ANALYSIS OF EXPORT AND EMPLOYMENT OPPORTUNITIES FOR THE SOUTH AFRICAN MANUFACTURING INDUSTRY

Mr. Johan Malan

Email: johan.malan@nwu.ac.za
Tel: + 27 73 143 2073

Dr. Ermie Annelies Steenkamp *(corresponding author)*

Email: ermie.steenkamp@nwu.ac.za
Tel: + 27 18 299 1479
Fax: +27 18 299 1398

Prof. Riaan Rossouw

Email: riaan.rossouw@nwu.ac.za
Tel: + 27 18 299 1437
Fax: + 27 18 299 1398

Prof. Wilma Viviers

Email: wilma.viviers@nwu.ac.za
Tel: + 27 18 299 1445
Fax: + 27 87 231 5540

All the authors are affiliated to:

TRADE (Trade and Development) research niche area
North-West University (Potchefstroom Campus)
Private Bag X6001, Potchefstroom 2520, South Africa

TABLE OF CONTENTS

1. INTRODUCTION 1

1.1 Economic climate 1

1.2 South Africa's manufacturing outlook 2

1.3 Focused export promotion 3

1.4 Paper outline 4

2. LITERATURE OVERVIEW 5

2.1 Industrialisation and manufacturing 5

2.2 Trade, growth and employment 6

3. METHODOLOGY 7

3.1 The CGE model 7

3.2 The Decision Support Model for identifying export opportunities 12

4. RESULTS 14

4.1 CGE simulation results 15

4.2 DSM results 20

5. CONCLUSION 22

5.1 Summary 22

5.2 Results 23

5.3 Policy recommendations 23

REFERENCES 24

APPENDIX 27

LIST OF TABLES

Table 1 − Values for key elasticities in UPGEM 9
Table 2 − Final categorisation of realistic export opportunities for South Africa 14
Table 3 − Trade and output indicators (R million, 1998 Prices) 15
Table 4 − Observed percentage change to selected exogenous variables (from the base case) 16
Table 5 – All manufacturing – distributional results – real household consumption 17
Table 6 – Basic metal products – distributional results – real household consumption 17
Table 7 – Transport equipment – distributional results – real household consumption 18
Table 8 – Machinery – distributional results – real household consumption 18
Table 9 – Chemicals – distributional results – real household consumption 18
Table 10 – Electrical machinery – distributional results – real household consumption 18
Table 11 – All manufacturing – household-specific consumption-price indexes 19
Table 12 – Basic metal products – household-specific consumption-price indexes 19
Table 13 – Transport equipment – household-specific consumption-price indexes 19
Table 14 – Machinery – household-specific consumption-price indexes 19
Table 15 – Chemicals – household-specific consumption-price indexes 19
Table 16 – Electrical machinery – household-specific consumption-price indexes 19
Table 17 − Top 10 new export opportunities in African, BRICS and N-11 countries for Basic metal products 21
Table 18 − Top 10 new export opportunities in African, BRICS and N-11 countries for Transport equipment 21
Table 19 − Top 10 new export opportunities in African, BRICS and N-11 countries for Machinery 21
Table 20 − Top 10 new export opportunities in African, BRICS and the N-11 countries for Electrical machinery 22
Table 21 − Top 10 new export opportunities in African, BRICS and N-11 countries for Chemicals 22

LIST OF ABBREVIATIONS/ACRONYMS

BRICS	Brazil, Russia, India, China and South Africa
CES	Constant Elasticity of Supply
CGE	Computable General Equilibrium
CPI	Consumer Price Index
DSM	Decision Support Model
GDP	Gross Domestic Product
HHI	Herfindahl-Hirshmann-Index
IPAP	Industrial Policy Action Plan
ITAC	International Trade Administration Commission
MCEP	Manufacturing Competitiveness Enhancement Programme
MTEF	Medium-Term Expenditure Framework
NDP	National Development Plan
NGP	New Growth Path
ONDD	Office National Du Ducroire
RCA	Revealed Comparative Advantage
REOs	Realistic Export Opportunities
SA	South Africa
SARS	South African Revenue Service
SIC	Standard Industries Classification
Stats SA	Statistics South Africa
UPGEM	University of Pretoria General Equilibrium Model

EXECUTIVE SUMMARY

The South African government recognises the importance of promoting manufactured exports as a means of ensuring sustainable economic growth and job creation. However, export promotion organisations have limited resources at their disposal and promoting all manufactured exports is not possible. Using a Computable General Equilibrium (CGE) model and Decision Support Model (DSM), this paper identifies those manufacturing sectors and markets that offer export, labour absorption and ultimately economic development potential for South Africa. The paper thus makes a valuable contribution to the literature while also offering useful insights to export promotion organisations tasked with developing sector-specific assistance programmes.

