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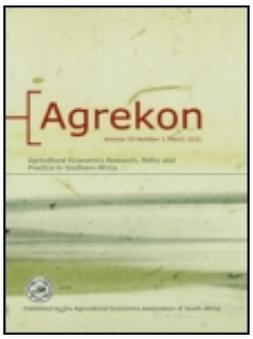

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Taylor & Francis Group

Agrekon

Agricultural Economics Research, Policy and Practice in Southern Africa

ISSN: 0303-1853 (Print) 2078-0400 (Online) Journal homepage: www.tandfonline.com/journals/ragr20

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To cite this article: Y.T. Bahta, B.J. Willemse & B. Grove (2014) The role of agriculture in welfare, income distribution and economic development of the Free State Province of South Africa: A CGE approach, Agrekon, 53:1, 46-74, DOI: 10.1080/03031853.2014.887905

To link to this article: https://doi.org/10.1080/03031853.2014.887905

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THE ROLE OF AGRICULTURE IN WELFARE, INCOME DISTRIBUTION AND ECONOMIC DEVELOPMENT OF THE FREE STATE PROVINCE OF SOUTH AFRICA: A CGE APPROACH

Y.T. Bahta[1], B.J. Willemse[1] and B.Grove[1]

ABSTRACT

This article researches quantitatively two distinctive roles of agriculture in the Free State provincial economy: a buffer role and the role of poverty alleviation using a Computable General Equilibrium model. To examine the capacity of the agriculture sector to act as a "buffer" in the presence of a negative external shock to the Free State provincial economy, two different shocks are considered: an increase in the international oil price together with a decrease in the international gold price and a devaluation of South African currency. In these simulations, the agricultural sector does not play a buffer role of absorbing labour displaced from other sectors. Our hypothesis was that in the presence of a negative external shock, the agricultural sector would be able to absorb, to some extent, the negative impact, especially labour. The argument is that when the rest of the economy suffers a slowdown, people will "migrate" back to agriculture and therefore the agricultural sector will grow and increase its labour demand, alleviating the impacts of the crisis. To analyse the impact of the agriculture sector on welfare and income distribution, an increase in agricultural production, industrial production and other sectors is simulated through increased labour productivity. The results suggest that the agricultural sector plays a significant role in reducing poverty and improving income distribution, but considering poverty the results suggest that the manufacturing sector increases income more than other sectors. Our hypothesis is that growth based on agriculture has a greater impact on poor income households than industrial-based growth. The assumption behind this is that more poor households rely on agriculture than on other sectors.

Keywords: Buffer role; poverty alleviation, CGE, external shock.

JEL classification: C68, D58, E16

1 INTRODUCTION

The Free State Province is one of nine provinces in South Africa. It has a population of 2.8 million people, which is approximately 5.7% of the South African population,

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Agrekon
Vol. 53 (1) 2014 • ISSN Print 0303-1853/Online 2078-0400
© Agricultural Economics Association of South Africa pp 46–74
DOI: 10.1080/03031853.2014.887905

according to the 2007 community survey produced by Statistics South Africa. The Free State is centrally situated among the remaining eight provinces. It is bordered by six provinces (the Eastern Cape, Northern Cape, Gauteng, Kwazulu-Natal, North West and Mpumalanga). The only two provinces not bordering it are Limpopo and the Western Cape. It also forms a border with Lesotho (Maisonnave *et al.*, 2010 and STATSSA, 2006).

The Free State has a surface area of 129 480km^2, which makes it the fourth largest province in South Africa, covering 10.6% of the total area of the country. The Free State is subdivided into five district council municipalities, namely Xhariep, Motheo, Lejweleputswa, Thabo Mofutsanyane and Northern Free State. These district councils comprise 20 municipalities (STATSSA, 2006).

The Free State agricultural sector is a dynamic and livelihood sustainable sector and about 69 000 people (2.3% of the Free State population) are working in the agricultural sector (STATSSA, 2007b). Approximately 4.2% of the Free State value added gross domestic product comes through agriculture (PROVIDE, 2009). Agriculture creates more jobs per R1 million value added than any other sector of the economy. This sector has also recorded the highest level of increase in export earnings since 1993. The Free State is aptly referred to as the "bread basket" of South Africa (FSDPF, 1999). This shows that the agricultural sector is an important sector in the Free State.

In the context of imperfect competition, the pass-through of external shocks to prices may be affected strongly by the behaviour of the mark-ups of prices over marginal costs (Hahn, 2003). Taylor (2000) argues that the perceived persistence of shocks affects the size of the pass-through. Yang (1997) maintains that the degree of exchange rate pass-through is negatively related to the degree of substitution among different products in industry.

With regards to oil price shocks, the November *Monthly Bulletin* of the European Central Bank (ECB) (2004) points out that direct, indirect and second-round price effects can be distinguished. Direct price effects via energy items in the consumer basket are unavoidable following oil price shocks, as energy is part of the households' consumer basket. Indirect effects may emerge on account of higher input costs being passed on to consumer prices via the domestic production chain. Second-round effects originate from wage reactions or, more generally, from inflation expectations to oil price increases. The full impact of oil price changes on prices largely depends on the actual reaction of wages as well as fiscal and monetary policy (ECB, 2004; National Institute of Economic and Social Research (NIESR), 2004). Moreover, a temporary oil price shock will have less impact on inflation through its effect on expectations than will a permanent shock (NIESR, 2004). According to a European Central Bank *Monthly Bulletin* (2004), the impact

of oil price shocks also depends on the flexibility of the economy and the way in which product and labour markets function.

Developing countries generally suffer more than the OECD countries from oil price increases, because their economies are more dependent on imported oil, energy-intensive manufacturing generally accounts for a larger share of their GDP and energy is used less efficiently (International Energy Agency, 2003).

The South African Reserve Bank's *Monetary Policy Review* of March 2001 points out that it may be expected that factors such as changes in the exchange rate or oil prices will have a larger effect on production prices than on consumer prices due to the fact that imported goods have a weight of 27% in the production price index, as opposed to an estimated weight of around 6% in the overall consumer price index (CPIX), excluding interest rates on mortgage bonds (Swanepoel, 2006).

The roles of agriculture as a buffer[2] have not been well identified or analysed in the context of development and poverty reduction. In the development literature the traditional roles are in terms of market linkages: a country's agriculture sector supplied food and acted as a source of labour and capital. In today's economically integrated world, many countries' economies have reduced the dependence of the rest of the economy on domestic agricultural production. Nevertheless, in low- and middle-income countries, the farming sector is still relatively large, especially in terms of employment and foreign exchange earnings.

The performance of the agriculture sector in developing countries is still far from satisfactory, and the majority of their populations are undernourished and food insecure. As a result, more people have moved from the countryside to urban areas in the past decades, often leading to congestion and deteriorating living conditions in large cities. Rapidly expanded labour markets in urban areas made up of many informal workers are particularly vulnerable to economic shocks.

