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Impact of excise tax on the South African economy: A dynamic CGE approach

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Abstract

Aim/purpose – This paper analyses the impact of excise tax on the South African economy by means of a Dynamic Computable General Equilibrium (CGE) model. We utilised a policy simulation to evaluate the effects of an excise tax, with the results indicating that the rise in excise tax should not impinge on lower revenue households, as long as the greater government revenue flows to those households.

Design/methodology/approach – The model applied in this study includes a specific database composed of a Social Accounting Matrix (SAM) constructed from data for the period 2010. A specific indirect tax block was disaggregated in such a way that VAT, excise tax and fuel levy taxes could be analysed. The household sector was further subdivided into 14 different revenue households.

Findings – The simulation results indicate that GDP is linked to certain variables, for example absorption and consumption, which are negatively marked by the short run settings. The trend changed positively from the base year 2018 to the following year 2019 with a constant increase until 2023. The main reason for the increase is that the change in investment proportionally affects the total absorption in the market system.

Research implications/limitations – The CGE model has been used extensively by the researchers for economic analyses of various projects. The production data constitute the main limitation, as Statistics South Africa has delayed collecting recent data. For this reason, data for the year 2010 were used in the SAM as the database for the CGE model.

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Originality/value/contribution – The specific economic tool, i.e. the dynamic CGE model, used in this study was seen to be the best model as far as an analysis of the excise tax was concerned. This model has never been used to study the excise tax in South Africa before, although Erero (2015) analysed the effects of increases in VAT through a dynamic CGE model, and found that the percentage increase in VAT would not affect lower revenue households negatively if the higher government revenue flowed to those households.

Keywords: excise tax, Dynamic Computable General Equilibrium model, South Africa.
JEL Classification: C68, H71.

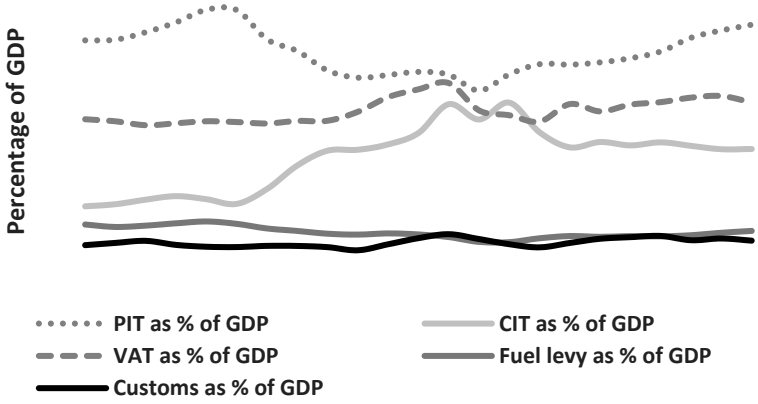
1. Introduction

The South African government assigned the South African Revenue Service (SARS) through Act No. 34 of 1997 with the obligation to administer all revenue from taxes and to safeguard total conformity with Customs and Excise regulations. In this respect, SARS offers a customs service that collects sufficient revenue tax, stimulates the economy, enables formal trade, safeguards the country from criminal trade activities and enables people to move across the country's borders. Given the importance of this vital institution, SARS is carrying out its obligation to collect the expected revenue tax to fund government projects.

Erero (2015) pointed out that in South Africa the largest collection of revenue tax (approximately 98%) is administered countrywide by SARS, while the remaining 2% is collected by the local and provincial government. SARS collects specifically from Corporate Income Tax (CIT), Value-Added Tax (VAT) and Personal Income Tax (PIT). These are included in the category of main sources of tax revenue, which constitutes approximately 80% of the country's total revenue tax. The remaining 20% includes motor vehicle licences, the fuel levy, gambling taxes, dividend tax, property rates, and excise and customs duties.

According to SARS (2018), revenue tax significantly increased from R572.8 billion in 2007/08 to R 1,144.1 billion in 2016/17. This indicates that there was a considerable improvement in the collection of revenue tax over that decade, despite the global recession of 2008/09. The effect of revenue tax is positive on the GDP. Indeed, more efforts were invested in building up the reputation of South Africa's fiscal system through law enforcement. The consistent and steady collection of revenue tax remains SARS' focus, as the government is challenged by the economic downturn, high unemployment, and social inequalities. Specific policies that focus on these issues could provide possible answers to the persistent defies of unemployment. Figure 1 provides the main sources of revenue tax as a ratio of GDP in South Africa.

Figure 1. Main sources of revenue tax as a percentage of GDP (1994/1995-2016/2017)



Source: SARS (2018).

Figure 1 indicates that CIT collections as a ratio of GDP plummeted marginally from 4.8% in 2012/13 to 4.7% in 2016/17. The main reason for this could be the impact of the world financial crunch, the unpredictability of the exchange rate, the variability of product prices, and the lag effects of the global downturn. Moreover, the composite annual growth rate in the collection of revenue tax contracted to 7.3% in 2012/13 from a peak of 17.8% in 2007/08. Although this rose to 8.9% in 2016/17, the government is faced with challenges when funding its projects because of budget constraints.