1. INTRODUCTION

"*While South Africa has maintained a reasonably sound trade balance, owing largely to high commodity prices, it is of concern that high value-added and labour-intensive exports are slowing*" (South African National Planning Commission, 2011).

1.1 Economic climate

South Africa, like many other developing countries, currently faces severe economic challenges, ranging from relentless unemployment and poverty to the reputational damage caused by high levels of corruption in both the public and private sectors.

The South African government has been acutely aware of the economic turbulence that has gripped the country in recent years. In this regard, two of the cornerstones of the NDP (National Planning Commission, 2011) are to increase employment from 13 million to 24 million in the period 2010 to 2030, and to achieve an annual GDP growth rate of 5.4% during the same period. The government recognises the pivotal role that manufacturing can and should be playing in stimulating economic and trade growth in South Africa which, in turn, could lead to higher labour absorption (National Planning Commission, 2011). The importance of establishing manufacturing as a driver of the South African economy, particularly as a creator of jobs and source of export revenue, is underlined in a number of government policy documents, including the New Growth Path (NGP), the National Development Plan (NDP) (National Planning Commission, 2011) and the Industrial Policy Action Plan (IPAP) (Department of Trade and Industry, 2011).

In the NGP's public document entitled *The NGP: Framework* (EDD, 2011) the government places strong emphasis on investing in capital- and labour-intensive industries, thus putting the spotlight on manufacturing. However, the document stresses that the sustainable economic well-being of the manufacturing sector is dependent on new export markets being identified and developed. The National Planning Commission supports these sentiments by setting clear goals for South Africa in its National Development Plan (NDP), which incorporates strategies for growth up to 2030. South Africa has long benefited from the fact that it is richly endowed with natural resources. During periods when commodity prices have been high and the Rand relatively weak, the country has enjoyed strong returns from its export activities. However, volatility in commodity prices is common (Tsen, 2009), and in a commodity-rich economy, such price fluctuations can create uncertainty and dampen growth prospects. The NDP asserts that increased exports of value-added (but also labour-intensive) goods, along with a stronger skills base in the country, can help to offset the economic distortions brought about by fluctuating commodity prices and an unstable Rand. The document also emphasises that diversifying into value-added industries and boosting exports requires significant investment (National Planning Commission, 2011).

This commitment at national level to support the manufacturing industry is reiterrated in IPAP 2012/13 to 2014/15 (Department of Trade and Industry, 2012). The latest revision of this document, IPAP2, outlines a strategy to diversify South Africa's export mix and address unemployment head on by placing greater emphasis on value-added manufactured and service exports (Department of Trade and Industry, 2012). In addition, numerous applications have been filed with the International Trade Administration Commission (ITAC) for increases, rebates and reductions of duties across a wide spectrum of sectors (Department of Trade and Industry, 2012). Furthermore, the Minister of Finance, Pravin Gordhan, has released R5.8-billion over the course of the current three year Medium-Term Expenditure Framework (MTEF) towards the Manufacturing Competitiveness Enhancement Programme (MCEP). The MCEP aims to attract, and instil more confidence in, potential investors in South Africa's manufacturing sector in today's uncertain economic climate by creating more opportunities in labour-intensive and value-added industries (Department of Trade and Industry, 2011).

The various government documents cited above are unanimous in their view that manufacturing in South Africa needs a shot in the arm so that production and exports can be significantly enhanced.

1.2 South Africa's manufacturing outlook

Despite the national preoccupation with the state of manufacturing in South Africa, the country has witnessed a slowdown in its manufactured exports in recent years. Imports are growing at a much faster rate than exports. Trade data for the period January-February 2012 to January-February 2013 shows a significant widening in South Africa's cumulative trade deficit from just under R24-billion to just over R34-billion (SARS, 2013). This can partly be ascribed to a decrease in demand from developed economies still recovering from the adverse effects of the global financial crisis (National Planning Commission, 2011). However, severe as it was, the global financial crisis does not fully explain why South Africa continues to see a sharp rise in imports and an expanding current account deficit. This in itself is enough to justify a more aggressive approach to export promotion. According to the Department of Trade and Industry (2012:25-26), the mining sector's exports have been growing at a rapid pace in recent years, but this has been noticeably offset by the manufacturing sector's comparatively lacklustre export performance.

