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PROVIDE PROJECT

The Provincial Decision-making Enabling Project

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General Equilibrium Effects in the South African Maize Market: International Trade Simulations

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PROVIDE PROJECT

The Provincial Decision-making Enabling Project

Overview

The Provincial Decision-Making Enabling (PROVIDE) Project aims to facilitate policy design by supplying policymakers with provincial and national level quantitative policy information. The project entails the development of a series of databases (in the format of Social Accounting Matrices) for use in Computable General Equilibrium models.

The National and Provincial Departments of Agriculture are the stakeholders and funders of the PROVIDE Project. The research team is located at Elsenburg in the Western Cape.

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For the original project proposal and a more detailed description of the project, please visit www.elsenburg.com/provide

General Equilibrium Effects in the South African Maize Market: International Trade Simulations[1]

Abstract

Following deregulation in the 1990's the South African maize producing industry has been suffering a gradual decline. Current low prices suggest that this trend may continue or worsen. This paper discusses the results from a static general equilibrium model for the South African economy to evaluate the effects on the economy. The analysis covers summer cereals producing agricultural regions, production in other sectors in the economy, commodity markets and the economy at large. Additionally, the effects on factors, households and the government are analysed. The first set of experiments is aimed to evaluate the effects of an increase in import tariffs on summer cereals. The results indicate that under normal conditions South Africa will experience little effect for even relatively large increases in the tariff rate, which follows from the fact that South Africa does not currently import sizeable quantities of maize. The second set of experiments evaluate the effects of a change in world prices of summer cereals, under the presumption that a reduction in levels of producer support in developed countries may lead to increased world prices. The results indicate that this terms-of-trade improvement does not necessarily lead to benefits to all in the economy. Benefits to summer cereals producers are largely offset by losses in other sectors of the economy, for example producers of livestock, though the overall effect is still positive.

[1] The main author of this paper is Melt van Schoor.

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1. Introduction

While SA is currently self-sufficient in maize production, and exports some maize to African countries, all is not well in the maize production industry. The main problems from the perspective of producers are variability in yields, typically due to adverse weather conditions, and low prices. Prior to the abolition of the maize board in 1997, the single channel marketing scheme mitigated against these risks for farmers with favourable administered prices and drought relief payments, thereby encouraging maize production in excess of the levels that would be sustainable under a liberalised system. Today producers need to sell their products on the open market, and are required to accept all marketing risk themselves[2].

The outcome has been an ongoing rationalisation of the industry since the early 1990s, in the form of lower total land area devoted to maize production. Despite this, total production has actually increased, as farmers have adopted newer maize cultivars, up-to-date technology and more efficient farming practices. The result is that production is currently in excess of current domestic and immediate export needs, and prices are therefore expected to remain low (Maize Tariff Working Group 2005: 10). Given that current prices on the South African Future Exchange (SAFEX) are considered to be below most farmers' production costs, it may be expected that the industry will consolidate further.

Since large-scale structural economic adjustment is costly, not only to producers but also to workers and potentially consumers, it could be argued that policies that may serve to soften or remove the need for such adjustment should be considered, hence there is a need to analyse such policies in terms of their costs and benefits. This is particularly important for maize in South Africa, which is both an important farming crop and a critical staple food amongst poor and rural populations, where food security is therefore a paramount concern.

Amongst other factors, low import and export prices have been blamed for threatening the feasibility of maize production in South Africa, particularly in the light of recent Rand strength. The purpose of this paper is to assess the effects on the domestic economy of possible changes in import and export prices that may result from trade policies. A SAM for 2000 and a computable general equilibrium model (CGE) are used to assess effects of such changes on markets, industries and on welfare. The benefit of this approach is that it takes a holistic view of the welfare implications of the simulations. For example it is possible to examine effects on income earned in the maize production sector, downstream industries such as milling and animal feeds, as well as effects on household welfare, taking account of changes in food prices and employment.

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[2] Marketing margins are high and have increased following deregulation, possibly a result of concentration in downstream industries (Traub and Jayne 2004).

There are essentially two avenues through which trade policy can influence import and export prices, both of which are explored in this paper. The first lies in the government's ability to control import prices through tariff protection, and we model various changes in tariff rates in section 5. Predictably, given current market conditions, import tariffs have very limited effects, because South Africa does not import significant amounts of maize.

Secondly, government may affect prices on international markets through trade negotiations aimed at influencing other countries' trade policies. One particularly contentious point in recent trade negotiations has been the subsidisation of agricultural production and protection in developed countries, particularly the EU and the USA, which developing countries say is unfair towards their producers. In the case of maize, the reduction of producer support in developed countries (particularly the United States) is expected to result in higher international prices, implying increased earnings for South African producers. The second set of simulations, which is reported in section 6 in this study, therefore captures the effect of exogenous price changes on international markets.

2. The South African Maize Industry

2.1. Overview

Maize is an important grain crop in South Africa, as it supports incomes of large sections of the agricultural population, is an important staple food, particularly for the poorer black segments of the population, and hence has strategic value in terms of food security (also regionally, in Southern Africa). In addition, it is important in supporting other industries, as maize is an important input to animal farming through feed and is used in various processed foods and certain chemical applications.

2.2. Production[3]

According to the Maize Tariff Working Group (2004), maize is the second most valuable agricultural product in South Africa, with a value of R8.32 billion for the 2003/2004 marketing year. In the past 5 years, South Africa produced between 7.2 and 10.1 million tons of maize, at an average of 9.2 million tons per year. Figure 1 shows the total area under maize cultivation and the total production tonnage. The trend of decreasing area cultivated against rising production indicates technological advancement and removal of marginal land from production.

Table 1 shows average production over the last five years by province. Three of the maize producing provinces, namely the Free State, North West and Mpumalanga produce 85% of

[3] Information in this section is mainly from Maize Tariff Working Group (2004).

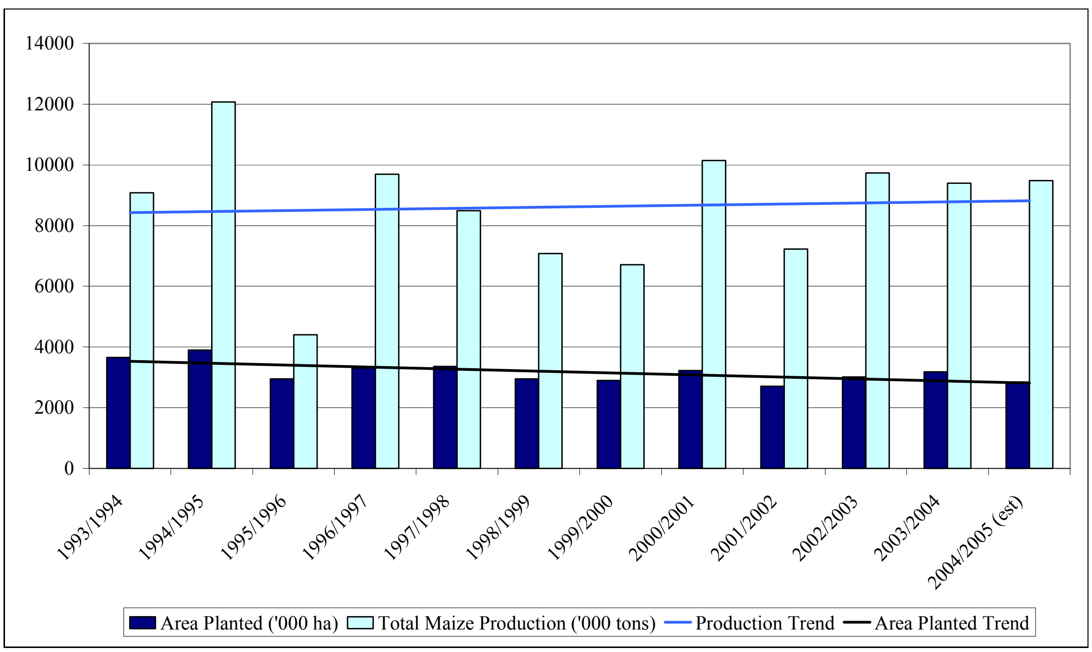
the maize output. However, maize also plays an important role in the Northern Cape and Gauteng when the smaller extent of their total agricultural sectors is taken into account.

Table 1. Average maize production in South Africa by province (1999/2000 - 2004/2005)

Province	Area Planted ('000 ha)	Production ('000 tons)	Average Yield (tons per ha)
Free State	1063.6 (35.8%)	3187.2 (35.0%)	3.00
North West	1047.4 (35.2%)	2600.6 (28.6%)	2.48
Mpumalanga	556.2 (18.7%)	1947.1 (21.4%)	3.50
Northern Cape	42.5 (1.4%)	424.8 (4.7%)	10.00
Gauteng	123.6 (4.2%)	421.1 (4.6%)	3.41
KwaZulu Natal	79.0 (2.7%)	335.3 (3.7%)	4.24
Limpopo	45.4 (1.5%)	117.6 (1.3%)	2.59
Eastern Cape	12.8 (0.4%)	52.9 (0.6%)	4.13
Western Cape	2.0 (0.1%)	13.4 (0.1%)	6.70
Total	2972.5 (100%)	9100.0 (100%)	3.06

Source: Maize Tariff Working Group

Figure 1. Maize production: Area planted and output



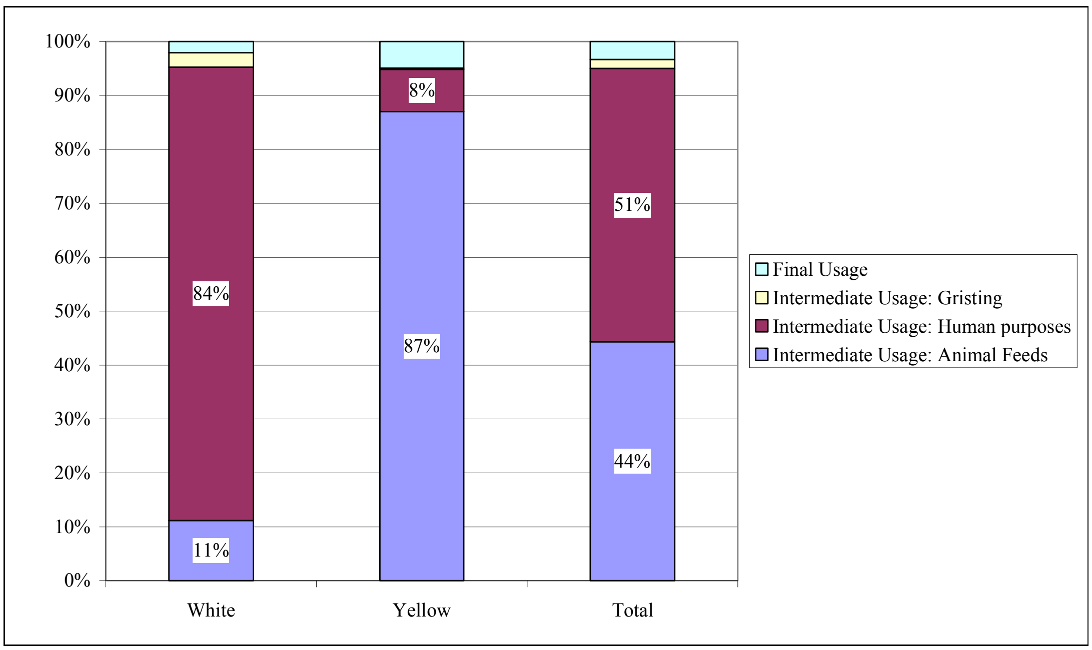
Source: Maize Tariff Working Group (2004)

Maize is largely a product of commercial farming in South Africa. Developing farmers (as defined by the Crop Estimates Committee) produced only 2.2% of the 2004/2005 maize crop, though 12.4% of the area under cultivation falls under this category (Crop Estimates Committee 2005). This implies that commercial farmers obtain dramatically higher yields. However, it is likely that there is a degree of unmeasured production, both in terms of area cultivated and in terms of output, particularly because maize is an important subsistence farming crop.

2.3. Use of Maize in South Africa

White maize is considered superior to yellow maize for human consumption in South Africa, and a large share of the black population consumes maize as a staple food. Yellow maize is largely used for making animal feeds. Prices for white maize are (currently 10%) higher than for yellow maize but they tend to move together fairly closely. There is therefore a degree of heterogeneity in the commodity that should be borne in mind when results are being interpreted, particularly since this dichotomy is also important in trade (see below).

Figure 2. Use of maize in South Africa (2001/2002 to 2004/2005)



Source: SAGIS online database

2.4. Trade

Trade in maize in South Africa is fairly limited due to the fact that South Africa is largely self-sufficient and transport costs to and from world markets are fairly high[4]. Occasional quantities of yellow maize are imported, most recently from Argentina, while South Africa exports some

[4] This is supported by the large price differential between import and export parity prices. Currently (2005-11-11), the calculated import parity price for "USA No3 Maize (Gulf)" delivered at Randburg is at R 1215 / ton, while the export parity price at Randburg is R 443 / ton (www.sagis.co.za). South African short term futures prices are currently (2005-11-15) at R 808 / ton and R 875 / ton for yellow and white maize respectively (SAGIS 2005). The large price differentials are partly explained by the fact that the main production (and some consumption) areas in South Africa are located far from the ports.

white maize to Southern African countries. Exports fluctuate and are partly driven by the demands of crop failures and food donations in other Southern African countries. On average over the last 4 years, imports constitute 7% of domestic use and exports 12% of production[5].

Table 2. South African maize trade 2001/2002 - 2004/2005

('000 tons)	Marketing Year			
	2001/2002	2002/2003	2003/2004	2004/2005
Maize Exports				
White	760	744	1004	668
(% of production)	(16%)	(13%)	(17%)	(12%)
Yellow	521	326	92	64
(% of production)	(16%)	(9%)	(4%)	(2%)
Total	1281	1070	1096	732
(% of production)	(16%)	(11%)	(13%)	(8%)
Maize Imports				
White	47	274	33	0
(% of use)	(1%)	(7%)	(1%)	(0%)
Yellow	348	651	408	219
(% of use)	(11%)	(19%)	(13%)	(7%)
Total	395	925	441	219
(% of use)	(5%)	(13%)	(6%)	(3%)

Source: SAGIS Database (www.sagis.org.za)

3. Social Accounting Matrix (SAM) Database

3.1. General

The primary benchmark data used to calibrate the CGE model is arranged in the form of a social accounting matrix (SAM), which is a system of accounts recording all transactions between agents in the economy. The SAM is a 269 account aggregation of the PROVIDE SAM for South Africa in 2000. See PROVIDE (2005b) for a full description of the South Africa SAM database. The model SAM has 51 commodities (12 agricultural), 69 activities (30 agricultural), 69 Factors (GOS (capital), 9 land factors (one for each province) and 59 labour factors) and 64 households. There are also accounts for taxes, enterprises, the government, savings and investment, and an account for international transactions (rest-of-world).

Agricultural activities relate to geographical regions, so that each agricultural activity produces the total agricultural output for a region. The regions have been aggregated so that there is correspondingly more detail, i.e. smaller regions, for the main maize producing provinces. Hence, there is disaggregation for North West (5 subregions), Free State (8 subregions), Mpumalanga (3 maize-producing subregions and 1 "other"), Gauteng (3 subregions and 1

[5] While there is no specific evidence, it is possible that there may be a degree of overestimation in these figures as some imports destined for exports may have been misclassified as destined for the domestic market.

"other") and Northern Cape (4 subregions and 1 "other"), and one region each for the remaining five provinces.

Non-agricultural activities and commodities are somewhat aggregated from the PROVIDE SAM; certain accounts were grouped together, particularly in manufacturing and services, while maximum detail was retained in agricultural accounts pertaining to maize. Government consumes a single commodity relating to all government expenditure, and this is produced by a corresponding single activity. Household and labour factor groupings are a standard aggregated version of the PROVIDE SAM accounts. Households are grouped according to province, race, education level of the head of household and agricultural/non-agricultural and homeland/non-homeland where relevant. Labour factors were grouped according to province, race, and skill level (high-skilled and skilled in one group, semi- and unskilled in another).

Relevant tax accounts include sales taxes (including VAT), import taxes, excise taxes, sales subsidies, production taxes (and subsidies) and direct (income) taxes on households and enterprises. A full listing of accounts is given in Appendix A and a mapping of agricultural regions used in the SAM to magisterial districts is given in Appendix B.

