CHAPTER 5
THE SOUTH AFRICA COMPUTABLE GENERAL EQUILIBRIUM (CGE) MODEL

5.1 INTRODUCTION

This chapter describes the CGE model used in this study. The model represents a small open economy that has no influence on international prices. Clearly, South Africa has influence in the world price of minerals such as gold and platinum, however, the assumption of a "small country" stands for simplification purposes and because it is applicable to the bulk of non-mining trade. The model is developed in such a way that it is consistent with the gendered Social Accounting Matrix of South Africa for the year 2000 and IES for the year 2000.

The major contribution to the model is to characterise the impacts of changes in globalisation policies for the distribution of income between the factors distinguished by gender and across a variety of household types. The chapter is arranged as follows: the following section gives a short background of the general format of CGE models, and the steps taken in their construction. In section three, the chapter explains the structure of the South African CGE model. Section four presents and explains the model equations indicating both variables and parameters. The equations consist of five blocks: (1) prices, (2) production and trade, (3) income and expenditure, (4) the model equilibrium and (5) macro closure.

5.2 THE CGE MODEL STRUCTURE

This section draws on Sadoulet (1995). A *computable general equilibrium* (CGE) *model* is defined as the fundamental macroeconomic general equilibrium link among incomes of various groups, the pattern of demand, the balance of payments, and a multisector production structure. In addition, the model incorporates a set of behaviour equations, which describes the economic behaviour of the agents, which are identified in the model and the technological and institutional constraints they face (Thissen 1998). For example, consumers strive to maximise utility subject to their budget constraints and prices of both domestically produced and imported commodities. Producers on the other hand, aspire to maximise profits subject to cost constraints and they decide whether to sell their products on the domestic market or to export their products based on relative prices. The interactions of demand and supply by economic agents in the market require market prices to adjust in order to keep all markets in

equilibrium. The government expenditure is set constant either in nominal or in real terms. Different types of tax payments and savings are given by constant coefficients.

The CGE is an equilibrium model whose time frame depends on the amount of time it takes for all markets to adjust to a new equilibrium after experiencing a policy shock[16]. CGE models are also seen as medium-term models because they that solve past the period of adjustment disequilibria, but before major dynamic effects can occur. The period of adjustment is influenced by the extent of mobility of factors of production. For example, in the short run, all factors are fixed, in the medium term, labour is mobile, and in the long run all factors are mobile.

CGE models are homogenous of degree zero in all prices; therefore, the model solves for relative prices. One price, or a price index such as CPI, is usually chosen to serve as the numeraire, against which all other prices are based. Money is regarded as neutral in the model, and agents make decisions according to relative prices.

Several steps are required in order to construct a CGE model. First, a social accounting matrix which is the database for the model, must be established. The producers and consumers, who are the economic agents of the model, are specified, together with other institutions, such as the government, households, enterprises and the rest of the world. The disaggregation of the economy in a SAM is determined both by the availability of data and by the aim of the study. The current study disaggregates factors by gender and skills.

The agents of the economy, which are identified in the SAM, have different rules of behaviour that must be specified. For example, optimisation behaviour is specified with Cobb-Douglas, Constant Elasticity of Substitution (CES) or Linear Expenditure System (LES) functions. Other functions such as translog (Ardnt 2001) could be used, given the data and appropriate focus. Robinson (1982) notes that a CGE framework is flexible enough to incorporate a wide variety of specifications of production technology. For example, Robinson (1993) used the Almost Ideal Demand Systems (AIDS), a flexible functional form, instead of a CES function because AIDS has the advantage of allowing expenditure elasticities which are different from

[16] This section draws on Sadoulet (1995)

one. Parameter estimation or lack thereof may also restrict the number of levels of nesting for a given agent's behaviour. The agents will subsequently respond to relative prices according to the specified behavioural rules.

After the construction of the SAM and the specification of the equations, the parameters of the model are selected. Most parameters are chosen through a calibration procedure, in which the parameters are computed from the base year data of the SAM. The calibration procedure is only based on one year's observation and is deterministic in nature. However, calibration is the most practical option of estimation for the detailed structure of the model which has numerous numbers of parameters. The share parameters of the CES and CET functions are derived from observed values in the SAM. The elasticities, i.e. between labour and capital, the income and price elasticities of household consumption, the elasticities of substitutions and of transformation, are usually collected from literature and econometric estimations.

In order to close the model, macro constraints are essential. The CGE induces four main macroeconomic components, the balance of payment, the savings-investment (S-I), the government budget, and the aggregate supply of primary factors of production. In order to achieve equilibrium, among these macro aggregates, the modeller must decide on the 'macro-closure' problem. In the macroeconomic equilibrium equations, some variables are allowed to adjust in order to equilibrate the model while others are fixed exogenously. Although the process does not affect the base run of the CGE model, it affects the outcome of the simulations (Taylor 1991).

The CGE model is first solved without instituting any policy in order to replicate the benchmark equilibrium. If the model is properly calibrated the results replicate the base year equilibrium, which represents the equilibrium for the economy. When the base year SAM is replicated, one is assured that the parameters are properly specified. The base year data serves as the benchmark against which all simulations are evaluated.

The equations of the model solve simultaneously. These equations can be either or both linear and non-linear, can contain a mixture of strict equalities and inequalities that are lined to bounded variables in reciprocity slackness conditions. The equations that contain a mixture of strict equalities and inequalities are referred to as a mixed complementarity problem (MCP).

A sensitivity analysis is usually employed to test the validity of the parameters. The sensitivity of the results to changes in behavioural rules indirectly tests for major behavioural assumptions. There are several ways of evaluating the equilibria, which result from

the simulations. The results generate data on all new prices and quantities, factors employed, income levels, and macroeconomic indicators. In addition, welfare measures, such as consumer surplus or equivalent variation, can be constructed as seen in section 5 below.

5.3 THE STRUCTURE OF THE SOUTH AFRICAN CGE MODEL

The South African computable general equilibrium (CGE) model is a one-country model consisting of 43 sectors. The model is both neoclassical and structuralist in nature assuming perfect competition, perfect market but labour force is not perfect homogenous. Skilled labour and capital are assumed sectorally fixed while semi-skilled and unskilled labour is mobile but unemployed. The model was first developed by Dervis, de Melo and Robinson in 1982 in order to analyse issues of trade. The International Food Policy Research Institute (IFPRI) designed it into a standard model in order to permit a multi-sectoral framework for analysing the effects of exogenous shocks on various global economies (Löfgren *et al.* 2001). Thurlow and Van Seventer (2002) extended the model to explicitly model the South African economic situation.

The South African CGE model is built as a non-linear problem which allows inequality and equality constraints in a mixed complementarity specification (MCP). The model is Walrasian in nature, determining only relative prices. The consumer price index (CPI) is chosen as a numeraire. Other prices such as product prices, factor prices, and the exchange rate are defined relative to a numeraire. The model assumes that South Africa is a small country with respect to imports and exports, therefore, it lacks influences on world market prices regardless of the transactions it makes. The terms of trade are thus fixed. It is assumed that all consumers have identical preferences so that their behaviours are modelled by a single representative consumer.

5.3.1 Modifications to the standard conventional South African model

The standard model assumes that men and women labour is perfect substitutes in market production, and in the household supply of labour. However, current literature maintains the existence of imperfect substitution between men and women labour. The South African model is thus made gender-aware by desegregating the factor variables according to gender. As a result, the labour for men and women is allowed to be imperfect substitutes in the market production process. The pioneering work on CGE and gender by Fontana and Wood (2000) stresses the rigidity of gender substitution by fixing the elasticity of substitution (EOS) between men and women labour in market production at a low level of substitution of 0.5

for all sectors. According to Sadoulet and de Janvry (1995), the possible range of substitutability is illustrated by four values: 0.3 for low substitutability, 0.8 for medium low, 1.2 for medium high and 3.0 for very high.

The model is written and solved by using the General Algebraic Modelling Software (GAMS) programming language[17]. The model uses the CES production functions which are preferred for most purposes in economy-wide modelling. This follows the characteristic of the CES production function of having realistic substitution elasticities that capture most of the interactions a modeller wants to analyse.

The production technology is a nested function of constant elasticity of substitution (CES) and Leontief functions. At any set of prices, producers in each sector maximise profits utilising various-level (CES) production function subject to the technology constraint. The production process starts as follows: At the bottom level, men and women labour of the same skills combine to form three types of skills. That is, unskilled men combine with unskilled women to form unskilled labour, semi-skilled men combine with semi-skilled women to form semi-skilled labour. The same applies to skilled men and skilled women. As with Fontana and Wood (2000), the ratio of women to men labour is based on the share parameter of their aggregation function. The share parameter differs across various sectors, varies with the wage rate of women relative to that of men, and induces substitution between men and women labours.

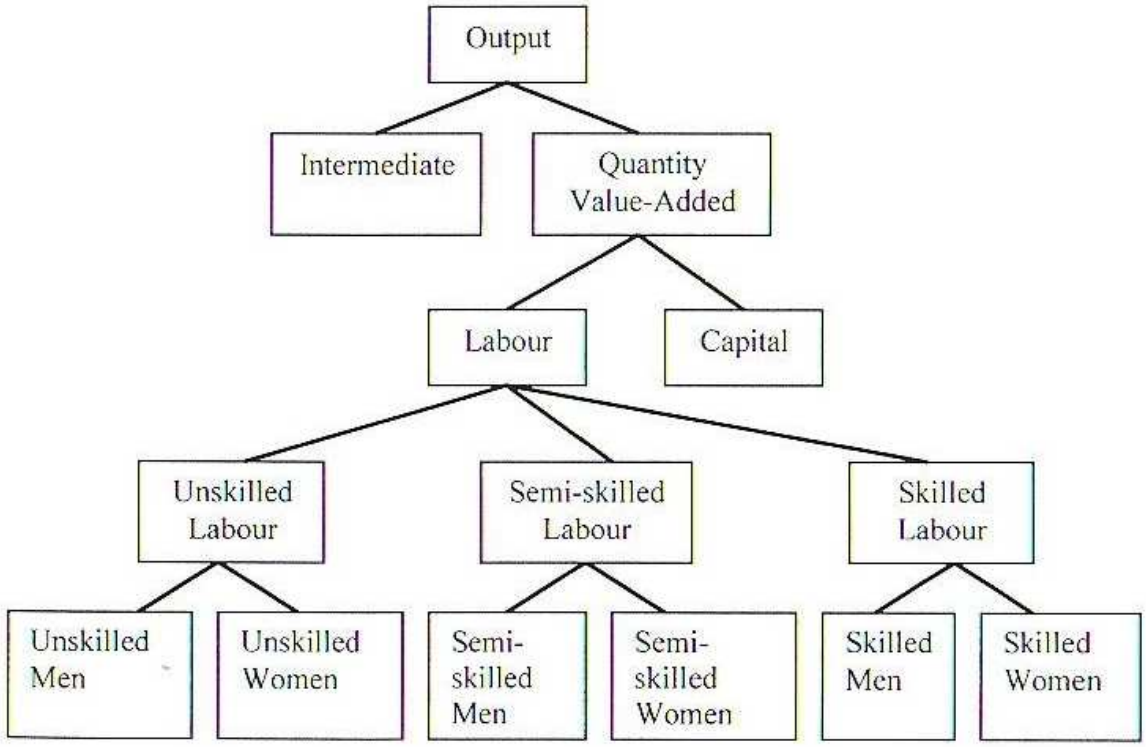
At the second level of the production function, the three skills type of composite labour is aggregated with a substitution elasticity of 0.50, into total labour. The resulting total labour combines with capital using a CES technology to form value added. At the top level, the value added combines with intermediate inputs utilising Leontief technology in order to produce activity total output (see Figure 5.1). The Leontief function aggregates individual intermediate input into an aggregate intermediate inputs.

This model adapts the Armington (1969) assumption that distinguishes imports from domestically produced goods, and exports from goods produced for domestic consumption

[17] GAMs is a software package designed to solve systems of equations.

because of imperfect substitutability. For example, a CES function aggregates domestic sales with imported commodities while a CET function combines domestic commodities for domestic sales with commodities for export markets.

Figure 5-1 Various levels within the production process



Source: Adapted from the model used in this study

The model institutions include households, government, enterprises, and the rest of the world accounts. As described in Chapter 4, households are disaggregated into 14 income categories. Sources of income include primary factor earnings, transfers from the government, from enterprises, from other households, and from the rest of the world. Households use their income to buy and consume commodities according to a linear expenditure function (LES), they make transfers to other households, pay income taxes, and save the rest.

The enterprises obtain their income from gains made by capital and transfers (from households, government, and the rest of the world). They use a proportion of their income to pay company tax to the government while they retain the rest for saving. Enterprises' savings are proportional to their disposable incomes and are converted into enterprises' investment. On the other hand, the savings of households and firms are referred to as private savings.

The government collects direct taxes from enterprises and households and indirect taxes (e.g. ad valorem tax on final sales) on goods and services; trade taxes on imports; net current transfers from households, firms, and the rest of world; and net capital transfers from government to firms. Indirect taxes are collected from the domestic output for domestic use and for imports. The government uses its income to consume commodities, make transfers to other institutions and to save. Government's savings are converted into public investment.

5.4 THE MODEL EQUATIONS

Section 5.4.1 presents the equations of the price system. Section 5.4.2 illustrates the production and trade block. Section 5.4.3 demonstrates institutional behaviour by showing equations that describe the mapping of value added into institutional income. Section 5.4.4 provides the system constraints that include both market-clearing conditions and the choice of macro "closure" systems for the model. Finally, special features of the model such as consumption are explained.

5.4.1 Price equations

$$PM_c = \overline{pwm_c} * (1 + tm_c) * EXR + \sum_{c' \in CT} PQ_{c'} * icm_{c'c} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where: $c \in C$ set of commodities (also referred to as c' and C')

$c \in CM (\subset C)$ set of imported commodities

$c \in CT \subset C)$ set of domestic trade inputs

Equation (1) represents the domestic import price, (PM_c), of commodity, c, as a function of world import price, $\overline{pwm_c}$, expressed in foreign currency, adjusted for tariff rate, (tm_c) and the exchange rate, EXR, plus the transaction cost, ($icm_{c'c}$), per unit of import. The small country assumption applies for all sectors in South Africa, hence, $\overline{pwm_c}$, is set exogenously.

$$PE_c = \overline{pwe_c} * (1 - te_c) * EXR - \sum_{c \in CT} PQ_{c'} * ice_{c'c} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where: $c \in CE (\subset C)$ is a set of domestically produced and exported commodities.

Equation (2) represents the domestic price of exports, PE_c, as a function of world price of export, (pwe_c) given in foreign currency (US $), adjusted for export tax rate, (te_c), or export subsidy (then a + sign) applies and the exchange rate (EXR), plus the cost of trade inputs, ($ice_{c'c}$), per export unit of, c. The tax and the cost of trade inputs reduce the price amount received by the domestic producers of exports. With this model, the cost of trade inputs is subtracted because domestic price of exports does not contain such cost.

$$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'} * icd_{c'c} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Where: $c \in CD(\subset C)$ is a set of commodities with domestic sale of domestic output. Equation (3) is the demand price, (PDD_c), of the domestically produced and sold commodities defined as domestic supply price, (PDS_c), plus the cost of trade, ($icd_{c'c}$), or transportation margins, which distinguish between prices paid by demanders and prices received by suppliers. The cost of trade for South Africa is contained in the 2000 SAM.

$$PQ_c * (1 - tq_c) * QQ_c = PDD_c * QD_c + PM_c * QM_c \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Equation (4) represents the price of composite commodities, (QQ_c), or the absorption function, as an average of the price, PDD_c of the commodity produced and sold domestically, QD_c, and the price, PM_c of the imported commodity, QM_c, weighted by their particular quantities, plus the sales tax rate, tq_c, which is imposed on both imported and domestically produced commodities. The equation reflects the Armington assumption of imperfect substitutability, which implies that the price that the consumer faces is not totally determined by world prices.

$$PX_c = ((PE_c * QE_c) + (PD_c * QD_c)) / QX_c \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Where: $c \in CX(\subset C)$ is a set of commodities with domestic output.

Equation (5) represents the average output price, PX_c, of the commodity output, QX_c, given as the weighted average of the price, PD_c, of commodities, QD_c, that are produced and sold

domestically and prices, PE_c, of commodities, QE_c that are domestically produced and exported. The equation reflects the use of constant elasticity of transformation function (CET), which implies that the world price is not completely transmitted to the output price that producers receive.

$$PA_i = \sum_{c \in C} PXAC_{ic} * \theta_{ic} \quad \text{.....(6)}$$

$$c \in I \,,\; i \in I$$

Equation (6) shows an activity price, PA_i, as being composed of the price, ($PXAC$), of the commodity, c, from activity, i, multiplied by its yield coefficient, θ_{ic}. The summation over all commodities indicates the possibility of an activity producing multiple commodities. In the current model, each activity produces one commodity, as a result, θ_{ic}, is equal to one. If one activity produces multiple commodities, θ_{ic}, equals the share of each commodity in the output of that activity.

$$PINTA_i = \sum_{c \in C} PQ_c * ica_{ci} \quad \text{.....(7)}$$

Equation (7) gives the activity-specific aggregate intermediate input price, $PINTA_i$, as a composite commodity prices, (PQ_c) and intermediate input coefficients, ica_{ci}. ica_{ci}, which refers to the quantity of commodity, c, per unit of aggregate intermediate input.

$$PA_i * (1 - ta_i) * QA_i = PVA_i * QVA_i + PINTA_i * QINTA_i \quad \text{.....(8)}$$

Equation (8) is an implicitly defined value added price, PVA_i which shows the activity revenue less cost as being equal to the payments for value-added and intermediate inputs. Specifically, PVA is the price received by domestic producers less taxes and the value of intermediate demand. Where: PA_i is the activity price, QA is an activity level, $PINTA$ is the aggregate intermediate prices, ta_a is tax for activity, and $QINTA$ is the quantity of intermediates.

$$\overline{CPI} = \sum_{c \in C} PQ_c * cwts_c \quad \text{.....(9)}$$

Equation (9) represents an exogenous consumer price index (CPI), defined as

being equal to domestically marketed output, PQ_i, times the weight, ($cwts_i$), which represents shares of each commodity in total demand of the commodity. Since the core analysis of this model operates through price mechanisms, it is necessary to define a numeraire price against which all relative prices and income changes are be measured. This study uses *CPI* as a numeraire.

$$\overline{DPI} = \sum_{c \in C} PDS_c * dwts_c \quad \text{.....(10)}$$

Where: $dwts_i$ is the weight of commodity c. Equation (10) represents the producer price index for domestically marketed output.

5.4.2 Production and trade block

The following section comprises quantity equations that represent the economic agents' decisions on production, domestic sales and international trade depending on the performance of the economy.

