University of Pretoria
Department of Economics Working Paper Series

The General Equilibrium Effects of a Productivity Increase on the Economy and Gender in South Africa

Godbertha Kinyondo
University of Pretoria
Margaret Mabugu
University of Pretoria
Working Paper: 2008-01
February 2008

_____
Department of Economics
University of Pretoria
0002, Pretoria
South Africa
Tel: +27 12 420 2413
Fax: +27 12 362 5207
http://www.up.ac.za/up/web/en/academic/economics/index.html

THE GENERAL EQUILIBRIUM EFFECTS OF A PRODUCTIVITY INCREASE ON THE ECONOMY AND GENDER IN SOUTH AFRICA.

By
Godbertha Kinyondo and Margaret Mabugu

Abstract

This study utilises a computable general equilibrium (CGE) model to examine the effects of economy-wide (SIM 1) and partial (SIM 2) productivity increases on the economy, gender employment, wages, income and welfare in South Africa. The model has 49 sectors, 14 household categories, and 2 primary inputs. SIM 1 results in 'output' led employment demand and increased earnings for all skill types of men and women. Skilled men benefits more than others in most sectors. Under SIM 2, productivity has negative employment impact of all skills mostly in labour-intensive sectors. Some displaced labour relocates to expanded export-orientation and service sectors resulting in increased economy-wide jobs and earnings. Unskilled women earnings, however, decline because they are concentrated in low-paying positions. In addition, productivity improves household's welfare due to reduced commodity prices and improved earnings.

1 Introduction

South Africa has a chronic unemployment rate with an annual narrow rate reported at 22.6% for men and 31.7% for women while broad unemployment runs at 40% (LFS, 2006). In 1996, the government introduced the growth, employment and redistribution policy (GEAR) to spur employment through increased investment. GEAR brought greater financial discipline and macroeconomic stability. However, the rate of employment maintained a negative growth of 1.6% between 1994 and 2001 (World Bank, 2006). In 2005, the government introduced 'Accelerated and shared growth initiative for South Africa'(ASGISA), to oversee economic growth rate of 6% by 2014, halving unemployment and poverty by 2014 and curbing skills shortages (Government of South Africa, 2005).

Low investment resulting from poor domestic savings was identified as a constraint to economic growth contributing to limited employment. GEAR advocated for capital inflow, particularly foreign direct investment (FDI). FDI improves economic growth through new technologies, improved management, higher wages, access to markets, and training, increased productivity, etc., (Markusen &Venables, 1999:22).

Productivity underlies the growth of real output, exports, employment, and national income (Blalock & Gertler, 2005; Edwards & Golub, 2003:29). Using a CGE model, Diao, Rattsø, and Stokke (2005) found high economic growth of Thailand to have emerged from tariff reduction and from improved productivity driven by foreign spillover capital investment. Their counterfactual analysis showed protection to constrain growth by stifling productivity.

Using a CGE model with risk-aversion and gender-divided labour, Arndt and Tarp (2003) tested the effects of a 30% increase in agricultural productivity for Mozambique and found a decline in men wages in commercial agriculture while the wages of women in food crops rose due to their concentration in the food crops sector. On the other hand, Fussel (2000) found technological upgrading of the Mexican *maquiladoras* to induce productivity that defeminised labour. He attributed defeminisation to skills disadvantage of women compared with that of men. Pretorius (2002) and Mai (2003) found productivity to have a negative employment relationship because as sectors become efficient they employ less labour per unit of output.

This paper contributes to the literature on the general equilibrium impact of productivity on gender by focusing on two simulations: economy-wide increases in productivity, and productivity increases targeted to selected sectors. The study starts by looking at the determinants of productivity and briefly discusses education and employment of men and women. Section 2 provides the study methodology. Section 3 presents the experiments and results of the first simulation (economy-wide) while section 4 provides results of the second simulation (selected sectors). Section 5 gives household welfare conditions and section 6 concludes.

1.1 Determinants of total factor productivity (TFP)

Sources of productivity include capital good imports, licensing agreements, international trade, investment in machinery etc., (Klein, Aaron, & Hadjimichael, 2000:3-4). Between 1994 and 2001 Arora and Bhundia (2003) accredit TFP in South Africa to: trade in real GDP (46.6%); equipment and machinery (50.4%); private sector (72.1%), and private sector investment in equipment and machinery (73.1%). Arezki, Ahmed and Funke (2003) found trade openness and private sector participation to have accounted for 90% of TFP growth during the 1990s in South Africa.

Research and development (R&D) induces productivity but has not played a major role in South Africa and Thailand (Arora and Bhundia, 2003:9; Diao et al., 2005). Braunstein (2000), Edwards and Golub (2003:29) associate quality education with enhanced labour-force productivity. Söderbom and Teal (2003) used a panel data on 93 countries between 1970-2000 to find if trade and higher levels of human capital promote productivity growth. Their results showed a doubling of the level of openness resulting in a 0.8% increase in technical progress. They also found a significant impact of the level of human capital on the level of income but found no effect on productivity emanating from the level of human capital.

FDI is a comprehensive source of productivity because it packages and incorporates various techniques (Klein et al, 2000:3-4). Blalock and Gertler (2005) found FDI to have raised average productivity in foreign and domestic firms in Indonesia. Urata and Kawai (2000) compared the level of TFP at 266 Japanese parent firms and 744 affiliates in textiles, chemicals, machinery and electrical machinery and found high intrafirm transfer through FDI. In Taiwan, results of a regression on the firm-level data of 8 846 firms by Chuang and Lin (1999) found a 1% increase in an industry's FDI ratio yielding a 1.4% to 1.88% increase in a domestic firm's productivity. Barrel and Pain (1997) used time series data and found a 1% rise in FDI to enhance labour efficiency by 0.27% in West Germany, and by 0.26% in the UK. Biggs, Shah and Srivastava (1995) found FDI to have enhanced productivity on manufacturing firms in Ghana, Kenya and Zimbabwe in the early 1990s. There is hence overwhelming evidence that FDI leads to or enhances productivity. Since South Africa has experienced relatively substantial inflow of FDI, the contribution of this study is to ascertain the impact of the implied increased productivity on gender and the South African economy.

