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A STANDARD COMPUTABLE GENERAL EQUILIBRIUM MODEL FOR SOUTH AFRICA

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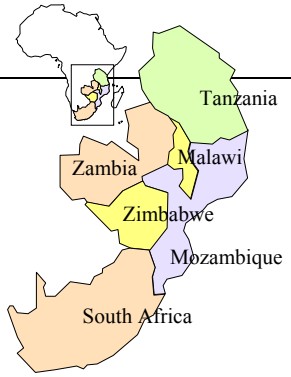

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A Standard Computable General Equilibrium Model for South Africa

James Thurlow[1] and Dirk Ernst van Seventer[2]

Abstract

The paper reports on the construction and testing of a Standard International Food Policy Research Institute (IFPRI) computable general equilibrium model for South Africa. A 1998 social accounting matrix (SAM) for South Africa is compiled using national accounts information and recently released supply-use tables. By updating to a recent year, and by distinguishing between producers and commodities, this SAM is an improvement on the existing SAM databases for South Africa. Furthermore, this SAM is made consistent with the requirements of IFPRI's standard comparative static computable general equilibrium (CGE) model. This model is then used to simulate the economy-wide impact of a range of hypothetical policy levers, including: increased government spending; the elimination of tariff barriers; and an improvement in total factor productivity. Results indicate that assumptions made regarding the mechanisms of macroeconomic adjustment are important in determining the expected impacts of these policies. Firstly, despite mixed results concerning changes in household income distribution, the impact of expansionary fiscal policy appears to be growth enhancing, with the Keynesian style adjustment mechanism producing the most positive results. Secondly, a complete abolition of import tariffs also appears to generate increases in gross domestic product, with negative and positive consequences for aggregate manufacturing and services respectively. Finally, an increase in total factor productivity is growth enhancing, with the most positive results derived under neoclassical assumptions of the macroeconomic adjustment mechanisms. These simulations are meant to demonstrate the usefulness for economy-wide policy modelling and the paper concludes by highlighting areas of policy analysis that might benefit from more detailed applications with this framework.

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1. Introduction

Since the beginning of 1990s, economy-wide policy analysis in South Africa has seen a considerable increase in the use of computable general equilibrium (CGE) models. Several of these models have contributed to the local policy making process. Gelb et al (1992) developed a dynamic one sector computable general equilibrium (CGE) model of the South African economy, based on an aggregate social accounting matrix (SAM) for the year 1990. This model, which was extended to include financial variables, was used to evaluate the impact of a negative external shock to the economy, as well as a program of government stimuli. Using a rigid, albeit multisectoral modelling template previously developed at the World Bank, Naude and Brixen (1993) examined the impact of an increase in government expenditure, export demand, world price, and a lowering of import tariffs under various sets of closure rules. Tarp and Brixen (1996) made use of the IMF's financial programming model and the World Bank's revised minimum standard model, and applied these to the South African economy. This modelling framework was based on a single sector accounting framework that can, in principal, be represented in a SAM format. They simulated exchange rate devaluations, external borrowing by the government, and higher international reserves.

Subsequently, several large-scale multisectoral CGE models of the South African economy were developed by the Industrial Development Corporation (Coetzee et al, 1997), the World Bank/OECD (van der Mensbrugghe, 1995; Devarajan and van der Mensbrugghe, 2000), and the Development Bank of Southern Africa (DBSA, Gibson and van Seventer, 1996a). These models resulted in a number of applications including: investigations in trade liberalisation; green trade restrictions; currency devaluations; and government expenditure and restructuring (see for example Cameron 1994; Gibson and van Seventer, 1996b, 1997a, 1997b). The most recent applications of CGE analysis in South Africa have, however, been developed outside the country and mainly by the Word Bank (see Arndt and Lewis, 2000, and Lewis, 2001).

In an attempt to improve the capacity to undertake economy-wide policy analysis using CGE models in South Africa, we present in this paper a standard South African model using the CGE modelling framework developed by Lofgren *et al* (2001). Although the specified model is essentially neoclassical, it is sufficiently flexible to accommodate a fairly wide range of views on how the South African economy adjusts to exogenous shocks and the use of policy levers. The paper is accompanied

by the associated program files which readers are able to download and execute in the GAMS programming language.

The main challenge in applying a pre-specified modelling framework to South Africa lies, firstly, in adapting country specific data in such a way that it fits the model, while secondly, maintaining the characteristics of the economy and remaining consistent with the national accounting framework. Section 2 of this paper is devoted to constructing an appropriate social accounting matrix (SAM) that can serve as the underlying database for the model. Although, as will be shown, we have been successful in developing an appropriate SAM, it was still necessary to adapt the SAM to fit the CGE model. Unfortunately, due to a lack of data, we were forced to omit certain features of the generic modelling template.[3] A discussion of these omissions and a description of the model are presented in Section 3. In order to ensure the robustness of the model's results, we undertake sensitivity analysis based on various assumptions regarding the adjustment mechanisms whereby macroeconomic balance is maintained in the modelled economy. These simulations are detailed in Section 4. We end with a summary of the results and recommendations for typical applications and further extensions to the basic framework.

2. An Appropriate Database for the 1998 Standard CGE of South Africa: a SAM with Supply-use Features

Although earlier CGE models of the South African economy were able to distinguish between commodities and activities (see for example Lewis, 2001), this was not supported by the underlying database. However, Statistics South Africa (Stats SA, 2000; 2001) has recently published its first set of supply-use tables (SUT) for the years 1993 and 1998.[4] Since these tables will be compiled or updated on a regular basis, it makes sense to use this format for the SAM database of the present CGE model. To date, official SAMs published by Statistics South Africa have not incorporated the additional information contained in the supply-use tables. In order to make use of the latest available data, this study compiles a SAM based on the 1998 SUT, as well as the latest institutional breakdown that is available from the 1997 SAM used by Lewis (2001). The SAM incorporates the correct accounting of

[3] The most notable of these omissions includes the home consumption of domestically produced goods.
[4] The supply-use table for 1993 was updated to 1998 using partial updating techniques.

commodity supply and secondary production, as well as a more satisfactory treatment of trade and transport margins. Furthermore it is consistent with the 1998 national accounts as published in the South African Reserve Bank's Quarterly Bulletin (SARB, September 2001).[5]

The process of compiling the SAM was achieved in two distinct phases. Initially, the various sources were merged into a framework at the highest level of disaggregation of commodities, activities and institutions. At this stage no attempt was made to keep the database consistent with the requirements of the CGE model. In the second phase, the SAM was adjusted to match the required format for inclusion in the CGE model.

2.1 Phase 1: A Generic SAM Framework for South Africa

In terms of the first phase, a number of characteristics of the resulting SAM need to be highlighted:

a) Despite Stats SA's attempt to construct a comprehensive macro SAM for South Africa, this study does not make use of the concepts of primary and secondary income distribution or financial accounting (both of which are suggested by the 1993 System of National Accounts). This decision is motivated by the limitations of the standard CGE framework which does not presently incorporate such detail.

b) In order to draw on information from both the 1998 SUT and 1997 SAM, it was first necessary to ensure that the sectoral breakdown across these two sources was consistent. The resulting 43 activities and commodities are presented in Table 1.

   It should be noted that 'government services' is treated as an industry supplying commodities, while it is maintained as a component of final demand only in aggregate. In this way, government services can be used as an intermediate input by other industries, as is, in fact, the case in the 1998 SUT.

[5] It should be noted that considerable adjustments were administered in the December 2001 issue of the SARB Quarterly Bulletin. Short of undertaking a major balancing act, we remain consistent with the older edition, while the process of constructing a more recent SAM for more recent years is in progress at Stats SA.

The sectoral breakdown presented below differs from the 1998 SUT, in that beverages and tobacco (row 6), construction and civil engineering (row 34), and medical and other services (row 41) had to be aggregated. Otherwise, the new SAM's disaggregation is the same as that used by Lewis (2001) in the 1997 SAM.

c) Only aggregate trade and transport margins are available in the 1998 SUT. To fit these margins into the SAM, the split between trade and transport margins across sectors is achieved using economy-wide proportions available from the SUT. According to the SUT, transport and insurance costs on imports are included in the value of imports for each commodity, but subtracted at the aggregate in order to maintain consistency with the national accounts' current account.

d) Similar to the 1997 SAM used by Lewis (2001), we identify three labour categories (i.e., skilled, semi-skilled, and unskilled) as well as the same disaggregation of households (i.e., income deciles with a considerable disaggregation of the top income decile). Government expenditure and gross domestic fixed investment have both been aggregated into a single account for reasons of convenience, although considerable disaggregation is an option that can be explored at a later stage.

e) The disaggregation of government income (as per the national accounts) includes: property income; indirect taxes (as well as subsidies) on products and production; direct taxes on households and firms; and transfers to and from households, firms and the rest of the world. Consistency with the government income and expenditure accounts of the SARB requires that we also include interest payments on government debt.

f) The SUT identifies purchases by residents abroad, and purchases by non residents in South Africa, as separate items of household expenditure and of imports and exports of commodities respectively. For reasons of convenience, we distribute and add these purchases across these accounts according to the household expenditure pattern. Accordingly, these purchases are eliminated from our framework.

g) By the end of Phase 1, the current SAM framework is similar to the one used by Lewis (2001). However, the current SAM now includes a more appropriate account of the supply of commodities and marketing margins. The macro SAM is shown in Table 2.

h) The derivation of GDP from the income side is as follows:

gdp at market prices		remuneration		net operating surplus		allowance depreciation		net other taxes on production		net taxes on products
(rb6006j)	=	(rb6001j)	+	(rb6001j)	+	(rb6002j)	+	(rb6600-rb6001j)	+	(rb6603-rb6604j)
		cell (4,1)		cell (3,1)		cell (14,1)		cell(9,1)		cell (8,2)
735,084	=	**371,762**	+	**192,820**	+	**94,781**	+	**11,018**	+	**64,703**

While GDP from the expenditure side is:

gdp at market prices		household consumpt expend		govern expend		gross domestic fixed investment		inventory change		exports		residual		imports		cif fob adjust-ment
(rb6006j)	=	(rb6007j)	+	(rb6008j)	+	(rb6009j)	+	(rb6010j)	+	(rb6013j)	+	(rb6011j)	+	(rb6014j) +cif fob	-	(sut98)
		cell (2,6)		cell (2,13)		cell (2,16)		cell (2,17)		cell (2,18)		cell (2,20)		cell (18,2)		cell (19,2)
735,084	=	**465,680**	+	**146,800**	+	**123,209**	+	**-5,327**	+	**190,189**	+	**-3,833**	+	**-190,606**	-	**-8,974**

i) Some key ratios from the SAM in Table 3 include:

Ratio description	Ratio	Source	Comment
Fiscal budget deficit on the current account as a proportion of GDP	3.5%	25,635 [rb6202j, cell(14,13)] / 735,084 (rb6006j)	This ratio ignores net government capital expenditure
Deficit on the foreign current account as a proportion of GDP	1.8%	12,867 [rb6206j) , cell(14,18)] / 735,084 (rb6006j)	
Gross domestic fixed investment as a proportion of GDP	16.0%	117,882 [rb6180j, cell(15,14)] / 735,084 (rb6006j)	This ratio ignores changes in inventories

2.2 Phase 2: Forcing the Standard SAM format

The reason for including in this paper the details of both phases of the compilation of the SAM, is that the first phase offers a generic SAM framework that can also be used for other purposes apart from CGE modelling. In such situations it might be preferable to preserve the finer level of disaggregation in the SAM presented in Table 2. The second phase entails tailoring the SAM to a specific model. For our purposes, this requires some adjustment and aggregation in order for the above SAM to fit the standard CGE framework discussed in the next section. The following steps were undertaken during Phase 2:

a) The allowance for depreciation by industries (cell [14,1] of Table 2) is added back to net operating surplus (cell [3,1]), in order to arrive at gross operating surplus. The production factor capital pays to firms an amount that now includes allowance for depreciation (cell [5,3]), less an allowance for depreciation on residential buildings This is allocated to households (in cell [6,3]) according to the 1997 SAM savings distribution. Firm income and firm savings is now raised by the allowance for depreciation as well as their savings (in cell [14,5]). Note that allowance for depreciation by the public sector is captured by the government services industry.

b) We remove the government balance account from the SAM (row and column 12 of Table 2).

c) We eliminate government receipts from property income (cell [7,5] of Table 2), and treat it in the model as a transfer from the production factor capital (gross operating surplus) to government (as in cell [11,3]). In addition, government's interest payments on total debt (cell [3,13]) is converted into a negative receipt by government from the production factor capital (cell [13,3]), see also point h) below.

d) Gross domestic fixed investment is aggregated over domestic institutions (firms, households and the government). We also remove the savings-investment balance account (row and column 15).

e) The cif-fob adjustment are disaggregated across commodities according to the import weights to obtain cif margins on imports by industry. The result is then subtracted from cell [18,2] and added to cell [2,2]. These margins increase the demand for transport and insurance services by the same aggregate amount, such that the sum of entries in cell [2,2] remains zero. Row and column 19 can now be eliminated.

f) The standard CGE model identifies aggregate trade and transport margins on domestic demand (locally supplied), exports and imports. Accordingly, three new sub-rows and sub-columns are added to row and column 2, which will replace the aggregated trade and transport margins currently shown in cell [2,2]. We disaggregate the sum of trade and transport margins from the SU tables according to the ratios of locally supplied domestic demand, imports and exports for each commodity respectively. The margins are summed to arrive at total margin values for domestic, imported and exported commodities. Subsequently, these were broken down into trade and

transport receipts according to the economy-wide breakdown of trade and transport margins according to the SU table, and these values serve as revenues for the trade and the transport commodity accounts. In doing so, we ensure consistency in that the sum of entries in cell [2,2] remains zero.

g) The national accounts' residual (cell [2,20]), disaggregated by commodity according to the SUT, is added to changes in inventories (cell [2,17]). The residual is also eliminated in cell [20,3] and absorbed by the firm's receipts from the production factor capital (cell [5,3]). This in turn adjusts firm's savings (and therefore total savings) so as to balance the adjustment in changes in inventories (cell [17,15]). The savings-investment balance now includes the residual on both sides of the equation.

h) Government's interest payments on total debt (cell [3,13]) is converted into a negative receipt by government from the production factor capital (cell [13,3]), see also point c) above.

i) Interest payments on government debt (cell [3,13]) *less* property income received by the government (cell [7,5]) is, for purposes of simplification, moved to government expenditure on the commodity government services (cell [2,13]). Now that the demand for the government services commodity has increased, the supply of this commodity (cell [1,2]) has to be increased by the same amount in order to achieve commodity balance. Output of this commodity is solely produced by the government services activity, and since we're dealing here with interest payments and property income, the gross operating surplus of this activity (cell [3,1]) increases by the same amount (so that this account is balanced again), see also points c) and h) above.

j) Finally, consistency (i.e., in order to eliminate rounding errors) was achieved by using the following entries as balancing or residual accounts:
   - Firm's receipts from the production factor capital (cell [5,3]).
   - Households unearned income (cell [6,5]).
   - Government transfers received from firms (including property income received by government).
   - Firm's transfers paid to the rest of the world (cell [18,5]).
   - Changes in inventories by commodity (now including the residual) in cell [2,17].

k) By the end of Phase 2, the SAM framework is ready for incorporation into the Standard CGE model for South Africa. The GDP derivation still holds, although now in a slightly more convoluted fashion. Since we have included interest payments on government debt, less government property income in final demand, we now have to subtract it specifically. This can be seen in the two following relationships.

gdp at market prices		**remuneration**		**gross operating surplus**		**net other tax on production**		**net taxes on products**		**govt interest paym on publ debt**		**govt property income**
(rb6006j)	=	(rb6001j)	+	(rb6001j)	+	(rb6600-rb6001j)	+	(rb6603-rb6604j)	-	(rb6255)	+	(rb6250)
		cell (4,1)		cell (3,1)		cell(7,1)		cell (7,2)		not shown		not shown
735,084	=	**371,762**	+	**326,585**	+	**11,018**	+	**64,703**	-	**46,534**	+	**7,550**

While GDP from the expenditure side is:

gdp at market prices		**household consump expend**		**governmt expend**		**gross domesic investment +residual**		**exports**		**imports**		**govt interest paym on publ debt**		**govt property income**
(rb6006j)	=	(rb6007j)	+	(rb6008j)	+	(rb6009j)	+	(rb6013)	-	(rb6014)	-	(rb6255)	+	(rb6250)
		cell (2,6)		cell (2,11)		cell (2,12)		cell (2,14)		cell (14,2)		not shown		not shown
735,084	=	**465,680**	+	**185,784**	+	**114,049**	+	**190,189**	-	**181,632**	-	**46,534**	+	**7,550**

j) Some key ratios from the SAM in Table 3 include:

Ratio description	**Ratio**	**Source**	**Comment**
Fiscal budget deficit on the current account as a proportion of GDP	3.5%	25,635 [rb6202j, cell(11,10)] / 735,084 (rb6006j)	This ratio ignores net government capital expenditure
Deficit on the foreign current account as a proportion of GDP	1.8%	12,867 [rb6206j) , cell(11,13)] / 735,084 (rb6006j)	
Gross domestic fixed investment as a proportion of GDP	16.0%	117,882 [rb6180j, cell(2,11)] / 735,084 (rb6006j)	This ratio ignores changes in inventories

2.3 Characteristics of the South African Economy According to the 1998 SAM

Using the results from Phase 2, we can now consider some salient features of the South African economy as represented in the SAM. Initially some observations concerning the industries identified in the SAM are discussed, followed by an examination of patterns with regard to commodities. We then turn our attention to household income and expenditure, and finally, the public sector.

