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Time-varying fiscal multipliers for South Africa

A large time-varying parameter vector autoregression approach

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Abstract: A critical requirement for efficient fiscal policy is a reliable understanding of its impact on the aggregate economy for different policy instruments and under different economic conditions. Indeed, there is strong evidence to suggest that fiscal multipliers vary with economic conditions, the components of government decision-making that are considered, and the identification strategy and modelling approach used. Previous studies on South Africa have typically used small-scale models or constant coefficient linear settings, which do not fully capture either the disaggregated components of spending and tax revenue or the time-varying nature of fiscal multipliers. In this paper we add to the critical evaluation of these limitations by using a large time-varying parameter vector autoregression approach estimated with Bayesian methods. We argue for an agnostic approach that studies the components of aggregate output in an economy which imposes as few restrictions and assumptions as possible. We model the impact of the government-controlled components of output on all other components and present a new way of reconciling these results to aggregate results in other studies. We find multipliers at the lower end of other findings in the literature on South Africa: our estimate of the average cumulative fiscal multiplier of government consumption on output is 0.155, while that of government investment is –0.118. Our approach also casts a cautionary light on both existing research and novel methods used to measure fiscal multipliers. As a result, convincing evidence that fiscal policy can be used actively for business cycle stabilization remains elusive.

Key words: time-varying parameter vector autoregression, fiscal multipliers, Bayesian methods, stabilization

JEL classification: C32, H11, E62

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1 Introduction

Public debt as a percentage of gross domestic product (GDP), has been steadily on the rise in South Africa. This rise in the debt-to-GDP ratio comes from the fact that South Africa has experienced muted economic growth since 2000, with an average growth rate close to 2.5%, while expanding the fiscal deficit since the financial crisis of 2008 (Havemann and Hollander 2022; Zungu et al. 2022). The government's lockdown response to the COVID-19 pandemic warranted a further fiscal expansion and an accompanying need for fiscal consolidation (Hollander et al. 2022; Loewald et al. 2020). Given this increased fiscal burden (and undiminished political pressure for more government spending), it is important to determine how the nature and context of fiscal policies evolve over time.

In this paper we argue for two novel approaches to studying fiscal multipliers, which capture the effect of government decisions on private decisions and the aggregate outcomes of these decisions in the economy.[1] First, we argue for a disaggregated approach, modelling the impact of government-controlled components of GDP (government consumption, government investment, and investment by public corporations) on other components (private consumption, private investment, exports, and imports) separately, and deducing the overall impact by appropriately aggregating the individual effects.

Second, we use a novel time-varying parameter approach created by Chan et al. (2020) that allows these effects to depend on aggregate economic conditions as they change. Our results are not very encouraging, yielding estimates of the average cumulative fiscal multiplier on GDP of 0.155 for government consumption and –0.118 for government investment. For the entire sample period from 1994 to 2019 we find that the average cumulative impacts on GDP are not statistically different from 0 and are statistically different from 1.[2] The results most comparable to ours are those of Kemp (2020), who finds multipliers in the range of 0.13 to 0.61, and Merrino (2021), who finds a range of –0.18 to 0.34, although each uses approaches and data that differ from ours. We refer the reader to Merrino (2021) for a more detailed summary of other results and methods in the literature on South African fiscal multipliers.

We also report some less than satisfactory outcomes. Our initial excitement in using Chan et al.'s method, published in the *Journal of Econometrics*, was eventually tempered by discovering two drawbacks: the code that implements the method is not user-friendly and required a large amount of work to convert to our applications, and the method performed less well than we anticipated when applied to larger systems than our main seven-variable approach.

The rest of the paper is organized as follows. We relate our work to the literature in Section 2. In Section 3 we describe the data we use for the main results. Section 4 describes the methods employed in the estimation and the construction of the output multiplier. Section 5 presents the main results, while Section 5.2 reports on models with additional controls, Section 6 concludes.

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[1] The literature measures the fiscal multiplier in several ways. A general definition of the fiscal multiplier is the unit-change in a target measure (such as real GDP) caused by a one-unit increase in a fiscal variable (such as government investment). For example, if government consumption increases by one rand and it causes real GDP to rise by 50 cents, then the fiscal multiplier for government consumption is 0.5. Impulse response functions capture this effect, where the 'impulse' is the identified fiscal innovation (government consumption in our example) and the response is the target measure for the multiplier (real GDP in our example). We discuss our specific measure of the fiscal multiplier relevant for policy analysis in Section 4.4.

[2] A motivation for fiscal policy as a stabilization tool requires multipliers larger than 1.

2 Relation to the literature

Standard analyses of fiscal multipliers that measure the effect of fiscal shocks on aggregate output typically follow a vector autoregression (VAR) approach (Ramey 2019). A systems approach has the advantage of controlling for some feedback mechanisms that would otherwise bias single-equation or heavily restricted multivariate approaches. However, a disadvantage of a multivariate systems approach, particularly due to data limitations, is the proliferation of coefficients that need to be estimated. In a context of time variation between estimated economic relationships, this cost is orders of magnitude higher (Jooste et al. (2013), for example, therefore restrict their time-varying parameter system to only three variables). Recent computational developments offer potentially powerful solutions to these problems that preserve the validity and economic interpretability of simpler approaches.

The first aim and contribution of this paper is to use recent econometric advances that permit the reliable estimation of large Bayesian structural VARs with time-varying parameters (hereafter, large TVP-VARs). This approach has the potential to add nuance to the understanding of the impacts of fiscal policy on the South African economy by allowing both more feedback mechanisms and a more disaggregated approach to the impact of various fiscal instruments and economic conditions. Indeed, there is a well-developed literature starting with Cogley and Sargent (2005) and Primiceri (2005) that attempts to assess the impact of policy shocks in a time-varying framework, but only Jooste et al. (2013) have thus far used this approach for South Africa, and only as a minor component of their study.[3]

A major limitation in the South African literature is therefore the use of small-scale models due to the difficulty of estimating larger models with limited data (e.g., Du Plessis et al. 2007; Jooste et al. 2013; Kemp 2020; Makrelov et al. 2020; Merrino 2021; van Rensburg et al. 2022; Zungu et al. 2022). As a result, disaggregated fiscal components and/or financial sector variables are often absent from these models to promote model parsimony, which leads to the possibility of omitted variable bias.[4] In contrast, Bayesian methods have been applied to estimate larger structural models with a view to capturing more complete feedback mechanisms and a wider set of fiscal instruments (see, for example, Hollander 2021; Kemp and Hollander 2020).

While these studies find strong evidence that fiscal multipliers vary substantially with the disaggregated components of government expenditure and tax revenue, their estimates are conducted in a constant coefficient, linear setting, using the whole sample to fit coefficients. Such estimates can draw information only from the average effect of a selected sample period. For example, if crowding-out effects of private contributions to output are stronger at higher levels of debt, linear approaches that can measure only average impacts would yield overly optimistic predictions of the effect under more extreme conditions. Overall, this literature typically finds government spending multipliers to be less than 1 and tax multipliers to be large, distortionary, and difficult to identify.

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[3] Jooste et al. (2013) compare impulse responses for government expenditure shocks in specific periods (1994, 1999, 2007, 2008, 2009) in a three-variable TVP-VAR: output, interest rate, and government expenditure. Their TVP-VAR model shows that the strongest fiscal multipliers occurred at the peak of the South African business cycle in 2007 and 2008, with mean multiplier values of slightly less than 1.5. Interestingly, based on a simple four-quarter moving average, South Africa was running its largest budget balance surpluses in this period since 1960 (see National Government deficit/surplus as % of GDP, code: KBP4420K). Jooste et al. (2013) also generate IRFs for three calibrated dynamic stochastic general equilibrium (DSGE) models and a structural vector error correction model. Broadly, they find fiscal multipliers are typically less than 1 in the short run and negligible (or statistically insignificant) in the long run.

