AN ANALYSIS OF SOUTH AFRICA'S VALUE ADDED TAX

by

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ABSTRACT

A value added tax (VAT) was introduced in South Africa in 1991 to replace the general sales tax (GST). Initially, there were some questions on the ability of VAT to replace GST as a revenue source for government. However, the overall performance of VAT, as revenue generator seems satisfactory; in 2002 the government stated VAT is a dependable and broad-based revenue source.

The VAT in South Africa is administered with a rebate for intermediate input use. Retail sellers pay the statutory rate times the value of output minus the VAT payments paid by the intermediate inputs used in production.

In this paper, we evaluate the effect South Africa's VAT has on welfare. We use a computable general equilibrium (CGE) model with detailed specification of South Africa's tax system. First we describe the effects of removing the VAT and replacing the revenue by a proportional increase in direct taxes. Then we consider the effect alternative statutory rates have on the regressiveness of the VAT.

1. Introduction

In September 1991, South Africa replaced its general sales tax (GST) with a consumption-type value added tax (VAT). The VAT is administered with a rebate for intermediates and investment purchases.[1] At the retail level, sellers are charged the statutory VAT rate (currently 14% for all commodities except gold which is zero-rated so pays no VAT) and receive a rebate for the tax revenue paid on intermediate inputs. The net payment is the statutory VAT rate applied to only the value added for that commodity. This tax collection method encourages "self-policing"—producers are more likely to purchase intermediates from sellers who can verify that they have paid the value added taxes due.

When the VAT was initially introduced, there were concerns that it could not replace the GST as a source of government revenue. In addition, a VAT may affect producers' input choices. When the VAT is administered with rebates for intermediate inputs, there is, in effect, a subsidy for intermediate input use. Producers may substitute intermediates for primary factors (land, labor and capital), affecting the return to factors and income distribution. Another concern is that the VAT, because it is an indirect tax that works through the price system, puts a larger burden of the tax on low-income households.

In this paper, we analyze the revenue, welfare, and income distribution effects of South Africa's value added tax. We use a computable general equilibrium (CGE) model of South Africa, with data for 2001.[2] We extend the model to include VAT payments with rebates on intermediate inputs. There are 10 households according to income deciles. We allow for unemployment in the semi-skilled and unskilled labor categories.

First, we describe the incidence of the VAT. Following Devarajan and Hossain (1995) we remove the VAT from the price system and replace it with a proportional increase in the income tax. With this approach, we maintain public expenditure levels because government revenue does not change and, because we use a direct tax to restore government revenue, we do not distort the pattern of indirect tax-incidence.[3] Next, we consider the effects of increasing the VAT rates by sector. Finally, we describe alternative tax structures: (1) remove the VAT on agriculture and food and (2) remove tariffs and replace lost government tax revenue with a uniform change in the value added tax rates.

We will use a variety of measures to describe the effect of a VAT on welfare. We report the regressiveness of the VAT, the progressiveness of the complete tax system, income distribution, the equivalent variation, and the changes in consumption and the cost of living. We also show the effects of changes in the tax system on total government revenue, the components of government revenue, and the structure of the economy.

[1] See Lewis (****) for a description of a similar VAT in Indonesia.

[2] The was originally programmed by Marna Kearney and uses the standard CGE model code developed by Lofgren et al. (2000) . In this paper we expand upon the tax specification in the standard model.

[3] Devarajan and Hossain (1995) analyze the combined incidence of taxes and public expenditure in the Philippines. They simulated the price effect of a particular tax, by eliminating the tax from the Philippines tax system and simultaneously replacing it with an increase in proportional income tax (Devarajan and Hossain,1995:10).

We begin with a brief overview of VAT and its performance since 1991. Next, we discuss the CGE model, focusing on the tax structure and the changes necessary to represent a VAT with rebates. We then simulate alternative tax structures to describe the welfare effects of a VAT on various household groups. Our conclusions follow.

2. Value Added Tax (VAT) in South Africa

VAT was introduced in South Africa in 1991 to replace GST.[4] VAT is an indirect tax and is levied on the value added in production during the different stages of production (Metcalf in Baker and Elliott,1997:413). In South Africa VAT is levied on the supply of goods and services as well as the importation of any goods or services, while exported goods and services are exempted. However, VAT is generally seen as a consumption tax as the consumer pays it at the final stage of production. VAT was imposed in 1991 at a statutory rate of 10 percent; the rate was increased to 14 percent in 1993. The newest changes in VAT aims at improving the administration of VAT with the objective to reduce the administrative burden especially for small businesses (RSA,2002:17).

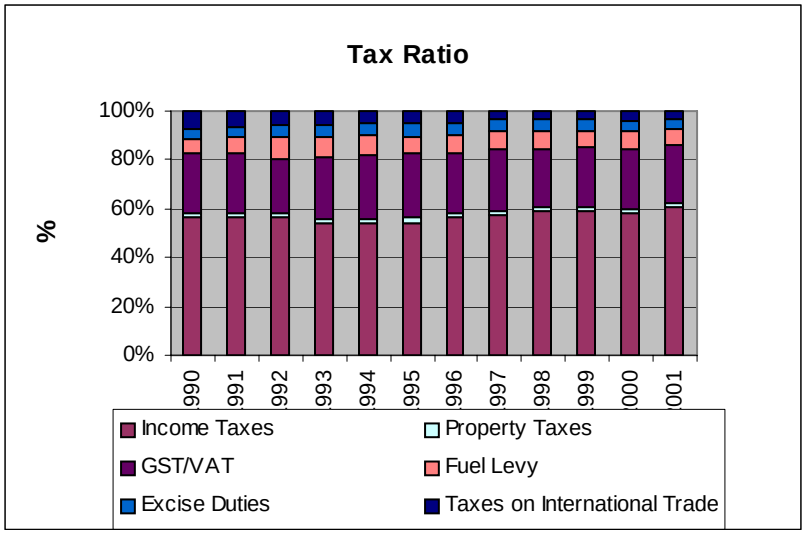
When VAT was initially introduced there were some questions on whether or not VAT can replace GST as a revenue source for government, to what extent VAT would increase inflationary pressures, and how regressive VAT would be. Each of these questions will now be addressed in turn.

VAT as a Revenue Source for Government

If one compares VAT to all the major taxes levied in South Africa, one can see that VAT is the second most important revenue source for government after income taxes. VAT's importance also remained relatively constant over the years. In 2002 VAT contributed 25 percent to total tax revenue (SARB,2002:S-54 and S-55).

[4] The discussion in this section draws heavily on Go and Kearney (March 2003).