Activities

Starting with Table 4, it can be seen in the first row that agriculture contributes about 3.6 percent to South Africa's GDP at factor costs (almost R25 billion). The single largest industry is trade with more than 10 percent of GDP (see row 35), followed by finance and business services, both with more than 8 percent of GDP (see rows 39 and 40 respectively), and then transport with 6 percent (row 37). Due to the disaggregation, contributions of individual manufacturing industries are relatively small. Contributions of more than 1 percent, however, are observed for food (row 5), beverages (row 6), petroleum refineries (row 14), other chemicals (including pharmaceuticals, row 16), basic iron & steel (row 21), metal products (row 22), machinery (row 23), vehicles (row 28), and other industries (row 31).

In columns 3 and 4 we show the estimates of unskilled labour demand in 1998. The largest employer of unskilled labour is agriculture (row 1) followed by construction (row 34) and trade (row 35). Highly skilled labour (shown in columns 7 and 8) is more in demand in the services industries such as trade (row 35), finance (row 39), business services (row 40) and other service providers (rows 41 & 43). Relative to their contribution to GDP, the manufacturing industries demand less skilled labour.

Interestingly, more than 50 percent of the most skilled labour appears to be employed by the government services industry.[6] In columns 9 and 10 we show the distribution of the capital stock in South Africa. After the public sector (row 43), the highest proportion of the capital stock is captured by the financial services industries.[7] Other large users of capital are business services (row 40), transport (row 37) and communication (row 38), followed by electricity (row 32) and trade (row 35). On the

[6] It should be noted here that skilled labour is assumed to include nurses and teachers, and this would account for a significant portion of government employment.
[7] This sector includes all residential housing stock.

goods producing side, only petroleum refineries (row 14), basic iron & steel (row 21) and gold (row 3) use significant proportions of South Africa's capital stock. Again, due to the disaggregation, most manufacturing sectors individually use relatively little capital stock.

Finally, in the last entry of the last column it can be seen that about 48 percent of industry's costs are spent on intermediate inputs, with the rest involving the production factors capital and labour and, to a small extent, producer taxes. Further up the column, we show the industry specific use of intermediate commodity inputs. It should be noted that these commodities can be produced locally or in the rest of the world, and would therefore include the marketing margins for trade and transport, as well as cost, insurance and freight. Typically, the services industries use less intermediate commodities in their production processes than manufacturing and other goods producers. Backward linkage indicators, such as Leontief multipliers, should therefore be higher in manufacturing industries. We, however, present multipliers together with a range of other indicators, at the commodity level, since the multiplier concept entails the exogenous increase in final demand, which is expressed in terms of commodities. Results are shown in Table 5.

Commodities

In the first two columns of Table 5 we focus on the proportion of commodity production that is destined for exports, and the proportion of final demand that is imported from the rest of the world. Starting in the first column it can be seen that relatively high proportions of commodity output are exported for mining commodities (rows 2-4), leather (row 9), basic chemicals (row 15), basic metals (rows 21-22), machinery (row 24), vehicles & other transport equipment (28-29) and furniture (row 30). Relatively low export intensities can be observed for the services industries, with the exception of the accommodation industry (row 36). The export orientation of clothing (row 8), plastic products (row 18) and electrical machinery (rows 25-26) is also relatively low.

Import duties, collected as a proportion of total supply of the commodity, are shown in column 3. On average, the value of duties collected as a proportion of supplied commodities is relatively low (less than half a percent as can be seen in the last entry of the column). Relatively high duties are collected on the following commodities: textiles, leather and footwear (rows 7, 9 and 10 respectively); rubber and plastic (rows 17-18); and electrical machinery and communications equipment (rows 25-26).

Regarding household expenditure, we have aggregated the 14 income classes up to three broad categories for reasons of display (i.e., poor household, encompassing the bottom 40 percent of the income earning households; a middle class, covering the 40-80 percent of the income earning households; and the rich households completing the picture). Their expenditure patterns are shown in column 4-6. It can immediately be seen that poor households spend a relatively large proportion of the income on agricultural, food and beverage, and clothing and footwear products (rows 1, 5-6 and 8 and 10 respectively). The same applies to electricity (row 32) and transport (row 37) (although the middle class uses transport services more than the poor). Towards the bottom of the columns it can be seen that rich households buy relatively more vehicles, accommodation, financial and business services (see rows 28, 36, 39 and 40 respectively). In total, poor households spend about 96 percent of their income on good and services, as opposed to rich households with 81 percent. The import content of the goods and services purchased does not appear to differ much between poor and rich households, as can be seen in the last entry of the column.

Government expenditure on goods and services (shown in column 7) is mostly towards: vehicles (row 28); specialised equipment (row 27); machinery (row 24); other chemicals (row 16); business services (row 40); and inter-industry government services (row 43). A total of only 21 percent of government income is spent on goods and services. Other aspects of government income and expenditure will be discussed below in more detail.

As can be seen in column 8, investment demand is mainly targeted at machinery (rows 23-27), transport equipment (rows 28-29), and construction goods and services (row 34). The import content, shown in the last entry of the column, is relatively high at 24 percent.

In the last four columns of Table 5 we show the impact on the South African economy of a R1 million increase in the final demand of the commodity listed on the left hand side of the table. The impact includes all the backward linkages or upstream effects, including the household income-expenditure loop. The latter can best be understood as the additional chain that will be set in motion when a worker receives labour income, which is subsequently distributed to a household. Here it is spent, amongst others, on goods and services according to the expenditure patterns of columns 4-6.

For example, the first entry of columns 9-12 shows the impact of a R1 million increase in the final demand of agriculture (consisting in this case of government expenditure, investment demand, changes

in stocks and exports, but not household expenditure as this has been endogenised as discussed above). The result is an increase in gross output in the South African economy by R2.71 million; an increase in GDP at factor costs by R1.32 million; and an increase in both imports (by R0.36 million) and employment (by 22 person year equivalents). Based on the assumption of fixed prices and spare capacity, this application of the conventional demand-driven first-generation SAM-based multiplier model, highlights which sectors are most connected to the rest of the South African economy in terms of gross output, net output and employment, as well as the direct and indirect impact on imports (through backward linkages).

In terms of output, the commodities with the highest multipliers are: construction (row 34); water (row 33); trade (row 35); basic iron and steel (row 21); and metal products (row 23). The reason for these commodities having relatively high gross output multipliers is, amongst others, because they rely less on imports (both directly and indirectly). Since imports constitute leakages out of this simple demand driven model, they do not contribute to the multiplier process. Consequently, the import multipliers of these commodities are relatively low (as can be seen in the corresponding entries of column 11). The value for construction is typical for a high multiplier industry, as it has strong linkages throughout the domestic economy, drawing mainly from domestic industries in the upper stream. Metal products have a strong backward linkage to basic iron and steel, which in turn has a strong backwards linkage to other mining without much leaking away in the form of imports (hence the relatively high multipliers). On the other hand, petroleum refineries (row 14), machinery (row 24), communications equipment and transport equipment, and to a lesser degree vehicles (rows 28-29), have relatively low output multipliers. This is because a large part of their backward linkages is towards imported goods.

One would expect the ranking of income (or GDP at factor cost) multipliers to be similar to that of output multipliers. This might not be the case if the final demand of a commodity stimulates economic activity in an industry that has a high reward for the factor capital. With more returns appropriated by capital than labour, more of the impact will ‘move’ off-shore in the form of repatriated dividends. Moreover, firms, as the only domestic recipient of the reward of capital, are usually taxed at a higher rate as well as having higher saving rates. All of these effects constitute leakages from the circular flow of income represented by the multiplier model. For example, basic and other chemicals (rows 15 and 16) and communications equipment (row 26) have relatively low income multipliers. On the other hand, the primary and tertiary industries appear to have relatively high income multipliers for the same reasons.

Finally, we turn our attention to the employment multipliers. The level of the multipliers, expressed here as person year equivalents per R1 million, not only depends on the degree of backward linkages, but also on the employment intensity of the activities that produce the relevant commodity and those upstream of these activities. Commodities with relatively high employment multipliers include: agriculture (row 1); food (row 5) (mainly because of its linkage with agriculture); wood products (row 11); paper (row 12); furniture (row 30); and construction (row 34). On the other hand, from an employment creation point of view, petroleum refineries (row 14), communications equipment, specialised equipment, vehicles and other transport equipment (rows 26-29) contribute relatively little to employment given the same R1 million increase in final demand for their commodities. It should be noted, however, that the employment multipliers are based on industry average employment-output ratios. If demand increases exogenously by a small amount, such as R1 million, it makes more sense to consider marginal employment output ratios (which may vary across industries in a different way) compared to the average counterpart. Apart from the absolute level of the employment multipliers, the ranking that would appear may well be quite different.

Lewis (2001) has pointed out that supply side constraints and flexible prices, as opposed to excess supply and fixed prices, may well complicate matters even further, especially if a distinction is made between low and high skilled workers. Multipliers may well turn out to be negative, if an increase in the final demand for commodities of a high paying industry pulls skilled labour out of other industries, which are then faced with a constrained factor of production possibly causing output to be cut back. Such consideration typically shifted the analysis into the field of second generation economy-wide modelling, which will be discussed in the next section.

Household Income and Expenditure

Next we turn to household income and expenditure patterns as covered by the SAM. For reasons of convenience we only present the three types of households mentioned above (instead of the 14 actually contained in the SAM). From Table 6 it can be seen that poor households receive the bulk of their income from wages of unskilled labour, followed by transfers and labour income from semi-skilled labour.

Rich households on the other hand, receive a large proportion of their income from property and semi-skilled labour. Interestingly, wage income from skilled labour is less important than semi-skilled labour. Transfers, as expected play an insignificant role.

A consolidation of household expenditure is shown in Table 7, where it can be seen that poor households spend a much higher proportion of their income on domestically produced goods and services than rich households. The latter pays more taxes and transfers and also save more (although the latter's share is still very low). The imported component of households as a proportion of their income is very similar across household income classes.

Government Income and Expenditure

We next examine the consolidated income and expenditure patterns of the public sector. Starting with income in Table 8, it can be seen that personal taxes form the largest source of government income, followed by indirect taxes on products (which consist here of a small proportion of import duties). Other indirect taxes on products might include VAT or excise duties. Taxes on producers, which involve such items as pay roll taxes, are paid for by the activities in the SAM. Company taxes constitute a relatively low proportion at only 16 percent.

Government expenditure patterns, shown in consolidated form in Table 9 below, suggest that one of the largest expenditure payments (25 percent) is to the production factor capital. This includes, amongst others, interest payments on government debt as discussed above. Wages of unskilled labour are also about 26 percent. Transfers of various forms amount to about R28 billion, which constitutes almost 15 percent of total government expenditure. Dissavings by the public sector amounts to 14 percent of total expenditure (which includes the dissavings itself). The import content of government expenditure on goods and services is very low at only 3 percent of government expenditure.

The Savings-investment Balance

Finally, we turn in Table 10 to the savings-investment balance, as captured by the SAM. Firms account for the largest bulk of savings, due to the bulk of the allowance for depreciation. Household savings appears to be relatively insignificant. As a result of the negative current account balance with payments outstripping receipts by about R13 billion, South Africa's foreign savings are positive. Note that in this

version of the standard model, no distinction is made between private and public sector investment, so that gross domestic fixed investment, after accounting for negative changes in stocks, makes up the balance.

3. Overview of the Standard Model

3.1 The Core Model

The computable general equilibrium (CGE) model described below is taken from the neoclassical modelling tradition that was originally presented in Dervis, de Melo and Robinson (1982). This framework has been extended to allow for several new features such as the home consumption of non-marketed goods, the explicit treatment of transaction costs, and the ability of producers to produce more than a single commodity (Lofgren *et al*, 2001) and now represents the standard model used by the International Food Policy Research Institute (IFPRI). Given that this paper offers a direct application of this generic model to the South African context, the description of the model is a brief heuristic summary of the more detailed model description presented by Lofgren *et al* (2001).

The CGE model is an attempt to express the flows represented in the South African SAM as a set of simultaneous linear and non-linear equations. The model therefore follows the SAM disaggregation of factors, activities, commodities and institutions. The equations describe the behaviour and interactions of these actors using rules captured by both fixed coefficients and non-linear first-order optimality conditions. Furthermore, the equations ensure that a set of both micro and macroeconomic constraints are satisfied, such that factor and commodity markets, savings and investment, and government and current account balance requirements are met. It is the purpose of this section to provide an overview of the structure of the model and the relationships described by the model equations.

The CGE model described below makes use of comparative static analysis. The model equations are used to define the interrelationships of the macroeconomy. The data in the SAM provides actual values for the coefficients in these equations through a process known as ‘calibration’. The model is initially solved for equilibrium to ensure that the base-year dataset is reproduced. It is then possible to ‘shock’ the model with a change in the value of one of the exogenous variables. The model is re-solved for

equilibrium and the changes in the values of the endogenous variables are compared to those of the base-year equilibrium to determine the modelled impact of the exogenous shock.

An important feature of this standard model is that it is a *static* rather than *dynamic* CGE model. Accordingly it does not take into account the second-period effects of changes in investment spending. Neither is the model specific about the time horizon of the adjustment or how the adjustment is sequenced. In other words, the model cannot determine whether adjustment from the base to a new equilibrium occurs over any particular length of time, or whether a large part of the adjustment takes place in a particular year.

Prices and Taxes

One of the distinctive features of the CGE model is its detailed handling of prices. Figure 1 below shows how producer prices evolve to become the prices of final commodities. Given that more than one activity can produce the same commodity, it is first necessary to combine the prices of the various activities producing a particular commodity (PXAC) into a single producer price for that commodity (PX). The activity price not only includes any activity taxes that may be placed on an industry's output, but also any factor taxes incurred during the production process. From the producer price of a commodity it is possible to arrive at a final export price (PE) by including any taxes that might be imposed on the exporting of commodities. The interaction of producer and export prices determines the final supply price for the domestic market (PDS).[8] By shifting focus from production to consumption, the domestic supply price is converted into the domestic demand price (PDD) by including the relevant domestic transaction costs. The price of imports (PM) is calculated by including any tariffs that might be placed on foreign commodities entering the domestic market. The interaction of the import and domestic prices determines the price of the composite commodity (PQ).[9] Sales taxes are then added to the composite price to arrive at a final market price.

[8] Details of the interaction of export and domestic supply prices are discussed in the section below describing the handling of commodities in the model.
[9] The details of this conversion to composite prices are discussed below.