[4] For a discussion of omitted variable bias in VAR models for policy analysis, see Jooste and Naraidoo (2017), who highlight several issues that face econometricians. Their study focuses on fiscal foresight in a calibrated DSGE model. They find that their results depend on correctly pinning down the labour supply elasticity, the share of rule-of-thumb consumers, and the degree of sticky wages. They also flag the sensitivity of results to assumptions about fiscal financing options and the optimizing behaviour of agents in the model.

Following the recent international literature, a few recent papers on South Africa have found asymmetrical effects of fiscal multipliers. The evidence suggests that recessions (or negative output gaps), the stance of monetary policy, and financial conditions are important in understanding the fiscal transmission mechanism (Kemp 2020; Makrelov et al. 2020; Merrino 2021; van Rensburg et al. 2022). But one rarely finds models that incorporate a wide set of fiscal and financial variables due to limits placed on model parameter dimensionality by the short samples and the proliferation of coefficients when more variables are added to a system.[5] However, most of the recent international research indicates that to obtain reliable estimates of relationships in macroeconomic data, we need a large set of variables (Carriero et al. 2019). Our approach allows a flexible time-varying estimation of effects over time, making it possible for us to investigate how fiscal multipliers evolve.

3 Data

We use standard publicly available macroeconomic data on the South African economy. In this iteration of the research we use only the components of GDP as recorded in the national accounts data published by the South African Reserve Bank (SARB), all obtained from the website of the SARB. The data cover the period from 1994 to 2019, at quarterly frequency. All data are in real terms, seasonally adjusted at an annual rate as reported in the *Quarterly Bulletin of the SARB*.

We evaluate spending multipliers, focusing on two fiscal variables[6] reported in the expenditure on GDP section of the national accounts: government consumption expenditure and general government investment expenditure (Table 1).

Table 1: Data description

Variable	Short name	Notation	Source and code
Private consumption	PrivCons	C^P	SARB (KBP6007D)
Private investment	PrivInvest	I^P	SARB (KBP6109D)
Government consumption	GovCons	C^G	SARB (KBP6008D)
Government investment	GovInvest	I^G	SARB (KBP6100D)
Public corporation investment	PCInvest	I^{PC}	SARB (KBP6106D)
Exports	Exports	X	SARB (KBP6013D)
Imports	Imports	M	SARB (KBP6014D)
Gross domestic product	GDP	Y	Aggregated components

Source: authors' compilation.

4 Methods

The large TVP-VAR model used in this paper closely follows Chan et al. (2020). Other papers, such as Koop and Korobilis (2013), have attempted to estimate large TVP-VAR using forgetting factors to

[5] In response to criticisms of the VAR and DSGE approaches, Makrelov et al. (2020) motivate the use of a stock-flow consistent model which incorporates a financial sector with four financial instruments into the traditional real sector framework. Although these models can produce estimates *ad infinitum*, they are primarily useful for focusing on short time horizons. Makrelov et al. find multipliers as large as 3.5 conditional on a range of fiscal, economic, and financial environments. While their approach provides an interesting perspective, the model remains highly restrictive: it is deterministic, calibrated, and dependent on a short time sample, which leads to unreliable results over time because of the many fixed assumptions about the interactions between variables. Akanbi (2013) and van Rensburg et al. (2022) take an alternative approach using a small macroeconometric model. They similarly highlight the above strengths and weakness of various approaches.

[6] We enter the investment of public corporations as a separate variable in our system, but for brevity in this paper we focus on the primary government variables. The results for shocks to public sector investment are even more negative than those for government investment. Details are available from the authors on request.

replace the state equation covariance matrix. However, the restrictions in the specification used by Koop and Korobilis (2013) does not allow for the full ambit of inferential measures to properly evaluate the relationship between variables required for our purposes. Their paper focuses specifically on the predictive power of the model, with an application directed at forecasting.

The approach to estimation used by Chan et al. (2020), described below, allows us to explore the full posterior distribution and investigate economic behaviour more deeply. This means that we are able to report impulse response functions, variance decompositions, and other inferential tools to better depict the time-varying nature of the fiscal multiplier. In the next section we outline their implementation and refer the reader to the paper by Chan et al. for a more detailed breakdown of the method. We will not, for example, discuss the computational aspects of the estimation procedure.

4.1 The development of large Bayesian VARs

Bayesian VAR (BVAR) models have become part of the toolkit of many central banking institutions and have played an important role in explaining important structural relationships in monetary policy. The addition of priors from a BVAR helps us include more explanatory variables than the frequentist approach. However, in recent years traditional BVARs have been supplanted by *large* BVARs. Banbura et al. (2010) were among the first to implement these large models, using the Litterman prior to allow for shrinkage of coefficient estimates.

In their paper Banbura et al. (2010) advocate for the use of a multitude of variables to prevent the exclusion of any that could be vital in the model specification. Not only does the exclusion of variables affect the interpretability of the model, it can lead to omitted variable bias. Large models in the literature generally include 10–30 variables, as opposed to the average of four or five used in traditional structural VAR models. Factor-augmented VARs, first introduced by Bernanke et al. (2005), are a complement to the large BVAR models.

The main difference between the factor-based approach, which relies on dimension-reduction techniques to reduce the collection of variables to a handful of factors, and the large BVAR lies in the interpretability of the models. With large BVAR models we do not have to speculate about what the factors imply, but can directly observe the relationship between variables and elicit impulse response functions based on direct perturbation of any of the variables in the model. A recent application is the large BVAR model employed by the Federal Reserve Bank of New York (Crump et al. 2021). However, these models have received less attention with regards to fiscal policy, with no application in South Africa to date.

In more recent years greater attention has been paid to the time-varying nature of coefficients and covariance of errors. This is a natural extension, since it is highly unlikely that coefficients on estimates for macroeconomic relationships are constant. In addition, it is also believed that volatility for observed relationships would be stochastic (Nakajima 2011). Some of the earliest attempts at capturing the time-varying nature of relationships used techniques that tried to identify structural breaks and impose regime switching on the structure of existing methods. There are also models that try to capture the full dimensionality of the time-varying coefficients and stochastic volatility, the so-called time-varying parameter VARs with stochastic volatility.

While these TVP-VARs have been used quite successfully in monetary policy to elicit relationships like the transmission of policy rate changes over time, they face a specific limitation with respect to how many variables can be introduced into the system. Bayesian shrinkage priors can act as a form of regularization to keep the dimensionality and interpretability intact. However, the introduction of a time dimension in the estimation of coefficients is difficult to deal with and this is why most time-varying models allow for the inclusion of only four or five variables. This is in the ideal scenario, such as that of the United States, where the time series extends for many decades and the problem with degrees of freedom in estimation is not as severe. In the case of a country like South Africa, with a much shorter time horizon for estimation, the inclusion of four or five variables within a normal time-varying parameter setting becomes difficult to manage.

To introduce more variables into a time-varying setup for a country such as South Africa, we could consider using the method of Koop and Korobilis (2014), which combines the factor-augmented VAR approach with time-varying parameters to create a TVP-FAVAR. However, this once again brings into play the problem of interpretability. Traditional inference with respect to impulse responses and variance decomposition is not entertained in these factor models. Our approach here is to use a large TVP-VAR, most recently advocated by Chan et al. (2020), which has a factor-like structure but retains all the inferential tools required to understand the relationship between variables. Our contribution to the literature is then twofold. First, we explore models that include more variables than traditionally used in the literature, without using factor methods. Second, we allow for time variation in the parameters of this structure with many variables.

4.2 Reducing sources of variation

Here we describe the method used by Chan et al. (2020) to reduce the sources of variation in the TVP-VAR model. In particular they focus on the structural form of the model.[7] The structural TVP-VAR can be written as

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

where y_t is an $n \times 1$ vector for $t = 1, \ldots, T$. The coefficient terms $B_{1,t}, \ldots, B_{p,t}$ are of dimension $n \times n$ and $\Sigma_t = \operatorname{diag}(\exp(h_{1,t}), \ldots, \exp(h_{n,t}))$. We can easily reformulate this model in state space format using Kronecker products and vectorization operators[8] to form the following measurement and state equations:

$$\begin{aligned} y_t &= x_t \alpha_t + \varepsilon_t, \quad \varepsilon_t \sim N(0, \Sigma_t) \\ \alpha_t &= \alpha_{t-1} + \eta_t, \quad \eta_t \sim N(0, Q_\alpha), \quad \alpha_0 = \alpha \sim N(\underline{\alpha}, \underline{V}) \end{aligned}$$

The general form of the state space is what we require for our discussion. In this setup x_t is the $n \times k$ matrix of regressors. The dimension reduction happens by application of rank reduction on the covariance matrix, Q_α, for the state equation. The rank of this Q_α matrix is reduced to $r_\alpha < k$. Here this means that we place a restriction on the states in the system. If we impose a restriction on k, then the number of time-varying parameters in the state equation is driven by fewer than k states. This imposes a structure on the model that is similar to a factor model.