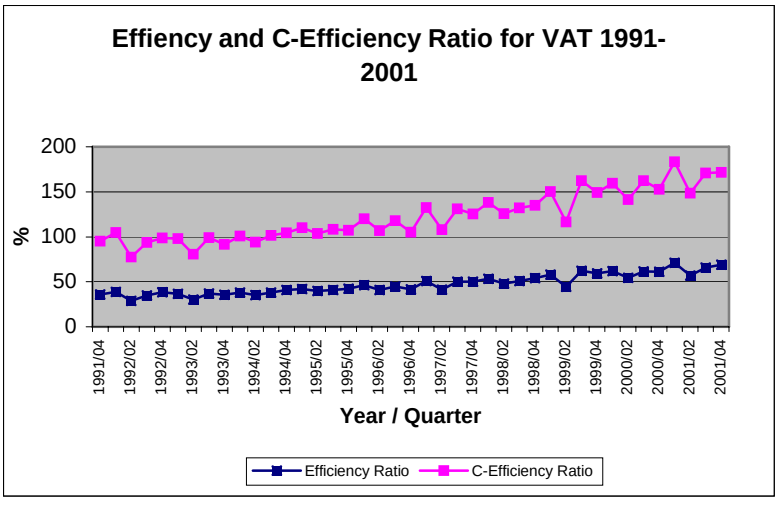
Figure 1: VAT Compared to Other South African Taxes 1990-2001



SARB Time series data KBP4570M, KBP4577M, 4578M, 4579M, 4580M, and 4592M

The government sees VAT as a dependable broad based revenue source (RSA,2002:7). The efficiency and C-efficiency ratio can be used as indicators of the extent to which the VAT bears uniformly upon a broad base. A higher ratio indicates a broader base. The efficiency ratio is the ratio of VAT revenues to GDP divided by the standard rate (expressed as a percentage) (Ebrill et al,2001:40). The C-efficiency ratio is a more applicable measure when differential rates or zero-rating applies (as in the case of South Africa). The C-efficiency ratio is the ratio of VAT revenues to consumption divided by the standard rate. The normalized C-efficiency ratio is 100 percent. A higher or lower C-efficiency rate will indicate the use of differential rates. Zero-rating will result in a C-efficiency rate of less than 100, while increasing the base will result in a C-efficiency ratio above 100. (Ebrill et al,2001:41-42). Both ratios were calculated for the period 1991 to 2001 and are shown in the figure below:

Figure 2: Efficiency and C-efficiency Ratio of VAT



SARB Time Series Data KBP6006C, KBP4578M, KBP6007C
*Household consumption expenditure only is used for C-efficiency ratio.

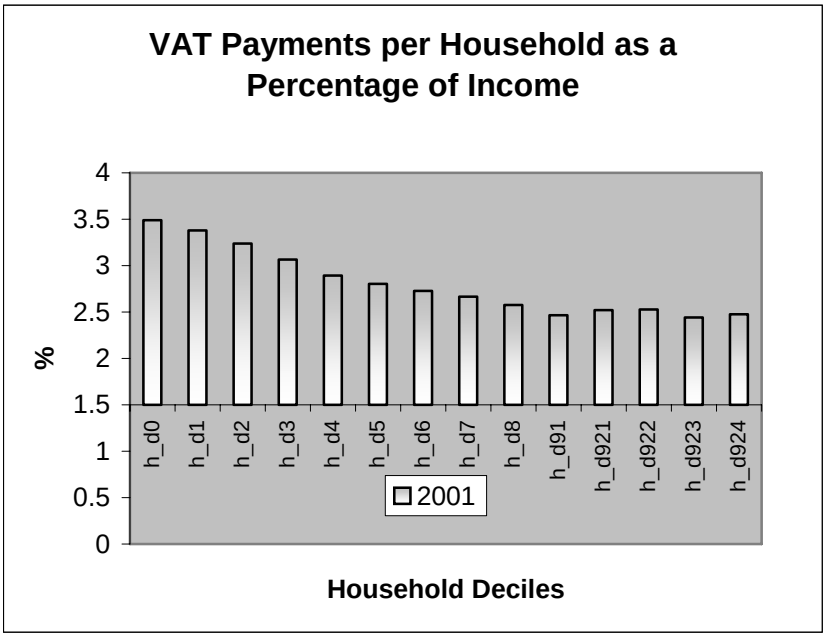
Both the efficiency and C-efficiency ratios for VAT increased steadily from 1991 to 2001. The C-efficiency ratio above 100 percent shows that the VAT base is broad, and is steadily increasing.

The Regressiveness of VAT

A tax is regressive when lower income groups spend a larger proportion of their income on the tax, than higher income groups. Indirect taxes, including VAT are generally seen as regressive: a single positive rate of VAT applied to the broadest possible base is essentially a proportional tax on consumption and is therefore regressive in nature. (Ebrill et al,2001:106).

Fourie and Owen (1993) evaluated the regressiveness of VAT in South Africa since the inception of VAT in 1991. They found that VAT is mildly regressive. They measured regressiveness as the ratio of total VAT payments by a household group to total household income. Davis and Kay (1985) also used this measurement to evaluate the regressiveness or progressiveness of UK VAT.

Figure 3: The Regressiveness of VAT in 2001



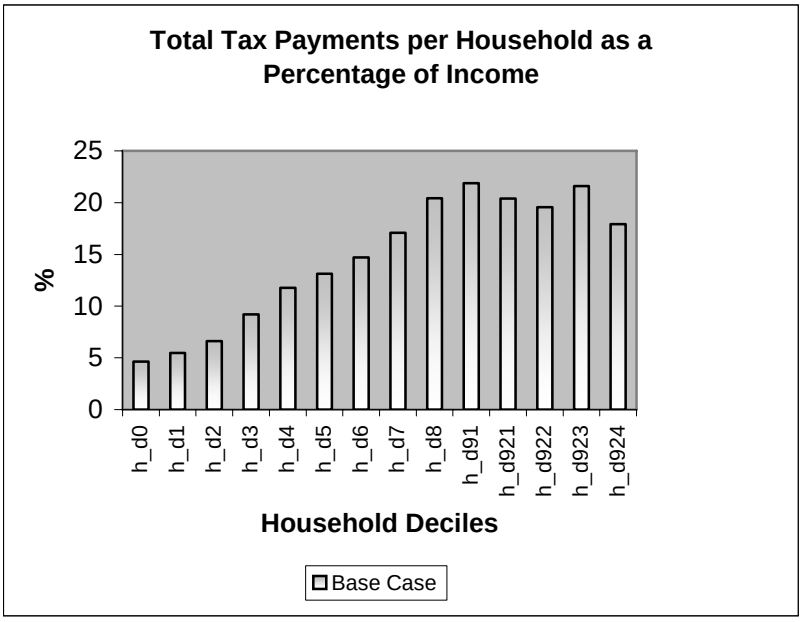
Source: SA SAM 2003

The same measurement was used to calculate the regressiveness of VAT for 2001. The low-income households pay up to 3.5 percent of their income to VAT, while the higher income groups pay in the region of 2.5 percent. VAT in South Africa is regressive.