1.2 Sectoral Productivity

Figure 1 shows capital and labour productivity trends for the years 1980, 1990 and 2000 in South Africa. Capital and labour productivity grew positively at an average annual rate of 1.3% and 3.47%, respectively, during the period 1980-2000. Higher capital productivity is found in mining, machinery and transportation sectors, although the rate for 1980 exceeded that for 1990 and 2000. Unlike capital, labour productivity was lower in 1980 compared with subsequent years of 1990 and 2000. Higher labour productivity is in sectors of agriculture, metals, metal products, machinery, transport equipment, construction, and transportation services. South Africa's productivity rise follows increase in foreign capital utilisation by local firms (Edwards, 2001).
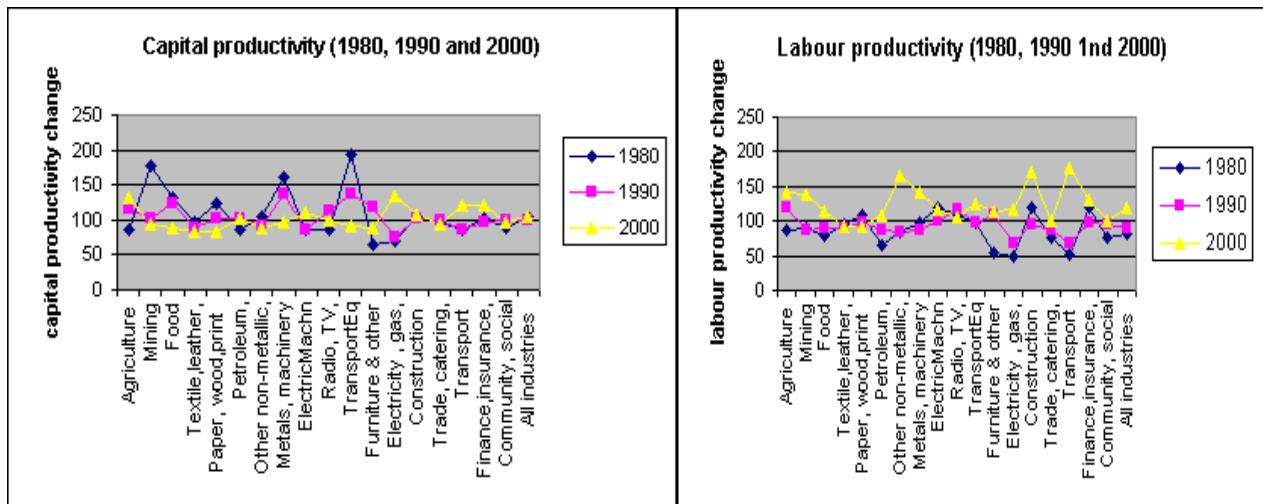
Figure 1 Factor productivity in South African sectors
Source: UNDP Human Development Report (2003)

1.2.4 Productivity between men and women workers

Figure 2 shows the value added (indicator of productivity) shares between men and women in various sectors. Productivity is calculated as the value added by the aggregate factors of production (labour disaggregated by gender) per unit of factor input. The results show lower productivity shares for women when compared with men in many sectors. Women productivity, however, exceeds that of men in the service sectors of trade and communication and in the other-manufacturing sector. Men's productivity exceeds that of women even in some women-intensive sectors of textile and apparel. This emanates from the 'vertical hierarchy' framework of these sectors where men concentrate at the top high-paying positions while women concentrate in low-paying positions.
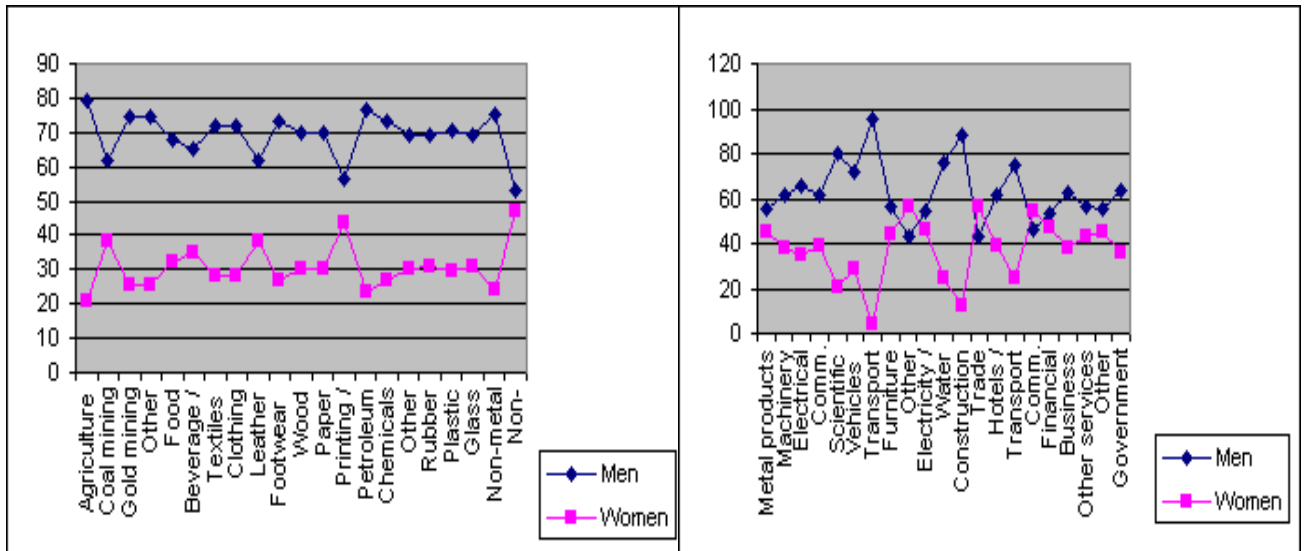
Figure 2 Men and women value added shares in various sectors

Source: own calculation from 2000 gendered SAM

1.3   Education and employment of men and women in South Africa

According to the World Bank (2006), women are participating at levels comparable to men in the education system. However, figure 3 shows women lagging behind men in educational areas such as engineering, mathematics, architecture and environmental design, areas closely associated with skills and sectors where productivity tends to create long-term and high-salaried employment. Women exceed men in areas of health, and social studies. Involvement in modern science and technology is a crucial issue at a time when productivity-based sectors are major forces in the growth and development of the international economy.
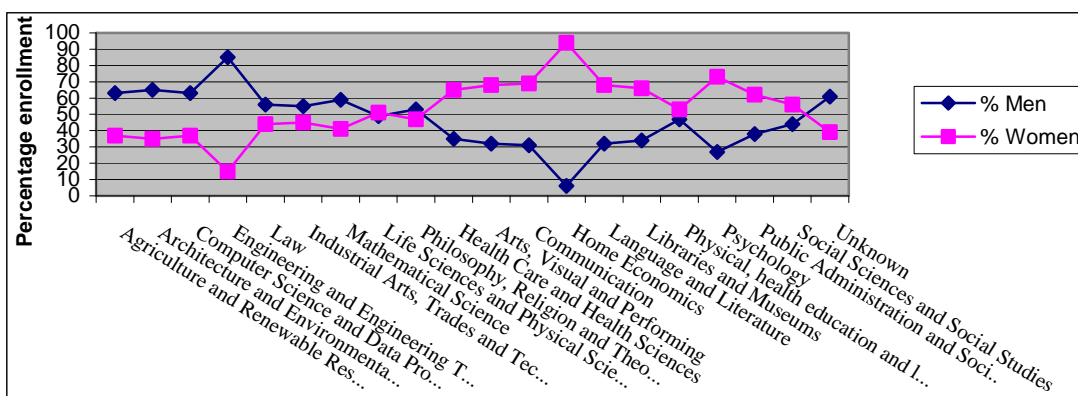

Figure 3: Gender skills enrollment in various fields in South Africa

Source: Department of Education (DOE), HEMIS database 2000

5

While education is a necessary condition for acquiring the skills and knowledge to participate in the economy, it is not a guarantee for equal employment. Women have higher rates of unemployment compared to men who achieve the same level of schooling (LFS, 2000-06). This partially reflects women foregoing employment to tend to household needs and the inherent discrimination towards women at the workplace (Leresche, 1993, Çagatay, Elson & Grown, 1995)

2. Methodology of the study

2.1. Model specification and data

This study uses a structural-neoclassical model, based on the general equilibrium model developed by Dervis, de Melo and Robinson (1982), which was extended into an International Food Policy Research Institute (IFPRI) standard CGE model (Lofgren, Harris & Robinson, 2001). The present paper introduces gender to the labour categories in the IFPRI model.

