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Fiscal policy and dimensions of inequality in South Africa: A time-varying coefficient approach

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Abstract

South Africa continues to face high inequality levels despite its progressive tax and extensive social protection systems. We compare the dynamic impact of fiscal policy on the distribution of incomes, wages, and wealth in South Africa from 1993 to 2019. For this purpose, we use a time-varying parameter vector autoregression to estimate the impact of direct tax revenue and total transfer spending on three distinct inequality datasets. The analysis of various dimensions of inequality is the main contribution of the paper as the literature typically focuses on income inequality. A second contribution lies in the incorporation of time-varying effects which enables the analysis of the changing relationship between fiscal policy and inequality. The results suggest that this relationship is indeed time-varying and that the impact of direct taxes and transfers differs markedly across the inequality dimensions, both in terms of magnitude and sign. Overall, we find that both transfers and direct taxes have not significantly reduced income, wage or wealth inequality in South Africa.

Keywords: income inequality, wage inequality, wealth inequality, fiscal policy, TVP-VAR

JEL Classification: C32, D31, E62

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1. Introduction

South Africa continues to struggle with stubbornly high levels of inequality despite its progressive tax and extensive social protection systems—indeed, it is often cited as the country with the most unequal distribution of income and wealth.[2] In 2019, the top 10 per cent of the population aged 20 and over earned 66 per cent of pre-tax income (Chatterjee, Czajka & Gethin, 2021:4). Although social protection in the form of cash transfers to households increased from 2.9 per cent to 5.4 per cent of GDP from 2000 to 2019 (Sachs, 2021:6), the overall distribution of income and wealth remained unchanged since the 1990s (Hundenborn, Leibbrandt & Woolard, 2018:3, Chatterjee, Czajka & Gethin, 2022:29). To date, the available macroeconomic evidence on the distributional impact of fiscal policy remains limited. It is thus puzzling to observe a highly redistributive fiscal system and persistently high inequality.

Our aim is to compare the dynamic impact of fiscal policy on the distribution of incomes, wages, and wealth in South Africa. We use a time-varying parameter vector autoregression (TVP-VAR) to estimate the impact of direct tax revenue and total transfer spending, over the period 1993 to 2019, on three distinct inequality datasets.[3] A large literature, including Cogley and Sargent (2001), Primiceri (2005) and Nakajima (2011), has established the effectiveness of employing a TVP-VAR for the analysis of macroeconomic matters. The evolving characteristics of the underlying structure in the economy can be captured with this model.

Three conclusions are made based on the brief literature review in Section 2. Firstly, there does not seem to be a consensus in the literature about the effectiveness of fiscal policy in addressing inequalities. For example, while Inchauste and Lustig (2017) find that indirect taxes are neutral, Chatterjee *et al*. (2021) find they increase income inequality. Goldman, Woolard and Jellema (2021) find that direct taxes reduce income inequality, but Getachew and Turnovsky (2020) find the opposite. Secondly, current research is based on income inequality. The distributional impact of fiscal policy on alternative dimensions of inequality remains to be explored. Thirdly, most studies employ fiscal incidence analysis. There is a shortage of papers adopting macroeconomic and econometric approaches. There is thus scope for research on various dimensions of inequality using a dynamic model that incorporates feedback effects.

The contribution of this paper is two-fold. Firstly, the paper takes a multi-dimensional approach to inequality by analysing income, wage and wealth inequality in a single model. This enables a comparison of the fiscal policies' impact across the various dimensions. Secondly, the paper adds to the South African literature on the distributional impact of fiscal policy by employing a TVP-VAR model. This model incorporates feedback effects as well as the time-varying effects of fiscal policy on inequality. The changing nature of the relationship between fiscal

[2] The share of wealth owned by the wealthiest 10 per cent of the South African population aged 20 and over stood at 85 per cent in 2019 (World Inequality Lab, 2023).

[3] Wealth inequality entails the distribution of financial and non-financial assets excluding liabilities (Chatterjee, 2019:843). Income inequality refers to the distribution of all sources of income such as capital and labour income, whilst wage inequality only involves the distribution of labour income (Leibbrandt & Pabón, 2021:177).

policy and inequality over time can therefore be analysed.[4] The results of the paper suggest that the impact of direct tax revenue and total transfer spending differs across the inequality dimensions. A direct tax shock had an insignificant impact on income inequality across the sample but had a positive impact on wealth inequality from the early 2000s until 2012. The tax shock had a positive effect on wage inequality during the 1990s and early 2000s, but from 2011 onwards it had a slight negative effect. A transfer shock reduced income inequality at certain points in the sample period, and reduced wealth inequality from 2004 onwards, but had an insignificant impact on wage inequality. Both transfers and direct taxes therefore has not significantly reduced income, wage or wealth inequality in South Africa.

A brief literature review is presented in section 2. Section 3 discusses the econometric model employed in the paper followed by the data utilised in section 4. Section 5 presents and discusses the results. Section 6 concludes.

2. Brief literature review

Although inequality is multifaceted, the South African literature has typically focused on income inequality. However, income inequality does not provide a comprehensive overview of inequality dynamics (Stewart & Samman, 2014:99). All three aspects of income, wage and wealth inequality influence one another. For example, an individual's access to wealth partly determines their access to health and education, both of which affect productivity and therefore the ability to generate income (Chatterjee, 2019:840). Access to income, in turn, also affects wealth inequality since excess income can be saved which can be used to accumulate wealth over time. Additionally, wage inequality influences both income and wealth inequality, since unemployment and earnings differentials among skilled and unskilled labour are important drivers of income inequality (Leibbrandt & Pabón, 2021:177). This paper focuses on these three dimensions to better understand the distributional impact of fiscal policy.

The methodology employed in the literature can be classified into three groups: fiscal incidence analysis, econometric modelling and macroeconomic modelling. The first approach analyses the effect of taxes and spending on the income distribution by comparing the Gini coefficient before and after taxes and transfers. Extensive work has been done in South Africa using fiscal incidence analysis. Inchauste and Lustig (2017), Maboshe and Woolard (2018), Chatterjee *et al*. (2021) and Goldman *et al*. (2021) analyse the impact of direct transfers, in-kind transfers, and direct and indirect taxes on income inequality. Their results show that direct taxes, direct (cash) transfers, and in-kind (goods and services) transfers all reduce the Gini coefficient and thus reduce income inequality. Results differ on the impact of indirect tax.[5] There thus seems to be a consensus on the inequality-reducing impact of transfers and direct taxes, but not indirect taxes. However, other methodologies have found different results.

[4] The importance of analysing the time-varying relationship between fiscal policy and inequality has been highlighted by Hailemariam, Sakutukwa and Dzhumashev (2021).
[5] Inchauste and Lustig (2017:255) find that indirect taxes do not affect income inequality, whilst Goldman *et al*. (2021:24) and Chatterjee *et al*. (2021:26) find that it increases income inequality.

