National and Regional Impacts of an Increase in Value-Added Tax: A CGE Analysis for South Africa

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Abstract

The South African National Treasury expected a revenue shortfall of R48.2 billion in 2017/18 and proposed tax policy measures to raise an additional R36 billion in 2018/19. A key component to raise the additional revenue was a 1% point increase in the VAT rate to 15% effective from 1 April 2018. The increase in the VAT rate was not welcomed as it would increase the cost of living, especially for the poor. We investigate the potential economy-wide and regional impacts of raising VAT and increasing public spending on education and health. We do this by developing and applying a multi-regional model of the South African economy that includes detailed tax and spending features. In this model, when we increase VAT, the impacts are driven by the direct shock to the model, accompanied by differences in regional economic activity. We find that effects on GDP vary between regions but are generally negative.

Keywords: Computable general equilibrium (CGE) models, regional modelling, VAT, South Africa

1 INTRODUCTION

In the 2018 budget, the South African Minister of Finance announced a 1% point increase in the Value-Added Tax (VAT) rate to 15%. The increase in the VAT rate is part of a set of tax proposals designed to increase revenue collection, especially in light of an estimated gross tax revenue shortfall of R48.2 billion for 2017/18 (National Treasury, 2018a:39). The shortfall is the difference between budgeted and revised estimates of tax revenue.[1,2] The set of tax proposals was expected to raise 36 billion Rand in 2018/19. The largest contribution to the increase in tax revenue was VAT at 22.9 billion Rand (National Treasury, 2018a:41–42).[3] Public spending was also revised to balance new spending commitments (*e.g.* free higher education and training for poor and working-class households) and an increase in social grants, with the poor revenue outlook (National Treasury, 2018a:51–55). The budget deficit for 2017/18 was estimated at 204.3 billion Rand which is 4.3 of GDP (National Treasury, 2018a:28).

While this proposed increase in the VAT rate was not welcomed by the wider public, with concerns raised about the impact on the poor and low-income households, it was viewed as the most effective way of raising revenue. To assist the poor, the South African VAT system includes 19 zero-rated basic food items[4] and paraffin (kerosene). In addition, the poor would receive further assistance through an above-inflation increase in social grants (National Treasury, 2018a:44).

A number of alternatives to a uniform VAT increase were suggested, namely (i) the introduction of multiple VAT rates (*e.g.* higher rates on luxury goods), (ii) increase in personal income tax rates and (iii) increase in corporate tax rates. The Treasury did not deem it appropriate to increase personal income- or corporate tax rates and felt that a VAT system with multiple rates would not improve equity in the VAT system (National Treasury, 2018a:44). In the context of fiscal policy, simplicity of tax systems and efficiency is important, and equity and social objectives should be addressed via the expenditure side of fiscal policy (*e.g.* national school nutrition programme or food stamps) (National Treasury, 2007; 2018a). Treasury is therefore opposed to a VAT system with multiple VAT rates as it would add significantly to the complexity and administrative burden of the tax.

In this paper, we investigate the national and regional impacts of an increase in the VAT rate and the recycling of these funds back to provincial governments to finance expenditure programmes such as education and health. This is important for two reasons. First, increasing the VAT rate increases the cost of living for all South Africans, especially the poor. Second, the manner in which the increased tax revenue is spent holds economic consequences for all regions in terms of GDP growth and aggregate consumption.

Tax authorities typically describe an ideal VAT system as one where a uniform rate is applied to the consumption of goods and services used by the final user. To assist the poor and low-income households, some commodities may be exempted from VAT or zero rated. As noted in Keen and Lockwood (2010), the theoretical and empirical literature on VAT has, historically, been relatively scant. In recent years, aided by the increased use of VAT worldwide,[5] more studies have appeared shedding light on various aspects of its economic impact. Barbone *et al.* (2012; 2014) review the costs of VAT and investigate the VAT gap between EU member states, respectively, whilst Abramovsky *et al.* (2017) review redistribution, efficiency and design aspects of VAT. Given the focus of this study, we briefly highlight two relevant papers. Go *et al.* (2005) describe South Africa's VAT and find it to be (i) mildly regressive, and (ii) an effective source of government revenue. In experimental work using a CGE model, they also find that alternative tax structures can benefit low-income households without placing excess burdens on high-income households. This analysis is important given the context of South Africa's VAT rate increase that seeks to reduce the government's revenue shortfall and subsequent budget deficit position. Mabugu *et al.* (2015) use a CGE model to assess the poverty and inequality implications of interventions associated with tax changes. In one scenario, they found that raising the VAT and redistributing the proceeds back to poor households is likely to generate pro-poor outcomes. This analysis is important with regards to the implications for tax incidence of VAT on poor households given its regressive nature. The pro-poor outcomes are, however, contingent on the recycling of all additional VAT revenue to poor households. The broader economic impact on key macroeconomic variables such as GDP was still found to be slightly negative.

The remainder of this paper is structured as follows. Section 2 provides an overview of the sources of tax revenue in South Africa; Section 3 describes the model with specific reference to the government sector in the model; Section 4 describes the database behind the model; Section 5 describes the simulation design; Section 6 reports and discusses national and regional results, and Section 7 gives a conclusion of the paper.

2 OVERVIEW OF THE SOUTH AFRICAN TAX REVENUE SOURCES

Fig. 1 shows the percentage contribution of each tax instrument to gross tax revenue for 2016/17. This figure shows that tax revenue is dominated by three tax sources, namely, personal income and corporate tax (known as tax on income and profit) and VAT (part of taxes on goods and services). For 2016/17, these taxes contributed over 83% of gross tax revenue, with taxes on income and profit contributing 58.5% followed by VAT revenue which contributed 25.3% (National Treasury, 2018a:Table 2).

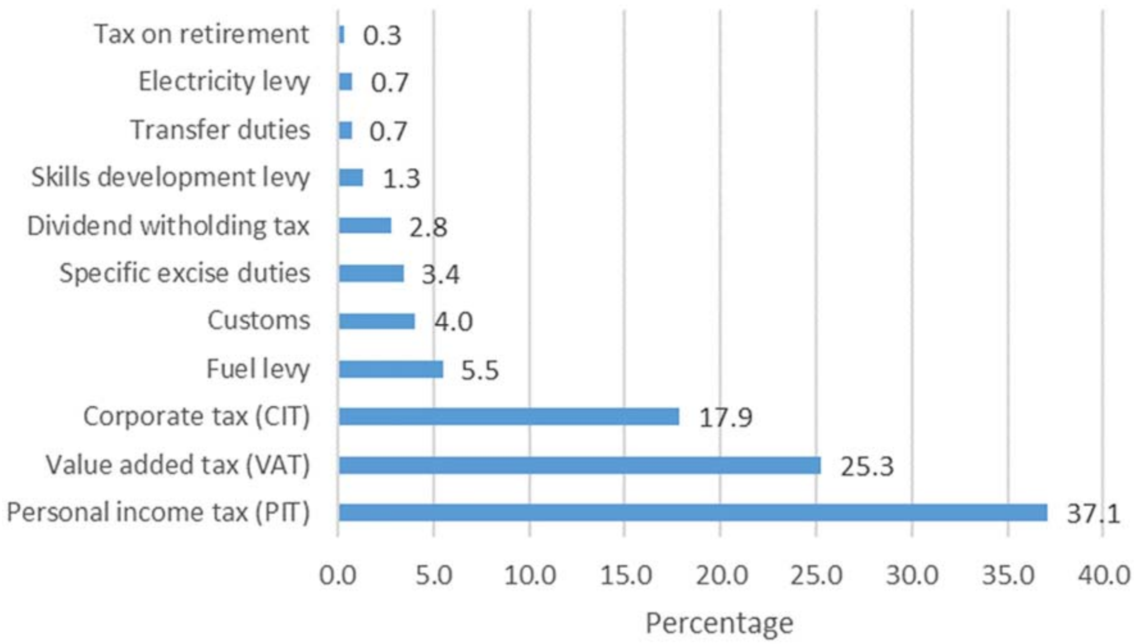

Figure 1. Contribution to gross tax revenue by tax instrument for 2016/17

Source: National Treasury (2018a), Main budget: estimates of national revenue, Table.

The contribution of each of these tax instruments remained stable over the period 1999/00 to 2017/18. Over this period, the contribution to overall tax revenue of taxes on income and profit varied between 55.2% in 2004/05 and 61.4% in 2008/09. The VAT contribution varied between 24% in 1999 to 27.7% in 2004/05.

For the 2017/18 period, the government faced a revenue gap of R48.2 billion. This shortfall was attributed to slower wage income growth, a weaker consumer outlook and lower import growth. These factors reduced tax collections of personal income tax, VAT and customs duties.

2.1 Increasing the VAT rate

VAT was introduced in South Africa in September 1991 to replace the General Sales Tax (GST). Globally, it is a popular instrument to raise revenue. The Mirrlees Report (2011) reports that 150 countries worldwide including every OECD country apart from the USA impose VAT (Mirrlees *et al.*, 2011:148). VAT is an indirect tax on consumption of goods and services in the economy and paid by the final user.[6] As of 1 April 2018, the VAT rate increased from 14% to 15% on most goods and services, adding approximately 22.9 billion Rand to tax revenue (National Treasury, 2018a:41).

Although the overall tax system in South Africa is progressive, VAT is inherently regressive[7, 8] and thus calls for concessionary treatment, which may include exempted or zero-rated commodities.[9] Overall, the wealthiest 30% of households contributes 85% of all VAT revenue (National Treasury, 2018a:44).

Why increase VAT? The increase in VAT, which was part of a set of tax proposals, was necessary due to the expected revenue shortfall of R48.2 billion (National Treasury, 2018a:8, 39). The tax proposals presented in the 2018 budget[10] are expected to raise R36 billion in additional revenue and help prevent further erosion of the public finances.[11]

The increase in the VAT rate has been criticised because of the probable resulting increase in the cost of living for all households, especially the poor. To assist the poor, the increase in the cost of living is offset by zero-rating of basic food items and paraffin as well as an above-inflation increase in social grants.