The model used here comprises capital and six types of labour identified by skills and by gender. The gendered model assumes that women and men workers are imperfect substitutes. According to Sadoulet and De Janvry (1995:), the range of substitutability is represented by 0.3 for low substitutability, 0.8 for medium low, 1.2 for medium high and 3.0 for very high. There is no empirical study of gender substitution in South Africa. The rate of 0.50 used in this study follows that used in Zambia by Fontana (2001) as per similarities in rigidity of gender substitution between the South African and the Zambian economies. The model is written and solved in General Algebraic Modeling System (GAMS) and gives short to medium-term equilibrium results due to its comparative static nature.

2.2. The data

The dataset for the CGE model is the 2000 South Africa SAM, which was developed without gender considerations (Thurlow and Van Seventer, 2002). The present study disaggregated labour according to gender and skills. The Income Expenditure Survey (IES, 2000), and Labour Force Survey (LFS, 2000-2003) and October Household Survey (OHS, 1999) provided data that supplied proportions of men and women in different sectors. This enabled the mapping of men and women value-added to their respective households. The model uses elasticities such as output, export, imports etc., based on estimated elasticities in other studies.

Sensitivity analyses using alternative elasticity parameters are done to check the robustness of the model. Appendix 1 gives some important base year magnitudes.

2.3 Selected equations for the model

$$U_h = \Pi (QH_{c,h} - \gamma_{c,h})^{\beta_{c,h}}$$ ……………………………..…………………………… (1)

In equation 1 households, h, maximise a Stone-Geary utility function, U_h, subject to their linear budget constraint, $QH_{c,h}$, yielding the linear expenditure system (*LES*). The model has one representative consumer per household type, rendering identical preferences for all consumers in a given category. Where: c, represents commodities consumed by households, γ_{ch} is minimum subsistence of commodities for the households, and β, are marginal budget share of commodities for the households.

$$EV_h = E(U_h^1, P_C^O) - E(U_h^O, P_C^O)$$ ……………………………………….……………….. (2)

Equation 2 denotes welfare changes depicted by the equivalent variation (EV_h). Positive EV_h shows improved welfare and vice versa. Where U^1 represents utility after simulation, U^O: baseline utility: h: household, P^0: original consumer prices.

$$QL_{i_s} = A_i \left[\alpha_i QL_{mn_s}^{-\rho_i} + (1 - \alpha_i) * QL_{fm_s}^{-\rho_i} \right]^{-(1/\rho_i)}$$ …………………………..…… (3)

Equation 3 shows that at the bottom level of the CES production process, men and women of the same skills (s) combine to form a composite skills labour (QL_{i_s}). Where ρ_i: substitution parameter, QL_{mn_s}: men skill type labour, QL_{fm_s}: women skill type labour, A_i: production technology.

$$QL_{fm_s} = \left[\left(\frac{W_{mn}}{W_{fm}} \right) \left(\frac{\alpha_i}{1 - \alpha_i} \right) \right]^{\sigma_i} * QL_{mn_s}$$
………………………………………….……..………. (4)

Equation 4 shows how relative demand for men and women labour relies on a share parameter $\left(\frac{\alpha_i}{1 - \alpha_i} \right)$, the relative wage rate $\left(\frac{W_{mn}}{W_{fm}} \right)$, where, w_{mn} and w_{fm} refers to men and women wages respectively and σ_i, refers to sectoral elasticity of substitution.

$$QV_i = A_i \left[\gamma_i K_i^{\rho_i} r_i + (1 - \gamma_i)(\omega_1 QL_{i1} + \omega_2 QL_{i2} + \omega_3 QL_{i3})^{-\rho_i} \right]^{-(1/\rho_i)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \text{(5)}$$

Equation 5 shows the aggregation of composite labour (QL_{is}) and capital (K) by a CES production function forming the sectoral value added, QV_i. Where A_i, is a technological production function shift parameter, γ_i, is production function share parameter; QL_{is} sectoral labour inputs and s, represents skills category of labour (i.e., s = 1: unskilled, 2:semi-skilled, 3:skilled); K_i sectoral capital stock, $\sigma_i = \dfrac{1}{(1+\rho_i)}$ is elasticity of substitution between the primary inputs (capital and labour), $w_s = \dfrac{W_s}{W_i}$ is weighted share for skill labour categories.

The value-added combines with intermediates (domestic and imports) in fixed proportions to produce gross output. The substitution elasticity varies per sector.

$$W_s = \frac{W_{fm_s} \sum_i QL_{fm_s,i} + W_{mn_s} \sum_i QL_{mn_s,i}}{\sum_i QL_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \text{(6)}$$

Equation 6 shows sectoral average wage rates, W_s, which depend on skill type of men and women labour.

$$QLS_{fm} = \sum_i QLD_{fm,i}$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \text{(7)}$$

$$QLS_{mn} = \sum_i QLD_{mn,i}$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \text{(8)}$$

Each market clears when the sum of the sectoral labour demand equates labour supply.

2.4 Model-closure rules

South Africa is assumed to be a price taker on international markets, hence all prices of imports and exports are fixed in foreign currency units and the balance of trade (BOT) is fixed at its SAM base level. The exchange rate is an equilibrating mechanism for the BOT. The model assumes a saving-driven investment economy that allows the investment rate to adjust in order to maintain a fixed level of total savings. According to Sadoulet etc., (1995:143) the S-I balance plays a minor role, for example, in a static model, like the current one, variations of the investment levels following changes in savings have few consequences, as they only affect the level of demand. The government account balance is achieved with constant direct

tax rates on domestic non-governmental institutions, which maintain government income, while government savings are free to adjust. The level of government expenditure is indexed to consumer prices in order to maintain government expenditure in real terms.

Capital is modeled as fully employed and sectorally mobile. The capital's rental rate adjusts in order to maintain the employment level in the economy. Skilled labour is assumed mobile and fully employed while its economy-wide wage adjusts to ensure that the sum of skilled labour demands from all sectors equals the quantity supplied. The unskilled and semi-skilled men and women labour is mobile across sectors but unemployed, their wages are fixed in nominal terms at the base level while their unlimited supply adjusts in order to equate to the sum of their demand.

All prices in the model are expressed relative to the consumer price index (CPI), the *numéraire*. The choice of CPI enables general equilibrium analysis to proceed without considering the effects of inflation on the optimal use of resources. Finally, the model solves, because it is square having equal numbers of equations and endogenous variables.

3   The model policy simulations

The first simulation (SIM1) involves a 1% economy-wide (all sectors) rise of total factor Productivity (TFP). (SIM2) involves a 1% productivity rise in selected sectors of textiles, apparels, leather, chemicals, other-chemicals, metal products, vehicles, food, beverages and tobacco, footwear, electrical machinery, machinery, communication equipment, and scientific equipment. The first seven sectors were selected because they have attracted considerable FDI in South Africa, hence increased productivity while others have a relatively high potential to employ women.

TFP is modeled as an exogenous source of technological changes by a 1 % increase in the technological parameter of a production function (see equation 5). The one-percent productivity increase is justifiable, given the modest inflow of FDI in South Africa and following empirical observations by Chuang and Lin (1999).

3.1   Simulation results of economy-wide factor productivity rise (SIM1)
3.1.1 Macroeconomic results: factor productivity rise economy-wide (SIM 1)

Following the productivity shock, output increases and domestic prices drop in all sectors, reflecting more efficiency and lower costs per unit of output. Greater efficiency increases output in all sectors resulting in increased real Gross Domestic Productt (GDP) by nearly 1.2%. Given constant real government expenditure, GDP boosts government revenue (1.4%) which raises government savings (0.8%). The higher level of real GDP allows consumers to enjoy a higher level of consumption. As a result, South Africa increases imports (1.4%) compared with the baseline level. Increased imports create a demand for foreign currency and raise the domestic currency (rand) price of foreign currency, which causes a depreciation of the currency. The depreciation raises exports (1.3%), which partially finance and discourage imports. Tariff revenue, indirect taxes, and the government's total revenues all improve with productivity rise.