The underlying cause of these problems in developing countries, including South Africa, can originate from the fact that the roles of agriculture appreciated by policymakers are still limited to direct and tangible contributions to a country's development. In other words, even though the agriculture sector has significantly higher potential for contributing to solving these problems, this potential does not fully materialise because of a combination of market, policy and institutional failures. The roles of agriculture with externality characteristics include contributions to poverty alleviation, food security, environmental services, out-migration control and a buffer in times of economic crisis.

2 The buffer role implies the temporary nature of cushion that the individual or the household sought in times of crisis, or implies that it is of short-term nature and arising primarily from some sort of a crisis situation (Ray, 2004).

The smaller share for agriculture of economic output and workers as incomes increase over time is the most robust "stylised fact" describing structural transformation. Does this mean that agriculture is unimportant, given that its relative share of the economy declines in any case? Such a widespread misconception led to development strategies that squeezed agriculture and rural areas on behalf of the more dynamic industrial sector and urban centres (Sakuyama, 2007). This "squeeze agriculture" paradigm has given way to a more balanced growth strategy and the development consensus is that a strongly performing agricultural sector is fundamental for overall economic growth.

Following recent international oil price increases, there has been increasing concern about their macroeconomic implications, both abroad and in South Africa. Indeed, the South African Reserve Bank (SARB) considers oil price movements to be one of the major threats to the continued attainment of its inflation target, as evidenced by numerous recent statements by its Monetary Policy Committee. Furthermore, rising energy prices have the potential to undermine the government's Accelerated and Shared Growth Initiative for South Africa (AsgiSA) to halve unemployment and poverty by 2014 (Wakeford, 2007).

As a consequence, there has been considerable interest in how this external factor can affect the South African economy, including the Free State province's economy. For instance, industrial agriculture (or "agri-business") depends heavily on oil for the production of fertilisers, herbicides and pesticides. The main motivation of the study is to provide policy guidance to the roles of agriculture in development strategies.

The objective of this study is to assess the role of agriculture in welfare, income distribution and economic development on the economy of the Free State province, designing policy scenarios and simulation of scenarios in a CGE; and identification of the likely effect and impact of different scenarios on the economy of the Free State (i.e. GDP, employment, income distribution, welfare, etc.).

The model is used to simulate the impact of a negative external shock to the Free State provincial economy on various macroeconomic variables. The change in employment in the agricultural sector *vis-á-vis* other sectors is examined for different shocks. The buffer role of agriculture is then analysed using a "what if" approach, where the impacts of different shocks on the benchmark situation are compared with the impact, assuming the agricultural sector cannot react to the shock.

To examine the role of agriculture in poverty reduction and income distribution, an increase in labour productivity of the sector is quantified and compared with the impact of a similar change in the industrial sector.

2 METHODOLOGY, DATA USED, POLICY SCENARIOS AND POLICY SCHOCK

To evaluate the role of agriculture in welfare, income distribution and economic development in the economy of the Free State was applied a computable general equilibrium (CGE). A CGE model is economy wide in the sense that it includes all sectors. Such models have gained increasingly wide acknowledgement in terms of policy evaluation. This model permits a systematic analysis at provincial level of external price shocks and shifts in other exogenous variables, tracking the effects of such changes on various actors in the economy. It is possible to distinguish the implications of various policy and external price regimes with respect to their effect on several variables of interest: macroeconomic variables, sectoral output, employment, household income and welfare (Nielsen, 2002; Bahta, 2007). The underpinning database to be used for the model is a social accounting matrix (SAM) of base year 2004, developed in 2006 by the Free State provincial government, the Development Bank of Southern Africa (DBSA) and the Free State provincial treasury. The model is initially set up to replicate the base year SAM by appropriately calibrating the parameters of the model. Most of the parameters of the model can be and are calibrated from the SAM; however, the Armington elasticities are obtained from Gibson (2003).

The production elasticities were set at 1.2 and 0.6; the household income elasticities were set at 0.20 and 0.48, and export demand elasticities were set at 0.9 and 2.

Gibson (2003) explains that the Armington elasticity forms an essential component of modelling the effects of international trade policy. Furthermore, applied partial and general equilibrium models employed to examine trade policy are almost all sensitive to trade elasticities. A key relationship for model analysis is the degree of substitution between imported and domestically produced goods as the relative prices of those two goods change, i.e. the Armington elasticity. Indeed, the Armington elasticity is a key parameter determining the quantitative, and in some cases qualitative, results used by policymakers. The anatomy of the model is presented in Figure 1.

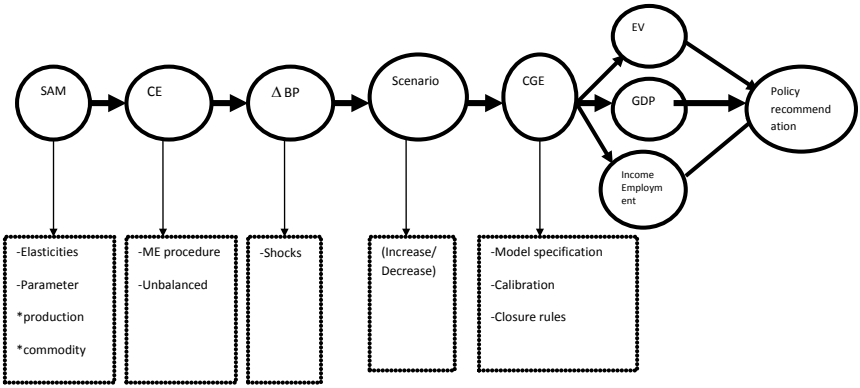

Figure 1: The anatomy of the model and database

Source: Own observation

Note: SAM = Social Accounting Matrix, CE = Cross Entropy, BP = Change of policy or shock, CGE = Computable General Equilibrium, EV = Equivalent Variation and ME = Method of Entropy for balancing.

A social accounting matrix (SAM) provides a comprehensive and consistent description of the transactions taking place in an economy in a given year; between production sectors, factors, households, government institutions and the rest of the world. Each macro account in the SAM is represented by a column and a row, with columns tracking expenditures and rows tracking incomes. The SAM follows the principles of double-entry accounting. This has two implications: (1) any purchase, expenditure or financial outlay by one account is sale, income or financial inflow to one or more other accounts, and (2) for each account total income must be equal to total expenditure (Nielsen, 2002).

The Free State province's SAM incorporates six major accounts, each of which can be sub-divided into numerous sub-accounts. These major trade accounts are: activity (production) accounts, commodity accounts, factor accounts (labour and capital – gross operating surplus), institutional accounts, capital accounts and trade accounts (rest of the world). The factor account households' account and trade account are discussed in the next paragraphs.