In contrast to this more extensive literature, very few papers have used econometric and macroeconomic models. Nuru and Zeratsion (2022) use a VAR to estimate the impact of government investment and consumption. They extend their focus beyond social spending. Income inequality is measured by the labour income share, contrary to most studies that use the Gini coefficient (Nuru & Zeratsion, 2022:695). The higher labour's income share relative to capital, the lower income inequality since capital ownership is highly concentrated. Their results show that consumption and investment shocks increase the labour income share and thus reduce income inequality (Nuru & Zeratsion, 2022:700).[6]

Getachew and Turnovsky (2020:270) calibrate a heterogeneous agent overlapping generations model with incomplete capital markets and find that both the direct income tax and the indirect consumption tax theoretically increase income inequality. The inequality-increasing impact of the direct tax contrasts the results of the fiscal incidence literature. However, the inequality-increasing impact of indirect tax confirms the results of Chatterjee *et al*. (2021) and Goldman *et al*. (2021). The model predicts that transfers slightly decrease inequality.[7]

From the literature review, it is evident that there is no consensus about the success of fiscal policy in addressing inequalities since results differ across studies. Secondly, most research is based on income inequality. This could mainly be due to data constraints. Thirdly, most studies employ fiscal incidence analysis while macro and econometric models remain under-explored.

3. Methodology

In this paper, a TVP-VAR is employed. This model estimates the dynamic effect of fiscal shocks through impulse response functions (IRFs). IRFs show how a shock to one variable affects the behaviour of other variables over time (de Souza Cardoso & de Carvalho, 2023:1184). Employing such a model is thus valuable since the relationship between fiscal policy and inequality is likely dynamic, and not static. Indeed, the work of Cogley and Sargent (2001), Primiceri (2005) and Nakajima (2011) has established the usefulness of employing a TVP-VAR when analysing macroeconomic-related topics.

In a standard VAR, the variables are regarded as endogenous and hence estimated simultaneously (Davtyan, 2016:38). However, a VAR only estimates one set of coefficients since a constant relationship between the variables is assumed. A TVP-VAR allows the relationship between the variables to change by allowing the estimated coefficients to vary (Chan, Eisenstat & Strachan, 2020:106). In other words, the processes that generate the variables are allowed to change over the sample period. A TVP-VAR thus captures the time-varying effects of fiscal policy on inequality.

In the international literature, Hailemariam *et al*.(2021) find that the results differ across their VAR and time-varying nonparametric model. In the VAR, government spending reduces

[6] See Omilola and Akanbi (2014) for a second paper that uses an econometric model to analyse the impact of total tax revenue and public investment on income and social (education and land access) inequality.

[7] Kavese and Phiri (2020)'s calibrated computable general equilibrium model also suggests that government spending reduces the income Gini to a negligible degree which contrasts the spending results of other studies.

income inequality. In the time-varying model, government spending has a statistically insignificant effect on income inequality (Hailemariam *et al*., 2021:1953). Allowing for time-varying effects is therefore important since the relationship between fiscal policy and inequality can change over time.

To see whether this is the case for South Africa, a standard Bayesian VAR (BVAR) with constant coefficients is employed to compare the results to that of the TVP-VAR. The model description and results are available in Appendix A. As in the case of Hailemariam *et al*. (2021) the results indeed differ when allowing for the time-varying effects of fiscal policy. In the BVAR, most of the results are statistically insignificant which suggests that the fiscal instruments analysed do not have an impact on income, wage or wealth inequality. This is not the case in the TVP-VAR, however. The impact of fiscal policy on the three inequality datasets differs across the sample, as pointed out in the results section. In some years, fiscal policy does have a statistically significant impact. This suggests that the relationship between fiscal policy and inequality changes over time, which supports the use of the TVP-VAR to incorporate these time-varying effects. The TVP-VAR will therefore provide valuable insight into the distributional impact of the fiscal policies.

In addition to the BVAR, a Chow test was conducted on each of the inequality series to assess the presence of structural breaks. The null hypothesis positing no structural break was rejected for all three series at a significance level of one per cent. This rejection provides evidence of a structural break in these series, indicating a change in the data-generating process and, consequently, in the relationship between the variables over the sample period. Since a TVP-VAR enables the data-generating process to vary over time, the presence of these structural breaks serves as additional justification for employing a TVP-VAR.

This paper follows the approach of Chan *et al*. (2020) in estimating a TVP-VAR with stochastic volatility using Bayesian estimation. The model allows for variation in the coefficients and the covariance matrix of the errors. The structural form of the TVP-VAR model is presented below.

$$B_{0,t}y_t = \mu_t + B_{1,t}y_{t-1} + \cdots + B_{p,t}y_{t-p} + \varepsilon_t, \;\; \varepsilon_t \sim N(0, \Sigma_t) \tag{1}$$

y_t is a $n\ x\ 1$ vector of endogenous variables for $t = 1, \dots, T$. μ_t is a $n\ x\ 1$ vector of time-varying intercepts, $B_{0,t}, \dots, B_{p,t}$ are $n\ x\ n$ matrices of time-varying coefficients, and ε_t is a $n\ x\ 1$ vector of structural shocks. Σ_t is the diagonal matrix where $\Sigma_t = diag\left(\exp\left(h_{1,t}\right), \dots, \exp\left(h_{n,t}\right)\right)$ (Chan *et al*., 2020:107). Each equation in the TVP-VAR therefore consists of an intercept and p lags of the n variables. The $B_{0,t}$ matrix is a lower triangular matrix with ones on the diagonal, as is standard in the literature (Primiceri, 2005:824). The matrix can therefore be written as $B_{0,t} = I - B_t$ where the B_t matrix has zeros on the diagonal. Equation 1 therefore becomes

$$y_t = \mu_t + B_t y_t + B_{1,t}y_{t-1} + \cdots + B_{p,t}y_{t-p} + \varepsilon_t. \tag{2}$$

Equation 2 can be rewritten as

$$y_t = \mu_t + (y_t' \otimes I_n)Db_t + (y_{t-1}' \otimes I_n)b_{1,t} + \cdots + \left(y_{t-p}' \otimes I_n\right)b_{p,t} + \varepsilon_t \tag{3}$$

where $Db_t = vec(B_t)$ with D a selection matrix and b_t a vector containing all the non-zero elements of B_t. Similarly, $b_{l,t} = vec(B_{l,t}), l = 1, \dots, p$ (Chan *et al*., 2020:108).