5.4.2.1 Production block equations

$$QA_i = \alpha_i^i * (\delta_i^i * QVA_i^{-\rho_i^i} + (1 - \delta_i^i) * QINTA_i^{-\rho_i^i})^{-\frac{1}{\rho_i^i}} \quad \text{.....(11)}$$

$i \in ICES$ *ICES*: a set of activities with a CES function at the top of the technology nest. At the top of the technology nest, equation (11) defines the production function, QA_i, as a CES function of value-added, QVA_i (composite of factors of production) and intermediate inputs, *QINTA*, with a transformation of the elasticity of substitution (EOS), ρ_i^i, between intermediate input and value-added. The higher the EOS, the smaller the value of ρ_i^i. The parameter, α_i^i represents the technological efficiency.

$$\frac{QVA_i}{QINTA_i} = \left(\frac{PINTA_i}{PVA_i} * \frac{\delta_i^i}{1 - \delta_i^i}\right)^{\frac{1}{1+\rho_i^i}} \quad \text{.....(12)}$$

$i \in ICES$ is a set of activities with a *CES* function at the top of the technology nest. Equation (12) shows the optimal mix of intermediate inputs and value added as a function of

the relative prices of value added and the aggregate intermediate input. Where: δ_i^i, is the *CES* activity function share parameter and ρ_i^i is a *CES* activity function exponent.

$$QVA_i = A_i\left[\gamma_i K_i^{\rho_i} r_i + (1-\gamma_i)(\omega_1 QL_{r1} + \omega_2 QL_{r2} + \omega_3 QL_{r3})^{-\rho_i}\right]^{-(1/\rho_i)} \quad \text{.....(13)}$$

Equation (13) represents a sector's value-added, QVA_i defined as the *CES* production function which aggregates two primary inputs: capital, (K), and labour, (QL), according to, ρ_i, which is an elasticity of substitution between capital and labour. Labour is a composite of skilled, semi-skilled and unskilled labour. A_i represents a production function shift parameter, γ_i, is a share parameter; QL_{is} is sectoral labour inputs, s is labour skill type (i.e., s represents 1,2 and 3 where 1= skilled; 2 = semi-skilled; 3 = unskilled) while $w_s = \frac{W_s}{W_i}$ represents the weighted-share for labour categories.

Gender equation: The South African model is gender neutral; therefore, gender equations were added in order to distinguish the effects of policies on men and women workers.

$$QL_{i_s} = A_i\left[\alpha_i QL_{mn_s}^{-\rho_i} + (1-\alpha_i)QL_{fm_s}^{-\rho_i}\right]^{-(1/\rho_i)} \quad \text{.....(14)}$$

Equation (14) shows a composite labour, (QL_{i_s}) defined as an aggregation of men and women workers of the same skill types, (s), with ρ_i as a substitution between men and women workers. Other parameters include, A_i, a production technology or production function shift parameter, QL_{mn_s} as men's labour and QL_{fm_s} as women's labour.

$$QL_{fm_s} = \left[\left(\frac{W_{mn}}{W_{fm}}\right)\left(\frac{\alpha_i}{1-\alpha_i}\right)\right]^{\sigma_i} * QL_{mn_s} \quad \text{.....(15)}$$

Equation (15) shows how relative demand for men and women labour, QL_{fm_s}, depends on the share parameter α_i, the relative wage rate $\left(\frac{W_{mn}}{W_{fm}}\right)$, and sectoral elasticity of substitution σ_i.

$$QINT_{ci} = \sum_i ica_{ci} * QINTA_i$$

……..……(16)

$$i \in I; c \in C.$$

Equation (16) represents the demand for the disaggregated intermediate inputs, $QINT_{ci}$, given as the sum of a fixed input-output coefficient, ica_{ci}, which is multiplied by sectoral outputs. This equation implies that for any level of output, intermediate demand for inputs, c, into sector, i, is determined through a fixed input-output coefficient.

$$QXAC_{ic} = \theta_{ic} * QA_i \quad \text{……...……...……(17)}$$

$$i \in I; c \in C$$

Equation (17) indicates the marketed output, $QXAC_{ic}$, of commodity, c, from activity, i, as an output of activity, QA_i, multiplied by the yield coefficient, θ_{ic}, which is equal to one in this model because as mentioned before, each activity produces only one commodity.

$$QX_c = \alpha_c^{ic} * \left[\sum_{i \in I} \delta_i^{ic}{}_c * QXAC_{ic}{}^{-\rho_c^{ic}} \right]^{-\frac{1}{\rho_c^{ic}-1}} \quad \text{……..……..……..(18)}$$

Equation (18) represents a CES aggregation of the quantities of marketed commodity, QX_c, produced by each activity. The activities are assumed to be imperfect substitutes according to the elasticity of substitution, ρ_c^{ic}. This equation permits more than one activity to produce one commodity or one activity to produce multiple commodities. The aggregation function includes a shift parameter, α_c^{ic}, and a share parameter, $\delta_i^{ic}{}_c$.

$$PXAC_{ic} = PX_c * QX_c \left[\sum_{i \in I} \delta_i^{ic}{}_c * QXAC_{ic}^{-\rho_c^{ac}-1} \right] * \delta_i^{ic}{}_c * QXAC_{ic}^{-\rho_c^{ic}-1} \text{……....(19)}$$

Equation (19) represents the first-order condition for the domestic output aggregation function given in equation 18. In this equation, the optimal quantity of the commodity from each activity is inversely related to the activity-specific price. This implies that a fall in price, $PXAC_{ic}$, of one activity relative to others would increase the demand of that activity without

affecting the demand for other higher price sources. The degree of substitutability between different producers depends on the value of the elasticity of substitution, ρ_c^{ic}.

$$QX_c = \alpha_c^t \left(\delta_c^t * QE_c^{\rho_c^t} + (1-\delta_c^t) * QD_c^{p_c^t}\right)^{\frac{1}{\rho_c^t}} \quad \text{.....(20)}$$

Equation (20) shows an output supply, QX_c, obtained by domestic producers maximising production subject to a constant elasticity of transformation (CET) function of the commodity, $QD_c^{p_c^t}$, supplied to the domestic market and the commodity, $QE_c^{p_c^t}$, supplied to the export market. This equation enables an activity to produce differentiated commodities for the domestic and export markets according to the elasticity of transformation, ρ_c^{ic}, which has a lower limit of one. The function's shift parameter is represented by , α_c^t, and a share parameters by, δ_c^t.

$$QE_c = QD_c * \left(\frac{PE_c}{PDS_c} * \frac{1-\delta_c^t}{\delta_c^t}\right)^{\frac{1}{\rho_c^t - 1}} \quad \text{.....(21)}$$

Equation (21) is the export supply response function, QE_c which shows how exports respond to changes in relative prices. The equation is given as a function of the domestic and export price ratio that defines the optimal mix between exports and domestic sales. The export supply is the first-order conditions from maximisation of equation (20). An increase in the export domestic price ratio generates a rise in the export domestic supply.

$$QX_c = QD_c \quad \text{.....(22)}$$

$$c \in (CD \cap CEN) \cup (CE \cap CDN)$$

Where: $c \in CEN(\subset C)$ represents non-exported commodities while $c \in CDN(\subset C)$ represents commodities without domestic market sales of domestic output.

Equation (22) shows the output supply as a CET function of the commodity supplied solely to the domestic market. This equation is applicable only when the good is not tradable.

$$QQ_c = \alpha_c^q \left(\delta_c^q * QM_c^{-\rho_c^q} + (1-\delta_c^q) * QD_c^{-p_c^q} \right)^{\frac{1}{\rho_c^q}} \quad \text{.....(23)}$$

$$c \in (CM \cap CD)$$

Equation (23) is the composite commodity supply referred to as Armington function given as a CES aggregation function between imports, QM_c, and the domestically produced commodities, QD_c, according to the elasticity of substitution, ρ_c^q, which has a lower limit of minus one. The assumption of imperfect substitutability allows transactions between imports and domestically produced commodity. Other parameters are: δ_c^q, a share parameter and α_c^q, a shift parameter.

$$QM_c = QD_c * \left(\frac{PDD_c}{PM_c} * \frac{\delta_c^q}{1-\delta_c^q} \right)^{\frac{1}{1+\rho_c^{qt}}} \quad \text{.....(24)}$$

$$c \in (CM \cap CD)$$

Equation (24) shows the import demand function, QM_c, which is derived from a CES of the composite commodity equation. An increase of the domestic import price ratio leads to an increase in the import domestic demand. The ρ_c^q represents the elasticity of substitution.

$$QQ_c = QD_c + QM_c \quad \text{.....(25)}$$

$$c \in (CD \cap CMN) \cup (CM \cap CDN); \quad c \in CMN (\subset C)$$

Equation (25) represents the composite supply for non-imported outputs and non-domestically produced imports. It replaces the Armington function for the union of commodities that have neither imports nor domestic sales of domestic output but not both.

$$QT_c = \sum_{c'C'} (icm_{cc'} * QM_{c'} + ice_{cc'} * QE_{c'} + icd_{cc'} * QD_{c'}) \quad \text{.....(26)}$$

$$c \in CT$$

Equation (26) is the transaction demand function where total demand for trade inputs (QT_c) is the sum of the demand for the inputs generated by imports, exports and domestic

market sales. In each of the three cases, fixed quantities of one or more transactions service inputs are required per unit of the traded commodity.

5.4.3 The institution block

The institution section shows income and expenditures of the institutions which are represented in the model. These institutions include: households, the government, enterprises together with the investment and savings accounts.

5.4.4 Factor income earnings.

$$W_s = \frac{W_{fm_s}\sum_i QL_{fm,i} + W_{mn_s}\sum_i QL_{mn,i}}{\sum_i QL_i} \quad \text{.....(27)}$$

Where: W_{fm_s} is women workers' wage rate; W_{mn_s} men workers' wage rate; QL_{mn_s} men labour and QL_{fm_s} women labour and QL_i is total labour (men and women). Equation (27) represents the economy-wide average sectoral wage calculated as the weighted average of the total number of men and women workers of various wage rates. Each sector's wage depends on its respective mixes between men and women workers of various skill types.'

$$YF_f = \sum_{i \in I} \left(WF_f * \overline{WFDIST}_{fi} * QF_{fi} \right) \quad \text{.....(28)}$$

Equation (28) represents the income, YF_f, of factor, f, earned as payment for their services rendered to activities. The factor income is obtained by the summation across sectors of the average wage, WF_f, times the quantity of the factor demanded, QF_{fi}, by each sector, i, times the wage distribution parameter, $WFDIST_{f,i}$. In the absence of factor market distortations $WFDIST_{f,i}$ equals one.

$$YIF_{if} = shift_{if} * (1 - tf_f) * YF_f - trnsf_{row\,f} * EXR \quad \text{.....(29)}$$

$$i \in INS \;;\; i \in INSD \quad (\subset INS)$$

Equation (29) illustrates the total institutional income, YIF_{if} (households, enterprises, governments, ROW which is available for the factors of production. The income is

divided among domestic institutions in fixed shares, $shift_{if}$, after payment of direct factor taxes, tf_f and transfers to the rest of the world, $trnsf_{row\,f}$ are made. Transfer to the ROW is fixed in foreign currency and is transformed into domestic currency by multiplying it with the exchange rate.

$$YI_i = \sum_{f \in F} YIF_{if} * \sum_{i' \in INSDNG} TRII_{ii'} + trnsfr_{i\,gov} * \overline{CPI} + trnsf_{i\,row} * EXR \quad \ldots\ldots\ldots (30)$$

$$i \in INSDNG\,,\ i \in INSDNG (= INSDNG' \subset INSD)$$

$TRII_{ii'}$ transfers from institution i'. to i (both in the set $INSDNG$). Equation (30) represents the total income, YI_i, of non-governmental institutions given as the sum of factor incomes, transfers from the government, transfers from the rest of the world, and from enterprises plus any income from the quota premium.

$$TRII_{ii'} = shii_{ii'} * (1 - MPS_{i'}) * (1 - TINS_{i'}) * YI_{i'} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (31)$$

$$I' \in INSDNG; I \in INSDNG\,.$$

Equation (31) is the intra-institutional transfers that show that transfers between domestic non-governmental organisations (NGOs) are paid as fixed shares of the total institutional incomes net of direct taxes, $TINS$, and savings. The saving rate of (NGOs), $MPS_{i'}$, is multiplied by an adjustment factor, $shii_{ii'}$, (used in the current study) in which the savings rate adjusts in order to maintain the balance between the savings-investment account..

$$EH_{hi} = \left[1 - \sum_{i \in INSDNG} shii_{ih}\right] * (1 - MPS_h) * (1 - TINS_h) * YI_h \ldots\ldots\ldots\ldots\ldots\ldots (32)$$

$$i \in H (\subset INSDN($$

Equation (32) shows total value of household consumption expenditure, EH_{hi}, as the total income less direct taxes, savings, and transfers to other domestic non-governmental institution. Savings and tax payments are determined as the product of household income and fixed savings and tax rates. Among domestic non-governmental organisations only households

demand commodities.

$$PQ_c * QH_{ch} = PQ_c * \gamma^m_{ch} + \beta^m_{ch} * \left(EH_h - \sum_{c' \in C} PQ_{c'} * \gamma^m_{ch} - \sum_{i \in I} \sum_{c' \in C} PXAC_{ic'} * \gamma^h_{ic'h} \right)$$

……..(33)

Equation (33) gives the linear expenditure system (LES), which is a demand system for marketed consumption, QH_{ch}. In the second part of the equation, the super-numerary income is calculated as, EH_h, minus the minimum levels of the marketed consumption, γ^m_{ch}, which represents the subsistence or minimum consumption of marketed commodity, c, for household, h. The β^m_{ch} gives the marginal share of consumption spending on marketed commodity, c, for household, h.

$$QINV_c = \overline{IADJ} * \overline{qinv_c} \quad \text{……..(34)}$$

The investment demand $QINV_c$ is shown in equation (34) as the quantity of fixed investment demand, $\overline{qinv_c}$, for commodities, c, which is defined as the base year investment quantity, $\overline{qinv_c}$, multiplied by an exogenous adjustment factor, $\overline{IADJ}$, which is used for simulations in which investment adjusts as in savings-driven models. The inventory investment is treated as an exogenous demand.

$$QG_c = \overline{GADJ} * \overline{qg_c} \quad \text{……..(35)}$$

The demand for commodity consumption by the government, QG_c, is given in equation (35). It is defined as the base year quantity of fixed government demand, $\overline{qg_c}$, multiplied by an exogenous government consumption adjustment factor, $\overline{GADJ}$. $\overline{GADJ}$ is used for simulations in which government expenditure is allowed to adjust.

$$\begin{aligned} YG = & \sum_{i \in INSDNG} TINS_i * YI_i + \sum_{f \in F} tf_f * YF_f + \sum_{i \in I} tva_i * PVA_i * QVA_i \\ & + \sum_{i \in I} ta_i * PA_i * QA_i + \sum_{c \in CM} tm_c * pwm_c * QM_c * EXR + \sum_{c \in CE} te_c * pwe_c * QE_c * EXR \\ & + \sum_{c \in C} tq_c * PQ_c * QQ_c + \sum_{f \in F} YF_{gov\,f} + trnsfr_{gov\,Row} * EXR \end{aligned} \quad \text{...(36)}$$

Equation (36) represents government revenue, YG, which is the sum of revenues from taxes, such as direct taxes on households and enterprises, sales taxes, factor taxes and value-added taxes. Other taxes are import tariff, export taxes and transfers from the rest of the world which are converted in domestic currency by multiplying with the exchange rate.

$$EG = \sum_{c \in C} PQ_{c*} QG_c + \sum_{i \in INSDNG} trnsfr_{i\,gov} * \overline{CPI} \quad \ldots\ldots (37)$$

Equation (37) indicates the government expenditure equation, which is the sum of government spending on consumption, QG_c and transfers, $trnsfr_{i\,gov}$, made to domestic institutions.

$$GSAV = YG - EG \quad \ldots\ldots (38)$$

Equation (38) shows government savings as the difference between government revenue and government expenditure.

5.4.5 The macroconstraint block

The following section illustrates equilibrium conditions which define the constraints that the model must satisfy in order to reach a solution. The equations do not describe the behaviour of agents or determination of prices and quantities but rather indicate conditions that must be satisfied in a closed model.

Factor markets closure

The model has two assumptions: the first assumption is that of full employment and full mobility of all factors of production which include capital, men and women of all skills types. The demand variables are flexible while the supply variable is fixed. Equilibrium in the factor market is reached through adjustment in factor prices refered to as WF_f.

$$\sum_{i \in I} QF_{f\,i} = \overline{QFS_f} \quad \ldots\ldots (39)$$

Equation (39) indicates the equilibrium condition between the total quantity demanded $QF_{f\,i}$ and the total quantity supplied $\overline{QFS_f}$ (exogenous) for each factor. Specifically:

$$\sum_{i \in I} QF_{fm_s,i} = \overline{QFS}_{fm_s} \quad \text{.....(40)}$$

$$\sum_{i=I} QF_{mn_s i} = \overline{QFS_{mn_s}} \quad \text{.....(41)}$$

Equation (40) indicates equilibrium between the demand and supply of men labour while equation (41) indicates equilibrium between the demand and supply of women labour. Where: mn: represents men labour while fm represents women labour. With this assumption, the market is assumed to be in equilibrium when a flexible wage adjusts until the demand for all skill types of labour is equal to all skill types of labour supply. The same reasoning applies to fully employed and mobile capital. However, the model assumes that payments to identical factors might vary across activities through the variable that captures the sectoral proportions for factor prices. These proportions are assumed to be a consequence of the use made by activities of factors, rather than of the factors themselves, and are therefore assumed fixed,i.e

$$WFDIST_{k\,i} = \overline{WFDIST_{k\,i}}$$

Factor closure with unemployment assumption:

The second assumption is that (a) capital is fully employed and sector-specific, (b) unskilled, and semi-skilled men and women labour is mobile and unemployed, and (c) Skilled men and women labour is assumed mobile and fully employed. Each market clears when the sum of the sectoral labour equates total supply of labour (QL) for the respective gender categories to yield equilibrium solutions to factor prices as well as the corresponding equilibrium quantities.