Factor account. These are income flows to factors of production from their employment in domestic activities. These may also include payment to foreign factors of production used in the production process. Typically, households own all labour services. Consequently, payments to domestically based labour are distributed across the different types of household as labour income and distributed profits. In terms of the remuneration of labour reflected in the labour account for the Free State, four population groups (i.e. Blacks/Africans, coloureds,

Indians and whites) have been specified in the SAM for the Free State, along with eleven occupational groups. This classification is the reflection of different skills levels employed in the provincial economy: legislature, professionals, technicians, clerks, service workers, skilled agricultural workers, craft workers, plant and machine operators, elementary occupations, domestic workers and occupation unspecified. In this particular study, labour categories are used as an aggregate of all labour groups as (FLAB) to see the overall implication of labour productivity in aggregate for each sector (agriculture, mining, manufacturing and other sectors) instead of each labour categories per sector. If the 11 skills categories incorporate four population groups, it will be 44 components of factor labour. If the simulation of labour productivity for 44 labour components for each sector is done the result will be redundant and the analysis will lose focus.

The households' account has been sub-divided into 48 different household types, corresponding to the four population groups and 12 income categories per group. The households were disaggregated into four population groups: Africans/ Blacks; Coloured; Indian/Asians and Whites. These were further subdivided into 48 different household types corresponding to the 4 population groups and 12 income categories per group (Percentile 1 to Percentile 12). The household divided into 5 household expenditure categories for each population group. Low-income households (P1 and P2), low-middle-income households (P3 to P5), middle-income households (P6 to P8), high-middle-income households (P9 and P10) and high-income or expenditure household groups (P11 and P12). Low-income households comprise all households with an income/expenditure per year from 1 to 10 602 Rand, low-middle-income households from 10 603 to 24 172 Rand, middle-income households from 24 173 to 49 394 Rand, high middle households 49 395 to 107 537 and high-income households group from 107 538 to 141 063 and above (Free State Provincial Treasury, 2006). In this particular study, 48 household categories are aggregated into five household income groups (low-income households; low-middle-income households; middle-income households, high-middle-income households and high-income households) for easier presentation of results. A detailed overview of households' real income and EV at disaggregated level for 48 accounts presented in Addendum.

Trade account with the rest of the world. Trade accounts recorded trade transactions with the rest of the world, and are important for trade policy analysis. These include current and capital accounts, as well as visible and invisible trade. Imports are reflected as an income, i.e. a row entry, because they represent an income to foreign countries that is associated with expenditure by domestic agents. Exports are reflected as expenditure by foreign countries and, hence, represent an income to the domestic account. The rest of the world account is divided between the rest of South Africa and the rest of the world. In other words, the rest of the

world (trade account) included exports from the Free State to the rest of South Africa and the rest of the world, factor payments from the Free State to the rest of South Africa and the rest of the world, transfers from households in the Free State to households in the rest of South Africa and the rest of the world, and transfers from the provincial Free State government to the rest of South Africa and the rest of the world.

The Free State's SAM does not include specific accounting for crude oil. Crude oil is included in the "other mining" account. In order to conduct an analysis of crude oil price movements, it is necessary to separate them from the aggregated "other mining" account. Based on the study by PROVIDE (2005) and Fofana *et al*. (2008) and trade data from customs data supplied by the South African Revenue Service (SARS), the share of aggregate commodity imports that related to crude oil is 75% to 84% of other mining. South Africa (i.e. the Free State province) does not export crude oil, so that in the modification of SAM it is assumed that the then local price of crude oil is the same as that of imported oil. There is no product tax on crude oil imports. As a result of all these included data discrepancies, the SAM is unbalanced, and the cross-entropy method is used to balance the SAM.

Balancing a SAM using the cross-entropy (CE) method has become a standard procedure in most SAM-based modelling. Robinson, Cattaneo and El-Said (2000) have explained that the CE method is built on information theory, as developed by Shannon (1948) and brought into economics by Theil (1967). The main idea is that the expected information value of additional data can be expressed as a Kullback-Leibler (1951) cross-entropy distance I (p:q) between the prior (q) and posterior (p) probability distributions of a set of n events.

$$-\mathrm{I}(\mathrm{p}:\mathrm{q}) = \sum_{i=0}^{n} \mathrm{P}_i \ln \frac{p_i}{q_i} \qquad (1)$$

The objective of the CE problem is to find the set of *pi* that minimises (1), using information on the prior and the data. With regards to SAM estimation or updating, the problem is to find a new SAM coefficient matrix A* that minimises the CE distance between itself and the prior (or initial and probably unbalanced) coefficient matrix A. Let *aij** and *aij* be the respective elements of A* and A, the minimisation problem can be written as follows:

$$Min\left[\sum_i\sum_j a_{ij}\ln\frac{a^*_{ij}}{a_{ij}}\right] = \text{ Subject to: } \sum_j a_{ij}y^*_j = y^*_i; \sum_j a_{ji} = 1 \text{ and } 0 \leq a_{ji} \leq 1 \qquad (2)$$

Problem (2) does not have a closed form solution, and needs to be solved numerically, after setting up the Langrangian multiplier. It is, however, possible to express the optimal solution *a*ij* as a function of both the Lagrange multipliers i associated with the row and column sums, and the initial coefficient *aij*:

$$a^*_{ij} = \frac{a_{ij}\exp(\lambda_i y^*_j)}{\sum_{i,j} a_j \exp(\lambda_i y^*_j)} \qquad (3)$$

Robinson, Cattaneo and El-Said (2000) discuss the comparability of (3) to Bayes's rule, in which "the posterior distribution is equal to the product of the prior distribution and the likelihood function, dividing by a normalisation factor to convert relative probabilities to absolute ones". Thus, Equation (3) may be seen as an efficient information processing rule that satisfies the information conservation principle of Zellner (1962). That is, it does not ignore any of the input information and neither does it produce any false information. The authors also draw on Golan *et al*. (1996) to argue that the CE estimator is consistent and has maximum likelihood properties under some distributional assumptions.

The basic minimisation problem in (2) can be made richer by incorporating aggregation constraints and measurement errors. For *k* restrictions, a typical aggregation constraint may be expressed as follows:

$$\sum_i\sum_j g_{ij}^{(k)} t_j = y^{(k)} \qquad (4)$$

where *gij* define an n-by-n aggregator matrix, which has ones for cells in the aggregate and zeros otherwise. Assume that there are k such aggregation constraints. Similarly, measurement errors are incorporated as follows:

$$y = x + e \qquad (5)$$

where *y* is a vector of row sums and *x*, measured with error *e*, is the vector of known column sums. The error is expressed as a weighted average of known constants *viw*:

$$e_i = \sum_w w_{i,w} . v_{i,w}$$

$$\sum_w w_{i,w} = 1 \text{ and } 0 \leq w_{i,w} \leq 1 \qquad (6)$$

The weights are treated as probabilities, which are estimated together with the elements of the matrix **A***. The estimation procedure used in this study is based on five weights that are symmetric about zero. The minimisation problem (2) is solved, subject to Equations (4), (5) and (6).