3.2. Maize in the SAM

Maize does not appear as a separate commodity in the SAM; it is part of an aggregate commodity named summer cereals. There is therefore a potential problem in that non-maize summer cereals are included in the study, and treated as maize. However, according to the Crop Estimation Committee's fifth estimate for 2004/2005, maize constitutes 80% of summer cereals production by area planted, and 90% by weight. The category furthermore contains sunflower seeds (11.9% by area, 4.9% by weight) and also sorghum, groundnuts, soybeans and drybeans. While these constitute a significant share of summer cereals, particularly in value terms (they are more valuable per ton than maize), the category is largely dominated by maize and we therefore use summer cereals as a proxy for maize in the modelling exercise.

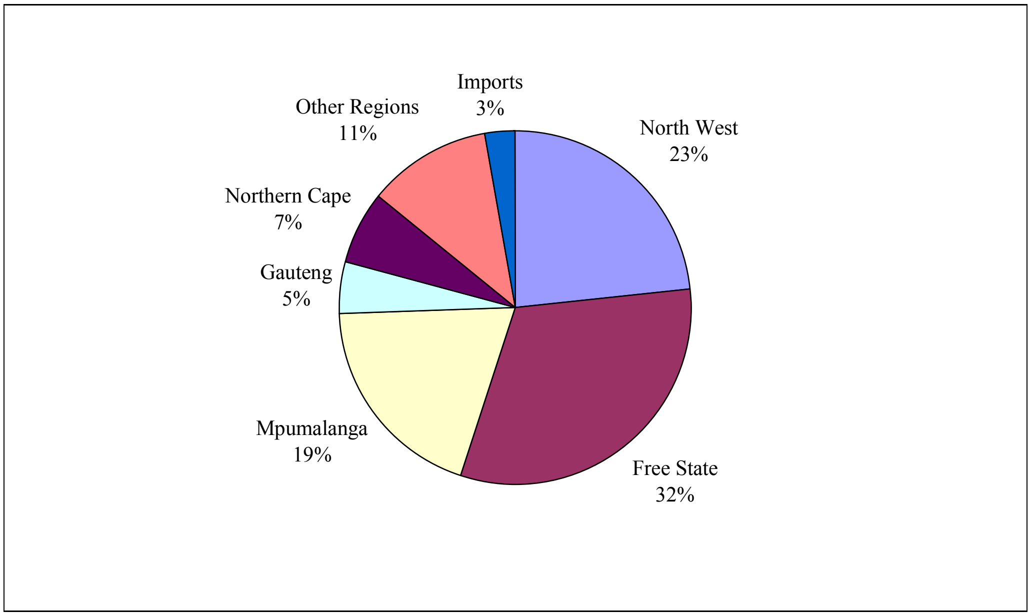
The role of summer cereals in the SAM, shown in Figure 3 and Figure 4, corresponds closely to the production and use data for maize from section 2. Supply is mostly from North West, Mpumalanga and the Free State, with a combined share of 74.5% of supply. Imports only make up 2.5% of supply. Import tariff revenue is R15.9 million, or 9.7% *ad valorem*. Further details of domestic production of summer cereals is given in Appendix C.

Grain mills dominate demand for summer cereals, while animal feeds and beverages and tobacco[6] also use significant amounts. There is no final-use demand by households for sum-

[6] It is likely that the use of summer cereals by beverages and tobacco is explained by the use of sorghum and other grains for the production of alcoholic beverages.

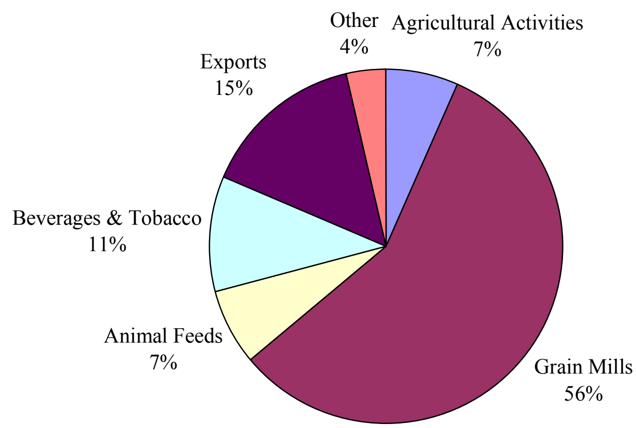
mer cereals (all household demand enters the SAM as demand for food commodities). Furthermore, the low share of animal feeds may be explained by the fact that summer cereals enter the animal feeds industry indirectly, as milled maize products[7]. 15% of domestic production is exported.

Figure 3. Supply of summer cereals in the 2000 SAM



[7] This is corroborated by the fact that 15% of the total expenditure of the animal feeds activity is on grain mills products as intermediate input. This commodity includes other grain products besides maize, but maize is likely to make up the major share.

Figure 4. Demand for summer cereals in the 2000 SAM



4. Computable General Equilibrium (CGE) Model and Closures

4.1. General Description

The computable general equilibrium (CGE) model (see PROVIDE 2005a) is a member of the class of single country computable general equilibrium (CGE) models that are descendants of the approach to CGE modeling described by Dervis *et al*., (1982). More specifically, the implementation of this model, using the GAMS (General Algebraic Modeling System) software, is a direct descendant and development of models devised in the late 1980s and early 1990s, particularly those models reported by Robinson *et al.*, (1990), Kilkenny (1991) and Devarajan *et al*., (1994). The model is a SAM based CGE model, wherein the SAM serves to identify the agents in the economy and provides the database with which the model is calibrated. The SAM also serves an important organisational role since the groups of agents identified by the SAM structure are also used to define sub-matrices of the SAM for which behavioural relationships need to be defined. As such the modelling approach has been influenced by Pyatt's 'SAM Approach to Modeling' (Pyatt, 1988).

The description of the model here is necessarily brief and proceeds in two stages. The first stage is the identification of the behavioural relationships; these are defined by reference to the sub matrices of the SAM within which the associated transactions are recorded. The second stage uses a pair of figures to explain the nature of the price and quantity systems for commodity and activity accounts that are embodied within the model. This description is followed by a discussion of the functioning of import tariffs and export prices in the model, as an understanding thereof is important for interpreting model results in this study.

4.2. Behavioural relationships

While the accounts of the SAM determine the agents that can be included within the model, and the transactions recorded in the SAM identify the transactions that took place, the model is defined by the behavioural relationships. The behavioural relationships in this model are a mix of non-linear and linear relationships that govern how the model's agents will respond to exogenously determined changes in the model's parameters and/or variables. Table 3 summarises the model relationships by reference to the sub matrices of the SAM.

Households are assumed to choose the bundles of commodities they consume so as to maximise utility where the utility function is a Stone-Geary function that allows for subsistence consumption expenditures, which is an arguably realistic assumption when there are substantial numbers of very poor consumers. The households choose their consumption bundles from a set of 'composite' commodities that are aggregates of domestically produced and imported commodities. These 'composite' commodities are formed as Constant Elasticity of Substitution (CES) aggregates that embody the presumption that domestically produced and imported commodities are imperfect substitutes. The optimal ratios of imported and domestic commodities are determined by the relative prices of the imported and domestic commodities. This is the so-called Armington assumption (Armington, 1969), which allows for product differentiation via the assumption of imperfect substitution (see Devarajan *et al*., 1994). The assumption has the advantage of rendering the model practical by avoiding the extreme specialisation and price fluctuations associated with other trade assumptions. In this model South Africa is assumed to be a price taker for all imported commodities.

Domestic production uses a two-stage production process. In the first stage aggregate intermediate and aggregate primary inputs are combined using CES technology. Hence aggregate intermediate and primary input demands vary with the relative prices of aggregate intermediate and primary inputs. At the second stage intermediate inputs are used in fixed proportions relative to the aggregate intermediate input used by each activity. The 'residual' prices per unit of output after paying for intermediate inputs, the so-called value added prices, are the amounts available for the payment of primary inputs. Primary inputs are combined to form aggregate value added using CES technologies, with the optimal ratios of primary inputs being determined by relative factor prices. The activities are defined as multi-product activities with the assumption that the proportionate combinations of commodity outputs produced by each activity/industry remain constant; hence for any given vector of commodities demanded there is a unique vector of activity outputs that must be produced. The vector of commodities demanded is determined by the domestic demand for domestically produced commodities and export demand for domestically produced commodities. Using the assumption of imperfect transformation between domestic demand and export demand, in the form of a Constant Elasticity of Transformation (CET) function, the optimal distribution of domestically produced commodities between the domestic and export markets is determined by the relative prices on the alternative markets. The model can be specified as a small country, i.e., price taker, on all export markets, or selected export commodities can be deemed to face downward sloping export demand functions, i.e., a large country assumption. The other behavioural relationships in the model are generally linear.

Table 3: Relationships for the computable general equilibrium model

	Commodities	Activities	Factors	Households	Enterprises	Government	Capital	RoW	Total	Prices
Commodities	0	Leontief Input-Output Coefficients	0	Utility Functions (Stone-Geary or CD)	Fixed in Real Terms	Fixed in Real Terms and Export Taxes	Fixed Shares of Savings	Commodity Exports (CET)	Commodity Demand	Consumer Commodity Price Prices for Exports
Activities	Domestic Production	0	0	0	0	0	0	0	Constant Elasticity of Substitution Production Functions	
Factors	0	Factor Demands (CES)	0	0	0	0	0	Factor Income from RoW	Factor Income	
Households	0	0	Fixed Shares of Factor Income	Fixed (Real) Transfers	Fixed (Real) Transfers	Fixed (Real) Transfers	0	Remittances	Household Income	
Enterprises	0	0	Fixed Shares of Factor Income	0	0	Fixed (Real) Transfers	0	Transfers	Enterprise Income	
Government	Tariff Revenue Export Taxes Commodity Taxes	Indirect Taxes on Activities Factor Use Taxes	Factor Income Taxes Fixed Shares of Factor Income	Direct Taxes on Household Income	Direct Taxes on Enterprise Income	0	0	Transfers	Government Income	
Capital	0	0	Depreciation	Household Savings	Enterprise Savings	Government Savings (Residual)	0	Current Account 'Deficit'	Total Savings	
Rest of World	Commodity Imports	0	Fixed Shares of Factor Income	0	0	0	0	0	Total 'Expenditure' Abroad	
Total	Commodity Supply (Armington CES)	Activity Input	Factor Expenditure	Household Expenditure	Enterprise Expenditure	Government Expenditure	Total Investment	Total 'Income' from Abroad		
	Producer Commodity Prices Domestic and World Prices for Imports	Value Added Prices								

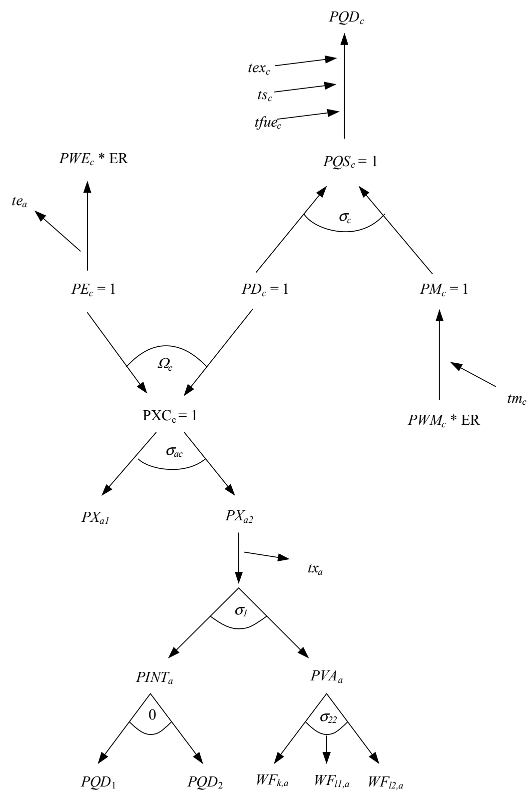
The model is set up with a range of flexible closure rules. The specific choices about closure rules used in this study are defined in the Policy Analysis section below.

4.3. Price and quantity relationships

Figure 5 and Figure 6 provide an overview of the interrelationships between the prices and quantities. The supply prices of the composite commodities (PQS_c) are defined as the weighted averages of the domestically produced commodities that are consumed domestically (PD_c) and the domestic prices of imported commodities (PM_c), which are defined as the products of the world prices of commodities (PWM_c) and the exchange rate (ER) uplifted by *ad valorem* import duties (tm_c). These weights are updated in the model through first order conditions for optima. The supply prices exclude sales, excise and fuel taxes, and hence must be uplifted by (*ad valorem*) sales taxes (ts_c) and excise taxes (tex_c) to reflect the composite consumer price (PQD_c). The producer prices of commodities (PXC_c) are similarly defined as the weighted averages of the prices received for domestically produced commodities sold on domestic and export (PE_c) markets; the weights are updated in the model through first order conditions for optima. The prices received on the export market are defined as the products of the world price of exports (PWE_c) and the exchange rate (ER) less any exports duties due, which are defined by *ad valorem* export duty rates (te_c).

The average price per unit of output received by an activity (PX_a) is defined as the weighted average of the domestic producer prices, where the weights are constant. After paying indirect/production/output taxes (tx_a), this is divided between payments to aggregate value added (PVA_a), i.e., the amount available to pay primary inputs, and aggregate intermediate inputs ($PINT_a$). The factor prices paid by activities ($WF_{f,a}$) constitute the components of value added, while total payments for intermediate inputs per unit of aggregate intermediate input are defined as the weighted sums of the prices of the inputs (PQD_c).

Figure 5: Price relationships for a standard model with commodity exports

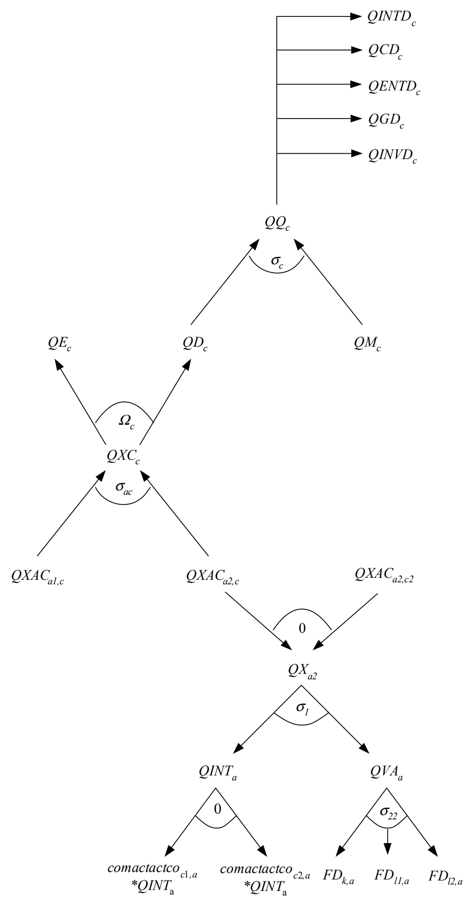


Total demands for the composite commodities, QQ_c, consist of demands for intermediate inputs, $QINTD_c$, consumption by households, QCD_c, enterprises, $QENTD_c$, and government, QGD_c, gross fixed capital formation, $QINVD_c$, and stock changes, $dstocconst_c$. Supplies from domestic producers, QD_c, plus imports, QM_c, meet these demands; equilibrium conditions ensure that the total supplies and demands for all composite commodities equate. Commodities are delivered to both the domestic and export, QE_c, markets subject to equilibrium conditions that require all domestic commodity production, QXC_c, to be either domestically consumed or exported.

The multi-product activities are modelled using the assumption that commodities are differentiated by (source) activity but that activities produced outputs in fixed proportions.[8] Hence the domestic production of a commodity (QXC_c) is a CES aggregate of the quantities of that commodity produced by a number of different activities ($QXAC_{a,c}$), which are produced by each activity in activity specific fixed proportions, i.e., the output of $QXAC_{a,c}$ is a Leontief (fixed proportions) aggregate of the output of each activity (QX_a).

[8] The model allows for the imposition of the alternative assumption that the 'same' commodities produced by different activities are homogenous.

Figure 6: Quantity relationships for a standard model



Production relationships by activities are defined by a series of nested Constant Elasticity of Substitution (CES) production functions. The nesting structure is illustrated in lower part of Figure 2, where, for illustration purposes only, two intermediate inputs and three primary inputs ($FD_{k,a}$, $FD_{l1,a}$ and $FD_{l2,a}$) are identified. Activity output is a CES aggregate of the quantities of aggregate intermediate inputs ($QINT_a$) and value added (QVA_a), while aggregate intermediate inputs are a Leontief aggregate of the (individual) intermediate inputs and aggregate value added is a CES aggregate of the quantities of primary inputs demanded by each activity ($FD_{f,a}$). The allocation of the finite supplies of factors (FS_f) between competing activities depends upon relative factor prices via first order conditions for optima. While the base model contains the assumption that all factors are fully employed and mobile; this assumption can be relaxed.