(a) Under this assumption, capital is assumed to be sectorally fixed, rendering no mobility between sectors.

$$QF_{k,i} = \overline{QF_{k,i}}$$

The returns to capital due to its services within different sectors are allowed to vary which implies:

$$WFDIST_{k\,i} = \overline{WFDIST_{k\,i}}$$

(b) The supply of unskilled and semi-skilled men and women labour is assumed perfect elastic,

implying infinite supply. This assumption stems from the high rate of unemployment which is related to this type of labour. Such labour is mobile across sectors and not fixed at the base level. Where: $unsmn$: unskilled men; $unsfm$: unskilled women; $sskmn$: semi-skilled men; $sskfm$: semi-skilled women; WF: wage of labour; QFS: total supply of labour

$$QFS_{unmn} = \overline{QFS_{unsmn}} \qquad QFS_{unsfm} = \overline{QFS_{unsfm}}$$

$$QFS_{sskmn} = \overline{QFS_{sskmn}} \qquad QFS_{ssfm} = \overline{QFS_{sskfm}}$$

The assumption of elastic supply of unskilled and semi-skilled men and women labour, implies that sectors can employ any amount of such type of skills at a fixed price as represented below:

$$WF_{unsmn} = \overline{WF_{unsmn}} \qquad WF_{unsfm} = \overline{WF_{unsfm}}$$

$$WF_{sskmn} = \overline{WF_{sskmn}} \qquad WF_{sskfm} = \overline{WF_{sskfm}}$$

$$QQ_c = \sum_{i \in I} QINT_{ci} + \sum_{h \in H} QH_{ch} + QG_c + QINV_c + qdst_c + QT_c \quad \text{.....(42)}$$

Equation (42) represents equilibrium between the quantities of composite commodity supplied with the quantity demanded. The composite commodity supply, QQ_c, is calculated as the sum of intermediate demands, $QINT_{ci}$, household demands, QH_{ch}, government demand, QG_c, investment demand, $QINV_c$, and stock change, $qdst_c$.

$$\sum_{c \in CM} pwm_c * QM_c + \sum_{f \in F} trnsfr_{rowf} = \sum_{c \in CE} pwe_c * QE_c + \sum_{i \in INSD} trnsfr_{irow} + \overline{FSAV} \quad \text{... (43)}$$

Equation (43) represents a current account balance which is an equilibrium between the country's spending and its earning of foreign currency. The left-hand side represents payments to the rest of the world (ROW) in terms of imports and transfers from factors to the ROW while the right hand side represents revenue from the ROW, expressed in terms of exports, transfers from the ROW to sectors and foreign savings, $\overline{FSAV}$. $\overline{FSAV}$ is an exogenous variable expressed in foreign currency, FCU.

$$YG = EG + GSAV \quad \text{.....(44)}$$

Equation (44) represents the government balance as the sum of the government expenditures, EG, (no government investment) and government savings, $GSAV$, which is an endogenous variable that clears the government balance.

$$\sum_{i \in INSDNG} MPS_i * (1 - TINS_i) * YI_i + GSAV + EXR * \overline{FSAV} = \sum_{c \in C} PQ_c QINV_c + \sum_{c \in C} PQ_c * qdst_c \quad \text{.....(45)}$$

Equation (45) shows the equality between the total savings and total investment. Total savings is the sum of savings from domestic non-governmental institutions, the government, and the rest of the world while total investment is the sum of the values of fixed investment (gross fixed capital formation) and stock changes. Since the savings side performs the balancing role, the closure for the current model represents a case of 'investment-driven' savings.

Macroeconomic definitions

The following section presents macroeconomic identities, which are utilised as measuring tools as well as used for the macroeconomic closure rules.

$$TINS_i = \overline{tins_i} * (1 + \overline{TINSADJ} * tins01_i) + \overline{DITINS} * tins01_i \quad \text{.....(46)}$$

Where: $TINS_i$ is the rate of direct tax on domestic institutions, i.

$\overline{TINSADJ}$ direct tax scaling factor (0 for base; exogenous variable).

$\overline{tins_i}$ exogenous direct tax rate for domestic institutions , i.

$tins01_i$ ..... 0-1 parameter, where , i, represents institutions with potential flexible direct tax rates.

$\overline{DITINS}$ change in domestic institution tax share (0 for base; exogenous variable).

Equation (46) defines the direct tax rates of domestic non-government institutions. In the model, all variables on the right-hand side are fixed, which implies fixed values for the direct tax rate variable of all institutions.

$$MPS_i = \overline{mps_i} * \left(1 + \overline{MPSADJ} * mps01_i\right) + DMPS * mps01_i \quad \text{.....(47)}$$

Where: $MPS01_i$ 0-1 parameter with 1 for institutions with potentially flexed direct tax rates

$\overline{mps_i}$ base savings rate for domestic institution, i

$\overline{MPSADJ}$ savings rate scaling factor (=0 for base)

$DMPS$ change in domestic institution savings rates (=0 for base; exogenous variable).

Equation (47) defines the savings rates of domestic non-governmental institutions. Depending on the closure rule for savings-investment balance, one or none of the variables $\overline{MPSADJ}$ and $DMPS$ might be flexible. In the current model, $DMPS$ is flexible, permitting MPS to be adjusted by a uniform rate for selected non-governmental institutions.

$$TABS = \sum_{h\in H}\sum_{c\in C} PQ_c * QH_{ch} + \sum_{i\in I}\sum_{c\in C}\sum_{h\in H} PXAC_{ic} * QHA_{ic}$$
$$+ \sum_{c\in C} PQ_c * QG_c + \sum_{c\in C} PQ_c * QINV_c + \sum_{c\in C} PQ_c * qdst_c \quad \text{.....(48)}$$

Equation (48) shows the total absorption equation which is measured as the total value of domestic final demands (GDP at market prices).

$$INVSHR * TABS = \sum_{c\in C} PQ_c * QINV_c + \sum_{c\in C} PQ_c * qdst_c \quad \text{.....(49)}$$

Equation (49) is the ratio of investment to absorption function, $INVSHR$, which is defined as the sum of total investment value $QINV_c$ across sectors plus any sectoral stock change, $qdst_c$.

$$GOVSHR * TABS = \sum_{c\in C} PQ_c * QG_c \quad \text{.....(50)}$$

Equation (50) shows the ratio of the government consumption to absorption, $GOVSHR$. The right-hand side defines the value of government consumption, while in the left-hand side, total absorption is multiplied by a variable, $GOVSHR$, which measures the ratio between government consumption and absorption.

5.5 GENERAL MACROECONOMIC BALANCE

The CGE model contains four macroeconomic accounts, which must be balanced: the current account with the rest of the world, the savings-investment account, the government account and the factor markets. In each condition, one or more of the variables serve to equilibrate the market in question. Choosing such a variable(s) is known as the 'closure' of the model. In addition, the CGE models are generally over determined and the way to ensure that the model is mathematically solvable requires the closure rule. The choice of a closure depends on the type of a simulation as well as the modeller's understanding of the structures of the economy Rattsø (1982). Robinson (1989) defines *closure* as being an assumption that one or more of macro account is exogenous, while the closure problem refers to the choice of which a variable is left endogenous in order to achieve equilibrium in savings and investment, government revenue and expenditure, and the balance of trade. The choice of closure is important because it affects the model's results and hence the policy conclusions that are drawn from them. There is no correct choice of closure; the modeller has to justify it.

In order to balance the current account, either the foreign savings are fixed while the real exchange rate varies, or vice versa. When the exchange rate is allowed to vary a specified simulation results in fluctuation of the trade balance. If the foreign savings are variable, this will affect the savings-investment balance. In the current model, the foreign savings are held fixed which keep fluctuations in inflows from affecting welfare. In addition, it prevents the Government from what is called "free lunch'.

If the model is savings-driven, savings rates are fixed (by fixing the *SADJ* variable) while investment varies in order to equilibrate the account. Otherwise, the model is investment-driven, where *IADJ* is fixed while the savings variable is endogenous.

The government balance consists of three equilibrating variables; government consumption, government savings, and tax rates. If the *GSAV* varies, then the model reflects flexible government savings while other variable are fixed. For example, in order to finance rising government expenditure, the government has to obtain money from the capital account thus increasing the budget deficit. If the model shows targeted government savings (i.e. a budget-neutral reform) through flexible tax rates, *DTAXADJ* and *DTINS* adjust accordingly in order to maintain the deficit in the base line level. If the government consumption spending is flexible, *GADJ* adjusts. In certain instances, Government consumption may be fixed as a pre-determined share of total absorption.

Under cases where investment and government spending are both fixed as a share of total absorption, it follows that the consumption is also fixed as a percentage share of total absorption. This method is called the 'balanced' closure, which spreads out the adjustment and ensures that the private savings rate adjust in order to achieve a savings-investment balance. Under such conditions, an external policy shock will affect investment, government expenditure, consumption, and savings.

The capital account ensures that investment is equal to investment. In an investment-driven savings models, there is uniform marginal propensity to save changes for selected institutions such as households and enterprises in order to maintain the investment levels. If the model is savings-driven, then the savings of institutions such as households, government, and enterprises adjust in order to maintain the saving investment balance.

The factor markets can either have, for a given factor, mobility and a fixed average wage across activities, in which case WF, is free, but $WFDIST_{fi}$ is fixed, or immobility, in which case the amount of the factor employed in the specific activity (i.e. $QF_{f,i}$) is fixed while $WFDIST_{fi}$ is allowed to vary enabling the wage to vary across activities.

5.6 THE CLOSURE RULES FOR THE GENDERED MODEL

Savings and investment balance:

In this model, the economy is investment-driven whereby the share of investment in absorption is fixed, and the level of savings adjusts in order to equate the level of investment as determined by fixed marginal propensities to save for each domestic non-governmental institution. At equilibrium, aggregate investment must equal savings (private, government and foreign), plus government balance and external balance (Kilkenny & Robinson 1990).

External balance:

Consistent with macroeconomic policies in South Africa, a flexible exchange rate is assumed while foreign savings are fixed in the rest of the world (ROW) account. This forms an external constraint for the balance of trade. This constraint helps to support policy changes. For example, trade liberalisation that increases imports has to be offset by increased exports or decreased imports in the rest of the economy. This prevents policy changes from being financed by a free lunch from the rest of the world (De Melo & Tarr 1992).

Government balance:

The government account balance is achieved by allowing government savings to vary while variables such as tax rates remain fixed at their initial levels. The government consumes a fixed share of total final domestic demand in each sector while government spending is set at a constant share of total absorption. The level of government expenditure is indexed on the consumer prices in order to maintain government expenditure in real terms. Changes in government revenues and expenditures are reflected in changes in the overall government budget deficit/surplus. For example, in order to finance rising government expenditure, the government has to obtain money from the capital account thus increasing the budget deficit.

Assumptions of the gendered model concerning factor (capital, labour) closure

The gendered model has different assumptions concerning the factor closure.

(a) The first assumption takes into consideration the situation of labour in the South African economy. Capital is assumed fully employed and sectorally fixed. Skilled men and women labour is fully employed and mobile across sectors the situation that mirrors rapid job turnover in the South African economy. Although capital is highly mobile (Seguino 2000b), due to difficulties associated in changing capital stock in the short run, capital is assumed to be fixed sectorally. The equilibrating variable is the wage rate for the case of labour while for capital its sector-specific returns adjusts in order to maintain the employment level in the sector. On the other hand, unskilled and semi-skilled men and women labour is modelled as mobile across sectors, but unemployed (elastic supply). This means that they have a fixed average wage across activities, in which case WF is free, but $WFDIST_{f,i}$ is fixed.

(b) Due to South Africa's strong trade unions, it is assumed that all workers face flexible wages in a market that is characteristic of full employment. In this instance, the assumption involves a given supply of fully employed and full mobile capital and men and women of various skills. The labour wages and capital returns move in sectors to equilibriate the labour market.

All prices in the model are expressed relative to consumer price index (CPI), the numeraire, thus expressing all value results of the model in real terms. The CPI enables general equilibrium analysis to continue without having to worry about the effects of inflation (and money supply) on the optimal use of resources.

The model employs a comparative static analysis and contains equations that guarantee that a set of microeconomic and macroeconomic constraints is satisfied. That is, factor and commodity markets, savings and investment, and government and current account balance requirements are met. The comparative static nature of the model gives short-term and medium-term equilibrium results. This means that after each simulation, the result indicates the new equilibrium obtained after the agents, consumers and producers have adjusted themselves to new prices and incomes. The comparative static, unlike the dynamic model, does not provide feedback effects on labour force growth, productivity, and investment behaviour from a policy change.

The gendered CGE model for South Africa has 50 basic equations, comprising 19 equations for production and trade block; 12 for institutions block; 10 for prices; and nine for equilibrium conditions and macroeconomic closures. Since there are 49 production activities and 14 categories of households, the total number of equations to be solved is 4 575 which matches the number of endogenous variables. The model solves because it is identified as containing the same number of endogenous variables as the equations. It is solved as a system of simultaneous non-linear equations and it reflects a Walrasian economy that solves for relative prices. The model is written and solved using the GAMS programming language.

5.6.1 Analysing the simulation results

The simulations performed by the CGE model result in counterfactual equilibriums, which are compared with the base run equilibrium. The results include solutions for all prices and quantities (for goods and factors), as well as utility levels, expenditures and macroeconomic variables. Important macroeconomic variables changes to be taken into considerations after economy-wide simulations of model include the total absorption, government revenues, government savings, government consumption and trade balance changes. Employment changes regarding capital and men and women labour, factor (capital, labour) income earnings and the welfare for households are also important variables to be analysed after the policy shock.

Household welfare indicator (Equivalent variation)

The analysis to determine the welfare of households in most of the CGE models involves using the equivalent variation (EV) measure. The Hicksian equivalent variation is derived from utility and is a commonly applied indicator in CGE analysis, because of its well micro-founded indicators. The CGE models are developed based on the economic agent's optimization

problems. For example, producers are assumed to maximize profits and households are assumed to maximize utility. As such, utility is used to evaluate the macro impacts of policies. However, utility has several setbacks. For example, it is based on ordinal numbers and not on cardinal numbers, which makes it impossible to quantify. Since the utility level is expressed in absolute numbers, it does not give concrete ideas about welfare status from a viewpoint of actual economic activities. In order to avoid such setbacks of utility as a welfare indicator, the utility given in an absolute number is converted into EVs.

First the expenditure function is employed as follows:

$$E(P_i^q, UU) \equiv \min X_i^p \left(\sum P_i^q X_i^p \middle| UU = UU(X_i^p) \right)$$

Where: $E(P_i^q, UU)$ expenditure function.

XP_i^p : consumption of the ith commodity

P_i^q : price of the ith commodity and

$UU(X_i^p)$: a given utility level.

The right-hand side represents minimum expenditure to achieve the given utility level, UU, under prices, $P_i^{q,}$ of ith commodity. Because the expenditure functions are given in value terms, it is possible to add them up in case they are more than two households.

The expenditure functions give the utility levels in value terms. In order to compare equilibrium, an indicator known as Hicks equivalent variation is used as follows:

$$EV_h \equiv E(P_i^{q0}, UU_h^1) - E(P_i^{qO}, UU_h^O)$$

Where UU^1 represents changes in utility after policy simulation while UU^O represents the base level utility for household, h, and the prices, P_i^{q0}, refer to the original consumer prices of the i-th commodity. If EV is positive after policy simulation, then the welfare of household, h, is positive. If after the policy shock EV is negative, then the welfare of household, h, is negative. Positive EV implies a certain amount of money a household is willing to be compensated with in order to avoid changes, while a negative EV implies a certain amount of money, a household is willing to pay in order to avoid a policy change. With government and investment spending held constant in real terms in this model, the EV represents the amount of income that would have to be given to the household sector in the base model to reach the

level of overall economic welfare achievable with globalisation. (Varian 1984:264)

APPENDIX 5

Table 5.1 Sets, variables and parameters of the CGE model

Sets	Definition
AC	Global set
i(ic)	Activities
aces(i)	Activities with a CES function at the top of the technology nest
aloe (i)	Activities with a Leontief function at the top of technology nest
c (ic)	Commodities
cd (c)	Domestic commodities
cdn (c)	Non-sold domestic Commodities
cm (c)	Imported commodities
cnm (c)	Non-Imported commodities
ce (c)	Exported commodities
cne (c)	Non-exported commodities
cx (c)	Commodities with output
f (ic)	Factors
flab(f)	Labour factors
fcap	Capital factor
ins	Institution (domestic and rest of world)
insd (ins)	Domestic Institution
insdng (insd)	Domestic non-government institutions
h (ins)	Households
en (ins)	Enterprises

Table 5.2 Parameters appearing in model equations

Parameters	
α_i^i	shift parameter for top-level CES function
α_i^{ic}	shift parameter for domestic commodity aggregation function
α_c^q	shift parameter for Armington function
α_c^t	shift parameter for CET function
α_i^{vi}	shift parameter for CES activity production function
$\beta_{c,h}^m$	LES marginal budget shares of household consumption for marketed goods (commodities)
$cwts_c$	Weights for consumer price index
$\delta_{f,i}^i$	share parameter for top-level CES function
δ_{ic}^{qc}	share parameter for domestic commodity aggregation function
δ_c^q	share parameter for Armington function
δ_c^t	share parameter for CET function
$\delta_{f,i}^i$	share parameter for CES activity production function
$cwts_c$	domestic sales price weights
$dwts_c$	domestic production price weights
$\gamma_{c,h}^m$	LES subsistence minima for marketed goods (commodities)
$\vartheta_{i,c}$	Yield of output c per unit of activity i
$ica_{c,i}$	intermediate input c per unit of aggregate intermediate

Parameters	
int q_i	aggregate intermediate input coefficient
iva_i	aggregate value added coefficient
$icd_{c,cp}$	trade input of c per unit of commodity cp produced & sold domestically
$ice_{c,cp}$	trade input of c per unit of commodity cp exported
$icm_{c,cp}$	trade input of c per unit of commodity cp imported
$mps\ 01_{ins}$	0-1 par for potential flexing of savings rates
mps_{ins}	marginal propensity to save for domestic non-governmental inst ins (exogenous part)
$qdst_c$	inventory investment by sector of origin
$qb\ \arg_c$	exogenous (unscaled) government demand
$qbarinv_c$	exogenous (unscaled) investment demand
ρ_i^i	CES top level function exponent
ρ_c^{ac}	domestic commodity aggregation function exponent
ρ_c^q	Armington function exponent
ρ_c^t	CET function exponent
ρ_i^{va}	CES value-added function exponent
$shif_{ins,f}$	share of domestic id in income of factor f
$shii_{ins,insp}$	share of domestic institution id in post-tax post-savings income of inst ip
$\sup ernum_h$	LES supernumerary income
$\upsilon_{i,c}$	yield of commodity c per unit of activity i
$\gamma_{i,c,h}^h$	subsistence consumption of marketed commodity c for household h
$trnsfr_{ins,ac}$	transfers from institution. or factor ac to institution ins
*	
Tax rates	
$tins_{ins}$	direct tax rate on institution ins
ta_i	rate of tax on producer gross output value
te_c	rate of tax on exports
tf_f	rate of direct tax on factors (soc sec tax)
$tins\ 01_{ins}$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
$tinsbar_{ins}$	rate of (exogenous part of) direct tax on domestic institution ins
tm_c	rate of import tariff
tq_c	rate of sales tax
tva_i	rate of value-added tax

Table 5.3 Exogenous model variables

Exogenous Variables	
CPI	consumer price index (PQ-based)
DTINS	change in domestic institution tax share
FSAV	foreign savings
GADJ	government demand scaling factor
IADJ	investment scaling factor (for fixed capital formation)

Exogenous Variables	
$MPSADJ$	savings rate scaling factor
QFS_f	quantity of factor supply
QFS_{mn}	quantity of men labour supply
QFS_{fm}	quantity of women labour supply
$TINSADJ$	direct tax scaling factor
$WFDIST_{f,i}$	factor wage distortion variable
DPI	index for domestic producer prices (PDS-based)