Due to the impact on the poor, the Minister of Finance appointed a panel of independent experts to consider and review the list of zero-rated food items. The panel recommended that the following items be zero-rated: white bread, white sugar, cake flour, sanitary products, school uniforms and nappies (National Treasury, 2018b, 2018a:7). They also suggested alternative ways to mitigate the VAT increase: (i) nutritional support; (ii) cash transfer programmes and (iii) lower (non-zero) VAT rates on some of the products identified in their report (National Treasury, 2018b, 2018a:73). They also specifically noted that expenditure programmes are important in mitigating the impact on the poor (National Treasury, 2018b, 2018a:8).

The call to expand the list of zero-rated goods is echoed in a report by WITS' Corporate Strategy and Industrial Development (CSID) Research Programme (WITS, 2018). They also find that a unilateral increase in the VAT rate on all goods and services would harm the poor and lower-income earners (Isaacs, 2018). They suggest that the list of zero-rated items should be expanded by targeting additional commodities bought by the poor, including all bread types, poultry, candles, soap, medicines, pay-as-you-go airtime and education related goods. Although all income earners will benefit from expanding the list of zero-rated commodities, the share of disposable income spent on these goods by the poor is higher. Therefore, the poor would benefit the most from an expanded list. Isaacs (2018) also suggests that a higher VAT rate (for example 20%) should be levied on luxury commodities such as yachts, fancy cars and expensive fridges. They argue that since a high share of luxury items are imported, this should not dampen domestic demand and could modestly assist the Balance of Payments (BOP) (Isaacs, 2018). The authors suggest alternative measures to an increase in VAT:

- Improving the administrative capacity of SARS, including tackling tax avoidance and evasion.
- Raising the personal income tax rate, particularly on the highest earners.
- Increasing the corporate income tax rate.
- Instituting an annual net wealth tax.
- Instituting a land tax especially on unused land, and increasing property tax particularly on non-residents and those owning multiple homes.
- Increasing other tax rates on property or income from property such as capital gains tax, estate duty and securities transaction tax.

3 THE MODEL

We simulate below the effects of:

1. raising the VAT rate by an amount sufficient to increase VAT revenue by 22.9 billion Rand in 2019, and thereafter maintaining the new VAT rates;
2. using the increase in national government revenue to boost transfers from the national to the provincial governments, by an amount sufficient to leave the national government budget balance at its baseline level. The transfer increase is not exactly equal to 22.9 billion Rand because other tax revenues change (*e.g.* income taxes); and
3. adjusting regional government spending by an amount sufficient to leave each regional government budget balance at its baseline level. Again, the spending increase in each region is not quite equal to the transfer increase because the various regional income sources change slightly (*e.g.* gambling tax).

Capturing the economy-wide and regional impacts of the above measures requires a detailed model that accounts for changes in commodity-specific tax rates and allows for an increase in public spending. For this paper, we use a multi-regional, multi-period general equilibrium model.

The core of the model is based on the well-known TERM model developed by Horridge (2011). While the complete model is too large to describe in this paper, a comprehensive description of the core model is contained in Horridge (2011) and Horridge *et al.* (2005). The TERM model was created for Australia (Horridge *et al.*, 2005; Wittwer and Horridge, 2010) and adapted for South Africa (Stofberg and Van Heerden, 2016), Poland (Zawalinska *et al.*, 2013), Brazil (Ferreira-Filho *et al.*, 2015), China (Horridge and Wittwer, 2008a) and Indonesia (Pambudi and Smyth, 2008; Pambudi *et al.*, 2009; Yusuf *et al.*, 2018). For this paper, we provide an overview only, as the theory of the TERM model and data structures are well documented. The overview of the core model is followed by a description of the modelling of the Government Financial Statistics (GFS) module.

The TERM-GPT model consists of two inter-dependent modules. The first module describes the core model equations related to region-specific behaviour of producers, investors, households, government and exporters at a regional level. It also describes the dynamic mechanisms in the model, namely, capital accumulation and labour market adjustment. The second module describes the treatment of all items included in the GFS.

In the core model, producers in each region are assumed to minimise production costs subject to a nested constant-returns-to-scale (CRTS) production technology. In this nested structure, each regional industry's inputs of primary factors are modelled as a constant elasticity of substitution (CES) aggregate of labour, capital and land inputs. Commodity-specific intermediate inputs to each regional industry are modelled as CES composites of foreign and domestic varieties of the commodity. Labour inputs used by each regional industry are distinguished by occupation, with substitution possibilities over occupation-specific labour described via CES functions specific to each regional industry. In each region, 48 representative households[12] are assumed to choose composite commodities to maximise a Klein-Rubin utility function. Households and firms consume composite commodities that are assumed to be CES aggregations of domestic and imported varieties of each commodity. The allocation of investment across regional industries is guided by relative rates of return on capital. For each region-specific industry, new units of physical capital are constructed from domestic/imported composite commodities in a cost-minimising fashion, subject to CRTS production technologies. Region-specific export demands for each commodity are modelled via constant elasticity demand schedules which link export volumes from each region, to region-specific foreign currency export prices.

There are alternative rules through which regional public demands for commodities are modelled. In simulations below, we assume that regional government demand is driven by regional government income (in turn driven by national government income). Regional and national government budget deficit are fixed.

The core model includes various indirect tax rates paid on the use of commodities. Some of these taxes accrue to the national government (*e.g.* VAT) while other taxes accrue to the provincial governments (*e.g.* gambling tax and motor vehicle registration). In the standard setting of the model, indirect tax rates are modelled exogenously. They may be altered to simulate a change in tax proposals, such as an increase in the VAT rate. For further details of the input-output structure, see Horridge (2011).

As mentioned above, the core section includes equations determining government demand at a national and regional level. Typically, we model government demand as exogenous (see Equation 1) or linked to regional private consumption (see Equation 3). In levels form, (Equation 1) sets the commodity and region-specific government demand equal to a number of shift variables.[13,14]

$$XGOVG(c, d, g) = FGOV\_S(c, d, g) * FGOVTOT(d, g) * FGOV\_D(c, g) * FGOVGEN \text{ for all } c \in COM, d \in REG, g \in GOV \quad (1)$$

where

- XGOVG is the government demand for all-source composite commodities c by government g in region d;
- FGOV_S is a shift variable for all-source composite commodities c by government g in region d;
- FGOVTOT is a shift variable specific to government g in each region d;
- FGOV_D is a shift variable for all-source composite commodities c by government g; and
- FGOVGEN is an economy-wide government shift variable.

The percentage change form of Equation (1) is:

$$xgovg(c, d, g) = fgov\_s(c, d, g) + fgovtot(d, g) + fgov\_d(c, g) + fgovgen \text{ for all } c \in COM, d \in REG, g \in GOV \quad (2)$$

where all the variables in Equation (2) are in percentage change form.

In the standard closure setting, the variables on the right-hand side (RHS) of Equation (2) are naturally exogenous, implying that they are determined outside of the model and if not directly shocked during a simulation, the change is zero.

Alternatively, regional government demand is linked to regional private consumption. Equation (3) is the levels form of this rule.

$$FGOVTOT(d, g) = FGOVTOT2(d, g) * MACRO(RealHou, d) \text{ for all } d \in REG, g \in GOV \quad (3)$$

where

- FGOVTOT2 is a shift variable specific to government g in each region d; and
- MACRO("RealHou", d) is private consumption in each region d.

In percentage change form, Equation (3) yields,

$$\text{fgovtot}(d, g) = \text{fgovtot2}(d, g) + \text{macro}(\text{RealHou}, d) \quad \text{for all } d \in \text{REG}, g \in \text{GOV}$$
(4)

where all variables in Equation (4) are in percentage change form.

In the standard closure setting for Equation (4), fgovtot2 and macro("RealHou", d) are endogenous while fgovtot is exogenous. By rendering fgovtot2 exogenous and fgovtot endogenous, government demand determined in Equation (1) follows regional private consumption.

Equation (5) determines the purchasers' value of the use of commodity c, from source s by user u in region d, as the sum of the commodity use valued at delivered price[15] and sales taxes levied on these commodities.[16]

$$\text{PUR}_{(c,s,u,d)} = \text{USE}_{(c,s,u,d)} + \sum_{t \in \text{TAXTYPE}} \text{TAX}_{(c,s,u,d,t)} \quad \text{for all } c \in \text{COM}, s \in \text{SRC}, u \in \text{USER}, d \in \text{REG}, t \in \text{TAXTYPE}$$
(5)

where

- PUR is the purchasers' value of commodity *c*, from source *s* paid by user *u* in region d;
- USE is the delivered value of commodity *c* from source *s* to user *u* in region *d*; and
- TAX is the tax (subsidy) value *t* paid by (too) user *u* for commodity *c* from source *s* in region *d*.

Tax revenue is calculated via Equation (6).

$$\text{TAX}(c, s, u, d, t) = \text{USE}(c, s, u, d) * \text{TAXRATE}(c, s, u, d, t) \quad \text{for all } c \in \text{COM}, s \in \text{SRC}, u \in \text{USER}, d \in \text{REG}, t \in \text{TAXTYPE}$$
(6)

where the TAXRATE is specific tax t levied on each commodity c from source s, used by user u in region d. These tax rates are naturally exogenous (See Equation 10).

Our focus is on the sales tax term, which is defined in ordinary change below:

$$\Delta\text{TAX}(c,s,u,d,t) = 0.01 * \text{TAX}(c,s,u,d,t) * \left[\text{xuse}(c,s,u,d) + \text{puse}(c,s,d)\right] + \text{USE}(c,s,u,d) * \Delta\text{TAXRATE}(c,s,u,d,t) \quad \text{for all } c \in \text{COM}, s \in \text{SRC}, u \in \text{USER}, d \in \text{REG}, t \in \text{TAXTYPE}$$
(7)

where

- xuse is the percentage change in the use of commodity *c*, from source *s* by user *u* in region *d*;

- puse is the percentage change in the delivered price of commodity *c*, from source *s* by user *u* in region *d*; and
- ΔTAXRATE is the ordinary change in the tax rate on commodity *c* from source *s* paid by user *u* in region *d* as determined in (Equation 8)

Equation (7) includes 2% change variables, xuse and puse, which are the percentage change in the use of commodity *c*, from source *s* by user *u* in region *d* and the percentage change in the delivered price of commodity *c*, from source *s* in region *d*. The percentage change in the delivered price is uniform over all users. The percentage change in the demand for commodity c (xuse) is derived from various optimisation problems.