Economy-wide productivity is expansionary as witnessed by a significant increase of more than one percent in domestic output in all sectors except in construction (0.1%) and government (0.1%) because the two sectors' products are not required as intermediates in other sectors. Imports rise mostly in the sectors with high import shares in the base year level. For example, imports rise in labour-intensive sectors (leather, 1.2%; apparel, 1.7%; scientific equipments, 1.5%) and in capital-intensive (chemical, 1.5%; vehicles, 1.4% and communication, 0.7%).

The depreciation of the real exchange rate improves exports with a significant rise in apparel (2.3%), scientific equipment (2.0%), communication equipment (2.0%), metal products (1.9%), electrical machinery (1.9%), machinery (1.5%), and vehicles (1.3%) exports. The presence of intra-industry trade in the economy allows sectors such as apparel and scientific equipment to have both export-orientation and import-competing characteristics.

3.1.2 Employment changes due to factor productivity rise

Results of economy-wide productivity rise show output having a significant positive impact on employment. The expansionary economy coupled with rising export demand raises the demand for factors of production. Figure 4 shows a general rise of sectoral employment by skills type with skilled labour benefiting more than other skill types in all sectors. The results support observations that find productivity to raise the demand for skilled labour relative to unskilled labour in South Africa (Edwards 2001; Pretorius 2002:17). The greatest rise of

unskilled employment occurs in mining (gold, coal, other-mining), other-chemicals, apparel, footwear and scientific equipment because these sectors increased exports. Slight employment rise occurs in metal products, machinery, iron and steel, non-ferrous, communication equipments, and food, because these sectors are highly capital-intensive. Unskilled labour demand holds steady in the leather sector with a slight rise of less than 0.10%. Sectoral demand for semi-skilled labour is similar to that of unskilled labour except in leather and electrical machinery where its demand falls reflecting their low output gain. As a result of productivity rise, all sectors, including those that are export-oriented, realise higher demand of skilled labour than that of semi-skilled and unskilled labour.
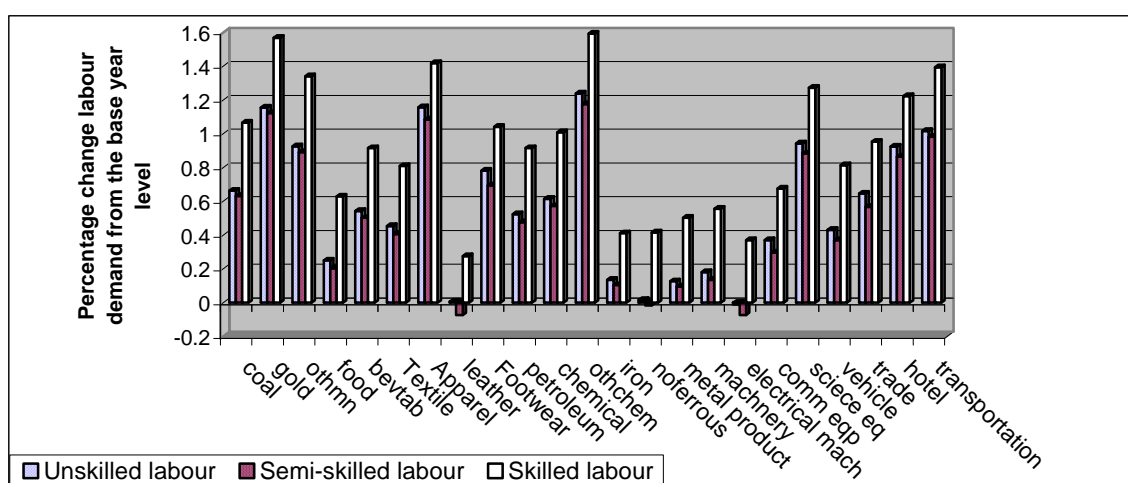

Figure 4 Percentage change labour demand: economy-wide productivity rise

3.1.3 Gender Employment changes due to economy-wide factor productivity rise

An economy-wide productivity increase raises employment of unskilled men and women in the apparel sector (unskilled women 1.2%; unskilled men 1.1%), in chemicals (unskilled women 0.78%; unskilled men 0.6%), and scientific equipment (unskilled women 1.0%; unskilled men 0.9%). The slightly increased demand for unskilled women relative to that of men is partially explained by the lower wages associated with women when compared with that of men so that more of their labour implies a cost advantage for a sector. In the short run, therefore, the expansion of firms has a trigger effect on retaining and increasing employment of unskilled women. However, the current static model cannot predict the sustainability of increased unskilled women jobs.

The outcome of the productivity increase for semi-skilled men and semi-skilled women shows slight differences between genders, although the trend favours semi-skilled women relative to

semi-skilled men. Significant differences, showing more gain for semi-skilled women, occur in women-intensive sectors of food, apparel and communication equipments.

In terms of high skills, increased productivity raises the economy-wide demand for skilled men more than for skilled women (see Figure 5). This happens in both traditional and non-traditional women-intensive sectors, for example, apparel (skilled women, 1.3%, skilled men 1.6%), footwear (skilled women, 0.9%; skilled men, 1.2%), textile (skilled women 0.6%; skilled men 0.9%), and in leather (skilled women, 0.2%; skilled men, 0.4%), respectively. This indicates a bias against skilled women in women-intensive sectors. The apparel sector, with a general higher concentration of women (72%) at the base level, experiences a higher increase in skilled men relative to skilled women. Gender economists term such occurrence as the 'defeminisation' through technology in both higher and in less value-added manufacturers (Elson 2000).
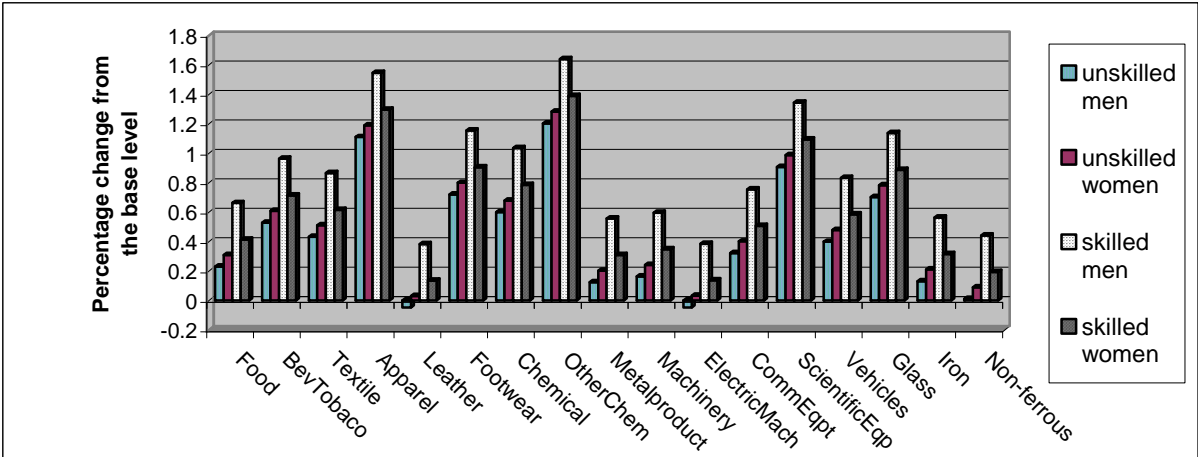

Figure 5 Percentage change employment by skills and gender: economy-wide productivity rise.