4.4. Export Prices in the Model

Increasing export prices in the PROVIDE model requires an understanding of the functioning of the constant elasticity of transformation (CET) function, which is used to differentiate locally produced goods according to market (as opposed to the Armington function which differentiates locally marketed goods according to source). Such functions are commonly used in single-country models of this type, in order to prevent corner solutions and large swings that would result from perfect substitutability (i.e. no differentiation) between exports and domestically marketed goods.

In the model, the relationship between domestic production (QXC), domestically marketed produce (QD) and exports (QE) of a particular commodity (summer cereals in this case) is specified as a constant elasticity of transformation (CET) function[9]

$$QXC = at \cdot (\gamma \cdot QE^{rhot} + (1-\gamma) \cdot QD^{rhot})^{\frac{1}{rhot}} \tag{1}$$

where the elasticity of transformation equals *1/(rhot-1),* γ is a share parameter and *at* is a scale (shift) parameter. For a valid model solution, it is necessary for the first-order condition (based on revenue maximisation) to hold:

$$\frac{QE}{QD} = \left[\frac{PE}{PD} \cdot \frac{(1-\gamma)}{\lambda} \right]^{\frac{1}{rhot-1}} \tag{2}$$

This essentially determines the relative output quantities by reference to their relative prices (*PE/PD*). A final condition is that the total output value must equal the value of production, which effectively defines a relationship between prices of Q*XC*, Q*E* and Q*D* (denoted *PXC, PE and PD*, respectively*)*:

$$PXC \cdot QXC = PE \cdot QE + PD \cdot QD \tag{3}$$

The domestic price of exports, *PE*, is determined by reference to the world price of exports (*PWE*), i.e. $PE = PWE * ER$ (there are no export taxes). Therefore, if a shock is applied to *PWE*, it is reflected directly in *PE*, but any changes in the exchange rate will also be reflected, (though this could be expected to remain a minor effect in this case, given that summer cereals exports do not make up a substantial part of total exports in the economy).

In the light of the above, the effects of an increase in the world price of a commodity can be expected to have two separate effects. Firstly, the balance of prices *PE/PD* will change, which implies that relative quantities *QE/QD* must also change in order for profit maximisation in marketing to hold, according to equation (2). This is a *substitution* effect and will lead

[9] Indexes are suppressed for simplicity, since we are concerned with a single commodity in this study. Note, however, that there are equivalent equations for all other commodities that are both produced and exported in the model.

to a decrease in supply of the commodity on the domestic market: less will be offered at a given price. Secondly, an increase in *PE* will increase the producer price *PXC*. Given profit maximisation behaviour higher up in the production chain, this will lead to an increase in production, i.e. more resources will be devoted to the production of the commodity. However, when QXC is increased, this will – given relative prices *PE/QE* in equation (2) – lead to an increase in supply of both exports and domestically marketed goods, i.e. there is an *income* effect in addition to the substitution effect[10]. In general then, an export price increase will have the direct effects of increasing exports and production and increasing the ratio of exports to the domestically marketed good.

4.5. Import Tariffs in the Model

In the model, an import tariff is modelled as a wedge between domestic and foreign import prices (i.e. as *ad valorem*):

$$PM = PWM \cdot ER \cdot (1 + tm) \tag{4}$$

where *PWM* is the foreign currency priced world price of imports, *PM* is the local currency priced domestic price of imports, *ER* is the exchange rate and *tm* is the import tariff rate. Imports are modelled using the Armington assumption of product differentiation by origin. Imports (QM) combine with domestically marketed and produced commodities (QD) to form domestic supply (QQ) according to a constant elasticity of substitution (CES) specification:

$$QQ = ac \cdot (\delta \cdot QM^{-rhoc} + (1-\delta) \cdot QD^{-rhoc})^{\frac{-1}{rhoc}} \tag{5}$$

where *ac* is a scale parameter, δ is a share parameter and the elasticity of substitution equals *1/(rhoc+1)*. Cost minimisation and the fact that the value of domestic supply must equal the total value of imports and domestic production imply the following two model equations:

$$\frac{QM}{QD} = \left[\frac{PD}{PM} \cdot \frac{\delta}{(1-\delta)} \right]^{\frac{1}{(1+rhoc)}} \tag{6}$$

$$PQS \cdot QQ = PD \cdot QD + PM \cdot QM \tag{7}$$

[10] In certain cases this effectively causes an increase in demand for exports to result in an increase in supply of the commodity on the domestic market, which usually causes the domestic price to drop. While seemingly perverse, this is entirely consistent with the way in which exports are modelled, i.e. with product differentiation by market and imperfect transformability.

Note that this issue does not manifest in the case of summer cereals in this model, i.e. the substitution effect outweighs the income effect and an increase in export demand leads to a decrease in domestic supply. This is most likely because it has a low effective elasticity of supply. The elasticities of supply are relatively low for agricultural activities, because they are constrained by the fixed supplies of the factor land.

An increase in the import tariff (*tm)* will therefore directly raise *PM*, which will – similarly to the CET function – cause a substitution effect (equation 6) and an income effect (equation 7). Hence, the effects of an increase in import tariffs of a product will be to change the ratio of quantities of imports and domestic produce in final supply towards domestic products, and to increase the producer prices, which is likely to stimulate production activity by providing higher returns.

4.6. Model Closures

The model contains certain conditions that must be satisfied – government account balance, external balance, factor market balance and savings-investment equality. These closure rules represent important assumptions on the way institutions operate in the economy and can substantively influence model results.

Closure rules for this study were selected for their appropriateness to the South African economy and the experiments to be conducted. While experiments were conducted under a set of alternative closures in order to test the implications, results and discussion are generally limited to a single set, except where closures directly influence aspects of the results. The different closures are discussed in turn below.

Government closure

One accounting constraint is that government finances must balance, that is, government income plus dissavings must equal total government expenditure. In the model, government expenditure consists of consumption and transfer payments, the latter of which is fixed at base levels. On the income side, government levies various taxes and receives certain fixed incomes from transfers.

Two alternative closures are defined to check for distributional implications of government policy:

- Inert: Under this closure, government maintains its expenditure levels in volume terms despite revenue shocks. Tax rates are likewise held constant at base levels. All shocks to government income (typically through tax revenue effects) will be reflected in the government deficit, which will adjust in order to maintain fiscal balance. The advantage of this closure is that it assumes no government response to shocks and can therefore indicate fiscal pressures from the government's perspective that could develop as a result of shocks.

- Neutral: In this scenario, the fiscal balance is fixed, and government consumption expenditure is held in fixed proportion to total final demand in the economy. Household tax rates adjust (equiproportionally) in order to achieve fiscal balance. Therefore, influences on government income or expenditures will need to be financed by households. While this closure is onerous in terms of assuming specific policy reaction to shocks, it has the advantages of being both fiscally neutral (i.e. there are no changes to government savings, which might affect the welfare of future generations) and distributionally neutral (government expenditure is held constant as a proportion of total final demand).

The inert closure can also be regarded as a short-term closure while the neutral closure is a long-term closure (i.e. where enough time has elapsed for policy to adjust). Most of the results shown in this study will make use of the neutral closure, because our interest is in the overall welfare effects, and not necessarily government policy responses.

External balance

We assume that South Africa has a flexible exchange rate. Net foreign savings are held fixed at the base level. Changes to tariff rates and international prices are therefore likely to affect the exchange rate, which has particular implications for the economy, especially in sectors where international trade is important. Nevertheless, exchange rate changes are expected to be very small, since trade in summer cereals is very small in terms of the whole economy.

Savings-investment closures

We use a balanced investment-driven savings configuration whereby the share of investment in absorption is fixed, and savings rates adjust equally in order to balance the identity,

investment = government balance + external balance + savings (household & other)

The external balance is fixed because of the selected closure for the external balance, but the government balance may vary under the inert government closure. In order to rebalance savings and investment, savings rates adjust, hence under the inert closure there is a link between government tax revenue and household expenditure. However, given the limited scope for such effects in the current study, these effects should be relatively minor.

This closure is chosen for realism (investment levels react to economic expansion/contraction) and because it tends to be distributionally neutral (like the neutral government closure).

Factor market closures

Factor market closures are chosen to best reflect the realities of the South African economy; hence unskilled African, coloured and Asian labour[11] is not fully employed, and wages are held fixed in nominal terms at the base level. As a result, employment is determined by marginal factor products, which depend, amongst other things, on the prices of outputs in various industries.

White and skilled African, coloured and Asian labour and capital, which are scarce factors, are in fixed supply and are mobile between industries in the default long term (LT) closure. This means that, following a negative shock to a particular sector, we can expect these factors to partially relocate to more profitable industries. An alternative short term (ST) factor market closure is also used, where scarce labour and capital is immobile and fixed. Distinguishing between the results of ST and LT can give an indication of the effects of factor reallocations following a shock, as opposed to the primary effects of the shock.

Land, on the other hand, is held fixed in each sector where it is used (agriculture only). Since the agricultural activities in the SAM used for this study are disaggregated by region, it would not make sense to allow land to relocate.

Numeraire

We use the consumer price index (CPI) as the numeraire; all prices are therefore relative to the CPI, which is held fixed.

5. Tariff Simulations

5.1. Introduction

The import tariff on maize is currently controlled according to a dollar-based floor price mechanism. A per-ton tariff is periodically calculated that would increase (according to certain rules) if there were a drop in world prices and vice versa. The tariff formula does not protect against exchange rate fluctuations.

However, the system is currently under review, and the International Trade Administration Commission of South Africa (ITAC) is expected to recommend a new system in the near future. Representatives from the milling industry have requested that the system be replaced by a Rand-based system, i.e. one that protects against both world price and exchange rate fluctuations (Maize Tariff Working Group 2005: 2). At the same time, producers would like to see a higher tariff, especially in the light of the low domestic prices.

[11] See Appendix A for information on the labour accounts that are modelled as partly unemployed.

Recent experience in the wheat industry, where ITAC fixed the tariff at a low *ad valorem* rate of 2%, suggests that ITAC is unlikely to maintain a system whereby tariffs protect against price fluctuations caused by either world price changes or exchange rate changes. Given the role of maize as a staple food, it is also likely that the level of protection will be relatively low, as for wheat. The current tariff *ad valorem* equivalent is 2.3%, down from 8.4% recently[12].

Yet there seems to be much less interest in the maize tariff compared to the tariff on wheat, which is easily explained by the fact that South Africa is not a net maize importer, and domestic prices are much lower than import parity. The immediate effects of changes in the maize tariff are therefore likely to be minimal, as our model results show.

5.2. Experiment Specification

Using a single combination of closure rules only (neutral government and long-term factor market closures), we simulate both a reduction in the import tariff rate on summer cereals from the base of 9.7% as well as an increase. As Table 4 shows, the simulations range from a 10 percentage point reduction to a 15 percentage point increase, and include a base case for comparative analysis. It must be emphasised that we are assessing the effects of a shock, hence relative changes in the tariff rate are critical, rather than any particular effective tariff rate.

Table 4. Tariff simulation specifications

Simulation	Change in import tariff rate on summer cereals (percentage points)	Effective rate (percent of import value)
TSIM00	-10%	-0.3%
TSIM01	- 5%	4.7%
TSIM02 (Base)	0%	9.7%
TSIM03	+ 5%	14.7%
TSIM04	+10%	19.7%
TSIM05	+15%	24.7%

5.3. Model Results

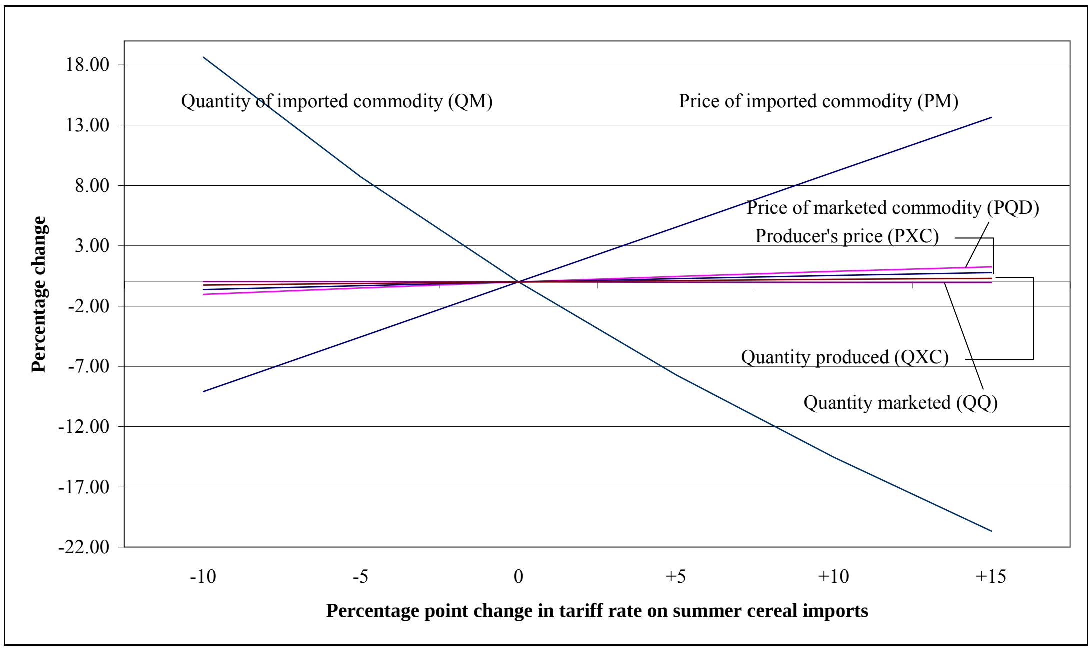
The base value of summer cereals imports is R 171 million, which represents 0.07% of total import value of all commodities and 3.5% of total domestic supply of summer cereals, both of which are small shares. Hence, any reasonable change in the tariff rate on imports of summer cereals is unlikely to have any major effects apart from the direct effects on the amount imported, and we therefore only report a small selection of results.

[12] Based on import parity prices calculated by SAGIS (www.sagis.co.za). A new tariff of R 22.91 / ton was effective on 23 September 2005, down from R84.24 / ton.

Direct effects

The immediate effect of a change in the import tariff on summer cereals is to raise the import price of the commodity. As a result, domestic prices will also be pushed up, but to a lesser extent. The result is a change in the ratio of import prices to domestic prices, and substitution will occur towards the domestically produced variant (see section 4.5). The results are shown in Figure 7. What is immediately clear is that, while the effects on imports are substantial, the other effects are very small. For the case a 15 percentage point increase in the tariff rate, there is a small increase in the prices of domestically marketed (1.27%) and produced (0.78%) prices. Quantity effects are even smaller: there is a decrease in marketed summer cereals of 0.05% and an increase in production of 0.3%.

Figure 7. Tariff simulations: Price and quantity effects for summer cereals

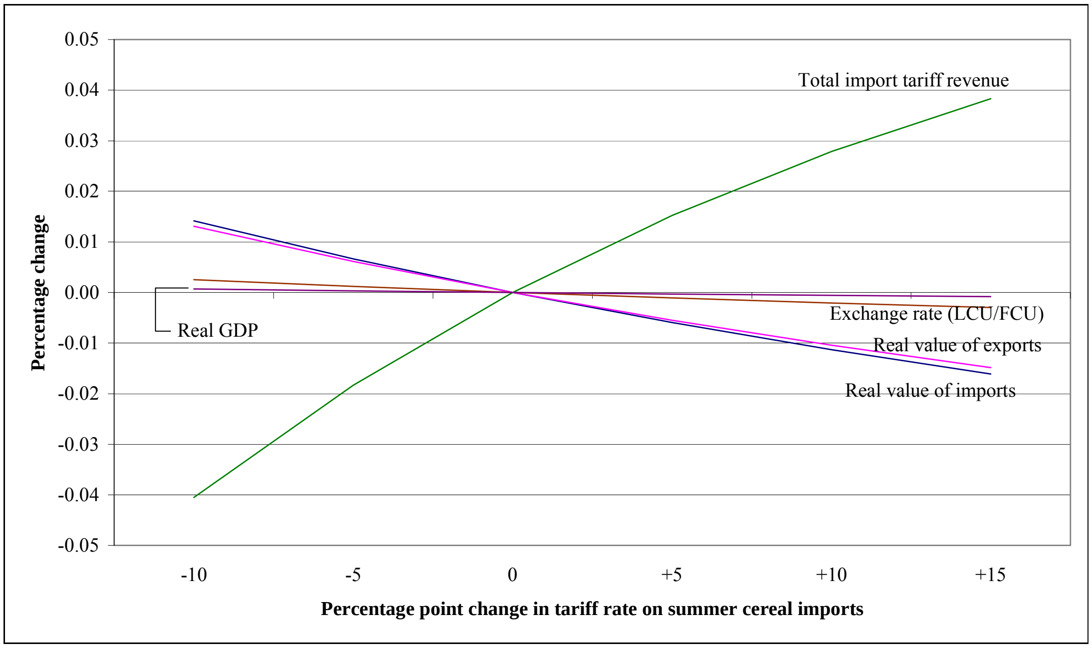


Other effects

Given the very small effects on the domestic market, it is unlikely that there will be any major economy-wide effects. As Figure 8 shows, there is a very slight increase of 0.04% in import tariff revenue, which translates to R14.3 million, when the tariff is increased by 15 percentage points. Trade declines slightly, the exchange rate appreciates slightly (by less than 0.01%) and real GDP is almost unchanged but slightly lower. Household are little affected, for example no household's real consumption expenditure changes by more than 0.03%.