Activity Production

In the standard model all producers (each represented by a sector or activity) are assumed to maximise profits subject to their existing production technology. This production technology, shown in Figure 2, is divided into two levels. The top level involves the substitution decision between intermediate inputs and the factors of production. Having decided on the proportions of value-added and intermediates, producers then, at the second level, decide how to combine the various factors of production. The choice between factors (level two) is governed by a Constant Elasticity of Substitution (CES) function, while the choice between value-added and intermediates (level one) allows for either a CES or Leontief specification. The choice between the various intermediate inputs to arrive at a composite intermediate commodity is derived under Leontief fixed proportions. Figure 2, taken from Lofgren *et al* (2001), shows the production structure assumed in the model.

As noted above, one of the distinctive features of this CGE model is that there need not be a one-to-one mapping between activities and commodities. Therefore as a starting point, producers use the above technology to arrive at the output level for their activity. Following this, the output of this activity is separated into commodities using the fixed coefficients found in the SAM. Thus, a distinction is made between activities and commodities in the model.

Institutions

The institutions represented in the standard model include households, enterprises, the government, and the rest of the world. Households receive income directly from producers for the latter's use of the factors of production. This is typically the case for labour. Alternatively, the production factor capital pays its income to households indirectly via enterprises. Over and above this, households can also receive transfers from all other institutions included in the model.

Households in turn use their income to pay taxes, save, consume commodities and make transfers to other institutions. As mentioned above, households are not restricted to the consumption of marketed commodities (which would be valued at market prices since they would include commodity taxes and transaction costs). Instead the model makes provision for the household consumption of home commodities (which are valued at activity-specific producer prices), although this is currently not an

active mechanism in the standard South African CGE. Household consumption is distributed across market and home commodities according to Linear Expenditure System (LES) demand functions.

Enterprises receive income from the production factor capital together with transfers from other institutions. Enterprises then make payments to cover direct taxes, savings and transfers to other institutions. It is assumed that enterprises do not consume commodities.

The government receives income from its taxing of sales, household and enterprise income, value-added, imports and exports (all of which are treated as fixed *ad valorem* rates). Furthermore, the government receives transfers from other institutions. The government then uses this income to (dis)save, to purchase commodities for its own consumption, and to make CPI-indexed transfers to institutions.

While commodity trade with the rest of the world is treated in the section below, it should be noted that all transfers to and from the rest of the world are fixed in foreign currency. Foreign savings are derived as the residual difference between foreign receipts and payments.

Commodity Markets

With the exception of home commodities, all commodities in the model enter markets. Figure 3 shows how both domestic and foreign goods move between producers and final demand.

As already mentioned, it is possible for a single activity to produce a number of commodities. The first stage of the commodity flow diagram therefore shows how output from each activity (QXAC) at activity prices (PXAC) is combined under a CES function to arrive at the aggregate output of each commodity in the economy (QX) at producer prices (PX).[10] According to Lofgren *et al* (2001), the output of these activities could be imperfectly substitutable as a result of differences in, for example, timing, quality and location. The demand for each activity's output is derived from the problem of minimising the cost of supplying a given commodity subject to the substitutability embodied in the CES function. The satisfaction of the first order conditions of the CES function derives the final producer prices for each commodity.

[10] Note that the commodity output for each activity referred to in Figure 3 corresponds to the top level of Figure 2 for that particular activity.

At the second stage of the commodity flow diagram, aggregate output (QX) is divided between exports (QE), and commodities available for sale on the domestic market (QD). This decision is determined by a Constant Elasticity of Transformation (CET) function, which assumes that producers aim to maximise sales subject to the imperfect transformability between exports and domestic sales. Under the small-country assumption, South African export demand is assumed to be infinitely elastic at constant world prices, and the price of exports (PE) is the sum of world prices and export taxes. The domestic price paid by demanders for each commodity (PDD) is the sum of the price received by domestic suppliers (PDS) adjusted to include transaction costs and export taxes. In the specific case where a commodity is not exported, then the whole of domestic production is made available for sale in the domestic market.

The level of domestic final demand is comprised of household and government consumption demand (QH and QG), investment demand (QINV), and the demand generated by domestic producers for intermediate inputs (QINT). This demand is met through the use of either domestically produced or imported commodities. The supply from these two sources is combined to form a composite commodity (QQ), which is then sold to domestic demanders. These demanders are assumed to minimise cost subject to the substitutability between imports and domestic commodities. This is the well-known Armington CES function (Armington, 1969). Demand is directed towards domestic production for commodities that lack imports, and total demand is satisfied by imports for commodities without domestic production.

The price of the composite commodity is determined under the first order conditions of the Armington function. It is assumed that international supply is infinitely elastic at constant world prices. The final import price paid by domestic demanders is inclusive of import tariffs and transaction costs.

3.2 System constraints

In order to achieve macroeconomic consistency a number of constraints are imposed on the behavioural equations mentioned above. The choice of these constraints also determines the way macroeconomic variables adjust in the modelled economy. While there is often only one obvious choice for most of these constraints when looking at the economy at hand, others represent major

macroeconomic policy levers or views on macroeconomic adjustment mechanisms. Here, we discuss the most obvious ones in more detail.

Factor market

The three available options for the factor market are shown in Table 11. For the first option (FAC1), the quantity supplied of each factor is fixed (i.e., the factor is assumed to be fully employed). An economy-wide wage variable is free to adjust to ensure that the sum of factor demands from all activities equals the quantity supplied. Each activity pays an activity-specific wage that is equal to the economy-wide wage multiplied by what could be thought of as an activity-specific "wage distortion" term. This latter term is fixed in this option.

The second option (FAC2) reverses the above by allowing for unemployment. This is achieved by allowing the quantity supplied of each factor to adjust, and then holding the nominal wage fixed. Each activity is free to hire any amount of each factor at the given wage, while the quantity supplied effectively reflects the quantity demanded. This would be preferable in situations where significant unemployment is present for a particular factor category. It is possible to allow perfectly inelastic supply to dominate in one factor category (as per FAC1) while treating other factor categories under perfectly elastic supply (as per FAC2).

Finally, in the third option (FAC3) it is assumed that the factor market is segmented and that each activity is forced to hire the observed base year quantities. This implies that the factors are activity-specific and are therefore immobile between the various activities. In this situation, the activity-specific wage distortion and the factor supply terms are flexible, while activity-specific factor demands and the economy-wide wage term are held constant. This would be preferable when it is suspected that there are significant quality differences between factors in different activities.

Government Balance

The first of the three macroeconomic constraints refers to the government balance. The initial constraint option (GOV1) assumes that government savings (the difference between current revenues and expenditure) is a flexible residual while all tax rates are fixed. Under the remaining two closure options the direct tax rates on households and enterprises are flexible to allow for an adjustment in

revenue and thereby maintain government savings. In the first of these (GOV2), the direct tax rate on non-government institutions is increased by a fixed number of percentage points, whereas for the second (GOV3), the tax rates are multiplied by a fixed scalar. In each of the three options above it is assumed that government consumption expenditure is held fixed either in real terms or as a share of total absorption. Another option, not mentioned here, would be to adjust the mix of expenditures in such a way that total expenditure remains constant. For example, in the case of an increase in government transfers to poor households, it is possible that government expenditure on goods and services is cut back by the same amount.

External Balance

Two options are available with regard to the treatment of the external balance. The first (ROW1) holds foreign savings (or borrowing) fixed while allowing the real exchange rate to adjust. The trade balance is effectively held constant, since the remaining components of the external balance (i.e. transfers between the rest of the world and other domestic institutions) are all fixed in the model. For example, a fall in the level of foreign savings would induce a depreciation in the real exchange rate, and this would result in a fall in imports and a rise in exports until the trade balance is restored to its original level. Alternatively (ROW2) holds the real exchange rate fixed while the level of foreign savings (i.e. the trade balance) is flexible.

Savings and Investment Balance

Macro savings (domestic plus foreign) must equal investment *ex post* by definition. The critical difference between the various constraints available for the savings-investment balance lies in whether savings are assumed to be investment-driven or whether investment is considered to be savings-driven. The first option (SI1) assumes an investment-driven economy in that the savings rate adjusts to maintain a fixed level of investment. In order to generate sufficient savings to equal the cost of investment, the savings *rates* of selected non-government institutions are adjusted until a balance is reached. The second option (SI2) is also investment-driven. It differs from the first option in that, instead of savings rates being increased by a fixed number of percentage points, the savings rates are multiplied by a flexible scalar across all institutions (firms, households).

The third option (SI3) is savings-driven. The savings rates for all non-government institutions are held fixed, while the quantity of each commodity in the investment bundle is multiplied by a flexible scalar so that investment is eventually equal to the new level of savings.

The fourth (SI4) and fifth (SI5) options are variations on the first and second options in that the constraints are also set up as investment-driven economy, yet the adjustment in absorption is not confined to changes in investment alone, but rather adjustments are 'balanced' evenly across household and government consumption, and investment spending. In order to ensure that these changes are spread evenly across all the components of absorption, the share of total absorption for each of these components is held fixed. In the fourth option (SI4) savings rates for selected institutions adjust by fixed percentage points, whereas for the final option (SI5), savings rates are multiplied by a flexible scalar.

3.3 Other Data Inputs

A number of additional data requirements are necessary to 'calibrate' or initialise the model discussed in this section. They are mentioned briefly below.

a) Trade elasticities for the Armington and transformation functions were imported from IDC (1997).

b) Substitution elasticities between factors of production were also obtained from IDC (1997).

c) It is assumed that the substitution elasticities between factors and intermediates were constant across all activities and set equal to 0.6 where applicable. The model also offers a Leontief specification.

d) The aggregator elasticities, which allow for commodities to be produced by various industries according to a CES specification, are all set at four.

e) Expenditure elasticities by commodity and households were taken from Case (2000). Elasticities are based on the 1993 SALDRU survey. The Frisch parameter, which allows for the determination of a subsistence floor in household expenditure is currently set to a constant across all household deciles at a value of three.

f) Factor demands for capital and the three types of labour were taken from the Trade and Industrial Strategies' Standardised Industry database for South Africa.

4. Some Basic Simulations

In order to get a feel for the model, three separate simulations were run to assess the directions of the results. These simulations are:

1. a 10 percent increase in the level of government expenditure
2. a full elimination of import tariffs
3. a 1 percent increase in factor productivity

The results from these simulations are presented below. As will be seen, these results are particularly sensitive to the set of macroeconomic adjustment rules assumed in each simulation. As such, the constraint sets imposed in this assessment of the model are discussed before presenting the results.

4.1 Adjustment Rules

Section 3.2 detailed how a variety of options are available to the user when deciding how to set the macroeconomic constraints for the model. These constraints or adjustment rules cover the factor and commodity markets, savings and investment, and government and current account balances. The choice of a particular set of adjustment rules is governed by the user's perceptions of the functioning of the macroeconomy. In order to provide a more general assessment of the model, this paper presents the results of the three simulations mentioned above under three different sets of macroeconomic constraints. These are presented in the Table 12.

While the above three adjustment rules have been labelled *neoclassical*, *Johansen* and *Keynesian*, these should be seen as suggestive definitions. The name 'Johansen' has been used since this constraint set is similar to that used by Johansen in the first CGE model (see Adelman and Robinson, 1988).

All three of the options make use of the same factor market constraints. Four types of factors of production are included in the standard model for South Africa: capital, and unskilled, semi-skilled, and skilled labour. It is assumed that unskilled and semi-skilled workers face a fixed wage rate while offering a perfectly elastic supply of labour to the market. The constraints placed on these factors correspond to the second factor market option from Table 11 (i.e. FAC2). Capital and skilled labour are treated differently in that they are assumed to face flexible returns in a market characterised by full employment (FAC1).

The adjustment rules imposed on the current account are again the same for all three options, i.e., a flexible exchange rate with fixed foreign savings is assumed (ROW1). Similarly, for the government balance, the constraints are identical for each option in that it is assumed that direct tax rates on domestic non-government institutions are fixed, while government savings is free to adjust (GOV1).

The three macroeconomic adjustment options differ in their treatment of savings and investment. In the neoclassical case it is assumed that the economy is savings-driven (SI3). This implies that the level of investment will adjust to ensure that it equals the level of savings as determined by fixed marginal propensities to save for each domestic non-government institution. Conversely, the Johansen option assumes that the economy is investment-driven and that savings-rates are scaled to ensure the level of savings and investment is balanced (SI2). Finally, the Keynesian approach takes the position that both the level of investment and the savings *rates* are fixed. Savings will however still adjust to balance investment in this option in that higher income will generate more savings given a fixed savings *rate*. In that sense the final option is a variation to the Johansen option.

There is no explicit modelling of the financial market in the standard IFPRI model. Rather, the mechanism that ensures that savings equals investment in equilibrium is assumed. For example, in the neoclassical case, the crowding-out of investment is assumed to be driven by implicit changes in the bond or money market. The government issues additional bonds and, in order to sell these to the private sector, it is necessary to raise interest rates. This increase in interest rates drives down the level of investment. Alternatively, in the Johansen case, it is assumed that savings adjust through some forced savings mechanism imposed by the government. For example, the government, may be able manage inflation and thereby induce households to save, or alternatively the central bank can increase private banks' reserve requirements, thereby forcing up the interest rate and promoting savings.

In the Keynesian case, where the CPI is allowed to adjust and the nominal wage rate of semi-skilled & unskilled labour is assumed fixed, the government could be seen to intervene in the wage bargaining process so as to persuade trade unions to maintain the initial level of nominal wages. In this way the government might be able to manipulate the level of real labour returns.

Finally, the neoclassical and Johansen adjustment rules use only the producer price index as a numeraire, while the Keynesian approach, due to the over-identification caused by fixing both savings-rates and investment, has both flexible producer and consumer price indices, while the wage rate of semi and unskilled labour is fixed.

The results from the simulations are reported below under each one of the above three constraint sets.

4.2 Expansionary Fiscal Policy

The first simulation involves assessing the impact of a 10 percent increase in government consumption expenditure.[11] From the SAM it can be seen that expenditure on the factors of production account for 78 percent of total government expenditure, while expenditure on goods and services accounts for the remaining 21 percent. Transfer payments account for 14 percent and by coincidence this is more or less offset by the deficit on the government's current account. Expenditure on the factors of production is divided across capital (36 percent), unskilled labour (34 percent), semi-skilled labour (27 percent), and skilled labour (6 percent).[12]

Table 13 shows the breakdown of government expenditure on intermediates across the most significant commodity categories. The largest component of the South African government's expenditure is the consumption of the government's own services. It should also be noted that most of the government's remaining expenditure is directed towards the machinery, equipment and vehicle commodity categories. The relevance of investment and household consumption spending shown in the next two columns will be discussed later.

[11] In technical terms, the impact is modelled by multiplying the government expenditure adjustment variable (GADJ) by 1.1.

[12] Note that the value for capital consumption (or gross operating surplus) includes interest on government debt and an adjustment for government's income from property.

Table 14 presents the impact on selected endogenous variables model of the increase in government spending. The base-year values correspond to those found in the SAM. The final three columns show the overall percentage changes in these variables once the model has resettled into a post-shock equilibrium.

Results under the Neoclassical Adjustment Rule

Given that direct tax rates are fixed under the neoclassical adjustment rule, the initial impact of the increase in government spending is to decrease government savings (or rather to increase government dissavings). Since the model is savings-driven in the neoclassical case, the decreased savings leads to a crowding out of private investment by 15 percent.

As a result of investment spending being more import-intensive than government spending (see Table 13), the impact of the crowding-out effect on South Africa's current account is to reduce imports by 3.8 percent. Since foreign savings are fixed in the foreign currency, the decrease in imports must lead to a decrease in exports such that the current account balance is maintained. This drop in exports by 3.7 percent is in part achieved through a slight appreciation of the real exchange rate by 0.2 percent.

The fall in imports reduces the level of tariff revenue received by the government, and despite changes in other tax revenue sources, this fall is sufficient to drive down government revenue by 0.3 percent. Given that the nature of this simulation is to raise government spending by 10 percent, the combined effect of falling revenue and rising expenditure drives the government deficit up by 74 percent from its initial ratio to GDP of 3.3 percent to a final ratio to GDP of 5.8 percent.