Table 5.4 Model endogenous variables

Endogenous Variables	
$DMPS$	change in marginal propensity to save for selected inst
EG	total current government expenditure
EH_h	household consumption expenditure
EXR	exchange rate
$GOVSHR$	govt consumption share of absorption
$GSAV$	government savings
$INVSHR$	investment share of absorption
MPS_{inst}	marginal propensity to save for domestic non-government institutions
PA_i	output price of activity i
PDD_c	demand price for commodity c produced and sold domestically
PDS_c	supply price for commodity c produced and sold domestically
PE_c	price of exports
$PINTA_i$	price of intermediate aggregate
PM_c	price of imports
PQ_c	price of composite good c
PVA_i	value added price
PWE_c	world price of exports
PWM_c	world price of imports
PX_c	average output price
$PXAC_{i,c}$	price of commodity c from activity i
QA_a	level of domestic activity
QD_c	quantity of domestic sales
QE_c	quantity of exports
$QF_{f,i}$	quantity demanded of factor f from activity i
$QLD_{mn,i}$	quantity demanded of men (mn) labour from activity i
$QLD_{fm,i}$	quantity demanded of women (fm) labour from activity i
QG_c	quantity of government consumption
$QH_{c,h}$	quantity consumed of marketed commodity c by household
$QHA_{i,c,h}$	quantity consumed of home commodity c from activity i by hhd h
$QINT_{c,i}$	quantity of intermediate demand for c from activity i

Endogenous Variables	
$QINTA_i$	quantity of aggregate intermediate input
$QINV_c$	quantity of fixed investment demand
QM_c	quantity of imports
QQ_c	quantity of composite goods supply
QT_c	quantity of trade and transport demand for commodity c
QVA_i	quantity of aggregate value added
QX_c	quantity of aggregate marketed commodity output
$QXAC_{i,c}$	quantity of output of commodity c from activity i
$TABS$	total absorption
$TINS_{ins}$	rate of direct tax on domestic institutions ins
$TRII_{ins,insp}$	transfers to dom. institution. insdng from insdngp
$WALRAS$	savings-investment imbalance (should be zero)
$WALRASSQR$	Walras squared
WF_f	economy-wide wage (rent) for factor f
WF_{mn}	wage rate for men workers
WF_{fm}	wage rate for women workers
YF_f	factor income
YG	total current government income
$YIF_{ins,f}$	income of institution ins from factor f
YI_{ins}	income of (domestic non-governmental) institution ins

CHAPTER 6

A CGE ANALYSIS: EFFECTS OF TRADE LIBERALISATION ON THE ECONOMY AND GENDER: FACTOR MOBILITY CONSIDERATIONS

6.1 INTRODUCTION

Using a CGE model, calibrated to the 2000 gendered South African economy, this study attempts a fuller understanding of the implications of trade liberalisation adopted by the government of South Africa on wages, income earnings, employment of unskilled, semi-skilled and skilled men and women workers, on the welfare of households, and on the economy. A simulation of a tariff reduction policy with two factor scenarios is used. The first simulation introduces a short-term analysis where capital is sectorally fixed due to rigidities but full employed. Skilled labour is fully employed and mobile across sectors. However, the reality in South Africa is that there is a high unemployment rate of unskilled and semi-skilled men and women. The simulation takes account of this situation by allowing unemployment and mobility across sectors of the unskilled and semi-skilled labour. The second simulation allows mobility and full employment of all factors of production. The study compares the two simulations and relates the results to other empirical studies done both in South Africa and in other parts of the world.

One of the most dramatic changes in the South African economy during the 1990s was the intensifying of its trade openness, which generated record growth in international trade, particularly of imports. As a consequence, changes were produced in the structure of consumption, production and employment. The effects of such changes on men and women have yet not been fully studied, but there exists a body of research that allows this study to reflect on the relation between trade liberalisation and employment, particularly the consequences as they relate to both men and women workers. The high level of unemployment in South Africa, particularly for unskilled women, clearly needs a further understanding of the markets and their effects on policy changes.

In order to simplify the interpretation of the results, sectors are grouped in specific categories as follows: capital-intensive sectors (machinery, vehicles, transportation equipments, chemicals, other chemicals, communication equipment, electrical equipment); labour-intensive sectors (textiles, apparel, leather, footwear, print, paper, wood, furniture): intermediates (petroleum, coal, mineral, chemical, rubber, plastics, metal products) and service sectors

(communication, government, finance, trade, business, transportation services). The data used for this study is fully explained in chapter 4. The low rate of gender elasticity of substitution (0.50) used implies gender rigidity in societies. This follows the low rates as used by Arndt (2001) in Mozambique and Fontana (2001) in Zambia which is a result of gender rigidities associated with many African countries including South Africa.

The rest of the chapter is arranged as follows. Section 6.2 gives the policy simulations that are carried out in this study. Section 6.3 discusses the results of the two simulations which analyse varying impacts under varying factor closure. Section 6.4 concludes the chapter.

6.2 STUDY POLICY SIMULATIONS

Simulation 1 (SIM 1): The first simulation involves a full-tariff reduction on all sectors. The tariffs refer to the nominal tariff rates, excluding any type of rebate concessions provided to certain sectors. Tariffs are applied as an ad valoreum rate to all sectors, irrespective of a sector's import weight. The assumption under SIM 1 includes the existence of unemployment with full mobility across sectors of unskilled and semi-skilled men and women while skilled men and women are assumed fully employed and mobile. On the other hand, capital is fully employed and sector-specific. This assumption reflects the employment characteristics of skills shortage and the existence of high unemployment rate of unskilled and semi-skilled labour in the South African economy.

Simulation 2 (SIM 2): As with SIM 1, SIM 2 undergoes full tariff reduction on all sectors. However, SIM 2 assumes that all factors (capital, skilled men and women, unskilled men and women, and semi-skilled men and women) are fully employed and mobile across various sectors of the economy. SIM 2 applies a neoclassical assumption of free markets characterised by full employment and full mobility of resources. The full-mobility assumption also characterises a long-term analysis where none of the factors is fixed. This assumption is in line with many studies that utilise the neoclassical assumption in their analysis. Gender advocates, however, challenge the full mobility assumption accorded to both men and women. They contend that mobility of men and women differs depending on the social, cultural, and economic conditions they encounter in their communities. For example, in most instances, household production restrains the mobility of women. Furthermore, given the high rate of unemployment, particularly of unskilled labour in South Africa, the assumption of full employment is not realistic. This has prompted many studies to relax some of the neoclassical hypotheses in order to allow for more market imperfections, such as the existence of

unemployment, price rigidities, and imperfect competition in their models. This model hence takes account of pre-existing and continuing unemployment of unskilled and unskilled labour in South Africa.

6.3 SIMULATIONS RESULTS: FULL TRADE LIBERALISATION (SIM 1)

6.3.1 Government and macroeconomic results (SIM 1)

The direct effect of full-tariff reduction on tradable commodities is the reduction of all import prices in local currency relative to domestic prices. This outcome makes imports more attractive to consumers who increase its demand while shifting away from the relative expensive domestically produced goods. Cheap imports include capital, intermediates and consumable goods hence affecting both producers and consumers. In order to maintain a current account balance, exports need to increase in order to offset the rising imports. This is achieved by the depreciation of the exchange rate and hence raising exports. Government revenue declines significantly (3.444%) due to foregone import tax thus widening the government deficit. In order to maintain the government balance, government deficit needs to be financed. Facing declining demand of their output, domestic producers react by reallocating themselves in other profitable entities, mainly exports. Increased demand for exports coupled with cheap imported inputs help producers increase production.

Increased demand of exports coupled with the availability of relatively cheap intermediates and capital imports contribute to the rise of gross domestic product (GDP). The economic expansion leads to growth of employment demand that see job creation for all skill types of men and women labour. The increased earnings for labour and subsequent increased consumption further improve the GDP. In addition, GDP benefits from high returns of sectorally fixed capital which has high initial rent, accorded to it because of its scarcity and its higher productivity. Increased earnings of factors due to improved employment help to raise income, resulting in increased private savings, which offsets reduced government savings, thus narrowing the government deficit. Furthermore, by lowering the domestic prices of importable relative to the prices of exportable, full tariff reduction raises real income which implies higher private savings rates (given a constant propensity to save), and in turn, a higher investment rate, and hence a rise in capital accumulation. The results from simulation of a tariff reduction by using a gendered South African CGE framework are consistent with the theoretical analysis.

6.3.2 General simulation results (SIM 1)

The full tariff reduction policy gives mixed results in various sectors with certain sectors gaining and others losing, depending on the sector's initial protection and its output substitutability. A reduction of domestic import prices coupled with initial import penetration ratios leads to a general increase of imports (3.2%). The greatest import rise occurs mostly in labour-intensive sectors of footwear (43.023%), furniture (25.048%), paper (26.337%), rubber (20.122%), plastics (12.634%), textiles (11.275%), and leather (10.194%). Other significant import rises occur in furniture, wood textiles, glass, apparel and other-industries (see Appendix 6, Table 6.3). Capital-intensive sectors of vehicles, transportation equipment, electrical equipment, communication equipments, beverage and tobacco experience moderate imports rises ranging from 0.2-3.5% respectively. Intermediate sectors of petroleum, coal, iron and steel, mineral, chemical, face moderate import rises. The results show that sectors with relatively high initial tariff rates do experience the greatest increase in import volumes following trade liberalisation. For example, footwear and leather with tariff rates (19.0 %; 9.3 %) witness greater import price fall (12.296 % and 10.108 %) and hence greater imports.

Imports in service sectors generally fall slightly by less than a percentage point due to their low import shares from the base year level. The only rise in import occurs in the service sector of transportation and trade. These sectors are mostly sought after in the vibrant economy by the expanding sectors because of the services they provide. Kusi (2002) indicates the existence of high protection in the service sectors of finance and insurance; however, finance experiences a decline in imports.

High imports result in a substantial decline of domestic production in the import-competing sectors (see Table 6.3 in Appendix 6). This is because producers, faced with lower net prices, choose to produce fewer import-competing goods. In addition, import represents an ample share of local consumption which signifies a negative impact on local demand for domestic production. Output decline is greatest in the labour-intensive sectors of footwear (8.466%), paper (3.658%), and textiles (2.346%), which are sectors which realised high imports while other sectors face a significant decline of around one percent. Intermediates sectors such as petrol, chemical, iron and steel see increased production since their output is required as inputs in the production process of the expanded sectors. The service sector experiences growth, following expanding sectors which demand more of its service. Trade liberalisation therefore benefits the service sector.

Because of higher initial tariff rates on final goods and a relatively high tariff on intermediate goods, sectors that experience high imports have low input usage. This implies reduced cost of production as seen by reduced producer prices, particularly in footwear (9.897%) and the paper sector (2.529%). Sectors that experience low import decline or where import holds steady expand their output. These include export-oriented sectors such as gold (2.695%) and capital-intensive sectors of transportation equipment (2.414%), communications equipment (1.42%), and scientific equipment (1.093%). Certain labour-intensive sectors (apparel, print), intermediates (coal, petroleum, other chemical) and capital-intensive (iron, machinery) which have increased exports experience a slight rise of less than a percentage point in output demand. Increased output follow mainly increased export demand coupled with relatively cheaper imports of capital and intermediate inputs. These mainly accrue to export-oriented sectors. For example, output expands in the mining, and in the capital-intensive sectors (transportation equipment, communication equipment, scientific equipment and machinery). Increased demand for products such as machinery follows its use as an intermediate product in the production process of the expanding sectors such as vehicles and transportation equipment. All of the service sectors (mainly transportation, trade, finance, and communication) expand their production, albeit slightly by less than a percentage point as the expanding economy requires their services in their production process. Trade liberalisation, therefore, has a positive expansionary impact on service sectors, which is induced by expanding and exporting sectors. In addition, growing demand of services comes from increased demand by high-income households, which are greater consumers of services.

Rising imports (3.4%) are partially paid off by rising exports (2.8%), in order to maintain the trade balance. Export rises is enhanced by the depreciation of the real exchange rate (1.2%), which is supported by the rise in imports which raise the supply of a local currency (rand) leading to the depreciation of the currency. In addition, exports benefit from declining domestic costs of production, due to lower prices of imported goods on both final and intermediate goods. The greatest rise in exports is mostly realised in the labour-intensive sectors of footwear (19.449%), plastics (6.535%), furniture (5.899%), glass (5.764%), and scientific equipment (4.086%). Other significant export increases occur with the electrical, communication, and transport equipments. Sectors such as rubber, chemicals, print, paper, wood, leather, textiles, and beverages also see export rises. Faced with a moderate reduction in domestic prices and fixed export prices, producers of exportable goods switch a portion of their sales to the export market. This occurs mostly in sectors where a large share of local production is initially exported, for example, mining sectors of coal, gold, other mining,

and in other export-oriented sectors. The only service sector with a significant export is the hotel sector because of its initial higher export shares.

The results show a concurrent rise of imports and exports in some of the commodities such as it occurs in the labour-intensive sectors of footwear, plastics, furniture, glass and apparel, etc. This phenomenon explains the existence of intra-industry trade in the South African sectors which reflects commodity differentiations among these sectors. It also partially indicates the existence of oligopolists mode of production in the economy.

The favourable export response partially offset declining local sales leading to increased total sectoral production. Declining prices of domestic commodities and cheap imports raise the quantity of composite commodities in all sectors (except leather and chemicals) which improves consumption, and hence the welfare of households.

In summary, trade liberalisation generates a clear sectoral reallocation of resources from the labour-intensive sectors where the initial tariff and import shares are relatively high in favour of export-oriented sectors such as mining, certain few labour-intensive sectors, other manufacturing and service sectors such as trade, transportation, and communication while other sectors remain relatively unaffected. Increase of exports and imports (capital and cheap intermediates) in export-oriented and service sectors help to restore domestic production.

6.3.2.1 Factors of production (SIM 1)

Table 6.4 in Appendix 6 shows the effects of full trade liberalisation on sectoral capital and labour. Tariff reduction affects employment directly by shifting output and wages. Workers, who are able to absorb the bulk of the effect through wages, are able to maintain employment. Workers, such as the unskilled and semi-skilled who are able to maintain the level of wages, are more affected in terms of employment as trade liberation pushes down wages.

Tariff reduction raises labour demand greatly in the transportation equipment (5.786%), followed with the export-oriented sectors of gold (4.601%), other-mining (2.391%), coal (2.064%), apparel (1.512%), communication equipment (2.045%), scientific equipment (2.057%), machinery (1.322%), and vehicles (0.889%). All the service sectors witness growth in employment demand largely in the transportation sector (1.977%). Increased employment demand for factors of production, including labour follows increased sectoral output and exports.

In addition, the positive effects on employment is partially explained by reduced tariffs on imported inputs, including capital which is needed to complement labour in the production process. The increased demand for these complementary factors requires demand for labour. Labour thus increases in both export-oriented sectors and in the sectors that produce commodities which are used as intermediate inputs in the production process.

Labour-intensive sectors (textiles, leather, footwear, paper, rubber, plastics, and glass) are negatively affected by full-trade liberalisation because of their inability to compete with cheap imports. As a result, they contract more relative to less labour-intensive sectors resulting in job losses. The outcome of sector contraction and job losses supports various studies done in South Africa using different methodologies and different datasets (Edwards 2002; Pretorius 2002; Fofana, Cockburn, Chitiga & Mabugu 2005; Thurlow 2006), which find trade liberalisation to have a negative impact on labour-intensive sectors.

Labour that is reduced from import-competing sectors reallocates to the expanded export-oriented and the profitable service sectors. These sectors, mainly apparel and mining, employ more unskilled workers than most of the sectors which shrunk. It is thus natural that such sectors will demand more unskilled labour relative to other skill types. Although there is no way of knowing whether the labour displaced from the import competing sectors is the same that gets jobs in these sectors, there are good reasons to believe that some labour relocates in such sectors. However, labour adjustment to trade liberalization changes comes with a cost. A certain segment of labour stays without work for some time, a situation which reduces improvement from overall GDP and has a negative impact on persons and households affected. Such effects are greater for unskilled and semi-skilled labour which has less job alternatives than skilled labour.

The effects of tariff reduction vary significantly with the skills composition of the sector workforce. The demand for all skill types falls mostly in the labour-intensive sectors due to output and sales reduction in these sectors effected by increased and relatively cheaper imports. The outcome of tariff reduction, which reduces real sales, has a negative effect on the employment of unskilled, semi-skilled and skilled labour employed in such sectors. However, employment demand of all skill types increases in agriculture and in capital-intensive sectors that have expanded their output and increased exports after the tariff cut. The service sector expands and increases its labour demand based on increased service demand by profitable sectors. The greatest increase is seen in the export-oriented mining sectors of gold (unskilled, 4.657%; semi-skilled, 4.624%, skilled, 3.999%); other-mining (unskilled, 2.488%;

semi-skilled, 2.452%, skilled, 1.840%), and coal (unskilled, 2.200%; semi-skilled, 2.169%, skilled, 1.560%). The capital-intensive sector include transportation equipment (unskilled, 6.018% semi-skilled, 5.976%, skilled 5.344%), communication equipment (unskilled, 3.043%; semi-skilled, 2.966%, skilled, 2.357%), scientific equipments (unskilled, 3.092%; semi-skilled, 3.030%; skilled%,), machinery (unskilled, 2.263%; semi-skilled, 2.226%, skilled, 1.103%), vehicles (unskilled, 1.417%; semi-skilled, 1.365%; skilled, 0.579%), and electric machinery (unskilled, 1.160%; semi-skilled, 1.105 %, skilled,%).

The service sectors which increase employment the most are transportation service (unskilled, 2.549%, semi-skilled, 2.471%, skilled, 1.864%) and trade (unskilled, 1.212%; semi-skilled, 1.092%; skilled. 0.494%). Increased employment demand in the trade service is related to the higher employment levels for all skill types from the base year level (see Chapter 4). The expanding economy induces slight employment in the construction sector (unskilled, 0.156%; semi-skilled, 0.118%, skilled, -0.480%) except for skilled labour. The greater beneficiary of employment is unskilled labour when compared with other type of skills. This might be related to their low initial wages and the expansion of work which needs low skills.

Because of the assumption of mobility coupled with unemployment, some of the unemployed, unskilled and semi-skilled labour, who are displaced mainly from the labour-intensive manufacturing sectors, find their way to expanded and exporting labour-intensive sectors (apparel, wood, furniture, other-industries), capital and intermediate-intensive sectors (vehicles, communication equipment, beverage and tobacco, transportation equipment machinery, iron, chemical non-chemicals, non-ferrous). Most labour also relocates to the service sector; in particular trade, electricity and transportation, which are sectors that have expanded their output after the policy change. These sectors, which are mostly labour-intensive and utilise unskilled labour, experience an upsurge of this type of labour. The simulation results show negligible demand changes pertaining to capital, because it is modelled as fully employed and fixed within sectors. However, capital is complemented by the unskilled, semi-skilled and skilled labour in the expanding sectors.