An example on the extent of dimension reduction is provided in Chan et al. (2020). This example is repeated here for the purpose of exposition. Consider the case with $n = 15$ variables and time dimension $T = 250$ in a VAR with $p = 2$ lags. The dimension of the states and the covariance matrix in the unrestricted equations above have dimension 305805. If we restrict the rank of the covariance matrix to 4, then we reduce the model dimension by 98.7%. The larger the value for n, the greater the dimension reduction.

In terms of the prior selection of the model, we follow Chan et al.'s strategy. This entails the usage of a stochastic variable selection prior in addition to the Minnesota prior and inexact differencing as used by Banbura et al. (2010)

[7] It is easy to switch to the reduced form, or even the vector error corrected form, by simply redefining the variables.

[8] See Chan et al. (2020) for details on this reformulation. Showcasing the manipulation does not add to the interpretation of the model. The steps are mechanically performed.

4.3 Identification

As a baseline structure for our TVP-VAR framework we use the Choleski identification scheme, following Blanchard and Perotti (2002). This identification assumption implies that fiscal instruments (government consumption and investment) respond to macroeconomic shocks with a lag because of delays in decision-making. However, since we are interested in cumulative multipliers that aggregate over many periods (the identification scheme that alters only the way the initial impact affects the various impulse response functions), the ordering of variables has little impact on the results.[9]

Most studies choose variables based on some model in the background. Given the dimensionality problem in estimating standard VAR approaches, the number of variables that can be used is typically limited to a small number (three to five variables), which necessitates a sacrifice in the scope of estimated economic interactions. Moreover, studies motivated by a simplified model sometimes use both output and components of output in the specification (e.g., Du Plessis et al. 2007; Jooste et al. 2013; Kemp 2020; Merrino 2021; Zungu et al. 2022). This latter point is not usually thoroughly discussed in the literature, and one of our contributions is to avoid the potential double counting involved in such an exercise.

We therefore take an agnostic approach as a first step and study the impact of various government expenditure components using the national accounts accounting identity at the following level of aggregation:

$$Y_t = C_t^P + C_t^G + I_t^P + I_t^G + I_t^{PC} + X_t - M_t \tag{1}$$

This allows us to study the impacts of government consumption and investment expenditure on each of the other components of aggregate GDP. We then construct the GDP multipliers by exploiting the linearity in the accounting identity. In the present paper we focus exclusively on the relationships between the variables of which GDP is composed. In Section 5.2 we augment this approach to consider interactions with features of monetary policy, the financial sector, and the external sector.[10]

We impose a simple Cholesky decomposition with government consumption ordered last (i.e. assuming that government consumption expenditure cannot respond contemporaneously to innovations in any other variables) and government investment second to last (i.e. government investment expenditure can respond contemporaneously only to innovations in government consumption expenditure).

While structural approaches that use the simple Cholesky ordering are sensitive to the ordering, this sensitivity is primarily concentrated on the immediate impact effect (i.e. the contemporaneous multiplier). Since our focus is on the cumulative multipliers over several periods, we argue, on the strength of our initial investigations, that the results will not be substantively sensitive to changes in ordering.

4.4 Definition of the fiscal multiplier

To map fiscal policy decisions appropriately to fiscal budgets over time, Ramey and Zubairy (2018) argue that the policy-relevant fiscal multiplier is one that captures the *cumulative* response of a target variable to the *cumulative* response of the fiscal instrument. Since fiscal multipliers change over forecast horizons as well, we will compare the cumulative multiplier at different horizons in future versions of

[9] Leeper et al. (2009) and Ramey (2011) review the Blanchard and Perotti (2002) identification scheme for tax changes and government spending changes, respectively. They show empirically that because agents have fiscal foresight (i.e. they correctly anticipate most future tax and spending changes) standard VAR schemes, like that of Blanchard and Perotti (2002), do not correctly identify the true fiscal shocks. In future work we plan to test other identification schemes in the large BVAR context.

[10] Extensions of the baseline model we have constructed could include scenarios of macroprudential policy shocks and the way they affect the macroeconomy; for example, in a case where the bank capital–asset ratio is used as a macroprudential policy proxy (Hollander and Havemann 2021).

this paper. Here we focus on the change over time of the effects accumulated over a typical business cycle frequency: three years (12 quarters).

The definition of the cumulative multiplier is expressed as follows. Let $z_k(\Xi_t)$ denote the impulse response function of an arbitrary response variable of interest (e.g. private consumption expenditure) at horizon k based on the coefficients Ξ estimated in the TVP-VAR at period t. Similarly, let $g_k(\Xi_t)$ be the corresponding impulse response function of the arbitrary government variable for which we wish to find the multiplier (such as government consumption or government investment). Our model is specified in first differences of the level of the real value of variables in millions. Thus, the implied impulse responses are measured in millions of real rands for all variables.

The h-quarter cumulative multiplier of the impact on z of g in period t in real-rand-for-real-rand units is then given by

$$\mathscr{M}(z|g)_{t,h} = \frac{\sum_{k=1}^{h_z} z_k(\Xi_t)}{\sum_{k=1}^{h_g} g_k(\Xi_t)} \tag{2}$$

We therefore deviate from the approach of Glocker et al. (2017), who employ a conversion factor that controls for the levels of variables at each moment. Their approach would be appropriate if the VAR were estimated in growth rates (or the first difference of the logarithm), but we prefer the differenced level specification and hence require no adjustment factor.

We set $h_z = h_g = 12$ quarters—that is, our results are the three-year cumulative impact of each government expenditure component. This definition of the cumulative multiplier implies the following desirable feature: by definition, the cumulative multiplier of a shock to a variable on itself is one at all times and over all horizons. Thus, the comparison with the cumulative multipliers of a shock on other variables is direct. Whenever the multiplier of a government variable on another (e.g. output) is less than 1, expenditure on this government variable for pure stabilization purposes is counterproductive.

We construct the multiplier on output, $\mathscr{M}(Y|g)_{t,h}$, as a weighted linear combination of the multipliers on individual components of GDP, with the time-varying ratio to GDP of each component as the weights:

$$\begin{aligned}\mathscr{M}(Y|g)_{t,h} \quad = \quad & \mathscr{M}(C^P|g)_{t,h}\frac{C_t^P}{Y_t} + \mathscr{M}(C^G|g)_{t,h}\frac{C_t^G}{Y_t} + \mathscr{M}(I^P|g)_{t,h}\frac{I_t^P}{Y_t} \\ & + \mathscr{M}(I^G|g)_{t,h}\frac{I_t^G}{Y_t} + \mathscr{M}(I^G|g)_{t,h}\frac{I_t^{PC}}{Y_t} + \mathscr{M}(X|g)_{t,h}\frac{X_t}{Y_t} - \mathscr{M}(M|g)_{t,h}\frac{M_t}{Y_t}\end{aligned} \tag{3}$$

This linear decomposition is valid due to the definition of the cumulative multiplier, and the fact that we estimate the TVP-VAR in first differences of real levels. The latter preserves the linearity of the GDP accounting identity, whereas estimation in, for example, log differences would not.

We argue that this is a more systematic approach than the smaller models employed in the South African literature: the objects we are studying constitute the total real amount of resources added to/removed from each component of GDP by some government decision that alters the amount of real resources spent on activities not under the control of government policy. By the definition of GDP (Equation 1) and a general Ricardian approach, government policies redistribute/change the expenditure on real resources from what would happen in a laissez-faire economy with no government. We argue that this is the appropriate measure by which to study the contribution of government decisions to the outcomes in the macroeconomy.