Under the neoclassical adjustment rules, unskilled and semi-skilled labour is assumed to have a perfectly elastic supply. Given that government expenditure uses these two factors directly and indirectly (through the backward linkages) more intensively than investment spending, the combined compositional effect of the crowding-out of investment and the increase in government spending is such that demands for unskilled and semi-skilled labour rises by 1.9 and 1.4 percent respectively. However, the nominal wage rates for these two factors are fixed, and as such, the slight consumer inflation is sufficient to reduce their real wages.

Government spending is less intensive in its use of skilled labour and capital. Given the fixed supply of these factors, the crowding out of investment leads initially to downward pressure on their real factor returns.

However, the increase in the demand for unskilled and semi-skilled labour offsets the fall in these factors' real returns. The net effect is an increase in the real incomes of those households who are more endowed with these factors of production. Accordingly the incomes of the low-income deciles rise relative to those of the high-income deciles. The result of rising real household incomes is an increase in household consumption demand. This rising demand leads to increased output from those sectors whose commodities fall relatively more within the household consumption basket. This, together with the increased demand from government expenditure, drives up GDP by 0.5 percent. Rising production generates demand for the factors of production, which in turn is sufficient to overcome the downward pressure of capital returns such that they ultimately rise by 0.2 percent.

Returning to Table 13, the shift away from investment spending towards government spending negatively impacts on the machinery and construction sectors. From Table 14 it is seen that construction is the worst affected of all the broadly classified industrial sectors. Although not shown in the table, machinery is the worst effected within manufacturing, contracting by over 11 percent.

The overall effect of an increase in government spending under the neoclassical adjustment rule is dominated by the crowding-out of investment. Given the compositional differences in investment and government spending, the increased demand for government services severely undermines the remaining industrial sectors. Much of the growth in GDP results from the increased employment of unskilled and semi-skilled labour, which is sufficient to offset the decline in these factors' real wages. While this growth causes all household incomes to rise, there is some evidence that increased government expenditure benefits lower income households more than households in the higher income deciles.

Results under the Johansen Adjustment Rule

Under the Johansen adjustment rule, the economy is now investment rather than savings-driven. As in the neoclassical case, the increase in government spending leads to a decline in government savings. However since investment levels are now fixed in nominal terms, there is no crowding-out of

investment, but rather an increase in domestic institutions' savings-rates. This in part explains the increase in private savings by 17 percent.

The increase in government spending leads to increased demand for the factors of production with similar effects on factor returns as in the neoclassical case. However, the increased savings-rates for domestic institutions leads to a decline in post-savings real household incomes. This is particularly the case for the high-income deciles where initial savings-rates are typically higher. Accordingly, the chief distinction between the neoclassical and the Johansen option is that the former leads to a crowding of investment spending, while the later reduces household consumption spending. Since household consumption spending is less import-intensive than investment spending, the decline in imports experienced in the Johansen case is less than that in the neoclassical case.

Government revenue falls by more under the Johansen adjustment rule, since the shift in income towards the low-income deciles as a consequence the lower increases in their savings rates, results in lower direct tax revenue. This raises the government deficit by more than in the neoclassical case.

Finally, from Table 14, household consumption expenditure makes little use of the construction sector, and as such, the decline in this sector as a result of the crowding-out of investment as seen in the neoclassical case is not present under the Johansen rule. Rather, those sectors worst affected are those whose output is largely sold into the household consumption bundle. At this level of aggregation, the most notable of these sectors are agriculture, and social and personal services.

Results under the Keynesian Adjustment Rule

As in the previous cases, the initial impact of an increase in government expenditure under the Keynesian adjustment rule is to reduce government savings. However, since savings rates and investment are fixed in this simulation, the price indices adjust to maintain the level of savings of investment. This accounts for the 10 percent inflationary pressure on consumer and producer prices resulting from the increased government spending.

Given that the wage of unskilled and semi-skilled labour is fixed in nominal terms, this rise in prices reduces *real* returns for these two factor categories (by 9.6 and 9.1 percent respectively). This reduction in labour wages reduces the cost of production and increases output and real GDP. However

the fixed supply of skilled labour and capital implies that the increased demand for these factors resulting from the overall increase in demand within the economy, drives up the real factor returns for these two factor categories. The final impact of real household incomes is therefore positive for those household deciles that are more endowed with capital and skilled labour, and negative for households possessing unskilled and semi-skilled labour. The overall redistribution effect of an increase in government expenditure on real household incomes is therefore expected to be regressive.

The increase in real GDP (3.1 percent) raises the demand for imported commodities by 1.3 percent. The trade balance is maintained through a nominal depreciation in the currency (10.3 percent) and this facilitates an increase in exports by 1.2 percent. Furthermore, the rise in GDP increases government revenue and partially offsets the upward pressure on the budget deficit resulting from the increased government spending. Accordingly, the increase in the deficit under the Keynesian rule from 3.3 to 4.2 percent of GDP is substantially less than in the neoclassical and Johansen simulations.

As with the previous simulations, the compositional changes in production towards government expenditure increases demand for and output of those sectors whose commodities feature in the government consumption bundle. Furthermore, the redistribution in real household incomes drives production towards those commodities demanded by high-income households.

Summary of the Findings on Government Expansion

The results indicate that an increase in government expenditure can have an expansionary effect on the level of real GDP. This is true regardless of which adjustment rule is imposed on the model. However, in the neoclassical case, the crowding-out of private investment very much limits the degree of this expansion. Investment spending is substituted by government expenditure and the resulting compositional shift across the various commodity categories accounts for much of the movement experienced under this adjustment rule.

A similar result is obtained under the Johansen adjustment rule with the exception that the fall in investment is replaced by a fall in consumption resulting from an increase in marginal propensities to save. As such the compositional shift is not between government and investment spending, but rather between government and consumption spending. In both of these first two simulations, fiscal expansion results in a progressive redistribution of real household incomes.

The Keynesian case produces significantly different results. However, much of the impact of government expansion is driven by changes in prices. Money illusion amongst unskilled and semi-skilled labour is an important assumption of this adjustment rule as it allows for a fall in these factors' real returns, and this stimulates production in the economy. However, this has regressive implications for the distribution of real household incomes. Furthermore, in this scenario, there is no immediate drop in investment or consumption following the increase in government spending, and as such, the results are not only driven by a compositional shift in demand.

4.3 Tariff Liberalisation

The second simulation assesses the impact of eliminating tariffs on imported commodities. The first column of Table 15 shows the initial tariff rates by commodity category for 1998. These rates are based on the ratio of duties collected to the value of imports rather than the rate that would be found in the published tariff schedule. Therefore, given that these rates take into consideration tariff rebates, the motor vehicle and textile categories do not appear as one of the most protected commodities (as would be expected if the book value of tariffs were used).

While nominal tariffs are rates levied on commodities, we are more interested in their impact on activities. Weighing the nominal tariffs on commodities by the supply matrix, allows us to determine nominal rates of protection on activities as is shown in the second column of Table 15. However, the nominal tariff rates do not account for the tariffs faced by domestic producers on their intermediate inputs. In order to calculate such rates of taxation it is necessary to weight the tariff rates on each commodity by the proportion that the commodity is used as an intermediate input by each activity. The third column of the table shows the weighted rates of taxation on intermediates for each activity. Note that while in the first column some commodities did not appear to be protected by tariff rates, the third column reveals that all sectors are affected by tariffs placed on their imported intermediate goods. These weighted tax rates on intermediate are highest on clothing, textiles and footwear, paper and printing, and on vehicles and machinery.

Given output tariffs as shown in the first column, and the input tariffs, shown in the third column, it is also possible to determine effective rates of protection embedded in our SAM. The simplest way to think about effective rates of protection is to consider the impact of nominal tariffs on *net* production,

or *value added*. In particular, we like to know the difference between a sector's value added in world prices and in domestic (i.e. distorted or observed) prices expressed in terms of the latter. This can be written as:

$$(1) \qquad ERP_j = \frac{VA_j^* - VA_j}{VA_j}$$

in which ERP_j is the effective rate of protection in activity j, the asterisk subscript indicates domestic price so that VA_j is the value added of activity j at domestic prices and VA_j^* is the value added of sector j at world prices (as observed in the input-output data base). Since value added is the difference between output (X_j) in activity j and intermediate inputs ($Intm_{ij}$) that activity j purchases from activity i, equation (1) can be rewritten as

$$(2) \qquad ERP_j = \frac{\left(X_j^* - \sum_1^i Intm_{ij}^*\right) - \left(X_j - \sum_1^i Intm_{ij}\right)}{\left(X_j - \sum_1^j Intm_{ij}\right)} = \frac{\left(X_j(1+t_j) - \sum_1^i Intm_{ij}(1+t_i)\right) - \left(X_j - \sum_1^i Intm_{ij}\right)}{\left(X_j - \sum_1^j Intm_{ij}\right)}$$

in which t_j and t_i are the nominal tariffs on activity j and commodity i respectively. As mentioned above, our SAM only presents nominal tariffs on commodities t_i . We therefore calculate the nominal tariff on activities t_j as the nominal tariffs on commodities (t_i) weighted by the row proportions of the supply matrix.

A property worth mentioning here is that effective protection will be higher if the nominal protection on output (t_j) is raised, but lower if the nominal protection on commodity inputs (t_i) is raised. With higher intermediate demand ($Intm_{ij}$), value added will be lower and with a given tariff on output the proportional effect on value added is greater as there is less to protect.

Within the context of context of this trade protection, Table 16 presents the results of a reduction of nominal tariff rates to zero under each of the three macroeconomic adjustment rules. We will discuss each in turn below.

Results under the Neoclassical Adjustment Rule

The initial impact of the lowering in tariff rates is expansionary in that it is a tax cut and it will reduce the price of imported commodities relative to domestic goods. This causes a shift towards imported goods and away from domestic production. Here, the value of imports rises by 2.2 percent. In order to maintain the fixed trade balance, exports must rise by 2.1 percent, and this is achieved through a 0.8 percent depreciation of the exchange rate.

The fall in prices of imported goods reduces the cost of intermediates for domestic producers and this, together with increased export demand, leads to an increase in production. Similarly, lower tariffs reduce consumer prices (by 0.4 percent) and this increases real income and further drives up economic activity.

On the fiscal front, the elimination of tariffs reduces government revenue. This results in decreased government savings and, since the savings rates of households and firms are fixed in the neoclassical world, a crowding-out of investment follows (by 2.6 percent). In the process, the fall in revenue drives up the budget deficit from 3.3 percent to ultimately 4.1 percent of GDP. While this drop in investment places downward pressure on GDP, it is insufficient to outweigh the positive effects of lower prices on imported goods on both final and intermediate consumption.

Despite the crowding-out effect, the increase in production leads to an increase in the demand for the factors of production, which together with falling producer prices, leads to increases in real factor returns for all factors of production. This increase in returns is greatest for the production factor capital, which benefits high-income households most. Accordingly, while all real household incomes rise, there is a slight regressive redistribution across the income deciles.

Finally, the fall in tariffs shifts demand away from domestically produced goods, and as a result, the domestic producers who experience the greatest contraction are those with the highest initial tariff rates on final goods and a relatively high weighted tariff on intermediate goods (see Table 15). These broadly include manufacturing and construction, with the worst affected sectors within manufacturing being leather and rubber products, vehicles and footwear.

Results under the Johansen Adjustment Rule

The effect of trade liberalisation under the Johansen adjustment rule is virtually the same compared to those of the neoclassical case. The key distinction between the two scenarios is that real GDP increases slightly more as a result of there being no crowding-out of private investment (0.2 percent growth as opposed to 0.1 percent). Savings rates adjust to maintain the savings-investment balance and this reduces the consumption spending of high-income households more than low-income households. Accordingly, there is a slight progressive redistribution of real household income across the deciles. Finally, since investment did not fall as much as in the neoclassical case, the contraction of output in the construction sector is less.

Results under the Keynesian Adjustment Rule

As in the case of expansionary fiscal policy, the results under the Keynesian adjustment rule are driven largely by changes in prices. Since the level of investment is fixed, there is no dampening effect on real GDP caused by a crowding-out of private investment. Similarly, since savings rates are fixed, there is no reduction in post-savings household incomes. Consequently there is no fall in the level of consumption demand, and this partly explains the higher real GDP growth.

Money illusion amongst unskilled and semi-skilled labour, as represented by fixed nominal wages, implies that the rise in consumer prices (by 1.3 percent) is allowed to erode real factor returns for these factor categories (by 1.2 and 1.4 percent respectively). This falling cost of production further increases real GDP. Increased production generates demand for capital and skilled labour which, given their fixed supply, drives up their real factor returns.

Falling returns on unskilled and semi-skilled labour, and rising returns on capital and high-skilled labour results in a redistribution of real household income away from the low income deciles and towards the higher income earning households.

Finally, higher real GDP generates additional revenue for the government, which partially offsets the fall in revenue resulting from a complete reduction in tariff revenue. Despite the increase in government expenditure to account for increased consumer prices, the budget deficit increases by less than in the neoclassical and Johansen cases (from 3.3 to 3.9 percent of GDP).

Summary of the Findings on Trade Liberalisation

The overall impact of the elimination of tariffs does not appear to differ substantially across the three different adjustment rules. The initial impact in each scenario is to reduce the price of imports relative to domestic commodities and this raises the level of imports. In order to maintain the trade balance, the currency depreciates so as to allow exports to rise alongside imports.

The main differences between the three macroeconomic adjustment packages results from the effect of the reduction in government revenue caused by the elimination of all tariff revenues. In the neoclassical scenario, the fall in revenue leads to a crowding-out of investment while in the Johansen scenario consumption demand is reduced through an increase in savings rates for domestic non-government institutions. Finally in the Keynesian case, neither savings rates nor investment changes, and higher output forces prices to adjust to equilibrate the level of nominal savings and investment.

The crowding-out of private investment under the neoclassical adjustment rule reduces real GDP growth and shifts production away from the production of commodities that form part of the investment bundle. Conversely, in the Johansen case, household consumption demand falls, reducing the domestic production of commodities found in the household consumption bundle. Finally, growth in real GDP in the Keynesian case is facilitated by money illusion amongst unskilled and semi-skilled labour, which reduces real factor returns and hence the cost of production. Output is shifted in this case towards those sectors that are more intensive in their use of these labour categories.

Under the neoclassical and Keynesian adjustment scenarios, the fall in factor returns for those factors owned mostly by low-income households leads to a slightly regressive redistribution of real household incomes. Since in the Johansen case the savings rates adjust to maintain the level of investment, it is those households that initially have high savings rates that have their real incomes reduced by the greatest amount. Accordingly, under this scenario, there appears to be a slightly progressive redistribution of real incomes across the deciles.

4.4 An Increase in Factor Productivity

The third simulation involves a 1 percent increase in the level of productivity of all factors of production across all industrial sectors. The simulation therefore enables each unit of production factor to produce 1 percent more value-added during the production process. It should be noted that, despite the option of substitution possibilities between intermediates and factors at the activity level (see Figure 2), the current specification of the model uses fixed shares (or a Leontief production function) thereby maintaining the ratio of intermediates inputs to factor inputs for each unit of output. Therefore, even though factor productivity increases under this simulation, there is no substitution of factors for intermediates by industries in the model.

Table 17 shows factor productivities across the various activities identified in the model. These values are in a sense efficiency parameters showing the value of output attributable to one composite factor unit. From the table it is seen that the machinery and equipment producing activities have relatively high factor productivities, while generally the agro and textiles-related industries have relatively low productivities in the base. We would thus expect that the increase in factor productivity will positively affect the machinery and equipment sectors more than the other activities. The results from the productivity increase simulation are presented in Table 18 under the three macro-adjustment packages used in the previous simulations.

Results under the Neoclassical Adjustment Rule

The increase in factor productivity effectively reduces the cost of production for each industrial sector, thereby driving up the level of production and GDP. Nominal GDP is only partially eroded by a slight rise in the level of consumer prices (by 0.1 percent). The final effect of an increase in factor productivities under the neoclassical rules is to increase real GDP by 1.3 percent.