6.3.2.2 Results of men and women employment (SIM 1)

As with the demand for total labour, and that of all skill types, demand for men and women labour follows the direction of the output increase from various sectors. Generally, sectors that expand their output and increase their export experience a rise in employment demand for unskilled, semi-skilled and skilled men and women and vice versa. A good example of the

sector with high proportion of output exported includes gold and other mining, which includes uranium. Almost the total output (100%) of these commodities is exported.

Labour-intensive sectors, which are mostly women-intensive sectors (footwear, leather, textile, rubber, plastic, glass, and metal), see significant reduction of employment for men and women of all skill types. These sectors, which have high marginal productivity for labour, face stiff competition from imports, rendering their production inefficient. As a result, they are forced to reduce employment in order to remain profitable. Increased imports due to trade liberalisation imply competitiveness for domestic producers.

Sectors which improve and demand for men and women labour include capital-intensive (mining, transportation equipment, food, beverage and tobacco, machinery, vehicles communication equipment, scientific equipment,), intermediate-intensive (petroleum, chemicals, iron, non-ferrous), and labour-intensive (apparel, wood, furniture, and other-industries, print) sectors. The greatest rise occurs in the transportation equipment sector (unskilled men, 6.007%, unskilled women, 6.092 %; semi-skilled men, 5.976 %, semi-skilled women, 5.982%; skilled men, 5.341%, skilled women, 5.374%), gold (unskilled men 4.655%, unskilled women, 4.738%; semi-skilled men, 4.624 %, semi-skilled women, 4.630%; skilled men, 3.997%, skilled women, 4.029%), other-mining (unskilled men, 2.483%, unskilled women, 2.564 %; semi-skilled men, 2.452 %, semi-skilled women, 2.458%; skilled men, 1.838%, skilled women, 1.870 %), and communication equipment (unskilled men, 2.994%, unskilled women 3.076%; semi-skilled men, 2.963 %, semi-skilled women, 2.969%; skilled men, 2.347%, skilled women, 2.378%). The scientific equipment sector (unskilled men, 3.057%, unskilled women, 3.139%; semi-skilled men, 3.026 %, semi-skilled women, 3.032%; skilled men, 2.409%, skilled women, 2.441%), and transportation services sector (unskilled men 2.501%, unskilled women, 2.583%; semi-skilled men, 2.471%, semi-skilled women, 2.476%; skilled men, 1.857%, skilled women, 1.888%) also expand their demand fro labour. All other sectors that raise their employment demand have a range of between 0.1% and 1%. The same explanation as with the other skill types rise applies.

Trade liberalisation raises the demand for unskilled men and women in the service sectors, with a significant rise in the transportation, trade and communication services. The increased demand of employment in the service sectors is derived from an expanding economy that stimulates production in the service sector by increasing the demand of its services. Reallocation of unskilled men and women labour to the services sector is expected because the sector is the largest employer of all skill types. Most unskilled, particularly unskilled

women, encounter fewer barriers to entry in the service sector relative to other sectors, albeit at the lower level of employment (Leresche 1993; Valodia 1996). The service sector, however, is very heterogenous; while some work is labour-intensive and low-paying, other types of work are characterised as high productivity, technological innovative and high-paying work, which require higher educational levels. This is contrary to the popular belief of easy entry, especially of women into the service sectors. Making a distinction within sectors shows that easy entry only applies to certain service sectors.

The demand for semi-skilled men and women labour is similar to that of unskilled men and women. However, the results show minor differences between semi-skilled men and women labour when compared with that between unskilled men and women. This can be attributed to the differences in the initial wages accorded to men and women which tends to favour men. In addition, most women predominate in lower value-added positions in most sectors. The higher initial level of unemployment faced by women coupled with mobility allowed in the model, help to absorb them in the expanding economy.

6.3.2.3 Wages and income of factors (SIM 1)

The results show an economy-wide wage increase for skilled men (1.080%) which slightly exceeds that of skilled women (1.017%). Wages for unskilled and semi-skilled men and women labour is sectorally fixed at their base year level and therefore show no changes following the policy shock. Changes in unemployment, wages, and factor allocations affect the total income accruing to a particular factor. Figure 6.1 shows the percentage changes in earnings of capital, and that of men and women labour. The return to capital is higher (2.059%) benefiting from the increase of the value-added price of most capital-intensive sectors. This is followed by the income earnings of skilled men (1.154%) and skilled women (1.061%). Unskilled men earning rises too (1.042%) and exceeds that of unskilled women and semi-skilled men and women. This is because unskilled men obtain most of their earnings from a profitable mining sector. The income of unskilled women rises by a mere 0.028%, due to employment loss mostly in labour-intensive sectors which is not offset by employment gains in the capital-intensive sectors, other labour-intensive, intermediate-intensive and service sectors where they relocate. This is because unskilled women reallocate to low-paying positions in these sectors.

The low income for women workers has negative implications for low-income households that derive most of their earnings from unskilled women. Unskilled men are largely employed in

export-oriented sectors such as coal, gold, other mining, iron and steel, non-ferrous minerals etc., which benefit from trade liberalisation as seen by the increased value added prices leading in higher earnings for the workers.

On the other hand, skilled women benefit from trade liberalisation as their income rises and exceeds that of semi-skilled and unskilled women. Income earning for skilled men and women differs slightly and almost equalises. This reflects high payments obtained by skilled women in various sectors including the men-intensive sectors of mining where very few women hold high-paying jobs. While there appears to be an equalisation between skilled men and skilled women, there is a wider earning gap between unskilled men and unskilled women. This study concludes that in South Africa, trade liberalisation results in more positive employment benefits for skilled women than unskilled and semi-skilled women.

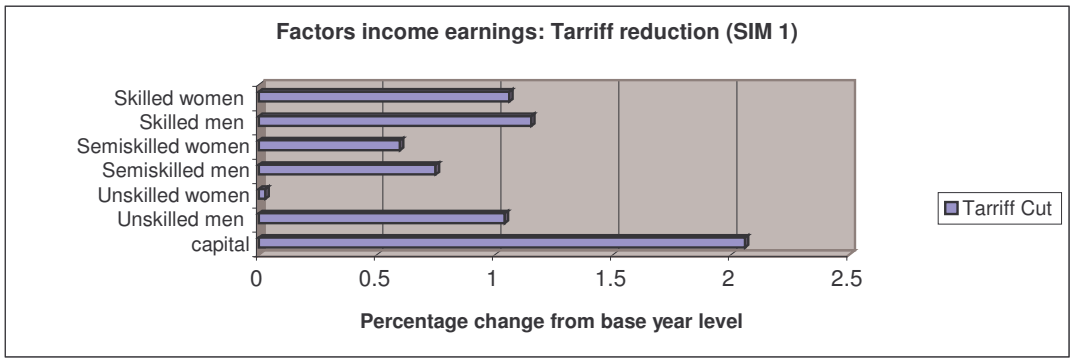


Figure 6-1 Percentage factor earnings men and women after tariff cut

Source: Simulation results

Household welfare measured by equivalent variation (EV)

In this chapter, household welfare is measured by the equivalent variation (see Chapter 5 for explanation of EV as a measure of welfare). Trade liberalisation causes varying welfare effects among households depending on the household's source of income and the type of household expenditures (see Figure 6.2). However, all households benefit due to tariff reductions, particularly middle-income to high-income households. Low-income households benefit mainly from reduced prices of the labour-intensive products which represent most of their expenditures (e.g. textile, footwear). In addition, they gain mainly from increased unskilled men's earnings from exporting sectors, and from the expansion of construction and transportation services that employ a good percentage of unskilled men. These sectors, however, utilise low levels of unskilled women labour. Therefore, low-income

households that depend mostly on unskilled women earnings benefit less than those that obtain most of their income from other types of labour. High-income households benefit the most because of better earnings from capital and skilled and semi-skilled labour. These households, however, gain less from price decline because their consumption basket includes services such as hotel and finance that did not necessarily face reduced prices due to their low initial import shares.

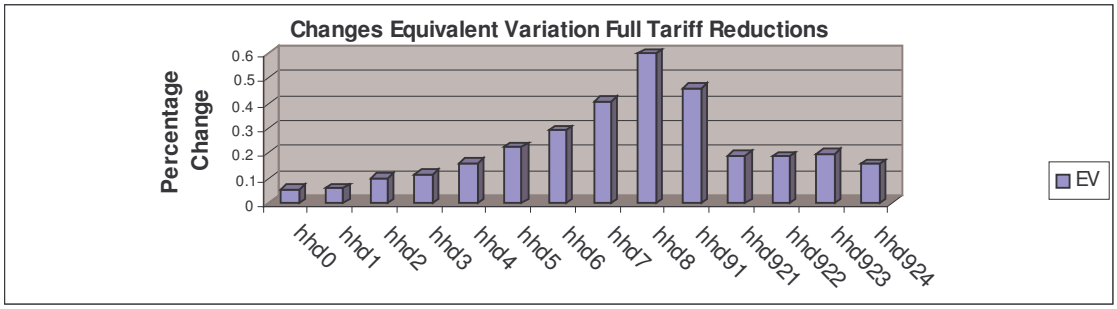


Figure 6-2 Equivalent variation (EV): fixed capital (SIM 1)

Source: Simulation results

6.3.3 Full tariff reduction: full employment and mobile factors (SIM 2)

6.3.3.1 Results (SIM 2 versus SIM 1)

Macroeconomics for SIM 2 is similar as that for SIM 1 except for the magnitudes. GDP at factor cost increases more for SIM 1 than for SIM 2 because more labour is employed in SIM 1. This follows an assumption of unemployment associated with unskilled and semi-skilled labour in SIM 1 which gets absorbed in the production process. The relatively less return for capital with SIM 2 compared with SIM 1 is based on capital mobility chasing higher returns which do not materialise.

SIM 2 imports rise but at a higher rate than with SIM 1. More imports rise with SIM 2 is due to full mobility of all factors which enables greater response (see Table 6.2 for results of 49 sectors). Imports rise in all sectors except in the export-oriented sectors of coal and gold. The greatest rise with both SIMs occurs in footwear (SIM 1, 40.631%; SIM 2, 63.09%), in paper (SIM 1, 25.348%; SIM 2, 32.08%), furniture (SIM 1, 24.788%; SIM 2, 26.13%), and rubber (SIM 1, 19.464%; SIM 2, 21.05%). Same reasons regarding the rise of imports for SIM 1 applies for SIM 2.

Both SIM 1 and SIM 2 realise import decline in export-oriented sectors and in service sectors,

with more decline occurring with SIM 2 than with SIM 1. This is due to added responses with SIM 2 made possible by full mobility of all factors of production. The exchange rate depreciates more in SIM 1 (1.4) than in SIM 2 (0.7), with subsequent greater rise of exports for SIM 1 relative to that for SIM 2. There are major differences with export performance from both simulations, for example, in textile (SIM 1, 7.071; SIM 2, -0.8); apparel (SIM 1, 7.214; SIM 2, 3.288); leather (SIM 1, 7.071; SIM 2, –9.96), and footwear (SIM 1, 19.449; SIM 2, –13.1), respectively. While SIM 1 witnesses a general rise of exports, SIM 2 realises an export fall mainly in the above-mentioned sectors together with the sectors of paper, chemical, plastic, metal product, hotel, business and finance services. SIM 2 witnesses a rise of exports only in capital-intensive sectors, unlike with SIM 1 where capital was sectorally fixed. In addition, reduced domestic production, due to high imports associated with SIM 2, reduces exports with SIM 2 in certain sectors. Similar to SIM 1 where export rises in all service sectors, SIM 2 see exports rise except for hotels, business and financial services, which are sectors with initial low export shares.

Output price falls in the agricultural and labour-intensive subsectors with both simulations causing their output to decline. Initial high protection rates, especially with labour-intensive sectors causes this. While the output of import-competing sectors falls, the production of export-oriented sectors rises. With both simulations, output holds steady or rise in the mining sectors and for only SIM 1 output also rises in all service sectors. As a result, output decline in the agricultural and labour-intensive manufacturing sectors is partially offset.

Prices of domestic commodities do not fall enough to offset the demand for relatively cheaper imports, and with both simulations domestic output demand declines. SIM 2 contracts more than SIM 1 because of full mobility of all factors that enables higher responses. Prices in the service sector rise with both SIM 1 and SIM 2 causing all service sectors' output to fall, mainly in SIM 2. With SIM 1, all other services output increases slightly by less than half a percentage point, except for transportation (0.919%) services which exceed that level. The transportation service is highly sought after by the expanding sectors which prompt its expansion.

With SIM 2, value-added prices rise in all subsectors of agriculture, in mining sectors (gold, coal and other mining), in labour-intensive sectors (apparel, leather, footwear, paper), capital intensive (chemicals, transportation equipment, and scientific equipments) and in service sectors. With SIM 2, value added falls in all service sectors except in transportation services where it rises by 1.502%. Value added rise greatly in gold 3.343%, other mining

6.388%, and leather 24.84%. With SIM 1 value-added prices drop in labour-intensive sectors of leather, footwear, paper and chemicals which explains low factor earnings from these sectors. With SIM 1, value added slightly rises in all service sectors except in the transportation services where it rises significantly.

Expansionary sectors raise the demand for intermediate inputs in both simulations, particularly for SIM 2 compared with SIM 1, for example, machinery (SIM 1, 1.063%; SIM 2, 1.999 %), communication (SIM 1, 0.292%; SIM 2, 1.664%), electricity (SIM 1, 0.011%; SIM 2, 0.092%) and transportation services (SIM 1, 0.998%; SIM 2, 1.502%). Intermediates are needed more in the expanding sectors and this is facilitated by the mobility of capital that moves from the contracting to the expanding sectors. In addition, intermediates are needed to match the demand for value-added since they are used in the same proportions in the production process which explains similarities in their similar rising levels.

Figure 6.3 shows the difference in output between SIM 1 and SIM 2. The results are different when there is a labour surplus and the labour market is in disequilibrium as with SIM 1. The figure shows improvement in production with both SIMs because of relatively cheaper imported inputs which includes capital. However, the output of some sectors decline partially because their prices are not competitive with cheap imports. As a result, these commodities are substituted by cheap imports and lead to a reduction in the demand for labour. With full employment of all factors (SIM 2), variations in output only come from the reallocation of resources among sectors and are relatively small. However, with SIM 1, increased production is delivered from the employment of surplus unemployed labour of the unskilled and semi-skilled men and women coupled with cheap intermediates imports.

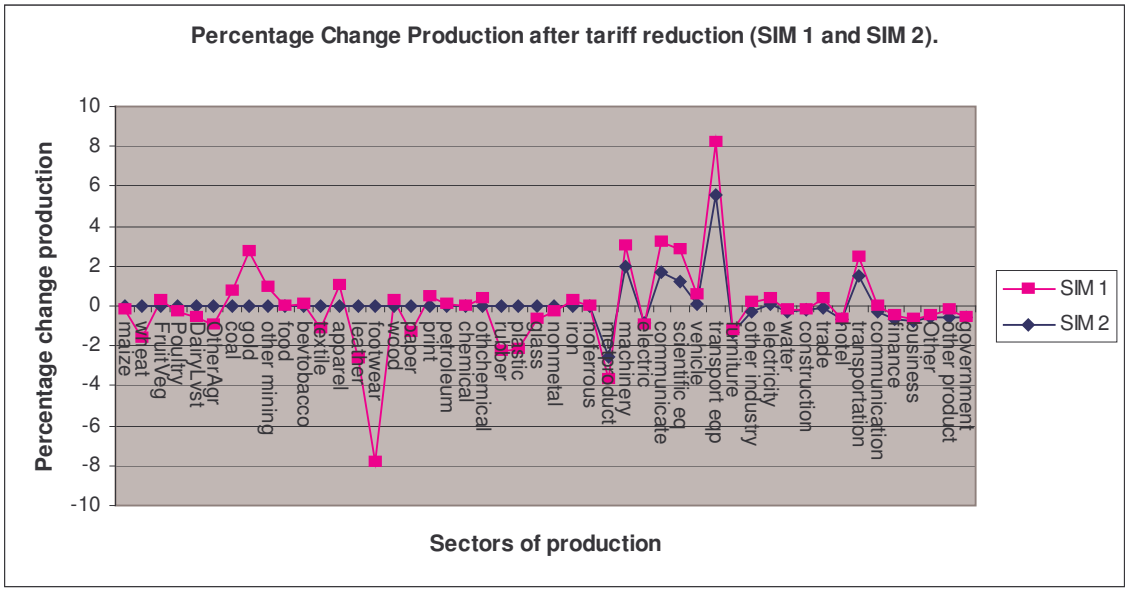


Figure 6-3 Percentage change production after tariff reduction

Source: Study simulation results

6.3.3.2 Factors of production (SIM 2)

As with SIM 1, results from SIM 2 show trade liberalisation to have a differential impact on sectoral employment, with employment opportunities created in some sectors while being lost in others. The allocation of factors follows the patterns of change in relative prices. As prices of domestic import-competing goods and output fall relative to their base-year level, their production also falls as they are substituted by imports resulting in low demand for factors.

Unlike SIM 1 where capital is sectorally fixed, with SIM 2 capital is mobile and its demand largely declines in labour-intensive sectors of leather and slightly in the capital-intensive sectors of food, beverage tobacco, paper, and chemicals (see Table 6.1 in Appendix 6). However, capital demand rises in the capital-intensive export-oriented sectors whose output has increased.

Only the service sector of electricity increases the demand for capital due to increased demand for its export. In general, the import-competing sectors reduce demand for capital, while the export-oriented sectors increase capital demand. This shows that exports are capital-intensive in South Africa. In an attempt to compete in both domestic and international markets sectors seek for the cost effective ways of production. Capital utilisation is preferred as a relatively efficient factor because of its low per unit cost compared with labour.

As in SIM 1, but with lesser magnitude, SIM 2 witnesses a rise of labour in export-oriented mining sectors, except for the other-mining where SIM 2 labour demand exceeds that of SIM 1. Labour rises in these sectors to provide services due to their expansion and increased exports. Unlike with SIM 1 where labour rises in capital-intensive sectors, with SIM 2 labour declines in these sectors with the greatest decline occurring in the paper sector (SIM 1, -2.284%; SIM 2, -6.316%). The only rise occurs in the transport equipment sector; the SIM 2 rise exceeds that of SIM 1. The mobility of capital allowed with SIM 2 allows capital to replace labour in the capital-intensive sectors.

As with SIM 1, but with lesser magnitude SIM 2, witness rising demand for labour in the intermediate-intensive sectors of petroleum. As with SIM 1, but with greater magnitude, total labour declines for SIM 2 in all labour-intensive sectors except in the apparel and machinery sectors. Labour rises in the apparel sector, because it is both import-competing and exporting sector. Thus, labour decline due to increased imports of apparel is offset by increased labour demand due to its increased export demand. Labour rises in the machinery sector follow its use as an intermediate input in the expanding sectors of vehicles, transport equipment and transportation services. Both SIMs increase labour in these sectors with a large scope for SIM 2 compared with that of SIM 1 (see Figure 6.5 and 6.6). However, in the labour-intensive sectors demand in all sectors declines with SIM 2 while it rises with SIM 1. This is partially explained by the mobility of capital allowed with SIM 2, which substitutes labour in those sectors.