2.1 Policy scenarios

The scenarios are based on negative external shock and an increase in labour productivity. The Free State province's CGE model was implemented using computer codes provided by the International Food Policy Research Institute (IFPRI), as documented in Lofgren *et al*. (2002). Model implementation consists of applying the theoretical model to behavioural parameters. The FSP CGE model was solved numerically with General Algebraic Modelling Systems (GAMS) software.

The reasoning behind the selection of the particular scenarios used for the analyses is supplied in the subsequent sections.

2.1.1 External shock

2.1.1.1 Increase in international oil price

The steep upward trend in the price of crude oil in recent years, reaching a record nominal high, has led to increasing concern about its macroeconomic implications, both abroad and in South Africa. Furthermore, rising energy prices have the potential to undermine the government's accelerated and shared growth initiative for South Africa to halve unemployment and poverty by 2014 (RSA, 2006). The world demand-driven oil price shock has affected the way emerging countries pursue macroeconomic policy. South Africa has also been concerned about the impact of the oil price increases on economic growth and on poor people (Fofana *et al*., 2008).

South Africa's economy is relatively energy intensive, with resource-based industries such as mining (especially gold mining), chemicals, iron and steel being particularly heavy users of energy (DMERI, 2002). Crude oil accounts for a further 17% of raw energy supply (PROVIDE, 2005).

Oil shocks are usually defined in terms of price fluctuations, but these may in turn emanate from changes in either the supply of or the demand for oil. Price shocks may of course be negative (a fall) or positive (a rise). South Africa's historical experience with oil shocks showed that four oil shocks could be identified in the post-war era, having occurred in 1973–1974, 1979–1980, 1990 and the period from 2003 to 2006 (Figure 2).

2.1.1.1.1 The first oil shock (1973–1974)

The first oil shock was catalysed by the Arab-Israeli war, which resulted in various Arab oil producing nations placing an embargo on oil exports to the United States and the Netherlands, which were seen as strongly pro-Israel. The oil price rose by a factor of nearly four, from about $3 per barrel prior to the war to around $11.50 per barrel in 1974. In response to inflation and international monetary instability, the average gold price rose by 66 per cent from 1973 to 1974 (see Figure 2). However, the following year the gold price stagnated and by 1977 it had made a partial retreat. Dagut (1978) claims that governments forced down the price of gold to bolster faith in the value of currencies and to restore stability to financial markets (Wakeford, 2006).

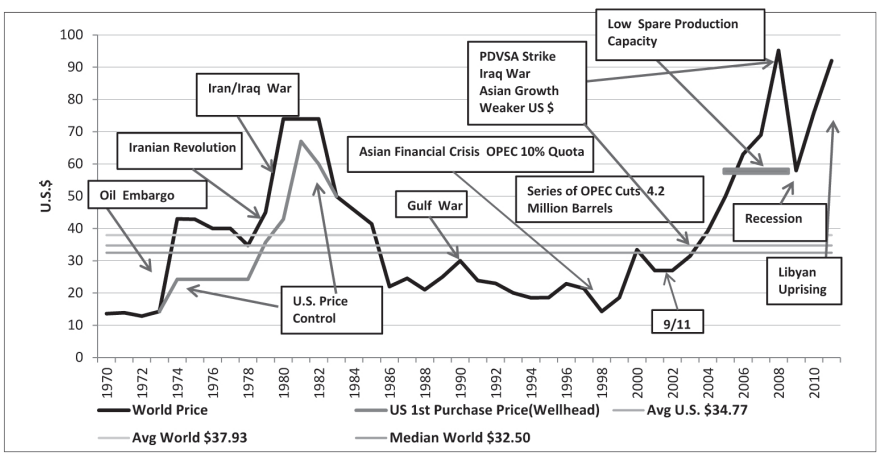

Figure 2: Crude oil price (2010 US Dollar) – 1970 to October 2011

Note: PDVSA – Petroleum of Venezuela

Source: WTRG Economics, http://www.wtrg.com/prices.htm

2.1.1.1.2 The second oil shock (1979–1980)

The second oil shock occurred in the wake of the Iranian Revolution in 1978/79 and the subsequent war between Iraq and Iran in 1980, which caused Iranian oil exports to dry up altogether (Figure 2).

2.1.1.1.3 The third oil shock (1990)

The third oil price shock was triggered by the Iraqi invasion of Kuwait in August 1990. As a consequence of fear-driven stockpiling and the elimination of Iraq's and Kuwait's approximately 7 per cent share of daily world oil production following the imposition of United Nations sanctions, the price of oil climbed by a factor of about two from $17 per barrel in July 1990 to an average of $35 per barrel in October (Van der Merwe and Meijer, 1990).

2.1.1.1.4 A fourth oil shock (2003–2006?)

The balance between supply and demand in the oil market has gradually been tightening over the past few years. This is partly attributable to steeply rising demand on the back of robust economic growth, especially in major emerging economies such as China, but also in the USA. On the other hand, supply has expanded less rapidly than demand. Moreover, there have been temporary or recurrent disruptions to the flow of oil in some areas as a result of various factors, such as the ongoing conflict in Iraq; sporadic conflict and sabotage in Nigeria; the devastation wrought by hurricanes Katrina and Rita in the Gulf of Mexico; and a leaking pipeline leading to a temporary closure of the Prudhoe Bay field in Alaska in August 2006. Speculation in the oil market has amplified the price effects of these relatively minor supply disruptions. In addition, fears among oil traders were exacerbated by the conflict between Israel and Hezbollah in July/August 2006.

As a consequence, the price of crude oil rose from around US$25 per barrel in 2003 to a high of US$78 per barrel in July 2006. This represents a trebling of oil prices over three years, which, according to the earlier definition, may be defined as a "trend" oil price shock. Since this shock has been drawn out over a number of years, its effects have been slow to manifest. In addition, the impact has to some extent been masked or offset by other factors such as declining prices of (particularly Asian) manufactured goods, low interest rates and cost-reducing technological innovations. South Africa has been buffered from the oil price trend by these factors as well as by a relatively strong currency from 2003 till around the middle of 2006 (on the back of robust commodity prices). As a result of these conditions, domestic consumers have been engaged in a credit-driven consumption boom. An increase in the prices of crude oil (21.2 %) will be simulated in the model.

2.1.1.2 A decrease in international gold price

In 1999, the price of gold dropped to a low point of $250/oz. This was very bad news for South African gold companies, South African gold miners, and the South African government. Gold companies scrambled to reorganise and streamline their operations. By the time the price again reached $290/oz in early 2000, the gold industry had changed dramatically in South Africa and globally. South Africa is the world's largest gold producer. In 2003, gold production fell by an estimated 6.5% to 373 074kg, but gold still accounted for an estimated 37% of dollar export revenue within the country (ESnet, 2012).