Between the third quarter of 2011 and the third quarter of 2012, the value of manufactured exports grew by 6.8%. However, this was overshadowed by an increase of 17.2% in the value of imports during this period. Also, in the same time frame, the value of intermediate goods exported fell from around R68-billion to R65-billion, while imports of intermediate goods rose in value from R71-billion to R80-billion. The negative trade balance in the manufacturing sector is not a new phenomenon - in fact, the sector has not seen a positive trade balance since the second quarter of 2002, reinforcing the fact that manufacturing has persistent and fundamental weaknesses. During the global financial crisis,

the manufacturing sector's year-on-year average production growth rate fell to -20%. Even though it is back in positive territory, the growth rate is not nearly sufficient to make a meaningful contribution to national goals. For example, a preliminary report issued recently by Statistics SA on manufacturing production and sales reveals that between November 2012 and November 2013, manufacturing output grew by a mere 0.3%. Seasonally adjusted figures for the three months ending November 2013 show that six of the 10 manufacturing divisions in the country recorded negative growth when compared with the previous three months (Stats SA, 2014).

Of growing concern, too, is the fact that the number of people employed in the manufacturing sector decreased by 0.2% between the third quarter of 2011 and the third quarter of 2012 (Industrial Development Corporation, 2012). More statistics produced by Statistics SA corroborate this worrying trend, showing that manufacturing employment declined by 1.3% in real terms between 2003 and 2010 (Stats SA, 2012).

In 2011, the respective contributions of the three main economic sectors to South Africa's GDP were as follows (Stats SA, 2013):

- Primary – 12.3%
- Secondary – 19.4%
- Tertiary – 68.3%

Despite the critical role it plays in the South African economy, the manufacturing sector's contribution to GDP has declined in real terms from 19% in 1993 to 17% in 2012. Manufacturing plays an even less prominent role in the provincial economies, with the greatest contribution being recorded in KwaZulu-Natal (15.8% of provincial GDP) and Gauteng (13.5% of provincial GDP) (Stats SA, 2013).

Clearly, South Africa's manufacturing sector is not growing its exports in line with national goals. In addition, not only does the sector appear to be failing to create more jobs but it is struggling to retain current levels of employment.

1.3 Focused export promotion

Although there is an undeniable link between a buoyant manufacturing sector and sustainable economic growth, various studies show that not only does directing all promotional efforts at manufactured exports require near unlimited resources, but not all export opportunities are realistic or have the power to deliver profitable returns (Papadopoulos & Denis, 1988; Kumar *et al.*, 1994; Cardozo *et al.*, 2003). For an export venture to succeed, it is imperative that the right markets are selected. To this end, two steps must precede and lay the foundation for an active export promotion drive: i) those manufacturing sectors with the highest economic and employment growth potential

(using their various linkages) must be identified, and ii) new export opportunities in these identified manufacturing sub-sectors should be determined.

Consequently, the aim of this paper is, firstly, to determine which sectors within the manufacturing industry as a whole would benefit the economy most (relative to other manufacturing sectors) in terms of economic and employment growth if exports in such sectors were to increase. The export opportunities in these sectors will then be explored, and new export opportunities will be identified.

1.4 Paper outline

A brief literature overview will be conducted to show the global progression from newly industrialised economies to manufacturing-led economies. In this regard, it will be emphasised that when such economies find markets abroad for their manufactured goods, they will have much greater prospects of achieving sustainable economic and employment growth.

A Computable General Equilibrium (CGE) model will be used to determine the possible economy-wide effects, specifically with respect to potential labour absorption, of increasing export volumes across a broad range of manufacturing sectors. Those sectors that have the greatest potential to positively influence economic growth and labour absorption will be selected.

A Decision Support Model (DSM) will also be applied to identify the export opportunities associated with the chosen manufacturing sectors. The DSM was first developed by Cuyvers *et al.* (1995:173-186) to identify the product-(destination) country combinations with the highest export potential for a specific country. The model's primary purpose was to give export promotion organisations a more scientific means of determining the most promising opportunity areas which would be deserving of promotional assistance.

The DSM methodology starts by considering all possible countries and products world-wide. Using four sequential filters, the DSM eliminates less interesting/promising product-country combinations with a view to categorising and prioritising realistic export opportunities (REOs) for the country to which the model is applied. In respect of each possible export destination, the model considers factors such as macroeconomic size and growth, size and growth of import demand, market concentration and various barriers to entry, such as shipping time and cost, logistical efficiency, *ad valorem* tariffs and non-tariff barriers.