In terms of skills, both SIM 1 and SIM 2, but with greater magnitude for SIM 2, show a demand for unskilled labour in export-oriented sectors. Unlike SIM 1, SIM 2 slightly demands unskilled labour in capital-intensive sectors because of allowed mobility of capital with SIM 2 that displaces labour in these sectors. With SIM 2, the demand for unskilled labour falls in the intermediate-intensive sectors, unlike with SIM 1 that faces a high demand for unskilled labour. This shows the high capital intensity use in the intermediate sectors.

With both SIMs, unskilled labour falls greatly in the labour-intensive sectors which are import-competing sectors. The highest fall with both SIMs is in leather and footwear although the falling magnitude for SIM 2 exceeds that for SIM 1. With both simulations, a reallocation of workers takes place mostly from manufacturing to service sectors. The service sector expands due to trade liberalisation and during this process, women appear to be the preferred labour supply.

The growth in demand for skilled labour with SIM 2 exceeds that for unskilled and semi-skilled. It rises significantly in the transport equipment sector (5.734%), and mostly in the export-oriented sectors, chiefly in other-mining, apparel and machinery. Machinery is a highly productive sector which requires skilled labour. The reason for this phenomenon is the complementarity associated with skilled labour and capital.

With SIM 2, however, demand for skilled labour greatly declines in contracting labour-intensive sectors, particularly footwear, leather and textile.

SIM 2's results indicate the complementarities of capital and skilled labour with skilled labour rising in sectors where capital has risen and vice versa. For example, skilled labour rises more than semi-skilled and unskilled labour in export-oriented sectors which are mostly capital-intensive sectors. The increase in exports benefits skilled labour more relative to unskilled labour. This result is different from SIM 1 where the demand for unskilled labour is higher than with that of semi-skilled and skilled labour. With SIM 1, the assumption of the existence of unemployment for semi-skilled and unskilled labour enables an expanding economy to absorb the unemployed labour. SIM 1 finding reflect differing results from other studies that find trade liberalisation to have a skills bias in South Africa; results of SIM 2 supports it. SIM 2 results imply the complementarity between skills and capital.

6.3.3.3 Women and men employment (SIM 2)

Men and women employment follows the pattern of total labour in terms of effect after the shock. Both SIM 1 and SIM 2 show an increase in unskilled men and women in the export-oriented sectors of mining with growth of women demand exceeding that of men in all three mining sectors. Magnitudes for SIM 2 are lower than that of SIM 1, especially for men. This is due to the stipulation of unemployment with SIM 1, which is greater for women, hence raising their absorption in the expanding economy. With SIM 2, unlike in SIM 1, there are varying results between the demand of men and women in capital-intensive sectors. With SIM 1, all sectors see a rise in unskilled men and women labour with unskilled women rising more than men. This outcome is different from that with SIM 2 where only women unskilled labour rises while the demand for unskilled men falls, mostly in all capital-intensive sectors. The rise of unskilled women with SIM 1, generally exceeds the rise with SIM 2, due to considerations of unemployment with SIM 1. This follows more output produced when unemployed men and women are put to work.

Unlike with SIM 1, where unskilled men and women labour increases in the intermediate-

intensive sectors, with SIM 2 unskilled men labour falls while the demand for unskilled women labour rises due to women being more affordable than unskilled men. This follows increased use of cost saving factors such as capital and unskilled women labour in the intermediate-intensive sectors.

With both SIMs, employment for both unskilled men and women falls in all labour-intensive sectors. With SIM 2, labour demand rises for unskilled women while it declines for unskilled men in sectors of apparel, electrical equipment, wood and in other industries. At the same time, these industries experience a rise of employment for both men and women with SIM 1.

Simulation results in the service sectors vary between SIM 2 and SIM 1. With SIM 1, labour rises in all service sectors, mostly in the transportation services, trade and electricity, with a slightly higher demand of women compared with men. This outcome follows the higher rate of women employment in the service sector from the base year level. With SIM 2, men and women labour falls in sectors of finance, business, hotel, while only men labour falls but women labour rises in sectors of water, trade, communication, and other-services. Both SIM 1 and SIM 2 see significant women and men labour rise in the expanded transportation service sector with a slightly higher rate for women than for men.

As with SIM 1, but with lesser magnitude, SIM 2 increases demand for semi-skilled men and women in the exporting sectors. As in SIM 1 women demand exceeds that of men. Unlike in SIM 1, where semi-skilled men and women labour rises in the capital-intensive sectors, with SIM 2 semi-skilled men and women rise in the transportation equipment; SIM 2 demand exceeds that of SIM 1. Labour rise in the intermediate sectors of iron and petroleum occurs with less magnitude in SIM 2 than with SIM 1. This is related to increased output and exports demand of these two sectors. However, SIM 2 demand exceeds demand for SIM 1 in the other intermediate-intensive sectors with a slight rise of women compared with men in all sectors.

Both SIMs show a declining demand for semi-skilled men and women labour in the labour-intensive sectors except in the apparel and machinery sectors. Due to full mobility of factors that gives greater responses, the magnitude of decline for men and women is greater for SIM 2 than with SIM 1, especially in the footwear and leather sectors. This result is the same as that of unskilled men and women in labour-intensive sectors.

Regarding skilled men and women, their labour demand falls greatly in the labour-intensive sectors, especially in footwear (skilled men 24.977%; skilled women 24.851%) leather (skilled men, 15.923%; women 15.782%), paper (skilled men 6.421%; women 6.264%),

textile (skilled men, 4.680%; women 4.520%), and slightly in wood and other industries by less than a percentage point, with women demand falling slightly less than the demand for men. However, the apparel sector see a rise of skilled men and women given the sector's increased export demand (see Table 6.1 in Appendix 6).

Skilled men and women demand rise in the capital-intensive sectors especially in the transportation equipment (skilled men, 5.716%, skilled women, 5.893 %), with significant rises in the vehicles, electrical equipment, non-ferrous, scientific equipment, and communication equipment.

There are mixed results concerning skilled labour demand in the intermediate-intensive sectors. Moderate labour demand occurs in sectors of coal and iron while rubber, metal and chemical sectors experience moderate reduction of skilled men and women labour. The contraction and expansion of sectors necessitates such a situation.

The biggest winner from trade liberalisation in terms of increased output and relative output prices are the mining sectors (gold, coal and other mining) given their strong positive export response and their large initial export shares. The losers are sectors with the original higher levels of protection which experience the brunt of price fall. These are mainly labour-intensives sectors and with mobility allowed in the model, factors of production move from contracting import-competing sectors towards the mostly expanding export-oriented sectors. Therefore, while jobs are lost due to imports, employment gains are made through exports. However, export led employment is not enough to offset the job losses mostly in the manufacturing sectors.

6.3.3.4 Wages and income of factors of production (SIM 2)

The results of the simulations on wages appear in Figure 6.4. The results show that economy-wide wages rise for all skill types of men and women, particularly wages of men. Women wages rise moderately except for unskilled women who see a negligible wage rise, because they are concentrated in low productivity and low-paying positions, and thus have low wages rises. The negligible increase of unskilled women wages widens the unskilled men-women wage gap due to a more positive effect on men real wages than on women real wages.

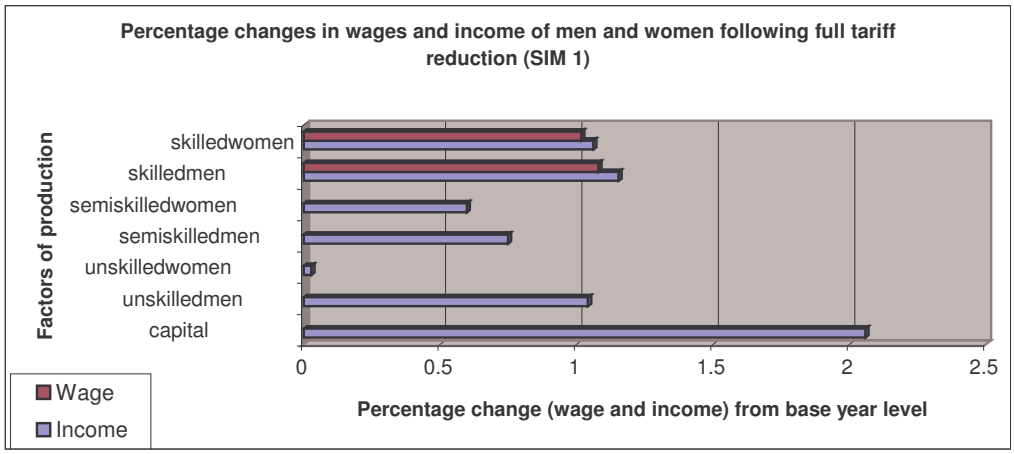
The expanding economy requires more factors of production which necessitates higher wages. Increased wages results in higher income earnings for all the skill types of men and women with skilled men benefiting the most. This is despite the fact that there is more demand for

unskilled women labour. Income earnings for semi-skilled men and women and unskilled men rise, while unskilled women see insignificant income earnings. This follows the concentration of unskilled women in shrinking labour-intensive sectors and their reallocation to sectors with low value-added prices leading in low pay.

Despite significant growth in women labour demand, their earnings do not rise because they are in low-paying positions. For example, in the vehicle sector, women are located mainly in the components section which offers low pay compared with men who are located mostly in the assembly line that pays higher wages. In the service sectors, women are mostly waitresses, maids, and data entry personnel.

Unskilled men receive income from export-oriented mining sectors where there is labour demand and wage increase. Semi-skilled women and skilled women benefits from trade liberalisation because their wages and earnings increase albeit less than the increase for men. The rent for capital increases significantly (1.364%) in SIM 2. The argument that increased openness to trade will reduce wage gaps between men and women based on discrimination (Becker 1971), only works for the skilled men and women labour in South Africa.

Differences in income between SIM 1 and SIM 2 favours SIM 1 which has assumptions of unemployment. Because of the presence of initial unemployment in unskilled and semi-skilled men and women labour markets, and because the overall scenario generates a higher level of demand for unskilled labour, it thus further increases total production and wage income due to general equilibrium effects. An abundant supply of unskilled labour in the South African economy means that workers can be drawn into production with no increase in wages or prices.



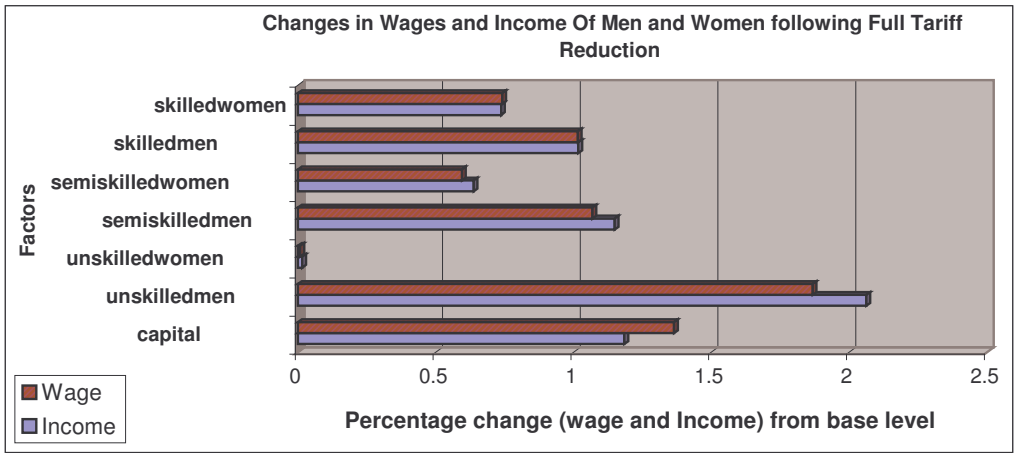


Figure 6-4 Percentage change wages and income earnings of men and women workers

Source: results from own study simulations

6.3.3.5 Household equivalent variation (EV)

As with SIM 1, SIM 2 results in improvement of household welfare as measured by the equivalent variation. The benefits, however, accrue more to low-income and middle-income households while rich households' welfare falls. This is because poor households consume most of the commodities that have experienced falling prices on the domestic market. For example, the reduction of tariffs on consumable goods such as clothing and food benefits poor households since they spend a large share of their expenditure on these goods. In addition, low-income households derive most of their income from export-oriented mining industries and basic metals which have expanded and increased exports.

The expanded transportation service sector, a highly sought-after services following improvement of the economy due to tariff reduction, also benefits low-income households which are comprised of unskilled workers who are mostly associated with the transportation service.

In addition, an economy-wide rises in income earnings due to increase in real wages of all skills except for the unskilled women labour enables increased consumption. High-income households are negatively affected by the tariff fall despite increased income. This happens because they increase personal savings due to reduced government savings brought about by loss of government revenue. This reduces consumption of high-income households in comparison with low-income households. In addition, high-income households are affected by rising prices of goods that they mostly purchase such as hotel, and transportation

services, finance, business, etc. This is because high-income households consume more of services than other types of households.

6.3.4 Comparison: Fixed factors vs. full employed and mobile factors

As shown in Figure 6.5, employment of unskilled men and women under the two simulations produces varying effects. Unskilled men and women gain employment more in SIM 1. As with SIM 1, but with lower scope in SIM 2, sectors with high export-intensity attract labour, particularly women unskilled labour. These include coal, gold, other-mining, iron and steel, transportation equipment and to some extent vehicles. With both simulations, the labour-intensive sector of apparel, print, petroleum, machinery, communication, scientific and transport increases the demand for unskilled employment given their improved export demand. Intermediates such as machinery, communication equipments, and transportation equipment raise labour demand in the same way as in SIM 1.

Concerning unskilled men and unskilled women, women labour increases while that of men falls in apparel, wood, print, petrol, other-chemical, non-metal, iron, non-ferrous, machinery, electrical machinery, furniture and other industries. However, results show job shedding in textile, leather, footwear, paper, rubber, plastic, glass for both unskilled men and women mostly with SIM 1. Employment of unskilled women increases more than that of unskilled men in communication and scientific equipments, vehicles, and transportation. Major men-women differences do not occur in SIM 1 but they are rather pronounced in SIM 2 (see Figure 6.6) because of high response. This shows the importance for taking into consideration factor mobility and unemployment when designing trade liberalisation policies.

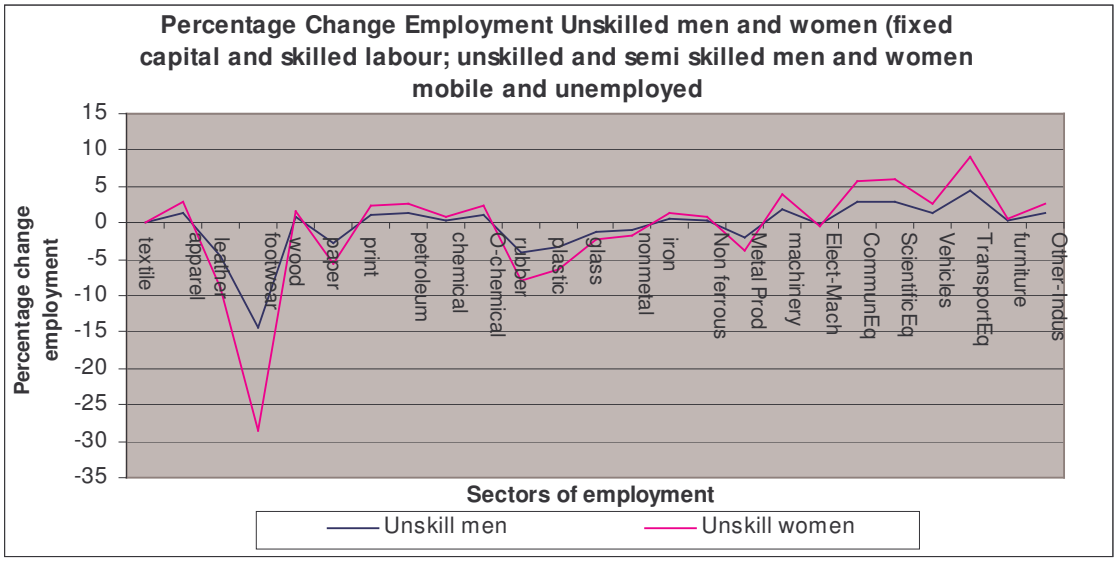


Figure 6-5 Percentage change employment unskilled men and women (SIM 1)

Source: Simulation result.

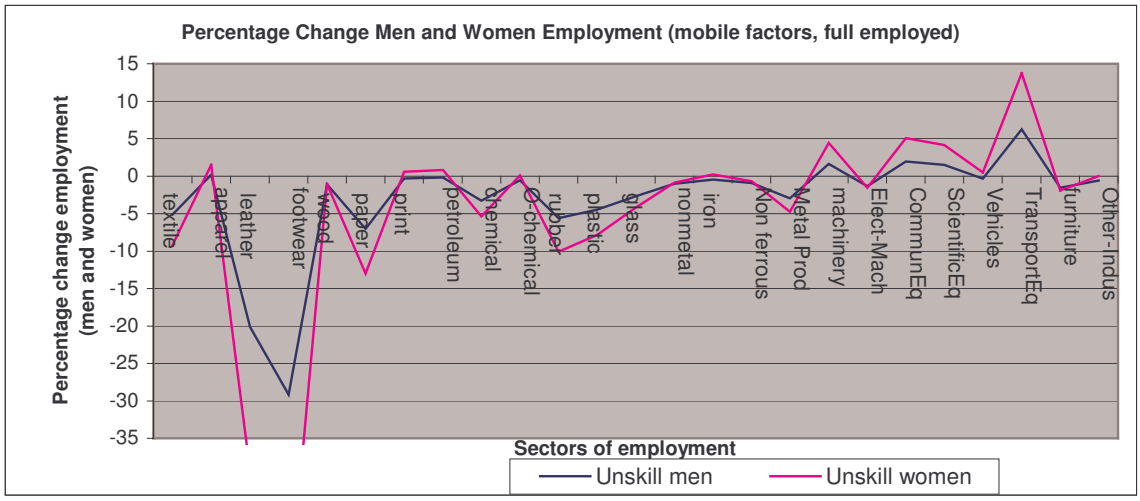


Figure 6-6 Percentage change men and women employment

Source: Simulation results.

6.4 CONCLUSION

The increase in the degree of openness of the South African economy (full trade liberalisation) generated significant changes in employment and wages. Most of the tradable good sectors lost employment, because either their activity fell, or their labour productivity had to be increased in order to face foreign competition. The sectors that decreased their

activity levels were those in which wages are lower and labour is generally less skilled than the average in many sectors. Men and women workers displaced in mostly labour-intensive manufacturing sectors were absorbed by other manufacturing and the service sectors such as retailing, trade, hotel and other services. The labour-intensive sector, that incorporated a significant part of the displaced workers, includes mostly women employment sectors, for example the apparel sector. Generally speaking, the women labour force seems to benefit by the trade liberalisation. Despite losing their jobs in labour-intensive sectors, some were able to regain employment in labour-intensive and in capital-intensive sectors which expanded and which increased exports. The re-allocation to service sectors is because the sector is the greatest employer of mainly unskilled men and women labour.