According to the 2000 Medium Term Budget Policy Statement (MTBPS), the South African economy has been buffeted by a number of external shocks. One of them was a depressed gold price. In the face of these shocks the economy has shown resilience and has adjusted to these challenges. Statistics South Africa reports that gold production is continuing to dive with an 11.3 % fall year on year in January 2012, following an 8.2% drop in December 2011, and a further fall of 12.8% in April 2012.

Local reserves declined due to the lower gold price and US dollar appreciation. South Africa's gross gold and foreign exchange reserves declined by US$1bn to US$48.9bn at the end of May 2012. The international liquidity position declined by US$1.2bn to US$47.7bn. The reserves were negatively impacted by valuation adjustments from the lower gold price and the substantial appreciation of the US dollar. The gold price decreased by 6% in May, deducting US$390m from reserves. Foreign exchange reserves decreased by US$577m as the rand depreciated to R8.53 from R7.74/US dollar. In this environment of rand volatility and weakness, the South African Reserve Bank's ability to accumulate foreign exchange reserves will be limited (ACSIS, 2012). A decrease in the international price of gold (21.2%) will be simulated in the model.

2.1.1.3 The devaluation of the South African currency

The South African economic debate has been dominated by the decision of the appropriate level of the exchange rate of the rand. With the high volatility of the rand and the rapid appreciation of the rand in 2012, there have been calls from various sectors for government to intervene and devalue the rand.

The premise is that devaluation will help counter the volatility of the rand and help stimulate South Africa's export sector, thereby resulting in improvement of trade balance (Moodley, 2010). Regarding exchange rate devaluation, Liew *et al*. (2002) argue that *ceteris paribus*, the competitiveness of a company's exports would improve and therefore the competitiveness of the country. This would lead to an increase in the demand for labour and other inputs that go into the

production process, thereby having a positive effect on the economy. On the other hand, devaluation of the domestic currency would make foreign goods expensive relative to domestic goods and therefore consumers will substitute domestic goods for foreign goods (Yusoff, 2009). This will tend to reduce the volume of imports.

For the purpose of determining the relative size of exchange rate depreciation (devaluation) to the CGE model, we use the nominal effective exchange rate of the rand (NEER) as published by the South African Reserve Bank (SARB). The NEER is calculated as a weighted index against a basket of 15 currencies. The weights of the five major currencies are the euro (9.5), US dollar (15.5), Chinese yuan (16.6), British pound (13.2) and Japanese yen (10.43). The index is calculated with the base year (2000 = 100). For a full discussion of the topic, refer to the *June 2012 Quarterly Bulletin* of the South African Reserve Bank. Underlying weighted calculations is that the NEER has declined by approximately 12.5%. We use this figure to consider the potential implications of such events that could be based on a CGE model approach.

2.1.2 An increase in labour productivity

The second role of agriculture that is analysed is the role of poverty alleviation and the effect of agricultural growth on income distribution. The Ricardian model assumes a single factor of production, which is labour. However, other factors of production, particularly capital, are also important determinants of output and costs. The focus on labour can be partially justified by the argument that labour is largely immobile internationally, but capital is mobile, so that labour costs are likely to diverge much more across countries than costs of capital. Nonetheless, allowing for capital could still be important in interpreting labour productivity, because labour productivity depends on capital input (Edwards and Golub, 2002).

In the 1990s, total factor productivity stagnated despite modest annual growth of labour productivity of about 2%, as the South African capital-labour ratio increased. While most of the increased capital-labour ratio reflects capital accumulation, some of it is also attributable to labour shedding. These findings are disconcerting in so far as sustainable long-run output and employment growth depends on raising productive efficiency – total factor productivity – rather than through capital-labour substitution and labour shedding. A 2% increase in labour productivity of agriculture, mining, manufacturing and other sectors are simulated. The simulations are presented in Table 1.

The variable shocked as part of the experiment is FLAB (factor labour) linked to the model through factor productivity (FP) for each sector. Variables for parameterization – ALPHAVASIM (A, SIM) – "A" – indicates each activity – in this particular study for sectors of agriculture, mining, manufacturing and other sectors. "SIM" – for labour productivity increase (PRODINCRFLAB). Labour is

modelled using a nesting of Constant Elasticity of Substitution (CES) functions. At the top level, the output is produced as a combination of aggregate intermediate demand and value added. At the second level, value added is produced by a capital and aggregate labour.

Table 1: Labour productivity simulations

Sector Increased	Percentage
Agricultural	2 %
Mining	2 %
Manufacturing	2 %
Other services	2 %

Source: Author's observation

3 CLOSURE RULE

The macro-economic closure rules selected for the purpose of the simulations in the FSP model or the economic environment under which the simulations are carried out are characterised by:

i. The numeraire – the consumer price index (CPI) is the numeraire and it is fixed while domestic producer index (DPI) is flexible.
ii. Savings-investment – Investment driven savings – uniform marginal propensity to save (MPS) rate for selected institutions
iii. Government – Flexible government savings with fixed direct tax
iv. External or Rest of World – Flexible exchange rate with fixed savings
v. Factor account/markets – Capital market – capital is activity-specific and fully employed

Labour market – labour is mobile and unemployed (fixed wages)

4 CGE MODEL IMPLEMENTATION AND RESULTS

As already indicated, this study analyses the role of agriculture in welfare, income distribution and economic development in FSP. Such an inquiry requires the quantification of the direction and magnitude of price and policy shocks associated with trade policy (based on the policy scenario mentioned).

4.1 Model results

This sub-section presents the main results of the simulation.

4.1.1 The buffer role of agriculture (increase of oil price and decrease of gold price)

Firstly, we analyse the buffer role of the agriculture sector. The main hypothesis is that in the presence of a negative external shock, the agricultural sector, to some extent, will be able to absorb the negative impact, particularly labour. The argument is that when the rest of the economy suffers a slowdown, people will "migrate" back to agriculture and therefore the agricultural sector will grow and increase its labour demand, alleviating the impacts of the crisis. Two negative external shocks were examined for the Free State provincial economy.

To analyse the buffer role of the agriculture sector, a simulation of an external price shock to the Free State economy has been prepared. An increase in the international oil price together with a decrease in the international price of gold is simulated. The effects on labour demand of all economic sectors are quantified.

The agricultural sector is small and it cannot absorb labour in the same way as other sectors of the economy. Table 2 shows that the agriculture share in total output is 4.51%, while other services (such as electricity and water, construction, trade and accommodation; and community and social services) are 51.92%. Manufacturing can absorb more jobs compared to other services. The agricultural sector does not play a buffer role relative to the other sectors (such as mining) in the presence of the negative external shock modelled.