The outcome of the whole analytical exercise will be the identification of new export opportunities (product-country combinations) in each of the top five manufacturing sectors that were revealed through the application of the CGE. On the basis of these focused results, export promotion organisations in South Africa will be able to allocate their limited resources in a more efficient

manner, knowing that the export opportunities revealed per manufacturing sector will have the greatest prospects of positively impacting economic growth and job creation in the country.

The study makes a valuable contribution to the literature as it highlights how an employment-driven approach to export promotion can produce long-term dividends for the manufacturing sector in South Africa.

2. LITERATURE OVERVIEW

The literature overview takes a brief look at the progression from industrialised economies to those powered by their manufacturing sectors. Special attention is given to manufactured exports and how they deliver value to an economy in the form of sustainable economic and employment growth.

2.1 Industrialisation and manufacturing

The late 18th century marked the start of a shift in countries' productive activities away from agriculture towards industry. Technological breakthroughs in the production of textiles, and the adoption of steam energy were two of the factors driving this change. This process, which saw labour output reach new and almost unprecedented levels (Szirmai, 2012), can best be described as industrialisation (Kemp, 1978). According to Kemp (1989), industrialisation is widely recognised as a stimulant to growth, as reflected in rising per capita income and a more well-rounded and productive economy. Industrialisation is traditionally viewed as having started in Britain, from where it spread to Europe and North America in the early 19th century. Not all countries were able to embrace change with the same degree of success, and this led to the phenomenon of 'advanced' countries and more 'backward' countries. The former group of countries largely had an industrial orientation, with changing lifestyles and attitudes to work signalling the start of a new, modern era. The latter group of countries remained heavily dependent on agriculture, trapped in traditional economic pursuits and a cycle of underdevelopment. The uneven spread of industrialisation since the middle of the 19th century was the key factor contributing to the stark divisions we see in the world today between the developed and developing economies (Lewis, 1978a, b; Maddison, 2001, 2007).

The developed economies had significant manufacturing capacity, which created a strong demand for primary agricultural and mining goods to sustain the high levels of output. As is an all-too-frequent phenomenon today, the developing economies supplied the developed economies with primary goods as inputs in their manufacturing industries, only to repurchase these goods from the developed economies – except they took the form of finished products - which they would use to once more produce primary agricultural and mining goods. It should be noted that advances in the areas of technology and infrastructure helped to facilitate and streamline this process of international exchange (Szirmai, 2012).

It is clear from the literature that industrialisation played a significant role in changing the character of manufacturing so that it became a source of value to an economy. Various studies (Kuznets, 1966; Chenery *et al.*, 1986; Chenery & Srinivasan, 1988) that focus on industrialising economies as well as the developed economies of today show that at an aggregate level, economic development is characterised by structural change that is marked by the initial growth and eventual decline of industries. This structural change is seen to follow three stages: i) primary goods (mainly agricultural) production is the dominant economic activity, ii) industrialisation takes centre stage, and then iii) the developed economy emerges. Chenery *et al.* (1986) found that during the period of industrialisation in the USA, per capita income rose from $400 to $2,100 by 1970. Furthermore, a study by Wells and Thirlwall (2003), which analysed data on 45 African countries covering the period 1980 - 1996, revealed that the GDP growth rate was strongly and positively linked to the extent to which manufacturing grew faster than agriculture and services.

From the literature it is clear that industrialisation has positive effects on manufacturing output and employment growth, which in turn provide positive inducements to economic growth and development.

2.2 Trade, growth and employment

Trade is a great generator of economic well-being (Appleyard *et al.*, 2010). The neoclassical theory of international trade, as proposed by Heckscher (1919) and Ohlin (1933), assumes that countries take advantage of the exogenous differences in resources, technology and taste that exist between trading parties. Trade then yields productivity gains and helps with the flow of goods internationally. However, the new trade theory proposed by Helpman and Krugman (1989) reverses some of the unrealistic assumptions of the neoclassicists. This theory assumes imperfect competition and increasing returns to scale. Yet gains from trade are still attainable (Singh, 2011).

In contrast to these trade theories, the neoclassical theory of economic growth (Solow, 1956; Swan, 1956) does not recognise the role of trade in bringing about economic growth. Rather, there is the assumption that an increase in factor inputs (capital and labour) drives economic growth, and any residual growth values are attributed to exogenous technological progress which is not affected by trade.