As mentioned above, for those activities that initially had high factor productivities (such as machinery and equipment), the increase in output is more pronounced. The machinery sector grows by 3.6 percent, while the beverages and tobacco sector only grows by 0.7 percent.[13] While initial levels of productivity largely determine how an industry will benefit relative to other sectors from a productivity increase, the model does take into account the effects of economy wide linkages across sectors. For

[13] Results for specific sectors within manufacturing are not shown in the table.

example, the second fastest growing sector following the productivity increase is not transport equipment (which grows at 2.9 percent), but rather the iron and steel sector, which grows at 3.2 percent as a result of its strong linkages with the machinery sector.

It is important to understand why the high productivity of the government services sector does not translate into high growth for that sector following the increase in factor productivity. This is due to the way in which government services are treated in the model. To begin with, government services are hardly used as intermediate inputs into any of the other activities. This implies that there are no forward linkage effects that would drive up demand for government services (as was the case in the basic iron and steel activity). Secondly and more importantly, the demand for government services is almost completely driven by the level of government expenditure which is indexed on the consumer prices so as to maintain government expenditure in real terms.

Real GDP growth increases government revenue through sales and income taxes (by 1.4 percent). However, government expenditure decreases by 0.3 percent (to adjust for changes in consumer prices as discussed above). The effect of rising revenue and falling expenditure is to increase government savings and to reduce the size of the deficit (to 2.9 percent of GDP). Since under the neoclassical adjustment rule the level of investment varies in order to maintain a higher level of savings, the effect of increased government savings is to increase the level of private investment (by 4 percent).

The rise in real GDP increases the demand for imports (by 1.9 percent). Maintaining the trade balance requires that exports rise by 1.9 percent, and this is achieved through a depreciation of the currency.

The increase in factor productivity, and the resultant increase in output, raises the demand for each factor of production. Under the assumption of a flexible supply of labour, this increased demand for unskilled and semi-skilled labour increases the number of workers employed. While there is no change in the nominal wage to these labour categories, the general increase in prices reduces real factor returns for semi-skilled labour. Conversely, the assumption of a fixed supply of capital and skilled labour prevents an increase in employment while driving up real factor returns.

Finally, since high-income households are endowed with more skilled labour and capital, the effect of a larger increase in real returns for these factors relative to the increased demand for unskilled and

semi-skilled labour, is to regressively redistribute real household incomes across the household income deciles.

Results under the Johansen Adjustment Rule

As was the case with the simulated trade liberalisation, the relatively insignificant magnitude of the shift in investment and savings is sufficient to ensure that the general results of the increase in the productivity are similar under the neoclassical and Johansen adjustment rules. Given that no crowding-out of private investment is permissible, the level of investment remains unchanged, while there is a fall in savings (by 4.6 percent) resulting from a decline in private savings rates. This decline in private savings is necessitated by the increase in government savings resulting from constant expenditure and rising revenues. Falling household savings rates increases the level of consumption demand resulting in higher levels of GDP. Accordingly, real GDP increases by 1.2 percent with imports and exports growing accordingly by 1.2 and 1.1 percent respectively. Furthermore, the increase in both government savings and GDP reduces the budget deficit to 2.8 percent of GDP.

As in the neoclassical case, the effect of an increase in productivity is to regressively redistribute real income across the household income deciles. However, since private savings rates are falling, those households with initially the highest savings rates have the greatest increase in post-savings disposable income. Accordingly, under the Johansen rule, the shift in relative income across the household deciles favours high-income households more than in the previous simulation.

Results under the Keynesian Adjustment Rule

Here, both the level of investment and the savings rates are fixed. This implies that, despite the initial increase in output resulting from rising factor productivity, there is no facilitating rise in the level of final demand (through either an increase in investment or consumption demand). As a result of excess supply at base-level prices, both producer and consumer price indices are placed under downward pressure. While nominal GDP falls by 2 percent, this drop is offset by a 2.7 percent fall in consumer prices such that real GDP grows by 0.5 percent.

Since government expenditure is indexed on the level of consumer prices, the general fall in consumer prices drives down the level of government spending by 2.2 percent. However, the fall in nominal

GDP also drives down government revenue by 2.1 percent. This fall in revenue (which was not the case in the previous two simulations) moderates the decline in the budget deficit to about half a percent, and leaves the deficit virtually unchanged at 3.3 percent of GDP.

Government savings increases by 2.6 percent following the slight reduction in the budget deficit, and the value of foreign savings is eroded by the appreciation of the currency (by 2.7 percent). Increased government savings and decreased foreign savings offset each other and reduce the need for private savings to adjust to maintain the level of private investment.

Since the economy is contracting in nominal terms and the level of productivity is rising, there is a decline in the demand for unskilled and semi-skilled labour. However the fall in factor demands is insufficient to offset the effects of falling consumer prices so that growth of real factor returns for these two factors are positive (at 2.6 and 2.7 percent respectively). Conversely for skilled labour and capital, the nominal contraction of the economy reduces the demand for these factors. However given their fixed supply, the drop-off in demand necessitates a fall in nominal wages. Falling consumer prices ensure that real factor returns for these two factor categories are virtually unchanged.

Following the above changes in real factor returns, the low-income households, who are more endowed with low and medium skilled labour, experience the greatest increases in real household incomes. However, the changes in real household incomes across the various income deciles are insufficient to conclude that the effect of a productivity increase is to progressively redistribute incomes across the household income deciles.

Summary of the Findings on an Increase in Factor Productivity

The impact of an increase in productivity is similar under the neoclassical and Johansen adjustment rules. The increase in productivity drives up factor demand for unskilled and semi-skilled labour, and increases real factors returns for skilled labour and capital. Furthermore, the rise in productivity reduces the cost of production and leads to increased production and real GDP growth. Investment rises in the neoclassical case due to the increase in government savings, while in the Johansen case, the savings rates adjust to reduce the level of savings to that of investment. Therefore in the neoclassical case the increase in supply is facilitated by an increase in investment demand, while under the Johansen scenario it is consumption demand that rises. In both cases there is an increase in both

demand and supply, and this results in an increase in real GDP. Rising GDP increases government revenue which, when coupled with virtually stationary government spending, is sufficient to reduce the budget deficit.

The Keynesian adjustment scenario produces quite different results. As in the previous two cases, the increase in productivity encourages an increase in supply through an effective lowering of production costs. However, there is no increase in demand since the level of investment and household savings rates are fixed. The absence of an increase in either investment or consumption demand following the increase in supply has the effect of driving down producer and consumer prices. Thus despite the fall in nominal GDP, the overall effect of an increase in factor productivity is to raise real GDP. Furthermore, since nominal wages for unskilled and semi-skilled labour are fixed, the effect of falling consumer prices is an increase in real factor returns for these categories. Despite the drop in demand for unskilled and semi-skilled labour, the increase in real returns is sufficient to redistribute real income towards lower-income households who are more endowed with these factors.

5. Conclusions and Recommendations for Further Work

5.1 Conclusions

The above three simulations provide an introduction to and illustration of the possible policy changes that can be assessed using the Standard South African CGE model. From the results it is evident that divergent conclusions can be drawn from a policy simulation depending on which macro adjustment scenario is imposed on the model.

Table 11 identified alternative adjustment rules that might be argued to better reflect the equilibrating mechanism of the South African economy under a particular change in policy or exogenous shock. The three options chosen above highlight how the results of the model can change significantly simply under differing assumptions of how savings and investment adjust.

The neoclassical constraint assumes that the level of investment is flexible and adjusts passively to match the level of savings. This scenario therefore allows for the crowding-out of private investment

with important implications for, for example, fiscal policy. Under the Johansen rule there is no crowding-out of investment, and it is the savings rates of domestic institutions that adjust to ensure that investment and savings are balanced. Since savings rates in part determine the amount of disposable income available for household consumption, the overall impacts of a policy change in the Johansen simulations are largely determined by changes in consumption, rather than investment spending (as was the case under the neoclassical simulations).

Finally, under the Keynesian constraint set, both the level of investment and the savings rates of domestic institutions are fixed. This implies, for example, that an increase in government spending leads to, neither a crowding-out of investment, nor a drop in consumption demand through increased savings rates. Accordingly, the balancing of demand and supply is achieved through changing levels of consumer and producer prices. Under this constraint set, the overall effect of a policy change on economic growth is largely determined by the response of production factors to changes in their real returns.

5.2 Recommendations for Further Model Development

Currently the South African CGE model estimates the impact of a change in policy using comparative static analysis, and as such provides policy assessments that are essentially medium to long-run in scope. There is no consideration of the path of adjustment over time, or of any dynamic feedbacks into the economy through changes in investment, technology or productivity. While static CGE models are useful in determining the overall effect of policies after the full adjustment process has been allowed to take its course, these models cannot provide insight into the costs of the adjustment or how long these adjustments may take to complete themselves. As such, it would be advisable to extend the model from a static to a dynamic specification. While this would complicate the relative simplicity of the current South African model, it would allow for an extended range of possible policy simulations, as well as providing a richer understanding of how the impact of these simulations are played out in the South African economy.

A second area where the model might be extended is in the workings of the financial aggregates. Currently the model does not explicitly incorporate the financial sector, and this limitation is evident in the absence of monetary variables such as the interest rate and money supply. The simulations detailed in this paper have implicitly assumed that the monetary sector passively adjusts to facilitate the

observed changes in real economy. For example, it is currently assumed that any adjustments in the interest rate necessary to induce changes in savings and investment are made without the need to explicitly model the market for loanable funds. While this 'black-box' approach to dealing with the operations of the financial sector might not severely distort the conclusions reached regarding the real economy, it does limit the model to assessing only real sector policy changes. In order to allow for policy simulations involving, for example, interest rate management and inflation targeting, it is necessary to extend the model to include an explicit treatment of the financial sector. Extending the model would require additional data in the form of a financial accounting matrix following earlier work by Gibson & van Seventer (1996a). Obtaining financial data that is consistent with the real SAM is not trivial. Although the SARB publishes financial accounts with a wealth of detail on financial instruments, the link to real side institutions, such as households and firms is only available at an aggregate level.

Improving on various aspects of the current dataset would be a third area of further work. An example might include the disaggregation of the government in the current SAM into both government expenditure and gross domestic fixed investment. The former could be disaggregated in terms of functional areas (see for example Gibson & van Seventer, 1997a). Incorporating this additional information would require a re-specification of the model's current treatment of government expenditure. Another limitation in the SAM is the broad breakdown of labour by skill categories. Further disaggregation of labour into occupational categories might enhance the model's ability to track changes in employment and income distribution. Finally, an important area of further research lies with the estimation of the elasticities used in the model. These include: the Armington elasticities (substitution between imported and domestic goods); export supply elasticities; and the elasticities of substitution between the factors of production, and between factors and intermediate inputs. Initial attempts have been made by Gumede (2000) but these results need further disaggregation by industrial activity.

Addressing the economic impact of environmental issues has now been firmly established in the international CGE literature. However, this has received limited attention in South Africa (see for example Gibson & van Seventer, 1997b). Availability of appropriate data is a limiting factor in this regard. Piecemeal updates of relatively old databases is continuing, however only at a slow pace.

Although the SAM used for our purposes identifies a higher number of household categories than labour categories, policy makers are often interested in a richer household picture than what can be offered by the current model. Ideally one would like to link the macro or economy-wide environment to individual households (or narrowly defined groups of poor households). The challenge is to attempt to bridge the gap between economy-wide and household level analysis. Although many links between the two levels can be explored, an example on one particular link might be between trade and poverty. If the primary structural issue facing South Africa is tackling unemployment, poverty and income inequality, and this objective is constrained by the need to manage globalisation, then the analysis of the link between trade and poverty appears to have policy relevance.

If it is feasible to quantify trade liberalisation and poverty, it may then be possible to establish some correlation between the two phenomena. Even if one were to get a quantitative handle on poverty, there are, according to McCulloch *et al* (2001), typically a range of other issues that may impact upon it (of which trade liberalisation is just one). From a simplistic point of view there are two ways of investigating the impact of trade liberalisation on poverty. From the top down, it may be possible to create a laboratory of the economy at hand that has some, albeit even fairly aggregate, poverty features. In such a laboratory it is then possible to simulate features of trade liberalisation, while, to the extent that this is realistic from a policy perspective, keeping other potential policy levers and shocks constant. This is typically achieved by the economy-wide policy modeling frameworks mentioned earlier.

On the other hand, one can take a bottom up approach, which starts by looking at poor households using household surveys. Such an approach considers how households link into the labour market and obtain other forms of income, and how trade liberalisation may be one source of impetus that could have an impact on households moving in and out of poverty (i.e., below or above the poverty line). Here the household and labour market surveys are useful.[14]

More recently, in an attempt to determine the impact of macroeconomic policies directly on the household or individual level, a middle ground between the two approaches has been explored. Although still in initial stages of development, the approach suggests using the full details of a household survey in combination with a scaled down macroeconomic or economy-wide model. The

[14] For more detail see Mukhopadhyay (2001).

advantage is that not only is the richness of household survey information preserved in a partial equilibrium setting, but that some general equilibrium feedback mechanisms are added to the analysis at the same level of detail. In the case of Madagascar, Cogneau & Robilliard (2000: 52-54) note, that apart from the affordability of social safety net programs in a macroeconomic context, some of the initial positive effects of introducing a social safety net may actually be eroded by negative general equilibrium price effects on non-traded "traditional" goods. Other applications look as the social costs of the financial crisis that hit Indonesia in the late 1990s (Robilliard, Bourguignon & Robinson, 2001) and the impact of trade liberalisation on poverty in Nepal (Cockburn, 2001). An overview can be found in Reimer (2002).

Clearly, trade policy reform is but one issue that may produce winners and losers, and for each macro or economy-wide policy environment a new set of channels can be considered. The integration of economy-wide policy modeling frameworks and household and labour market survey data is evidently an important area of further research.