3.1.4 Change in wages and factor earnings due to factor productivity rise

Capital's earnings rise (1.2%) more than other factors based on its higher productivity. Under the assumption of flexible supply of unskilled and semi-skilled labour (elastic supply), the increased demand for such skills type raises their supply, while their nominal wages remain fixed at the base year level. Economy-wide rise of employment of men and women leads to an increase of their income earnings (see Figure 6). The income earnings of unskilled and semi-skilled women are slightly greater than that of unskilled and semi-skilled men because of higher increased demand for women's labour as compared to that of men of the same skill. On the other hand, hiring is higher for skilled men than skilled women leading to greater earnings for skilled men compared to skilled women workers. Nevertheless, there is almost

12

equalization of skilled men and women earnings, which explain higher earnings associated with highly skilled women.
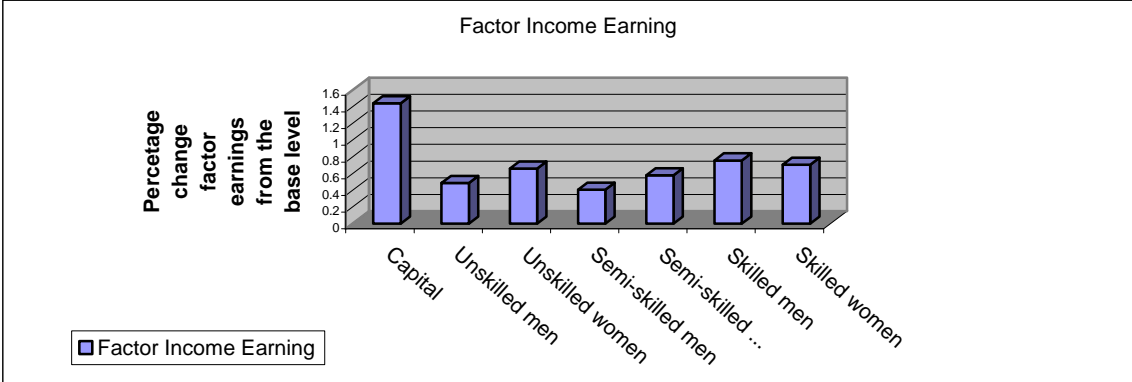

Figure 6 Percentage change factor income: economy-wide productivity rise

4. Results of factor productivity rise in selected sectors (SIM 2)

South Africa's productivity, which generally is concentrated in selected sectors, has been growing at the rate of 3.2% per year, but this has not led to job creation (South Africa Department of Labour 2006). This finding is consistent with other studies on employment, that find productivity to be a major factor associated with reduced levels of employment in South Africa (Jenkins and Thomas 2002; Edwards 2001). This section aims to analyse the economy-wide effects of a productivity rise in a few selected sectors.

4.1 Macroeconomic results: Factor productivity rise in selected sectors

Except for lower magnitudes, macroeconomic results for SIM 2 are similar to those for SIM 1. Increased factor earnings and increased consumption due to reduced commodity prices raise household welfare especially for low-income households.

4.1.1 Employment changes due to factor productivity rise in selected sectors

The direct effect of productivity increase in selected sectors is the reduction of employment in these sectors, albeit slightly by less than a percentage point (see Figure 7). Efficiency gains due to improved productivity enable sectors to switch their production process by reducing employment demand of all skill types. Skilled labour in labour-intensive sectors is mostly negatively affected because of its substantial higher wages which raises its marginal productivity, for example, skilled labour in the scientific equipment decline more than other skill types. The negative employment outcome differs from that of SIM 1 where employment rises significantly in all sectors. The fall in employment is effected by increased efficiency,

13

which enables profit-maximising producers to expand by employing fewer resources, particularly labour, due to its risen marginal productivity. Despite shedding jobs, all productivity-raised sectors expand their output.

Sectors with initial low productivity levels, which include the women-intensive sector of apparel, witness the worst of employment contraction. Sectors such as non-ferrous, metal products, transport equipment, other-industries, and furniture, which have strong linkages with policy-affected sectors, respond by slightly reducing their demand for employment as they are forced to become efficient in order to stay in business.

A certain amount of labour, which is released from the efficient sectors, relocates mostly to service sectors of trade (unskilled 0.5%; semi-skilled 0.6%) and water (unskilled 0.5 %; semi-skilled: 0.6%) (see Figure 7). Other service sectors such as communication, finance and business, also see a slight rise of such labour. The influx of women into the trade sector is mostly in subsectors such as retail, which is due to easy entry as it relates to low skills requirements.

Despite employment downturns in sectors where a productivity rise began, the relocation of labour from such efficient sectors to other sectors has economy-wide positive employment effects. A similar outcome has been observed in South Africa. For example, using a CGE model to study the effects of productivity rise on agriculture, Punt *et al* (2003) found a productivity rise in agriculture to reduce employment sectorally while increasing it economy-wide in an expanding economy. This outcome shows that efficiency gains in few sectors have economy-wide positive employment effect based on intersectoral linkages. The direct and indirect economy-wide employment effects are more easily captured with the use of CGE models than with partial equilibrium models, which focus mostly on direct effects.
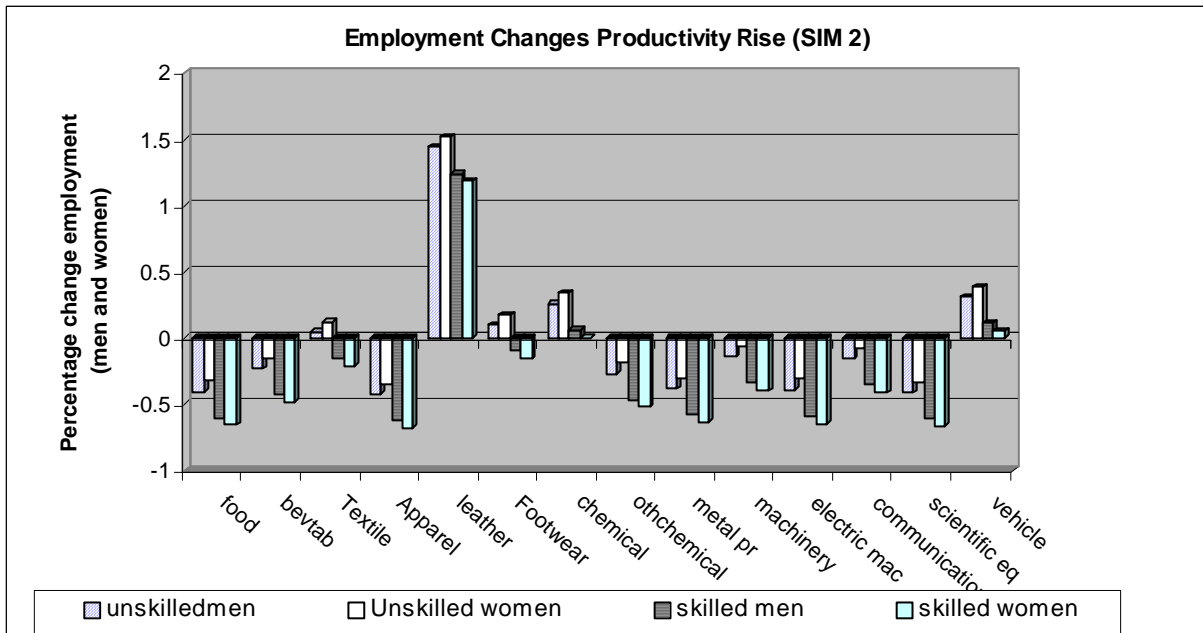
Employment Changes Productivity Rise (SIM 2)