The post-neoclassical endogenous theory of economic growth (Romer, 1986; Lucas, 1988) specifically models these technological advances and proposes that endogenous factors, including trade, do have positive effects on productivity and economic growth. This positive relationship between trade and economic growth forms the basis of this particular study.

Recent findings by Babatunde *et al.* (2012:875) indicate that even though exports can drive growth, this result does not always correlate directly with more labour absorption. Certain industries are more

conducive to increasing employment than others. Various factors come into play when determining whether an industry would absorb more labour as a result of increased trade. High growth in itself is a prerequisite to alleviating poverty. However, high growth on its own does not alleviate poverty. An empirical study on the relationship between foreign trade and employment in the Southwest minority region of China (Xiong, *et al.,* 2012) found that GDP growth and trade can promote employment growth, while import activity by itself cannot promote employment effectively.

In a study conducted by Kucera *et al.* (2012:1126) on the effects of trade contractions on employment as a result of the global financial crisis, it was revealed that trade is positively correlated to employment. Based on import mirror data from the USA and the EU, an estimated 886 000 jobs were lost and a possible 77 000 "possible jobs created" were lost in South Africa due to contractions in the country's exports as a result of the global crisis. Similarly, Indian manufacturing employment declined during the crisis as a result of trade contractions. The results of a study conducted by Colen, Maertens and Swinnen (2012:1086-1087) indicate that as an industry positions itself for higher volumes of exports, it enhances the employment conditions and opportunities, and extends the period of employment for poor households in such an industry.

Kotabe and Czinkota (1992), in their study on government promotion of manufactured exports, found that such exports not only increase employment in the sector but lead to an increase in non-manufacturing-related employment. It was also noted that a doubling of US exports in the first half of the 1980s accounted for more than 80% of the increased number of jobs in the manufacturing sector (1992:639).

From the above discussion, it can be deduced that increased manufactured exports have a strong and positive correlation with employment and employment growth.

3. METHODOLOGY

This section details the two methodologies applied in the study, namely the Computable General Equilibrium (CGE) and the Decision Support Model (DSM) methods, as well as the underlying assumptions and inherent limitations of each method.

3.1 The CGE model

In this section we provide a brief description of the model used to assess the impact of increased manufactured exports on selected macroeconomic and labour market indicators in South Africa. Since we are interested in the economy-wide impacts, and in particular the "relative" impacts, of increased exports in each of the manufacturing sectors at the macro and meso/sector levels, the most appropriate modelling tool is a CGE model. A CGE model is "*an economy-wide model that includes feedback between demand, income and production structure, and where all prices adjust until decisions made*

in production are consistent with decisions made in demand" (Dervis *et al*., 1985:132). The model is applied (or computed) using economy-wide, consistent data pertaining to a particular economy, as is normally contained in a Social Accounting Matrix (SAM). In this particular case, we use the most recent SAM for South Africa (i.e. the official 1998 SAM) which is published by Statistics South Africa (Stats SA, 2001). Other parameters, notably expenditure elasticities, are obtained from outside the model (typically from econometric studies or by making plausible guesstimates) (Naudé & Coetzee, 2004).

In this paper we use a South African adaptation of ORANI-G[1] to solve the model. It is known as the UPGEM (University of Pretoria General Equilibrium Model) and was developed for South Africa by the University of Pretoria (see, for example, www.monash.edu.au/policy/oranig.htm for a list of all the country models that have been built in the ORANI-G style). The specific version of the UPGEM model used in these simulations is comparative-static and distinguishes 32 sectors (Bohlmann &Van Heerden, 2005). This is an older version of the UPGEM (later versions exist where, for example, 6 additional agricultural and 6 additional energy-related sectors have been added to the original 27 economic sectors in the official 1998 SAM—see Van Heerden *et al*. (2006); recursive-dynamic (year-on-year) capabilities have been added—see Bohlmann (2012)), which distinguishes 32 sectors 12 household/income types and 4 ethnic groups (Bohlmann & Van Heerden, 2005). However, for the purposes of this study, the older version is still sufficient to generate a relative picture of the benefits of increased manufactured exports. For a more detailed exposition of the modelling approach followed in UPGEM, see Horridge (2000) and for recent applications of different versions of the model, see Bohlmann and Van Heerden (2005), Van Heerden *et al*. (2006), Van Heerden *et al*. (2008) and Bohlmann (2012).