The World Bank (2010a) described excise tax as an indirect tax levied on specific kinds of goods and products such as alcohol, cigarettes and gambling. Usually excise taxes are perceived as double dividend taxes because they constantly contribute to revenue tax and they restrain most of the population from consuming products that cause a threat to human health or the natural world. Besides, the justification of excise taxes as sin taxes is mainly due to the highest tax rate in South Africa when compared to the countries such as Spain, Switzerland, United Kingdom and United State of America. Excise taxes occasionally reduce revenue taxes without impacting positively on the behaviour of consumers. For example, the largest contributor of revenue tax (tobacco retail sales) can decline due to higher excise duties and stricter legislation, yet consumers maintain the same behaviours. High excise taxes are one of the reasons for the surge in smuggling and illicit markets, especially at the borders of South Africa. There has been a continual drop in revenues collected from tobacco products thanks to the higher excise duties levied in recent years, for example they reduced from R18 billion in 2015/16 to R16.7 billion in 2017/18 (SARS, 2018). Subsequently,

the total amount collected from the VAT and customs duty expanded during the same period. Table 1 provides the total amount of excise tax collected during the year 2016 in South Africa.

Table 1. Excise industry revenue in 2016 (Rand billion)

Number	Industry	Revenue (billion)	Percentage
1	Fuel	R 60,8	55.97
2	Tobacco	R 12,6	11.64
3	Beer	R 11,7	10.79
4	Electricity levy	R 8,5	7.79
5	Spirits	R 5,9	5.39
6	Ad valorem	R 3,4	3.13
7	Wine	R 3,2	2.91
8	Environmental levy	R 1,6	1.46
9	Air departure tax	R 1,0	0.92
Total		R 108,6	

Source: SARS (2018).

Table 1, which shows the total revenue received from excise taxes in 2016, indicates that fuel (55.9%) was the largest contributor of excise tax, followed by tobacco (11.6%), beer (10.8%), the electricity levy (7.8%) and spirits (5.4%). The collection and analysis of data is crucial to show a comprehensive picture of the excise tax's role in the economy. SARS gathers a considerable amount of data on individual and corporate taxpayers, entrepreneurs and merchants, which is then dynamically mined and analysed to provide tax administrations and policy makers with useful information that is substantiated by comprehensive data (SARS, 2018). It was against this background that the researchers evaluated the impact of excise tax on the South African economy.

This paper assessed the impact of excise tax on the South African economy by means of a dynamic CGE model. Section 2 provides an overview of the excise tax as well as a literature review, Section 3 describes the methodology used for this study, Section 4 offers the findings of the study, and Section 5 provides a conclusion and recommendations.

2. Excise overview and literature review

2.1. Tax policy

The implementation of tax policies by the South African government over the past five years eased taxpayers' direct tax burdens in nominal terms, while they stimulated indirect taxes. The policy consisted of providing tax relief to the

small businesses or entrepreneurs. The partial tax relief for fiscal drag heightened the progressive character of the tax system. Table 2 provides the total amounts of direct and indirect taxes for the period between 2012/13 and 2016/17.

Table 2. Direct and indirect taxes (2012/2013 – 2016/2017)

R million	Direct taxes				Indirect taxes				Other	Total relief
	PIT	CIT	Other	Total	Excise	Fuel levy	Other	Total		
2012/13	9 800	1 100	1 950	12 850	1 840	4 517	1 985	8 342		4 508
2013/14	7 382	860	–	8 242	2 065	3 270	495	5 830		2 412
2014/15	9 250	1 000	–	10 250	2 110	2 565	–	4 675		5 575
2015/16	–	150	100	250	1 835	6 490	–	8 325		8 075
2016/17	5 650	1 000	100	6 750	2 284	6 800	–	9 084	456	1 878
Total	**32 082**	**4 110**	**2 150**	**38 342**	**10 134**	**23 642**	**2 480**	**36 257**	**456**	**22 448**

Source: SARS (2018).

Table 2 indicates that excise tax revenue grew from R1,840 million in 2012/13 to R2,284 million in 2016/17 with a drop in 2015/16. The substantial reduction of excise tax from R2,110 in 2014/15 to R1,835 million in 2015/16 was mainly due to tax avoidance by South African citizens. Fortunately, tax assistance of R32.1 billion was credited to individual taxpayers between 2012/13 and 2016/17. During the same period, indirect taxes expanded by R36.3 billion, with a net surplus in tax after schemes of approximately R3 billion. It must be noted that some identifiable indirect taxes are levied at a rate per unit as opposed to a rate per value (*ad valorem*). These are modified each year for inflation to sustain the indirect tax burden in real terms (SARS, 2018).

2.2. Literature review

In South Africa, excise duties and levies are enforced primarily on high--volume regular disposable products such as tobacco, petroleum, and alcohol. This is also enforced on specific non-consumable luxury articles, such as electronic equipment and cosmetics. The main objective of these duties and levies is to generate revenue tax for the government, while the secondary objective is to discourage individuals from consuming dangerous products that harm their health and the environment. In addition to excise duties and levies, there is also the Diesel Refund System (DRS), which was adopted on 4 July 2001 in respect of fuel levies generated at the time of supplying goods. Its main purpose is to stimulate the worldwide competitiveness of primary production in fishing, farming, forestry, and mining. Furthermore, the DRS takes account of electricity

production by plants with a capacity higher than 200 Megawatts that use distillate fuel exclusively for producing electricity. Excise tax and the DRS are managed by the customs division within the SARS. The recent data indicate that tax revenue generated by these duties and levies amounts to approximately 10% of the total tax revenue collected by SARS (SARS, 2018).