Legend: unskilledmen, Unskilled women, skilled men, skilled women

Figure 7 Percentage change employment due to selected productivity rise

4.1.2 Gender employment changes due to factor productivity rise in selected sectors

Figure 8 shows, for the policy shocked sectors, a decline of all skill types for men and women employment due to productivity rise in selected sectors. Unskilled men labour drops more, than unskilled women labour because of unskilled men's higher marginal productivity when compared with unskilled women who receive lower wages. However, compared to skilled men, skilled women employment declines more in all sectors that reduce employment due to efficiency rises. This is due to the higher initial levels of skilled men in such sectors. The full employment assumption associated with skilled labour requires displaced men and women to obtain employment in other sectors. As such, the results show labour increases in sectors such as trade, etc, which are sectors that were not directly affected by productivity increase.

As seen in Figure 8, skilled men employment exceeds that of skilled women in those sectors. Sectors such as other mining, leather, paper, print and petroleum witness a fall of women labour while men labour demand rises. This is partly due to initial higher levels of men in such sectors when compared with initial levels of women. In sectors where employment rises, which are leather and vehicles, the rate of rise for skilled men exceeds that of skilled women. These two sectors increase men and women employment because of their increased demand by other expanding sectors, for example, leather in vehicles (car seats) and vehicles in expanded transportation services.

15

The negative employment effects associated with skilled women when compared to skilled men supports the observation that productivity is associated with competitive skills, which are mostly possessed by men. This limits the benefits of productivity in terms of job creation, particularly for skilled women who mostly possess skills that are different from those of men in most sectors. However, in reality, there is no guarantee that all retrenched employees, particularly unskilled labour will be absorbed in other sectors. Bezuidenhout, Khunou, Mosoetsa, Sutherland, and Thoburn (2006) found most retrenched workers in the textile sector in South Africa to have difficulties finding new employment in other sectors because of non-transferable skills. They found, however, that retrenched men were able to obtain employment faster than retrenched women.
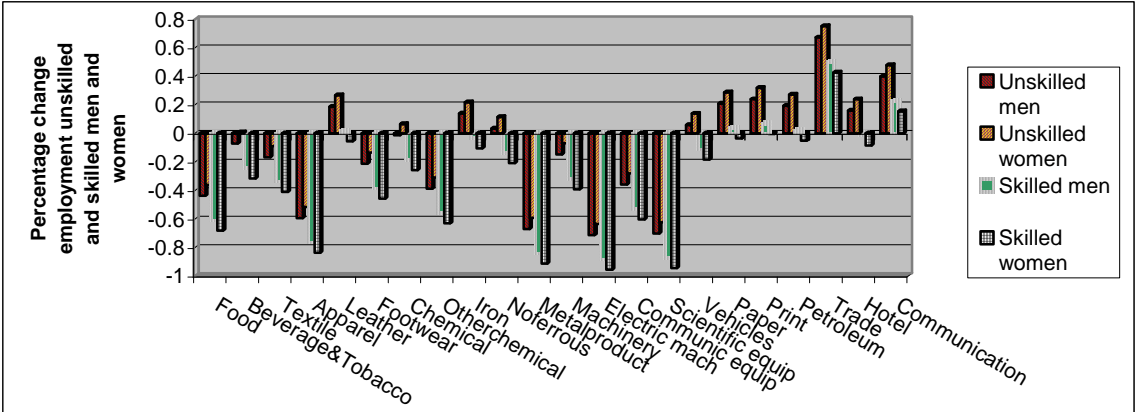

Figure 8 Percentage change unskilled gender: productivity rise selected sectors

4.2 Wages and factor earnings changes due to factor productivity rise

Figure 9 shows changes associated with capital rent and wages for men and women that occurred due to a selected sector productivity rise. Wages of unskilled and semi-skilled workers are fixed at their base level, and hence do not vary, while capital's rent and skilled labour wages vary in order to balance the employment requirements. Results show productivity increasing wages for skilled men and women labour.

The differing effects (expansion and contraction) in sectors of all skill types lead to an overall rise in their labour earnings. All factors, except unskilled women and men, see an increase in their earnings, among labour, skilled men benefit the most. Semi-skilled women earnings increase more, relative to earnings of semi-skilled men because of their economy-wide increased demand. The earnings for the skilled men and women labour increase with the earning of skilled men increasing more than that of the skilled women due to men's higher

16

initial wages. Several studies find higher wages to be associated with FDI, which is a major source of productivity (Braunstein 2000). However, economy-wide earnings of unskilled women and men decline, with that of men declining more than that of unskilled men following their employment loss in the efficient sectors, which outweighs the rate on which they are absorbed in other sectors, which are mainly low paying sectors. For example, the movement of unskilled men and women workers in the service sector does not guarantee increased earnings. This is because the service sector is heterogeneous where certain work is labour intensive with low pay and other types are characterised by high productivity and technological innovation with high pay.
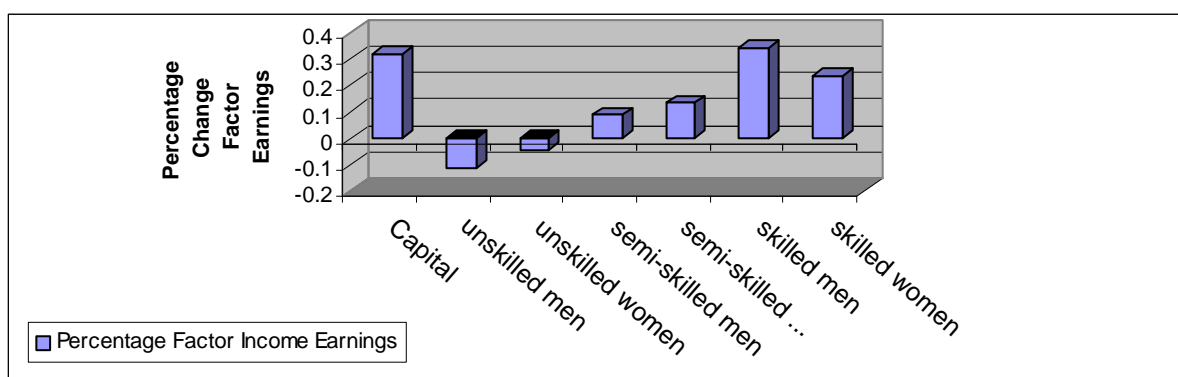

Figure 9 Percentage change earnings: Productivity rise selected sectors

5. Equivalent variation (EV): Factor productivity rise (SIM 1 AND SIM2)

In this study household welfare is measured by the equivalent variation (EV) methodology. Figure 10 shows the improvements of welfare for all the households with higher magnitudes for SIM 1 when compared with that for SIM 2 based on higher responses for SIM 1. With both simulations, the shift in relative income across the household deciles favours high-income households. These households derive most of their income from increased capital earnings and from increased earnings of skilled labour.