Table 2: Relative impacts on employment of an external price shock

Economic sector	% share in total production	% increase in labour demand after shock	Product of labour demand and share in total output
Agriculture	4.51	−1.2	−5.41
Mining	0.27	7.49	2.02
Manufacturing	30.1	−6.25	−188.13
Transport & communication	10.96	−0.15	−1.64
Financial & business services	2.24	0.17	0.38
Other services	51.92	−0.89	−46.21

Source: CGE simulation result

Another way of analysing the buffer role is by examining how the economy absorbs the impact on GDP. The agricultural sector cannot substitute factors and increase production. This assumption is equivalent to assuming that the agricultural sector cannot absorb or release labour from or towards other sectors to adjust to a negative shock.

Table 3: Percentage of real GDP at factor cost by activity

Agriculture	−0.89
Mining	4.03
Manufacturing	−2.84
Transport & communication	−0.06
Financial & business services	0.13
Other services	−0.47
TOTAL	−0.01

Source: CGE simulation result

The impacts on household incomes not allowing the agricultural sector to act as a buffer are more informative. As Table 4 shows, the household incomes of middle income, high-middle income and high income households groups, rise more than the low and low-middle income households. It also reflects that the agricultural sector doesn't absorb the negative impacts of shocks, especially for the poorest groups. When the agricultural sector is not allowed to react, the lower income households are more affected. The result of the impact of household's real income and EV of an external price shock at disaggregated level (48 accounts) presented in Addendum "A" Table A1.

According to Gohin (2003), one of the main tasks of applied economists is the computation and explanation of the welfare effects of policy reform or other shocks to the economy that may be of interest. The effects of the simulated results on household welfare in the Free State can further be measured by the concept of Equivalent Variation (EV). EV is a welfare measure indicating the money equivalent the households are better (worse) off as a result of the shock/simulation.

The highest gain observed in middle-income households gain in welfare (EV), followed by other high middle-income households and high-income households. The lowest welfare gain observed in poor households.

Table 4: Impact on households' real income and welfare (EV) of an external price shock

	Household income (Percentage)	EV (Rand)
Low-income households	−0.41	2574.92
Low-middle-income households	−0.62	10320.35
Middle-income households	−0.78	15690.39
High middle-income households	−0.88	13178.62
High-income households	−0.79	11936.93

Note: EV is in value terms R – (South African currency – Rand)

Source: CGE simulation result

4.1.2 The buffer role of agriculture (devaluation of currency)

A similar shock is analysed using the CGE model. It must be noted that the devaluation of currency shock only affects real income and the macro-economic variables, and is not necessarily a bad shock, because, at least in the medium term, it generates a boom in the export sector. As in the previous case, it is assumed that the agricultural sector cannot respond as a result of the devaluation of currency shock. The transmission mechanism of a devaluation to the economy of the Free State follows: devaluation will increase both export and import prices. As import prices increase, imported goods will become more expensive, and this will generate a decrease in real income (price effect).

On the other hand, as export prices rise, both import-substitution sectors and export sectors become more attractive, thus increasing output in both these sectors. This will increase their capital (FCAP) and labour (FLAB) demand (Table 5).

Table 5: Percentage change of factor income (YFXP)

FLAB	3.05
FCAP	6.7

Source: Model simulation result

As capital is assumed to be less mobile than labour, wages (WFXP) will increase relatively more than the price of capital (3.05%). This will generate an income effect. The non-tradable sectors will be negatively affected, and will dismiss labour and capital generating a decrease in demand for factors, reducing the income effect. In summary there are three effects: a price effect due to higher import prices; a positive income effect from tradable and import-substitution sectors, and a negative income effect from non-tradable sectors.

The overall effect on household income will be determined by which of these effects dominate in the presence of this devaluation. Low-income household groups are most affected by devaluation. A devaluation of South African currency has greater welfare (EV) impacts on the richer household income groups than on the poorer ones (Table 6). The result of the impact of household's real income and EV of devaluation of currency shock at disaggregated level (48 accounts) presented in Addendum "B" Table B1.

Table 6: Percentage of household incomes (YIXP) and value of welfare (EV)

Income Categories	Household income	EV (Rand)
Low-income households	−1.59	1873.37
Low middle-income households	−3.06	7401.47
Middle-income households	−3.95	11311.7
High middle-income households	−4.55	9500.87
High-income households	−1.76	8810.88

Note: EV is in value terms R – (South African currency – Rand)

Source: Model simulation result

The results show that, confronted with devaluation, the agricultural sector does not play a significant buffer role. The negative effects of this shock are not offset in this case by the existence of agriculture and all macroeconomic variables are affected very similarly (real GDP falls by 2.38 %) (Table 7). This explains why the export-oriented sectors will absorb more labour than agriculture.

Table 7: Percentage of macroeconomic impact of devaluation of currency

Real GDP	−2.38
Private consumption	−28.28
Exports	18.23
Imports	−11.72

Source: Model simulation result

4.2.2 Agriculture's role in poverty alleviation and income distribution

The hypothesis is that growth based on agriculture has a greater impact on poor-income households than growth based on industry or other sectors. The assumption

is that more poor households rely on agriculture than on other sectors. In order to address this increase in labour productivity (of agriculture and non-agriculture sectors), a simulation was conducted.

It is important to bear in mind that the comparisons between sectors may not be entirely fair. It can be expected that increasing the labour productivity by 2% in each sector has different costs because the size of the sector is different. However, the objective here is to have an idea of the effect of poverty and income distribution on labour productivity increases shock.

Table 8: Macroeconomic effects of increasing labour productivity by 2%

	Agriculture	Mining	Manufacturing	Other services
Read GDP	0.047	0.132	0.324	0.193
Consumption	0.055	0.153	0.376	0.224
Investment	0.038	0.107	0.264	0.157
Exports	0.073	0.116	0.67	0.14
Imports	0.054	0.085	0.496	0.103

Source: Model simulation result

The increase in productivity drives up factor demand labour, and increase real factor returns for skilled labour. Furthermore, the rise in productivity reduces the cost of production and leads to increased production, real GDP growth, consumption and investment.

From a macroeconomic perspective, Table 8 shows that increasing labour productivity in the manufacturing sector has greater overall impacts. As was expected, the manufacturing sectors account for a greater share of output in the economy than other sectors. Even so, increasing agriculture productivity also has an important effect.

The effect on household income and poverty explained in Table 9. An increase in labour productivity in manufacturing has a positive effect on income distribution. The income of high-income household groups increase more than that of the low-income household groups.

Table 9: Impacts on households' real income of an increase in labour productivity (Percentage change)

	Agricultural	Mining	Manufacturing	Other services
Low income	0.019	0.04	0.122	0.09
Low-middle	0.027	0.064	0.165	0.123
Middle	0.038	0.107	0.251	0.168
High-middle income	0.046	0.143	0.318	0.196
High income	0.048	0.153	0.355	0.21

Source: Model Simulation result

The effects of labour productivity on different sectors of welfare of households, measured in terms of equivalent variation (EV) are shown in Table 10.