The Progressiveness of the Complete Tax System

Davis and Kay (1985) as well as Fourie and Owen (1993) stressed that the progressiveness of the complete tax system should be taken into account and not only the regressiveness of VAT. The progressiveness of the taxes takes direct taxes paid by households as well as VAT into account. One must not focus on the distributional impact of VAT in isolation: what affects poverty and fairness it the impact of the tax system as a whole. (Ebrill et al,2001:105).

Figure 4: The progressiveness of the complete tax system in 2000



Source: SA SAM 2003

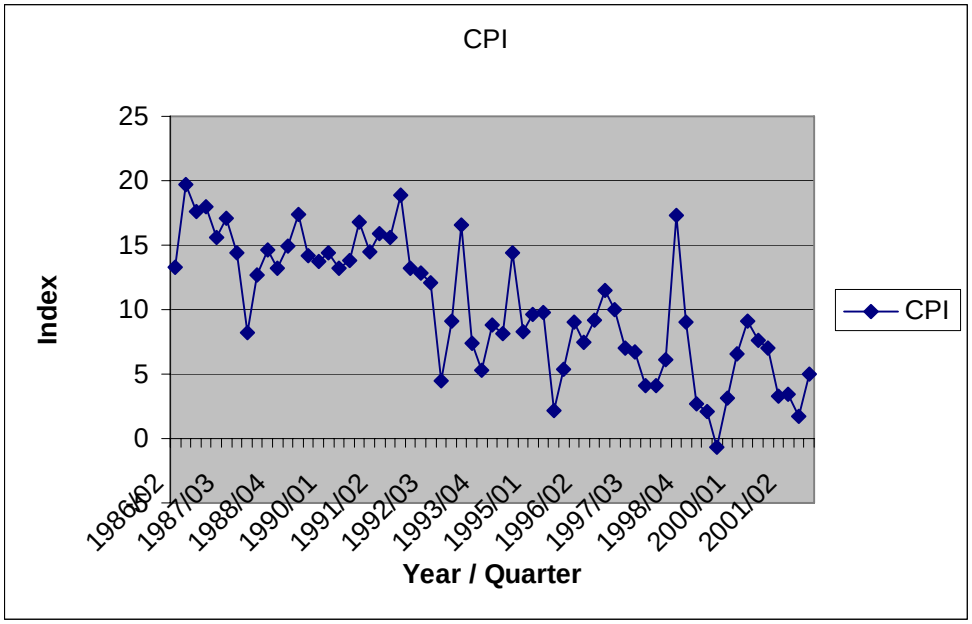
As can be seen from *figure 4*, South Africa's complete tax system is progressive. The high-income households pay a larger percentage of their income to tax, than low-income households.

VAT and Inflation

When VAT was initially proposed, the greatest controversy surrounding it was its effect on retail prices. If VAT increases, prices would increase, however the magnitude of the increase in VAT would not necessarily be reflected to the same extent, in prices. The extent to which prices would increase depends on the ability of producers to shift the tax burden on to the consumer, which in turn depends on the demand and supply elasticities.

The effect of changes in prices due to an increase in VAT can be classified as either a shift or an acceleration effect. A shift occurs when VAT leads to a higher CPI. The increase in VAT is a once-and-for all increase. The CPI will continue at a higher level. The intercept of the CPI changes but not the slope. The acceleration effect is associated with a change to the rate of the CPI. The acceleration effect, *per se* is not due to an increase in VAT, but rather changes in the tax burden, uncertainty and inflationary expectations can introduce acceleration in the rate of change of the CPI. (World Bank Symposium,1990:17-19). VAT in itself cannot be inflationary.

Figure 5: CPI Trends for the Period 1991 - 2001



SARB Time Series Data KBP7032Q

From the figure above it seems as if a shift effect occurred when VAT was introduced during the last quarter of 1991. A shift effect also occurred when VAT was increased to 14 percent in the second quarter of 1993. It does not seem that any acceleration effects occurred during the two events, as the CPI shows a downward trend. However, it must be stated that it is difficult to isolate the effect of a single occurrence (like increasing VAT) on the CPI.

Although the overall revenue performance of VAT seems satisfactory, however VAT is still regressive and due to the large number of exclusions from the VAT base there are efficiency issues that need to be considered within the VAT system. Devarjan and Panagariya (In Fiscal Reform and Structural Change in Developing Countries 2000) showed that a uniform value-added tax would closely mimic a lump-sum tax. It is only when commodities are left out of the tax base when an efficiency loss arise. This is certainly the case for South Africa as the South African Value-Added Tax Act No.89 of 1991 makes allowances for exemptions, exceptions, deductions and adjustments that effectively lower the VAT liability. At inception various basic food items such as brown bread, maize meal, samp, mealie rice, dried mealies, dried beans, lentils, pilchards, milk powder, milk, rice, unprocessed vegetables and fruit, vegetable oil, and eggs were exempted from VAT (SA Tax, 2001:Schedule 2 Part B). To reduce the regressiveness of VAT even further paraffin, an energy source used by most poor households, was exempted in 2001. Various other exclusions exist: Small firms supplying less than R300 000 per year are not required to register as a VAT payer (SARS,2003). Some services provided within the financial sector are also exempt. (International VAT Monitor,1995:376). VAT will introduce an efficiency loss in South Africa as certain commodities are excluded from the tax base.

The effectiveness of VAT especially on welfare and distribution is the focus of the rest of this paper. A CGE model is used for the analysis.

3. The CGE Model

CGE models incorporate consumer and producer behavior as well as the interaction between other economic agents and therefore incorporate all effects on the distribution of income and economic welfare. The standardized CGE model developed for IFPRI by Löfgren et al (2001) is used for the purpose of this analysis.[5] The CGE model equations are solved simultaneously with the computer software package GAMS and the solver PATH.

3.1 Tax Structure

The social accounting matrix (SAM) for South Africa reports taxes paid by institutions, commodity sales, and production activities. In the tax instruments are summarized in table 1.