5 Results

In the sections below we show the results of a shock to government consumption and government investment on GDP and its components. The cumulative multipliers for each component are computed as in Equation 2, and the cumulative multiplier on GDP constructed from the individual component multipliers as in Equation 3.

We present two sets of results. Section 5.1 presents the results of our base model, which uses only the seven variables described in Table 1. Section 5.2 shows that adding measures of interest rates and the effective exchange rate (both in nominal and real terms) and stock variables (government debt and measure of the aggregate stock of money (M3)) all reduce the estimated multipliers substantially.

The TVP-VAR yields an individual set of VAR coefficients for each period, implying a distinct cumulative multiplier in every period. We fix the coefficients estimated for a specific period to compute the three-year cumulative multipliers implied for that period. We also present the ratio of the impulse variable (government consumption or investment) to the response variable, to show the relative strength of the impulse over time. In summary, the cumulative multipliers show the rand-for-rand effect of an impulse to the government variable on the response variable, while the ratio of the impulse variable to the response variable shows the actual size of the impulse relative to the response variable over time.

5.1 Model with only national accounts data

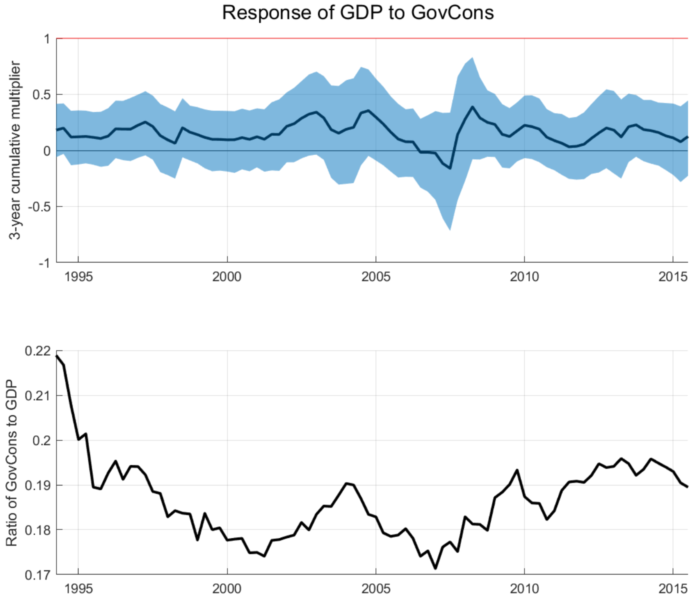
Government consumption multipliers

Impacts on GDP and summary: Figure 1 shows that our estimate of the impact of government consumption is lower than many estimates in the literature. On average, over time, the cumulative multiplier is only 0.155, far below the value of 1, which would imply that government consumption increases aggregate output more than one for one. The time-varying nature of the multiplier is generally positive and it varies only moderately, except for the lowest value, –0.16, which occurred in the third quarter of 2007, just before the global financial crisis of 2007/08. The maximal effect of 0.39 occurred during this crisis in the second quarter of 2008. For the entire sample period we find that the average cumulative impact on GDP is not statistically different from 0 and is statistically different from 1.

Table 2 shows the individual components that compose our estimate of the total effect on GDP. We analyse each component individually in the subsections below. Generally, we find little evidence of strong differences in multipliers between recessions and booms. We use the phases of the business cycle as published by the SARB in the *Quarterly Bulletin*. Our approach for evaluating the differences is direct: the average of the time-varying cumulative multiplier in each phase. If there is a strong cyclical component that corresponds to the business cycle phases, the continuously varying multipliers should reflect this naturally. By contrast, other South African studies (e.g., Kemp 2020; Merrino 2021) estimate multipliers independently in the different phases of the cycle.

One striking implication of considering the components of GDP is an open economy result: government consumption tends to increase imports but reduce exports. This suggests that one reason for the low multiplier on GDP is an external 'leakage' channel, where government expenditure encourages an increase in imports and suppresses exports. The mechanism responsible for this effect is not obvious from this version of our results. We will study this in future versions, where we will add more variables that may offer an explanation. One candidate would be the levels of debt and/or international confidence induced by the nature of government consumption, which may operate through exchange rate shocks. Below we analyse the cumulative multipliers on each component of GDP.

Figure 1: Response of GDP to government consumption



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier of a shock to government consumption on GDP. The bottom panel shows the ratio of government consumption to GDP.

Source: authors' compilation.

Table 2: Summary of the cumulative multiplier of government consumption on the components of GDP

Variable	Average	Recession	Boom	Max	Max date	Min	Min date
GovInvest	0.1070	0.1030	0.1080	0.1933	2004Q3	–0.0004	2010Q4
PCInvest	0.1110	0.0980	0.1160	0.2003	2007Q1	0.0664	2014Q1
PrivInvest	0.3700	0.3720	0.3690	0.6106	2002Q4	0.2266	2007Q1
PrivCons	0.1210	0.1130	0.1250	0.6234	2003Q1	–0.4565	2007Q3
Imports	0.3430	0.3530	0.3380	0.9341	2003Q1	–0.5760	2007Q1
Exports	–0.2640	–0.1470	–0.3150	0.3990	2008Q2	–0.6995	2007Q3
Output	0.1550	0.1810	0.1440	0.3890	2008Q2	–0.1603	2007Q3

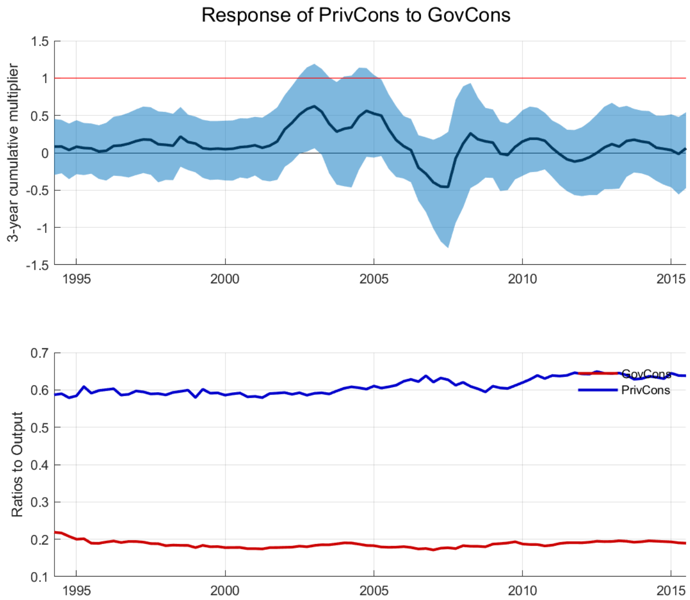
Note: the table shows the average of the cumulative multiplier of government consumption on each component over the whole sample, during recessions and booms, as well as the maximum and minimum values and the dates at which they occur.

Source: authors' compilation.

Impacts on private consumption and private investment: Figure 2 shows that the cumulative multiplier of government consumption on private consumption was generally positive over the sample (with an average impact of 0.121), with brief periods of negative values during the global financial crisis and the European debt crisis (circa 2013). This also corresponds to the period where government consumption was lowest relative to private consumption. This shows that we need to consider the impact of government actions in a non-linear way that is sensitive to the relative levels of variables. The maximal impact of government consumption on private consumption occurred just before the global financial crisis, during the longest upward phase in the South African business cycle. That said, the statistical significance of this result is only marginally different from 0 (on the lower bound) and above 1 (on the upper bound). Since private consumption is the largest component of GDP, this result explains the low multipliers on aggregate GDP.