Tariff changes are likewise unlikely to make much difference to producers of summer cereals, though of course an increase in producer's prices will benefit them. However, the effects are small, and no region's total value added changes by more than 1%. There is a net loss to the economy in value added of R31.9 million.

Figure 8. Tariff simulations: Macroeconomic effects



5.4. Further Remarks

The results indicate that the immediate effects of increased or decreased tariff protection are very small, both in terms of effects on summer cereals markets and in terms of the whole economy. Does this indicate that the tariff is unimportant? While the tariff may be unimportant given prevailing conditions (i.e. domestic overproduction), it should be remembered that conditions might change that could increase the importance that tariffs may have. This would typically happen if the domestic price of maize in South Africa rose to levels approaching import parity. This could happen either because of an increase in demand or because of a decrease in supply. A recurrent scenario in South Africa is that of crop failure brought about in a particular year by drought, which necessitates large-scale maize imports. Under such conditions, high tariffs (e.g. at a fixed *ad valorem* rate) could dramatically increase the profitability of maize production (at least of those that escaped the disaster), but at the cost of higher food prices.

6. International Price Simulations

6.1. Introduction

The international market for maize is characterised by government intervention and protectionist trade regimes. The United States is the primary actor, since it is the world's largest producer with 41% of world output and 60% of world exports (Maize Tariff Working Group 2004: 40), and offers extensive support to its producers. Combined support (subsidies and price support policies) to maize producers in the US is estimated to total 6.8 billion US Dollars for 2002, and the corresponding figure for all OECD countries is 10.64 billion US Dollars (World Bank 2005: 44)[13].

This support is thought to be largely responsible for depressed world prices of maize because it encourages producers to produce under circumstances that would otherwise not be tenable and hence overproduction. This of course negatively affects the welfare of net exporting countries like South Africa.

The extent to which maize prices may react to liberalisation of the world market is uncertain. A survey (Wise 2004: 21) suggests that the effects may be quite limited, partly because farmers are likely to be very inelastic in their supply due to sunk costs. Over the long run effects could increase. A removal of direct payments to producers is expected (depending on the study) to lead to world price increases of less than 4%, while full liberalisation may lead to price increases of up to 14.5% (Beghin, Roland-Holst and van der Mensbrugghe 2002: 24).

In this study, we do not adopt a view that prices will increase or decrease to a particular level and we model different international price changes to cover a range of possibilities.

6.2. Experiment Specification

A series of decreases and increases in the world price of summer cereals exports is applied to the model, in increments of 5 percentage points, and including a base case for comparison:

Table 5. World price simulation specifications

Simulation name	**Increase in world price of exports (*PWE*) of summer cereals**
WSIM00	- 20.0%
WSIM01	- 15.0%
WSIM02	- 10.0%
WSIM03	- 5.0%
WSIM04 (Base)	0.0%
WSIM05	+ 5.0%

[13] The bulk of these are made up of border protection mechanisms such as tariffs.

WSIM06	+ 10.0%
WSIM07	+ 15.0%
WSIM08	+ 20.0%

All the different closures discussed in section 4.6 are used, hence there is distinction between short term and long term factor markets on the one hand and between inert and neutral government closures on the other. The results that are reported are mostly for the long-term fiscally neutral closure combination, and results for any other closure will be specifically indicated. We also concentrate on the effects of price increases rather than decreases.

6.3. Model Results

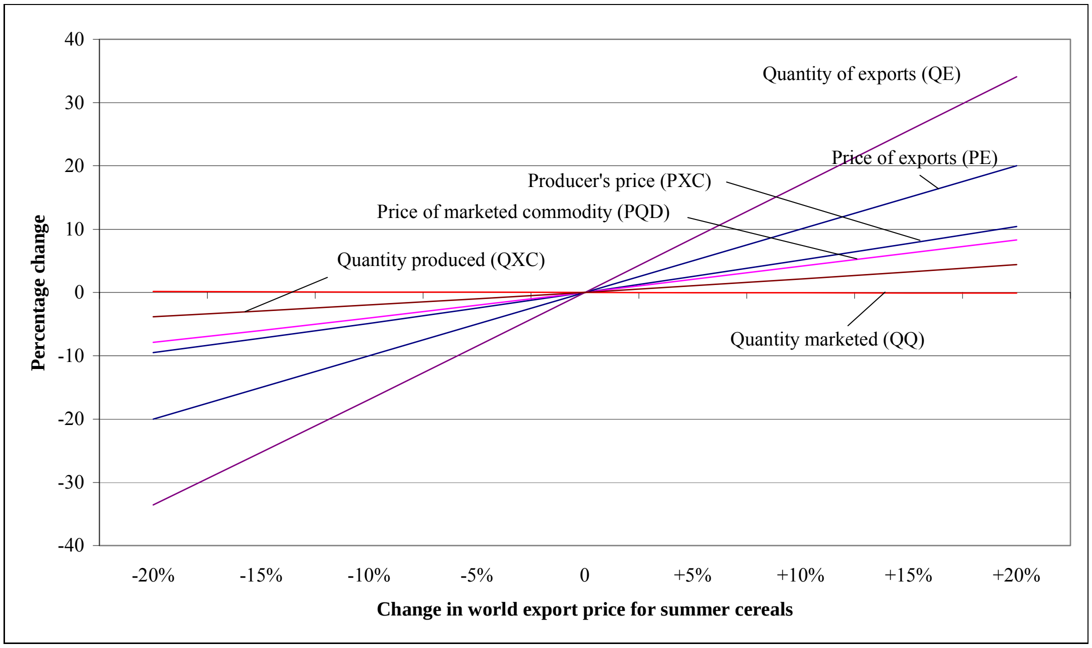
South Africa is a net exporter of summer cereals; hence an increase in the world price of the commodity can be expected to benefit South Africa, particularly those farmers and workers directly involved in production. However, the effects are likely to be small in terms of the total economy given that summer cereals is not a major export product and given that there is limited capacity for increasing production due to the limited availability of land.

Direct effects

Increasing the world price (*PWE*) of summer cereals will cause a proportional increase in the domestic export price (*PE*)[14]. The direct effects of this include a substitution effect and an income effect (see section 4.4). The substitution effect is the result of an increase in the ratio of the export price (*PE*) relative to the domestic price (*PQD*), as can be seen in Figure 1. As a result, the ratio export quantity (*QE*) relative to domestic quantity (*QQ*) must also increase, which is the case. There is a large increase in the quantity of summer cereals exported (up to 34.1% for the case of a 20% increase in world prices), while the quantity of domestically marketed summer cereals is very little affected, despite the fact that domestic prices increase (8.3%). This indicates that final domestic demand is relatively inelastic, as would be expected for a staple food.

[14] Changes in the exchange rate will also be reflected in *PE* – see below.

Figure 9. World price simulation: Price and quantity effects for summer cereals



Producers devote more resources to the production of summer cereals (see below); hence there is an increase in production (*QXC*) of 4.4%. This is the income effect, due to the fact that the producer's price (*PXC*) must increase when the price of one of the outputs (exports) is increased according to the zero profit condition (equation 3 in section 4.4).

Producer effects

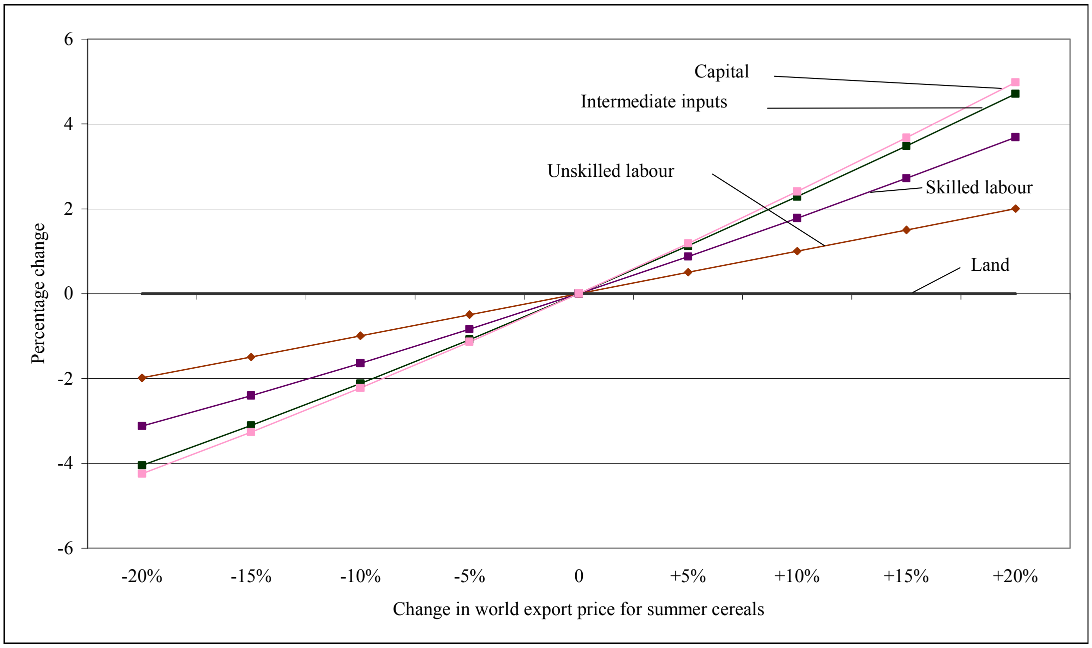
Since the producer's price increase is more than the quantity increase, domestic supply must also be relatively inelastic. In the model, under the current (long-term) closure, this is caused by the limited availability of land: farmers can cultivate existing summer cereals farms more intensively, using more labour, capital and intermediate inputs, but cannot increase the amount of land under cultivation. Figure 10 shows the aggregate quantities of inputs to maize producers[15].

As can be seen in the previous section, there is a large increase in the quantity of exports of summer cereals, and a large increase in the price of such exports, both tending to increase the value of domestic summer cereals production. Producers of summer cereals will furthermore benefit from the increase in the domestic price in an inelastic market caused by the fact

[15] Summer cereals are produced by agricultural activities (regions), which also produce other agricultural outputs. The aggregates have been formed by weighting each activity's values by the share of summer cereals in the initial output of the activity. Fisher quantity indices were used to calculate changes in the quantity of skilled and unskilled labour used by summer cereal-producing regions; these are also weighted by the summer cereals output share.

that a part of the supply has been diverted to exports. Hence, the increase in the value of summer cereals production (R997.5 million by value) is higher than the increase in exports (R551.4 million) even though the proportional increase in export value (60.9%) is higher than in production (15.3%).

Figure 10. World price simulation: Aggregated input quantity effects for summer cereals producers



Value added effects

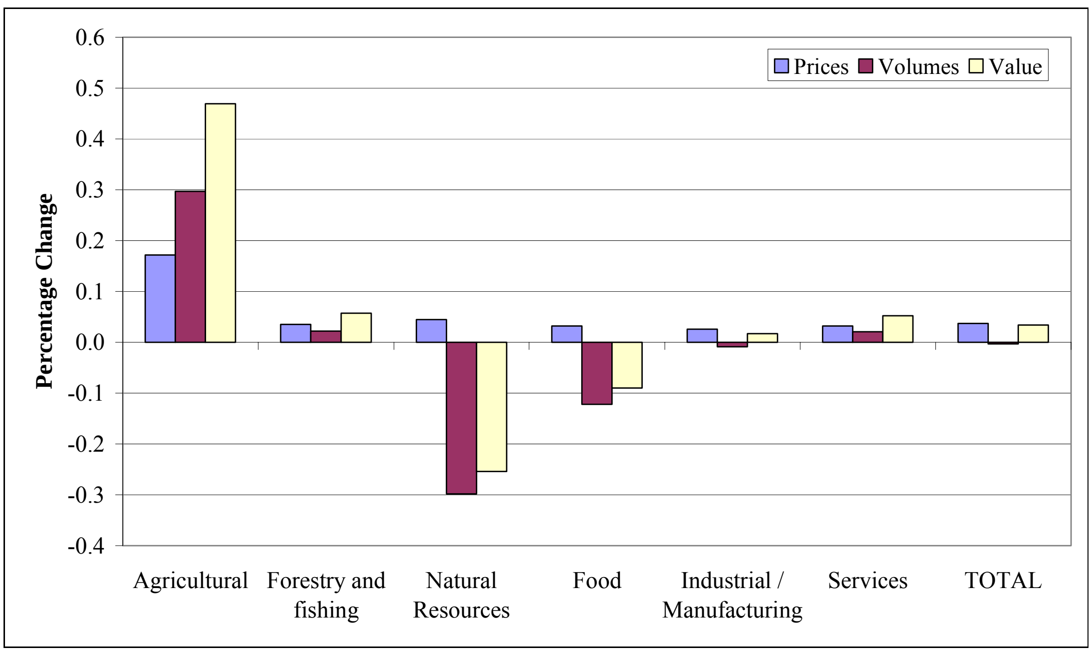
In the previous sections, we have shown that the value of domestically produced summer cereals increases fairly substantially, suggesting a substantial benefit to the producing and upstream industries (i.e. those that produce intermediate inputs used in summer cereals production). However, raising production in summer cereals will draw scarce resources from alternative uses and affect the foreign exchange market. The net benefit to the economy, in terms of production value, is therefore likely to be substantially less than the increase in the value of produced summer cereals.

The value of production in a particular activity can be captured by the concept of value added, which is the additional value produced by production factors (i.e. not including intermediate inputs) in that activity. Since this is measured by the payments to factors used by the activity, total value added as a measure of production in the economy will equal total factor income in the economy. Table 6 provides results for value-added in the economy for the case of a 20% increase in world prices of summer cereals, decomposed into sectors with varying degrees of aggregation and also into price and quantity elements.

The total value added in the economy (over the long run) increases by 0.03%, or R273.89 million, which is also (with minor adjustments for indirect taxes and subsidies) equal to the change in gross domestic product from value added (which changes by R268.81 million). It can be seen that total production volume in the economy is unchanged; hence the increase in value mainly derives from price changes relative to the fixed CPI[16]. However, this figure masks a complex situation whereby different sectors are affected in different ways.

Agriculture, as may be expected, benefits significantly from an increase in world prices of summer cereals, with a 0.47% increase in value added and 54.7% of the total change in value added. The change is driven by both price (0.17%) and volume (0.30%) changes, representing increased production as a result of price incentives. However, while it is clear that the summer cereals producing regions benefit substantially (with over 10% value added increases in some regions) all agricultural sectors do not benefit. More details are provided in section 0.

Figure 11. World price simulation (+20%): Value added effects for aggregate sectors



A large share of the increase in total value added derives from the non-agricultural sectors, with an increase of 45.3%, indicating that general equilibrium and secondary effects are important. The food industry, which can be expected to face cost increases as a result of more expensive summer cereals, show a decline in value added of 0.09%. Beverages and tobacco see a particularly large negative effect.

[16] For small and/or non-uniform changes, the use of volume indices may be problematic due to their semi-arbitrary weighting schemes.

The single largest increase in value terms derives from the services sector (R 271.85 million or 0.05%), which is nearly equal to the change in the economy's total change. This means that changes in other sectors roughly balance each other out. The increase in services is due to multiplier effects and increased income generated in other sectors. Industrial / manufacturing sectors are largely unaffected, at least in aggregate.