The change in sales tax revenue, determined in Equation (7), can be summed over different dimensions.[17] For example, summing over the commodity, source and user dimension, Equation (7) yields Equation (8) which is the ordinary change in tax revenue by region d and tax type t.

$$\Delta \text{TAX\_csu}(d,t) = \sum_{c \in COM} \sum_{s \in SRC} \sum_{u \in USER} \Delta \text{TAX}(c,s,u,d,t) \text{ for all } c \in \text{COM}, s \in \text{SRC}, u \in \text{USER}, d \in \text{REG}, t \in \text{TAXTYPE}$$

(8)

The ordinary change in the respective sales tax rates in Equation (7) is set equal to a number of shift variables:

$$\Delta \text{TAXRATE}(c,s,u,d,t) = \Delta \text{TAXRATE\_u}(c,s,d,t) + \Delta \text{TAXRATE\_su}(c,d,t) + \Delta \text{TAXRATE\_sd}(c,u,t) \text{ for all } c \in \text{COM}, s \in \text{SRC}, u \in \text{USER}, d \in \text{REG}, t \in \text{TAXTYPE}$$

(9)

where

- ΔTAXRATE_u is the ordinary change in the ad valorem tax rate *t* paid on commodity *c* from all sources *s* in region *d*. This rate is uniform over all users *u*.
- ΔTAXRATE_su is the ordinary change in the ad valorem tax rate *t* paid on commodity *c* region *d*. This rate is uniform over all users *u* and sources s.
- ΔTAXRATE_sd is the ordinary change in the tax rate *t* paid on commodity c by user u. This rate is uniform over all sources and regions.

These shift variables are naturally exogenous and unless their values change,[18] the change in the tax rate remains zero.19 By altering the respective sales tax rates, sales tax revenue will change (see Equation 6), and ultimately the value of commodities at purchasers' price will adjust (see Equation 5).

The core model includes two dynamic mechanisms that relate variables in adjacent periods.

1. The labour market mechanism guides the labour market from a short-run environment (sticky real wages, flexible labour) to a long-run environment (flexible wage, fixed employment). Therefore, in the short run, positive (negative) outcomes are reflected in positive (negative) changes in employment (with no change in real wage) and in the long run reflected as positive (negative) changes in real wage (with employment unchanged).
2. In each region and sector, changes in capital stocks are driven by changes in investment in the previous year. Current-year industry-specific investments are linked to changes in rates of return. The rates of return are forced to gradually move towards their long-run baseline levels. Therefore, in the first year (short run), positive (negative) outcomes are

reflected in positive (negative) changes in the rates of return and investment (capital stock remains fixed), while in the long run, positive (negative) outcomes are reflected in positive (negative) changes in capital stocks (rates of return remain fixed).

A dynamic simulation is a sequence of short-run simulations. However, the effect of the above two mechanisms is that long-run deviations from baseline are consistent with a long-run closure where rates of return and employment are fixed at baseline levels.

The second module describes the treatment of the GFS accounts. The structure of this module is based on the framework used in the Government Financial Statistics (GFS) (IMF, 2014), which presents standardised financial data across jurisdictional governments on a financial year basis. In other words, it determines the financial position for each of the nine provincial and national governments. This module includes three sections: (i) government revenue; (ii) government expenditure and (iii) government budget balances.

In essence, changes in each GFS item are linked to changes in the core model through the use of relevant drivers of underlying economic activity and, in the case of taxes, to the relevant average tax rates. For example, the percentage change in government demand, determined in the core model (see E.2), drives changes in the operating expense, which is one of the expenditure items listed in the GFS account. Various tax revenue items listed in the GFS income account (*e.g.* VAT, fuel levy and excise taxes) are driven by the change in tax collections (see E.6) which are determined in the core model.

Table 1 shows the GFS revenue items for 2014/15 and to which government jurisdiction income accrues. There are three main sources of revenue, tax (A in Table 1), grant receipts (B) and other revenue (C). Each numbered revenue item is explicitly accounted for in the model. For example, tax payable by individuals (item 1.1) accrues to the national government while gambling tax and motor vehicle taxes (item 1.8 and 1.9) accrue to provincial governments. For the regional distribution of total provincial income, see Appendix 1.

Table 1. Government revenue items in the government finance module

GFS revenue item	National	Provincial
A. Taxes		
Tax on income, profits and capital gains		
1. Payable by individuals	353,918	–
2. Payable by business	207,872	–
3. *Taxes on pay-roll and workforce*	14,032	–
4. *Taxes on property*	12,471	
Taxes on goods and services		
5. Value-added taxes	261,312	–
6. Excises	48,467	–
7. Other excise	35,296	83
8. Taxes on specific services (incl gambling and betting)	–	2,272
9. Motor vehicle taxes	–	7,901
10. Other (Business and professional licenses)	11,303	–
Taxes on international trade and transactions		
11. Customs and other import duties	41,463	–
12. Other taxes	−16	–
B. Grants		
13. Foreign grants	1,837	159

GFS revenue item	National	Provincial
14. Other general government institutions	–	445,173
C. Other revenue		
15. Sales of goods and services	1,822	2,847
16. Property income	12,133	1,605
17. Fines, voluntary transfers and miscellaneous revenue	13,639	1,730
D. GFS operating income (=A+..+..C)	1,015,549	461,770
18. Sale of non-financial assets	78	260
E. GFS income (incl NFA) (= D + 1.18)	1,015,627	462,030

Nearly all of the taxes listed under point A in Table 1 accrue to the national government (98.9%), while nearly all grant incomes (point B in Table 1) accrue to provincial governments (99.6%). In fact, 96% of the income generated by provincial governments is from grant payments from the national government. These payments to the provincial governments are based on an equitable share formula which is largely population driven (National Treasury, Annexure W1, 2015b:19).

Table 2 summarises the economic drivers determined in the core model that drives the income items listed in Table 1. For example, tax payable by individuals (item 1.1 in Table 2) is indexed to the change in employment, the wage rate and a shift variable.

Table 2. Drivers of government revenue in TERM-GPT

Source of government revenue	Drivers
Taxes on income	
1. Income taxes levied on individuals	Employment; wage rate; shift term
2. Income taxes levied on companies	Capital stock; unit income on capital; quantity of land; unit income on land; shift term
Factor inputs	
3. Payroll	Employment; wage rate; shift term
4. Property	Capital stock; unit income on capital; shift term
Taxes on the provision of goods and services	
5. VAT	Tax rates on usage in production, investment, household consumption and exports; real usage and the delivered price of goods and services in production, investment, household consumption and exports
6–7. Excises and levies	Commodity tax rates on other food, beverages & tobacco, petrol and other petroleum; real usage and delivered price of food, beverages & tobacco petrol and other petroleum & refined products used in production, investment and household consumption
8. Gambling	Commodity tax rates on hotels, cafes & accommodation and other services; real usage and delivered price of hotels, cafes & accommodation and other services used in production, investment and household consumption
9. Use of motor vehicles	Commodity tax rates on motor vehicles & parts; real usage and delivered price of motor vehicles & parts used in production, investment and household consumption
10. Environmental taxes	Commodity tax rates on plastic products, motor vehicles and electricity; real usage and delivered price of plastic products, motor vehicles and electricity used in production, investment and household consumption
11. International trade (customs duties)	Import duty rates; import volumes and delivered price of imported commodities
12. Other tax	Commodity tax rates; real usage and delivered price on a variety of commodities
Grants to provinces	
13. Current grants	Population growth; CPI; shift variable
14. Other grants	Regional/National nominal GDP; shift variable

Source of government revenue	Drivers
15. Sales of goods and services	Real government consumption; government consumption price deflator; shift term
16. Property (eg interest)	Regional/National nominal GDP; shift variable
17. Other revenue	Regional/National nominal GDP; shift variable
18. Non-Financial assets	Regional/National nominal GDP; shift variable

The government finance section separately identifies 11 individual sources of government expenses and a number of expense aggregates (Table 3). Both national and regional governments incur expenses.

Table 3. Government expense items in the government finance module

GFS expense item	National	Provincial
1. Gross operating expenses	186,669	369,217
2. Interest	114,807	24
3. Subsidy expenses	14,134	7,615
4. Grant payment		
4.1 Foreign grants	53,356	2
4.2 University	24,014	44
4.3 Municipality	57,252	2,961
4.4 Other current grants	471,035	5,663
5. Capital grants	79,593	1,676
6. Social Benefits	126,150	2,201
7. Other payments	39,135	32,853
GFS operating expenses (=1+..+..10)	1,166,145	422,256
8. Purchases of non-financial assets	16,119	32,527
GFS expenditure (=operating expense + 11)	1,182,264	454,783

Table 4 summarises the economic drivers calculated in the core model that drives the expenditure items. For example, gross operating expenses (item 1 in Table 4) are indexed to nominal government demand and a shift variable.

Table 4. Drivers of government expenditure in TERM-GPT

Type of government expenditure	Regional/National drivers
1. Gross operating expenses	Regional/National nominal government consumption; shift term
2. Interest	Regional/National nominal GDP; shift variable
3. Subsidy expenses	Regional/National nominal GDP; shift variable
4. Grant payment	
4.1 Foreign grants	Regional/National nominal GDP; shift variable
4.2 University	Regional/National nominal GDP; shift variable
4.3 Municipality	Regional/National nominal GDP; shift variable
4.4 Other current grants	Regional/National nominal GDP; shift variable
5. Capital grants	Regional/National nominal GDP; shift variable
6. Social Benefits	Regional/National nominal GDP; shift variable
7. Other payments	Regional/National nominal GDP; shift variable
8. Purchases of non-financial assets	Regional/National nominal GDP; shift variable

The final section of the GFS module draws together the data on GFS revenue and GFS expenses to derive three summary measures of the overall nominal financial position of each government (Table 5). The module also reports a fourth summary measure, namely the government budget as a share of nominal GDP.