In Canada, two categories of levies on manufactured goods are administered by the federal government. The first is called excise taxes and the second excise duties. Both levies are considered for a specific variety of goods at various rates and in various states, subject to the quantity of the goods, before adding Harmonised Sales Tax (HST). Excise taxes are imposed on specific petroleum products, fuel-inefficient motor vehicles and automobile air conditioners. The Canada Revenue Agency (CRA) determines the excise tax rate applied on every type of goods through the Excise Tax Act. When products are made in Canada, excise tax is paid by the buyer during their collection, however, as soon as they are exported, the importer pays the excise tax at the time that the products are imported. Nonetheless, in some particular conditions, an importer is entitled to a refund of the excise tax paid.

All medium and large manufacturers are required to apply for an excise tax licence ('E' licence) in Canada. Each individual can be qualified as an apprentice producer if his gross yearly sales are less than 50,000 Canadian dollars. A supplier licence ('W' licence), meanwhile, stimulates individuals to purchase products for resale free of excise taxes. Furthermore, individuals can qualify for a type 'W' licence in certain conditions. Once in possession of this licence, an individual can pay the excise tax when selling the products (Canada Revenue Agency, 1995).

In Brazil, an excise tax called the IPI tax, which is an acronym in Portuguese for Tax on Industrialised Products, is imposed on manufactured goods. It is charged on nearly all sales and transfers of goods produced or imported in Brazil. Based on the type of consumable or non-consumable goods being sold, the IPI rate varies between 0% and 330% (between 10% and 15% on average). The IPI tax is determined according to the retail sales price for domestic goods. In addition, an extra fee is added to the import duty and other import fees for all imported goods. Generally, the IPI tax is paid by all manufacturers and importers of manufactured goods in Brazil. However, the IPI tax is mostly used as an incentive, it also discourages individuals from consuming dangerous products that harm human health and the environment. For example, the government lowered the IPI tax between 2012 and 2014 for the purpose of encouraging the purchase of vehicles and electrical appliances, while at the same time increasing the

IPI on tobacco products by up to 300% in order to hamper consumption (IPI, 2018).

In Australia, the Australian Taxation Office (ATO), which is in charge of excise taxes, describes excise as a commodity-based national tax levied on different products such as petroleum (including oil), cigarettes and alcoholic products. This excise duty is imposed on product manufacturing warehouses, with a corresponding customs duty payable on related imported products (Australian Taxation Office, 2017). In New Zealand, the Customs Service (NZCS) is a law enforcement agency in its own right, with the obligation to administer all revenue from taxes and to safeguard total conformity with Customs and Excise regulations. Its main purpose is to evaluate and collect excise taxes from cigarettes and alcohol. The NZCS plays a crucial role in discouraging cigarette consumption. This can be seen in The Customs and Excise Amendment Act 2012, which created significant increases in tobacco excise taxes. One of the strongest arguments in the Amendment Act is that beneficiaries of social assistance are not refunded for rises in cigarette prices through Consumer Price Index (CPI) adjustments. This should stimulate the purpose of pushing up the tobacco excise (New Zealand Customs Service, 2017).

In India, the Central Board of Indirect Taxes and Customs (CBIC) is the main administrative body accountable for the national collection and control of Central Excise, Service Tax and Narcotics products. The CBIC was instituted in 1855 by United Kingdom to manage customs regulations in the country for the purpose of collecting import duties. Special land revenue was taken into consideration at the same time due to the value given to land. The CBIC is one of the oldest and most efficient government departments in India, which operates under the umbrella of the Department of Finance. Central excise duty is described by the CBIC as an indirect tax imposed on goods that are produced in India that are exclusively destined for domestic consumption. The producers of goods are compelled to pay the central excise duty as long as the goods are domestically produced. Unfortunately, this cost is always passed on to consumers (Central Board of Indirect Taxes and Customs, 2015).

In the United States of America (USA), there are three categories of excise tax. The first consists of an estimated fixed dollar amount for purchasing gasoline, while the second takes into account the *ad valorem* tax that is incorporated into the price of cigarettes. The third category is Individual Retirement Accounts (IRA), which consist of excess payments to IRAs, prior arrangement for pay-

ments from IRAs, and fines for missing the deadline of payments (Accurate Tax, 2018).

The applicable federal excise tax rate differs depending on the revenue group of the taxpayer. For instance, the top 1% of revenue earners pay approximately 0.1% in excise taxes, while the bottom 40% pay between 1 and 1.5% in excise taxes. All taxpayers are required to pay taxes on gasoline, yet the hardest hit by excise duties are low revenue earners.

The US government is currently implementing a new kind of excise tax, Cadillac, as described in its Affordable Care Act. This tax considers the impact of high-cost health benefit plans by adding an extra 40% excise tax. The maximum annual amount payable is fixed at $10,200 for individuals or $27,500 for couples and families (Accurate Tax, 2018).

In Swaziland, the excise tax is governed by the Swaziland Revenue Authority (SRA) Customs and Excise Department in conjunction with the Customs and Excise Act of 1971. Excise duties are levied on alcohol, cigarettes, fuel, vehicles, televisions, and refrigerators. All the member states of the Southern African Custom Union (SACU) collect excise duties at the point of importation from SACU countries (Swaziland Revenue Authority, 2016).