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Table 1: Industries and Commodities Used in the 1998 Standard CGE for South Africa

	Sector Description	SIC Code		Sector Description	SIC Code
1	Agriculture, forestry and fishing	1	23	Metal products excluding machinery	353-355
2	Coal mining	21	24	Machinery and equipment	356-359
3	Gold and uranium ore mining	23	25	Electrical machinery and apparatus	361-366
4	Other mining	22/24/25/29	26	Television, radio and communication equipment	371-373
5	Food	301-304	27	Professional and scientific equipment	374-376
6	Beverages & Tobacco	305-306	28	Motor vehicles, parts and accessories	381-383
7	Textiles	311-312	29	Other transport equipment	384-387
8	Wearing apparel	313-315	30	Furniture	391
9	Leather and leather products	316	31	Other manufacturing	392-393
10	Footwear	317	32	Electricity, gas and steam	41
11	Wood and wood products	321-322	33	Water supply	42
12	Paper and paper products	323	34	Building construction & civil engineering	5
13	Printing, publishing and recorded media	324-326	35	Wholesale and retail trade	61-63
14	Coke and refined petroleum products	331-333	36	Catering and accommodation services	64
15	Basic chemicals	334	37	Transport and storage	71-74
16	Other chemicals and man-made fibers	335-336	38	Communication	75
17	Rubber products	337	39	Finance and insurance	81-82
18	Plastic products	338	40	Business services	83-88
19	Glass and glass products	341	41	Medical, dental and veterinary & other services	93
20	Non-metallic minerals	342	42	Other producers	92, 95-96, 99
21	Basic iron and steel	351	43	General government services	91, 94
22	Basic non-ferrous metals	352			

Table 2: A generic macro SAM for South Africa for 1998 (current R million)

	1 industr	2 commodity	3 factors of production capital	4 labour	5 instit firms	6 instit households	7 instit: gvt rec prop inc	8 instit: gvt rec nt on prods	9 instit: gvt rec not on pr'ction	10 instit: gvt rec dir tax	11 instit: gvt rec transfers	12 govt bal	13 govt expend	14 savings	15 sav - inv sav = inv bal	16 gdfi	17 invent ch	18 row exp/receipt s	19 cif fob	20 residual	21 row total
1 Industries		1,340,096 supply matrix (sut98)																			1,340,096
2 Commodities	669,716 use matrix (sut98)	0 tr & trnsp marg (sut98)				465,680 hh consump exp (rb6007j)							146,800 aggr gvt expend (rb6008j)			123,209 gdfi (rb6009j)	-5,327 invent ch (rb6010j)	190,189 exports (rb6013j)		-3,833 residual (rb6011j)	1,586,432
3 Capital	192,820 net op surpl (rb6001j)												46,534 interest gvt debt (rb6255j)					7,193 fact inc receipts (rb5680j)			246,547
4 Labour	371,762 remuneration (rb6001j)																				371,762
5 Firms			227,651 fact inc loc firms (see note 1)																		227,651
6 Households				369,964 lab inc residents (rb6240j)	157,259 unearned hh inc (rb6241+rb6231j)								22,697 gvt trnsf to hh (rb6257j)					190 row trnsf to hh (rb6243j)			550,110
7 Property income					7,550 gvt prop inc (rb6250j)																7,550
8 Net taxes on products		64,703 net tax on prods (rb6603-rb6604j)																			64,703
9 Net other taxes on products	11,018 net oth taxes (rb6600-rb6001j)																				11,018
10 Direct taxes					29,581 corp tax (rb6230j)	79,818 personal tax (rb6245j)															109,399
11 Transfers					779 firm trnsf to gvt (rb6232j)	1,085 hh trnsf to gvt (rb6252j)												144 row trnsf to gvt (rb6253j)			2,008
12 Government balance							7,550 gvt prop inc (rb6250j)	64,703 net tax on prods (rb6603-rb6604j)	11,018 net oth taxes (rb6600-rb6001j)	109,399 corp & pers tax (rb6230j+rb6245j)	2,008 all trnsf receipts (rb6232+52+53j)										194,678

Table 2 continued: A generic macro SAM for South Africa for 1998 (current R million)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
			factors of production				instit: gvt rec	instit: gvt rec nt on prods	instit: gvt rec not on pr'ction	instit: gvt rec	instit: gvt rec				sav - inv sav = inv bal			row			row total
	industr	commodity	capital	labour	firms	households	prop inc			dir tax	transfers	govt bal	govt expend	savings		gdfi	invent ch	exp/receipts	cif fob	residual	
13 Government expenditure												194,678 (rb6254j - rb6005j)									194,678
14 Savings	94,781 allowance deprec (rb6002j)				32,452 corp savings (rb6201j)	3,417 hh savings (rb6200j)							-25,635 gvt savings (rb6202j)					12,867 foreign investmt (rb6206j)			117,882
15 Savings = investment balance														117,882 gross dom inv (rb6180j)							117,882
16 GDFI															123,209 gdfi (rb6009j)						123,209
17 Inventory change															-5,327 invent change (rb6010j)						-5,327
18 Imports/ payments		190,606 imports (rb6014j)+cif fob	22,728 fact paym to row (see note 2)	1,798 fact paym to row (rb6000-rb6240j)	37 firm trnsf to row (rb6233j)	110 hh trnsf to row (rb6248j)							4,280 gvt trnsf to row (rb6258j)						-8,974 cif fob adjustm (sut98)		210,585
19 CIF/FOB		-8,974 cif fob adjustm (sut98)																			-8,974
20 Residual			-3,833 residual (rb6011j)																		-3,833
21 Total	1,340,096	1,586,432	246,547	371,762	227,658	550,110	7,550	64,703	11,018	109,399	2,008	194,678	194,676	117,882	117,881	123,209	-5,327	210,583	-8,974	-3,833	

Source: 1998 Supply Use Table (Stats SA, 2001) and SARB Quarterly Bulleting, Sept 2001.

Note 1: net operating surplus (rb6001j) + interest on government debt (rb6255j) + income receipts (rb5680j) - {income payments (rb5681j) - [compensation of employees (rb6000j) - compensation of residents (rb6240j)]} - residual (rb6011j).

Note 2: income payments (rb5681j) - [compensation of employees (rb6000j) - compensation of residents (rb6240j)]

Table 3: A SAM for a Standard CGE of South Africa for 1998 (current R million)

		1 industr	2 comm	3 factors of production capital	4 factors of production labour	5 instit firms	6 instit households	7 instit: gvt rec nt on prods	8 instit: gvt rec not on pr'ction	9 instit: gvt rec dir tax	10 govt expend	11 sav-inv	12 invent ch	13 row exp/receipts	14 row total
1	industr		1,379,080 supply matrix (sut98)												
2	comm	669,716 use matrix (sut98)	0 tr & trnsp marg (sut98)				465,680 hh consump exp (rb6007j)				185,784 aggr gvt expend (rb6008j)	123,209 gdfi (rb6009j)	-9,160 invent ch + resid (rb6001j+rb6010j)	190,189 exports (rb6013)	
3	prod fact: capital	326,585 net op surpl (rb6001+2j)												7,193 fact inc receipts (rb5680j)	
4	prod fact: labour	371,762 remuneration (rb6001j)													
5	institition s firms			311,050 fact inc loc firms (see adjustm											
6	institition s hh				369,964 lab inc residents (rb6240j)	157,259 unearned hh inc (rb6241+rb6231j)					22,697 gvt trnsf to hh (rb6257j)			190 row trnsf to hh (rb6243j)	369,964 lab inc residents (rb6240j)
7	nt on prods		64,703 net tax on prods (rb6603-rb6604j)												
8	not on pr'ction	11,018 net oth taxes (rb6600-rb6001j)													
9	instit: gvt dir tax					29,581 corp tax (rb6230j)	79,818 personal tax (rb6245j)								
10	govt expend					776 firm trnsf to gvt	1,085 hh trnsf to gvt (rb6252j)	64,703 net tax on prods (rb6603-rb6604j)	11,018 net oth taxes (rb6600-rb6001j)	109,399 corp & pers tax (rb6230j+rb6245j)				144 row trnsf to gvt (rb6253j)	
11	savings-investm					123,399 gr crp sav + resid (rb6002+11-6201)	3,417 gross hh savings (rb6200j)				-25,635 gvt savings (rb6202j)			12,867 foreign investmt (rb6206j)	
12	inventory change											-9,160 invent ch + resid (rb6010j)			

Table 3 continued: A SAM for a Standard CGE of South Africa for 1998 (current R million)

		1 industr	2 comm	3 factors of production capital	4 labour	5 instit firms	6 instit households	7 instit: gvt rec nt on prods	8 instit: gvt rec not on pr'ction	9 instit: gvt rec dir tax	10 govt expend	11 sav-inv	12 invent ch	13 row exp/receipts	14 row total
13 rest of the world	imports/paym		181,632 imports (rb6014)	22,728 fact paym to row (as in phase1)	1,798 fact paym to row (rb6000-rb6240j)	34 firm trnsf to row (rb6233j)	110 hh trnsf to row (rb6248j)				4,280 gvt trnsf to row (rb6258j)				1,798 fact paym to row (rb6000-rb6240j)
14	total	294,794	371,762	311,050	550,110	64,703	11,018	109,399	148,142	114,049	-9,160	210,583		294,794	371,762

Source: 1998 Supply Use Table (Stats SA, 2001), Lewis 2001 and SARB Quarterly Bulleting, Sept 2001

Table 4: Value Added at Factor Costs, Employment and Capital Stock by Activities

	1	2	3	4	5	6	7	8	9	10	11
	Value Added		Employ. (Low Skilled Labour)		Employ. (Medium Skilled Labour)		Employ. (High Skilled Labour)		Employ. (Capital Stock)		Inter-mediates
	Value (Rmil)	Share of Total	Value (Rmil)	Share of Total	Value (Rmil)	Share of Total	Value (Rmil)	Share of Total	Value (Rmil)	Share of Total	Share of Total
1 agri	24,795	3.6	706,051	25.3	32,135	1.1	13,270	1.1	45,034	3.5	47.6
2 coal	9,089	1.3	40,283	1.4	16,941	0.6	3,797	0.3	163,865	1.3	49.1
3 gold	16,199	2.3	217,899	7.8	29,280	1.0	7,254	0.6	56,294	4.4	42.4
4 othmn	17,445	2.5	113,088	4.1	24,532	0.9	6,680	0.6	31,352	2.5	47.3
5 food	13,282	1.9	89,605	3.2	67,978	2.4	11,767	1.0	16,635	1.3	78.6
6 bev&t	9,584	1.4	16,962	0.6	11,074	0.4	4,353	0.4	9,197	0.7	62.3
7 text	3,433	0.5	45,323	1.6	7,937	0.3	3,232	0.3	2,500	0.2	71.6
8 appar	3,134	0.4	105,874	3.8	18,119	0.6	5,379	0.4	1,016	0.1	64.0
9 leath	196	0.0	5,556	0.2	964	0.0	431	0.0	205	0.0	88.1
10 footw	984	0.1	19,988	0.7	1,671	0.1	791	0.1	286	0.0	66.6
11 wood	3,038	0.4	51,014	1.8	23,789	0.8	2,281	0.2	1,648	0.1	64.3
12 paper	5,108	0.7	28,479	1.0	12,261	0.4	3,859	0.3	6,599	0.5	73.6
13 print	4,794	0.7	13,003	0.5	29,816	1.1	9,350	0.8	2,717	0.2	61.4
14 petro	7,776	1.1	7,415	0.3	5,946	0.2	3,268	0.3	45,232	3.6	66.2
15 chem	6,197	0.9	18,809	0.7	10,702	0.4	5,023	0.4	12,561	1.0	71.6
16 othch	8,118	1.2	29,977	1.1	25,420	0.9	11,955	1.0	8,748	0.7	73.3
17 rubb	1,479	0.2	9,751	0.3	3,424	0.1	1,502	0.1	1,350	0.1	68.0
18 plast	3,711	0.5	36,571	1.3	12,842	0.5	5,633	0.5	964	0.1	61.7
19 glass	866	0.1	5,695	0.2	1,380	0.0	573	0.0	1,523	0.1	61.9
20 nomet	3,951	0.6	35,778	1.3	8,671	0.3	3,598	0.3	6,014	0.5	60.6
21 iron	7,683	1.1	28,077	1.0	14,857	0.5	5,367	0.4	37,785	3.0	72.2
22 nofer	5,590	0.8	9,043	0.3	4,785	0.2	1,729	0.1	10,980	0.9	62.6
23 metpr	8,941	1.3	74,069	2.7	32,828	1.2	8,834	0.7	4,937	0.4	65.8
24 machn	6,944	1.0	33,777	1.2	28,380	1.0	9,636	0.8	2,934	0.2	68.4
25 elmac	3,917	0.6	45,882	1.6	17,918	0.6	13,269	1.1	2,339	0.2	68.2
26 comeq	1,346	0.2	10,889	0.4	4,252	0.2	3,149	0.3	657	0.1	72.4
27 scieq	444	0.1	3,441	0.1	1,344	0.0	995	0.1	205	0.0	67.8
28 vehic	8,020	1.1	39,301	1.4	24,921	0.9	12,933	1.1	7,231	0.6	79.7
29 trneq	1,484	0.2	5,473	0.2	3,471	0.1	1,801	0.1	1,777	0.1	58.9
30 furn	1,811	0.3	30,908	1.1	11,026	0.4	2,282	0.2	874	0.1	71.6
31 othin	6,911	1.0	45,569	1.6	50,589	1.8	9,071	0.8	510	0.0	42.0
32 elegs	17,540	2.5	29,133	1.0	22,640	0.8	16,224	1.3	76,816	6.0	33.2
33 water	3,210	0.5	3,408	0.1	2,648	0.1	1,898	0.2	17,148	1.3	58.1
34 const	20,494	2.9	206,477	7.4	58,501	2.1	14,570	1.2	6,235	0.5	69.7
35 trade	72,963	10.4	149,333	5.4	513,132	18.1	91,665	7.6	55,956	4.4	44.3
36 hotel	13,987	2.0	57,741	2.1	135,384	4.8	18,852	1.6	6,756	0.5	35.5
37 trans	41,809	6.0	64,966	2.3	130,163	4.6	17,009	1.4	126,365	9.9	43.0
38 comm	21,423	3.1	23,990	0.9	44,398	1.6	6,944	0.6	92,160	7.3	42.3
39 finan	57,335	8.2	7,738	0.3	153,637	5.4	55,398	4.6	152,488	12.0	40.9
40 bus	59,914	8.6	50,950	1.8	187,914	6.6	61,475	5.1	135,593	10.7	31.4
41 m&oths	11,838	1.7	4,965	0.2	90,117	3.2	79,117	6.6	12,969	1.0	49.5
42 othpr	26,845	3.8	23,099	0.8	264,325	9.3	51,264	4.2	435	0.0	32.8
43 gvtsrv	154,719	22.2	245,707	8.8	689,330	24.3	618,741	51.3	251,491	19.8	21.3
Total	698,347	100	2,791,057	100	2,831,442	100	1,206,219	100	1,270,920	100	48

Source: a 1998 SAM for South Africa

Table 5: Economic Variables at the Commodity Level

	1	2	3	4	5	6	7	8	9	10	11	12
	Percentages								Multipliers			
	Export Intensity	Import Pene-tration	Import Duties Collect.	Poor HH < 40	Middle 40 -80	Rich HH > 80	Gov. Expend-iture	Invest-ment Demand	Output	Income	Import	Employ-ment
1 agri	15.0	6.4	0.04	5.5	3.4	1.6	0.1	0.0	2.71	1.32	0.36	22.04
2 coal	49.5	3.0	0.00	0.1	0.0	0.0	0.0	0.0	2.88	1.40	0.35	11.50
3 gold	96.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	3.17	1.59	0.33	18.51
4 othmn	62.2	26.0	0.00	0.0	0.0	0.0	0.0	0.0	2.21	1.10	0.50	9.50
5 food	10.3	8.8	0.52	35.4	22.0	10.7	0.3	0.0	2.87	1.22	0.38	14.66
6 bev&t	5.3	6.0	0.06	18.9	11.7	5.7	0.0	0.0	2.32	1.06	0.29	9.19
7 text	11.0	16.9	1.66	1.3	1.6	1.0	0.1	0.0	2.59	1.12	0.46	11.94
8 appar	5.1	6.8	0.28	4.9	4.7	2.5	0.1	0.0	2.81	1.31	0.37	16.86
9 leath	35.8	19.6	1.81	0.0	0.0	0.0	0.0	0.0	2.89	1.04	0.50	13.41
10 footw	6.2	22.1	4.21	1.8	1.8	0.9	0.0	0.0	2.28	1.02	0.47	11.49
11 wood	16.3	9.2	0.53	0.0	0.0	0.0	0.0	0.0	3.12	1.39	0.41	19.82
12 paper	16.2	12.6	1.32	0.0	0.1	0.5	0.1	0.0	2.92	1.21	0.45	11.50
13 print	3.0	17.7	0.18	0.2	0.5	0.9	0.2	0.1	2.67	1.19	0.46	11.41
14 petro	8.1	8.9	0.00	0.8	1.8	3.9	0.6	0.0	1.77	0.81	0.30	6.30
15 chem	26.1	25.1	0.88	0.0	0.0	0.0	0.0	0.0	2.32	0.98	0.53	7.85
16 othch	7.2	18.0	0.64	3.5	3.6	3.4	1.2	0.0	2.57	1.10	0.47	10.00
17 rubb	8.8	21.7	5.02	0.0	0.3	0.7	0.1	0.1	2.33	1.02	0.49	9.72
18 plast	6.9	15.2	2.27	0.1	0.1	0.1	0.0	0.0	2.72	1.21	0.47	12.71
19 glass	11.1	20.3	2.87	0.0	0.0	0.0	0.0	0.0	2.56	1.17	0.48	10.59
20 nomet	9.0	10.6	1.62	0.0	0.0	0.0	0.3	0.0	2.79	1.28	0.42	12.44
21 iron	50.9	7.0	0.35	0.0	0.0	0.0	0.0	0.0	3.06	1.32	0.42	11.03
22 nofer	46.9	13.5	0.17	0.0	0.0	0.0	0.0	0.0	2.75	1.21	0.44	8.65
23 metpr	7.9	9.9	1.07	0.1	0.1	0.1	0.3	3.5	3.04	1.32	0.41	12.74
24 machn	11.2	45.3	0.59	0.3	0.8	1.2	1.0	31.7	1.58	0.70	0.64	6.48
25 elmac	8.8	22.2	2.33	0.1	0.2	0.2	0.1	3.5	2.33	1.01	0.49	11.09
26 comeq	6.4	53.1	2.59	0.4	0.9	1.1	0.1	5.9	1.11	0.48	0.69	4.84
27 scieq	4.9	44.6	0.22	0.0	0.2	1.0	1.0	2.3	1.49	0.72	0.61	6.68
28 vehic	10.1	28.2	1.66	0.1	1.1	4.5	2.1	12.8	2.13	0.84	0.57	7.78
29 trneq	15.9	50.4	0.17	0.0	0.1	0.1	1.1	2.6	1.37	0.63	0.68	5.43
30 furn	24.4	5.2	0.99	1.2	2.2	1.2	0.1	1.0	2.98	1.34	0.36	15.24
31 othin	25.5	19.8	1.04	0.3	0.7	1.7	1.1	0.2	2.19	1.12	0.44	12.18
32 elegs	2.4	0.9	0.00	3.1	1.9	1.4	0.2	0.0	2.78	1.51	0.28	10.29
33 water	0.4	0.7	0.00	0.6	0.4	0.2	0.2	0.0	3.18	1.43	0.28	8.52
34 const	0.1	0.6	0.00	0.0	0.0	0.0	0.9	33.5	3.33	1.37	0.35	14.60
35 trade	0.2	0.2	0.00	1.6	1.3	1.0	0.5	0.0	3.09	1.55	0.31	14.37
36 hotel	15.2	12.6	0.00	1.0	1.9	2.7	0.2	0.0	2.33	1.23	0.35	14.86
37 trans	7.8	14.2	0.00	5.0	6.1	3.7	0.3	0.0	2.52	1.28	0.41	9.57
38 comm	3.6	5.6	0.00	2.2	3.1	1.8	0.4	0.0	2.73	1.41	0.37	9.50
39 finan	4.2	2.8	0.00	2.7	4.7	6.9	0.8	0.0	2.86	1.49	0.29	9.85
40 bus	1.4	2.2	0.00	0.8	2.7	11.2	1.6	2.8	2.62	1.39	0.28	10.19
41 m&oths	2.2	2.4	0.00	2.2	3.9	4.0	0.5	0.0	2.78	1.35	0.32	14.62
42 othpr	1.8	2.7	0.00	2.0	3.6	5.2	0.1	0.0	2.96	1.52	0.34	15.81
43 gvtsrv	0.0	0.0	0.00	0.1	0.2	0.2	5.3	0.0	2.95	1.72	0.31	16.90
tot/ave	10.8	10.3	0.38	96.5	87.9	81.5	21.1	100.0				
imports				8.1	8.1	8.3	3.0	24.9				