In the natural resources sector, there is a 0.25% decrease in the value added, which is of a similar magnitude in value to the increase in agriculture. The fact that price and quantity changes in this sector move in opposite directions seems to indicate that the change is driven by resource-cost effects rather than demand factors. In other words scarce resources (capital and labour) are being drawn away from the natural resource sector to agriculture and other sectors, causing a loss in value added despite a small exchange rate depreciation that would otherwise tend to benefit these export-biased sectors.

Food industries are also negatively affected through cost increases, but in this case it is driven largely by intermediate input price increases. While food as an aggregate experiences an intermediate cost increase, the effect is not homogenous (see Figure 14) as some intermediate input prices also decline. As a result the net effect, a decline in value added of 0.09%, is muted.

Table 6. World price simulation (+20%): Value added results

Activity/Group	Value Added Base Case (R million)	Prices %Change	Volume %Change	Value % Change	Value Change (R million)	% Contribution to Total Change
Agriculture	**31 918.61**	**0.17**	**0.30**	**0.47**	**149.73**	**54.67**
Agriculture: Western Cape	7 223.84	-0.01	-0.29	-0.30	-21.78	-7.95
Agriculture: Northern Cape	2 947.71	-0.09	-0.37	-0.46	-13.54	-4.94
NC Frances Baard*	617.04	0.37	3.82	4.21	25.99	9.49
Northern Cape Other	2 330.67	-0.22	-1.48	-1.70	-39.52	-14.43
Agriculture: North West	2 898.66	0.94	4.00	4.98	144.29	52.68
NW Vryburg*	381.40	0.81	4.05	4.90	18.67	6.82
NW Potchefstroom District*	1 490.48	1.55	7.64	9.31	138.83	50.69
NW Klerksdorp*	126.12	1.52	10.56	12.23	15.43	5.63
NW Rustenburg District	789.61	-0.27	-4.01	-4.28	-33.76	-12.33
NW Marico*	111.04	0.68	3.91	4.61	5.12	1.87
Agriculture: Free State	3 997.89	0.84	3.25	4.12	164.57	60.09
FS West Xhariep	377.58	0.44	1.41	1.86	7.04	2.57
FS Bloemfontein	140.81	0.01	-0.71	-0.69	-0.98	-0.36
FS East Xhariep	88.98	-0.92	-5.75	-6.62	-5.89	-2.15
FS Goudveld*	134.20	2.01	10.09	12.31	16.52	6.03
FS Bothaville District*	1 438.33	1.61	6.76	8.48	121.94	44.52
FS Thabo Mofutsanyane*	1 208.31	0.41	1.25	1.66	20.06	7.32
FS Southern Free State	532.98	-0.04	-0.98	-1.02	-5.43	-1.98
FS Sasolburg*	76.69	1.95	12.56	14.76	11.32	4.13
Agriculture: Eastern Cape	2 417.13	-0.62	-4.41	-5.00	-120.79	-44.10
Agriculture: KwaZulu Natal	3 900.28	-0.23	-1.71	-1.94	-75.76	-27.66
Agriculture: Mpumalanga	3 335.42	0.87	3.25	4.15	138.30	50.49
MP Mpum. East Rand*	242.66	2.82	10.08	13.18	31.99	11.68
MP Witbank District*	526.85	1.69	5.79	7.57	39.90	14.57
MP Govan Mbeki*	860.26	1.15	4.59	5.80	49.88	18.21
Mpumalanga Other	1 705.66	0.18	0.79	0.97	16.53	6.04
Agriculture: Limpopo	3 322.02	-0.06	-0.51	-0.57	-19.08	-6.97
Agriculture: Gauteng	1 875.67	-0.38	-2.10	-2.48	-46.48	-16.97
GT South Ekhurhuleni	336.58	-0.38	-1.78	-2.16	-7.26	-2.65
GT Cullinan District	356.39	-0.33	-1.86	-2.18	-7.78	-2.84
GT Sedibeng	155.91	0.46	1.29	1.75	2.74	1.00
Gauteng Other	1 026.79	-0.53	-2.81	-3.33	-34.18	-12.48
All Nonagricultural	**777 007.13**	**0.03**	**-0.02**	**0.02**	**124.16**	**45.33**
Forestry fishing	4 880.28	0.04	0.02	0.06	2.79	1.02
Food	25 086.25	0.03	-0.12	-0.09	-22.52	-8.22
Meat	1 528.66	0.04	0.07	0.10	1.56	0.57
Dairy	1 940.53	0.01	0.06	0.07	1.31	0.48
Grain mills	3 074.80	0.04	-0.16	-0.12	-3.84	-1.40
Animal feeds	834.60	0.05	0.38	0.43	3.58	1.31
Bakeries	1 855.47	0.02	-0.01	0.01	0.26	0.09
Confectionery	1 876.90	0.03	-0.04	-0.01	-0.21	-0.08
Other food	5 343.23	0.03	0.02	0.05	2.62	0.96
Beverages and tobacco	8 632.05	0.03	-0.36	-0.32	-27.80	-10.15
Natural Resources	61 783.30	0.04	-0.30	-0.25	-156.81	-57.26
Industrial / Manufacturing	166 002.89	0.03	-0.01	0.02	28.85	10.53
Services	519 254.41	0.03	0.02	0.05	271.85	99.26
TOTAL	**808 925.74**	**0.04**	**0.00**	**0.03**	**273.89**	**100.00**

Notes: * indicates regions with over 18% summer cereals share in output. Aggregations across sectors were done using Fisher price and quantity indices.

Effects on agricultural production

In the previous section, it was indicated that there are mixed effects on agricultural sectors, though on aggregate there is an increase in production value (0.46%), and both prices (0.16%) and volumes (0.30%) increase. Domestically produced commodity price, quantity and value changes are shown in Figure 12. As mentioned, the price increase leads to an increase in production in regions where summer cereals constitute a significant share of output. Many of these regions also produce livestock, causing an increase in the supply thereof[17], hence there is an increase in the quantity of livestock produced (0.5%), which in turn pushes down prices (3.8%). The substantial magnitude of the price change is due to a low effective elasticity of demand for livestock products. There is a similar but smaller effect for winter cereals, and this in turn causes a decrease in the supply of wine grapes (and therefore a price increase), since these are both produced in the Western Cape.

Figure 12. World price simulation (+20%): Agricultural commodity price and quantity effects

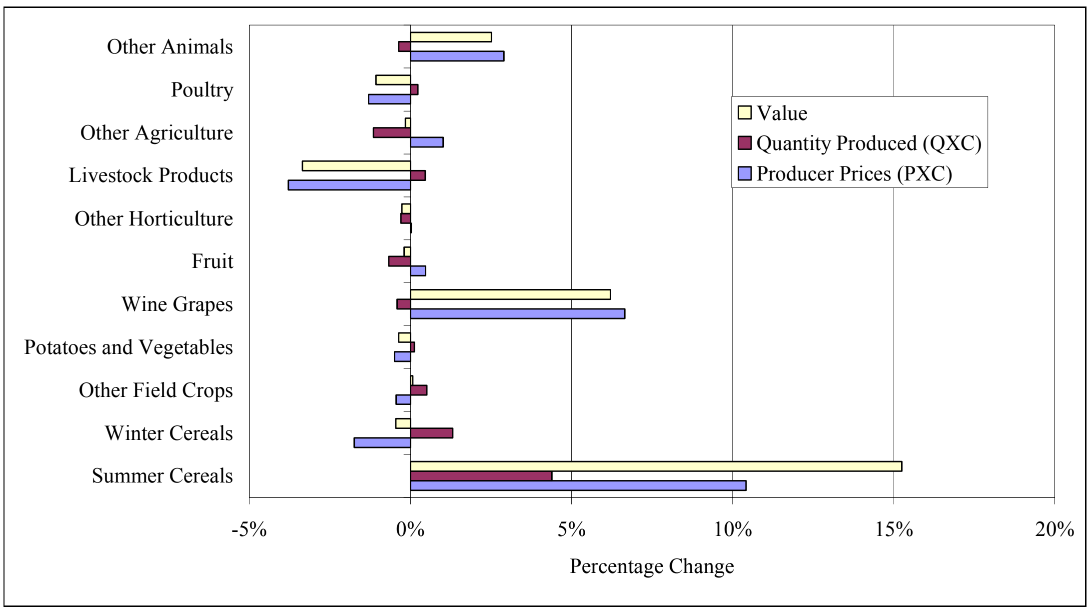
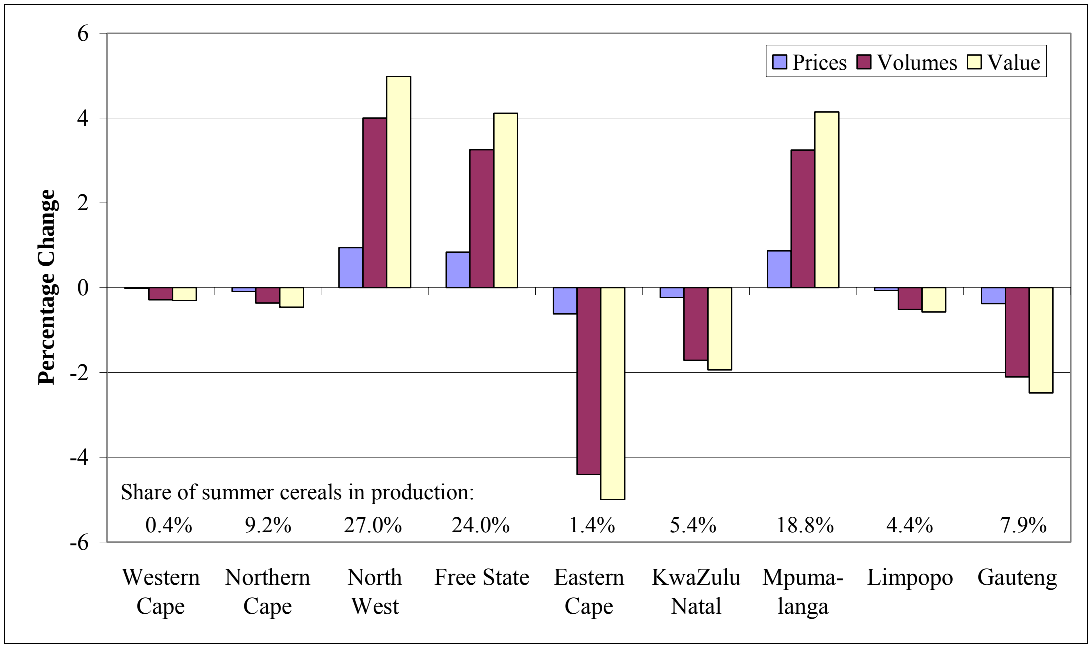


Figure 13 (summarising from Table 6) shows changes in value added for the provinces. The relative differences are driven by differences in the share of summer cereals in each province's output – the three provinces with a relatively high share shows increased prices, volumes and value, while the other provinces show declines of varying intensities. The two provinces most hurt are the Eastern Cape and KwaZulu Natal, with declines in value of 5.0% and 1.9% respectively, which in both cases is caused by the decline in livestock prices. The Northern Cape and Gauteng both experience declines despite a reasonable share of summer

[17] Agricultural regions are modelled as multi-product firms; hence there are complementarities in production of livestock and summer cereals if the same regions produce them.

cereals in their output, indicating that the benefit of increased prices of summer cereals are outweighed by decreased prices in other commodities that they produce, such as livestock.

Figure 13. World price simulation (+20%): Value added in agricultural activities



Food and other commodity prices

Food prices, especially for maize due to its role as staple, is a particular concern in South Africa, and there is a danger that an increase in world prices of maize will increase South African economic production but have a negative effect on the poor. As shown in Figure 15, aggregate food prices do increase, but only by 0.1%. This suggests that the poor may be worse off, even if their incomes increase by a small amount, following a world price increase of summer cereals. Real household expenditure results, which take into account price changes, are discussed in section 0.

However, there are significant differences between commodities, with grain mills products (consisting mainly of maize meal and wheat flour) increasing by 1.6% and meat products and dairy products decreasing by 0.9% and 0.6% respectively. The increase in the price of summer cereals directly explain the increase in grain mill product prices, which in turn explain the increases in prices of animal feeds and bakery products. The decrease in meat and dairy product prices are caused by the increase in supply of livestock (see section 0), while the increase in beverages and tobacco prices is similarly explained by the drop in supply of wine grapes. Changes in prices of intermediate input costs to food industries are shown in Figure 14.

Prices of other commodities are generally unaffected, but there are small increases for forestry and fishing, natural resources, industrial / manufactured goods, utilities and services. Agricultural commodity prices decline on average by 0.20%, in contrast to the aggregate of producer prices for agricultural commodities, which increase by 0.17%. The difference can be explained by the favourable terms of trade effect of increased export prices for summer cereals.

Figure 14. World price simulation (+20%): Intermediate input prices (*PINT*) to food industries

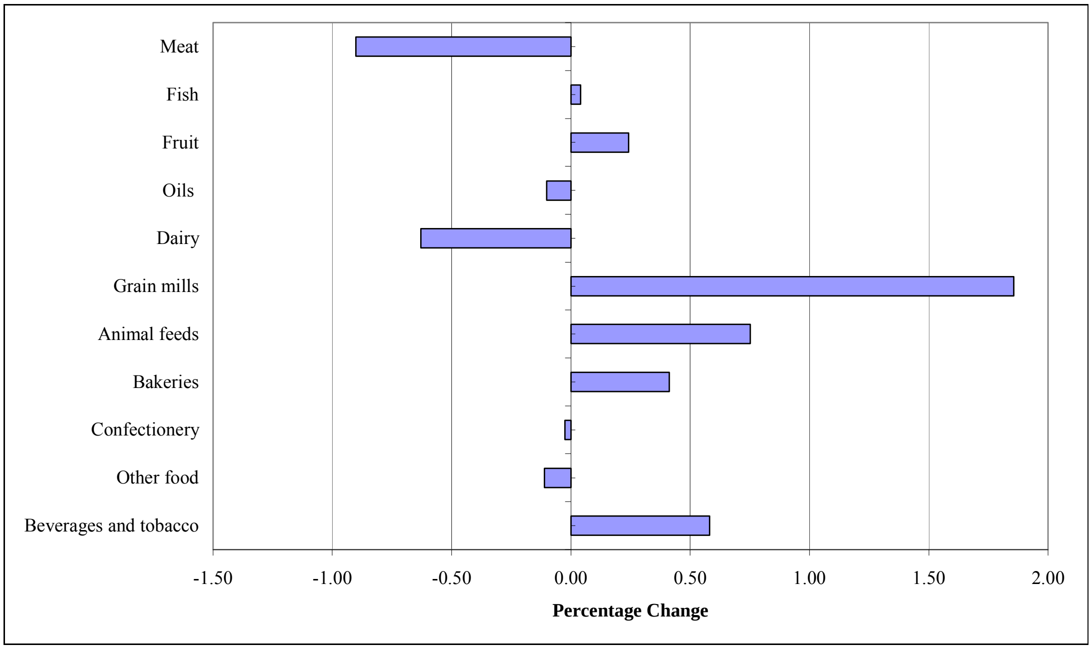
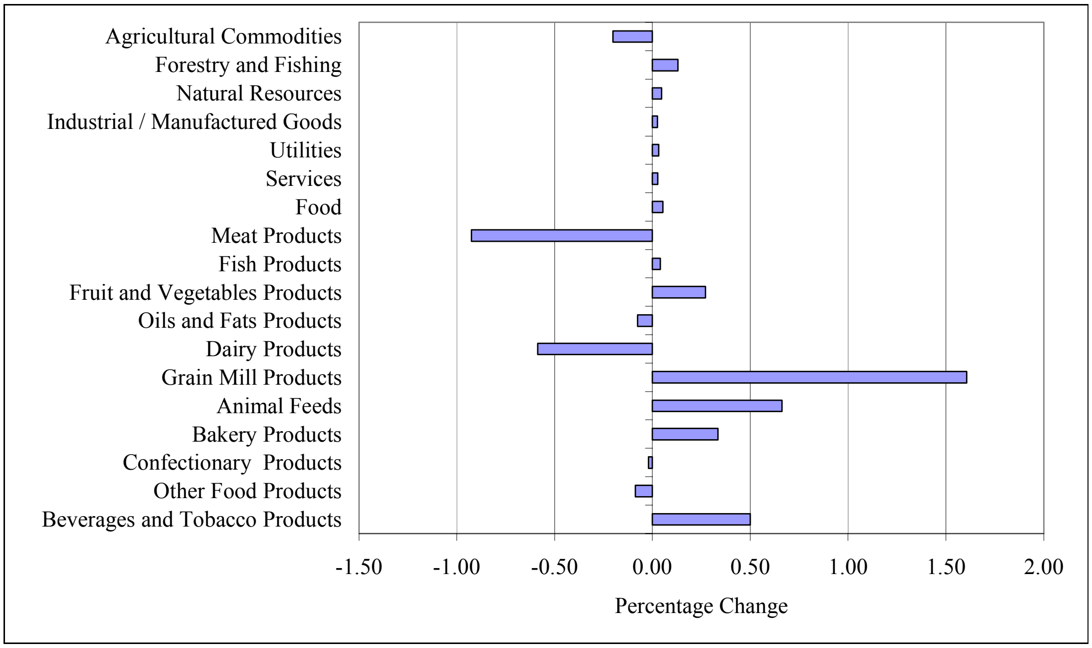