The improvement in regular earnings coupled with falling commodity prices due to rising cheap imports, which is induced by the efficiency rise, makes commodities affordable especially for low-income households who respond by increasing consumption. Low-income households spend a large share of their expenditure on consumables (textile, footwear etc.,) whose price has fallen. Due to concentration of men workers relative to women workers in higher-income households, a productivity rise that benefits high-income households tends to favour those men over women. Women, particularly unskilled women, are concentrated in

low-income households (South Africa SAM 2000) and, as such, their welfare improves less than that of skilled men and women in high-income households.
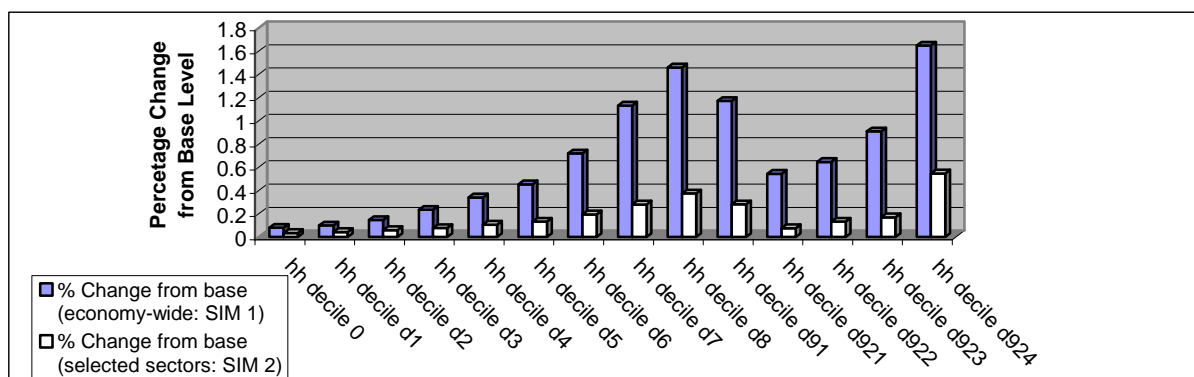

Figure 10 Percentage change equivalent variation (SIM 1 and SIM 2)

Conclusion

This paper has analysed impacts of productivity on South African economy and gender by means of a Computable General Equilibrium (CGE) model. The results show that factor productivity rise results in gains from a more efficient usage of resources, which increases GDP and improves the government budgetary position. In addition, productivity generates direct welfare benefits to households by lowering domestic commodity prices, and by increased earnings for factors, especially for skilled men and women.

An economy-wide productivity increase creates jobs for all skill types of men and women, through an economy-wide rise in output. However, productivity benefits skilled men more than other skill types of men and women. In most instances, skilled labour is preferable due to its appropriate training and expertise that enable the absorption and adaptation of technology. On the other hand, unskilled and semi-skilled women labour benefit more from economy-wide productivity rise than unskilled and semi-skilled men because women earn lower wages than men. This outcome differs from that for skilled women who obtain higher wages from the base year level.

Unlike economy-wide productivity rise, a direct effect of a partial productivity rise is efficiency gain resulting in job losses in productivity-raised sectors and in sectors in which they have strong linkages. Unskilled women labour falls less than unskilled men while skilled women labour falls more than that of skilled men. Some of the displaced workers, both skilled, semi-skilled and unskilled men and women, switch to export-oriented, labour-

intensive and capital-intensive sectors which have expanded resulting in economy-wide job creation.

The indirect effect of job creation through intersectoral linkages is overlooked in many partial equilibrium studies, which conclude that productivity leads to job losses. While partial productivity directly reduces levels of employment in the affected sectors, it also creates employment in sectors that provide goods and services to efficient sectors. This type of analysis explains the importance of looking at both direct and indirect economy-wide effects.

From a gender perspective, the increase in productivity creates challenges for women seeking employment. Lack of appropriate skills for women has the potential of maintaining gender inequality in South Africa by keeping women in low paying positions. Economy-wide productivity raises the employment demand of unskilled women mainly in low-paying positions. However, productivity within selected sectors sheds employment mostly in women intensive sectors. Although retrenched men and women relocate to other sectors, earnings of unskilled women drop because their job losses are outweighed by their job gains mostly in low-paying positions. This has an implication on the welfare improvement of low-income households, which derive most of their income from unskilled women.

This model assumes no relocation costs. In reality, relocation will be required to find alternative employment, increasing the time required and other costs to find new work. Adjustments costs may be severe and long lasting for the poorest members of households, particularly unskilled women due to low levels of education and skills, and limited savings that could be used to finance relocation or retraining.

As jobs and wages improve in quality, women tend to be excluded from them. Investing and mentoring in the skill development of women, in mathematics, science, engineering and information technology, areas associated with productivity could enhance women potential to benefit from productivity-enhanced economy.

References:

AREZKI, R; AHMED, F. & FUNKE, N. (2003) "Foreign Direct Investment and Portifolio Flows: Is South Africa Different?" *mimeo*. International Monetary Fund: Washington DC.

ARNDT, C. & TARP, F. (2003) "Trade Policy Reform and the Missing Revenue: A Gendered Analysis for Mozambique", *Working Paper No. 07/2003*. Danish Research Institute of Food Economics: Copenhagen.

ARORA, V. & BHUNDIA, A (2003) "Potential Output and Total Factor Productivity Growth in Post-Apartheid South Africa", IMF Staff Country Report No 03/173.

BARREL, R. and PAIN, N. (1997) "Foreign Direct Investment, Technological Change, and Economic Growth within Europe". *The Economic Journal*. 107: 1770-1786.

BIGGS, T.; SHAH, M. & SRIVASTAVA, P. (1995) "Technological Capabilities and Learning in African Enterprises." *World Bank Technical Paper 288* (Africa Technical Department Series). World Bank :Washington DC.

BLALOCK, G. & GERTLER, J. (2005) "Foreign Direct Investment and Externalities: The Case for Public Intervention." In Theodore Moran, Edward Graham and Magnus Blomström (eds.), Institute for International Economics: Washington, D.C.

BRAUNSTEIN, E. (2000) "Engendering Foreign Direct Investment: Family Structure, Labour Markets and International Capital Mobility", *World Development*, 28 (7): 1157-72.

ÇAGATAY, N.; ELSON, D. and GROWN, C. (1995) "Introduction." *World Development*, 23(11): 1827-63.

CHUANG, Y, C. & LIN, C, L. (1999) "Foreign Direct Investment, R&D and Spillover Efficiency: Evidence from Taiwan's Manufacturing Firms." *The Journal of Development Studies,* 35(4): 117-137.

DERVIS K.; De MELO, J. & ROBINSON, S. (1982) "General Equilibrium Models for Development Policy", Cambridge University Press.

DIAO, X.; RATTSO, J. & STOKKE, H.E. (2005). International spillovers, productivity growth, and openness in Thailand: A general equilibrium analysis, *Journal of Development Economics,* 76(2): 429-450.

EDWARDS, L. (2001) "Globalisation and the Skills Bias of Occupational Employment in South Africa", *South African Journal of Economics*, 69(1): 40-71.

EDWARDS, L. & GOLUB, S. (2003) South Africa's International Cost Competitiveness and productivity: A sector Analysis. Report for National Treasury, Pretoria, USAID.

FONTANA, M. (2001) "Modeling the Effects of Trade on Women: The case of Zambia', *IDS Working paper 155*, Brighton: Institute of Development Studies.

FUSSELL, E. (2000) "Making Labour Flexible: The Recomposition of Tijuana's Maquiladora Female Labour force", *Feminist Economics*, 6(3)

GROSSMAN, G. M. & HELPMAN, E. (1997) "Innovation and Growth in the Global Economy." MIT Press: Cambridge MA.