Table 1: South African Taxes included in the CGE model

Tax Category	**Description**	**Model parameter**	**Percent of total government revenue collected**
Institutional taxes			
Corporate Tax	Taxes Levied on Firms	$tins(firms)$	20.5
Income Tax	Taxes Levied on Individuals (Households)	$tins(h)$	37.3
Commodity taxes			
VAT	Value Added Tax net of rebates	$tvat(c)$	15.4
Fuel tax	Government levy on fuel	$tfuel(c)$	3.7
Excise tax	Excise taxes on goods	$texcise(c)$	3.1
Net taxes on products	Other taxes on products excluding subsidies	$tproducts(c)$	2.0
Tariffs	Taxes levied on imports of goods and services	$tm(c)$	2.2
Activity taxes			
Net taxes on production	Other taxes on production excluding subsidies	$ta(a)$	15.7
Note: government revenue shares are calculated from SA SAM 2003.			

In the standard model code, the VAT, fuel levy, excise tax, and net tax on products operate like a retail sales tax. They can be summarized in the single tax instrument:

$$tq(c) = \frac{SAM('g\_vat', C) + SAM('g\_fuel', C) + SAM('g\_excise', C) + SAM('g\_products', C)}{PQ(C) \cdot QQ(C)}$$

where:

tq(C) is the total sales tax rate against commodity C

[5] A detailed discussion on the mathematical structure of the standard model can be found in Löfgren et al (2001).

PQ(C) is the price of commodity C
QQ(C) is the quantity of commodity C sold.

Alternatively, one could construct each tax instrument separately as follows:

$$tvat(C) = \frac{SAM('g\_vat', C)}{PQ(C) \cdot QQ(C)}$$

$$tfuel(C) = \frac{SAM('g\_fuel', C)}{PQ(C) \cdot QQ(C)}$$

$$texcise = \frac{SAM('g\_excise', C)}{PQ(C) \cdot QQ(C)}$$

$$tproducts = \frac{SAM('g\_products', C)}{PQ(C) \cdot QQ(C)}$$

We modify the model to include a European-styled value added tax with rebates for intermediate input and investment purchases. This is a consumption-type VAT in which the full cost of capital is deducted in the year of purchase.

We assume the VAT is administered using the "invoice method." All transactions are taxed a fixed proportional rate, tvat, regardless of whether they are final or intermediate transactions. Firms can deduct taxes paid on intermediate inputs and that tax amount is reported on the invoices for intermediates. Import sales are subject to a VAT, export sales are not.

To calibrate the model, we assume the observed VAT tax revenue in the SAM is the gross payment by sector.[6] Producers must pay the statutory VAT on retail sales and can collect a rebate on taxes paid by intermediate input use. The VAT rebate on intermediate inputs affects the producer's decision making process because it is, in effect, a subsidy on intermediate inputs.

We compute the rebate on intermediate expenditure at the activity level which describes the production process. The commodity is the product sold on the market and it consists of a domestic variety and an imported variety. The domestic component of the commodity can come from more than one activity.

The rebate, computed by activity (the index, "A", is over activities) is:

$$REBATE(A) = \sum_{c} tvat(C) \cdot PQ(C) \cdot QINT(C, A)$$

where:

tvat(C) is the statutory value added tax by commodity sales
PQ(C) is price of composite good c

[6] The rates differ by sector and differ from the reported statutory rate of 14% due to sector aggregation, the treatment of the informal sector and/or measurement error.

QINT(C, A) is the quantity of intermediate commodity, c, purchased by activity, a

Production is described by a constant elasticity of substitution (CES) function over the aggregate intermediate input and the aggregate primary factor input. The rebate by activity affects the producer's choice over these two inputs, because it is, in effect, a subsidy for the aggregate intermediate. The price of the aggregate intermediate input now includes the rebate per unit of aggregate intermediate input:

$$PINTA(A) = \sum_c PQ(C) \cdot ica(C, A) - REBATE(A) / QINTA(A)$$

where:

PINTA(A)	is the price of the intermediate aggregate input
PQ(C)	is the price of the composite commodity
ica(C,A)	is the intermediate input c per unit of aggregate intermediate
QINTA(A)	is the quantity of aggregate intermediate input

The price, PINTA(A) is used in the producer's first order condition over the intermediate aggregate input and the primary factor aggregate input.

In the original SAM data, the taxes paid by the activity to the government are net of subsidies. The rebate is a subsidy on the use of intermediate inputs. When we use rebates explicitly in the model, the tax payment from the activity to the government must be adjusted upward to add back in the subsidy payment:

$$SAM('acttax', A) = SAM('acttax', A) + REBATE(A)$$

The indirect tax rate, ta(A), must be recomputed to take into account the adjustment to the SAM:

$$ta(A) = SAM('acctax', A) / SAM(A, 'total')$$

(Alternatively, one could add a rebate row to the SAM.)

The value added tax revenue paid to the government becomes:

$$VATREV = \sum_c tvat(c) \cdot PQ(c) \cdot QQ(c) - \sum_a REBATE(a)$$

The tax rates by sector and activity are reported in appendix one.

3.3 Structure of the economy

The production structure of the economy is:

Table 2: Production structure of the economy by aggregate sector

Aggregated Sector	Components	Percent of Total Output
Agriculture	Agriculture Forestry and Fishing	3.3
Fuels & Minerals	Coal Mining Gold and Uranium Ore Mining Other Mining	6.7
Food Products	Food Beverages and Tobacco	5.5
Textiles	Textiles Wearing Apparel Leather and Leather Products Footwear	1.5
Manufacturing	Wood and Wood Products Paper and Paper Products Printing Publishing and Recorded Media Coke and Refined Petroleum Products Basic Chemicals Other Chemicals and Man-Made Fibres Rubber Products Plastic Products Glass and Glass Products Non-metallic Minerals Basic Iron and Steel Basic Non-ferrous Metals Metal Products Excluding Machinery Machinery and Equipment Electrical Machinery TV Radio and Communication Equipment Professional and Scientific Equipment Motor Vehicles Parts and Accessories Other Transport Equipment Furniture Other industries	23.3
Utilities	Electricity Gas and Steam Water supply	2.4
Construction	Construction and Civil Engineering	4.5
Services	Wholesale and Retail Trade Catering and Accommodation Transport and Storage Communication Financial Services Business Services Health Community Social and Personal Services Other producers	39.6
Government Services	General Government Administration General Government Defense General Government Law and Order General Government Education General Government Health General Government Social Services General Government Economic Services	13.2
Note: Production shares are calculated from SA SAM 2003.		