The results show that trade liberalisation creates winners and losers among sectors, among gender and among different type of skills. This occurs as the economy adjusts to changes in export and import prices and other trade-induced changes. All skill types except for unskilled women emerge as winners in terms of their improved earnings. Unskilled women, however, benefit the most in terms of employment after the policy change, but gain the least in terms of income earnings. This is because women job losses, mostly in labour-intensive sectors of textile, and leather are not completely offset by their job gains in low-paying positions.

The effort made by South African women to increase their skills seems to have placed them in an improved position to face the new economic challenges. The results indicate improved wages and income earnings for skilled women albeit slightly less than that of skilled men. However, the great share of unskilled and semi-skilled women groups have been adversely affected by the trade reforms. Specifically, results show sectors such as textile, footwear, leather, and plastics which are sectors employing a substantial amount of women, as having significantly contributed to the loss of employment.

Specifically, sectors that benefit due to tariff reduction are capital-intensive sectors (mineral-based processing, plastics, metal products, and transportation equipment), intermediate-intensive (iron and steel), labour-intensive sectors (apparel, furniture) and natural resources sectors of mining (coal, gold, and other mining) due to increased demand of their exports which results in increased demand for labour. The export-oriented sector of mining benefits men more than women, because the sector is highly men-intensive. Although the results show an increasing demand for women in the mining sectors, those jobs are concentrated at the low levels of clerks and general services. After disaggregating labour in the mining sector, there was no indication of women workers in the underground mining nor are there significant

levels of skilled women labour in areas of metallurgist, mining engineers, accountants, etc. By the year 2009, however, mining sectors would be required to have a 10% level of women labour which is a requirement under the government mining charter.

The losers are import-substituting sectors, which are mainly labour-intensive sectors (textiles, footwear, leather, wood, furniture, plastics, rubber, glass); they contract because they are unable to compete with increased imports. The textile industry contributes the most to employment loss in manufacturing. The greatest reduction in employment is generated in sectors that made an import-oriented adjustment, through the displacement of domestic supply by the growth of imports.

This outcome has negative employment effects on unskilled women who are mostly employed in these sectors. This results in the loss of income by low-income households that derive most of their income from unskilled women.

The study shows variation in the labour market specification that affects the predicted impacts of a trade policy. For example, by taking into account the presence of unemployment for both unskilled and semi-skilled labour, the CGE model produces a significant impact on the results for employment and factor income earnings. Gains in employment and factor income earnings improve with the presence of unemployment, depending on the competitiveness of sectors that use unskilled and semi-skilled labour. The increase in demand for labour absorbs previously unemployed unskilled labour into the production process. The presence of initial unemployment enables trade liberalisation to increase labour in the agricultural, manufacturing and service products based on the extra advantage that the economy gains when wages are constrained by unemployment.

The sensitivity analysis suggests that models that do not acknowledge unemployment (SIM 2) in a country like South Africa, which has high levels of unemployment, understate to a significant degree gains that will be realised from competitive sectors. This potentially minimises the negative impacts on less competitive sectors.

The results from full trade liberalisation simulations show that the magnitude, and nature of employment income and GDP changes, depends on the microeconomic and macroeconomic state. Using appropriate assumptions concerning labour mobility is essential for assessing the expected gains from liberalisation. Factor mobility is a needed to achieve efficiency gains, but as SIM results show, gains do not necessarily rise with increasing mobility.

The main findings of this study indicate an existence of a big gender gap, especially between unskilled men and women which is an adverse to women. This could be explained by the concentration of unskilled men in the major exporting sector of mining while women concentrate in low paying positions in many sectors. In addition, there are initial low levels of women in many sectors.

The wage gap between skilled men and women, albeit small, could not easily be explained, which raises the issue of wage discrimination against women. The gender composition of employment shows significant differences by sector. For example, about 70% women work in personal services and retail sectors, in contrast to only 30% of men. These sectors pay lower wages than the other sectors and, due to market segmentation, the women work in the low-wage segment while men work in the high-wage segment. On the other hand, whereas over 90% of men work in natural resource export-oriented sectors, less than 10% of women workers do so. Women thus gain less in such high paying sectors compared with men who concentrate the sector.

All types of households show welfare improvement especially for high-income households that derive most of their income from capital and skilled and semi-skilled labour. This is particularly true for men who benefit from sectors that expand and increase exports. Low-income households benefit from increased employment of unskilled labour, which earns income derived from expanding sectors of construction, transportation services, and export sectors such as mining. The presence of additional productive factors increases production and income and in turn improves households welfare.

APPENDIX 6 (A)

Table 6.1 Percentage change factors: all factors full employed and mobile (SIM 2)

	Capital	Total labour	Unskillec labour	Semiskille labour	Skille labour	Unskillec Men labc	Unskilled Women	Semiskille men	Semiskille men	Skille men	Skille wome
Maize	-0.346	-0.056	-0.177	-0.008	0.014	0.537	0.806	-0.062	0.205	-0.017	0.151
Wheat	-3.559	-3.208	-3.247	-3.194	-3.183	-3.743	-2.443	-3.284	-3.025	-3.241	-3.078
Fruit vegetables	-0.698	-0.371	-0.378	-0.357	-0.337	-0.889	0.451	-0.415	-0.148	-0.370	-0.203
Poultry	-0.805	-0.559	-0.686	-0.412	-0.424	-0.995	0.342	-0.522	-0.256	-0.477	-0.31
Dairy livestock	-1.608	-1.386	-1.549	-1.298	-1.225	-1.797	-0.470	-1.328	-1.063	-1.283	-1.117
Other agriculture	-3.025	-2.467	-2.314	-2.686	-2.657	-3.210	-1.903	-2.748	-2.487	-2.704	-2.541
Coal	0.491	0.552	0.323	0.799	0.844	0.298	1.654	0.777	1.048	0.823	0.992
Gold	3.383	3.326	3.23	3.691	3.739	3.185	4.579	3.678	3.956	3.725	3.899
Other-mining	6.381	6.402	6.263	6.702	6.743	6.177	7.611	6.684	6.97	6.732	6.911
Food	-0.029	0.020	-0.093	0.121	0.126	-0.418	0.928	0.058	0.326	0.103	0.271
BeverageTobacco	-0.431	-0.32	-0.532	-0.207	-0.198	-0.750	0.591	-0.276	-0.009	-0.231	-0.064
Textile	-4.829	-4.787	-4.859	-4.582	-4.644	-5.176	-3.895	-4.723	-4.468	-4.680	-4.520
Apparel	0.158	0.691	0.73	0.616	0.576	-0.034	1.317	0.444	0.713	0.489	0.658
Leather	-16.20	-15.71	-15.59	-15.86	-15.86	-16.36	-15.23	-15.96	-15.74	-15.92	-15.78
Footwear	-25.012	-24.71	-24.6	-24.9	-24.92	-25.37	-24.36	-25.01	-24.81	-24.98	-24.85
Wood	-0.791	-0.744	-0.865	-0.59	-0.548	-1.104	0.232	-0.632	-0.366	-0.587	-0.42
Paper	-6.813	-6.316	-6.222	-6.404	-6.354	-6.908	-5.650	-6.463	-6.213	-6.421	-6.264
Print	-0.894	-0.655	-0.786	-0.646	-0.61	-1.194	0.141	-0.722	-0.456	-0.677	-0.510
Petroleum	-0.103	0.128	-0.027	0.172	0.209	-0.329	1.018	0.147	0.415	0.192	0.360
Chemical	-2.83	-2.584	-2.789	-2.509	-2.492	-3.016	-1.705	-2.553	-2.291	-2.508	-2.345
Other-chemical	-0.519	-0.152	-0.136	-0.160	-0.158	-0.710	0.632	-0.236	0.032	-0.190	-0.023
Rubber	-5.386	-4.934	-4.74	-5.137	-5.106	-5.635	-4.360	-5.184	-4.930	-5.141	-4.982
Plastic	-4.22	-3.799	-3.692	-3.903	-3.921	-4.466	-3.175	-4.009	-3.752	-3.966	-3.805
Glass	-2.192	-2.095	-2.305	-1.894	-1.883	-2.422	-1.104	-1.956	-1.693	-1.911	-1.747
Non-metal	-0.973	-0.563	-0.577	-0.546	-0.549	-1.089	0.248	-0.616	-0.350	-0.571	-0.404
Iron	-0.053	-0.029	-0.305	0.153	0.263	-0.362	0.984	0.114	0.382	0.159	0.327

	Capital	Total labour	Unskilled labour	Semiskilled labour	Skilled labour	Unskilled Men labo	Unskilled Women	Semiskilled men	Semiskilled men	Skilled men	Skilled wome
Non ferrous	-0.446	-0.421	-0.671	-0.228	-0.221	-0.758	0.583	-0.284	-0.017	-0.239	-0.071
Metal-product	-2.636	-2.569	-2.785	-2.325	-2.279	-2.823	-1.510	-2.359	-2.097	-2.314	-2.150
Machinery	1.958	2.009	1.844	2.094	2.111	1.551	2.922	2.035	2.309	2.082	2.253
Electric machine	-1.083	-0.706	-0.678	-0.709	-0.747	-1.273	0.061	-0.801	-0.536	-0.756	-0.591
Com equipment	1.283	1.791	1.905	1.695	1.672	1.089	2.454	1.571	1.844	1.618	1.788
ScienceEquipmt	0.953	1.365	1.347	1.432	1.336	0.762	2.121	1.241	1.513	1.287	1.457
Vehicles	0.056	0.182	0.181	0.171	0.194	-0.341	1.006	0.135	0.404	0.181	0.349
Trans equipment	5.479	5.571	5.351	5.702	5.734	5.166	6.587	5.668	5.951	5.716	5.893
Furniture	-1.369	-1.304	-1.441	-1.113	-1.103	-1.646	-0.317	-1.176	-0.911	-1.131	-0.965
Other industry	-0.548	-0.153	-0.173	-0.144	-0.131	-0.739	0.602	-0.265	0.002	-0.219	-0.052
Electricity	-0.015	0.283	0.148	0.342	0.326	-0.207	1.142	0.271	0.539	0.315	0.484
Water	-0.452	-0.121	-0.18	-0.089	-0.109	-0.641	0.701	-0.167	0.101	-0.121	0.046
Construction	-0.246	-0.145	-0.291	0.065	0.096	-0.437	0.908	0.038	0.306	0.084	0.251
Trade	-0.357	0.071	0.305	0.021	0.024	-0.547	0.796	-0.073	0.195	-0.027	0.141
Hotel	-0.773	-0.38	-0.451	-0.368	-0.376	-0.963	0.375	-0.490	-0.224	-0.445	-0.278
Transport	1.397	1.632	1.286	1.717	1.769	1.202	2.572	1.686	1.958	1.732	1.902
Communication	-0.437	-0.069	-0.286	-0.011	-0.085	-0.628	0.715	-0.153	0.115	-0.108	0.062
Finance	-0.853	-0.466	-0.45	-0.457	-0.488	-1.043	0.294	-0.571	-0.304	-0.525	-0.358
Business	-0.904	-0.498	-0.298	-0.475	-0.529	-1.094	0.242	-0.622	-0.355	-0.577	-0.412
OtherManufactu	-0.863	-0.361	-0.01	-0.405	-0.433	-1.053	0.284	-0.58	-0.314	-0.535	-0.368
Other production	-0.321	0.051	-0.063	0.077	0.080	-0.512	0.832	-0.037	0.231	0.009	0.176
Government	-0.252	0.108	-0.084	0.119	0.119	-0.444	0.902	0.032	0.301	0.077	0.245

Table 6.2 Percentage change prices and output: all factors full employed and mobile (SIM 2)

Commodities	PD	QD	PE	QE	PQ	QQ	PM	QM	PX	QX	Sectors	PINT	QINT	PVA	QV
maize	0.133	-1.269	1.252	1.174	-0.420	-0.397	-4.399	6.306	-0.420	-0.397	maize	-0.227	-0.286	1.578	-0.286
wheat	0.335	-3.436	1.274	0	-0.550	0.047	-8.729	41.021	-0.551	0.047	wheat	-0.313	-3.482	1.54	-3.482
FruitVegetable	0.621	-0.930	1.252	1.782	0.339	-0.373	-2.698	5.943	0.339	-0.373	Fruit vegetable	-0.318	-0.571	1.44	-0.571
Poultry	0.287	-0.642	1.239	0.012	0.004	-0.195	-3.436	5.541	0.004	-0.195	Poultry	-0.353	-0.647	1.377	-0.647
Dairy livestock	0.736	-1.535	1.251	0.003	0.371	-0.963	-4.057	6.432	0.371	-0.963	Dairylivestock	-0.059	-1.546	1.573	-1.546

Commodities	PD	QD	PE	QE	PQ	QQ	PM	QM	PX	QX	Sectors	PINT	QINT	PVA	QV
Other agriculture	0.432	-2.721	1.337	0.011	-0.260	-1.650	-7.376	10.69	-0.260	-1.650	Other agricultu	-0.047	-2.754	1.136	-2.754
Coal	0.472	-0.090	1.341	1.494	0.498	-0.117	1.182	-0.807	0.498	-0.117	Coal	-0.031	0.520	1.643	0.520
Gold	-0.722	0.020	1.351	4.010	-0.680	0.000	1.081	-0.875	-0.682	0,001	Gold	-0.094	3.343	1.781	3.343
Other mining	-1.097	1.522	1.558	6.630	0.808	-0.445	1.024	-0.664	0.808	-0.445	Other mining	0.282	6.388	1.687	6.388
Food	0.243	-0.338	1.262	2.324	-0.330	0.082	-4.125	3.002	-0.331	0.082	Food	-0.151	-0.001	1.416	-0.001
Beverage tobacco	0.621	-0.607	1.481	1.068	0.448	-0.207	-1.347	4.074	0.448	-0.207	Beverage tobac	0.048	-0.397	1.549	-0.397
Textile	-0.429	-5.079	1.291	-0.801	-2.220	-0.109	-6.542	13.44	-2.222	-0.109	Textile	-0.882	-4.796	1.351	-4.796
Apparel	0.281	-0.666	1.294	3.288	-0.130	0.349	-2.615	6.815	-0.131	0.349	Apparel	-1.218	0.619	0.771	0.619
Leather	-4.662	-20.78	1.315	-9.960	-6.870	-12.17	-10.462	4.469	-6.872	-12.17	Leather	-1.046	-15.87	0.901	15.87
Footwear	-2.439	-22.76	1.315	-13.111	-6.731	4.897	-12.59(	63.09	-6.731	4.897	Footwear	-2.944	-24.84	0.886	24.84
Wood	0.101	-1.213	1.256	1.309	-0.762	-0.625	-5.724	2.941	-0.763	-0.625	Wood	-0.408	-0.758	1.453	0.758
Paper	-1.071	-7.436	1.339	-2.391	-2.600	-1.990	-10.223	32.08	-2.601	-1.99	Paper	-1.157	-6.579	1.278	6.579
Print	-0.067	-1.166	1.317	1.882	-0.350	-0.255	-1.575	3.749	-0.351	-0.255	Print	-1.115	-0.711	1.154	0.711
Petroleum	0.976	-0.223	1.283	0.399	0.862	-0.051	-0.099	1.422	0.862	-0.051	Petroleum	0.562	-0.064	1.61	0.064
Chemical	-0.155	-3.171	1.371	-0.321	-0.850	-2.139	-2.003	-0.367	-0.85	-2.139	Chemical	0.060	-2.73	1.494	2.73
Other chemical	0.218	-0.758	1.286	1.921	-0.312	0.032	-1.636	2.115	-0.300	0.032	Other chemical	-0.283	-0.272	1.199	-0.272
Rubber	-0.171	-5.295	1.282	-2.112	-5.780	3.294	-15.243	21.05	-5.780	3.294	Rubber	-0.376	-5.057	0.892	-5.057
Plastics	-0.559	-3.788	1.251	-0.021	-2.661	-0.661	-10.862	13.35	-2.660	-0.661	Plastics	-0.909	-3.843	0.789	-3.843
Glass	-0.021	-2.063	1.275	0.907	-3.442	-0.104	-14.39	6.989	-3.440	-0.104	Glass	-0.529	-2.12	1.485	-2.12
Non-metal	0.576	-1.028	1.312	0.419	-0.991	-0.137	-8.190	4.253	-0.990	-0.137	Non-metal	0.078	-0.815	1.436	-0.815
iron	0.187	-1.084	1.308	1.272	-0.332	-0.649	-4.582	3.067	-0.332	-0.649	iron	0.271	-0.041	1.556	-0.041
Non-ferrous	0.708	-0.797	1.283	0.291	0.354	-0.502	-0.676	0.367	0.354	-0.502	Non-ferrous	0.486	-0.44	1.636	-0.44
Metal product	0.084	-2.644	1.451	-0.18	-1.383	-0.079	-7.694	12.34	-1.381	-0.079	Metal product	-0.325	-2.591	1.606	-2.591
Machinery	0.002	0.255	1.287	3.505	-0.100	0.304	-0.147	0.328	-0.121	0.304	Machinery	-0.317	1.999	1.277	1.999
Electric machinery	-0.247	-1.285	1.269	2.275	-2.351	0.302	-6.893	3.955	-2.351	0.302	Electrimachinery	-0.783	-0.876	1.277	-0.876
Comm. equipment	-1.295	-0.315	1.470	5.787	-2.361	0.500	-2.682	0.747	-2.362	0.511	Comm. equip	-1.447	1.664	0.94	1.664
Science equipment	0.312	-0.237	1.407	3.503	0.284	-0.211	0.271	-0.197	0.284	-0.211	Science equip	-0.586	1.268	1.07	1.268
Vehicle	-1.759	-1.393	1.239	5.731	-2.210	0.54	-2.852	3.415	-2.210	0.541	Vehicle	-1.917	0.128	1.319	0.128
Transport equipmet	-0.248	3.200	1.239	6.618	0.252	1.026	0.412	0.341	0.252	1.026	Transport equip	-0.261	5.562	1.346	5.562
Furniture	-0.093	-2.264	1.239	2.216	-1.631	1.274	-10.58	26.131	-1.632	1.274	Furniture	-0.981	-1.321	1.469	-1.321
Other industry	0.343	-1.399	1.239	1.281	-1.652	0.493	-5.176	4.022	-1.651	0.493	Other industry	-0.150	-0.312	1.22	-0.312
Electricity	0.958	0.071	1.239	0.629	0.961	0.07	1.181	-0.039	0.961	0.071	Electricity	0.143	0.092	1.484	0.092

