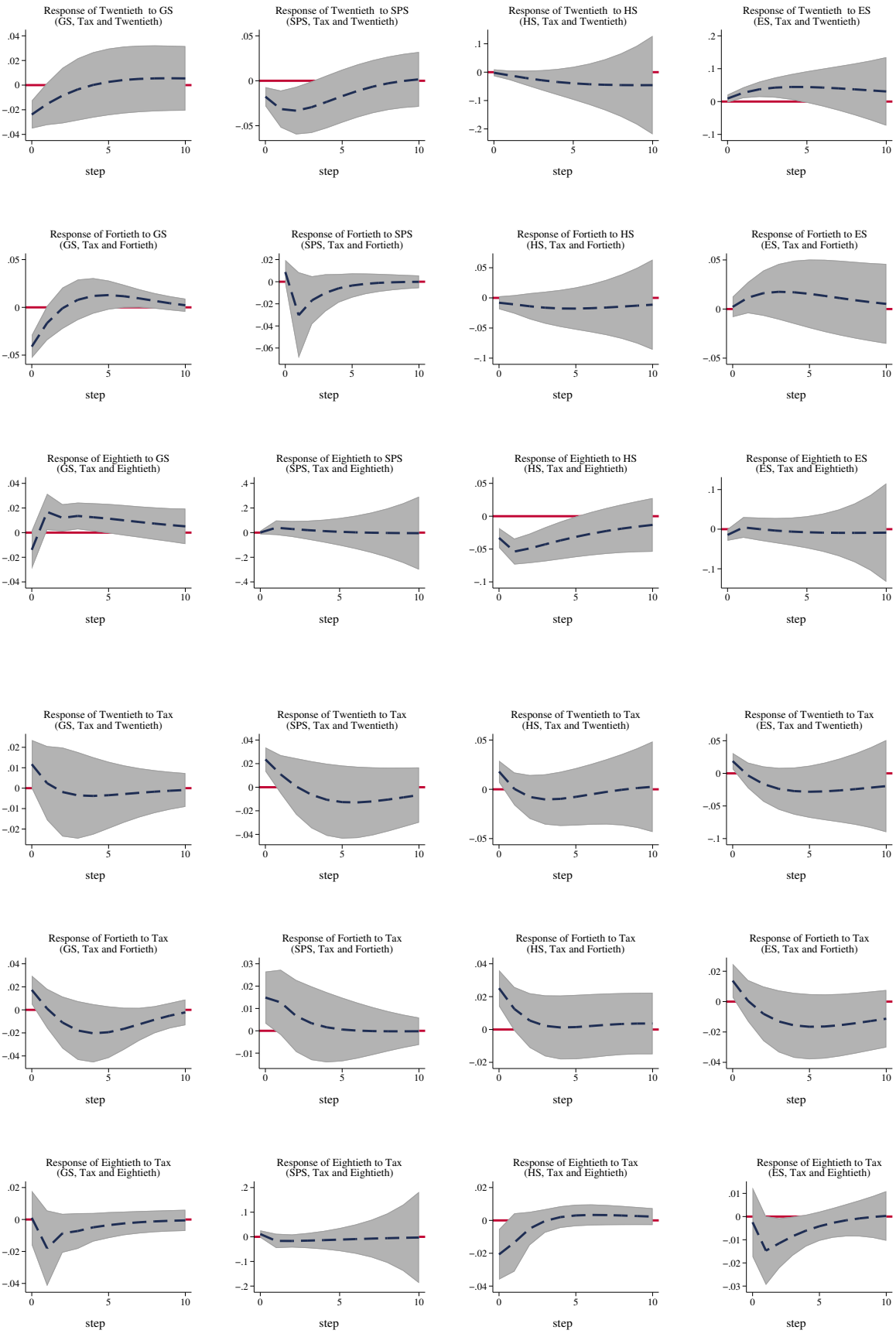


Figure (G4) Impulse Responses: Spending and Tax Shocks on the Twentieth, Fortieth and Eightieth Percentiles



Note: The dashed blue lines denote the point estimates of the response of the relevant income distribution variable to the respective government spending shocks. The shaded regions represent the corresponding 90 percent confidence intervals.

Table (G8) Variance Decomposition: Twentieth, Fortieth and Eightieth Percentiles

Twentieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax and Twentieth			SPS, Tax and Twentieth			HS, Tax and Twentieth			ES, Tax and Twentieth		
Twentieth	GS	Tax	Twentieth	SPS	Tax	Twentieth	HS	Tax	Twentieth	ES	Tax	Twentieth
1	0.028	0.007	0.965	0.020	0.035	0.945	0.000	0.018	0.982	0.005	0.019	0.977
2	0.027	0.005	0.968	0.053	0.027	0.919	0.004	0.010	0.986	0.023	0.010	0.966
3	0.025	0.004	0.970	0.082	0.023	0.895	0.012	0.008	0.980	0.045	0.013	0.942
4	0.024	0.004	0.972	0.102	0.022	0.876	0.023	0.008	0.968	0.065	0.020	0.915
5	0.023	0.005	0.972	0.114	0.025	0.861	0.037	0.009	0.954	0.084	0.027	0.889
Fortieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax and Fortieth			SPS, Tax and Fortieth			HS, Tax and Fortieth			ES, Tax and Fortieth		
Fortieth	**GS**	Tax	Fortieth	SPS	Tax	Fortieth	HS	Tax	Fortieth	ES	Tax	Fortieth
1	0.068	0.012	0.920	0.005	0.014	0.981	0.004	0.038	0.958	0.000	0.011	0.988
2	0.050	0.008	0.943	0.054	0.021	0.926	0.006	0.028	0.965	0.005	0.007	0.988
3	0.042	0.009	0.949	0.066	0.022	0.913	0.010	0.023	0.967	0.011	0.007	0.982
4	0.041	0.015	0.944	0.070	0.022	0.908	0.015	0.020	0.965	0.016	0.010	0.974
5	0.043	0.023	0.934	0.071	0.022	0.907	0.021	0.018	0.961	0.021	0.014	0.965
Eightieth Percentile												
Response variable and periods ahead	Impulse variable											
	GS, Tax and Eightieth			SPS, Tax and Eightieth			HS, Tax and Eightieth			ES, Tax and Eightieth		
Eightieth	**GS**	Tax	Eightieth	SPS	Tax	Eightieth	HS	Tax	Eightieth	ES	Tax	Eightieth
1	0.005	0.000	0.995	0.000	0.004	0.996	0.037	0.014	0.949	0.008	0.000	0.992
2	0.012	0.008	0.980	0.050	0.013	0.938	0.121	0.019	0.860	0.009	0.009	0.983
3	0.015	0.010	0.975	0.075	0.021	0.905	0.180	0.018	0.802	0.009	0.014	0.978
4	0.020	0.011	0.969	0.085	0.027	0.887	0.220	0.017	0.763	0.009	0.016	0.975
5	0.024	0.012	0.965	0.089	0.032	0.878	0.248	0.017	0.736	0.011	0.018	0.972