Define x_t as the $n\ x\ k$ matrix and α_t as the $k\ x\ 1$ vector of stacked coefficients as below

$$x_t = \begin{bmatrix} I_n & (y_t' \otimes I_n)D & (y_{t-1}' \otimes I_n) & \cdots & (y_{t-p}' \otimes I_n) \end{bmatrix} \quad (4)$$

$$\alpha_t = (\mu_t' \quad b_t' \quad b_{1,t}' \quad \cdots \quad b_{p,t}')' \quad (5)$$

such that $k = \left(np + 1 + \frac{n-1}{2}\right)n$ (Chan *et al*., 2020:108). Using the above, equation 3 can be rewritten as

$$y_t = x_t\alpha_t + \varepsilon_t, \ \ \varepsilon_t \sim N(0, \Sigma_t) \quad (6)$$

$$\alpha_t = \alpha_{t-1} + \eta_t, \ \ \eta_t \sim N(0, Q_\alpha), \ \ a_0 = \alpha \sim N(\underline{\alpha}, \underline{V}) \quad (7)$$

$$h_t = h_{t-1} + \eta_{h,t}, \ \ \eta_{h,t} \sim N(0, Q_h). \quad (8)$$

Equation 6 represents the standard measurement equation. Equations 7 and 8 are the state equations for α_t and h_t, respectively. In terms of prior selection of the model, we use a stochastic variable selection prior combined with a Minnesota prior as in Chan *et al*. (2020).

A TVP-VAR of order one is estimated. Only one lag is modelled to keep the TVP-VAR parsimonious. Four variables are included in the model namely a measure of fiscal policy, a measure of inequality and two factors that incorporate information on macroeconomic conditions. These variables are discussed in the following section.

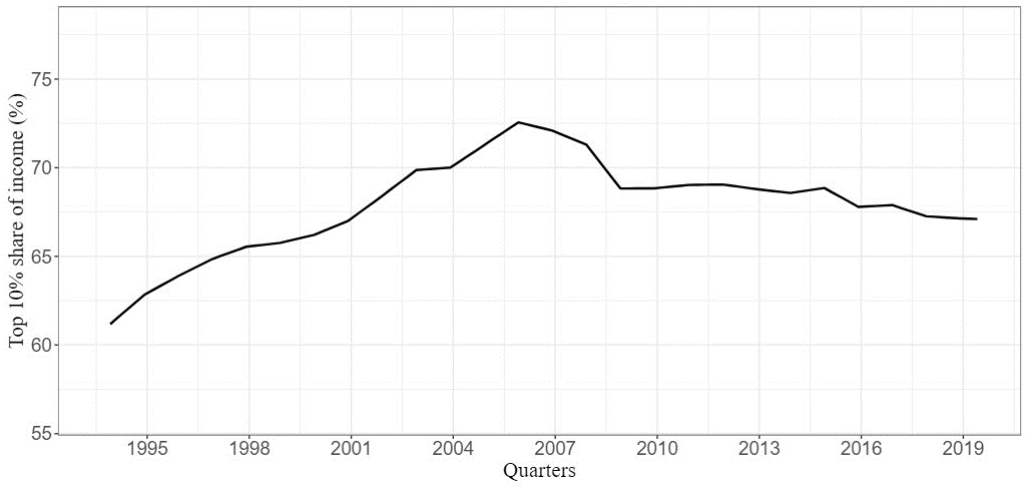
4. Data

4.1 Inequality data

Obtaining inequality data for time series analyses poses a challenge. Despite the range of surveys available in South Africa, incomparability between surveys and waves within surveys render these sources of inequality data problematic for time series analyses (Merrino, 2020:1). Furthermore, since wealthier households are less willing to accurately disclose their income and wealth, surveys underrepresent the upper tail of the distribution (Leibbrandt & Pabón, 2021:178). Although popular international databases such as the Standardized World Income Inequality Database provide comparable time series data, they mostly rely on survey data.

The income inequality data employed in this paper is obtained from Chatterjee *et al*. (2021) (see Figure 1). Survey, national accounts and tax data were combined to construct a time series of the pre-tax income share of the top 10 per cent of the population aged 20 and over. This data is comparable over time and captures a larger portion of the income distribution since it combines survey and tax data. The data is thus more reliable than data that only rely on surveys.

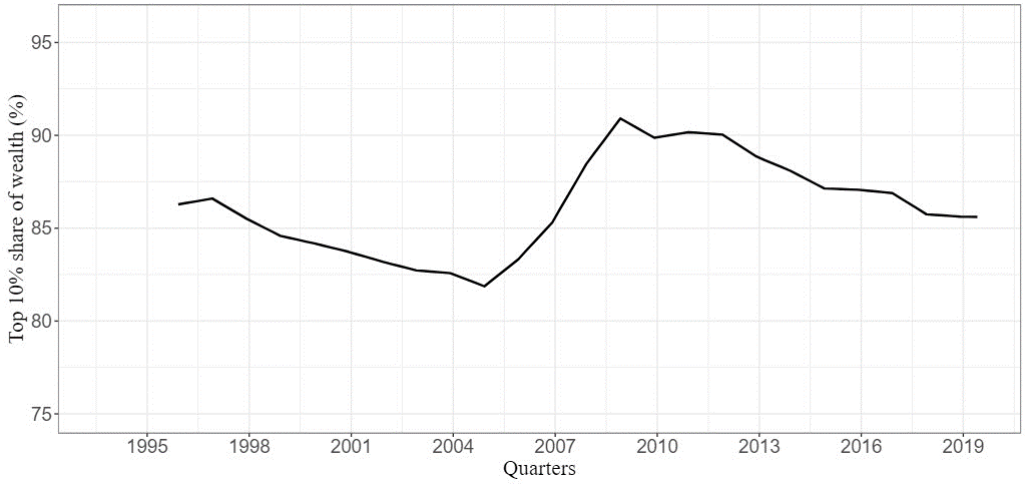
Figure 1: Income inequality series, 1993 – 2019



Source: Chatterjee et al. (2021)

Wealth inequality data is obtained from the World Inequality Database (WID) (World Inequality Lab, 2023). The WID takes a similar approach to Chatterjee *et al*. (2021) in combining survey, national accounts and tax data. The net personal wealth share held by the top 10 per cent of the population aged 20 and over is used as the measure of wealth inequality (see Figure 2). Net personal wealth refers to the value of non-financial and financial assets held by households, minus their debts. Although the Gini coefficient is frequently used in studies, income shares are also a popular measure in the international literature.[8] Whilst the Gini contains information on the entire distribution, it does so in one statistic and thus conceals changes in the distribution (Wittenberg, 2017:309). Income shares enable the analysis of changes in the income or wealth distribution at specific points in the distribution.