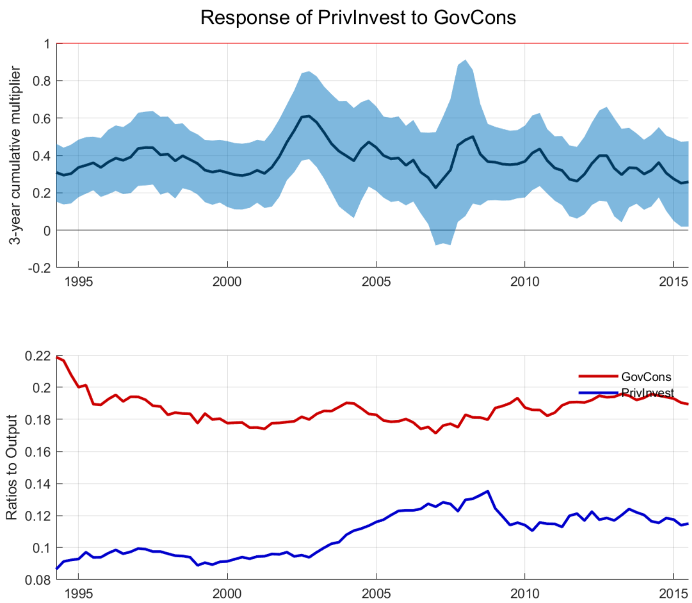
Figure 3 shows that the cumulative multiplier of government consumption on private investment is positive throughout the sample, with a sample mean of 0.37 as reported in Table 2, and low variation over the whole sample. Although the impact is statistically different from 0, it never exceeds 1.

Figure 2: Response of private consumption to government consumption



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows the ratio of government consumption to private consumption.
Source: authors' compilation.

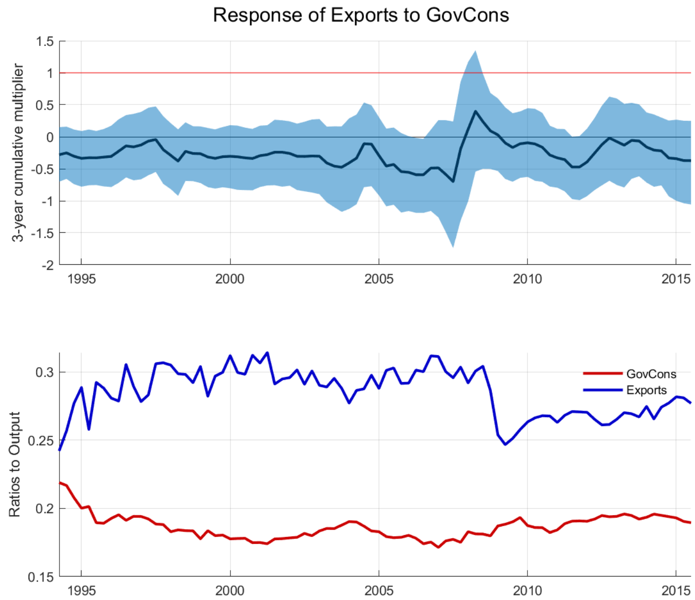
Figure 3: Response of private investment to government consumption



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows the ratio of government consumption to private investment.
Source: authors' compilation.

Impacts on exports and imports: Figures 4 and 5 show no obvious relationship between the ratios of government consumption, exports, or imports to GDP that could explain the time variation in the cumulative multiplier of either component of GDP.

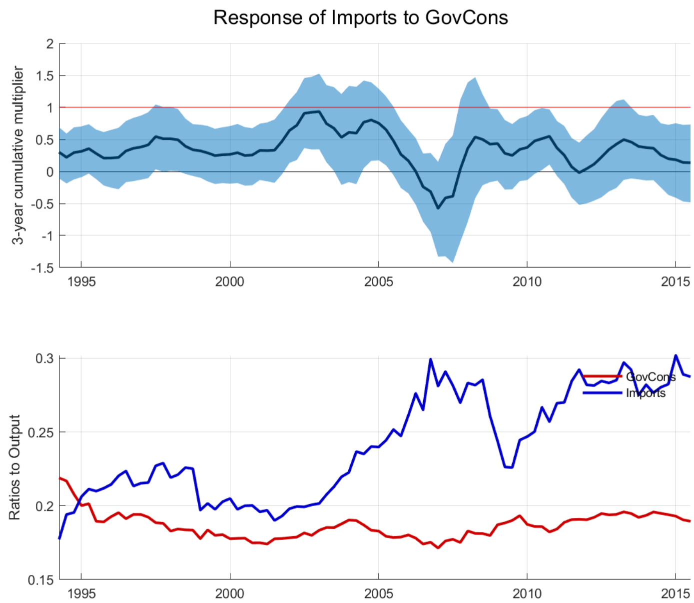
Figure 4: Response of exports to government consumption



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows the ratio of government consumption to exports.

Source: authors' compilation.

Figure 5: Response of imports to government consumption



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows the ratio of government consumption to imports.

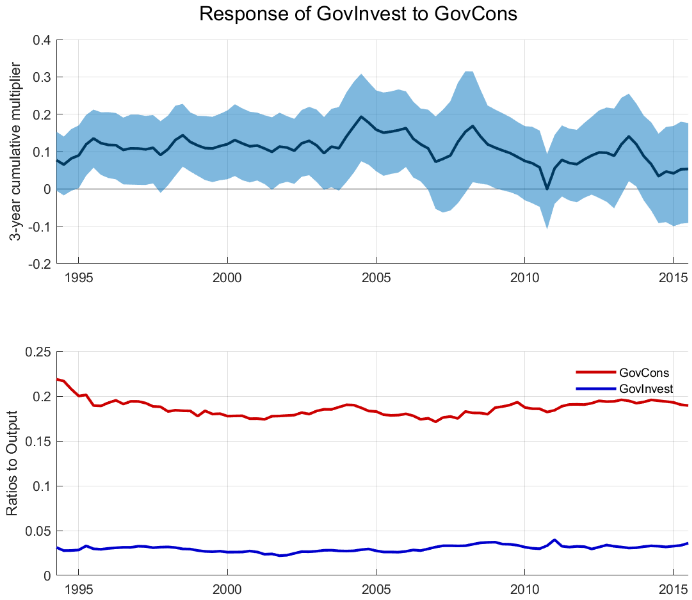
Source: authors' compilation.

However, a strong open economy result emerges. The impact of government consumption on exports is generally negative, but generally positive on imports over the sample. This suggests a 'leakage' channel that helps explain the low overall multiplier of government consumption on aggregate GDP, since the negative impact on exports and the positive impact on imports both reduce the aggregate effect on GDP.

Only the impact on imports, in the early- to mid-2000s, is statistically different from 0 and above 1. Future analysis will explore the economic mechanisms responsible for these effects.

Impacts on government investment: The cumulative multiplier of government consumption on government investment (Figure 6) is mostly positive and statistically different from 0 over the sample, with an average value of 0.107. This also offers some explanation for the low government consumption multiplier on GDP, but given the small fraction of GDP that consists of government investment, this is a matter of less interest in this section.

Figure 6: Response of government investment to government consumption



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows the ratio of government consumption to government investment.
Source: authors' compilation.

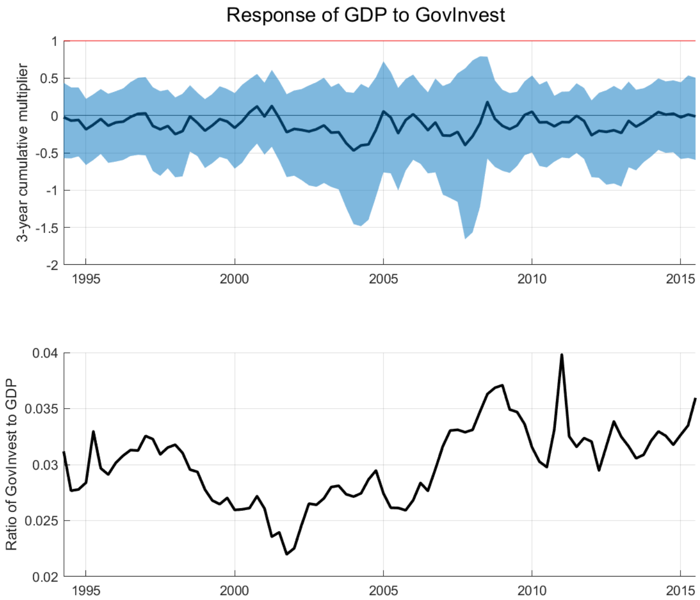
Government investment multipliers

In this section we report the three-year cumulative multipliers of government investment on each of the other components of GDP as well as on aggregate GDP. As government investment is the smallest component of GDP, we limit our discussion to summarizing the impact across the components of GDP, and relegate the graphs of the individual impacts to the Appendix.