Table 10: Impacts on household welfare (EV) as a result of an increase in labour productivity (Rand)

	Agricultural	Mining	Manufacturing	Other services
Low income	2600.90	2603.50	2606.09	2600.90
Low-middle	10424.60	10445.45	10455.87	10445.45
Middle	15880.76	15896.63	15928.36	15912.49
High-middle income	13338.53	13365.18	13378.50	13365.18
High income	12081.77	12105.91	12130.05	12105.91
Total	54336.98	54391.27	54499.83	54445.55

Note: EV is in value terms R – (South African currency – Rand)

Source: Model simulation result

On aggregate, the Free State could experience a welfare gain as a result of an increase in labour productivity. The highest gain observed in the manufacturing sector accounted for R54 499.83 gain in welfare (EV), followed by other services (R54 445.55), mining (R54391.27) and agriculture (R54 336.98) (Table 10). The result of the impact of household's real income and EV of an increase in labour productivity shock at disaggregated level (48 accounts) presented in Addendum "C" Table C1.

Thus, growth in the agricultural sector is important to reduce inequality, but considering poverty the results suggest that the manufacturing sector increases

income more than other sectors. However, the low-income households are better off with an improvement in the agriculture-based sectors. Concluding from this analysis, the role of agriculture in poverty reduction and alleviation is undeniable.

5 SUMMARY, RECOMMENDATIONS AND CONCLUSION

This article has explored two distinctive roles of agriculture: the buffer role and the role of poverty alleviation using a general equilibrium model framework. The results provide very interesting insights as to the extent of the importance of agriculture in poverty alleviation and income distribution.

The first insight is that the agriculture sector in fact does not play much of a role as a buffer when negative external shocks (an increase in international oil price with a decrease in international gold price) affect the economy. Besides, the agricultural sector is small and it cannot absorb labour in the same way as other sectors . As indicated agriculture share in total output is 4.51 % while other services 51.92%. The agriculture sector also does not play a significant buffer role as a result of devaluation of currency. However, the positive effects of the devaluation make export-oriented sectors attractive, and therefore overall impacts are also lower.

The second result indicates that the agricultural sector is important to alleviate poverty, but in considering poverty, the results suggest that the manufacturing sector increases income more than other sectors. An increase in productivity in labour in the agriculture sector has greater impacts on the richer household income groups than on the poorer ones. In order to achieve important results in poverty reduction, the increase in productivity might have to be high.

Based on the results of this study the following recommendations are proposed. It is inevitable that there will always be some external shocks outside the control of economic policies. Hence it is necessary to strengthen the effectiveness of agricultural growth in reducing poverty by incorporating target available resources on farmers for which agricultural growth represents a viable path out of poverty and ensuring coherence in policy design both between the various sectoral policies as well as between the overall agricultural policy and other policies such as social protection policies, which are explicitly targeted at the poor. Those policy responses should take due account of the changing roles of agriculture in the course of development. There is no one-size-fits-all approach and an appropriate policy mix should be found.

Market, policy and institutional failures hampering agriculture's potentials should be redressed so that decision makers of resource allocation face the right incentives by incorporating its social benefits.

With rising energy and food costs, a highly restrictive monetary policy may prove devastating to the economy, and especially its poorer members. Therefore, it may be wise to broaden the explicit goals of monetary policy to include the levels of economic activity and employment, and to allow greater flexibility in the inflation target range.

While currently South Africa officially has a market-determined, floating exchange rate, the external value of the currency is still of concern to the SARB in that it influences the degree of import price inflation. To protect the capital account (and the rand) against the possibility of rapid portfolio disinvestment (e.g. from emerging markets generally), the National Treasury may be advised to reconsider its relaxation of exchange controls. The introduction of a Tobin tax on foreign currency transactions could also help to stabilise the value of the currency in the face of international financial market turmoil.

Fiscal policy will also be challenged by future oil shocks, both on the revenue side (as tax collection weakens) and the expenditure side (as demands for poverty alleviation and social spending rise). In addition, government debt repayments will rise along with interest rates. It is therefore imperative that the National Treasury take whatever steps it can, while economic conditions are still reasonably favourable, to invest in mitigation options.

In conclusion, a CGE model is a useful tool for policy analysis. A CGE model has some limitations, in particular, a number of assumptions, including production technologies, product and factor market. Usually the model results are sensitive to various parameters. For this specific study, the critical parameters were obtained from literature. Then, if all the resources are available, it is advisable to calculate the exact parameters using different econometric methods.

CGE modelling, which requires extensive data in order to capture broad economic interdependency, still has a somewhat limited scope. Future research should include more advanced estimation techniques for the response parameters of the CGE model, relying on historical data series and incorporating all CGE constraints at the outset and further research using a dynamic CGE model.

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ADDENDUM A

Table A1: Impact on households' real income (Percentage change) and EV (Rand) of an external price shock

Income Categories	Household income	EV
Low–income black households – P1	-0.13	1013.58
Low–income black households – P2	-0.39	747.31
Low–middle-income black households – P3	-0.7	1252.57
Low–middle-income black households – P4	-0.8	2597.06
Low–middle-income black households – P5	-1.03	2604.32
Middle–income black households – P6	-0.98	2294.62
Middle–income black households – P7	-0.9	3031.27
Middle–income black households – P8	-2.195	2193.65
High–middle-income black households – P9	-1.09	3695.82
High–middle-income black households – P10	-1.24	3120.97
High–income black households – P11	-2.27	1304.33
High–income black households – P12	-0.37	2815.21
Low–income Coloureds households – P1	-1.03	186.35
Low–income Coloureds households – P2	-1.55	59.15
Low–middle-income Coloureds households – P3	-0.24	108.15
Low–middle-income Coloureds households – P4	-0.74	155.13
Low–middle-income Coloureds households – P5	-1.99	168.31
Middle–income Coloureds households – P6	-0.55	245.72
Middle–income Coloureds households – P7	-0.64	187.89
Middle–income Coloureds households – P8	-0.53	390.55
High–middle-income Coloureds households – P9	-0.76	174.44
High–middle-income Coloureds households – P10	-0.84	162.66
High–income Coloureds households – P11	-0.53	321.31
High–income Coloureds households – P12	-0.53	80.93
Low–income Asians/Indians households – P1	-2.24	190.91
Low–income Asians/Indians households – P2	-0.2	0.50
Low–middle-income Asians/Indians households – P3	-0.26	4.97
Low–middle-income Asians/Indians households – P4	-0.3	5.66
Low–middle-income Asians/Indians households – P5	-0.37	9.92
Middle–income Asians/Indians households – P6	-0.46	33.50
Middle–income Asians/Indians households – P7	-0.54	66.83
Middle–income Asians/Indians households – P8	-0.58	104.85
High–middle-income Asians/Indians households – P9	-1.44	33.58
High–middle-income Asians/Indians households – P10	-1.66	55.76
High–income Asians/Indians households – P11	-2.23	27.98
High–income Asians/Indians households – P12	-2.07	71.83
Low–income Whites households – P1	-0.11	48.31
Low–income Whites households – P2	-0.09	329.38
Low–middle-income Whites households – P3	-0.16	604.67
Low–middle-income Whites households – P4	-0.27	1147.43
Low–middle-income Whites households – P5	-0.28	1661.85
Middle–income Whites households – P6	-0.3	2146.91
Middle–income Whites households – P7	-0.32	2382.73
Middle–income Whites households – P8	-0.34	2610.84
High–middle-income Whites households – P9	-0.41	2836.58
High–middle-income Whites households – P10	-0.64	3098.41
High–income Whites households – P11	-0.68	3353.26
High–income Whites households – P12	-0.42	3976.68