3.1.1 Labour demand and the CGE equations

The main equations used in this model are derived from the constrained optimisation of neo-classical production and utility functions (Horridge, 2000). Producers choose inputs to minimise the costs of a given output, subject to non-increasing returns to scale industry functions. Consumers are assumed to choose their purchases in order to maximise utility functions subject to budget constraints. Production factors are paid according to their marginal productivity (Van Heerden *et al*., 2008).

At the equilibrium level these models' solutions provide a set of prices that clear all commodity and factor markets and make all individual agents' optimisations feasible and mutually consistent. The behavioural equations of the model are augmented by sets of equations showing the flows of income in the economy as well as sets of equations defining an economic equilibrium in each market as the

[1] ORANI-G ('G' stands for 'generic'), an applied general equilibrium model, is a version of ORANI which serves as a basis from which to construct new models. It has been applied to many countries, including China, Thailand, Korea, Pakistan, Brazil, the Philippines, Japan, Ireland, Vietnam, Indonesia, Venezuela, Taiwan, South Africa and Denmark.

point where supply equals demand (Van Heerden *et al*., 2008). Equilibrium is reached through adjustments in prices and/or quantities.

As the focus of this paper is on the labour market impact of increased manufactured exports, some comments on the modelling of labour demand in the UPGEM may be appropriate. Firstly, it should be noted that the demand for labour, in contrast to the demand for other primary factor inputs, is disaggregated in the UPGEM according to occupation group and race (Van Heerden *et al*., 2008). The occupational composition of labour demand in each industry is also derived from an optimisation problem. An industry can choose different combinations of occupations in their labour force in order to minimise their total labour costs. This follows a CES-production function which results in an occupation-specific demand for labour function (Van Heerden *et al*., 2008:108).

The occupation-specific demand for labour is a function of the composite labour demand and the relative prices of occupation-specific labour and an elasticity of substitution. Substitution between different occupations will take place if the relative wages of the occupations change. In the current version of the UPGEM, relatively conservative elasticities of substitution between these occupations are assumed (Horridge, 2000). The elasticities used for the CES functions in the model are summarised in Table 1.

Table 1 − Values for key elasticities in UPGEM

Export demand elasticities	-5
CES between imported and domestic goods	0.5 to 1.5
CES between capital, labour and land	0.5 to 1.0
CES between labour skill groups	0.5

[Source: Van Heerden et al. (2008:109)]

After choosing the occupation-specific labour inputs, an industry must, according to the model, decide from which race group this occupation-specific labour will have to be drawn. In the present model it is assumed that an industry will minimise its total occupational labour costs by employing the cheapest combination of race-specific, occupation-specific labour (Horridge, 2000). Again a CES-production function is used in the optimisation procedure, leading to an occupation-specific, race-specific labour demand function. This equation will be a function of the occupation-specific demand and the relative wages of race-specific wages. Hence, if relative wages between racial groups change, employers will substitute within an occupation group towards a specific race group (Horridge, 2000).

Scientifically, the occupational composition of labour demand in each industry is derived from the following optimisation problem (Horridge, 2000). Inputs of occupation-specific labour are used to minimise the total labour cost for each industry,

$$\sum_i P_i X_i \ (i = 1,2,\dots,32)\,,$$

subject to the production function,

$$Z_i = \left(\sum_j \delta_j [X_j]^{-\rho}\right)^{-1/\rho} \quad (i = 1,2,\dots,32 \ and \ j = 1,\dots,12),$$

where

$$\sigma = \frac{1}{1+\rho}$$

is an elasticity of substitution between occupational groups. Similarly, the racial composition of labour demand for each industry is the optimisation problem of minimising the total labour cost for each occupational group,

$$\sum_j P_j X_j \ (j = 1,\dots,12),$$

subject to the production function,

$$Z_j = \left(\sum_k \delta_k [X_k]^{-\rho}\right)^{-1/\rho} \quad (j = 1,2,\dots,32 \ and \ k = 1,2,\dots,4),$$

where σ is an elasticity of substitution between the four race groups (i.e. white, coloured, Asian and black).

Secondly, wages in the UPGEM are assumed to be flexible, and will adjust according to the closure relating to the primary factor market (Horridge, 2000). The average nominal wage is, however, indexed to the consumer price index (CPI), implying a constant average real wage rate. The fixed relationship between average nominal wages and the CPI can be changed by adjusting coefficients to some value less than unity. If chosen, for example, at a value of 0.6, then wages would on average be 60% indexed. Movements in the average real wage rate can also be incorporated by adjusting real wages exogenously.