There are two kinds of excise taxes in Swaziland. The first is a special duty levied according to the quantity of goods, while the second is *ad valorem* levied at a set percent of the value of goods. The main excise taxes are levied on spirits, beer, wine and cigarettes, while the main *ad valorem* excise taxes are on phones, videos, televisions, air conditioners, perfumes, firearms, golf balls, cosmetics, and motor vehicles. The excise tax rate for motor vehicles varies, ranging from 5% for a small vehicle, to 7.5% for a medium-sized vehicle and 10% for a luxury vehicle (Swaziland Revenue Authority, 2016).

In Seychelles, the Trades Tax Import Division (TTID) administers excise in accordance with the Excise Tax Act of 2009. Excise tax is imposed on tobacco, cars, alcohol and fuel, whether they are imported or domestically produced. In this respect, producers of these products have to register with the TTID. In addition, producers must identify a specific supplier where their excisable products are produced, and report back on all the excise tax collected on or before the 21st day of the month (Seychelles Revenue Commission, 2017).

Although excise accounts for only a small share of total consumption revenue, it varies widely within that narrow range from one country to another. In Seychelles and Zimbabwe, for example, it accounts for more than 5.3% of GDP, with the highest single source of revenue coming from fuel in Zimbabwe – 4%

of GDP. In Seychelles and Uganda, revenues from excise duty on fuel account for more than 2% of GDP, while in South Africa it is just over 1%. In Burundi, Cameroon, Mauritius and Seychelles, the excise on alcohol accounts for more than 1% of GDP, as does excise on tobacco in Liberia. It must be noted that in Burundi, excise revenue nearly doubled during the period between 2011 and 2015, while it rose in Togo by over 50% (African Tax Outlook, 2017, pp 58-60).

Table 3 provides some examples of excise tax as a percentage of taxation in select countries in 2016. The country with the highest percentage is Turkey at 18.1%, followed by Estonia at 13%.

Table 3. Excise tax as a percentage of taxation in select countries in 2016

Country	Percentage
Australia	5.5
Austria	5.3
Belgium	4.6
Canada	4.1
Chile	7.6
Czech Republic	8.7
Denmark	8.2
Estonia	13.0
Finland	8.3
France	5.4
Germany	6.1
Greece	10.6
Hungary	8.4
Iceland	7.4
Ireland	9.3
Israel	5.0
Italy	6.9
Japan	5.3
Korea	7.7
Latvia	11.2
Luxembourg	8.3
Mexico	6.0
Netherlands	7.2
New Zealand	2.6
Norway	6.5
Poland	12.0
Portugal	8.2
Slovak Republic	8.5
Slovenia	11.7
Spain	6.8
South Africa	10.0
Switzerland	4.7
Turkey	18.1
United Kingdom	8.1
United States	3.4

Source: OECD (2017).

3. Methodology

3.1. Conceptual framework of the CGE Model

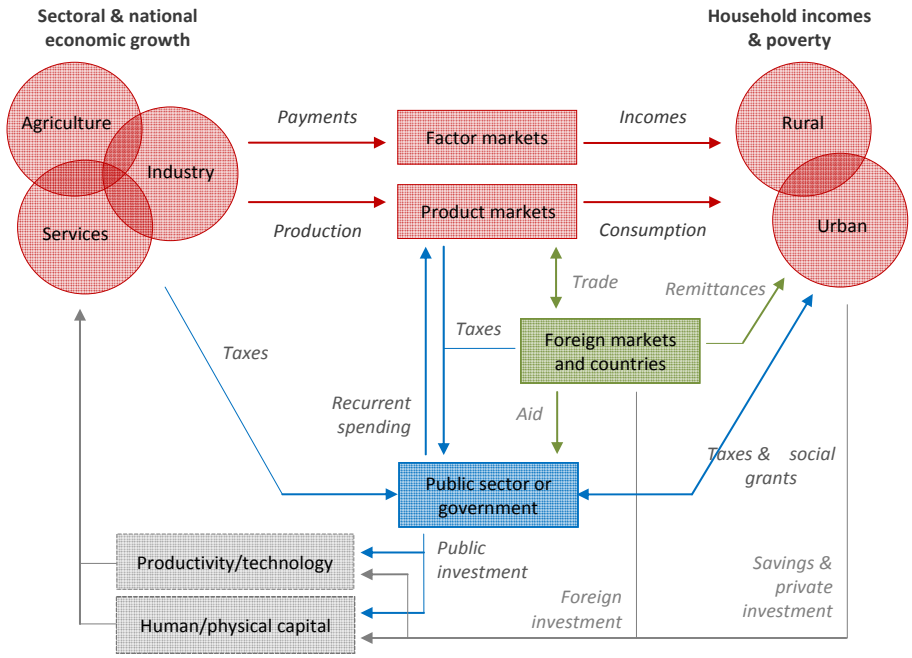
The dynamic CGE model utilised for the simulations in this paper is predominantly based on the dynamic CGE model constructed by Alton et al. (2012) for the Department of National Treasury in South Africa. It portrays the interactions and correlations between various economic representatives, such as producers, investors and government in the economy, in both the factor and product markets. The model is a recursive dynamic model that includes foreign markets by means of trade and foreign savings, while also making provision for the intertemporal adjustments in the economy and considering the impacts of policy interventions as they unfold over time. When performing simulations, the model is updated each iteration using the solution values of the previous iteration. In this respect, capital stock is expanded according to investment expansion in the previous period, where the share of capital accrued by each sector is dependent on the weighted average of sector profitability as well as the sector's initial share in capital stock. In addition, economic growth is further influenced by changes in factor supplies and productivity.