Impacts on GDP: Figure 7 shows that the cumulative multiplier of government investment on GDP is generally negative in the sample, with only small positive values on occasion. While the impact of both government investment and government consumption on GDP is not statistically different from 0, the average cumulative multiplier of government investment on GDP is –0.118 compared to the average of 0.155 for government consumption.

Notably, except for government consumption and public corporation investment, the sign of the cumulative multipliers of government investment is opposite to that of government consumption. This suggests a crowding-out effect: government investment has a negative impact on private consumption and private investment, and its impact on imports and exports is the opposite of the impact of government consumption. This surprising change in (some) signs suggests a fruitful direction for further exploration.

Figure 7: Response of GDP to government investment



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier of a shock to government investment on GDP. The bottom panel shows the ratio of government investment to GDP.

Source: authors' compilation.

Table 3: Summary of the cumulative multiplier of government investment on the components of GDP

Variable	Average	Recession	Boom	Max	Max date	Min	Min date
GovCons	0.4180	0.4050	0.4240	0.9403	2010Q3	0.1115	2004Q2
PCInvest	0.1350	0.1250	0.1390	0.3019	2010Q3	0.0124	2004Q3
PrivInvest	–0.2420	–0.2230	–0.2500	0.0849	2008Q3	–0.5488	2007Q4
PrivCons	–0.6710	–0.6570	–0.6760	–0.2872	2010Q3	–1.1772	2004Q1
Imports	–0.5450	–0.5850	–0.5270	0.5329	2010Q3	–1.6552	2007Q4
Exports	0.2630	0.2800	0.2560	1.0656	2000Q4	–0.7389	2007Q4
Output	–0.1180	–0.0900	–0.1300	0.1794	2008Q3	–0.4696	2004Q1

Note: the table shows the average of the cumulative multiplier of government investment on each component over the whole sample, during recessions and booms, as well as the maximum and minimum values and the dates at which they occur.

Source: authors' compilation.

5.2 Models with additional controls

Our base model is an agnostic approach that uses seven aggregate flow variables that constitute GDP. In this subsection we document how the multipliers reported above change when we augment the base model in three different ways. First, we add the real effective exchange rate (as a measure of external competitiveness) and measures of real interest rates of three maturities. Second, we use the same rates but in their nominal form and add inflation as a separate variable. Third, we consider a model with the four real rates mentioned before as well as the stock of real money and real government debt. Table 4 summarizes the additional variables used.[11]

[11] FRED refers to the database of the Federal Reserve Bank of St. Louis (https://fred.stlouisfed.org).

Table 4: Data description for additional variables

Variable	Short Name	Source (code)
Overnight interbank rate	InterbankRate	FRED (IRSTCI01ZAM156N)
0–3 year government bond yield	GovBondYieldShort	SARB (KBP2000M)
10+ year government bond yield	GovBondYieldLong	SARB (KBP2003M)
Nominal effective exchange rate	NEER	FRED (NBZABIS)
Real effective exchange rate	REER	FRED (RBZABIS)
Year-on-year headline inflation	Inflation	FRED (ZAFCPIALLMINMEI)
M3 money supply	M3	FRED (MABMM301ZAM189S)
Government debt	GovDebt	SARB (KBP4114M)

Source: authors' compilation.

We keep our coverage of the change in results brief because of two over-arching findings. First, all of the augmented models yield *lower* fiscal multipliers on output (and on private consumption) than the baseline model, where multipliers were far below 1 already. A motivation for fiscal policy as a stabilization tool requires multipliers larger than 1. Second, the new method of Chan et al. performs poorly with more variables: statistical significance deteriorated (although never to the point that a value of 1 was included within the confidence bounds of the cumulative multiplier for GDP) and computational time increased to frustrating degrees. We would not advise readers to use this method for larger models unless they have significantly longer data series available (although this will further increase the computational time cost).

Tables 5 and 6 summarize how adding additional controls affects the average cumulative multipliers over time on different components of GDP. The *nominal rates model* augments the seven-variable base model with (1) a measure of short-term interest rates (the overnight interbank market rate); (2) a measure of medium-term interest rates (the average yield on security traded government bonds of maturity from 0 to 3 years); (3) a long-term interest rates (the average yield on security traded government bonds with maturity of 10 years or longer) all in annualized form; (4) the real effective exchange rate; and (5) the year-on-year headline inflation rate. The *real rates model* employs rates (1)–(3) in real terms as well as the real effective exchange rate. The *real rates and stocks model* includes the rates of the *real rates model* as well as the real money supply (M3 divided by headline CPI) and the real government debt.

Nominal versus real rates: We initially considered that it would be appropriate to augment the base model, which is in real terms, with real rates. The results from the *real rates model* were counter-intuitive. Regardless of which selection of rates we used, we found that the impact of increases in both government consumption and investment induced significant and negative impacts on the real yields (see Figure B1 in the Appendix for the impulse response functions to government consumption shocks,[12]) where economic theory would suggest the opposite, especially in a country with a debt evolution like South Africa (Havemann and Hollander 2022; Hollander 2021; Kemp and Hollander 2020). This drove us to consider a more flexible specification with nominal rates and inflation entered as individual variables.

In the model with nominal rates and inflation (*nominal rates model*), we found that shocks to government consumption had strong and persistent positive effects on inflation, but that the estimated impact on the nominal yields on government bonds were small and imprecise (very wide confidence intervals—see Figure B2 in the Appendix). The results therefore suggest a strong inflationary impact of government consumption which provides some context to the low real effect in our base model and the counter-intuitive results from the *real rates model*.

[12] Results for government investment shocks are very similar and available from the authors.

Table 5: Summary of the average cumulative multiplier of government consumption on the components of GDP when the model is augmented with various additional controls

Variable	Base model	Nominal rates model	Real rates model	Real rates and stocks model
GovInvest	0.107	0.029	0.06	0.023
PCInvest	0.111	0.143	0.167	0.131
PrivInvest	0.37	0.27	0.252	0.295
PrivCons	0.121	–0.127	–0.024	–0.08
Imports	0.343	0.042	0.208	0.377
Exports	–0.264	–0.602	–0.612	–0.541
Output	0.155	–0.039	–0.017	–0.069

Source: authors' compilation.

Table 6: Summary of the average cumulative multiplier of government investment on the components of GDP when the base model is augmented with various additional controls

Variable	Base model	Nominal rates model	Real rates model	Real rates and stocks model
GovCons	0.418	0.374	0.38	0.334
PCInvest	0.135	0.076	0.099	0.023
PrivInvest	–0.242	–0.299	–0.269	–0.23
PrivCons	–0.671	–0.665	–0.584	–0.49
Imports	–0.545	–0.665	–0.518	–0.576
Exports	0.263	–0.035	–0.037	–0.182
Output	–0.118	–0.187	–0.171	–0.143

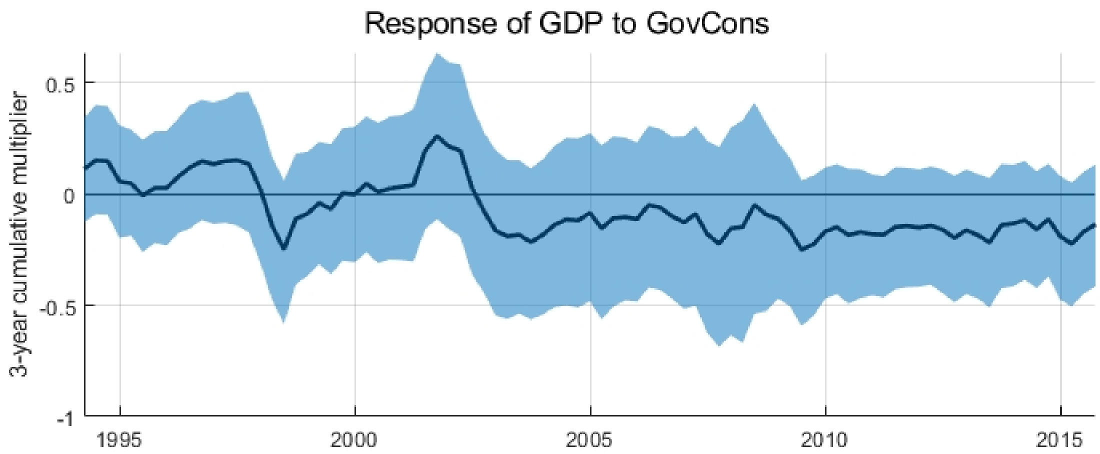
Source: authors' compilation.