Figure 2: Wealth inequality series, 1995 – 2019



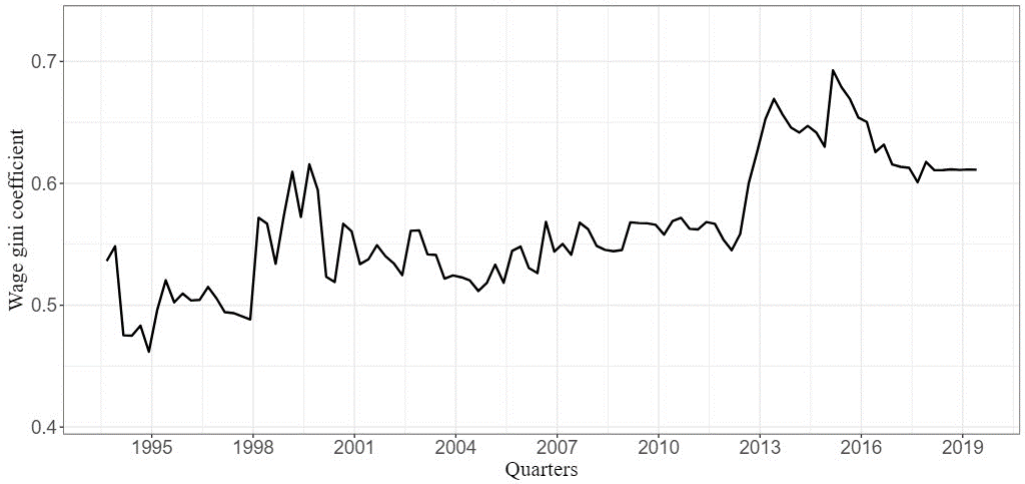
Source: World Inequality Lab (2023)

Wage inequality data is obtained from Merrino (2020) who used the Post-Apartheid Labour Market Series (PALMS)[9] to construct a series of the pre-tax wage income Gini (see Figure 3).

[8] See Furceri, Ge, Loungani & Melina (2022) and Hailemariam *et al*. (2021).
[9] The PALMS dataset was constructed by Kerr, Lam and Wittenberg (2019).

PALMS consists of an integrated set of labour market surveys that are designed to harmonize data between surveys, such that the data can be used for analyses over time (Finn & Leibbrandt, 2018:8). Merrino (2020) improved comparability by applying statistical corrections to the data. Although the series retains some comparability issues, and likely underrepresents the upper part of the wage distribution as it only consists of survey data, this is the best available wage inequality data for South Africa to our knowledge.

Figure 3: Wage inequality series, 1993 – 2019



Source: Merrino (2020)

4.2 Fiscal and macroeconomic data

This paper analyses fiscal policies that are specifically used by the government to address inequality through the redistribution of resources from wealthier to poorer households. The two fiscal variables analysed are direct tax revenue and total transfer spending (see Figure 4). Direct tax revenue is defined as the sum of national government tax revenue on income, profits, capital gains and property. Total transfers consist of cash payments on social benefits and grants by central government. This includes direct transfers such as the child support and old age grants, and in-kind transfers such as health and education-related transfers. The fiscal data is obtained from the South African Reserve Bank's (2022) Quarterly Bulletin.

The two factors included in the TVP-VAR to summarise information on macroeconomic conditions are constructed using principal component analysis. One cannot include too many variables in a TVP-VAR. As the number of variables increases, the parameters to estimate and the computational burden increase exponentially (Koop & Korobilis, 2013:185). However, including too few variables leads to omitted variable bias. To overcome this challenge, factors are used. Factors summarise information from a large number of variables and are thus a simple dimensionality reduction method (Bernanke, Boivin & Eliasz, 2005:390). The two factors employed in this paper are constructed from 21 macroeconomic variables as listed in Table 1 below. The list of variables was informed by the literature on factor-augmented VARs such as Bernanke *et al*. (2005). All the variables, except two, were sourced from the Quarterly Bulletin. The consumer price index was obtained from the Federal Reserve Economic Data (2023), while the business confidence index was obtained from the Bureau for Economic Research (2023).

Figure 4: Fiscal variables, 1993 – 2019

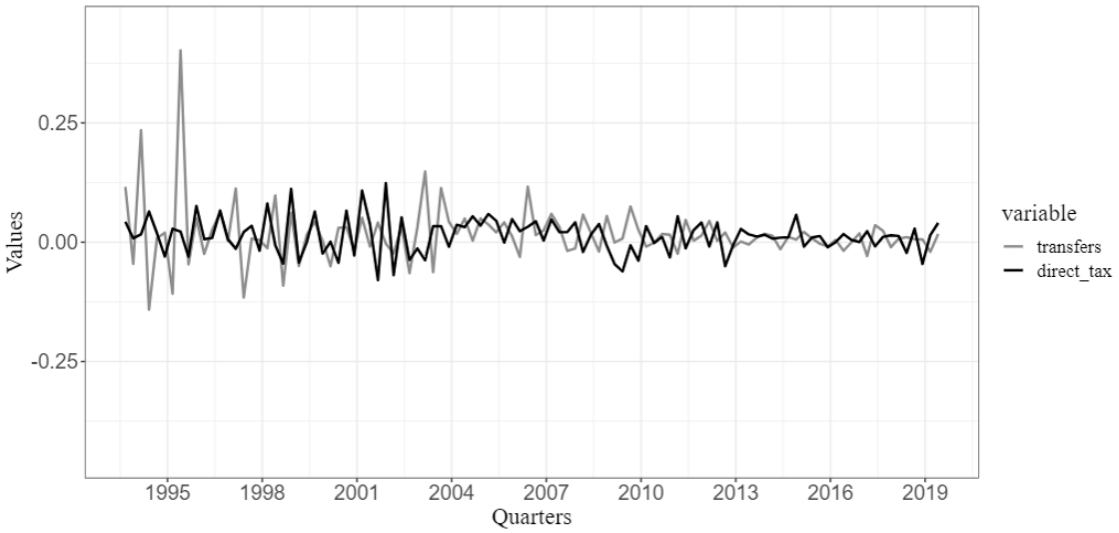


Table 1: Macroeconomic variables included in factors

Variable	Source
Gross domestic product	Quarterly Bulletin, South African Reserve Bank (2022)
Real effective exchange rate of the rand	
Bank rate (rediscount rate at SARB)	
10-year and over government bonds yield	
M3 money supply	
Final consumption expenditure by households	
Gross fixed capital formation of private business enterprises	
Gross fixed capital formation of public corporations	
Total volume of manufacturing production	
Total employment in the non-agricultural sectors	
Total remuneration per worker in the non-agricultural sector	
Buildings completed	
Retail sales	
Wholesale sales	
Number of new vehicles sold	
Total credit extended to the private sector	
Net credit extended to the government sector	
Exports of goods and services	
Imports of goods and services	
Consumer price index	Federal Reserve Economic Data (2023)
RMB/BER business confidence index	Bureau for Economic Research (2023)

All the macroeconomic and fiscal variables are in real terms and seasonally adjusted where applicable. All monthly and annual series are converted to quarterly frequency. Series that are naturally bounded are not stationarised. These variables include the three inequality series, the CPI, and rates used to construct the macroeconomic factors. Since these series are naturally bounded, non-stationarity is not problematic as these series are not explosive. The stationarity in the remaining variables needs to be addressed. For this purpose, the variables were transformed to growth rates. The Augmented Dickey-Fuller (ADF) test was conducted and indicated that all the variables are non-stationary in levels and stationary in growth rates, except for the M3 money supply and the credit extended to the private sector variables, both of which are used to construct the factors.[10] These two variables are non-stationary even after taking growth rates.

5. Results and discussion

The results of a shock to transfer spending is presented below followed by the results of a shock to direct tax revenue.