Figure 15. World price simulation (+20%): Commodity price effects (*PQD*) (including disaggregated food prices)



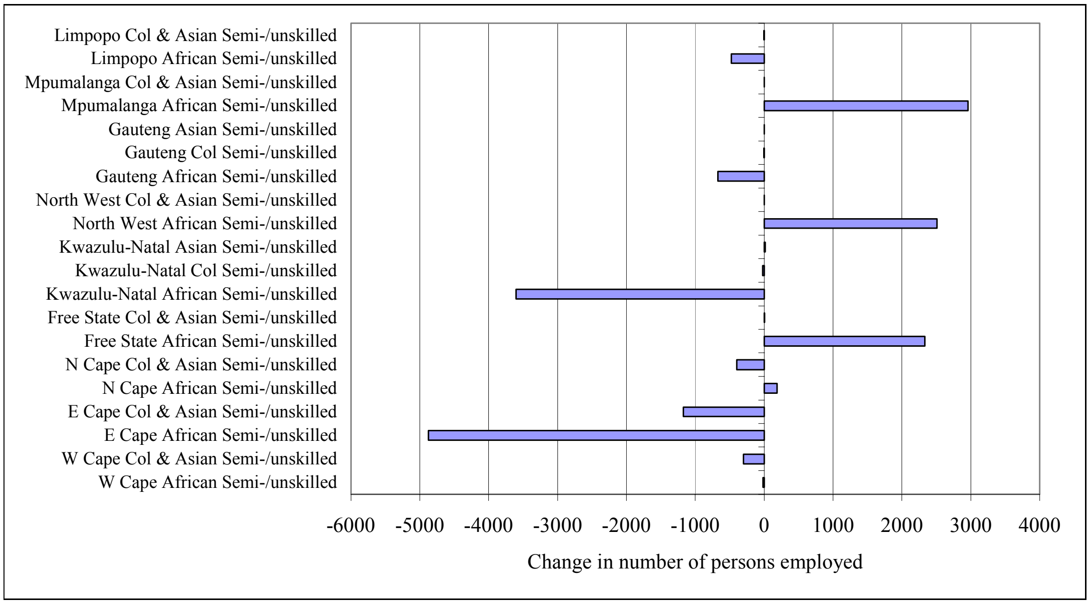
Labour employment and wages

The effects of a shock on the various labour categories depend largely on the effects on the activities that provide employment. According to the selected closures (see section 0), semi- and unskilled labour categories (except white) are modelled as unemployed by fixing their wages at base levels in nominal terms and allowing activities to vary their employment. The effects of an increase in the world price of summer cereals on employment can be seen in Figure 16. It appears as if agricultural employment effects are critical, as the employment largely follows the effects in the agricultural sectors of the various provinces (see Figure 13). The three provinces producing substantial amounts of summer cereals increase their employment, so that 2 959 jobs are created in Mpumalanga, 2 513 in North West and 2 340 in the Free State.

On the other hand, there are even stronger negative effects in the two provinces whose agricultural sectors are hurt, namely KwaZulu Natal, where 3 613 jobs are lost and Eastern Cape, where 6 049 jobs are lost. On the balance, there is a loss of 3 532 employment opportunities throughout the economy. While this is a very small figure (0.03% of employment) the result sounds a cautionary not against an overoptimistic appraisal of the benefits of an increase in summer cereals prices – while the effect on production and value added and hence income are positive, there is a net loss of jobs, which constitutes a substantial socioeconomic cost to be balanced against the benefits.

This negative result is caused by the fact that labour intensive processes are harmed against benefits to relatively less labour intensive processes. Specifically, it is dependent on the negative result in livestock producing regions, namely that they are harmed due to the increase in livestock supply in maize producing areas. Under the alternative short-term labour closure, the negative employment effect does not occur[18], because scarce factors (skilled labour and capital) are unable to exit the affected agricultural activities and the scarce factors need to be complemented by unskilled labour.

Figure 16. World price simulation (+20%): Employment (*FS*) effects



Changes in wages and wage incomes, shown for fully employed (in the model) factors in Figure 17 are larger than changes in employment, and hence have relatively greater (but still small) effects[19], albeit for a different subsection of the population. Again, the patterns generally mirror the effects on value added in activities (see Figure 13); but they seem to matter only for white workers (amongst the fully employed categories) to a significant extent – there is an increase in white wages in the Free State and North West provinces, and a decrease in wages for white workers in the Eastern Cape and KwaZulu Natal. This disparity is due to the fact that white fully employed workers include those categorised as semi- and unskilled, while other racial groups do not include them; these are instead included in groups with unemployment.

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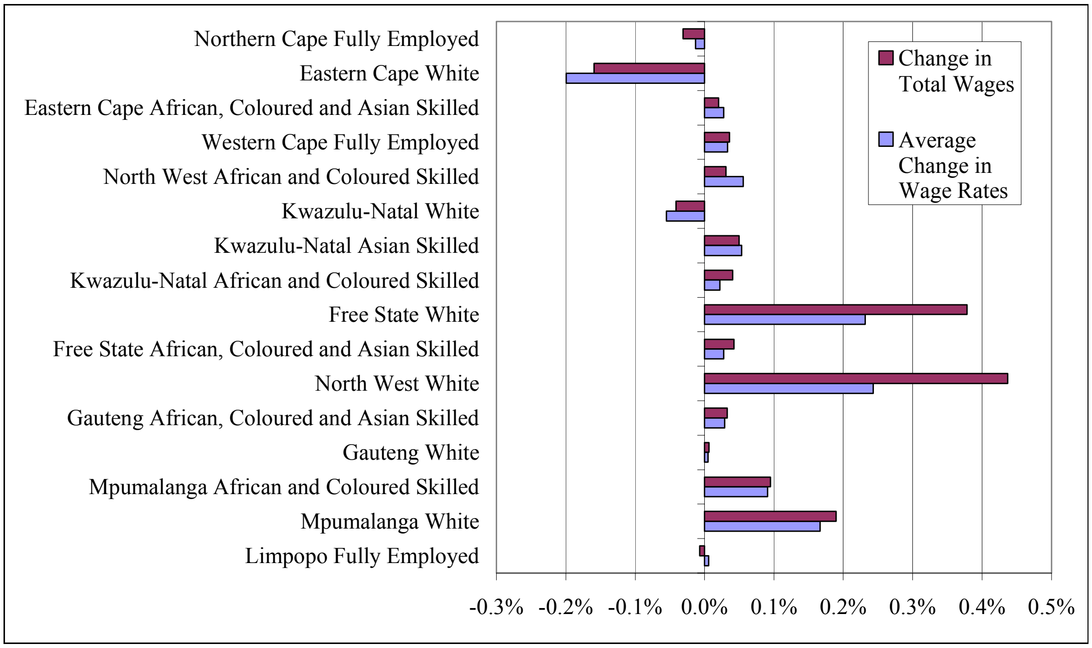
[18] In this case, there is a net gain in employment of 2816 workers.

[19] Changes are represented with individual workers as the basis of aggregation. Differences in wage rates and average wage income can occur because wage rates differ by activities, and (under the long-term closure) factors reallocate. In this case, white workers in the Free State and North West provinces experience a greater proportional increase in average wages than the average increase in wages, which is due to the fact that white workers are paid more in the farming sectors in these provinces when they relocate there from other activities.

Since these effects are driven by summer cereals and livestock markets respectively, the lack of matching effects for skilled African, coloured and Asian workers suggests that these workers are relatively unconnected to the farming sectors. The only exception is skilled African and coloured workers in Mpumalanga, where there is a subtantial increase in wages, though still less than for white workers.

Figure 17. World price simulation (+20%): Wage effects for fully employed workers

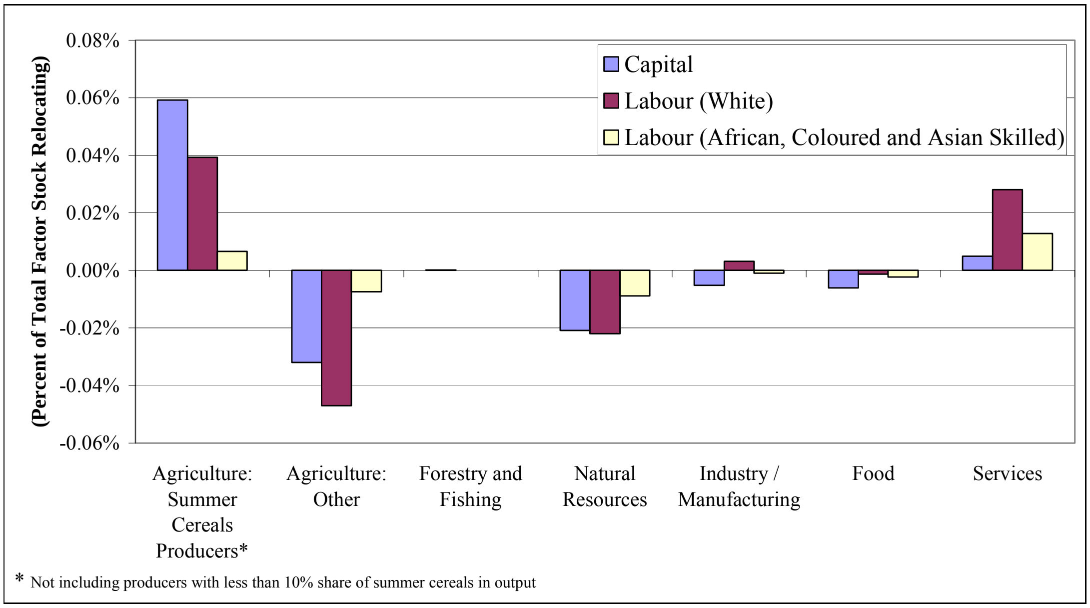


Factor reallocation

Under the long-term closure for which results are being reported, scarce (i.e. fully employed) factors are able to reallocate to follow changes in relative returns between sectors. Figure 18 shows these movements for aggregated categories of labour across the national economy. For scarce factors, the total factor stock is fixed, hence the changes over all activities sum to zero. The graph does not show relative increases from the perspective of an activity. For example, the movement of 0.01% of skilled African, coloured and Asian workers to summer cereals producers (incidentally representing 196 individuals) constitute an increase of 5.5% of this labour category for these activities.

The importance of this representation is to show that, for scarce factors, a gain in some activities necessarily implies a loss in others, for example the summer cereals producing agricultural regions draws capital away from other agricultural regions, and natural resources. Furthermore, it can be seen that disproportionally more of the total supply of white labour and capital are involved in reallocation (compared to skilled African, coloured and Asian skilled labour), reflecting the importance of these factors in the summer cereals producing activities.

Figure 18. World price simulation (+20%): Factor movements under long-term closure



Total factor income

Changes in unemployment, wages and factor allocations will change the total income accruing to a particular factor. Percentage changes in factor incomes are summarised in Table 7, which also contains additional aggregations and changes in the return to land and capital. The change in total factor income for all factors, an increase of 0.03%, matches that shown in Table 6.

Table 7. World price simulation (+20%): Percentage changes in factor incomes

Province	Labour				Land	Capital	Total
	White	African, coloured and Asian		Total			
		Unskilled	Skilled				
Western Cape	0.03	-0.01	0.04	0.02	-0.37		0.02
Northern Cape	-0.07	-0.15	0.04	-0.06	-0.68		-0.08
North West	0.43	0.19	0.03	0.18	7.08		0.27
Free State	0.37	-0.01	0.04	0.16	5.07		0.27
Eastern Cape	-0.16	-0.53	0.02	-0.17	-6.06		-0.21
KwaZulu-Natal	-0.04	-0.12	0.05	-0.03	-2.37		-0.05
Mpumalanga	0.19	0.22	0.09	0.17	6.03		0.29
Limpopo	-0.13	-0.04	0.04	-0.02	-0.70		-0.03
Gauteng	0.01	-0.05	0.05	0.00	-2.75		0.00
Undifferentiated						0.05	0.05
Total	0.03	-0.05	0.04	0.01	1.26	0.05	0.03

(foreign factor income excluded)

Returns to land change fairly substantially because land cannot be used for any other purpose than the specific type of agricultural production as are found in each region, hence land's return is intimately connected to the fortunes of the products that are produced on it. There are increases to the return to land in the three provinces where summer cereals production is important: North West (with an increase in the return to land of 7.08%), Free State (5.07%) and Mpumalanga (6.03%). Gauteng and the Northern Cape, despite also being summer cereals producers, experience a decline in return to land, indicating that other outputs of these provinces, notably livestock, are harmed. The Eastern Cape and KwaZulu Natal experience decreases in returns to land of 6.06% and 2.37% respectively.

The return to capital in the economy increases by 0.05%, while white and skilled African, coloured and Asian labour's incomes also increase by 0.03% and 0.04% respectively. However, there is a decrease in the income earned by unskilled African, coloured and Asian labour of 0.05%, which corresponds with the disappointing employment effects shown above (see Figure 16). The combination of these effects suggests that the poorest households may not actually benefit from an increase in the world price of summer cereals, a notion that we can now directly examine by looking at household income effects.

Household income and expenditure

A population-weighted average[20] of changes in nominal income, nominal consumption expenditure and real consumption expenditure is shown in Figure 19 for a number of household group aggregates, as well as an aggregate for all households combined. The results are in effect a summary of the factor income results above, also accounting for tax and savings (in the case of expenditure) and price changes (in the case of real consumption expenditure).

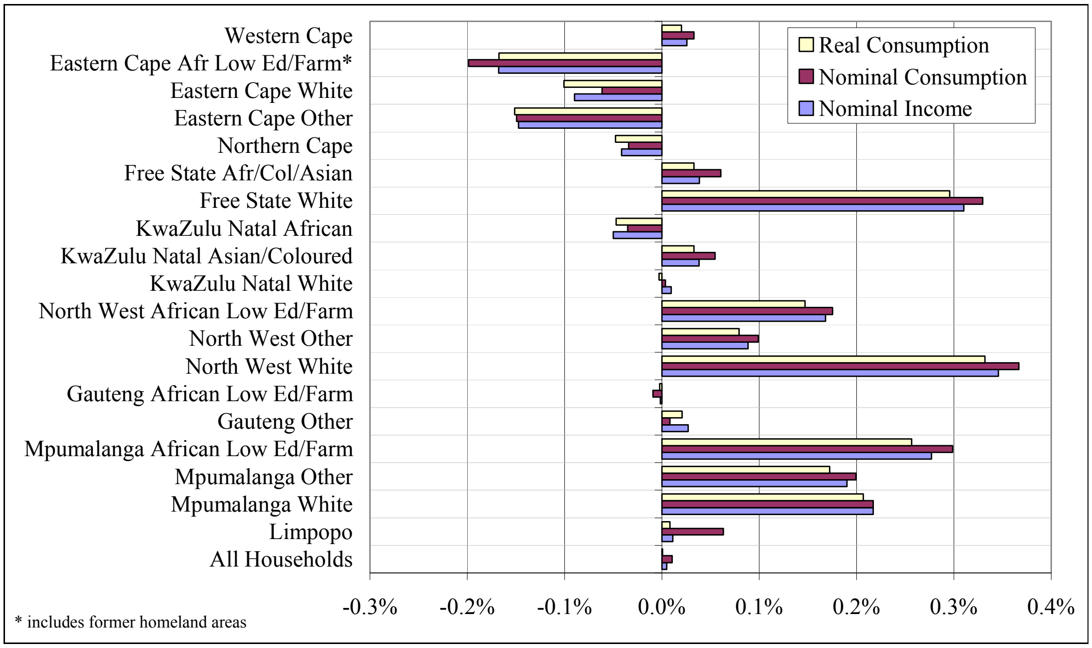
White households in the summer cereals producing regions show substantial increases, mainly indicating the combined effects of increased labour, capital and land income involved in agriculture. Other households in the Free State and North West also benefit, though not to the same extent. In Mpumalanga, however, gains are enjoyed in near equal measures by all groups.