4. Model closure rules

The standard model specifies closures for the government, the rest of the world, savings and factor markets. To represent the labor market situation in South Africa, we assume capital and high-skilled labor are fully employed and activity specific, while semi-skilled and low-skilled labor are unemployed and mobile. For capital and high-skilled labor total employment will not change, only the factor payment, which is activity-specific, will change. For semi- and unskilled labor nominal wages will remain constant as these factors experience high levels of unemployment.[7] The only factor that would change for semi- and unskilled labor is employment.

We assume a flexible exchange rate with fixed foreign savings.

For the savings-driven investment closure will be used for the simulations. The marginal propensity to save for all non-government institutions will be fixed, while capital formation is flexible. The level of savings determines investment. In a paper done by Nell (2002) on the long-run exogeneity between saving and investment in South Africa, he found that private savings is strongly exogenous to private investment in the period 1977 to 2001. This implies that the savings level will determine investment. (Nell,2002:26). It is for this reason the savings-driven closure is chosen for the simulations.

The last closure to consider is that of the government balance. When we analyze the effect of removing the VAT and replacing it with a direct tax, on the level of government savings will be fixed and direct taxes will be scaled to absorb the loss in revenue due to the removal of VAT. For the other simulations, we are interested in either changes in government revenue (i.e. when we change the VAT rates and the sectors eligible) or adjustments in the VAT rate when we remove tariffs and maintain government revenue. In those scenarios, the government savings rate is flexible and the direct tax is constant.

5. The Data

The SA SAM (2003) commissioned by the World Bank in 2002/2003 and developed by Claude Van der Merwe from Quantec is used as the main data source. The SA SAM is based on 2001 data including:

- SSA IO 1971-1993
- SSA SUT 1993-1998
- SAM 1998
- SARB published and unpublished data 1970-2001
- SSA industry censuses and surveys
- 1970-1996 population census
- OHS 1994-1999
- LFS 2000-2002
- HH Income and expenditure survey 2000

[7] Depending in the choice of numeraire, real wages may also be held constant. For example, when the consumer price index is the numeraire, real wages are held constant. In this version of the model, the producer price index is the numeraire.

- McGregor BFA 1970-2001
- ASSA 2000 Demographic model
- RSA Standardized Industry Database developed by Quantec.

(Van der Merwe,2002).

The SAM consists of 49 commodities at industry level as well as 49 activities. The government enters as a producer and produces six of the 49 commodities. The SAM includes four production factors, namely capital, high-skilled, semi-skilled and unskilled labor. The households are divided into the 10 income deciles. Due to the magnitude of the 10^{th} decile it is further divided into 95 percent, 96.25 percent, 97.5 percent and 98.75 percent. The SAM also includes firms, the government and the rest of the world. Savings and investment is also captured within the SAM. The SA SAM (2003) includes residuals on the capital factor payment column as well as residuals on the commodity receipts row. The capital factor residual was removed by assuming the capital factor returns of firms contains undisclosed items, the factor returns was increased as well as the savings of firms to the same extent. The residual in the commodity row was entered into the change in stock variable. A balanced SAM was estimated using entropy[8] by assuming the production technologies and the tax structure is known. The balanced estimated SAM is used as data input. A combination of elasticities obtained from Gibson(2003), Van Heerden and Van der Merwe (1997), the CGE model of Lewis (2001) and Thurlow and Van Seventer (2002) will be used in the CGE model. The other parameters will be calibrated within the CGE model to balance and configure the model.

6. Instruments to Measure of the Effects of Changes in the Tax Structure

The effectiveness of a tax can be measured by looking at the ability of the tax to raise revenue, the fairness of the tax and the cost incurred by the government and the taxpayer (Ebrill et al,2001:25). The CGE model includes a large number of economic variables that allow one to observe the effect of changes in VAT on the effectiveness of the tax.[9] Changes in these variables will be observed during each simulation. Apart from these variables other issues such as the, the progressiveness of the complete tax system, the cost of living, changes in income distribution, as well as the equivalent variation is calculated. Through these variables welfare changes and the effectiveness of VAT is observed. As the simulations remove VAT it is not possible to calculate the regressiveness of VAT, or the efficiency of C-efficiency ratios within the CGE model.

6.1 Regressiveness

Regressiveness is measured by taking the household's expenditure on VAT as a percentage of total income. The total expenditure on VAT for each household category will be calculated within the CGE model as follows:

$$Regress(H) = \frac{\sum_{c} QH(C,H) * PQ(C) * tvat(C)}{YI(H)}$$

[9] The discussion in this section draws heavily on Go and Kearney (March 2003).

where

Regress(H)	measures the regressiveness of VAT for each household H
$QH(C,H)$	is the quantity of commodity C consumed by household, H
$PQ(C)$	is the price of commodity C
tvat(C)	is the VAT rate paid on commodity C
$YI(H)$	is the total income of households H

6.2 Progressiveness

The progressiveness of the complete tax system is measured by taking the total payment of taxes by each household as a percentage of total income.

$$Progress(h) = \frac{\sum_{c} QH(C,H) * PQ(C) * (tvat(C) + tfuel(C) + texcise(C) + tproducts(C)) + tins(H) * YI(H)}{YI(H)}$$

where

Progress(H)	measures the progressiveness of VAT for each household H
$QH(C,H)$	is the quantity of commodity *c* consumed by household H
$PX(C)$	is the average output price of commodity C
$tvat(C)$	is the actual VAT rate paid on commodity C
$YI(H)$	is the total income of household H
$tins(H)$	is the marginal tax rate of household H

6.3 Distribution

To impact of policy changes on distribution a will be measured by using a Gini Coefficient. The Gini Coefficient can be defined in terms of covariances:

$$Gini = \frac{2\,\mathrm{cov}(y, F(y))}{\mu}$$

where

y	is a measure of income
$F(y)$	is the cumulative density function of income, distributed between 0 and 1
μ	is the mean level of income (Stuart,1954 As in McDonald et al,2000:431)

An alternative measure of the redistributive impact of a tax structure is the degree to which it reduces the measure of inequality when moving from pre-tax to post-tax total household expenditure. This is referred to the Reynolds-Smolensky (1977) (In Creedy 1999) measure and is denoted as:

$$L = G_{pre-tax} - G_{post-tax}$$

where

L is the Reynolds-Smolensky (1977) measure

(In Creedy,1999:27).

A high L ratio indicates that the redistribution was associated with changes in income, rather than taxes, whereas a low L ratio indicates the redistribution is more associated with tax policy changes promoting the progressiveness of the tax system.