Commodities	PD	QD	PE	QE	PQ	QQ	PM	QM	PX	QX	Sectors	PINT	QINT	PVA	QV
Water	0.594	-0.334	1.239	0.947	0.604	-0.339	1.141	-0.604	0.604	-0.339	Water	0.216	-0.324	1.443	-0.324
Construction	0.131	0.004	1.239	2.232	0.141	-0.001	1.198	-0.525	0.141	-0.001	Construction	-0.439	-0.185	1.577	-0.185
Trade	0.914	-0.173	1.239	0.471	0.915	-0.173	1.188	-0.308	0.915	-0.173	Trade	0.497	-0.124	1.228	-0.124
Hotel	0.921	-0.820	1.239	-0.211	0.994	-0.856	1.211	-0.962	0.994	-0.856	Hotel	0.170	-0.676	1.502	-0.676
Transportation	0.768	1.367	1.239	2.316	0.862	1.201	1.239	0.529	0.862	1.201	Transportation	0.078	1.502	1.49	1.502
Communication	0.767	-0.337	1.239	0.599	0.799	-0.353	1.211	-0.555	0.799	-0.353	Communication	-0.011	-0.289	1.399	-0.289
Finance	1.181	-0.708	1.239	-0.591	1.182	-0.709	1.239	-0.737	1.182	-0.709	Finance	0.854	-0.701	1.39	-0.701
Business	1.153	-0.800	1.239	-0.630	1.155	-0.801	1.211	-0.828	1.155	-0.801	Business	0.549	-0.778	1.442	-0.778
Other services	0.679	-0.637	1.239	0.470	0.696	-0.645	1.201	-0.894	0.696	-0.645	Other services	0.263	-0.605	1.174	-0.605
Other producers	0.729	-0.334	1.239	0.677	0.750	-0.344	1.211	-0.571	0.751	-0.344	Other producers	-0.079	-0.007	1.065	-0.007
Govt. services	0.941	-0.014	1.239	0.578	0.941	-0.014	1.119	-0.102	0.941	-0.014	Govt. services	-0.019	-0.014	1.216	-0.014

Table 6.3 Percentage change output and prices: SIM 1 fixed capital, skilled: mobile& full employed; unskilled and semi-skilled labour mobile but unemployed

Commodities	PD	QD	PE	QE	PQ	QQ	PM	QM	PX	QX	Sectors	PINT	QINT	PVA	QVA
Maize	0.701	-0.879	1.689	1.078	0.121	0.039	-4.070	7.105	1.099	-0.091	Maize	-0.106	-0.092	2.750	-0.092
Wheat	-2.579	-1.831	1.023	0.021	-3.117	0.367	-8.430	25.768	-2.844	-1.831	Wheat	-0.431	-1.856	-7.218	-1.856
FruitVegetables	0.517	-0.328	1.731	4.650	0.274	0.157	-2.358	5.630	0.667	0.340	FruitsVegetables	-0.372	0.342	1.419	0.342
Poultry	0.191	-0.239	1..101	0.001	-0.058	0.157	-3.101	5.224	0.148	-0.239	Poultry	-0.191	-0.241	0.766	-0.241
Dairy livestock	0.470	-0.566	1.431	0.025	0.153	-0.062	-3.727	6.442	0.451	-0.566	Dairy livestock	0.065	-0.571	0.837	-0.571
Other agriculture	-0.494	-1.071	1.421	0.003	-1.067	-0.155	-7.068	10.332	-0.596	-1.071	Other agriculture	0.010	-1.084	-1.538	-1.084
Coal	0.754	0.236	1.688	2.100	0.783	0.207	1.533	-0.553	1.115	0.954	Coal	0.031	0.954	2.289	0.954
Gold	-0.162	0.017	1.663	3.707	-0.129	1.325	1.312	-0.714	1.413	3.197	Gold	-0.205	3.283	2.482	3.283
Other mining	1.261	0.303	1.686	1.089	1.391	0.170	1.405	0.155	1.665	1.047	Other mining	0.437	1.030	2.704	1.030
Food	0.835	-0.204	1.853	1.731	0.229	0.242	-3.818	3.346	0.993	0.021	Food	-0.299	0.024	5.300	0.024
Beverage tobacco	0.645	-0.209	1.857	2.265	0.498	0.133	-1.032	3.777	0.775	0.104	Beverage	-0.036	0.103	2.044	0.103
Textile	-1.769	-2.397	1.877	6.710	-3.057	1.295	-6.241	11.275	-1.927	-1.110	Textile	-1.244	-1.207	-2.535	-1.207
Apparel	-0.224	0.242	2.278	7.494	-0.523	0.991	-2.352	5.745	-0.909	0.898	Apparel	-1.795	1.299	0.345	1.299
Leather	-5.565	-11.486	1.708	3.555	-7.275	-4.059	-10.142	10.194	-2.098	-4.050	Leather	-0.911	-4.192	-3.342	-4.192
Footwear	-6.157	-9.989	2.130	16.015	-8.556	7.341	-12.335	43.023	-9.283	-8.466	Footwear	-3.378	-9.423	-17.526	-9.423

Commodities	PD	QD	PE	QE	PQ	QQ	PM	QM	PX	QX	Sectors	PINT	QINT	PVA	QVA
Wood	0.081	-0.259	1.761	3.246	-0.727	0.298	-5.395	3.672	0.305	0.313	Wood	-0.638	0.353	1.924	0.353
Paper	-2.912	-3.945	1.770	6.703	-4.043	0.271	-9.907	26.337	-2.303	-1.668	Paper	-1.805	-1.748	-2.459	-1.748
Print	-0.564	0.212	1.809	5.453	-0.690	0.619	-1.234	2.399	-0.584	0.554	Print	-1.715	0.661	0.968	0.660
Petroleum	1.313	0.043	1.810	0.565	1.198	0.216	0.233	1.694	1.610	0.171	Petroleum	0.909	0.172	2.287	0.170
Chemical	-0.211	-1.288	1.697	2.610	-0.743	-0.480	-1.637	0.906	0.359	-0.071	Chemical	0.171	-0.088	0.533	-0.088
Other Chemical	-0.001	0.055	1.855	4.268	-0.367	0.619	-1.317	2.102	0.003	0.511	Other Chemical	-0.358	0.602	1.003	0.602
Rubber	-1.340	-3.851	1.814	3.080	-6.373	4.006	-14.947	20.122	-1.106	-2.748	Rubber	-0.504	-2.918	-2.217	-2.918
Plastics	-1.457	-2.557	1.749	4.152	-3.292	0.230	-10.529	12.634	-1.369	-2.133	Plastics	-1.054	-2.750	-0.626	-2.750
Glass	-0.902	-1.114	1.915	4.998	-4.030	0.710	-14.096	7.276	-0.856	-0.634	Glass	-0.742	-0.811	-0.531	-0.811
Non-metal	-0.297	-0.555	1.753	3.720	-1.646	0.222	-7.857	4.017	-0.235	-0.294	Non-metal	0.116	-0.313	-0.658	-0.313
Iron	0.806	-0.558	1.746	1.281	0.254	-0.097	-4.250	3.850	1.217	0.232	Iron	0.500	0.258	2.985	0.258
Non-ferrous	1.256	-0.276	1.687	0.541	0.857	0.056	-0.303	1.037	1.438	0.048	Non-ferrous	0.804	0.028	2.372	0.028
Metal product	-1.038	-1.807	1.732	4.064	-2.211	0.288	-7.360	10.363	-0.863	-1.177	Metal product	-0.124	-1.304	-1.174	-1.304
Machinery	0.701	0.129	1.801	2.333	0.361	0.296	0.190	0.380	1.142	1.012	Machinery	-0.181	1.241	3.404	1.241
Electrical machine	-0.763	-0.843	1.797	4.938	-2.594	0.551	-6.575	3.748	-0.684	-0.115	Electrical	-0.785	-0.151	-0.031	-0.151
Comm. equipment	-1.146	-0.014	1.749	6.626	-2.056	0.682	-2.330	0.893	-0.501	1.962	Comm. quipment	-1.416	2.113	1.541	2.113
Science equipment	0.257	0.410	2.072	5.228	0.459	0.213	0.567	0.111	0.268	1.542	Science uipment	-0.687	2.170	1.553	2.170
Vehicle	-1.476	-0.994	1.755	6.357	-1.899	0.834	-2.510	3.553	-1.086	0.501	Vehicle	-1.849	0.553	2.640	0.553
Transport equipment	0.151	2.915	1.722	6.294	0.628	0.858	0.780	0.209	0.941	4.664	Transport ipment	-0.165	5.186	2.784	5.186
Furniture	-0.563	-1.408	2.109	5.799	-1.983	1.911	-10.327	25.048	-0.688	0.082	Furniture	-1.137	0.138	0.492	0.138
Other industry	0.288	-0.671	1.987	3.160	-1.582	1.113	-4.889	4.436	0.652	0.476	Other industry	0.003	0.690	1.108	0.690
Electricity	1.112	0.308	1.663	1.405	1.118	0.305	1.535	0.099	1.133	0.349	Electricity	0.109	0.349	1.733	0.349
Water	0.553	0.221	1.663	2.446	0.570	0.213	1.445	-0.221	0.562	0.239	Water	0.174	0.239	1.417	0.239
Construction	-0.619	0.069	1.663	4.717	-0.596	0.057	1.572	-1.016	-0.613	0.080	Construction	-0.880	0.002	0.103	0.002
Trade	0.675	0.500	1.663	2.483	0.677	0.498	1.551	0.065	0.678	0.506	Trade	0.272	0.532	0.984	0.532
Hotel	1.063	-0.259	1.663	0.930	1.199	-0.326	1.602	-0.524	1.251	0.113	Hotel	0.177	0.089	1.659	0.089
Transportation	1.295	1.062	1.663	1.798	1.368	0.933	1.663	0.411	1.347	1.166	Transportation	0.057	1.166	2.464	1.166
Communication	0.615	0.245	1.663	2.345	0.685	0.209	1.601	-0.243	0.669	0.353	Communication	-0.048	0.353	1.209	0.353
Finance	0.833	0.160	1.663	1.816	0.862	0.145	1.663	-0.250	0.883	0.260	Finance	0.561	0.260	1.078	0.260
Business	0.790	0.082	1.663	1.824	0.814	0.070	1.601	-0.318	0.807	0.117	Business	0.336	0.118	1.028	0.118
Other manufacture	0.542	0.136	1.663	2.382	0.575	0.120	1.578	-0.375	0.575	0.202	Other Manuf	0.109	0.202	1.087	0.202

Commodities	PD	QD	PE	QE	PQ	QQ	PM	QM	PX	QX	Sectors	PINT	QINT	PVA	QVA
Other product	0.288	0.350	1.663	3.121	0.343	0.322	1.599	-0.300	0.331	0.437	Other product	-0.195	0.627	0.536	0.627
Govt. services	0.396	0.006	1.663	2.546	0.397	0.006	1.397	-0.489	0.397	0.007	Govt. services	-0.141	0.007	0.551	0.007

KEY TO SYMBOLS: PD:domestic price; QD: domestically demanded commodity; PE: price of exports; QE: exports; PQ:composite good Price; QQ: composite good; PM: price of imports; QM: imports; PX: producer price; QX: domestically produced output; PINT:price of intermediates; QINT: intermediates; PVA: value-added price; QV: value added.

Table 6.4 Percentage change factors : capital fixed and full employed, skilled labour mobile and full employed, unskilled and semi-skilled labour mobile with unemployment (SIM 1)

Sectors	Total labour	Unskilled labour	Semi skilled labour	Skilled labour	Unskilled men	Unskilled women	Semi-killed men	Semi-skilled women	Skilled men	Skilled women
Maize	1.168	1.390	1.339	0.736	1.368	1.448	1.338	1.343	0.731	0.762
Wheat	-5.564	-5.347	-5.402	-5.96	-5.376	-5.3	-5.404	-5.398	-5.971	-5.941
FruitVeg	1.118	1.177	1.117	0.517	1.146	1.227	1.116	1.122	0.510	0.542
Poultry	0.046	0.253	0.207	-0.386	0.234	0.314	0.204	0.21	-0.396	-0.365
Dairy and livestock	-0.134	-0.047	-0.091	-0.679	-0.062	0.018	-0.092	-0.086	-0.69	-0.659
Other agriculture	-1.843	-1.702	-1.784	-2.365	-1.756	-1.678	-1.785	-1.78	-2.373	-2.343
Coal	2.064	2.200	2.169	1.560	2.199	2.280	2.168	2.174	1.556	1.588
Gold	4.601	4.657	4.624	3.999	4.655	4.738	4.624	4.630	3.997	4.029
Other mining	2.391	2.488	2.452	1.84	2.483	2.564	2.452	2.458	1.838	1.870
Food	0.534	0.686	0.638	0.038	0.666	0.746	0.636	0.642	0.034	0.065
Beverage and tobacco	0.511	0.755	0.714	0.115	0.742	0.822	0.712	0.718	0.109	0.14
Textile	-1.460	-1.363	-1.409	-1.996	-1.383	-1.304	-1.412	-1.406	-2.003	-1.972
Apparel	1.512	1.615	1.542	0.947	1.569	1.65	1.539	1.545	0.93	0.962
Leather	-5.826	-5.666	-5.744	-6.298	-5.718	-5.643	-5.746	-5.741	-6.311	-6.282
Footwear	-14.386	-14.269	-14.344	-14.847	-14.321	-14.253	-14.346	-14.341	-14.859	-14.833
Wood	0.623	0.720	0.676	0.079	0.705	0.785	0.675	0.681	0.072	0.103
Paper	-3.258	-3.085	-3.155	-3.724	-3.128	-3.051	-3.157	-3.151	-3.737	-3.707
Print	0.875	1.165	1.112	0.517	1.141	1.221	1.111	1.116	0.505	0.536
Petroleum	1.004	1.297	1.249	0.645	1.278	1.359	1.248	1.254	0.642	0.673

Sectors	Total labour	Unskilled labour	Semi skilled labour	Skilled labour	Unskilled men	Unskilled women	Semi-killed men	Semi-skilled women	Skilled men	Skilled women
Chemical	-0.005	0.286	0.243	0.355	0.272	0.352	0.242	0.248	-0.358	-0.327
Other chemical	0.924	1.235	1.172	0.57	1.201	1.281	1.170	1.176	0.564	0.596
Rubber	-3.904	-3.709	-3.791	-4.362	-3.763	-3.687	-3.792	-3.786	-4.368	-4.338
Plastics	-3.055	-2.871	-2.944	-3.52	-2.918	-2.84	-2.947	-2.941	-3.528	-3.498
Glass	-1.043	-0.872	-0.907	-1.497	-0.879	-0.800	-0.909	-0.903	-1.502	-1.472
Non-metal	-0.774	-0.601	-0.659	-1.252	-0.631	-0.552	-0.661	-0.655	-1.256	-1.225
Iron	0.501	0.663	0.630	0.046	0.659	0.739	0.629	0.635	0.026	0.058
Non-ferrous	0.217	0.389	0.355	-0.244	0.384	0.464	0.354	0.360	-0.247	-0.216
Metal product	-1.907	-1.790	-1.821	-2.403	-1.793	-1.714	-1.822	-1.816	-2.410	-2.380
Machinery	1.549	1.755	1.708	1.103	1.737	1.818	1.707	1.713	1.098	1.129
Electrical machinery	-0.255	-0.037	-0.100	-0.699	-0.072	0.007	-0.102	-0.096	-0.701	-0.67
Comm. equipment	2.831	3.043	2.966	2.357	2.994	3.076	2.963	2.969	2.347	2.378
Science equipment	2.877	3.092	3.030	2.418	3.057	3.139	3.026	3.032	2.409	2.441
Vehicle	1.011	1.244	1.184	0.579	1.213	1.294	1.183	1.189	0.577	0.608
Transport equipmet	5.786	6.018	5.976	5.344	6.007	6.092	5.976	5.982	5.341	5.374
Furniture	0.239	0.355	0.314	-0.283	0.342	0.422	0.312	0.318	-0.288	-0.258
Other industry	1.194	1.376	1.314	0.721	1.342	1.422	1.311	1.317	0.705	0.736
Electricity	1.006	1.331	1.281	0.675	1.31	1.391	1.280	1.286	0.673	0.704
Water	0.734	1.070	1.013	0.409	1.042	1.122	1.012	1.017	0.407	0.438
Construction	0.020	0.156	0.118	-0.48	0.147	0.227	0.117	0.123	-0.483	-0.452
Trade	0.931	1.172	1.092	0.494	1.121	1.201	1.090	1.096	0.485	0.516
Hotel	0.865	1.041	0.983	0.388	1.010	1.090	0.980	0.986	0.375	0.406
Transportation	2.360	2.506	2.471	1.864	2.501	2.583	2.471	2.476	1.857	1.888
Communication	0.889	1.073	1.026	0.422	1.053	1.133	1.023	1.028	0.418	0.449
Finance	0.686	0.929	0.866	0.266	0.893	0.974	0.863	0.869	0.259	0.290
Business	0.393	0.774	0.699	0.102	0.726	0.806	0.696	0.702	0.093	0.124
Other manufacturing	0.454	0.902	0.813	0.225	0.839	0.920	0.809	0.815	0.206	0.237
Other product	0.744	1.018	0.963	0.369	0.990	1.071	0.960	0.966	0.356	0.387
Govt. services	0.019	0.398	0.348	-0.247	0.376	0.456	0.346	0.352	-0.255	-0.224

APPENDIX 6 (B)

MACROECONOMIC VARIABLES

Table 6.5 Percentage changes (macroeconomic variables)

Variable	Base level	Fixed capital, Skilled labour mobile, fully employed, unskilled & semiskilled labour mobile with unemployment	All factors mobile
Total Real Absorption	891.2	0.4	0.161
Household consumption	558.4	0.6	-0.1
Nominal Govt consumption	205.338	0.397	0.941
Real GDP	900.124	0.170	0.161
Private Consumption	558.420	0.520	0.001
Total Real Export	224.2	2.5	2.8
Total Real Import	275.2	3.2	3.4
Real Exchange Rate	91.4	1.4	0.7
Exchange rate	100.1	1.7	1.2
Trade Deficit	5.5	-0.7	-0.7
Investment	13.8	-0.1	-0.1
Private Savings	16.2	0.7	1.0
Governement income	217.516	-3.341,	-3.883
Governmet Savings	-1.9	-0.8	-1.1
Import Tax	1.0	-1.0	-1.0
Equivalent Variation			
Household decile 0	8.9	0.062	0.067
Household decile 1	12.0	0.065	0.062
Household decile 2	16.0	0.112	0.128
Household decile 3	20.4	0.130	0.133
Household decile 4	26.0	0.183	0.155
Household decile 5	32.9	0.255	0.228
Household decile 6	45.5	0.333	0.199
Household decile 7	63.9	0.471	0.221
Household decile 8	95.5	0.708	0.282
Household decile 91	74.7	0.551	0.115
Household decile 921	26.6	0.228	0.114
Household decile 922	31.1	0.218	-0.05
Household decile 923	34.9	0.230	-0.140
Household decile 924	70.1	0.149	-1.307
Total	558.4	0.5	
Factor Earnings			
Capital	396.041	2.059	1.492
Unskilled men	73.599	1.042	2.317
Unskilled women	26.711	0.028	-0.707
Semiskilled men	113.619	0.749	1.169
Semiskilled women	57.550	0.598	0.583
Skilled men	114.417	1.154	1.010
Skilled women	40.357	1.061	0.651

Source: Study simulation results