Changes to government consumption multipliers in augmented models: Table 5 shows that adding the additional controls in the three considered models reduces the average cumulative multiplier on output from 0.155 to negative values, with the lowest values being in the largest model with the addition of the four real rates and the two stock variables. The rest of the table provides the decomposition of the average output multiplier into its components. Except for imports and public corporation investment, all multipliers are reduced by adding more controls.

We note a final result on our largest model which includes the real money supply and the real government debt stock. Figure 8 shows that the cumulative multiplier of government consumption on output appears to be falling over time and then becoming more constant with narrower confidence bounds from 2009. This observation stands in contrast to Figure 1 from the base model, which shows no clear trends. We interpret this as tentative evidence that increases in the level of debt may reduce the impact of government consumption.[13]

[13] In both models the cumulative multiplier is never statistically different from 0 and the upper bounds never reach 1.

Figure 8: The time-varying three-year cumulative multiplier of government consumption on output in a model with seven national accounts variables, three real interest rates, and the real effective exchange rate



Note: a steady decrease in the median (black line) to consistently negative values, along with a narrowing of the confidence bands (shaded area) is observable over time.

Source: authors' compilation.

6 Concluding remarks

In this paper we argue for an agnostic approach to modelling the impact of resources under the control of the government on the outcomes on the value of resources generated by non-government decision-makers. This is motivated by the lack of consensus in the extant literature, which uses a variety of approaches that are either purely econometric or based on theoretical models, and reaches widely disparate conclusions on whether government expenditure adds to or detracts from the aggregate performance of an economy.

We use a new method by Chan et al. (2020) that allows us to estimate larger TVP-VARs. This method is an exciting development and has clear potential. However, our experience in implementing it to investigate a question different from that of the original paper was quite frustrating. The available code for performing the estimation is not user-friendly and required a large amount of work to convert it to our purpose. In addition, while the model seems to be able to allow for integrated processes, we found that the results were highly unstable when implemented with non-stationary data. Hence we were forced to use a model in first differences, which implies a loss of long-run information that may be necessary for measuring fiscal multipliers accurately.

That being said, our main results do not bode well for stabilization efforts via fiscal policy—all the multipliers we find suggest that resources spent through government decision-making processes in South Africa are net negative on both individual components of GDP and on the aggregate. We do not argue that our results are more or less conclusive than others in the literature, but raise the issues of consistency across approaches as an important caveat to assertions as to the effects of government spending on aggregate outcomes. Critically, our results are purely from the perspective of stabilization policy, and should not be read as a comment on the fundamental welfare properties of fiscal expenditure in general. By analogy, expenditure on public health or education need not increase aggregate output in order to be welfare-improving. In future development of fiscal multiplier research, we want to encourage other researchers to test our specification approach with alternative methods, in the hope of clarifying the many confounding factors in this branch of research.

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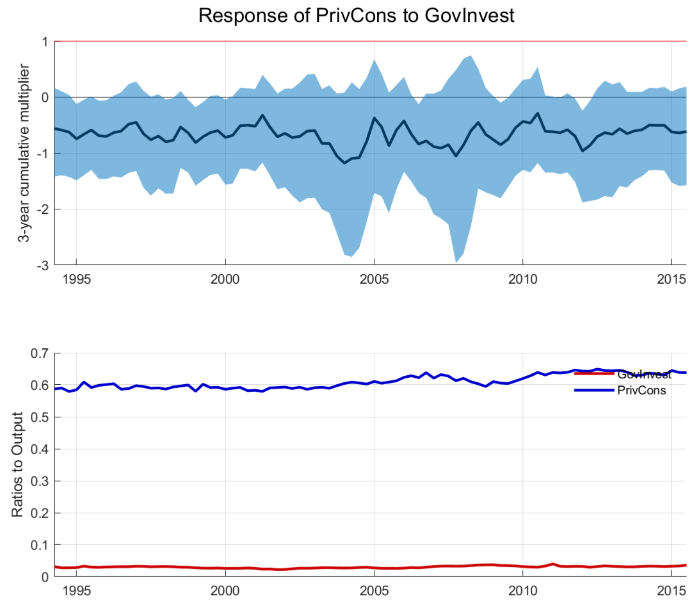
Appendix A: Cumulative multipliers of government investment

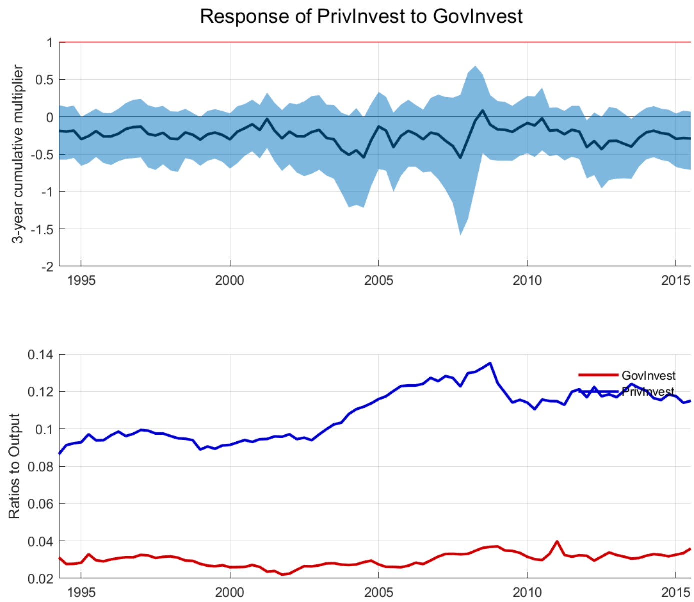
Figure A1: Response of private consumption to government investment



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows ratios to GDP.

Source: authors' compilation.

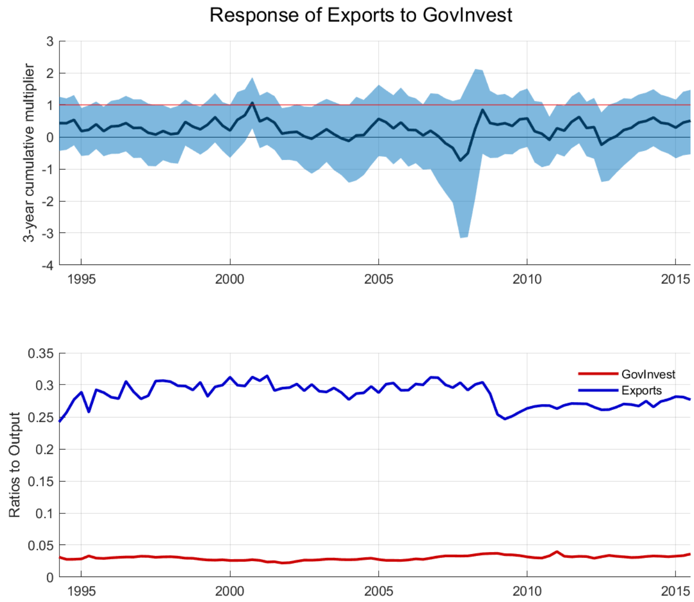
Figure A2: Response of private investment to government investment



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows ratios to GDP.

Source: authors' compilation.