Source: a 1998 SAM for South Africa

Table 6: Household Income Patterns, 1998

		Percentage of Total					
		Property	**Unskilled W&S**	**Semi-skilled W&S**	**Skilled W&S**	**Transfers**	**Total**
Poor	HH < 40%	10.1	44.4	19.1	1.5	24.9	100
Middle	40% < HH < 80%	19.9	36.5	31.2	7.3	5.1	100
Rich	HH > 80%	35.3	16.0	28.4	19.5	0.8	100

Source: a 1998 SAM for South Africa

Table 7: Consolidated Household Expenditure Patterns, 1998

	Percentage of Total		
	HH < 40%	**40% < HH < 80%**	**HH > 80%**
HH Expenditure: Domestic goods	88.4	79.7	73.2
HH Expenditure: Imported goods	8.1	8.1	8.3
Taxes and Transfers	3.4	11.7	17.7
Savings	0.1	0.4	0.8
Total	**100**	**100**	**100**

Source: a 1998 SAM for South Africa

Table 8: Government Income Patterns, 1998

	R million	**%**
Taxes on Producers	11,018	5.9
Import Duties	6,642	3.5
Other Taxes on Products	58,062	31.0
Company Taxes	29,581	15.8
Personal Tax	79,818	42.7
Transfers	2,005	1.1
Total	**187,126**	**100**

Source: a 1998 SAM for South Africa

Table 9: Government Expenditure Patterns, 1998

	R million	**%**
Government Expenditure: Domestic	33,891	18.1
Government Expenditure: Imports	5,634	3.0
Gross Operating Surplus	47,226	25.2
Wages and Salaries: Low	49,488	26.4
Wages and Salaries: Medium	39,576	21.1
Wages and Salaries: High	9,303	5.0
Transfers and Other	27,643	14.8
Deficit	-25,635	-13.7
Total	**187,126**	**100**

Source: a 1998 SAM for South Africa

Table 10: The Savings-investment Balance

		R million
Savings	Firms	123,399
	Households	3,417
	Government	-25,635
	Foreign	12,867
	Total	114,048
Investment	Gross Domestic Fixed Investment	123,209
	Change in Stocks	-9,161
	Total	114,048

Source: a 1998 SAM for South Africa

Table 11: Micro and Macroeconomic Model Constraints

Factor Market	Government	Rest of World	Savings-Investment
FAC1: Fixed factor supply; flexible wages; mobile factors	**GOV1:** Flexible government savings; fixed direct tax rates	**ROW1:** Fixed foreign savings; flexible real exchange rate	**SI1:** Fixed capital formation; uniform MPS[a] point change for selected institutions
FAC2: Flexible factor supply; fixed wages; mobile factors	**GOV2:** Fixed government savings; uniform direct tax rate point change for selected institutions	**ROW2:** Flexible foreign savings; fixed real exchange rate	**SI2:** Fixed capital formation; scaled MPS for selected institutions
FAC3: Fixed factor supply; fixed wages; immobile factors (activity specific)	**GOV3:** Fixed government savings; scaled direct tax rates for selected institutions		**SI3:** Flexible capital formation; fixed MPS for all non-government institutions
			SI4: Fixed investment and government consumption absorption shares (flexible quantities); uniform MPS point change for selected institutions
			SI5: Fixed investment and government consumption shares (flexible quantities); scaled MPS for selected institutions

[a] *MPS = marginal propensity to save*

Table 12: Macroeconomic Adjustment Rules Used in the Simulations

Constraints	Neoclassical	Johansen	Keynesian
Factor Market	**FAC2:** Low and medium skilled labour: flexible factor supply; fixed wages; mobile factors **FAC1:** High skilled labour and capital: fixed factor supply; flexible wages; mobile factors		
Rest of World	**ROW1:** Fixed foreign savings; flexible real exchange rate		
Government	**GOV1:** Flexible government savings; fixed direct tax rates		
Savings-Investment	**SI3:** Flexible capital formation; fixed MPS for all non-government institutions	**SI2:** Fixed capital formation; scaled MPS for selected institutions	**Not shown:** Fixed capital formation; fixed MPS for all non-government institutions
Numeraire Price	Flexible consumer price index; fixed producer price index	Flexible consumer price index; fixed producer price index	Flexible consumer price index; flexible producer price index, fixed wage (as per FAC2)

Table 13: Expenditure Patterns of Government, Investment Demand and Households on Selected Commodities.

Commodity Categories	Share of Total Government Spending on Intermediates	Share of Total Investment Spending	Share of Total Household Consumption Spending
Government services	25.0%	0.0%	0.3%
Vehicles	9.9%	12.8%	3.7%
Business services	7.6%	2.8%	9.2%
Other chemical products	5.9%	0.0%	4.1%
Transport equipment	5.2%	2.6%	0.1%
Other manufacturing	5.0%	0.2%	1.6%
Scientific machinery	4.8%	2.3%	0.8%
Machinery	4.6%	31.7%	1.2%
Construction	4.4%	33.5%	0.0%
Remaining commodities	27.6%	14.1%	79.1%

Source: A 1998 SAM for South Africa

Table 14: Results from a 10 Percent Increase in Government Consumption Expenditure

	Base-year Values	Percentage Change from Base-year		
		Neoclassical Constraints	Johansen Constraints	Keynesian Constraints
Real GDP	R774.1 b	0.5%	0.7%	3.1%
Consumer Inflation		+0%	-0%	10.6%
Producer Inflation				10%
Rest of World				
Exchange Rate (Rands per FCU)		-0.2%	+0%	10.3%
Exports	R190.2 b	-3.7%	-1%	1.2%
Imports	R181.6 b	-3.8%	-1%	1.3%
Savings-Investment				
Private Savings	R126.8 b	0.2%	17.3%	16.6%
Government Savings	-R25.6 b	74.7%	85.5%	44.6%
Foreign Savings (in Rands)	R12.9 b	-0.2%	+0%	10.3%
Investment	R114 b	-15.1%		
Government				
Government Revenue	R181 b	-0.3%	-1.8%	13.1%
Government Expenditure	R206.6 b	9%	9%	17%
Deficit to GDP	-3.3%	73.9%	84.1%	28.0%
Factor Demands				
Capital	1,270,921			
Low skilled labour	2,791,055	1.9%	3.3%	8.1%
Med. skilled labour	2,831,445	1.4%	1.3%	8.1%
High skilled labour	1,206,219			
Real Factor Returns				
Capital		0.2%	0.1%	5.1%
Low skilled labour		-0.1%	+0%	-9.1%
Med. skilled labour		-0%	+0%	-9.6%
High skilled labour		-1%	-0.5%	4.9%
Contribution to Real GDP by Industrial Sector				
Agriculture, forestry and fishing	R24 b	0.4%	-1.9%	0.7%
Mining and quarrying	R43 b	-3.7%	-0.5%	1.1%
Manufacturing	R129 b	-2.9%	-1.1%	1.4%
Electricity, gas and water	R21 b	-1.7%	-0.9%	0.9%
Construction	R21 b	-10.7%	0.2%	0.4%
Trade and catering	R89 b	-1.3%	-1.5%	1.3%
Transport and communication	R63 b	-1.5%	-1.6%	1.6%
Financial and business services	R123 b	-0.6%	-2.8%	1.7%
Social and personal services	R12 b	1.4%	-2.7%	1.1%
General gov. and other producers	R183 b	8.3%	8.1%	8.8%
Real GDP at factor cost	R709 b	0.7%	0.9%	3.3%
Real Household Incomes by Income Deciles				
0-10	R4.9 b	1.1%	0.7%	-0.7%
10-20	R7.0 b	1.0%	0.5%	-0.5%
20-30	R9.8 b	1.2%	0.6%	-0.6%
30-40	R13.2 b	1.1%	-0.1%	-0.3%
40-50	R17.8 b	1.2%	-0.3%	-0.2%
50-60	R23.3 b	1.2%	-0.6%	0.0%
60-70	R33.6 b	1.1%	-1.1%	0.2%
70-80	R49.3 b	1.0%	-1.8%	0.6%
80-90	R78.4 b	0.8%	-1.8%	0.8%
90-95	R63.5 b	0.7%	-2.2%	1.2%
95-96.25	R21.5 b	0.6%	-1.0%	0.9%
96.25-97.5	R25.2 b	0.4%	-3.7%	2.1%
97.5-98.75	R29.1 b	0.4%	-4.7%	2.4%
98.75-100	R58.0 b	0.3%	-10.5%	4.2%
Total real household income	R433.8 b	0.8%	-2.9%	1.3%

Source: Own calculations

Table 15: Nominal and Effective Rates of Protection

	Nominal Tariff on Commodities	Nominal Tariff on Activities	Nominal Tariff on Activity Intermediates	Effective Rate of Protection on Activities
Agriculture	0.6%	0.6%	3.0%	-1.4%
Coal mining	0.0%	0.0%	2.5%	-2.1%
Gold mining	0.0%	0.0%	3.2%	-2.1%
Other mining	0.0%	0.0%	1.5%	-1.2%
Food products	5.9%	5.5%	2.1%	20.8%
Beverages and tobacco	1.1%	1.1%	4.0%	-3.2%
Textiles	9.8%	9.2%	5.0%	22.0%
Wearing apparel	4.0%	4.0%	6.9%	-0.6%
Leather and leather products	9.3%	8.8%	4.8%	53.2%
Footwear	19.0%	18.3%	8.0%	47.1%
Wood and wood products	5.8%	5.8%	2.4%	12.8%
Paper and paper products	10.5%	9.8%	5.3%	25.6%
Printing and publishing	1.0%	1.1%	5.1%	-4.4%
Petroleum products	0.0%	0.4%	0.1%	1.0%
Chemical products	3.5%	3.2%	1.8%	7.3%
Other chemicals	3.6%	3.4%	4.0%	2.1%
Rubber products	23.2%	22.2%	3.2%	101.8%
Plastic products	15.0%	13.7%	4.1%	34.1%
Glass products	14.1%	13.5%	4.8%	32.2%
Non-metallic mineral products	15.2%	14.5%	2.8%	39.4%
Basic iron and steel	5.0%	4.4%	2.4%	10.5%
Non-ferrous metals	1.2%	1.5%	0.8%	2.7%
Metal products	10.8%	10.2%	3.6%	26.2%
Machinery	1.3%	1.2%	4.4%	-4.5%
Electronic machinery	10.5%	10.0%	5.3%	22.2%
Communication equipment	4.9%	4.7%	5.4%	3.1%
Scientific equipment	0.5%	0.5%	5.4%	-7.9%
Vehicles	5.9%	5.5%	5.7%	5.5%
Transport equipment	0.3%	0.3%	2.6%	-2.7%
Furniture	19.2%	18.3%	5.2%	74.1%
Other manufacturing	5.2%	5.1%	3.1%	6.8%
Electricity and gas	0.0%	0.0%	1.2%	-0.5%
Water	0.0%	0.0%	0.8%	-1.0%
Construction	0.0%	0.0%	5.4%	-9.9%
Trade	0.0%	0.0%	1.5%	-1.1%
Hotels and catering	0.0%	0.0%	2.8%	-1.4%
Transport	0.0%	0.0%	2.1%	-1.4%
Communication	0.0%	0.0%	1.7%	-1.1%
Financial services	0.0%	0.0%	0.6%	-0.4%
Business services	0.0%	0.0%	1.2%	-0.5%
Medical and other services	0.0%	0.0%	1.7%	-1.6%
Other production, n.e.c.	0.0%	0.0%	2.3%	-1.0%
Government services	0.0%	0.0%	2.0%	-0.5%