Source: CGE simulation result

ADDENDUM B

Table B1: Impact on households' real income (Percentage change) and EV (Rand) of a devaluation of currency shock

Income Categories	Household income	EV
Low–income black households – P1	5.08	795.37
Low–income black households – P2	-3.76	536.17
Low–middle-income black households – P3	-7.13	870.09
Low–middle-income black households – P4	-5.57	1837.39
Low–middle-income black households – P5	-9.50	1767.03
Middle–income black households – P6	-8.42	1577.84
Middle–income black households – P7	-5.10	2155.98
Middle–income black households – P8	-27.89	1196.95
High–middle-income black households – P9	-7.43	2605.07
High–middle-income black households – P10	-10.07	2119.73
High–income black households – P11	-28.80	704.28
High–income black households – P12	5.69	2228.94
Low–income Coloureds households – P1	-31.54	100.36
Low–income Coloureds households – P2	-18.59	36.84
Low–middle-income Coloureds households – P3	4.48	85.73
Low–middle-income Coloureds households – P4	-14.06	101.23
Low–middle-income Coloureds households – P5	-24.66	97.06
Middle–income Coloureds households – P6	1.98	191.97
Middle–income Coloureds households – P7	0.75	144.29
Middle–income Coloureds households – P8	2.84	311.42
High–middle-income Coloureds households – P9	-1.29	131.45
High–middle-income Coloureds households – P10	-2.68	121.42
High–income Coloureds households – P11	2.82	257.18
High–income Coloureds households – P12	2.82	62.76
Low–income Asians/Indians households – P1	-28.31	102.10
Low–income Asians/Indians households – P2	4.29	0.39
Low–middle-income Asians/Indians households – P3	3.49	4.00
Low–middle-income Asians/Indians households – P4	0.06	4.26
Low–middle-income Asians/Indians households – P5	-0.17	7.41
Middle–income Asians/Indians households – P6	1.90	25.55
Middle–income Asians/Indians households – P7	1.90	51.03
Middle–income Asians/Indians households – P8	1.68	83.16
High–middle-income Asians/Indians households – P9	-13.65	21.96
High–middle-income Asians/Indians households – P10	-17.60	34.77
High–income Asians/Indians households – P11	-28.10	15.44
High–income Asians/Indians households – P12	-25.18	40.63
Low–income Whites households – P1	8.50	39.92
Low–income Whites households – P2	9.11	272.50
Low–middle-income Whites households – P3	8.17	498.43
Low–middle-income Whites households – P4	6.19	929.48
Low–middle-income Whites households – P5	6.18	1344.51
Middle–income Whites households – P6	5.87	1736.95
Middle–income Whites households – P7	5.32	1915.76
Middle–income Whites households – P8	5.15	2101.28
High–middle-income Whites households – P9	3.90	2254.42
High–middle-income Whites households – P10	0.66	2386.28
High–income Whites households – P11	-0.03	2565.65
High–income Whites households – P12	5.32	3174.12

Source: CGE simulation result

ADDENDUM C

Table C1: Impact on households' real income (Percentage change) and EV (Rand) of an increase in labour productivity

Income Categories	Household income	EV
Low–income black households– P1	0.01	1020.72
Low–income black households – P2	0.02	755.23
Low–middle-income black households – P3	0.03	1269.03
Low–middle-income black households – P4	0.03	2633.86
Low–middle-income black households – P5	0.04	2647.90
Middle–income black households – P6	0.05	2332.63
Middle–income black households – P7	0.05	3078.88
Middle–income black households – P8	0.09	2257.40
High–middle-income black households – P9	0.06	3758.30
High–middle-income black households – P10	0.07	3178.01
High–income black households – P11	0.09	1340.85
High–income black households – P12	0.04	2839.28
Low–income Coloured households – P1	0.06	189.57
Low–income Coloured households – P2	0.06	60.44
Low–middle-income Coloured households– P3	0.01	108.96
Low–middle-income Coloured households– P4	0.05	157.17
Low–middle-income Coloured households– P5	0.08	172.67
Middle–income Coloured households– P6	0.05	248.28
Middle–income Coloured households– P7	0.05	190.07
Middle–income Coloured households– P8	0.05	394.59
High–middle-income Coloured households– P9	0.05	176.64
High–middle-income Coloured households– P10	0.06	164.79
High–income Coloured households– P11	0.05	324.71
High–income Coloured households– P12	0.05	81.70
Low–income Asians/Indians households– P1	0.09	196.28
Low–income Asians/Indians households– P2	0.02	0.50
Low–middle-income Asians/Indians households– P3	0.02	5.01
Low–middle-income Asians/Indians households– P4	0.01	5.71
Low–middle-income Asians/Indians households– P5	0.02	10.02
Middle–income Asians/Indians households– P6	0.04	33.88
Middle–income Asians/Indians households– P7	0.04	67.64
Middle–income Asians/Indians households– P8	0.05	106.09
High–middle-income Asians/Indians households– P9	0.07	34.29
High–middle-income Asians/Indians households– P10	0.08	57.07
High–income Asians/Indians households– P11	0.09	28.80
High–income Asians/Indians households– P12	0.09	73.85
Low–income Whites households– P1	0.01	48.60
Low–income Whites households– P2	0.01	331.03
Low–middle-income Whites households– P3	0.01	607.71
Low–middle-income Whites households– P4	0.02	1155.51
Low–middle-income Whites households– P5	0.02	1673.54
Middle–income Whites households– P6	0.02	2162.02
Middle–income Whites households– P7	0.02	2399.49
Middle–income Whites households– P8	0.02	2631.85
High–middle-income Whites households– P9	0.03	2857.98
High–middle-income Whites households – P10	0.04	3129.65
High–income Whites households – P11	0.04	3387.06
High–income Whites households– P12	0.05	4022.83

Source: CGE simulation result