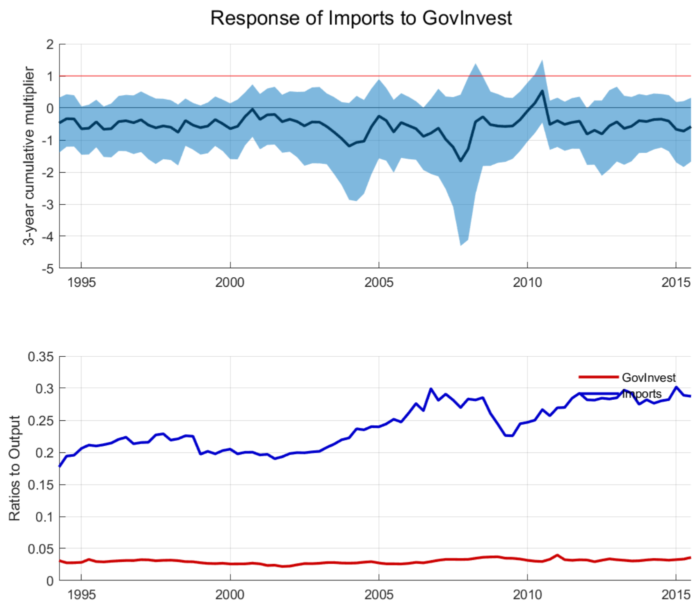
Figure A3: Response of exports to government investment



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows ratios to GDP.

Source: authors' compilation.

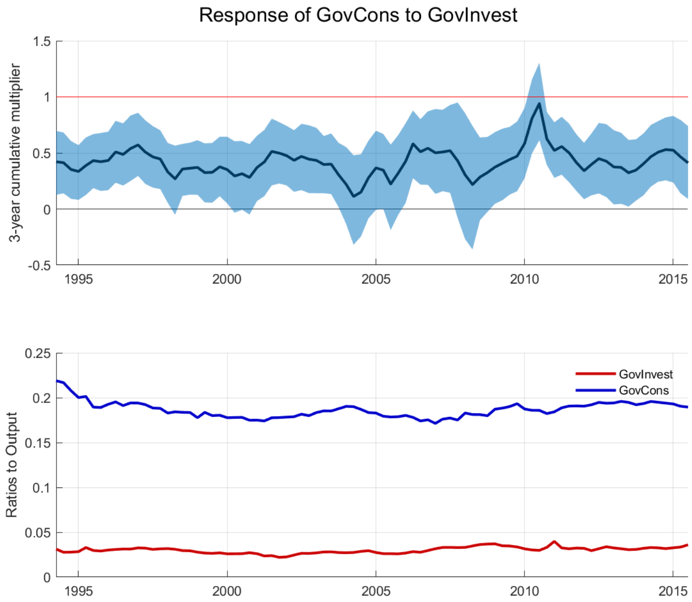
Figure A4: Response of imports to government investment



Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows ratios to GDP.

Source: authors' compilation.

Figure A5: Response of government consumption to government investment

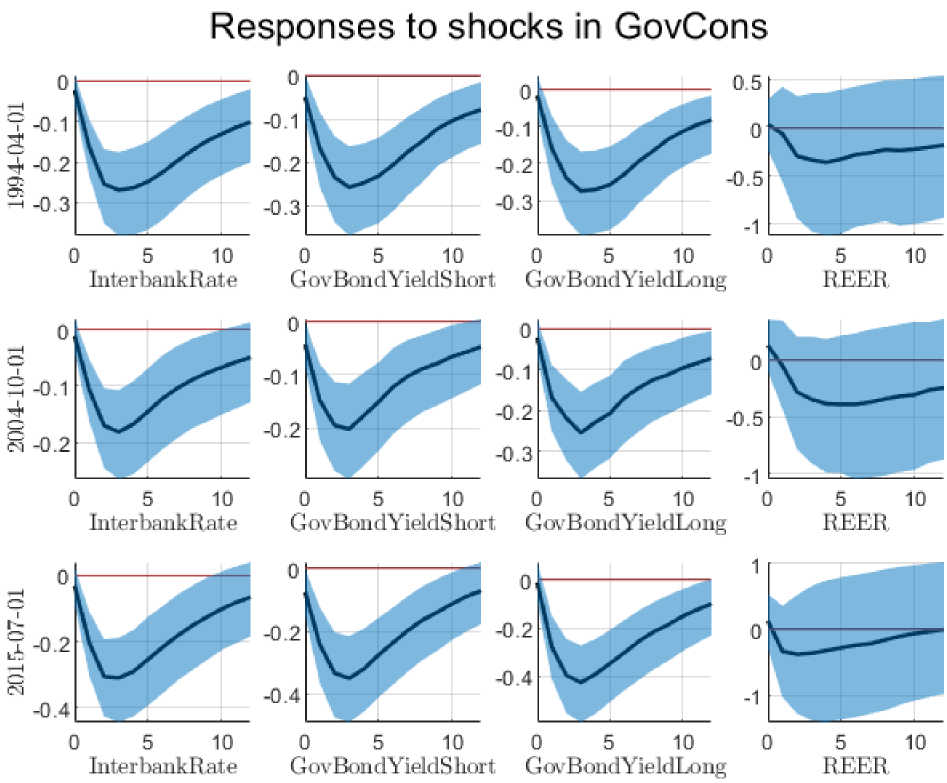


Note: the top panel shows the median (solid line) and the 32nd to 68th percentile range (shaded area) of the time-varying three-year cumulative multiplier. The bottom panel shows ratios to GDP.

Source: authors' compilation.

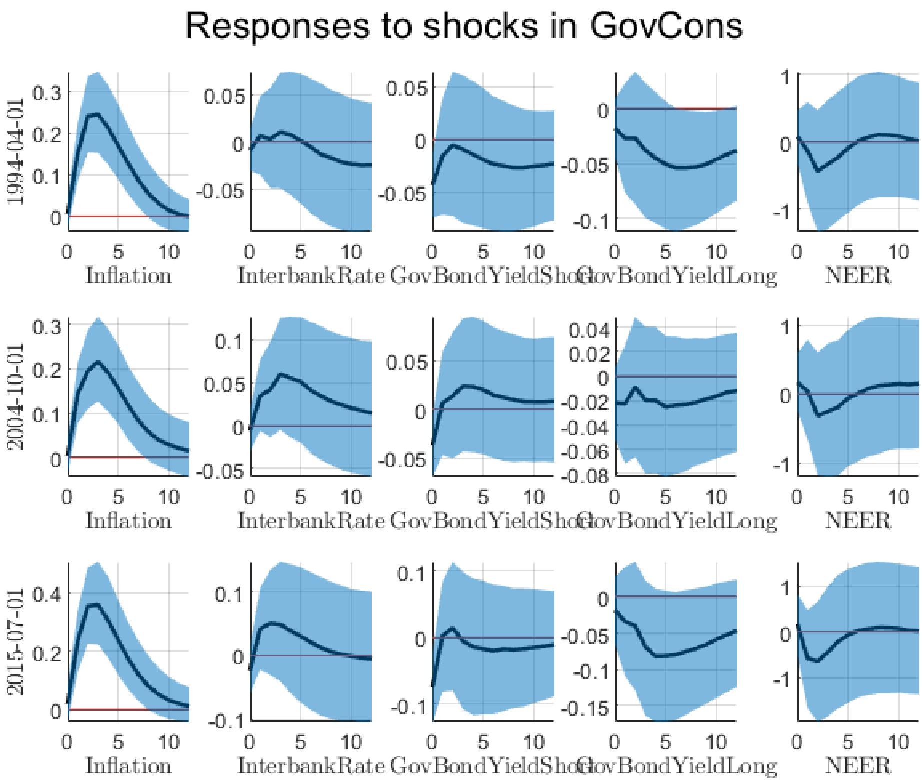
Appendix B: Impulse response functions of rates in extended models

Figure B1: Impulse response functions of various rates to government consumption in a model where the national accounts data were augmented with four real rates



Source: authors' compilation.

Figure B2: Impulse response functions of various rates to government consumption in a model where the national accounts data were augmented with five nominal rates



Source: authors' compilation.