Source: Own calculations

Table 16: Results from the elimination of import tariffs

	Base-year Values	Percentage Change from Base-year		
		Neoclassical Constraints	Johansen Constraints	Keynesian Constraints
Real GDP	R774.1 b	0.1%	0.2%	0.6%
Consumer Inflation		-0.4%	-0.4%	1.3%
Producer Inflation				1.7%
Rest of World				
Exchange Rate (Rands per FCU)		0.8%	0.8%	2.5%
Exports	R190.2 b	2.1%	2.6%	3%
Imports	R181.6 b	2.2%	2.7%	3.1%
Savings-Investment				
Private Savings	R126.8 b	1.2%	4.1%	3.9%
Government Savings	-R25.6 b	24.2%	26.1%	19%
Foreign Savings (in Rands)	R12.9 b	0.8%	0.8%	2.5%
Investment	R114 b	-2.6%		
Government				
Government Revenue	R181 b	-3.2%	-3.5%	-1.1%
Government Expenditure	R206.6 b	0.2%	0.2%	1.4%
Deficit to GDP	-3.3%	24.4%	26.3%	16.8%
Factor Demands				
Capital	1,270,921			
Low skilled labour	2,791,055	+0%	0.3%	1.1%
Med. skilled labour	2,831,445	0.4%	0.4%	1.5%
High skilled labour	1,206,219			
Real Factor Returns				
Capital		1.6%	1.6%	2.4%
Low skilled labour		0.5%	0.5%	-1.2%
Med. skilled labour		0.4%	0.4%	-1.4%
High skilled labour		0.8%	0.9%	1.9%
Contribution to Real GDP by Industrial Sector				
Agriculture, forestry and fishing	R24 b	0.4%	0.0%	0.4%
Mining and quarrying	R43 b	3.0%	3.6%	3.9%
Manufacturing	R129 b	-1.2%	-0.9%	-0.5%
Electricity, gas and water	R21 b	0.2%	0.3%	0.6%
Construction	R21 b	-2.0%	-0.1%	-0.1%
Trade and catering	R89 b	-0.1%	-0.1%	0.4%
Transport and communication	R63 b	1.1%	1.1%	1.7%
Financial and business services	R123 b	0.3%	-0.1%	0.7%
Social and personal services	R12 b	0.8%	0.1%	0.8%
General gov. and other producers	R183 b	0.0%	0.0%	0.1%
Real GDP at factor cost	R709 b	0.1%	0.1%	0.5%
Real Household Incomes by Income Deciles				
0-10	R4.9 b	0.5%	0.4%	0.2%
10-20	R7.0 b	0.4%	0.3%	0.2%
20-30	R9.8 b	0.5%	0.4%	0.2%
30-40	R13.2 b	0.6%	0.4%	0.3%
40-50	R17.8 b	0.7%	0.4%	0.5%
50-60	R23.3 b	0.8%	0.5%	0.6%
60-70	R33.6 b	0.8%	0.4%	0.7%
70-80	R49.3 b	0.9%	0.4%	0.8%
80-90	R78.4 b	0.9%	0.4%	0.9%
90-95	R63.5 b	0.9%	0.4%	1.0%
95-96.25	R21.5 b	0.8%	0.5%	0.9%
96.25-97.5	R25.2 b	0.9%	0.2%	1.2%
97.5-98.75	R29.1 b	1.0%	0.2%	1.4%
98.75-100	R58.0 b	1.3%	-0.5%	2.0%
Total real household income	R433.8 b	0.9%	0.3%	1.0%

Source: Own calculations

Table 17: Factor Productivity in the Base Year

	Industry	VA Per Factor Input[a]		Industry	VA Per Factor Input[a]		Industry	VA Per Factor Input[a]
1	Machinery	3.8	16	Iron and steel	3.0	31	Financial services	2.3
2	Transport equipment	3.7	17	Non-metallic mineral prods	3.0	32	Footwear	2.2
3	Vehicles	3.6	18	Rubber products	2.9	33	Electricity	2.2
4	Scientific machinery	3.5	19	Transport services	2.7	34	Wearing apparel	2.1
5	Communication machinery	3.4	20	Medical and other services	2.6	35	Agriculture	1.9
6	Printing	3.4	21	Other production	2.6	36	Business services	1.8
7	Other chemical prods	3.4	22	Communication services	2.6	37	Hotel	1.8
8	Metal products	3.4	23	Chemical products	2.6	38	Textiles	1.7
9	Government services	3.4	24	Furniture	2.5	39	Petroleum products	1.7
10	Plastic products	3.3	25	Coal mining	2.5	40	Water	1.6
11	Glass	3.2	26	Food	2.5	41	Beverages and tobacco	1.6
12	Trade	3.2	27	Gold mining	2.4	42	Other manufacturing	1.5
13	Paper products	3.1	28	Leather products	2.4	43	Non-ferrous metals	1.5
14	Construction	3.1	29	Other mining	2.4			
15	Electrical machinery	3.0	30	Wood products	2.4			

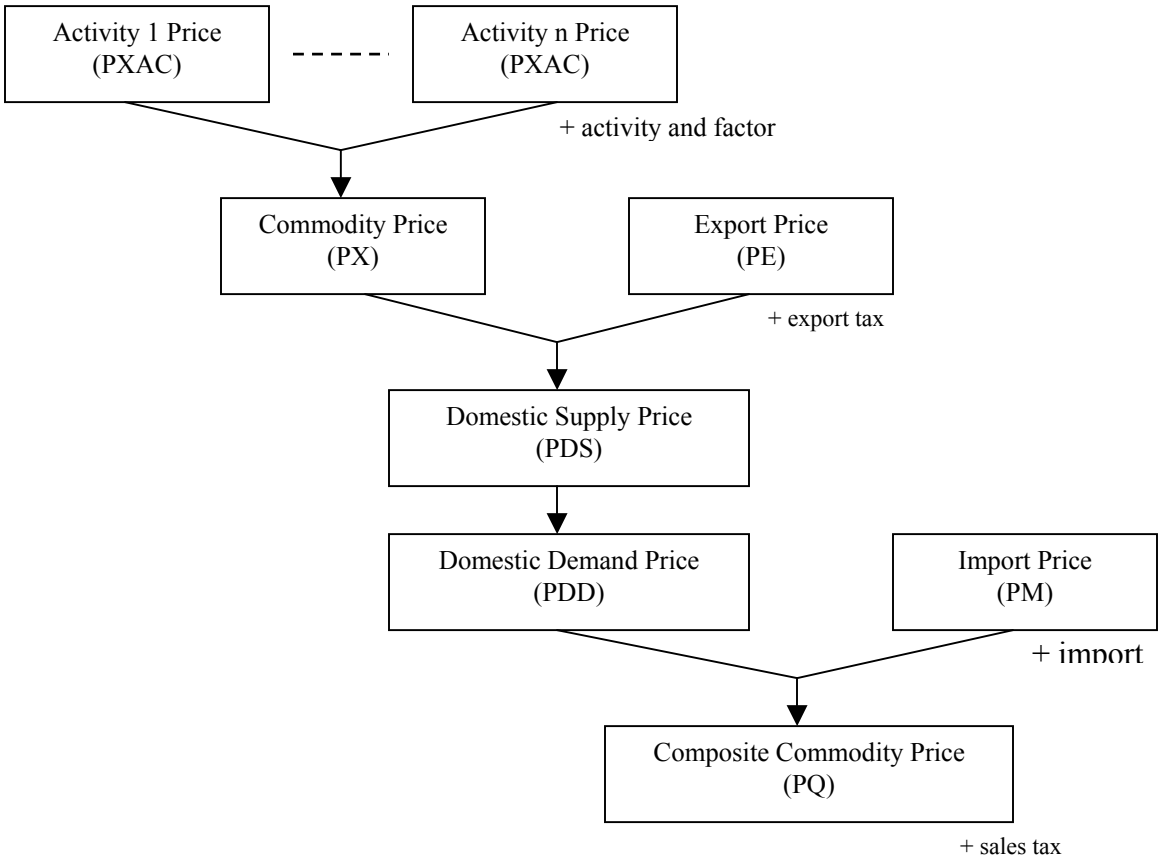
Source: a SAM for South Africa, [a]: Productivity is measured as the value-added by the composite factors of production per unit of factor input

Table 18: Results from a 1 Percent Increase in Factor Productivity

	Base-year Values	Percentage Change from Base-year		
		Neoclassical Constraints	Johansen Constraints	Keynesian Constraints
Real GDP	R774.1 b	1.3%	1.2%	0.5%
Consumer Inflation		0.1%	0.1%	-2.7%
Producer Inflation		.	.	-2.6%
Rest of World				
Exchange Rate (Rands per FCU)		0.1%	+0%	-2.7%
Exports	R190.2 b	1.9%	1.1%	0.5%
Imports	R181.6 b	1.9%	1.2%	0.5%
Savings-Investment				
Private Savings	R126.8 b	1.7%	-4.6%	0.5%
Government Savings	-R25.6 b	11.7%	14.7%	2.6%
Foreign Savings (in Rands)	R12.9 b	0.1%	0.01%	-2.6%
Investment	R114 b	4%	.	.
Government				
Government Revenue	R181 b	1.4%	1.8%	-2.1%
Government Expenditure	R206.6 b	-0.3%	-0.3%	-2.2%
Deficit to GDP	-3.3%	-12.8%	-15.6%	-0.6%
Factor Demands				
Capital	1,270,921	.	.	.
Low skilled labour	2,791,055	0.4%	+0%	-1.2%
Med. skilled labour	2,831,445	0.6%	0.6%	-1.2%
High skilled labour	1,206,219	.	.	.
Real Factor Returns				
Capital		1.5%	1.5%	0.1%
Low skilled labour		+0%	-0%	2.6%
Med. skilled labour		-0.1%	-0.1%	2.7%
High skilled labour		1.7%	1.6%	0.1%
Contribution to Real GDP by Industrial Sector				
Agriculture, forestry and fishing	R24 b	1.0%	1.6%	0.9%
Mining and quarrying	R43 b	1.8%	0.9%	0.5%
Manufacturing	R129 b	1.7%	1.2%	0.5%
Electricity, gas and water	R21 b	1.3%	1.1%	0.6%
Construction	R21 b	3.1%	0.1%	0.0%
Trade and catering	R89 b	1.4%	1.4%	0.7%
Transport and communication	R63 b	1.5%	1.5%	0.7%
Financial and business services	R123 b	1.4%	2.0%	0.8%
Social and personal services	R12 b	1.1%	2.2%	1.2%
General gov. and other producers	R183 b	0.2%	0.3%	0.1%
Real GDP at factor cost	R709 b	1.2%	1.1%	0.5%
Real Household Incomes by Income Deciles				
0-10	R4.9 b	0.5%	0.6%	1.0%
10-20	R7.0 b	0.4%	0.5%	0.8%
20-30	R9.8 b	0.5%	0.7%	1.0%
30-40	R13.2 b	0.5%	0.9%	0.9%
40-50	R17.8 b	0.7%	1.1%	1.0%
50-60	R23.3 b	0.7%	1.2%	1.0%
60-70	R33.6 b	0.8%	1.4%	1.0%
70-80	R49.3 b	0.9%	1.7%	1.0%
80-90	R78.4 b	1.0%	1.7%	0.9%
90-95	R63.5 b	1.1%	1.8%	0.9%
95-96.25	R21.5 b	1.0%	1.5%	0.9%
96.25-97.5	R25.2 b	1.2%	2.3%	0.7%
97.5-98.75	R29.1 b	1.2%	2.7%	0.7%
98.75-100	R58.0 b	1.5%	4.4%	0.4%
Total real household income	R433.8 b	1.0%	2.0%	0.8%

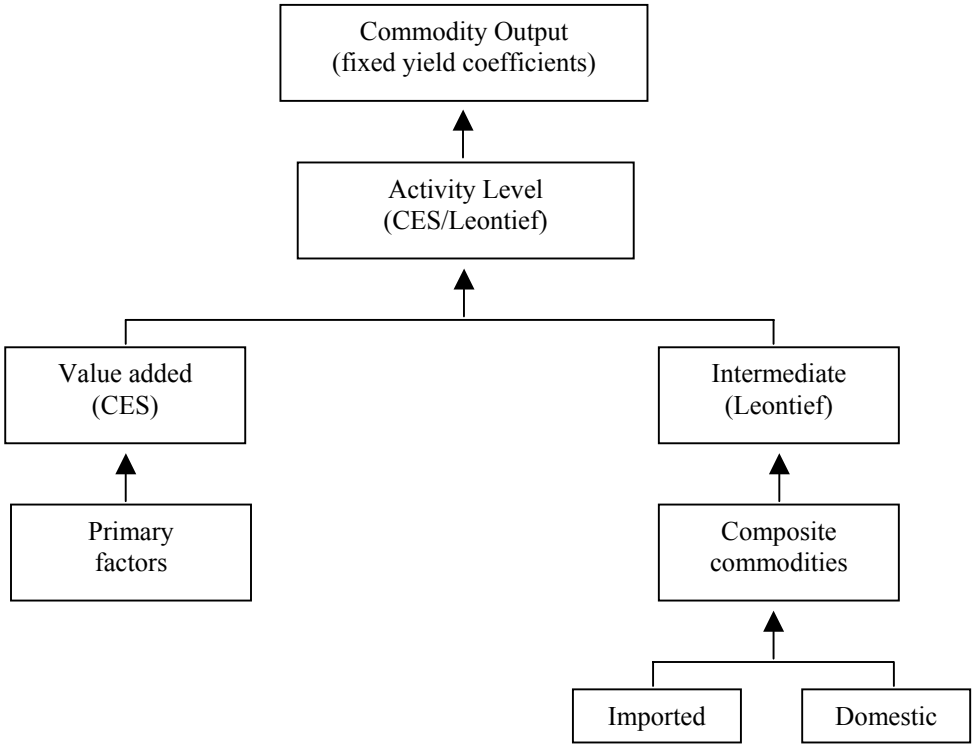
Source: Own calculations

Figure 1: Prices in the Standard Model



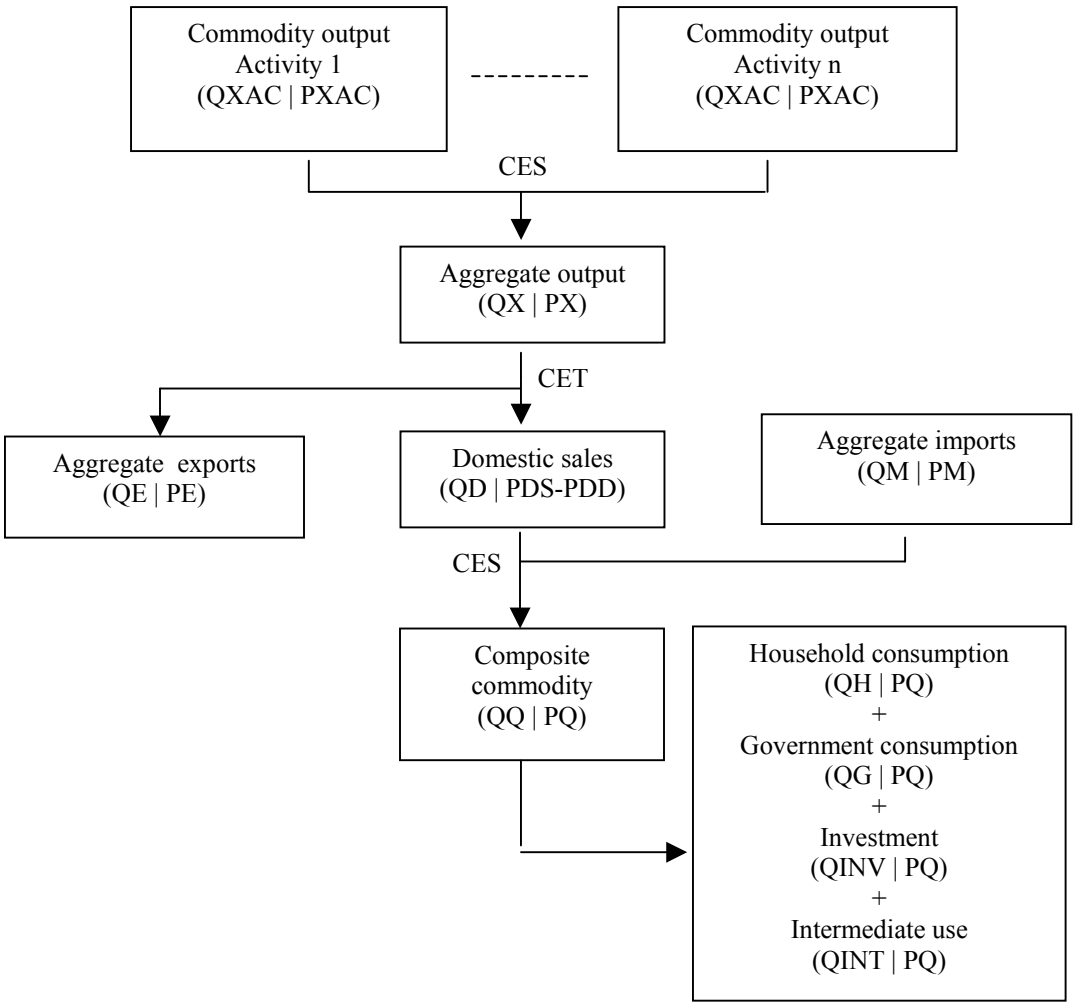
Source: Lofgren et al (2001)

Figure 2: Production Technology



Source: Lofgren et al (2001)

Figure 3: Flows of marketed commodities



Source: Lofgren et al (2001)

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