Table 5. Summary measure of financial position in the government finance module

GFS summary item	National	Provincial
Net operating balance	−150,596	39,514
Net acquisition of non-financial assets	−16,041	−32,267
Change in Net lending/borrowing balance	−166,637	7,247

The net operating balance is calculated (in levels) as:

$$NOB(d) = OperateInc\_i\ (d) - OperateExp(d) \quad (10)$$

where

- OperateInc is the total operating income by government jurisdiction, summed over all income sources, excluding the sales of financial assets.[20]

$$OperateInc\ (d) = \sum_{i \in GFSI} GFSINC\ (i, d)\ \text{ for all } i \in GFSI,\ d \in GOVT$$

- OperateExp is the total operating expenditure by government jurisdiction, summed over all expenditure items, excluding purchases of financial assets.[21]

$$OperateExp\ (d) = \sum_{e \in GFSE} GFSEXP\ (e, d)\ \text{for all } e \in GFSE,\ d \in GOVT$$

The ordinary change form of Equation (10) is:

$$\Delta NOB(d) = \Delta OperateInc\_i\ (d) - \Delta OperateExp(d) \quad (11)$$

The net acquisition of non-financial assets is the difference between income generated by the sales of financial assets (OperateInc(“SFA”, d)) and the purchases of financial assets (OperateExp(“PFA”, d)):

$$NFA(d) = OperateInc\ (SFA, d) - OperateExp\ (PFA, d) \quad (12)$$

The ordinary change form of Equation (13) is:

$$\Delta NFA(d) = \Delta OperateInc\ (SFA, d) - \Delta OperateExp\ (PFA, d) \quad (13)$$

Finally, the change in the net lending or borrowing balance for provincial and national government is determined as the sum of the net operating budget and net financial assets:

$$\Delta BUDGET(d) = \Delta NOB(d) + \Delta NFA(d) \quad (14)$$

4 THE DATABASE

Two large databases form the initial solution to the model in levels form:

- The first, reflecting the core data used by all versions of TERM, shows the structure of the South African economy in 2015.
- The second contains the additional GFS income and expenditure data for 2015, needed for our fiscal extension.

The core TERM database is calibrated using various data sources:

1. National Supply-Use Table (SUT) 2015 (StatsSA, 2017).
2. Regional shares of production, investment, private and public spending for each commodity.
3. International exports of commodities from each region (this is not inter-regional trade).
4. Imports of commodities from the rest of the world to each region.
5. GFS data for 2014/15.
6. Tax statistics for 2015.

In creating the database, we follow the approach developed by Horridge[22] and discussed in Horridge (2011), Horridge and Wittwer (2008b, 2008a) and Horridge *et al.* (2005). We begin by developing a national input-output table based on the SUT (StatsSA, 2017). The national input-output table shows a USE matrix, which captures the flows of commodity c, from source s to user u. This matrix captures the interdependence of industries due to upstream and downstream linkages in the commodity market. The margin matrices show the value of margins (*e.g.* transport and trade) that facilitate these flows. There are also indirect tax matrices showing the values of commodity taxes t paid on commodities c from source s by user u. The value-added matrices show industry-specific capital and land rentals, labour payments and production taxes. The database is balanced implying that the costs equal sales for each sector. We use additional data on region-specific output shares to inform on regional demand for inputs and production. Similarly, we use regional shares on investment, private and public consumption, international exports and imports to distribute national values over regions. Finally, we construct inter-regional trade flows of commodities between regions. Our task is made easier by assuming that industry-specific technologies are similar across regions. Given these assumptions, we ensure that regional data is consistent with national data.

GFS data (2014/15) is used to create an income and expenditure database for the national and nine provincial governments (StatsSA, 2016a,2016b). Government expenses are presented in excel format and summarise seven main expense categories.[23] Each expense category is presented by functional[24] and economic classification.[25] Government income is presented in excel format and summarises income from four main sources, namely tax revenue, social contributions,[26] grants and other revenue. Data from the National Treasury (National Treasury, 2015a) complement the GFS data.

5 SIMULATION DESIGN

To conduct policy simulations with our model, we run two simulations. First, we run a baseline forecast, modelling the time path of the economy in the absence of the policy change under consideration. Our baseline incorporates macro forecast data from the National Treasury (National Treasury, 2018a:17) and the World Economic Outlook Database from the International Monetary Fund (IMF, 2018). Specifically, we adopt forecasts for the GDP expenditure components, employment and population growth.[27] We do not alter the various tax rates in the baseline simulation. Tax revenue in the baseline simulation is calculated from initial database tax rates and the underlying performance of the relevant economic drivers (see Tables 2 and 4).

The second simulation incorporates all of the features of the baseline forecast, plus policy-related shocks reflecting the increase in the VAT rate from 2018 onwards. The results of the policy simulation are typically reported as percentage deviations away from the baseline forecast. We solve the model using GEMPACK (Horridge *et al.*, 2018).

5.1 Assumptions about the macroeconomic environment

1. The labour market is characterised by short-run stickiness of the real wage with flexible employment adjustment. TERM includes a mechanism that allows the labour market to transition from a short-run environment to a long-run environment where the real wage adjusts and employment moves to its long-run baseline level. In the policy simulation, we assume that, if employment is above (below) the trend employment rate, real wages will increase (fall) during the simulation year. Since employment is negatively related to real wages, this mechanism causes employment to adjust towards the long-run employment trend. On a regional level, migration is driven by wage differentials.
2. In our policy simulation, the economy-wide APC is an endogenous variable that moves to ensure that the ratio of the balance of trade to GDP (BOT/GDP ratio) remains at its baseline level.
3. Subject to the movements in the economy-wide average propensity to consume, household- and region-specific private consumption is determined as a fixed proportion of wage income.
4. Capital and investment are specific to each industry. TERM allows for short-run deviations in expected rates of return from their baseline levels. These cause deviations in investment and hence capital stocks that gradually erode the initial deviations in rates of return. Provided there are no further shocks, rates of return revert to their baseline levels in the long run.
5. In the baseline closure, all commodity-specific tax rates are fixed. Tax revenue is then determined subject to fixed effective tax rates and the change in the relevant economic drivers associated with each tax. In our policy closure for 2018, we impose a once-off increase in VAT revenue of R22.9 billion, and allow the model to endogenously determine the required increase in the VAT rate to accommodate the additional VAT revenue. From 2019 onwards, we hold the VAT rate exogenous at the higher level and allow the model to determine VAT revenue based on the higher VAT rate and the change in the underlying economic drivers. In our policy simulation, we ensure that:
6. the tax rates of the zero-rated items (mostly food items) remain at their baseline level;
7. the VAT increase falls on households.
8. The extra VAT revenue is returned to the economy via transfers to the provincial governments to finance public spending, specifically education and health services.
9. For the national government, all non-tax revenue sources are held at their baseline growth paths. For the provincial governments, all non-tax revenues except grant receipts from the national government are held at their baseline levels.
10. Values for real public spending increase relative to the baseline:
    1. At a national level, the government budget balance is held at its baseline level by ensuring that the increase in additional VAT revenue to the national government is offset by an increase in grant payments to each province.[28] Consequently, provincial income increases.

2. Provincial government budget balances are held at their baseline levels to ensure that the increase in grant payments received from the national government, finance regional government spending on health and education.

11. The model explains changes in relative prices, but has no mechanism to determine the absolute price level. Thus, one price must be exogenous. This price is the benchmark against which all other prices are measured. In the simulations, the numeraire is the nominal exchange rate.
12. TERM contains many variables to allow for shifts in technology and household preferences. In the policy scenarios, most of these variables are exogenous and have the same values as in the baseline projection.

6 RESULTS

6.1 Direct impact of the shock

Fig. 2 shows the direct impact of VAT revenue to the national government. The baseline results (solid line) show a steady increase in VAT revenue over the simulation period. With the 1% point increase in the VAT rate effective from 2018, VAT revenue increases by Rand 22.9 billion. From 2019 onwards, the VAT rate is permanently set at a higher rate, generating higher than baseline VAT revenues (policy line). Our results further suggest that VAT as a percentage of tax revenue increases from 26.5% in the baseline to 28% in the long run (broken line).

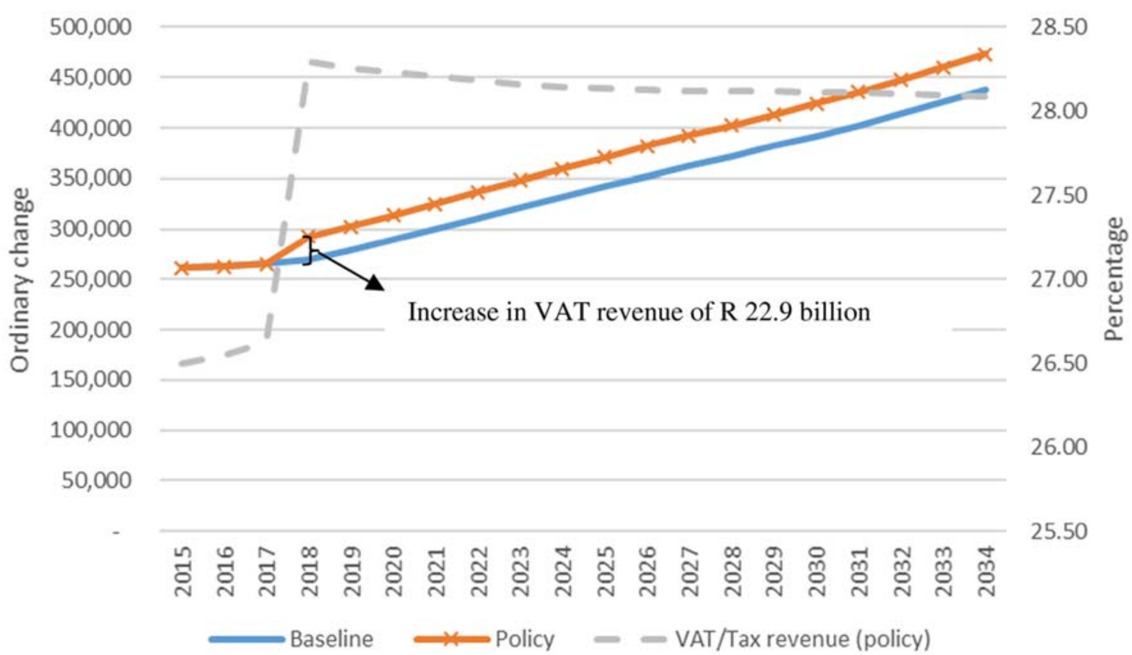

Figure 2. VAT revenue to national government, 2018–2035 (R million)

Total tax revenue accruing to the national government increases over time, but by a slightly higher value than the VAT revenue. The other largest revenue changes are for personal income tax and company tax.[29]

The main source of provincial revenue is grant receipts from national government.[30] In the policy simulation, the additional VAT revenue is distributed to the provincial governments to finance additional spending on education, health and administration services. The additional VAT revenue is distributed over provinces in proportion to their existing initial grant receipts (which are based on an equitable share formula [National Treasury – Annexure W1, 2015b: 19]). Additional grant payments of R22.9 billion are approximately 4.5% of total grant transfers to provincial governments.