The database that the dynamic CGE model is composed of (SAM) merely depicts the structure of an economy at a particular time. In order to gain some insight into how an economy works and to predict how changes will affect it, there is a need for an active model to be employed (World Bank, 2010b). In this case, the SAM for the year 2010 served as a database for constructing the dynamic CGE model used. The parameters of the dynamic CGE equations were calibrated to observed data from the SAM. The model illustrates the performance of a market economy, where the dealings between the economic agents are determined using prices and quantities. Some macroeconomic limitations are taken into consideration for policy purposes, for example, there is only one fundamental law of economics: for every revenue there must be a corresponding expenditure. No economic theory can thus be considered complete unless all revenue and outlays are accounted for.

CGE models are data demanding and do not tolerate inconsistencies in data. The researchers' dynamic CGE model included 85 commodities at industry level as well as 47 activities. It further comprised four factors of production, i.e. labour with primary, middle, secondary and tertiary education, with households being split into 14 revenue groups. Although by definition the number of decile groups is exactly 10, the household sector was disaggregated according to rev-

enue into deciles, with the top decile being further split into five groups. The government, enterprises, 14 revenue groups based on their per capita expenditure, and interactions with the rest of the world were all captured. In addition, the behaviour of industries and households is governed by the performance of the economy (Thurlow, 2008). Figure 2 below illustrates the conceptual framework of the dynamic CGE model and the relationships between all the economic agents.

Figure 2. Conceptual framework of the CGE Model



Source: Arndt, Davies, & Thurlow (2011).

Figure 2 indicates that there are linkages between all the economic agents in the economic system. Those agents include producers, households and government. As indicated earlier, the database applied for the dynamic CGE model consisted of the SAM for 2010. The primary data sources applied for the construction of the 2010 SAM were supplied by Statistics South Africa (Stats SA) and the South African Reserve Bank (SARB). The specific data used to analyse the sectoral linkages between economic agents and labour were taken from the supply and use tables (Erero, 2015). This paper only describes a limited number of equations due to the huge number of variables and equations in the model.

The trade equations are based on an external account that includes global commodity prices, foreign financial flows, payments for imports, revenues from exports, and trade elasticities. The main description of the dynamic CGE model is presented below.

3.2. Producer and consumer behaviour

The dynamic CGE model included the behaviours of consumers and producers based on data extracted from Statistics South Africa (Stats SA, 2018). As mentioned above, the model split households into 14 revenue groups, with an assumption that every revenue group should maximise its welfare by taking into account the available budget (Case, 2000). In this respect, a Linear Expenditure System (LES) of demand was used as per Equation 1 below. The LES determines the variability of revenue elasticities between household revenue groups.

$$P_j \bullet H_{jh} = P_j \bullet \gamma_{jh} + \beta_{jh} \bullet \left((1 - S_h - td_h) \bullet Y_h - \sum\nolimits_{jt} P_{j'} \bullet \gamma_{j'h}\right) \qquad (1)$$

while H_{jh} represents the expenditure on product j by household h, β_{jh} represents the minimal budget portion, Y_{jh} represents the lowest survival level, P_j represents the market price of every product, Y_h represents the gross household salary, S_h represents minimum savings and td_h represents the direct tax rates.

Likewise, it was assumed that producers earn more revenue while considering the prices of output. The quantity A_j for each sector j is defined by the Constant Elasticity of Substitution (CES) function.

$$A_j = \alpha_j \bullet \left(\delta_j \bullet L_j^{-pj} + (1 - \delta_j) \bullet \overline{K}_j^{\,-\rho j} \right)^{-1/\rho j} \qquad (2)$$

while α represents the overall factor productivity (TFP), δ_j is the share, P_j is the replacement parameter, L_j is the labour and K_j is the capital demand. The production function allows technologies to adjust for all the economic activities. Maximising the revenue subject to Equation 2 describes the following factor demand:

$$L_j / K_j = \left[(r \bullet Z_j / W) \bullet (1 - \delta_j / \delta_j)\right]^{1/(1+\rho_j)} \qquad (3)$$

while W represents the labour wage, P_j is the elasticity deducted for the factor replacement and r describes the capital rental rate modified by Z_j. In this respect, Leontief technology defines the intermediate demand. Equation (4) indicates that the producer price PA_j represents the total of factor and intermediate expenditures per output's entity (Arndt, Davies, & Thurlow, 2011).

$$PA_j \bullet A_j = W \bullet L_j + r \bullet Z_j \bullet \bar{K}_j + \sum_j P_j io_{jj'} \quad (4)$$

where io_{jj} represents the fixed input-output coefficients. It portrays the number of product j' sourced to generate one component of product j.

3.3. Investment and revenue for the government

Excise tax constitutes one of the sources of revenue for the government, with direct and indirect taxes being the main contributors of revenue. The amount of total tax revenue collected is used by the government to pay salaries to households, as well as for consumption of goods and services. Equation 5 indicates the total revenue of government with the assumption that factor revenue is retained by households.

$$Y_h = \sum_j (\omega \bullet W \bullet L_j + \theta \bullet r \bullet Z_j \bullet \bar{K}_j) + st_h \quad (5)$$

While st_h represents social transfers from the government, ω is the coefficient representing the factor revenue and θ defines the coefficient of factor earnings to each household group. The dynamic CGE model captures the firms that receive profits from the capital accumulated and pay corporate revenue taxes and dividend taxes, as well as make investments.