6.4 Price changes

An additional CPI index is specified to determine the cost of living for each of the household deciles. The index is calculated as follows:

$$CPI(H) = \sum_{c} (cwts(C) * QH(C,H))$$

with

$$cwts(C) = \frac{\sum_{h} Consumption(C,H)}{\sum_{c}\sum_{h} Consumption(C,H)}$$

where

$cwts(C)$ is the weight of each commodity in the total consumption bundle.

The *CPI(H)* gives an indication of the change in the standard of living of each household.

6.5 Welfare

With CGE models an exact welfare comparison between two equilibrium situations can be achieved. Hicks (1939) identified four different measures of welfare impact between equilibriums. They are equivalent and compensating variations, as well as equivalent and compensating surpluses. For the purpose of this paper the equivalent variation measure will be used to give and indication of the welfare impact of VAT. The equivalent variation can be written as:

$$EV = E(U^N, P^0) - E(U^0, P^0)$$

Shoven and Whalley (1984) also use the equivalent variation to determine the welfare impact of changes in taxes, or international trade policies. The equivalent variation is calculated for each household group, and then the aggregate effect can be determined by summing across all household groups.

$$EV = \frac{(U^N - U^O)}{U^O} \cdot I^O$$

with

$$U(h) = \left[\sum_i (\alpha_i^h)^{\frac{1}{\sigma_h}} \cdot (X_i^h)^{\frac{\sigma_h - 1}{\sigma_h}} \right]^{\frac{\sigma_h}{\sigma_h - 1}}$$

where

EV	is the equivalent variation
U	is the level of utility
N	indicates the level of utility after the policy change
O	indicates the level of utility before the policy change
I^O	s the level of income before the policy change
α_i^h	is the share parameter for good *i* by household *h*
X_i^h	is the quantity of good *i* demanded by household *h*
σ_h	is elasticity of substitution for household h

(Shoven and Whalley,1984:1010-1014)

The larger the EV value the higher the distance between the original consumption point and the new consumption point, and also the higher the welfare gain from the change in prices. A higher EV value is therefore an indication of an increase in welfare due to either an increase in income or an increase in utility.

6.6 Tax effectiveness

Tax effectiveness can be measured looking at the price distortions resulting from changes in VAT, the administrative cost or burden of VAT, and the distributional impact of VAT through incidence analysis.

From basic welfare economics it is known that per-unit taxes, like VAT is more likely to introduce price distortions than lump-sum taxes. The question that often arises with taxes is "who pays the tax?" (McLure,1987:1). With consumption taxes consumers and producers share the burden, however, the producer often tries to shift the burden to the consumer. The extent to which a per-unit tax can be shifted to the consumer is determined by the elasticity of supply and demand (Ebrill et al,2001:15). The excess burden of taxation measures the loss in welfare associated with a tax-induced distortion between demand and supply (McLure,1987:5). A CGE model is very useful to analyze the excess burden of taxes as it is automatically captures within the model (World Bank Symposium,1990:33).

In the analysis of the results of the simulations it is therefore important to observe the loss of the consumer and producers, compared to the gain of government to determine the efficiency loss.

7. Simulations and Results

We consider four scenarios to show the effects of changes in the tax structure on welfare and government revenue. The scenarios are summarized as follows:

Table 3: Model scenarios

Scenario	Description
Remove VAT	Remove VAT and replace lost government revenue with a proportional increase in direct taxes; sector-specific capital and high-skilled labor; endogenous supply of semi-skilled and unskilled labor at a constant wage.
Increase VAT by 50%	Increase the VAT rate by 50%; balanced savings and investment closure with fixed absorption shares for government and investment demand; sector-specific capital and high-skilled labor; endogenous supply of semi-skilled and unskilled labor at a constant wage.
0 VAT for food	Zero VAT tax for food and agriculture; balanced savings and investment closure with fixed absorption shares for government and investment demand; sector-specific capital and high-skilled labor; endogenous supply of semi-skilled and unskilled labor at a constant wage.
Replace tariff with uniform VAT increase	Remove tariffs and replace lost government revenue with a uniform increase in the VAT rate; balanced savings and investment closure with fixed absorption shares for government and investment demand; sector-specific capital and high-skilled labor; endogenous supply of semi-skilled and unskilled labor at a constant wage.

7.1 Remove VAT and replace government revenue with a proportional increase in direct taxes on all institutions

The incidence and effectiveness of VAT is measured by removing VAT completely from the tax system. The loss in revenue for government is replaced by a proportional increase in direct taxes for all institutions. By doing this one is examining the "true" price-distorting effect of the tax, rather than combining them with those generated by macroeconomic imbalances. Indirect tax burden is then comparable with a direct tax burden calculation as income tax is proportional and does not disturb prices. (Devarajan and Hossain,1995:10).

For the purpose of this simulation the statutory VAT rate will be set equal to zero, eliminating VAT. At the same time the direct tax rates will be scaled proportionally to absorb the loss in

revenue. Government consumption and government savings are therefore maintained at existing levels.

VAT is effectively removed from the South African tax system and replaced with a proportional increase in direct taxes. To absorb the loss in revenue direct taxes of firms as well as household was increased with 33.5 percent. *Table 4* gives a summary of the changes in direct tax rates. These are effective direct tax rates, calculated from actual tax receipts:

Table 4: Direct tax changes

	BASE	Remove VAT
Firms	0.128	0.159
h_d0	0.001	0.001
h_d1	0.011	0.013
h_d2	0.024	0.030
h_d3	0.052	0.065
h_d4	0.080	0.099
h_d5	0.095	0.118
h_d6	0.111	0.138
H_d7	0.135	0.168
H_d8	0.169	0.210
H_d91	0.185	0.230
h_d921	0.168	0.209
h_d922	0.160	0.199
h_d923	0.181	0.226
h_d924	0.144	0.179
Proportional Change in Direct Taxes		**0.244**

BASE : SA SAM 2003
Remove VAT: CGE MODEL SIMULATION

We find that removing VAT from the tax system will increase the progressiveness of the complete tax system (table 5). The tax burden of lower-income groups declines and the burden of high-income households generally increases slightly.

The three Gini coefficients give an indication of the effect of VAT on income distribution (table 6). The *L* measure shows that the income distribution without a VAT is more equal. The higher level of equality is generated by an increase in income rather than a reduction in taxes as the Gini coefficient measured at pre-tax levels shows a larger percentage difference.