6.2 National results

Figs. 3-9 illustrate macro, sectoral and regional results from the TERM-GPT model simulating the increase in the VAT rate given the underlying assumptions described in Section 5.1. The figures show percentage deviations from the baseline. Most graphs show an initial negative impact which then evolves smoothly towards the long-run impact – so it is sufficient to explain the initial and long-run results.

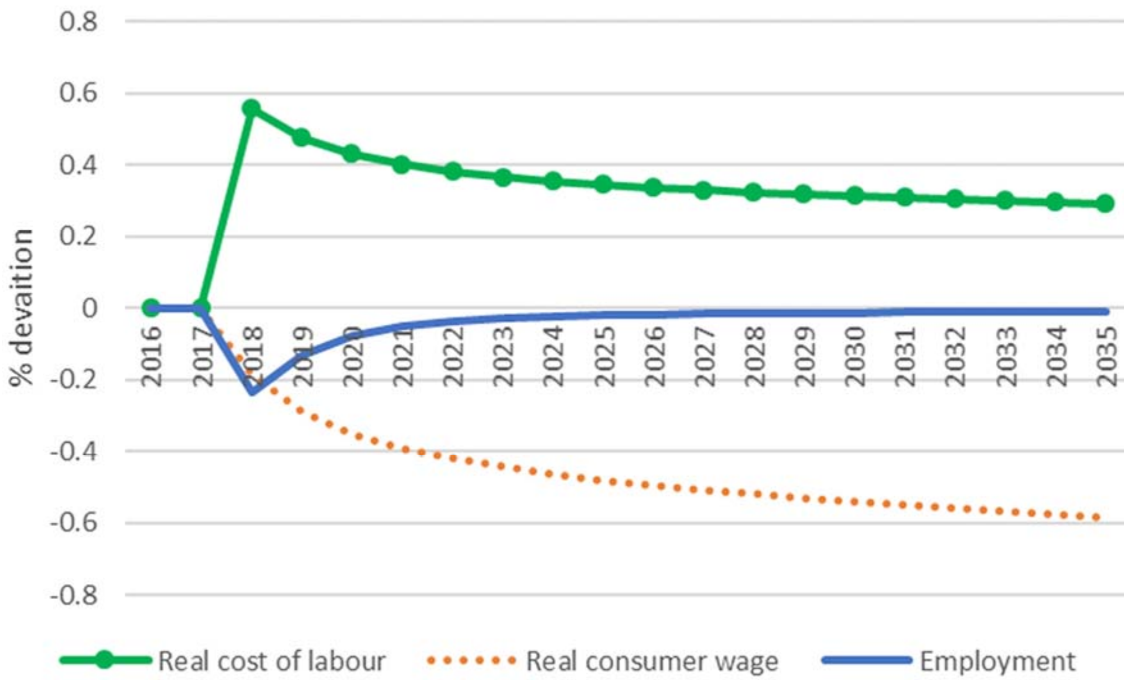

Figure 3. Employment, real cost of labour and the real consumer wage (% deviation from baseline)

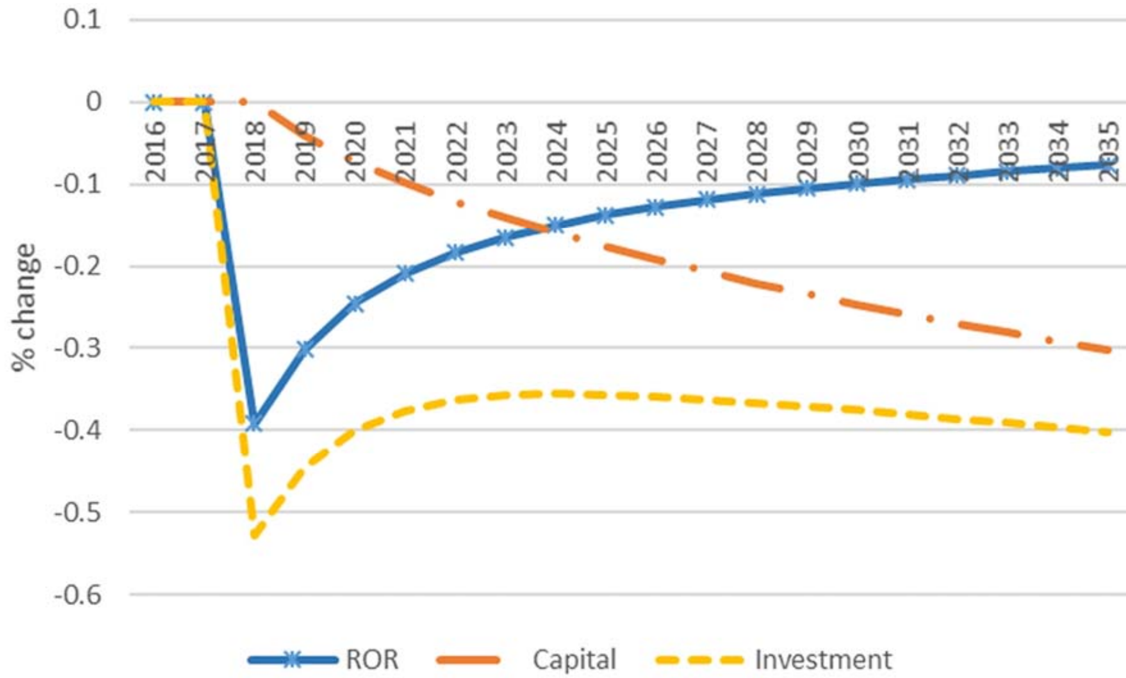

Figure 4. National capital stock, investment and rate of return (% deviation from baseline)

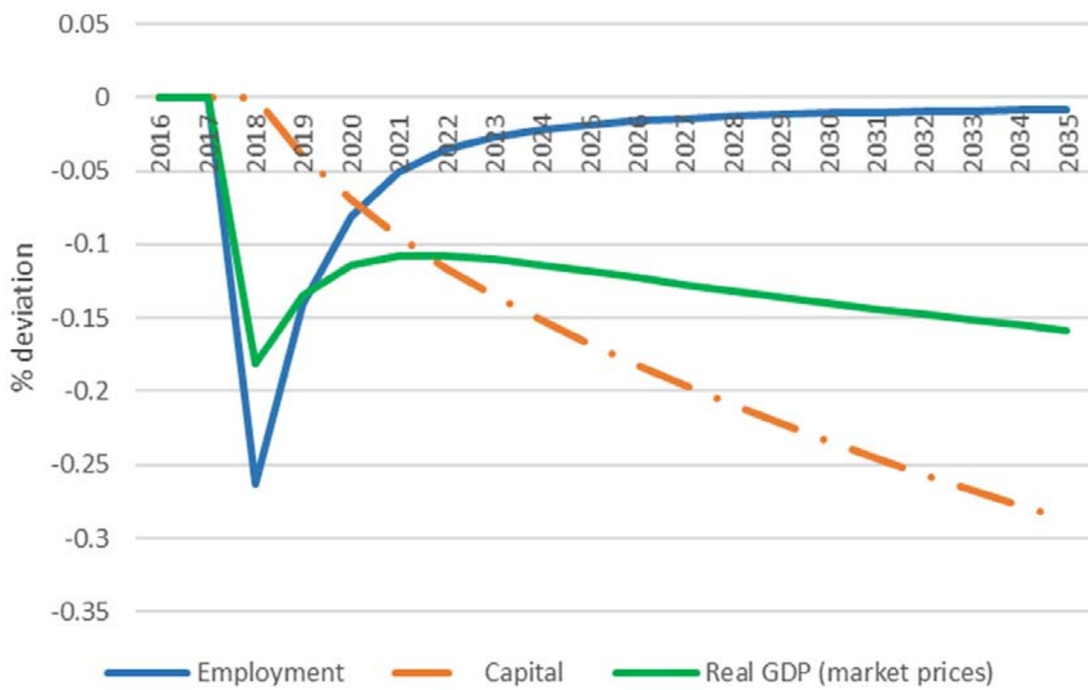

Figure 5. National employment, capital stock, real GDP (% deviation from baseline)

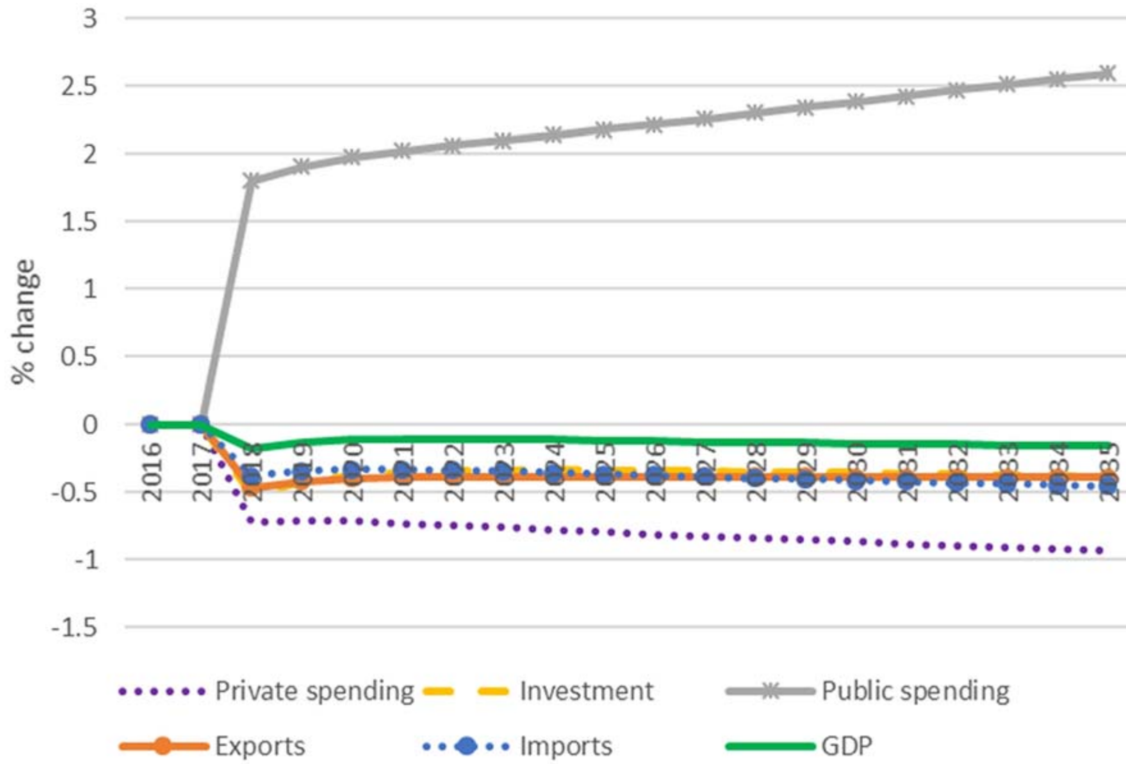

Figure 6. The expenditure components of real GDP (% deviation from baseline)