Finally, the manner in which the labour market specification is "closed" is important as it will influence the results from simulations. Accordingly, the next section discusses the short-run closure applied to perform the simulations reported in the paper.

3.1.2 Specification of the economic environment

The UPGEM model requires an assumption about the macroeconomic environment in which the simulations are to take place. Results are presented below for a short-run environment in which there are assumed to be significant rigidities in the economy. To implement the simulation, a number of further assumptions were made which related to the closure of the model. An in-depth discussion on the closure of CGE models can be found in Horridge (2000). See also Bohlmann and Van Heerden (2005), Van Heerden *et al*. (2006) and Van Heerden *et al*. (2008) for a discussion on the short-run closures specific to the UPGEM.

In the present case, each of the simulations was conducted using a short-run comparative static closure for the model. This implies that the impact reflects the change in a short period of time (approximately 2 to 3 years) before investment can react to the changed market conditions. Here, land, the rate of return on capital, employment, the trade balance, technology variables and the real wage (*realwage*), amongst others, are taken as exogenous. On the income side of GDP, we have realwage and capital exogenous (and real cost of labour) and the nominal rate of return on capital to adjust. On the expenditure side of GDP, we have aggregate investment, government consumption and inventories as exogenous, while consumption and the trade balance are left to adjust. This allows us insight into the effect of the increased exports on South Africa's consumption and competitiveness. All technological change variables and all tax rates are exogenous in the closure. The model differentiates between 3 different labour groups, namely high-skilled, medium-skilled and low-skilled. A fixed supply of highly skilled and skilled labour in the short run is assumed, but with a perfectly elastic unskilled labour supply. This assumption reflects the South African labour market realistically and allows testing of the effect of increased exports on the levels of employment of differently skilled labour. Finally, the nominal exchange rate is set to be the numeraire in each of the simulations.

3.1.3 Simulations

We use the UPGEM model to simulate a hypothetical increase in exports (i.e. of 10 percent) for each of the manufacturing sectors in the model, and use the resulting economy-wide influences to identify the top manufacturing sectors for investment/promotion purposes. More specifically, we compare the various simulations in the short run, and compare their respective impacts on (a) economic growth, (b) employment, and (c) consumption patterns of the poor in South Africa. Because only limited funds are available to promote the exports of any product, the idea is to identify those sectors that will have the greatest relative benefits throughout the economy and then to identify specific products within those sectors by using the results of the DSM.

The UPGEM model has a variable depicting the exports per sector (i.e. *x4*). This variable, for each of the 20 manufacturing sectors, is exogenised to enable the implementation of the hypothetical shock to each sector. All results presented in the tables below are in the form of percentage changes from a

base case (or business as usual) scenario. The economy-wide simulation results presented from the UPGEM analysis generally serve to highlight the extent to which the different manufacturing sectors are connected with the rest of the economy. It should be noted, however, that the simulation results should be interpreted as being indicative of the actual impact of increased exports in the different manufacturing sectors on the South African economy.

3.2 The Decision Support Model for identifying export opportunities

The Decision Support Model (DSM) is based on Walvoord's model for selecting foreign markets (Walvoord as in Jeannet & Hennessey, 1998:137-140). Walvoord's idea was that certain filters or screenings should be used to evaluate international market opportunities. Even though Walvoord's model focuses on selecting foreign markets for a firm, Cuyvers *et al.*(1995:173-186) used the basic structure of Walvoord's model to construct a product-country-level market selection model to aid government export promotion agencies. It is called the Decision Support Model (DSM) and it is used to identify realistic export opportunities for an exporting country.

The DSM uses filters to remove the countries and products that do not present realistic export opportunities. These filters are listed and described below.

Filter 1:Identifying preliminary market opportunities

This filter considers two criteria: i) political and commercial risk that an exporter would face in the foreign market and ii) macroeconomic size and growth of the country. Political risk can be defined as anything that can occur in the importing country that would take on the same nature of a *force majeure* event. Commercial risk can be defined as the risk resulting from a deterioration in the importer's financial position that can lead to non-payment for the exporter (ONDD, 2011). Countries in the two highest risk categories of the ONDD are filtered out.

The macroeconomic indicators used to determine the market size and growth are measured by using the gross domestic product, the gross domestic product per capita, and the short and long term growth rates. Countries falling below a cut-off value determined around the world averages are then filtered out. For more detail on the cut-off values, see Cuyvers, Steenkamp and Viviers (2012).