5.1 The impact of a transfer spending shock on inequality

The IRFs presented in Figure 5 graph the time-varying responses of income, wage and wealth inequality to a one-standard deviation shock in transfer spending on impact, at one quarter and four quarters after impact. The black line is the mean response of the inequality measure, and the shaded blue areas are the 68 per cent posterior confidence bands. These bands represent a span of values that encompasses the parameter with a 68 per cent likelihood and thus quantify the uncertainty in the estimated parameter (Chan *et al*., 2020:116).

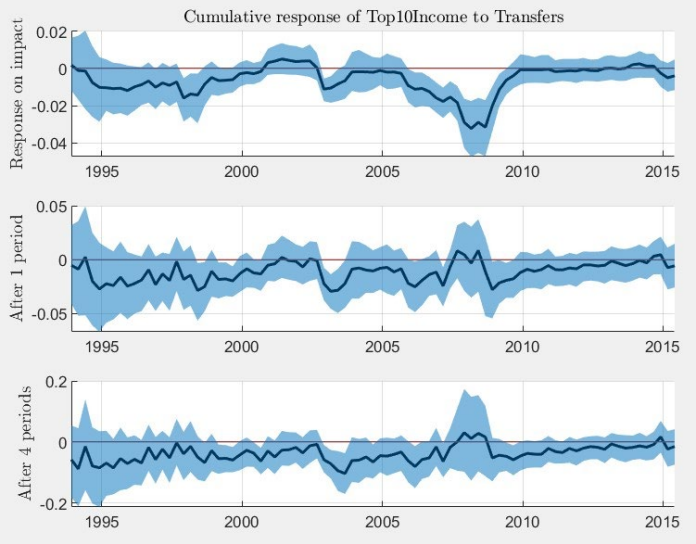
The impact of a transfer shock varies over time, specifically for income and wealth inequality. A transfer shock reduced the top 10 per cent's share of income on impact around 2003 and from 2006 to 2009, signalling a reduction in income inequality. For the remainder of the sample, and the longer run (after one and four quarters) the impact is insignificantly different from zero. This result might seem unexpected. At an individual level, transfers assist the poorer part of the distribution through grants such as the child support grant (Maboshe & Woolard, 2018:10, 13). These results show that there is an insignificant effect of transfers on the top 10 per cent's share of income. This could suggest that transfers are insufficient to reduce income inequality in a significant, lasting manner. This has frequently been proposed in the literature.[11]

Labour income and wage inequality have been identified as key drivers of income inequality (Finn & Leibbrandt, 2018:1). It is evident from Figure 5 that a transfer shock does not reduce the wage Gini in a significant manner. This could explain the small income inequality-reducing effect. Transfers do seem to affect wealth inequality, however. From around 2004 onwards a transfer shock reduced the top 10 per cent's wealth share which indicates reduced wealth inequality. This effect was larger during the years surrounding the Global Financial Crisis.

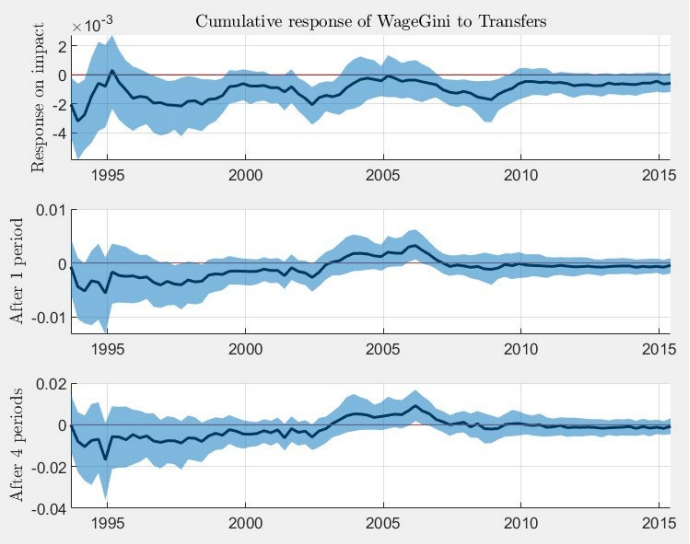
[10] ADF results are available upon request.
[11] For example, see Hundenborn *et al*. (2018), Chatterjee *et al*. (2021), and Leibbrandt and Pabón (2021).

Figure 5: Time-varying impulse responses to a transfer shock

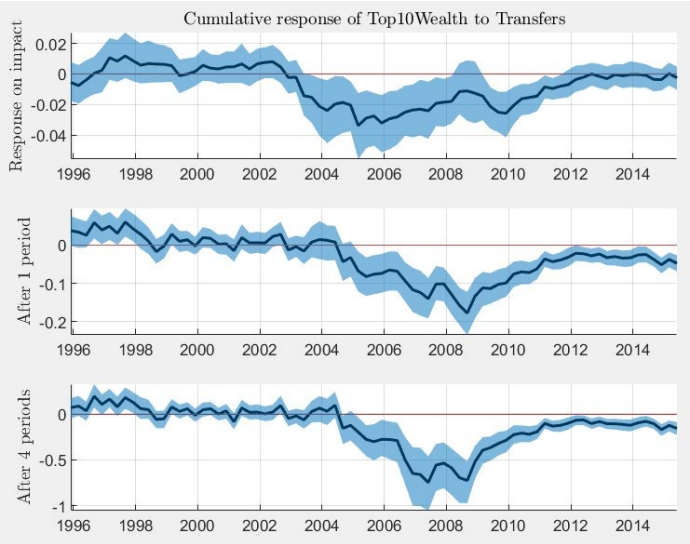
Income inequality



Wage inequality



Wealth inequality



Taken together, these results suggest that transfers reduced income inequality at certain points in the sample period, had an insignificant impact on wage inequality and reduced wealth inequality from 2004 onwards. The slight income inequality-reducing impact confirms the results of Getachew and Turnovsky (2020:270), and to a lesser extent the fiscal incidence literature. The latter finds that transfers greatly reduce the income Gini. This could suggest that transfers have a larger inequality-reducing impact at alternative, likely lower, points in the income distribution. The results suggest that although transfers assist poorer individuals, it is insufficient to change the distribution of income and wages among the population.