JENKINS, R. (2002) "The labour Market Effects of Globalisation in South Africa", Paper presented at the workshop on Globalisation Production and Poverty in South Africa", Johannesburg, TIPs, June 24.

KLEIN, M; AARON, C & HADJIMICHAEL, B (2000) Foreign Direct Investment and poverty reduction

LERESCHE, A. (1993) "Women Obstacles and Opportunities" *The Innes Labour Brief.* (4): 52-61.

LEWIS, J. (2001) "Reform and Opportunity: The Changing Role and Patterns of Trade in South Africa and SADC," Africa Region *Working Paper Series* No.14, Washington DC, The World Bank.

LOFGREN, H., HARRIS, R.L. & ROBINSON, S. (2001) "A Standard Computable General Equilibrium (CGE) Model in GAMS*."* Trade and Macroeconomics Discussion Paper no. 75, International Food Policy Research Institute: Washington, DC.

MAI, Y. (2003) "Effects of Reducing Tariffs and Endogenous Productivity Growth" *General Working Paper No. G-139 December 2003*, Centre of Policy Studies, Monash University.

BEZUIDENHOUT, A.; KHUNOU, G.; MOSOETSA, S.; SUTHERLAND, K. & THOBURN, J. (2006) "Globalisation and Poverty: Impacts on Households of Employment and Restructuring in the Textiles Industry of South Africa." *Journal of International Development: Forthcoming.*

MARKUSEN, J. R. & VENABLES, A. (1999) "Foreign Direct Investment as a Catalyst for Industrial Development." *European Economic Review*. (43):335-356.

MODY, A. & WANG, F.Y. (1997) "Determinants of Industrial Growth in Coastal China, 1986-9." *The World Bank Economic Review.* 1(2):293-325.

PRETORIUS, S. (2002) "How Does Globalisation Affect Income Distribution in South Africa?, paper presented at TIPS Annual Forum.

SADOULET, E. & DE JANVRY, A. (1995) "Quantitative Development Policy Analysis", The John Hopkins University Press: Baltimore and London.

SODERBOM, M. & TEAL, F. (2003) *Centre for the Study of African Economies Department of Economics*, University of Oxford.

STATISTICS SOUTH AFRICA. (2000) *October Household Survey (OHS), 199*9. *Statistical release* P0317.

STATISTICS SOUTH AFRICA. (2000-2005) *Labour Force Survey Statistical release P0210*.

SOUTH AFRICAN GOVERNMENT. (2005) "Accelerated and Shared Growth Initiative-South Africa (ASGISA)", Available at: SA Government on line: www.info.gov.za/asgisa

SOUTH AFRICAN RESERVE BANK (SARB). *Quarterly Bulletins (2000-2006 series)*

PUNT, C.; PAUW, K.; VAN SCHOOR, M.; RANTHO, L.; GILIMANI, B.; McDONALD, S.; CHANT, L. & VALENTE, C. (2003) "The welfare impacts of national and international agricultural efficiency gains-A South African Case Study", *PROVIDE* Working Paper Series, 2004:3.

THE WORLD BANK. (2006) "World Development Indicators". The World Bank: Washington DC. Available: http://devdata.worldbank.org

THURLOW, J. & VAN SEVENTER, D. (2002) "A standard computable general equilibrium model for South Africa" International Food Policy Research Institute (IFPRI): Washington DC.

URATA, S. & Kawai, H. (2000) "Intrafirm Technology Transfer by Japanese Manufacturing Firms in Asia." In Takatoshi Itoh and Anne O. Krueger, *The Role of Foreign Direct Investment in East Asian Economic Development*, Chicago and London: Chicago University Press, 49-77.

Appendix 1
Table.1 Trade, productivity levels and factor shares in sectors

	Productivity level (2000)	Export shares	Import shares	Capital share in sectors	Men share in sectors	Women share in sectors
Maize	2.1	1.8	0.4	85.3	13.4	1.3
Wheat	2.4	0.2	0.2	92.0	7.3	0.7
Fruit Vegetables	2.7	0.9	1.0	63.0	24.8	12.2
Poultry	1.7	0.2	0.3	37.5	45.8	16.7
Dairy Livestock	1.7	0.2	0.3	76.4	21.6	2.0
Other Agriculture	1.8	0.3	0.2	57.2	20.6	22.2
Coal mining	2.4	3.4	0.2	54.4	44.4	1.2
Gold mining	1.8	10.1	0.0	29.3	68.9	1.9
Other mining	2.2	19.9	10.0	66.1	32.3	1.6
Food processing	2.7	2.6	2.6	44.0	44.2	11.7
Beverage / tobacco	2.3	1.6	1.0	71.1	23.9	5.0
Textiles	1.6	0.9	1.4	21.4	57.4	21.3
Clothing	0.9	0.9	1.2	13.2	35.9	50.8
Leather	1.8	0.4	0.3	46.6	16.3	37.1
Footwear	1.6	0.1	0.8	49.2	12.1	38.8
Wood product	1.6	0.8	0.5	30.5	59.5	10.0
Paper product	3.4	2.4	1.2	55.0	26.7	18.3
Printing	3.5	0.4	1.0	24.0	51.2	24.8
Petroleum	2.3	3.5	1.2	85.6	13.5	1.0
Chemicals	2.5	3.8	4.6	61.9	34.3	3.9
Other chemicals	3.0	1.9	5.1	33.5	48.1	18.3
Rubber product	3.0	0.5	0.8	29.7	39.1	31.1
Plastic product	3.7	0.3	0.9	10.2	46.7	43.1
Glass product	2.3	0.2	0.3	29.0	69.9	1.2
Non-metal	2.8	0.4	1.0	65.3	25.6	9.1
Iron & steel	3.0	7.2	1.0	51.1	39.3	9.6
Non-ferrous	3.1	3.5	1.7	81.5	17.6	0.9
Metal product	3.4	1.1	1.7	33.4	62.1	4.5
Machinery	3.8	4.6	13.1	19.3	66.0	14.7
Electrical machinery	3.0	1.0	2.5	47.7	37.5	14.8
Comm. equipment	2.4	0.7	5.5	27.2	37.0	35.8
Scientific equipment	2.6	0.4	2.7	28.6	40.3	31.1
Vehicles	3.4	5.0	12.2	44.3	44.0	11.7
Transport equipment	3.0	1.1	3.2	7.6	90.3	2.1
Furniture	2.4	1.1	0.4	28.3	63.3	8.4
Other manufacture	1.9	1.5	1.4	46.9	29.3	23.8
Electricity / gas	1.7	0.5	0.1	65.2	29.5	5.4
Water	1.7	0.0	0.0	67.2	29.1	3.7
Construction	3.7	0.1	0.3	40.1	54.5	5.5
Trade services	3.2	0.2	0.2	45.5	33.5	21.0
Hotels services	2.3	2.6	1.9	76.8	13.1	10.3
Transport service	2.2	5.3	8.8	55.5	39.3	5.2
Comm. service	2.6	1.1	1.6	60.2	23.9	15.7
Financial service	1.9	3.0	1.9	60.8	24.8	14.4
Business service	2.0	1.0	1.7	69.0	18.0	12.9
Other services	1.8	0.3	0.4	49.3	17.3	33.5
Other produce	2.2	0.9	1.3	15.6	49.7	34.6
Government	3.0	0.0	0.0	33.7	47.8	18.6

Source: 2000 South African-gendered SAM