In KwaZulu Natal and the Eastern Cape, interestingly, white households are relatively less negatively affected than might be expected following changes in wages (see Figure 17). This is most likely due to their increased income from capital and non-agricultural labour (which earn income in the entire economy, not just in households' home provinces) offsetting losses in wage incomes as a result of the effects in livestock producing areas. African households'

[20] An alternative weighting scheme, namely by base value of expenditure, could tend to concentrate the results to those of the most affluent households. However, a comparison between the results from the alternative weighting schemes does not show any significant difference.

incomes decrease on the other hand, again in contrast to simple wage effects, this time as a result of decreased land income.

Figure 19. World price simulation (+20%): Average changes in per-capita household income and consumption expenditures



* includes former homeland areas.

Inter-household[21] price effects (indicated by the differences between real and nominal consumption expenditures) are mostly minor. On average, households do not experience any significant change in either real consumption expenditure or nominal incomes, though there is a small increase in nominal consumption. The change in total nominal and real household expenditure for the whole economy, if weighted by expenditure and therefore equal to each other since the overall CPI is fixed, is positive at 0.3%. From these facts can be deduced that both price and income changes are slightly biased to the detriment of poorer households.

The fact that average nominal income increases by less than average nominal consumption indicates a slight benefit of fiscal policy under the neutral closure towards poorer households. Some of the gains to more affluent households are therefore also shared with less affluent households via the tax system.

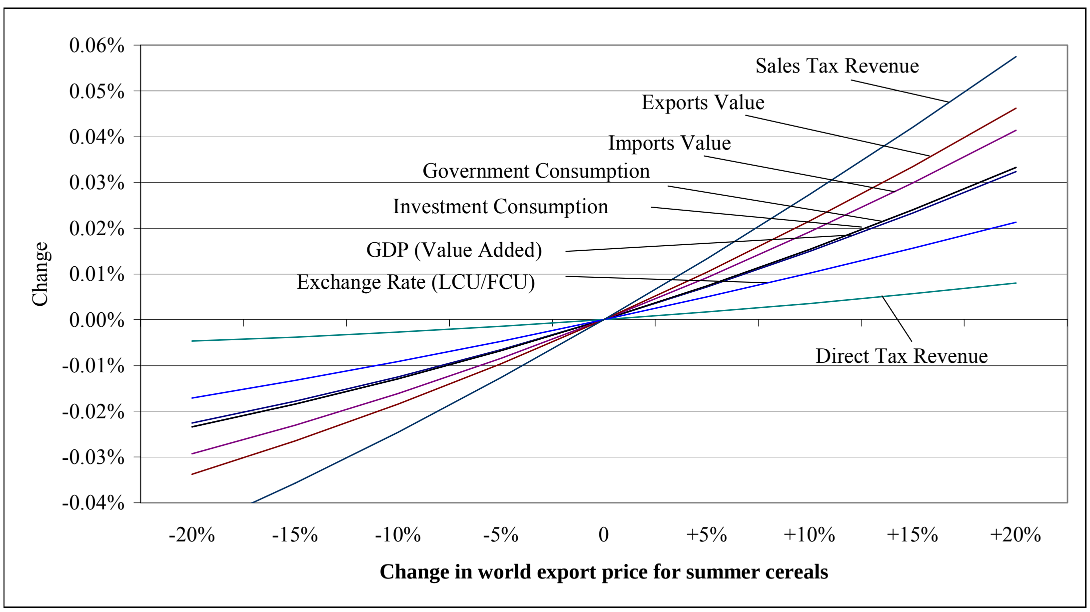
[21] Recall that the economy-wide CPI is held fixed, hence there is no overall inflationary effect, such influences would enter though changes in nominal income, which is therefore already "real" in the sense that it measures income adjusted for economy-wide (consumer) inflation. They are still nominal in the sense that household-specific price effect adjustments have not been made.

Government and macroeconomic results

The effect of changes in world prices of summer cereals on a number of government and macroeconomic variables are shown in Figure 20. At the 20% increase in world price of summer cereals simulation, the gross domestic product (GDP) increases by 0.03%, which matches the total value added effect shown in section 0. Total investment and government consumption expenditures increase by a similar amount, due to the closure rules that the shares of these in total final demand must be constant. The government revenue increase (necessitated by the increased consumption expenditure) is made up by a relatively large increase in sales tax revenue (0.06%) at constant rates and direct tax revenue (0.01%), the latter varying to balance the government finance equation (recall that the level of government dissavings is held constant).

The improvement in the terms of trade also leads to marginally increased trade relative to GDP (both imports and export values increase by more than GDP) and there is a small (0.01%) appreciation. Despite the immediate increase in export demand for summer cereals, there is a depreciation of the exchange rate, indicating that in this case secondary production and consumption effects on trade outweigh the primary effect (see section 12.2 below for further discussion). It should be appreciated that the macro and government effects are very small, with less than 0.1 of a percentage point of change in any of the variables.

Figure 20. World price simulation (+20%): Government and Macroeconomic effects



7. Conclusion

The analyses reported in this paper have evaluated trade-related policies that could affect the welfare of maize farmers in terms of effects that such policies could have on the whole economy. Two policies, namely an increase in the rate of import tariff protection on summer cereals and an increase in world prices of summer cereals (e.g. as a result of participation in trade negotiations with countries that subsidise their production) were evaluated.

Under the assumption that current conditions (of more-than-adequate domestic production) prevail, import tariffs are shown to have effects bordering on the insignificant. Decisions on import protection would therefore have to be taken in the light of projected effects under alternative scenarios, for example droughts and/or dramatic world price decreases.

As opposed to the case of the tariff adjustment, the change in world prices of summer cereals does have substantive effects on the South African, though the effects are still small in terms of the entire economy. There are serious implications for agricultural regions that are summer cereals producers, and also for regions that produce livestock, since livestock markets are affected indirectly through an increase in the supply of livestock from summer cereals producing regions. Further strong effects enter through price increases of intermediate inputs (particularly affecting food industries) and resource reallocation, which negatively impacts on natural resource sectors.

While it seems logical that terms of trade effects such as this would be to the economy's benefit, and the results indeed indicate a 0.03% increase in GDP and total nominal income, the results presented draw this simple assessment into question by showing relatively strong adverse effects in addition to the direct benefits. Food price increases, often thought to be crucial, is shown to be of little importance for the aggregate households in the model. However, shifts in factor incomes brought about by the changes in the productive sectors tend to benefit mostly high-income white households (those involved in summer cereals farming) and hurt poorer segments of the populations in the Eastern Cape and KwaZulu Natal. These effects show that the enduring effects of the patterns of ownership of scarce resources (land, capital and skills) can cause unexpected economic reactions to external shocks, which may call for adjustment measures.

Furthermore, despite the negative effects on certain segments of the population, a liberalisation of international trade is not necessarily undesirable. Firstly, the overall effects are not negative per se, for example there is an increase in total nominal (but at constant CPI) income to households, and also on average no decrease in household income (using population weighting of changes in income). Secondly, as the results have shown, the changes also tend to put more tax revenue in government's purse, which could be used to ameliorate the negative effects. Thirdly, the results shown are necessarily sensitive to the nature and specifics of the model used, for example the complementarities in summer cereals and livestock production may be overstated, and technology, ownership and investment in the economy (all fixed in the current model) may adjust favourably over time to the new circumstances.

The value of the modeling approach is therefore, in this case, to question overly simplistic trade theoretic conclusions that would predict clear benefits to a terms of trade improvement, to provide details on expected resource movements and to actively identify sections of the population that will benefit and that will be harmed by the changes. The fact that the entire economy is modelled also serves to place the expected effects into perspective, for example it is obvious from the results that the economy-at-large is unlikely to be severely affected by even large shocks to maize producing sectors, and food price effects may be less important than income effects even for the poor, who spend large shares of their incomes thereon.

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9. Appendix A: SAM Accounts

This section contains a complete listing of SAM accounts used in the model for this study, organised by type.

Commodities: Agriculture

1. Summer cereals
2. Winter cereals
3. Other field crops
4. Potatoes and vegetables
5. Wine grapes
6. Fruit
7. Other horticulture
8. Livestock products
9. Other agriculture
10. Poultry
11. Other animals

Commodities: Food

12. Meat products
13. Fish products
14. Fruit and vegetables products
15. Oils and fats products
16. Dairy products
17. Grain mill products
18. Animal feeds
19. Bakery products
20. Confectionary products
21. Other food products
22. Beverages and tobacco products

Commodities: Other

23. Forestry and fishing
24. Coal and lignite products
25. Gold and uranium ore products
26. Crude oil products
27. Other mining products
28. Textile products
29. Wood paper media products
30. Petroleum products
31. Other chemical products
32. Fertilizers
33. Pesticides
34. Rubber plastic products
35. Non-metallic products
36. Iron and steel products
37. Agricultural machinery
38. Special purpose machinery
39. Electrical products
40. Audiovisual products
41. Transport products
42. Other manufacturing
43. Electricity and water
44. Construction
45. Trade and accommodation
46. Transport services
47. Communications
48. Business services
49. Government health social
50. Other services and activities
51. Domestic service

Activities: Agriculture

52. Western Cape Agriculture
53. NC Victoria West Karoo
54. NC De Aar Karoo
55. NC Carnarvon Karoo
56. NC Frances Baard
57. Northern Cape Other
58. NW Vryburg
59. NW Potchefstroom District
60. NW Klerksdorp
61. NW Rustenburg District
62. NW Marico
63. FS West Xhariep
64. FS Bloemfontein
65. FS East Xhariep
66. FS Goudveld
67. FS Bothaville District
68. FS Thabo Mofutsanyane
69. FS Southern Free State
70. FS Sasolburg
71. Eastern Cape Agriculture
72. KwaZulu Natal Agriculture
73. MP Mpumalanga East Rand
74. MP Witbank District
75. MP Govan Mbeki
76. Mpumalanga Other
77. Limpopo Agriculture
78. GT South Ekhurhuleni
79. GT Cullinan District
80. GT Sedibeng
81. Gauteng Other

Activities: Other

82. Forestry and fishing
83. Coal
84. Gold
85. Other mining
86. Meat
87. Fish
88. Fruit
89. Oils
90. Dairy
91. Grain mills

92. Animal feeds
93. Bakeries
94. Confectionery
95. Other food
96. Beverages and tobacco
97. Textiles
98. Wood paper media
99. Petroleum
100. Other Chemicals
101. Fertilizers
102. Pesticides
103. Rubber plastic
104. Non-metallic
105. Iron and steel
106. Agricultural machinery
107. Special purpose machinery
108. Electrical
109. Audiovisual
110. Transport equipment
111. Other manufacturing
112. Electricity water
113. Construction
114. Trade and accommodation
115. Transport services
116. Communication
117. Business services
118. Government health social
119. Other Activities and services
120. Domestic services

Households

121. African Lower Secondary and lower
122. Western Cape African Upper Secondary and higher
123. Western Cape Asian and Coloured Lower Secondary and lower
124. Western Cape Asian and Coloured Upper Secondary and higher
125. Western Cape White Lower Secondary and lower
126. Western Cape White Upper Secondary
127. Western Cape White Tertiary
128. Eastern Cape African Agricultural
129. Eastern Cape African Homeland Lower Secondary and lower
130. Eastern Cape African Homeland Upper Secondary and higher
131. Eastern Cape African Non-Homeland Lower Secondary and lower
132. Eastern Cape African Non-Homeland Male Upper Secondary and higher
133. Eastern Cape Asian and Coloured Lower Secondary and lower
134. Eastern Cape Asian and Coloured Upper Secondary and higher
135. Eastern Cape White Lower Secondary and lower
136. Eastern Cape White Upper Secondary
137. Eastern Cape White Tertiary
138. Northern Cape African Primary and lower
139. Northern Cape African Lower Secondary and higher
140. Northern Cape Coloured and Asian Lower Secondary and lower
141. Northern Cape Coloured and Asian Upper Secondary and higher
142. Northern Cape White
143. Free State African Agricultural
144. Free State African Lower Secondary and lower
145. Free State African Upper Secondary and higher
146. Free State Asian and Coloured
147. Free State White Lower Secondary and lower
148. Free State White Upper Secondary
149. Free State White Tertiary
150. Kwazulu-Natal African Agricultural
151. Kwazulu-Natal African Lower Secondary and lower
152. Kwazulu-Natal African Upper Secondary and higher
153. Kwazulu-Natal Asian Lower Secondary and lower
154. Kwazulu-Natal Asian Upper Secondary and higher
155. Kwazulu-Natal Coloured
156. Kwazulu-Natal White Lower Secondary and lower
157. Kwazulu-Natal White Upper Secondary
158. Kwazulu-Natal White Tertiary
159. North West African Agricultural
160. North West African Lower Secondary and lower
161. North West African Upper Secondary and higher and higher
162. North West Asian and Coloured
163. North West White Lower Secondary and lower
164. North West White Upper Secondary and higher
165. Gauteng African Agricultural
166. Gauteng African Lower Secondary and lower
167. Gauteng African Upper Secondary and higher
168. Gauteng Coloured Lower Secondary and lower
169. Gauteng Coloured Upper Secondary and higher
170. Gauteng Asian Lower Secondary and lower
171. Gauteng Asian Upper Secondary and higher
172. Gauteng White Lower Secondary and lower
173. Gauteng White Upper Secondary
174. Gauteng White Tertiary
175. Mpumalanga African Agricultural
176. Mpumalanga African Lower Secondary and lower
177. Mpumalanga African Upper Secondary and higher
178. Mpumalanga Asian and Coloured
179. Mpumalanga White
180. Limpopo African Agricultural
181. Limpopo African Lower Secondary and lower
182. Limpopo African Upper Secondary and higher

183. Limpopo Asian and Coloured
184. Limpopo White

Factors: Labour (Fully Employed)

185. Western Cape African High-skilled and Skilled
186. Western Cape Coloured and Asian Skilled
187. Western Cape White High-skilled and skilled
188. Western Cape White Semi- and Unskilled
189. Eastern Cape African High-skilled and skilled
190. Eastern Cape Coloured and Asian High-skilled and Skilled
191. Eastern Cape White High-skilled and skilled
192. Eastern Cape White Semi- and Unskilled
193. Northern Cape African High-skilled and Skilled
194. Northern Cape Coloured and Asian High-skilled and Skilled
195. Northern Cape White High-skilled and Skilled
196. Northern Cape White Semi- and Unskilled
197. Free State African High-skilled and Skilled
198. Free State Coloured and Asian High-skilled and Skilled
199. Free State White High-skilled and Skilled
200. Free State White Semi- and Unskilled
201. Kwazulu-Natal African High-skilled and skilled
202. Kwazulu-Natal Coloured High-skilled and Skilled
203. Kwazulu-Natal Asian High-skilled and Skilled
204. Kwazulu-Natal White High-skilled and Skilled
205. Kwazulu-Natal White Semi- and Unskilled
206. North West African High-skilled and Skilled
207. North West Coloured and Asian High-skilled and Skilled
208. North West White High-skilled and Skilled
209. North West White Semi- and Unskilled
210. Gauteng African High-skilled and skilled
211. Gauteng Coloured High-skilled and Skilled
212. Gauteng Asian High-skilled and Skilled
213. Gauteng White High-skilled and skilled
214. Gauteng White Semi- and Unskilled
215. Mpumalanga African High-skilled and skilled
216. Mpumalanga Coloured and Asian High-skilled and Skilled
217. Mpumalanga White High-skilled and Skilled
218. Mpumalanga White Semi- and Unskilled
219. Limpopo African High-skilled and skilled
220. Limpopo Coloured and Asian High-skilled and Skilled
221. Limpopo White High-skilled and Skilled
222. Limpopo White Semi- and Unskilled

Factors: Labour (Partly Unemployed)