5.2 The impact of a direct tax revenue shock on inequality

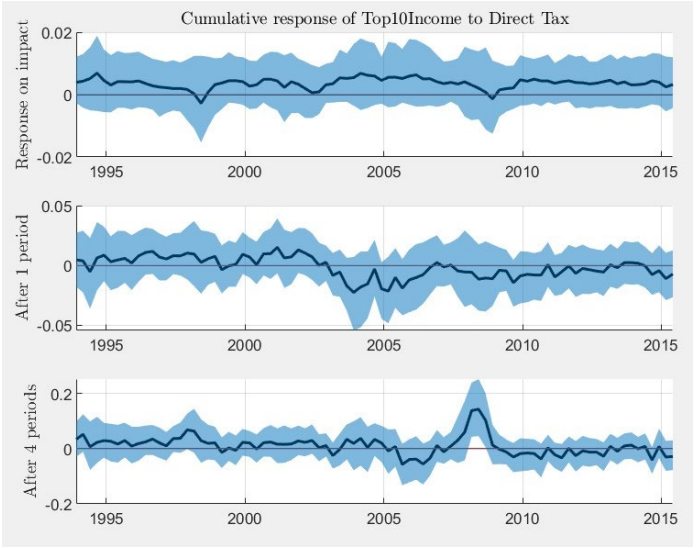
Figure 6 presents the time-varying responses of income, wage and wealth inequality to a one-standard deviation shock in direct tax revenue on impact, one quarter and four quarters after impact. From the IRFs, direct tax revenue has an insignificant impact on the top 10 per cent's income share. Given the progressive structure of South Africa's direct tax system (Goldman *et al*., 2021:14), these results are surprising. It could be that while certain direct taxes, such as personal income tax (PIT), reduce the top 10 per cent's income share, others such as corporate income tax do not. The overall effect of direct tax is therefore insignificant. The literature generally finds that direct taxes reduce income inequality while Getachew and Turnovsky (2020) find that it increases income inequality. Our results contribute to the mixture of results.

The IRFs indicate that during the 1990s and early 2000s, a direct tax revenue shock increased the wage Gini coefficient and thus wage inequality. This positive effect diminished over time. By 2011, the immediate impact of the shock slightly reduced the wage Gini. This could reflect changes introduced in the tax system. For example, during the 1990s and 2000s, the PIT tax brackets were adjusted in excess of inflation. From 2010 onward, effective tax rates were increased by ensuring tax adjustments accounted for inflation (Sachs, 2021:20).

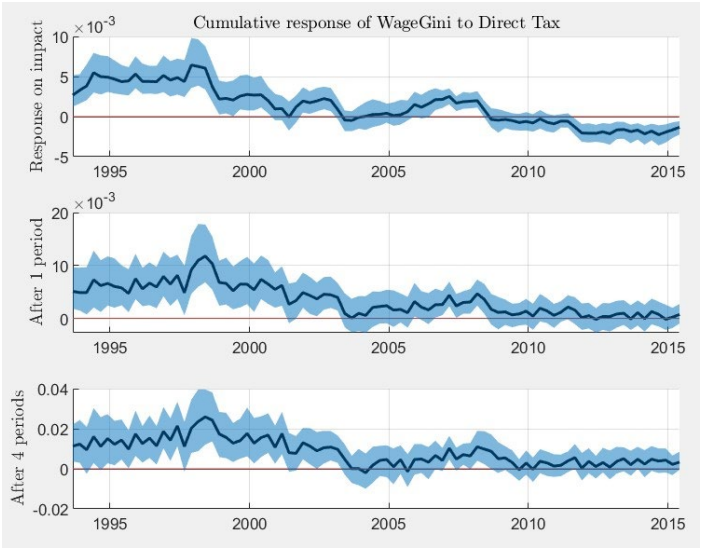
Direct tax revenue increased the top 10 per cent's wealth share, and thus wealth inequality, between 2003 and 2012, peaking between 2006 and 2008. This could be due to a variety of factors. Firstly, the corporate tax rate was lowered during the early 2000s (Bond & Malikane, 2019:812). Secondly, capital, corporate income and wealth tax collections decreased notably between 2008 and 2010 (Sachs, 2021:18). These two factors possibly contributed to the positive impact of direct tax on the wealth share. Finally, various tax increases implemented after 2010 could have contributed toward lowering the positive impact of direct tax on the wealth share. For example, dividend withholding tax increased in 2012 and 2016 (Sachs, 2021:20), and the PIT tax rates of the upper brackets increased in 2015 (Donaldson, 2023:8).

Figure 6: Time-varying impulse responses to a direct tax revenue shock

Income inequality



Wage inequality



Wealth inequality

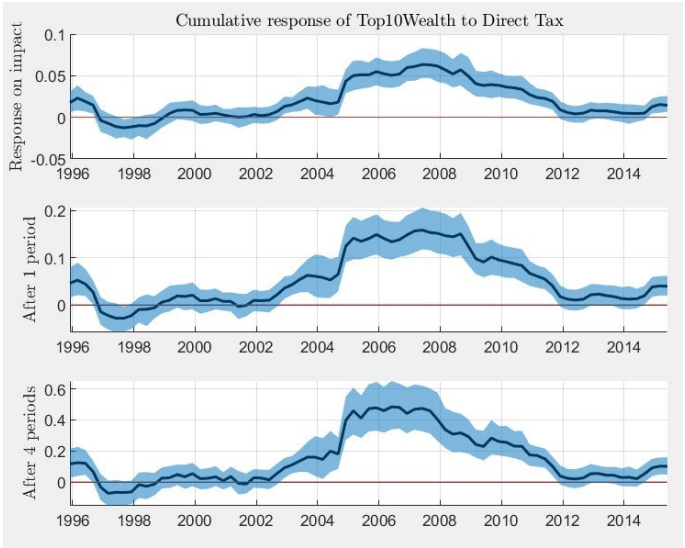


Figure 6 shows that a direct tax revenue shock has varied impacts on the dimensions of inequality, as is the case with a transfer shock. Whilst direct tax revenue had an insignificant impact on income inequality, it had an initial positive effect on wage inequality which later turned slightly negative from 2011 onwards. Furthermore, direct tax revenue had a positive impact on wealth inequality between 2003 and 2012. The results suggest that despite the progressive structure of direct taxes, it does not reduce the various dimensions of inequality substantially. The limited ability of increasing direct taxes further to reduce inequality has been highlighted in the literature.[12]

6. Conclusion

This paper examined the impact of South Africa's direct tax revenue and total transfer spending on the income, wage and wealth distributions using a TVP-VAR. This paper contributes to the literature by comparing the impact of fiscal policy on multiple dimensions of inequality in a single model. The literature typically focuses on income inequality. The second contribution is in terms of methodology. The TVP-VAR models time-varying effects and thus incorporates the time-varying nature of the relationship between fiscal policy and inequality.

The time-varying IRFs showed that the impact of the fiscal shocks differs across the inequality dimensions. A transfer shock reduced income inequality at certain points in the sample period, and reduced wealth inequality from 2004 onwards, but had an insignificant impact on wage inequality. Despite the assistance offered to poorer households at an individual level, these results suggest that transfers are insufficient to change the income and wage distribution at a macro level. A direct tax shock had an insignificant impact on income inequality across the sample but had a positive impact on wealth inequality between 2003 and 2012. The tax shock had an initial positive effect on wage inequality during the 1990s and early 2000s which turned slightly negative from 2011 onwards. Despite the progressive structure of direct taxes, these results suggest that it does not reduce the various dimensions of inequality substantially.