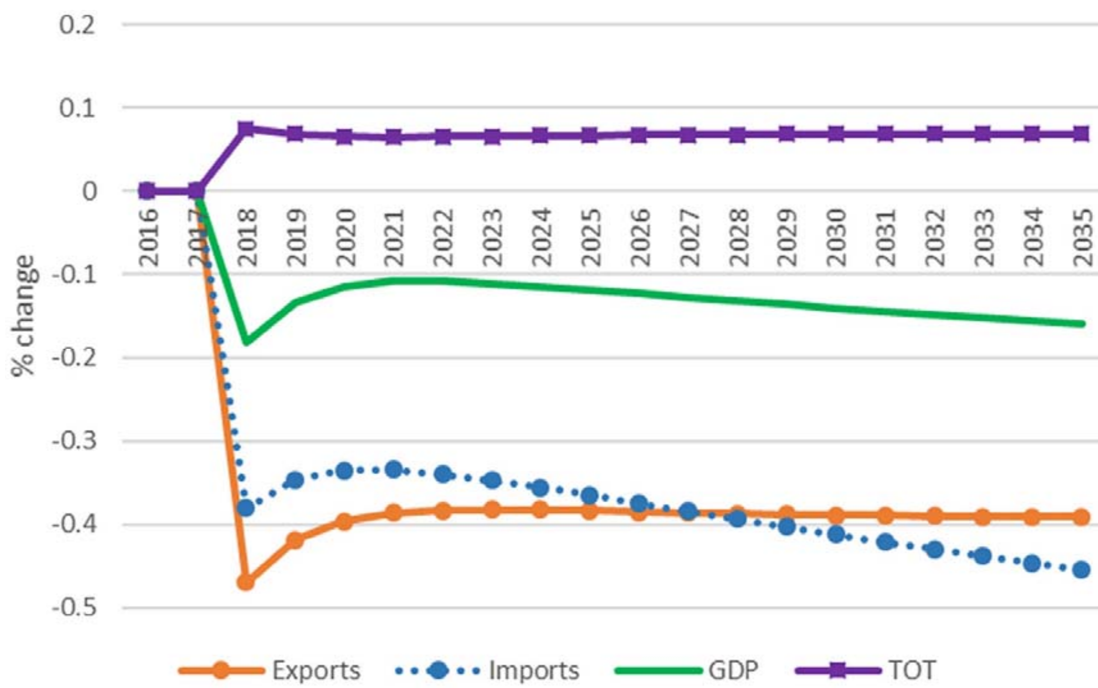

Figure 7. Exports, imports, TOT and real exchange rate (% deviation from baseline)

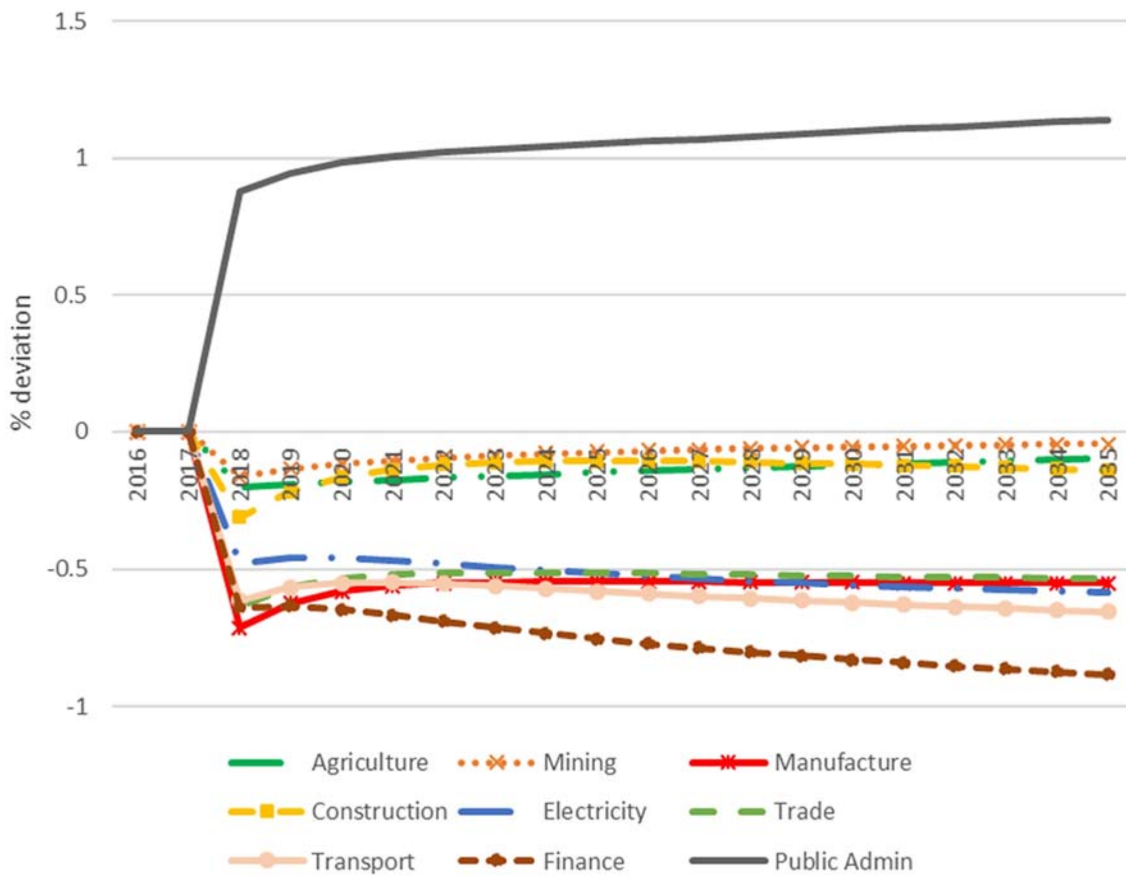

Figure 8. Output for nine broad sectors (% deviation from baseline)

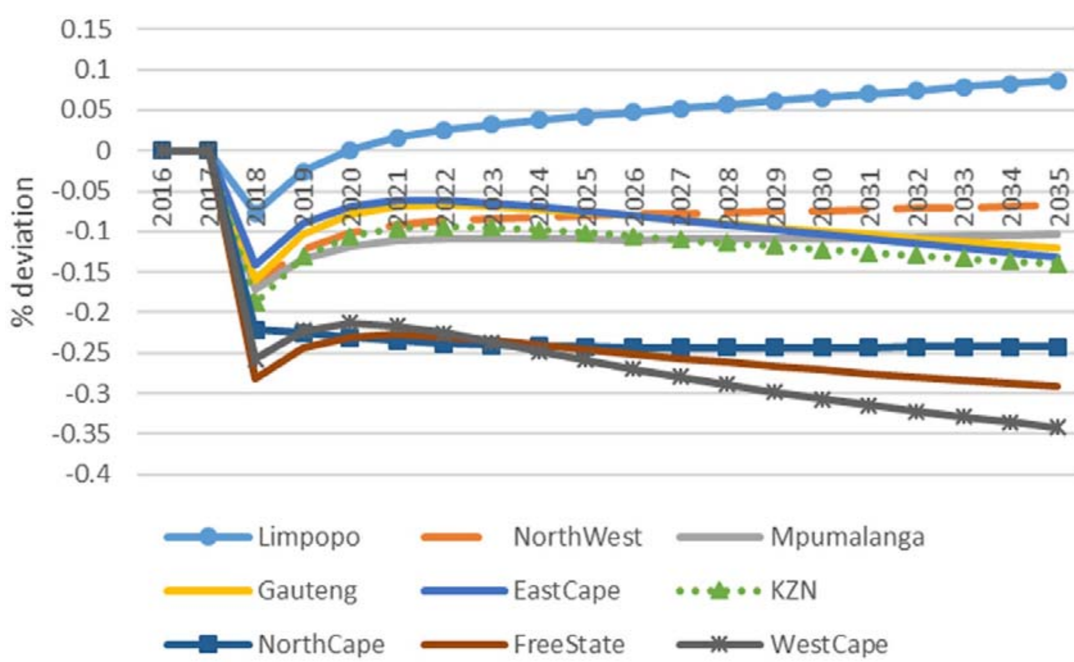

Figure 9. GDP by region (% deviation from baseline)

6.2.1 Initial (short-run) results

We begin with results from the first year of the simulation, where:

- Wages are sticky; employment is in elastic supply.
- Capital stocks are fixed at baseline levels; rates of return are flexible.
- The BOT/GDP ratio is fixed; all household consumption is scaled equally to allow this.

Government demands such as hospitals, schools and administration tend to be far more labour-intensive than other sectors. So increased government demand in isolation tends to expand employment (in elastic supply) and GDP, without raising prices much.