223. Western Cape African Semi- and unskilled
224. Western Cape Coloured and Asian Semi- and unskilled
225. Eastern Cape African Semi- and unskilled
226. Eastern Cape Coloured and Asian Semi- and Unskilled
227. Northern Cape African Semi- and Unskilled
228. Northern Cape Coloured and Asian Semi- and Unskilled
229. Free State African Semi- and unskilled
230. Free State Coloured and Asian Semi- and Unskilled
231. Kwazulu-Natal African Semi- and Unskilled
232. Kwazulu-Natal Coloured Semi- and Unskilled
233. Kwazulu-Natal Asian Semi- and Unskilled
234. North West African Semi- and unskilled
235. North West Coloured and Asian Semi- and Unskilled
236. Gauteng African Semi- and Unskilled
237. Gauteng Coloured Semi- and Unskilled
238. Gauteng Asian Semi- and Unskilled
239. Mpumalanga African Semi-skilled
240. Mpumalanga African Unskilled
241. Mpumalanga Coloured and Asian Semi- and Unskilled
242. Limpopo African Semi- unskilled
243. Limpopo Coloured and Asian Semi- and Unskilled

Factors: Other

244. Gross operating surplus mixed income (capital)
245. Western Cape Land
246. Northern Cape Land
247. North West Land
248. Free State Land
249. Eastern Cape Land
250. KwaZulu-Natal Land
251. Mpumalanga Land
252. Limpopo Land
253. Gauteng Land

Trade and Transport Margins

254. Transport margin
255. Trade Margin

Tax Accounts

256. Import duties (IMPTAX)
257. Production rebates (INDREF)
258. Production taxes (INDTAX)
259. Production subsidies (INDSUB)
260. Value added taxes in imports (VATM)
261. Value added taxes on domestic goods (VATD)
262. Sales subsidies (SALSUB)
263. Excise duty (ECTAX)

Other Accounts

264. Enterprises
265. Government
266. Savings
267. Stock Changes

268. Rest of World
269. Account Totals

10. Appendix B: Agricultural Regions

SAM Region	Magisterial Districts
NC Victoria West Karoo	Fraserburg, Victoria, West
NC De Aar Karoo	Hopetown, Britstown, De, Aar, Philipstown, Richmond, Hanover, Colesberg, Noupoort
NC Carnarvon Karoo	Prieska, Carnarvon
NC Frances Baard	Herbert, Barkly, West, Warrenton, Hartswater
NW Vryburg	Vryburg
NW Potchefstroom District	Potchefstroom, Ventersdorp, Coligny, Koster, Lichtenburg, Delareyville, Wolmaransstad, Schweizer-Reneke, Bloemhof, Christiana
NW Klerksdorp	Klerksdorp
NW Rustenburg District	Rustenburg, Brits
NW Marico	Marico, Swartruggens
FS West Xhariep	Boshof, Fauresmith, Jacobsdal, Koffiefontein, Petrusburg
FS Bloemfontein	Bloemfontein, Botshabelo
FS East Xhariep	Bethulie, Rouxville, Smithfield, Zastron
FS Goudveld	Odendaalsrus, Welkom, Virginia
FS Bothaville District	Kroonstad, Ventersburg, Hennenman, Parys, Vredefort, Koppies, Heilbron, Viljoenskroon, Bothaville, Wesselsbron, Hoopstad, Bultfontein, Theunissen
FS Thabo Mofutsanyane	Bethlehem, Harrismith, Vrede, Frankfort, Reitz, Lindley, Senekal, Fouriesburg, Ficksburg
FS Southern Free State	Brandfort, Winburg, Marquard, Clocolan, Excelsior, Ladybrand, Wepener, Dewetsdorp, Reddersburg, Edenburg, Trompsburg, Jagersfontein, Philippolis
FS Sasolburg	Sasolburg
MP Mpumalanga East Rand	Highveld, Ridge, Balfour, Kriel, Delmas
MP Witbank District	Witbank, Middelburg
MP Govan Mbeki	Bethal, Standerton, Volksrust, Carolina
GT South Ekhurhuleni	Brakpan, Springs, Nigel, Heidelberg
GT Cullinan District	Bronkhorstspruit, Cullinan
GT Sedibeng	Vereeniging, Vanderbijlpark

11. Appendix C: Domestic Summer Cereals Production

Province	SAM Region	Value of Summer Cereals Production (R million)	Share of Region's Production in Domestic Summer Cereals Production	Summer Cereals Share in Region's Production
Western Cape		46.37	0.8%	0.4%
Northern Cape		399.49	6.8%	9.4%
	NC Victoria West Karoo	0.00	0.0%	0.0%
	NC De Aar Karoo	88.42	1.5%	16.0%
	NC Carnarvon Karoo	42.94	0.7%	16.9%
	NC Frances Baard	188.14	3.2%	19.4%
	Northern Cape Other	79.99	1.4%	3.4%
North West		1 411.74	24.1%	27.2%
	NW Vryburg	181.55	3.1%	27.6%
	NW Potchefstroom District	1 095.11	18.7%	38.0%
	NW Klerksdorp	81.22	1.4%	38.4%
	NW Rustenburg District	10.82	0.2%	0.9%
	NW Marico	43.04	0.7%	24.4%
Free State		1 903.69	32.6%	24.2%
	FS West Xhariep	117.99	2.0%	16.8%
	FS Bloemfontein	32.97	0.6%	12.5%
	FS East Xhariep	3.83	0.1%	2.3%
	FS Goudveld	111.42	1.9%	43.2%
	FS Bothaville District	963.61	16.5%	34.1%
	FS Thabo Mofutsanyane	480.65	8.2%	19.2%
	FS Southern Free State	135.05	2.3%	13.4%
	FS Sasolburg	58.18	1.0%	47.4%
Eastern Cape		52.09	0.9%	1.4%
KwaZulu Natal		339.98	5.8%	5.4%
Mpumalanga		1 168.26	20.0%	19.0%
	MP Mpumalanga East Rand	236.83	4.1%	43.2%
	MP Witbank District	366.20	6.3%	34.2%
	MP Govan Mbeki	486.78	8.3%	25.4%
	Mpumalanga Other	78.44	1.3%	3.0%
Limpopo		234.94	4.0%	4.4%
Gauteng		290.31	5.0%	7.9%
	GT South Ekhurhuleni	105.47	1.8%	16.5%
	GT Cullinan District	83.85	1.4%	12.1%
	GT Sedibeng	43.19	0.7%	14.8%
	Gauteng Other	57.79	1.0%	2.8%
TOTAL		5 846.87	100.0%	10.8%

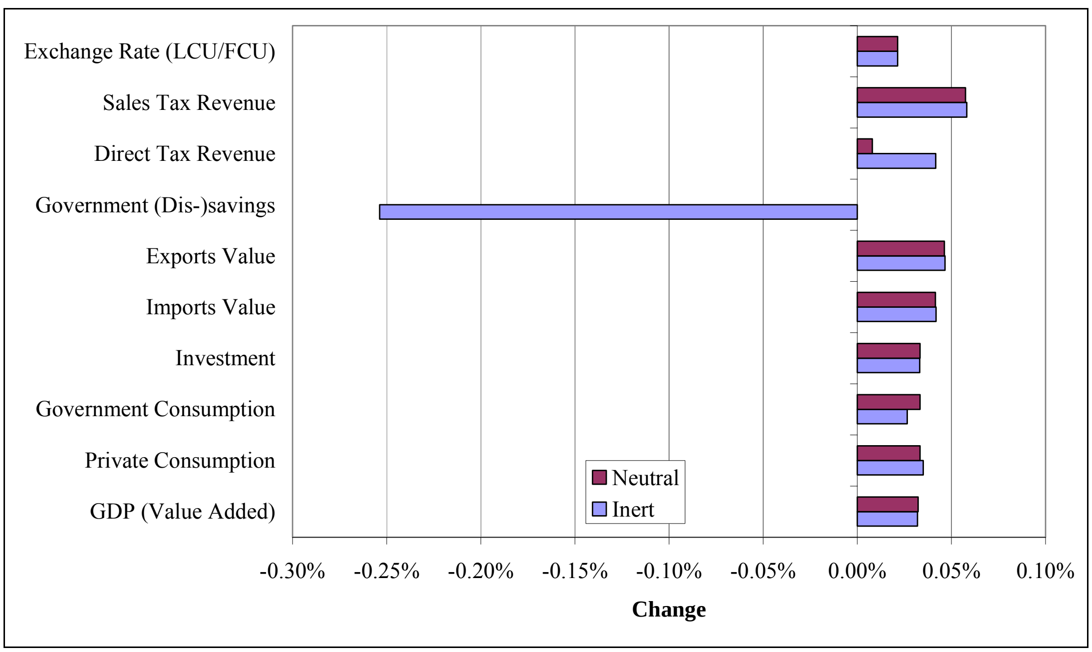
12. Appendix D: Results for alternative closures

12.1. An alternative government closure

Up to now, an assumption of a particular government policy response has been maintained under the "neutral" closure, namely that government acts to maintain its relative role in the economy (see section 0). The neutral closure has certain desirable properties, but it may not necessarily be realistic, hence it is important to compare the results to feasible alternatives.

The alternative government closure investigated in this study is an "inert" policy, where government consumption volumes and tax rates are held constant and the deficit is left floating to balance the fiscal equation. A number of results are shown in Figure 21, and they indicate that there are no remarkable differences between the two closures except for the drop in the deficit of 0.25% under the inert closure (discussed below). The fact that government consumption does not differ significantly whether government consumption volumes are fixed (inert) or government consumption as a share of total final demand (neutral) indicates that most of the changes under the neutral closure is driven by price changes. In this sense then, the results reported thus far are robust with respect to such a change in government consumption behaviour.

Figure 21. World price simulation (+20%): Alternative government closures compared

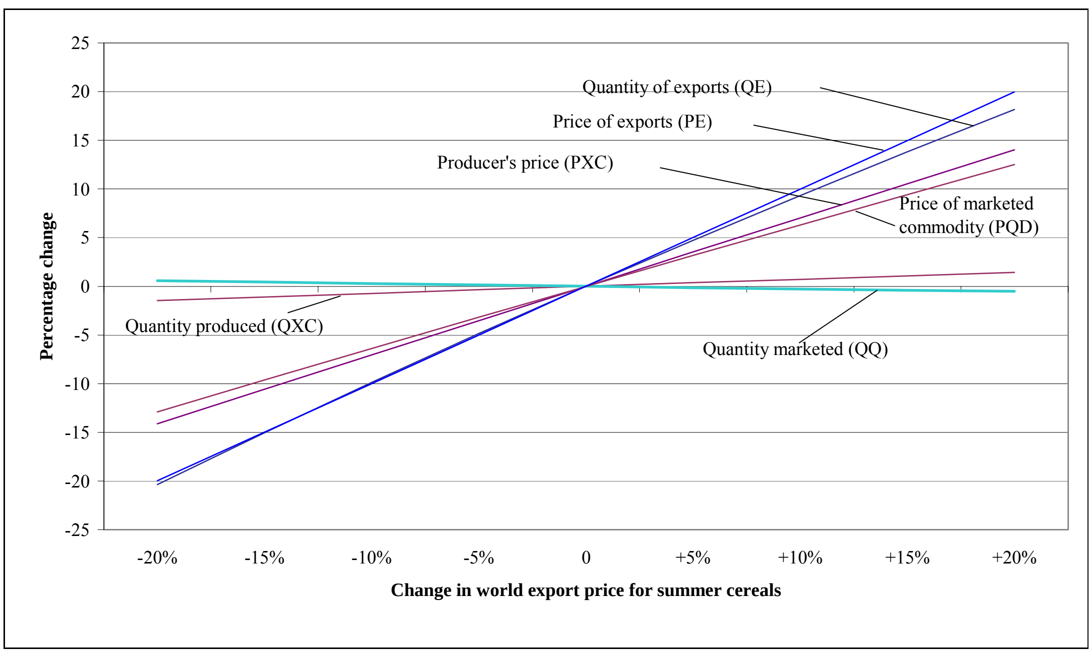


The differences in direct tax revenue and government dissavings are more apparent. Under the neutral closure, direct tax rates are lowered a little while under the inert closure the deficit decreases instead. This suggests that changes in the economy as a result of the shock tends to increase tax revenue (also relative to the economy) at constant tax rates[22], and the differences in the results relate to how this "additional revenue" is treated; under the neutral closure the additional revenue is returned to taxpayers, thereby benefiting taxpaying households, while under the inert closure the additional revenue is used to reduce the fiscal deficit. However, these differences are too small to make a noticeable impact on the pattern of household expenditures (e.g. Figure 19), hence no further reporting of results for the inert closure will be done.

12.2. The short run

In the short run, scarce labour and capital factors are unable to relocate between sectors, hence it is to be expected that supply will be even more inelastic, as only unskilled labour and intermediate inputs can now be hired to increase output. When the world price is increased therefore, there would be a sharper price increase than under the long run closure. The results, shown in Figure 22, indeed indicate that a lower output quantity response (1.4% for the case of a 20% increase in the world price, versus 4.4% in the long run scenario) is responsible for a sharper final market price effect (a 12.5% increase versus 8.3%).

Figure 22. World price simulation (short run): Price and quantity effects for summer cereals



In the short run, scarce labour and capital are held fixed, hence only intermediate inputs and those unskilled labour factors that are not fully employed can be increased in summer ce-

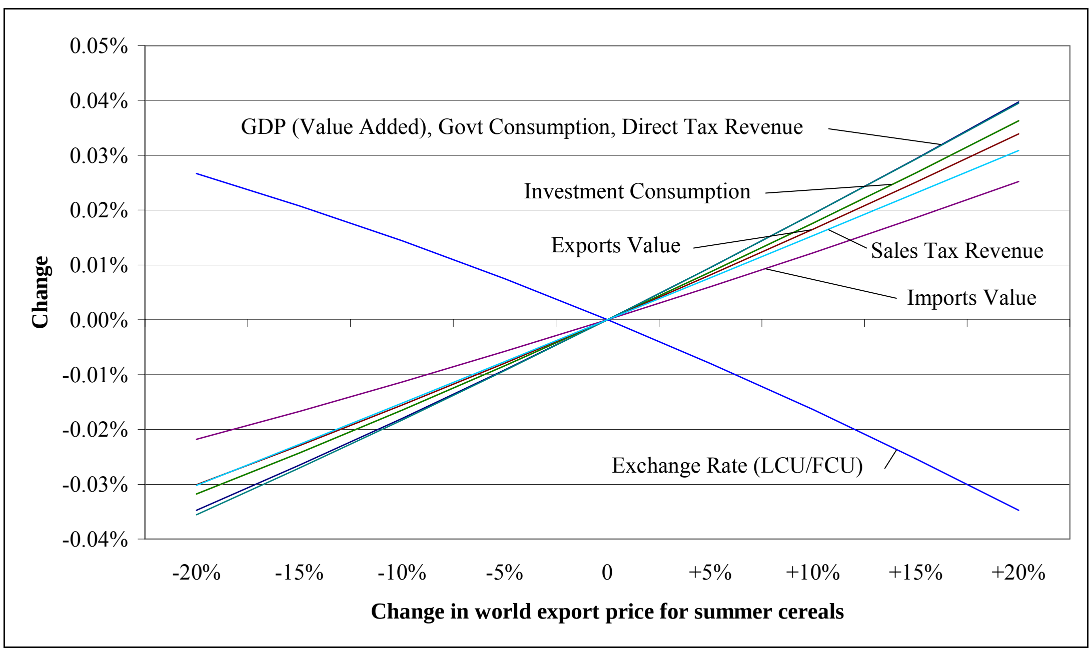
[22] The increase in income to white households in summer cereals producing regions partially explains this.

reals production. These increase by 2.1% and 3.9% respectively when world prices increase by 20%, which is less than for the long run (4.7% and 4.2% respectively), as the marginal productivity of these inputs declines faster when they are not complemented by increased amounts of capital and scarce/skilled labour.

As a result of the lower elasticity of supply in the short run, there is a greater incentive to substitute exports for domestically marketed summer cereals, hence there is a slight decrease in the quantity sold domestically (0.5% for a 20% increase in world prices). As in the case of the long run, the low demand elasticity results in a higher value of domestically sold summer cereals, which, combined with the increase in export value results in an increase in producer value of R1 021.9 million (15.6%).

Changes in government and macroeconomic variables, again very small, are shown in Figure 23. While most of the effects are very similar to those under the long-run solution, the exchange rate shows a small appreciation this time. This suggests that the depreciation seen under the long-run closure is caused by production rather than consumption effects (production is more directly affected by resource reallocations than consumption). For example, the decrease in resources devoted to natural resource production under the long-term closure is likely to cause downwards pressure on the exchange rate.

Figure 23. World price simulation (short run): Government and Macroeconomic effects



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