The IRFs suggest that both transfers and direct taxes are insufficient to significantly reduce income, wage and wealth inequality. The government can therefore not solely rely on these fiscal policy tools to address inequality. Additional efforts are needed such as improving the quality of education and health services, and improving the access of lower-income individuals to the formal sector through upskilling of these individuals.[13]

This paper contributes to the mix of results in the literature. There remains no consensus in the literature about the effectiveness of fiscal policy in addressing inequalities. More research is needed where alternative macroeconomic and econometric methodologies are employed, as well as alternative sources of inequality data. The limited availability of inequality data remains a challenge to be addressed in future research.

[12] For example, see Inchauste and Lustig (2017), and Leibbrandt, Ranchhod and Green (2018).
[13] See Van der Berg and Moses (2012), D'Agostino, Giuli, Lorusso and Scarlato (2020), Leibbrandt *et al*. (2018) and Inchauste and Lustig (2017).

Appendix A

A standard Bayesian VAR (BVAR) is employed to compare the results to that of the TVP-VAR. This is done to determine whether the relationship between fiscal policy and inequality varies over time, thus highlighting the importance of employing a TVP-VAR which incorporates these time-varying effects. In a BVAR, it is assumed that the relationship between the variables is constant meaning that one set of coefficients is estimated (Nakajima, 2011:124). This is the main difference between a BVAR and a TVP-VAR. As explained in section 3, in a TVP-VAR the estimated coefficients can vary (Chan *et al*., 2020:106).

The structural form of the BVAR with p lags is presented in equation 1 below.

$$By_t = \Gamma_0 + \sum_{j=1}^{p} \Gamma_j y_{t-j} + \varepsilon_t \quad (1)$$

B and Γ_j are $n\,x\,n$ matrices of coefficients, y_t is a $n\,x\,1$ vector of endogenous variables for $t = 1, \dots, T$. Γ_0 is a $n\,x\,1$ vector of constants and ε_t is a $n\,x\,1$ vector of the structural error terms (Albert, Peñalver & Perez-Bernabeu, 2020:90). To estimate the VAR, the structural VAR is written in the reduced-form as presented in equation 2.

$$y_t = A_0 + \sum_{j=1}^{p} \mathrm{A}_j y_{t-j} + e_t, \;\; e_t \sim N(0, \Sigma) \quad (2)$$

Here $A_0 = B^{-1}\Gamma_0$, $A_j = B^{-1}\Gamma_j$ and $e_t = B^{-1}\varepsilon_t$, where e_t is the reduced-form residuals. A_0, A_j and Σ are the parameters that need to be estimated. A Minnesota prior is used to estimate the model following Albert *et al*. (2020). The Metropolis-Hastings algorithm is used to approximate the posterior distribution.

As with the TVP-VAR, four variables are included in the BVAR namely a measure of fiscal policy (transfer spending or direct tax revenue), a measure of inequality (income, wage or wealth inequality) and two factors that incorporate information on macroeconomic conditions. For the BVAR with wage inequality as the measure of inequality, a VAR of order one is modelled. For the remaining two BVARs, i.e. income and wealth inequality, a VAR of order two is modelled. The lag selection was informed by the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC).

To identify the reduced-form VAR (see equation 2) and to recover the structural shocks, ε_t, the Cholesky ordering is imposed by restricting B to a lower triangular matrix. Transfer spending is ordered first, followed by the two macroeconomic factors while the inequality measure is ordered last. In the case where the impact of direct tax revenue is considered, the two factors are ordered first, followed by direct tax revenue and the inequality measure.[14] The ordering of the variables is informed by the literature.[15]

[14] As a robustness check, an alternative ordering is considered where direct tax revenue is ordered first, followed by the two macroeconomic factors and the inequality measure. The results are similar and are thus invariant to this alternative ordering. The results are available upon request.

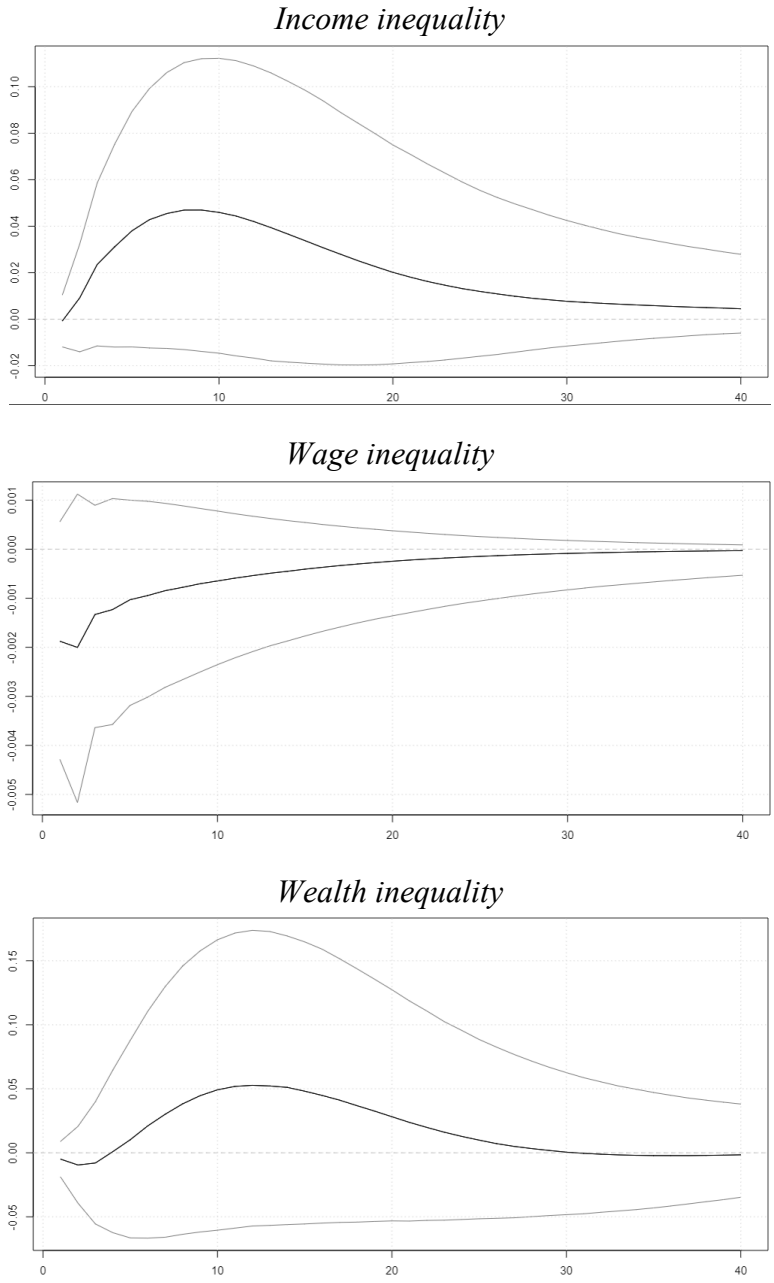
[15] See Blanchard and Perotti (2002), Ramos and Roca-Sagalés (2008), Gunasinghe, Selvanathan, Naranpanawa and Forster (2020), and Nuru and Zeratsion (2022).