Table 5: Tax payments per household as a percentage of income

Household	Base case	Remove VAT	Increase VAT by 50%	0 VAT for Food	Replace Tariff with uniform VAT increase
h_d0	7.58	1.98	10.50	3.03	7.99
h_d1	8.26	3.10	11.07	3.96	8.65
h_d2	9.23	4.65	11.92	5.28	9.60
h_d3	11.62	8.04	14.15	8.05	11.97
h_d4	13.97	11.37	16.34	10.85	14.30
h_d5	15.23	13.15	17.54	12.45	15.55
h_d6	16.74	15.19	19.01	14.70	17.06
h_d7	19.11	18.24	21.37	17.11	19.44
h_d8	22.40	22.46	24.64	20.88	22.73
h_d91	23.70	24.38	25.81	22.55	24.01
h_d921	22.37	22.50	24.61	21.47	22.71
h_d922	21.47	21.43	23.69	20.54	21.80
h_d923	23.40	24.04	25.53	22.51	23.72
h_d924	19.70	19.44	21.83	18.79	20.02

Table 6: Gini coefficients

	Base	Remove VAT	Increase VAT by 50%	0 VAT for Food	Replace Tariff with uniform VAT increase
Gini pre-tax	0.67	0.63	0.63	0.63	0.63
Gini post-tax	0.61	0.61	0.61	0.61	0.61
Reynolds-Smolenski measure (L)	0.05	0.02	0.02	0.02	0.02

Table 7: Percent change in equivalent variation

Household	Remove VAT	Increase VAT by 50%	0 VAT for Food	Replace Tariff with uniform VAT increase
h_d0	4.95	-2.11	3.60	0.61
h_d1	3.67	-1.62	3.11	0.56
h_d2	4.08	-1.96	3.14	0.59
h_d3	2.71	-1.74	2.78	0.55
h_d4	2.50	-2.07	2.73	0.55
h_d5	2.05	-2.13	2.49	0.51
h_d6	1.59	-2.25	2.21	0.45
h_d7	0.80	-2.40	1.96	0.37
h_d8	-0.26	-2.52	1.55	0.25
h_d91	-1.07	-2.41	1.18	0.18
h_d921	-0.13	-2.47	0.84	0.07
h_d922	-0.36	-2.47	0.92	0.10
h_d923	-1.40	-2.45	0.93	0.13
h_d924	-1.22	-2.44	1.03	0.17

To describe the welfare effect of each tax shock, we report equivalent variation (EV) (see table 7). A higher EV value is an indication of an increase in welfare. Removing VAT would generate a welfare gain for low-income households over high-income households. In fact, high- income households experience an overall loss in welfare due to the removing of VAT and the simultaneous increase in direct taxes. As the direct taxes are increased proportionately the higher income groups will be worse off.

Table 8 shows the employment changes for both semi- and unskilled labor:

Table 8: Percent change in employment for semi- and unskilled-labor

	BASE	Remove VAT	Increase VAT by 50%	0 VAT for Food	Replace Tariff with uniform VAT increase
Semi-skilled Labor	2932.01	0.27	-0.19	0.10	0.14
Unskilled Labor	2786.02	1.03	0.40	-0.13	0.05

BASE CASE: SA SAM 2003-03-26
CGE MODEL SIMULATIONS

When the VAT is removed, employment for semi-skilled and unskilled labor increases slightly. For semi-skilled labor, the increase does not generate the magnitude of the increase in income for high-skilled labor and capital. Instead, the increase in factor income from capital and high-skilled labor is higher than the increase for semi-skilled labor (see table 9).

Table 9: Percent change in total factor income

	BASE	Remove VAT	Increase VAT by 50%	0 VAT for Food	Replace Tariff with uniform VAT increase
Capital	458.49	1.21	-0.44	0.23	0.31
High-skilled Labor	144.48	0.36	-0.29	0.11	0.22
Semi-skilled Labor	179.58	0.34	-0.36	0.15	0.16
Unskilled Labor	133.91	0.69	0.66	-0.61	0.11

BASE CASE: SA SAM 2003
CGE MODEL SIMULATIONS

The macro economic effects of VAT are summarized in table 10.

Table 10: Macroeconomic effects

	BASE	Remove VAT	Increase VAT by 50%	0 VAT for Food	Replace Tariff with uniform VAT increase
	Aggregate real indicators	**Percent change from base**			
CPI	100	-5.90	3.1	-2.2	-0.2
Real Exchange Rate	90.6	-0.20	0.9	-0.60	0.5
Nominal Exchange Rate	100	-0.20	0.9	-0.50	0.5
Absorption	991.537	0.26	-0.05	-0.03	0.09
Private Consumption	608.633	0.36	-2.33	1.69	0.30
Fixed Investment	144.127	0.28	9.54	-7.39	-0.67
Change in Stock	7.436	0.00	0.00	0.00	0.00
Government Consumption	231.34	0.00	0.00	0.00	0.00
Exports	301.841	0.74	0.63	-0.69	0.86
Imports	-264.464	0.84	0.72	-0.78	0.98
GDP at market prices	1028.914	0.25	-0.04	-0.03	0.08
Net Income Tax	112.464	0.94	-0.52	0.24	0.36
GDP at Factor Cost	916.450	0.17	0.02	-0.07	0.05
	Percent of nominal GDP	**Deviation from base**			
Investment	14	0.1	1.7	-1.1	-0.2
Private Savings	14.7	0.2	-0.4	0.2	0.0
Foreign Savings	0.2	0.0	0.0	0.0	0.0
Transfers to Domestic Institutions	3.5	0.2	0.0	0.0	-0.5
Government Savings	-0.2	0.0	2.0	-1.0	-0.2
Import Tax	0.6	0.0	0.0	0.0	-0.6
Direct Taxes	15	4.3	-0.4	0.2	0.0

BASE CASE: SA SAM 2003
CGE MODEL SIMULATIONS

The removal of VAT will lead to a six percent reduction in the CPI. This effect will most probably be a once-and-for-all reduction. This result does not say that VAT contributes 5 percent to the CPI level. Total absorption increases by 0.3 percent. Real GDP will increase with 0.3 percent driven by the increase in household consumption and investment

The increase in real fixed investment of 0.3 percent is explained by the reduction in commodity prices and the increase in savings, since investment is savings driven by assumption. In this scenario, private savings increases.

The real exchange rate will depreciate. The increase in income results in an increase in consumption of both domestic and imported goods. Exports need to increase to finance the increase in imported goods and this is achieved by a depreciation of the exchange rate. Foreign savings level is assumed fixed and therefore will not adjust to finance the increase in imports.

8. Conclusion

The exclusion of commodities from the VAT base introduces an efficiency loss. Even though most of the exclusions were aimed at reducing the regressiveness of VAT, VAT in South Africa is still regressive. The effectiveness of VAT is analyzed using a CGE model and is simulated with the removal of VAT from the tax system. The loss in revenue is replaced with a proportional increase in direct taxes. The results show that VAT reduces the overall progressiveness of the tax structure. VAT also reduces the overall welfare of low-income households. Without a VAT system real the cost of living of low-income households is significantly reduced.