These positive effects are outweighed by the increase in VAT which is entirely paid by households. Since wages follow the CPI, households are compensated for the price rise, but wages as a cost to employers rise so that labour demand falls. See Fig. 3.

In the absence of technological change, the percentage change in real GDP is calculated as the share-weighted sum of changes in quantities of factor inputs (labour, capital and natural resources):

$$y = Sl * l + Sk * k + Sn * n \qquad (15)$$

where

- y, l, k and n are the percentage deviations in real GDP, employment (l), capital (k) and natural resources (n). Here, n equals zero.
- Sl, Sk and Sn are the shares of labour, capital and natural resources in GDP. In our model, they are approximately 53%, 41.6% and 5%.

The calculation below shows that real GDP falls in the short run by approximately 0.16% which is close to the results produced by the model (Fig. 5).

$$y = 0.534 * -0.23 + 0.417 * 0 + 0.048 * 0 = -0.13 \qquad (16)$$

6.2.2 Long-run results

We can understand the long-run deviations from baseline as being close to results based on a long-run comparative static closure where:

- Wages adjust to keep employment fixed.
- Rates of return are fixed while capital is available elastically.
- As in the short run, the BOT/GDP ratio is fixed while household consumption adjusts.

In this environment, increased consumer prices do not affect wages and employment nor do they directly affect real household consumption. We see only the effect of redirecting consumption spending from household to government. As remarked above, government demands are particularly labour- intensive. Imagine that sectoral capital/labour ratios were fixed. In the long run, where labour is fixed, increased government employment implies matching falls in non-government sectors. While government labour is combined with very little capital, non-government labour partners with a similar value of capital (in elastic supply). Thus, redirecting labour reduces the economy-wide capital stock. Applying Equation (15) above, we see that the fall in GDP is about 40% of the fall in the aggregate capital stock.

$$y = 0.51 * 0 + 0.42 * -0.30 + 0.07 * 0 = -0.13 \qquad (17)$$

With the long-run deviation in capital of −0.30%, GDP is calculated at −0.15%. This is close to the long-run outcome of real GDP in Fig. 5.

Fig. 4 shows the percentage deviations from the baseline in capital, investment and the rates of return. Initially rates of return fall, since the capital/labour ratio has increased. The sharp fall in the rate of return accounts for the fall in real investment in the short run. Over time, capital shrinks and rentals rise until rates of return are restored. Throughout the simulation period, investment is below baseline due to the negative growth path of capital.

Fig. 6 reports deviations in the expenditure side components of GDP. Additional VAT revenue is used to finance increased government spending. Household consumption must fall to preserve the BOT/GDP ratio. Exports and imports fall together by more than GDP, as explained below.

We now turn our attention to the growth paths of imports and exports. Imports broadly follow household consumption and investment, which are both relatively import-intensive.[31] It is the combination of the negative deviations in real GDP, investment and consumption that explains the negative deviation in imports. For the BOT/GDP ratio to be exogenous, the negative import deviation requires a simultaneous fall in exports, which in turn requires the terms of trade (TOT) to improve. We see this confirmed in Fig. 7.

6.3 Industry results

Although aggregate employment moves towards baseline values in the long run, employment by sector and region diverges. In most industries and regions, there are significant permanent employment responses. Employment in public administration is 1.7% higher in the long run, while employment in other sectors is below baseline levels.

Our external balance assumption (BOT/GDP fixed, household consumption adjusting) tends to give a pattern in industry results which is similar in both and short and long run. The relative performance of traded and non-traded industries is mainly controlled by the amount of real devaluation or appreciation which in turn follows from the BOT assumption.

Fig. 8 shows the output deviations for nine broad sectors in three groups: (1) best performing; (2) middle performing and (3) worst performing sectors. By simulation design, the public administration sector does well due to the increased spending on education, health and administration services. In the long run, the public sector is approximately 1.2% above baseline.

The middle performing sectors include agriculture, mining and construction. On the demand-side, output from these industries is mainly exported (*e.g.* mining), or is used for investment purposes (*e.g.* construction) or is used as an intermediate input (fishing, agriculture). However, it is the use of natural resources in the agricultural and mining sectors (which is assumed to be fixed throughout the simulation period), which dampen the impact on output in these sectors. Construction is 0.15% below baseline in the long run, mainly because it sells to investment, which is below baseline (Fig. 6).

The worst performing sectors include finance, transport, electricity, manufacturing and trade. Within these sectors, the bottom five industries, as ranked by the 2035 outcomes, are research and development, furniture, insurance, radio and communication devices and renting services. These industries mainly sell their output (i) directly to investors (*e.g.* research and development); (ii) directly to households (*e.g.* insurance and furniture); or (iii) as an intermediate input to industries who then sell their output to households, investors or foreigners (*e.g.* renting of machine equipment, radio and communication equipment. The worst performing industry is "renting of machinery and equipment" which sells nearly all of its output to other industries such as construction, transport and business. These industries in turn sell their output to investment (*e.g.* construction) and households (*e.g.* transport), both shrinking.

6.4 Regional results

Fig. 9 shows the percentage deviation in regional GDP. We compare Limpopo (the only winner) with Western Cape (the biggest loser).

In the long run, Western Cape performs the worst at below base growth of 0.35%, while Limpopo shows positive growth of 0.1% above the baseline. Regional performance is largely driven by national results and the type of economic activity taking place in each region. In comparing the regional distribution of domestically produced commodities between Limpopo and Western Cape, we find that the share of mining production and government services in total regional production is higher in Limpopo than in Western Cape.[32] Western Cape produces slightly more manufacturing commodities as well as services (*e.g.* food production, transport and finance).

Recall from Fig. 8 and the adjacent discussion that on a national level, industries providing public goods (*e.g.* health and education) perform the best. Industries producing mining and agriculture commodities show very little change in output, while industries providing manufacturing, trade, transport and finance services perform the worst. So Limpopo did well compare to Western Cape.

6.5 Household results

Table 6 shows household results for 2035 (cumulative % difference from base). Rows P1 and P2 show results for the bottom 5% and the next poorest 5%, respectively. Rows P3 to P10 represent income deciles (excluding the bottom 10 and top 10%). Rows P11 and P12 show the top two 5% income groups. The right most column shows the effect on real consumption by income group (% deviation from the baseline). The effects differ by income group because each group has a unique CPI (see column 3) and a different occupational composition leading to different amounts of wage income (column 1). All the column 4 consumption results are negative – because our experiment has the effect of transferring consumption from households to government. We do not quantify the benefits to households of increased provision of health and education.

Table 6. Summary of income group results, 2035 (% deviation from baseline)

	Wage income	Nominal consumption	CPI	Real household consumption
P1	0.27	−0.11	0.84	−0.95
P2	0.28	−0.11	0.93	−1.03
P3	0.28	−0.10	0.96	−1.05
P4	0.30	−0.08	0.98	−1.04
P5	0.37	−0.02	0.98	−0.99
P6	0.47	0.06	0.98	−0.91
P7	0.57	0.16	0.99	−0.83
P8	0.60	0.18	0.99	−0.80
P9	0.59	0.18	1.01	−0.82
P10	0.56	0.17	1.04	−0.86
P11	0.49	0.12	1.09	−0.97
P12	0.34	−0.03	1.24	−1.26

Table 7 shows the effect on wage income by occupation. Note that supply of each occupation is fixed in the long run: the income differences reflect wage dispersion arising from difference in demand for each skill type. Clerks and Service workers are concentrated in the expanding government sectors so their income grows most. Conversely, Craft workers and Plant machine operators experience reduced wage income as they are concentrated in shrinking manufacturing sectors.

Table 7. Wage income, 2035 (% deviation from baseline)

1	Legislators	−0.04
2	Professionals	0.48
3	Technicians	0.31
4	Clerks	1.09
5	Service workers	1.29
6	Skilled agricultural workers	0.21
7	Craft workers	−0.23
8	Plant and machine operators	−0.39
9	Elementary occupations	0.41
10	Domestic workers	0.32

These occupational results translate into results for wage income by income group shown in column 1 of Table 6. Workers in the scarcer government-related occupations (Clerks and Service workers) tend to be concentrated in the upper-middle income groups (P6 to P11) and therefore experience higher wage income. In Table 6, the second column, nominal household consumption, is approximately equal to the first column less 0.4. The difference reflects the overall national adjustment to consumption implied by the BOT constraint. Since government consumption is growing, household consumption must shrink. Apart from this uniform difference, the column 2 results follow those of column 1 (small differences arise from regional and ethnic differences in the employment composition of income groups). Real household consumption results (column 4 in Table 6) are also driven by differences between the CPI of income groups (column 3 in Table 6). Here, we see that the cost of living rises more for the richer income groups. The reason is that food is a larger share of expenditure for the poor and our VAT increase did not apply to foods.

In summary, wage income by occupation (Table 7) drives wage income by income group (Table 6 column 1) which in turn drives nominal consumption by income group (column 2). This, with variation in CPI (column 3), implies the real household consumption result of column 4 in Table 6. These column 4 results have only a small dispersion. Nonetheless, we see that the upper middle-income groups P6 to P10 suffer the least (government workers who eat food). Groups P1 to P5 (who tend not to work for the government) experience smaller wage growth but gain most from relatively lower food prices. The big losers are the richest groups P11 and P12, who are concentrated in the shrinking private sector yet have only a small food budget share. However, they could be compensated by a much overdue reduction in the top income tax rate.

7 CONCLUSION

From 1 April 2018, the VAT rate in South Africa increased by 1% point from 14% to 15%. A 1% increase is expected to generate R 22.9 billion additional VAT revenue. This increase was necessary to partly finance a revenue shortfall of R 48.2 billion in 2017/18.

This paper aims to evaluate the economy-wide and regional impact of increasing the VAT rate and the subsequent recycling of these funds back to the provincial governments to finance public spending on education and health.

We use a recursive dynamic multi-regional model, with detailed GFS accounts, to model the impact of the VAT increase and increased public spending. The GFS module, linked to the core model, includes detailed accounts of income (such as tax) and expenditure items (gross operating expenditure) accruing to the national or provincial governments. The percentage changes in economic variables (*e.g.* wages and capital rentals) determined in the core model drive the change in the GFS accounts.