The results of a shock to transfer spending is presented below followed by the results of a shock to direct tax revenue.

A.1 The impact of a transfer spending shock on inequality

Figure A1 presents the IRFs of income, wage and wealth inequality over 40 quarters to a one-standard deviation shock in transfer spending. The black line is the mean response of the inequality measure, and the grey lines represent the 68 per cent posterior confidence bands. As with the TVP-VAR, these bands represent a span of values that contain the parameter with a 68 per cent likelihood (Chan *et al*., 2020:116).

Figure A1: Impulse responses to a transfer shock



The IRFs in Figure A1 suggest that a transfer shock has a positive impact on the top 10 per cent of the population's share of income and wealth, and a negative impact on the wage Gini.

The results are statistically insignificant, however, which implies that transfer spending does not influence income, wage and wealth inequality. These results could suggest that transfer spending is insufficient to reduce inequality. Alternatively, these results could be insignificant due to transfer spending having differing impacts on the inequality measures across the sample period. When analysing the TVP-VAR results in Figure 5 of section 5.1, this seems to be the case, especially for income and wealth inequality. Figure 5 indicates that a transfer shock reduced the top 10 per cent's income and wealth share during certain years of the sample period, while the impact on wage inequality was insignificant.

Although the overall conclusion from the two models regarding a transfer shock is similar, which is that transfer spending is insufficient to change the distribution of income and wages among the population, solely analysing the BVAR results leads to the conclusion that transfer spending does not affect the inequality measures at all. This is an inaccurate conclusion. The TVP-VAR indicates that once the time-varying nature of the relationship between transfers and inequality is taken into account, transfers do have an impact on the inequality measures at certain points in the sample.

A.2 The impact of a direct tax revenue shock on inequality

Figure A2 presents the IRFs of income, wage and wealth inequality over 40 quarters to a one-standard deviation shock in direct tax revenue. According to the IRFs, direct tax revenue has an insignificant effect on income and wealth inequality and increases wage inequality. While the income inequality results are similar to the TVP-VAR, as presented in Figure 6, the results of wage and wealth inequality differ. According to the BVAR results below, direct tax revenue increases wage inequality. However, when incorporating the time-varying effect of direct tax revenue, it is clear from Figure 6 that the impact has changed over the sample period. While a shock to direct tax revenue initially had a positive impact on wage inequality, this positive effect diminished over time and by 2011 direct tax revenue slightly decreased wage inequality. As explained in section 5.2, this could be due to changes introduced in the tax system.

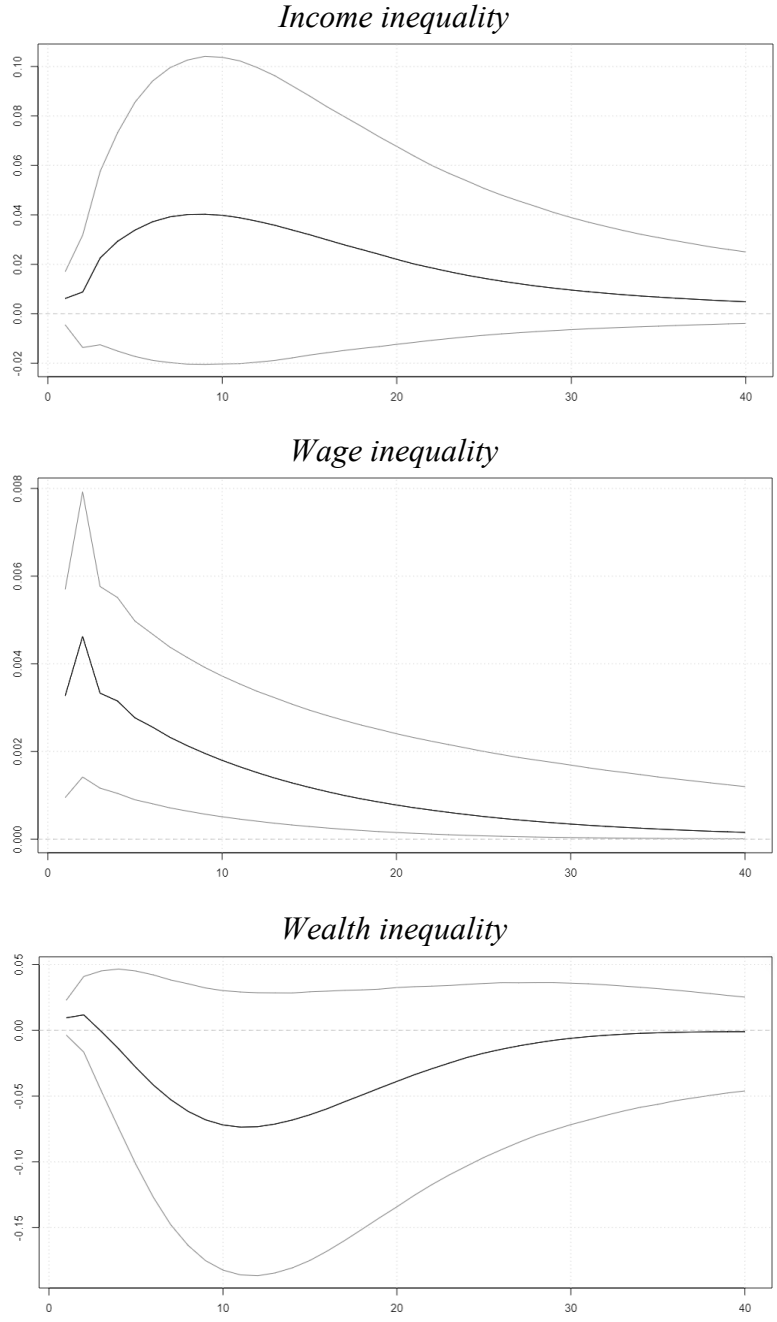
Figure A2 shows that a direct tax revenue shock has a statistically insignificant impact on the top 10 per cent's share of wealth, and therefore wealth inequality. Contrastingly, the TVP-VAR results suggest that direct tax revenue increased wealth inequality between 2003 and 2012 (see Figure 6). This could also be due to various tax changes introduced during those years.

As with transfers, incorrect conclusions can be drawn when analysing the BVAR results alone. The findings indicate that direct tax revenue seemingly does not affect income and wealth inequality, while it worsens wage inequality. However, the TVP-VAR results suggest that the impact has changed over time. This underscores the significance of specific tax changes in shaping the distributional consequences of direct tax revenue.

From the above analysis, it is clear that the results of the BVAR and TVP-VAR differ. This suggests that the relationship between transfer spending and direct tax revenue and the inequality measures indeed differ over the sample period. Employing a TVP-VAR is therefore

valuable since this model incorporates these time-varying effects and thus provides better insight into the distributional impact of the fiscal policies analysed.

Figure A2: Impulse responses to a direct tax revenue shock



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