The model considers the government to be a special agent that collects revenue from direct and indirect taxes. Excise tax is an indirect tax that is included in the variable (ts_j) as reflected on the left-hand side of Equation 6. Therefore, for the purposes of this study, the shock will be applied to the excise tax by the use of variable ts_j.. The following equation presents the total revenue for the government.

$$\sum_h td_h \bullet Y_h + \sum_j ts_j \bullet P_j \bullet Q_j + \sum st_g = \sum_j P_j \bullet \bar{G} \bullet g_j + \sum_h st_h + B \quad (6)$$

while G represents the product purchased by the government, td_h represents the direct taxes, st_g represents the transfers to government, st_h is the social transfers

to the households by the government, *B* is the fiscal balance, *G* is the exogenous adjustment factor and *g* represents the amounts of goods and services consumed. Equation 7 indicates the level of entire savings and investments.

$$\sum_h s_h \bullet Y_h + B + \overline{F} \bullet X = \sum_j P_j \bullet I \bullet i_j \tag{7}$$

while *i* represents fixed base-year investment quantity and *I* is the endogenous modification factor.

3.4. Investment and capital accumulation

Our CGE model is a recursive dynamic model that includes distinct within- and between-period components. Exogenous variables and parameters are updated based on externally determined trends between years. From all the equations presented above, every variable is linked to a specific time *t*. The equations introduced below indicate that the number of new capital N_t is based on the value of investment and the capital price PK_t^{-1}. Additional capital is allocated to sectors after applying a depreciation rate υ and according to a capital allocation factor SK_{jt} ($0<SK<1$; Σ SK = 1) (Dervis, de Melo, & Robinson, 1982).

$$N_t = \sum_j (P_{jt} \bullet I_t \bullet i_j) \bullet PK_t^{-1} \tag{8}$$

$$\overline{K}_{jt+1} = \overline{K}_{jt} \bullet (1-\upsilon) + SK_{jt} \bullet N_t \tag{9}$$

$$SK_{jt} = SP_{jt} + SP_{jt} \bullet \left[(SR_{jt} - AR_t)/(AR_t)\right] \tag{10}$$

Where SP_{jt} represents the sector's actual share in entire capital stocks, AR_t represents the average turnover rate and SP_{jt} represents the sector's turnover rate. It was assumed that the additional capital is mobile and sector-driven.

3.5. Closures

The performance of the dynamic model is dependent on the macroeconomic and factor closures selected. These closures allow for the placement of constraints into the model, which is essential in the analysis of large-scale policy changes (Alton et al., 2012). A provision is made to choose between making factors fully employed and mobile, fully employed and activity-specific, unemployed and mobile, or partially unemployed. In this case supply is increased

according to an upward-sloping supply curve. The following macroeconomic closures are permitted in the dynamic CGE model:

Macroeconomic closures are as follows:

- **Savings and investment**: there is a choice between investment and government expenditure being fixed shares of absorption, investment-driven savings and savings-driven investments.
- **Government**: the focus is on the government savings. It can either be fixed or flexible with the implication that tax rates are either flexible or fixed. The model allows for the option of changing the direct or indirect tax rate at a uniform or scaled rate.
- **Current account**: the exchange rate may either be flexible or fixed, with the consequence that foreign savings are either fixed or flexible.

4. Simulation results

The dynamic CGE model was applied to assess the impacts of increasing excise taxes by 10% over the period 2018 to 2023 with shocks imposed in 2018. As pointed out by Erero (2015), a more representative closure with a view to maintaining the share of balanced absorption was assumed, so that the investment was permitted to vary with absorption in the model. The savings rate constitutes an important variable that permits the adjustment in tax rates. While the performance of the dynamic model depends on the selected closures, we allowed the government savings to be flexible with the implication that the direct tax rate remains fixed. Furthermore, due to the reality of the South African labour market, labour with primary, middle and secondary school education was considered unemployed and mobile, whereas labour with tertiary education was considered entirely employed and mobile. The simulation imposed an exogenous shock on the economy, in this case the increase in the excise tax by 10%. The results quantifying the impact of the shock were then reported as percentage changes between the values in the baseline run and the policy run for each variable. The simulation results for the macroeconomic variables, government revenue, factor revenue and household consumption are presented in percentage changes, while the GINI coefficients are in absolute value or level difference. The prior expectations were confirmed by the simulation results. Intuitively, one would expect affirmative contributions to GDP, exports, government revenue and employment. Table 4 includes the results of the key macroeconomic variables.