Our results suggest that the increase in the VAT rate increases not only the cost of living but also the short-run cost to the employer. With the real cost of labour increasing, employment falls below baseline in the short run. Over time, the real wage adjusts and employment moves back towards the baseline. Yet, there are permanent employment outcomes at industry and regional levels. Capital is below base in the long run resulting in a slightly lower capital/labour ratio. Could another tax (instead of VAT) fund vitally needed schools and hospitals? Economic theory suggests that taxing the fixed factor (land, and labour in the long run) will be least damaging.[33]

Government consumption improves in the long run due to increased spending on education and health. Investment in the long run is below base due to the below-base path of capital. With the BOT/GDP ratio exogenous, consumption must fall relative to GDP. Sectors producing public commodities such as education and health do the best. Those industries selling mainly to investors and consumers tend to do badly. Regional growth largely depends on the economic activity prevalent in each region. In the long run, Limpopo shows a small but positive increase in GDP. Regions with port access (*e.g.* KZN, Eastern Cape and Western Cape) fare the worst because exports to the rest of the world fall.

Government spending might increase productivity (smarter workers and better roads).[34] We did not model this. Had we included such effects we may have observed a more favourable result.

Notes

1 Table 4.1 of the 2018 Budget Review shows the *budgeted* tax revenue estimates and *revised* estimates for 2017/18. For 2017/18, the total gross tax revenue was budgeted at 1,265,488 million Rand and revised to 1,217,307 million Rand. The shortfall, *i.e.* the deviation between the budgeted and revised value, was 48,181 million Rand (National Treasury, 2018a:39).
2 Table 4.2 of the 2019 Budget Review shows the *actual* gross tax revenue outcomes for 2017/18 at 1,216,464 million Rand, which was 843 million Rand lower than the revised value of 1,217,307 million Rand (National Treasury, 2019:39).
3 Whether VAT collections for 2018/19 actually increase by 22.9 billion Rand is unclear as this paper was written before the October Mid Term Budget Policy Statement for 2019 and the Budget Review for 2020 are published. However, the 2019 Budget Review shows that for 2018/19, VAT revenue is estimated at 325,917 million Rand, which is 27,919 million Rand higher than actual VAT revenue collection in 2017/18 at 297,998 million Rand (National Treasury, 2019:38).
4 The current VAT system includes 19 zero-rated basic food items, namely brown bread, maize meal, samp, mealie rice, dried mealies, dried beans, lentils, pilchards/sardines in tins, milk powder, diary powder blend, rice, vegetables, fruit, vegetable oil, milk, cultured milk, brown wheat meal, eggs, edible legumes and pulses of leguminous plants (Fin24, 2018). Other goods and services that are zero-rated include: exports, illuminating paraffin, goods which are subject to the fuel levy (*e.g.* petrol and diesel), international transport services, farming inputs and certain grants by the government. Goods and services exempted from VAT are non-fee related financial services, education services provided by an approved educational institution, residential rental accommodation and public road and rail transport.
5 There are over 160 countries that operate VAT or GST systems.
6 Value-Added tax Act No.89 of 1991 makes allowances for exemptions, exceptions and deductions. When VAT was imposed in 1991, it was at a statutory rate of 10%. The rate increased to 14% in 1993 and to 15% in 2018.
7 It may be the case that poorer households will pay a larger share of their disposable income on VAT in any given period. Higher income households tend to pay a lower share of their disposable income on VAT and save a greater portion of their income. These savings are then used in subsequent periods such as retirement to finance current spending. At this stage, the higher income households will attract VAT. The proportion of disposable income paid in VAT by the different income groups tends to converge (National Treasury, 2007: 11)
8 A report by WITS (Isaacs, 2018) reports that the lowest earning 10% spend 13.8% of their disposable incomes on taxes compared to 12.6% of the highest earning 10% (Isaacs, 2018).
9 The South African government explored the possibility of implementing a luxury VAT to make the tax more progressive. At this stage, a luxury VAT is not an option as the VAT system is not the appropriate instrument to reduce inequality; it adds significantly to the complexity and administrative burden of the tax and may lead to legal uncertainty (National Treasury, 2018a: 44).
10 The tax proposals include (1) higher ad valorem excise duty, (2) increase in the estate duty rate, (3) increase in excise duties on tobacco and alcohol and (4) increase of 22 cents per litre in fuel levies and 30 cent per litre to the Road Accident Fund. These tax proposals will generate an additional 36 billion Rand (National Treasury, 2018a: 38, 41-49; Merten).
11 Personal income tax was considered as an alternative to an increase in VAT. However, due to increase in personal income tax rates in 2015/16 and the introduction of a new top income tax bracket of 45% for those earning above 1.5 million Rand, the tax burden on individuals has been increasing. Capital gains tax rates have also increased over time. Increasing corporate income tax rates is also not advisable because, in a global environment where corporate tax rates are falling in advanced and middle-income countries, South Africa will lose competitiveness. Currently, South Africa's corporate tax rate of 28% is comparable with other African countries (Uganda, Nigeria and Tanzania at 30%, Zambia at 35%), but higher than developed countries (USA and the Netherlands at 21%, the United Kingdom at 19%) (National Treasury, 2018a: 42-43).
12 Distinguished by 4 ethnic groups and 12 income groups.
13 A shift variable is a useful tool in CGE modelling. Shift variable is used to switch on or switch off equations.
14 COM is a set that includes 52 commodities; SRC includes two sources (domestic and imported); the set GOV includes the levels of government (national, provincial).
15 The delivered price includes trade and transport margins, but not commodity taxes.
16 USR is a set including all users in the model (52 industries, 1 investor, 1 household, 1 government and 1 foreign agent). The set TAXTYPE includes indirect sales taxes (VAT, Customs, Fuel levy, Excise, Environmental tax, Other).
17 The variable ΔTAX determines the change in tax revenue by COM, SRC, USR, DST and TAXT. This matrix has 314,496 elements (52*2*56*9*6).
18 The shift variables' values can change by (1) directly shocking the appropriate variable and dimension to change a specific tax rate, or (2) altering the exogenous status of the appropriate variable to endogenous. The newly endogenous shift variable can then adjust to accommodate an exogenous change in tax revenue.

19 Altering the tax rates for specific dimensions highlights the flexibility of the model and allows for various tax proposals to be modelled.

20 GFSI includes all GFS income sources except the sales of financial assets. See Table 1 for the list of income sources. GOVT includes the nine provincial governments and one national government.

21 GFSE includes all GFS expenditure items except the purchases of financial assets. See Table 3 for the list of expenditure items.

22 A natural starting point in creating a large regional input-output database is a published set of regional input-output tables. However, often these tables are not available and when they are, might suffer serious deficiencies: (i) the tables are very aggregated and distinguish too few sectors for comprehensive CGE modelling; (ii) tables may be inconsistent with each other (*e.g.* different dates and formats); and (3) these regional tables are often not created for CGE modellers (Horridge, 2011). Due to these deficiencies, Horridge developed an automated process where a detailed regional database is constructed using very little data.

23 Expense categories include (i) compensation of employees, (ii) use of goods and services, (iii) interest payments, (iv) subsidies, (v) grants, (vi) social benefits, ad (vii) other payments.

24 Functional classification refers to the main functions of the government, for example, (i) general public services, (ii) defence, (iii) public order and safety, (iv) economic affairs, (v) environmental protection, (vi) housing and community amenities, (vii) health, (viii) recreation, culture and religion, (ix) education and (x) social protection.

25 Economic classification is unique to the type of expense. For example, Expense 1 presents compensation of employees by function (see previous footnote) and items specific to salary payments such as (i) wages and salaries and (ii) social contributions. Expense 5 shows grant payments by function (see previous footnote) to foreign governments and international organisation.

26 The GFS data show no receipts from social contributions.

27 National Treasury provides forecast data for aggregate private and public consumption, aggregate investment, exports and imports for the period 2018 to 2020. Thereafter, we assume that these variables continue to grow at a rate consistent with the GDP growth of 1.7% per annum over the simulation period.

28 The distribution of VAT revenue over provinces is in line with the equitable shares by province calculated by National Treasury (National Treasury – Annexure W1, 2015b: 19).

29 In the current version of the model, personal income tax is indexed to move with the change in the wage rate and employment. The results show that in the long run, the percentage change in nominal labour payments increases by approximately 0.5% in the policy simulation. This is due to an increase in the nominal wage over the simulation period while employment moves back to baseline. This accounts for the slight increase in income tax revenue. Company tax is indexed to nominal capital and land rental payments. With both rental values and capital falling (land is held fixed) over the simulation period, income from company tax falls by approximately 0.3%.
The contribution of personal income and company tax as a share of overall tax revenue shows a slight decrease in the policy simulation. The contribution of income tax is 0.6% points lower in the policy simulation. This is interpreted in the following way: in the baseline simulation year 2018, personal income tax contributes approximately 35.5% to total tax revenue. In the policy simulation, that contribution is 34.9%, which is 0.6% points lower than the baseline contribution. Over the simulation period, the contribution of company tax to total tax revenue is 0.8% points lower. The share of VAT in total tax revenue increases due to the 1% increase in the VAT rate.

30 Over 96% of provincial income is grant transfers from the national government. The distribution of grants over provinces is based on an equitable share calculation which is driven by population statistics.

31 The initial database shows that on average 18% of aggregate household consumption and 31% of aggregate investments are imported. For example, import shares for commodities mainly consumed by households include wearing apparel (58%), rubber products (50%) and radio and television (84%). Import shares for commodities mainly used for investment include non-ferrous metals (88%), fabricated metals (52%), machinery (73%) and communication equipment (69%).

32 In the initial setting of the total production in Limpopo, approximately 26% is mining activities compared to very low mining activities in Western Cape.

33 Because there is no supply response and so no dead-weight loss. This idea goes back to Adam Smith (The Wealth of Nations, Book V, Chapter 2) and before (the Physiocrats).

34 See Aschauer (1989) which investigates the relationship between aggregate productivity and stock and flow government spending variables. Aschauer finds that non-military public capital is more important in determining productivity than either the flow of non-military or military spending. Spending on infrastructure such as roads, airports, water and sewerage systems are important in approving productivity. Chu *et al.* (2018) shows that a shift in government expenditure away from non-productive expenditure towards productive forms of expenditure are associated with higher levels of growth in high-income and low-to middle-income economies.

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