The presence of a VAT in the South African tax system, impacts negatively on the welfare of the low-income households. This suggests that more attempts should be made to lower the VAT burden of poor households.

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Appendix 1:
South Africa CGE Model

Sectors & Factors

*Commodities

C_AGRI	Agriculture Forestry and Fishing
C_COAL	Coal Mining
C_GOLD	Gold and Uranium Ore Mining
C_OTHMN	Other Mining
C_FOOD	Food
C_BEVT	Beverages and Tobacco
C_TEXT	Textiles
C_APPAR	Wearing Apparel
C_LEATH	Leather and Leather Products
C_FOOTW	Footwear
C_WOOD	Wood and Wood Products
C_PAPER	Paper and Paper Products
C_PRINT	Printing Publishing and Recorded Media
C_PETRO	Coke and Refined Petroleum Products
C_CHEM	Basic Chemicals
C_OTHCH	Other Chemicals and Man-Made Fibres
C_RUBB	Rubber Products
C_PLAST	Plastic Products
C_GLASS	Glass and Glass Products
C_NOMET	Non-metallic Minerals
C_IRON	Basic Iron and Steel
C_NOFER	Basic Non-ferrous Metals
C_METPR	Metal Products Excluding Machinery
C_MACHN	Machinery and Equipment
C_ELMAC	Electrical Machinery
C_COMEQ	TV Radio and Communication Equipment
C_SCIEQ	Professional and Scientific Equipment
C_VEHIC	Motor Vehicles Parts and Accessories
C_TRNEQ	Other Transport Equipment
C_FURN	Furniture
C_OTHIN	Other industries
C_ELEGS	Electricity Gas and Steam
C_WATER	Water supply
C_CONST	Construction and Civil Engineering
C_TRADE	Wholesale and Retail Trade
C_HOTEL	Catering and Accommodation
C_TRANS	Transport and Storage
C_COMM	Communication
C_FINAN	Financial Services
C_BUS	Business Services
C_MOTHS	Health Community Social and Personal Services
C_OTHP	Other producers

CG_Admin	General Government Administration
CG_Defense	General Government Defense
CG_LO	General Government Law and Order
CG_Educ	General Government Education
CG_Health	General Government Health
CG_Social	General Government Social Services
CG_Econ	General Government Economic Services

Factors:

f_cap	Capital
f_labhi	High skilled labor
f_labmed	Semi-skilled labor
f_lablo	Unskilled labor

Tax Structure:

Commodity tax rates (percent)

	SALES	TM	TVAT
C_AGRI	0	1.2	1.6
C_COAL	0	0	0.3
C_OTHMN	0	0	0.1
C_FOOD	0.2	2.3	5.5
C_BEVT	7.3	39.3	10.1
C_TEXT	0.9	8.9	2.4
C_APPAR	0.3	11.9	3.8
C_LEATH	0.5	0.9	0.2
C_FOOTW	0.5	6.1	3.3
C_WOOD	0	1.1	0.5
C_PAPER	0.2	6.3	0.4
C_PRINT	0.2	1.3	3.6
C_PETRO	14.5	0.2	17.8
C_CHEM	0.2	1.2	0.8
C_OTHCH	0.3	1.4	2.8
C_RUBB	4.2	6.1	0.9
C_PLAST	1.7	1.4	0.3
C_GLASS	1.6	1.3	0.3
C_NOMET	0.3	2.3	0.8
C_IRON	0	1.1	0.1
C_NOFER	0	0.2	0
C_METPR	0.8	3.5	1.5
C_MACHN	0.3	2.3	3.7
C_ELMAC	2.3	4.9	1.5
C_COMEQ	3.5	2.5	3.6
C_SCIEQ	3.7	0.4	2.4
C_VEHIC	0.2	2.6	4.1
C_TRNEQ	5	0	1.1
C_FURN	1	14.9	6.4
C_OTHIN	2.5	5.3	11.3
C_ELEGS	0	0	2.9
C_WATER	0	0	2.1
C_CONST	0	0	3.3
C_TRADE	-0.4	0	1.4
C_HOTEL	0	0	4.9
C_TRANS	-0.3	0	0.2
C_COMM	0.2	0	2.1
C_FINAN	2.2	0	0.9
C_BUS	1.4	0	2
C_MOTHS	0	0	4.5
C_OTHPR	0	0	2.5
CG_Admin	0	0	0.1
CG_Defense	0.8	0	0.8
CG_LO	0	0	0.1
CG_Educ	0	0	0.1
CG_Health	0.1	0	0.1
CG_Social	0.1	0	0.1

CG_Econ	0	38.8	0.2

Activity tax rate (percent)

	TA	REBATE
I_AGRI	0	0
I_COAL	1.3	0
I_GOLD	1.5	0
I_OTHMN	0.6	0
I_FOOD	0.3	0
I_BEVT	0.7	0
I_TEXT	1.5	2.5
I_APPAR	1.6	2.9
I_LEATH	3.5	5.7
I_FOOTW	1.1	1.7
I_WOOD	1.6	1.9
I_PAPER	1.3	1.8
I_PRINT	1.3	1.9
I_PETRO	1.8	1
I_CHEM	2.8	3.2
I_OTHCH	2.3	2.6
I_RUBB	1.4	1.8
I_PLAST	0.9	1.4
I_GLASS	1.4	2.3
I_NOMET	1.8	1.8
I_IRON	1.5	1.9
I_NOFER	1.2	1.7
I_METPR	1	1.4
I_MACHN	1.7	2.3
I_ELMAC	1.3	1.6
I_COMEQ	1.8	3.1
I_SCIEQ	2.8	2.7
I_VEHIC	2.4	3.7
I_TRNEQ	2.1	1.5
I_FURN	0.9	1.6
I_OTHIN	0.9	1.4
I_ELEGS	1.3	1.7
I_WATER	1.9	2.4
I_CONST	2.3	2.9
I_TRADE	3	2.5
I_HOTEL	4.7	6.2
I_TRANS	4.1	8.4
I_COMM	1.9	3.4
I_FINAN	2.4	1.8
I_BUS	7.3	2.9
I_MOTHS	3.1	3.9
I_OTHPR	2.5	3.3
LG_Admin	0.4	0
LG_Defense	3.6	0
LG_LO	0.4	0
LG_Educ	0.3	0
LG_Health	0.8	0
LG_Social	0.6	0
LG_Econ	1.1	0

r domestic and imported sales