Table 4. Macroeconomic variables

Variables	Description	Base (2010 R Billion)	2018	2019	2020	2021	2022	2023
ABSORP	Absorption	2687	**–0.00019**	**0.00202**	**0.00397**	**0.00566**	**0.00719**	**0.00857**
PRVCON	Private consumption	1570	**–0.01708**	**–0.01334**	**–0.01005**	**–0.00714**	**–0.00458**	**–0.00234**
FIXINV	Investment	516	**0.05103**	**0.05186**	**0.05252**	**0.05306**	**0.05350**	**0.05387**
DSTOCK	Stock	–3	0	0	0	0	0	0
GOVCON	Government consumption	604	0	0	0	0	0	0
EXPORTS	Exports	645	**0.00896**	**0.01109**	**0.01299**	**0.01468**	**0.01620**	**0.01759**
IMPORTS	Imports	–669	**0.00865**	**0.01069**	**0.01255**	**0.01417**	**0.01565**	**0.01699**
GDPMP	GDP (market prices)	2663	**–0.00019**	**0.00204**	**0.00399**	**0.00571**	**0.00725**	**0.00865**
NETITAX	Net indirect tax	285	**–0.00189**	**0.00065**	**0.00281**	**0.00472**	**0.00643**	**0.00799**
EXRXY	Exchange rate	1	–0.01693	0.11914	0.11935	0.11883	0.11779	0.11636
YGX	Government income	2378	**0.50470**	**0.62813**	**0.71081**	**0.81155**	**0.96092**	**1.07241**

The first reaction from the simulation results (Table 4) is that when the excise tax increased by 10%, GDP, net indirect tax and consumption declined marginally by 0.00019%, 0.00189% and 0.01708%, respectively, during the same year of shock (2018). Although these are counterintuitive results, in the short run we can affirm that the GDP is linked to certain variables, for example absorption and consumption, which are negatively marked by the short run settings. The trend changed positively in the following year (2019), with a constant increase until 2023. The main reason is that the capital stock is grown according to investment growth in the previous period, where the share of capital accumulated by each sector is dependent on the weighted average of sector profitability as well as the sector's initial share in capital stock. Economic growth is further influenced by changes in factor supplies and productivity. Even though consumption can be substituted with welfare, in the short run, the simulation result shows that welfare is negatively affected as a result of the excise shock. The slight increase in exports could be ascribed to other factor such as consumer price, which was unaffected, while imports (capital goods) increased as described by the CET function. In this respect, the gain in real exchange rate is shown through a boost in exports, which declined marginally by 0.01693% in the same year (2018). This short run result indicates that the shock in excise tax should increase the cost of production, even though the price of goods destined for exports could increase. With changed prices of domestic output, the demand for domestically produced goods did not spur domestic production, hence output declined during the period of shock. However, in the long run, the GDP and the net indirect tax augmented continually for the duration of 2019 and 2023, when the excise tax is shocked by 10% in the CGE model. This benefits mostly the

government revenue and other macro-economic variables. This finding is in line with the study of Venter (2011). The impact of the shock on the GDP is thus minute but positive, as GDP increased slightly by 0.00204% and 0.00865% in 2019 and 2023, respectively. Table 5 provides the simulation results for GINI coefficient.

Table 5. GINI coefficient

Variables	2018	2019	2020	2021	2022	2023
Base	0.6208	0.6209	0.6210	0.6212	0.6214	0.6216
Excise (10%)	**0.6186**	**0.6100**	**0.6102**	**0.6104**	**0.6106**	**0.6210**

The GINI coefficients obtained from the simulation results are presented in level difference. In terms of welfare impacts, the dynamic CGE model results reflect a marginal decrease in inequality over the period between 2018 and 2023. Although the inequality between rich and poor households is very pronounced in South Africa, the impact of increasing the excise tax by 10% seems positive. For instance, during the first year of the shock, the GINI coefficient was found to decrease to 0.6186 in 2018 from 0.6208 in the baseline scenario. The same trend was observed in 2023, where the GINI coefficient declined to 0.6210 from 0.6216 in the baseline scenario. The main reason could be the effort by the government to reduce the gap between the rich and poor households. Erero (2015) pointed out that the earnings percentile ratio of the poorest 50% to 20% of households increase more substantially than the earnings percentile ratio of the richest 90% to 50%. Table 6 provides the simulation results for the government revenue.

Table 6. Government revenue

Period	Base (2010 R Billion)	Excise (10%)
2018	697	**0.50470**
2019	707	**0.62813**
2020	717	**0.71081**
2021	726	**0.81155**
2022	735	**0.96092**
2023	743	**1.07241**

Table 6 indicates that the policy shock of excise tax being increased by 10% seems to have a positive impact on the government revenue over the modelled period. In fact, total government revenue grew from 0.50% in 2018 to 1.07% in 2023. This implies that the increase in excise tax should be inexpensive for gov-

ernment, but may be costly for consumers. Table 7 provides the simulation results for the factor revenue.

Table 7. Factor revenue

Variables	Description	Base (2010 R billion)	2019	2020	2021	2022	2023
flab-p	Factor labor primary education	76,88	0.16	0.27	0.37	0.46	0.54
flab-m	Factor labor medium education	208,09	0.11	0.2	0.28	0.35	0.4
flab-s	Factor labor secondary education	386,55	0	0	0	0	0
flab-t	Factor labor tertiary education	540,85	0	0	0	0	0
fcap	Factor capital	5828,29	4.47	4.15	3.85	3.59	3.34

Table 7 indicates that the labour demand improved with the increase in excise tax mainly due to an increase in the GDP. The impact of the increased excise tax was perceived in a slight employment expansion in the factor labour within the primary and medium education categories. As described in the closure, labour supply is entirely flexible at constant real wages for unskilled labour, but skilled labour is constant by hypothesis. Even with an expansion in employment as a result of the improved productivity, factor labour with primary education increased relatively more than labour with secondary education employment. Employment of people with primary education level improved from 0.16% in 2019 to 0.54% in 2023. As pointed out by Erero (2015), the main reason could be the absorption of unskilled labour by the primary sector. Overall, the simulation results show that labour demand increases marginally amongst all primary and middle factor revenue once the excise tax is increased by 10% during the period between 2018 and 2023. The positive impact of the increased excise tax on the employment can be explained as any gains due to a tax shock which influences activity level. Table 8 provides the simulation results for the household consumption.

Table 8. Household consumption

	Base (2010 R billion)	2019	2020	2021	2022	2023
1	*2*	*3*	*4*	*5*	*6*	*7*
POOR	273	–0.0026	0.0006	0.0034	0.0058	0.0080
hhd-0	27	0.0007	0.0033	0.0053	0.0073	0.0089
hhd-1	47	–0.0004	0.0023	0.0049	0.0070	0.0088
hhd-2	57	–0.0021	0.0009	0.0035	0.0059	0.0080
hhd-3	65	–0.0031	0.0003	0.0035	0.0059	0.0083
hhd-4	77	–0.0049	–0.0015	0.0017	0.0044	0.0068
NPOOR	1297	–0.0201	–0.0162	–0.0128	–0.0099	–0.0072

Table 8 cont.

1	*2*	*3*	*4*	*5*	*6*	*7*
hhd-5	89	–0.0070	–0.0034	–0.0002	0.0026	0.0049
hhd-6	108	–0.0126	–0.0090	–0.0057	–0.0029	–0.0004
hhd-7	150	–0.0160	–0.0122	–0.0089	–0.0059	–0.0034
hhd-8	285	–0.0225	–0.0183	–0.0147	–0.0114	–0.0086
hhd-9	665	–0.0230	–0.0192	–0.0158	–0.0128	–0.0102
hhd-9-1	83	–0.0241	–0.0198	–0.0160	–0.0126	–0.0097
hhd-9-21	97	–0.0249	–0.0206	–0.0168	–0.0135	–0.0105
hhd-22	116	–0.0230	–0.0188	–0.0151	–0.0118	–0.0089
hhd-23	141	–0.0266	–0.0228	–0.0195	–0.0164	–0.0139
hhd-24	228	–0.0196	–0.0163	–0.0134	–0.0109	–0.0087
TOTAL hhd	1570	–0.0171	–0.0133	–0.0100	–0.0071	–0.0046

It must be noted that tax revenue collected by South Africa is mostly from domestic households and not foreign taxes. In this respect, the positive or negative changes in household consumption should not be offset by tax revenues. In fact, employment should be affected due to household consumption, which is a vital source of demand for labour-intensive goods. Nonetheless, total absorption composed of welfare losses from excise tax confirms that households are the largest consumers of products affected by the shock in excise tax. Those products include tobacco, alcohol, and fuel. The findings from the simulation results (Table 8) indicate that the higher revenue categories are the hardest hit by the policy scenario.

5. Policy implications

The simulation results, even though effective, should be comprehended by the policy makers. A thorough analysis of the findings is required for an effective implementation of a policy. The study on the impact of increased excise tax on the South African economy indicates that excise tax is a meaningful source of revenue for government and requires establishments to comply when excise taxes on goods are solicited. The simulation results indicate that low revenue households and government (revenue) benefit the most from the policy shock. Therefore, excise tax can be increased by the government for the purpose of combating unemployment and inequality in South Africa.

6. Conclusions and recommendations

In this paper, a dynamic CGE model of South Africa was used to assess the impacts of a 10% increase in excise tax on South Africa's economic growth and revenue distribution. A more representative closure was assumed with a view to maintaining the share of absorption so that the variable investment in the model is permitted to vary with absorption. The savings rate constitutes the important variable that permits the adjustment in tax rates. Due to the reality of the South African labour market, labour with primary, middle and secondary school education was considered unemployed and mobile, whereas labour with tertiary education was considered entirely employed and mobile. The simulation imposed an exogenous shock on the economy, in this case the increase in the excise tax by 10%. The results quantifying the impact of the shock were then reported as percentage changes between the values in the baseline run and the policy run for each variable. The simulation results for the macroeconomic variables, government revenue, factor revenue and household consumption are presented in percentage changes, while the GINI coefficients are in absolute value or level difference.

In the short run, the policy shock indicates that total government tax revenues increase, while GDP and private consumption decline slightly. The increase in government revenue means that poverty will be alleviated as the revenue will be distributed through social services (grants) and other expenditures. The findings thus indicate that the low revenue households profit the most from the policy shock. In this respect, any policy designed to stimulate economic growth, employment and relocation of revenue should take into account an increase in excise tax. Nonetheless, in the long run, the trend for GDP and private consumption changed to positive growth. For example, the GDP and the net indirect tax improved continually for the duration of 2019 and 2023, when the excise tax is shocked by 10% in the CGE model. Again this benefits mostly the government revenue and other macro-economic variables. The impact of the shock on the GDP is thus minute but positive, as GDP increased slightly by 0.00204% and 0.00865% in 2019 and 2023, respectively. This finding is in line with the study of Venter (2011). In general, therefore, the excise tax increase has a positive impact on GDP, employment and consumption.

This paper indicates that there is scope for restructuring the tax system to ensure stable tax revenues without imposing a serious strain on the consumption of products that are harmful to human health. A slight adjustment in the tax sys-

tem can have a significant influence on the tax burden for households. It is recommended that assessing the trade-offs between excise taxes and other taxes should be a subject for future research.

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