Filter 2: Identifying possible opportunities

In this filter, several attributes of all the HS 6-digit products are investigated for the remaining countries. The short and long term import growth rates as well as import market size are used as criteria to determine the size and growth of import demand for all the HS 6-digit products per country. Cut-off values depend on whether the exporting country for which the model is applied is specialised

in exporting the product in question or not[2]. If the exporting country is not specialised in exporting the product, the importing country's short- or long-term import growth rate of the product must be between one and two times (depending on the degree of specialisation) the world average import growth rate for the product. If, however, the exporting country for which the DSM is applied specialises in exporting the product, the importing country's import growth rate is allowed to be just below the world average import growth rate for the product.

In terms of market size, the importing country's imports of the product in question must be above 2% and up to 3% of total world imports if the exporting country does not specialise in exporting the product. If, however, the exporting country for which the DSM is applied specialises in exporting the product, the importing country's imports are allowed to be 2% of total world imports of the product.

Only markets that are considered (i) relatively large (without necessarily showing adequate growth), (ii) growing in the short *and* long term (without necessarily being adequately large) or (iii) growing in the short and/or long term and are considered large markets, are selected to enter filter 3.

Filter 3: Identifying probable and realistic export opportunities

This filter considers the market concentration (filter 3.1) and accessibility (filter 3.2) of the potential export opportunities.

Filter 3.1 considers the degree of concentration in the market in question as it is not easy to penetrate a market that is dominated by one or two competitors (Cuyvers *et al*, 2012). The Herfindahl-Hirshmann-Index (HHI)[3] of Hirshmann (1964) is used to measure the degree of market concentration in each market (product-country combination). The cut-off value is established within a determined percentage of the standard deviation around the average for all the product-country combinations under consideration. A higher degree of concentration is allowed for larger, growing markets (Cuyvers *et al*., 1995:180).

[2] To calculate the exporting country's (country *i*) level of specialisation in exporting a particular product, the Revealed Comparative Advantage (RCA) of Balassa (1965) is used:

$$RCA = \left(\frac{X_{i,j}}{X_{W,j}} \right) / \left(\frac{X_{i,tot}}{X_{W,tot}} \right)$$

with $X_{i,j}$ denoting country *i*'s exports of product *j*; $X_{i,tot}$ denoting country *i*'s total exports; $X_{w,j}$ denoting the world's (all countries) export of product *j*; and $X_{w,tot}$ denoting total exports in the world.

[3] The Herfindahl-Hirshmann-Index is computed as follows (Hirshmann, 1964):

$$HHI_{ij} = \sum \left(\frac{X_{k,ij}}{M_{tot,ij}} \right)^2$$

with $X_{k,i,j}$ denoting exports of a competitor country *k* to importing country *i* for product category *j*; and HHI=1 denoting that there is a monopolistic country supplier to the market.

The accessibility of the markets under consideration is measured in relation to the different barriers to entry (including shipping time and cost, logistical efficiency, and tariffs and non-tariff barriers) the exporting country will face in each market. A market accessibility index is calculated and a cut-off value is determined around the average index value for all the markets under consideration.

To qualify for *filter 4*, the product-country combinations need to have both low concentration and low trade barriers (Cuyvers, *et al.*, 2012).

Filter 4: Final analysis of opportunities

In this filter the markets identified in filters 1 to 3 are categorised and prioritised, and no markets are eliminated.

The strength of South Africa's position in each of the selected markets is determined by its relative market share. This involves determining South Africa's revealed comparative advantage in the product-country combinations emerging from filter 3, relative to the average revealed comparative advantage enjoyed by the top 6 competitors in each market (Cuyvers *et al.*, 2012). Each potential importing country is assigned to one of 20 cells (see Table 2) that reflect specific combinations of the size and growth of import demand (rows of Table 2, determined in filter 2) and South Africa's relative market share in each market (columns of Table 2, determined in filter 4).

Table 2 − Final categorisation of realistic export opportunities for South Africa

	South Africa's relative market share			
	Small	Intermediately small	Intermediately high	High
Large product/market	Cell 1	Cell 6	Cell 11	Cell 16
Growing (short- & long-term) product/market	Cell 2	Cell 7	Cell 12	Cell 17
Large product/market with short-term growth	Cell 3	Cell 8	Cell 13	Cell 18
Large product/market with long-term growth	Cell 4	Cell 9	Cell 14	Cell 19
Large product/market with short- and long-term growth	Cell 5	Cell 10	Cell 15	Cell 20

[Source: Cuyvers, Steenkamp and Viviers (2012)]

For more specific information on the methodology of the DSM, including the calculation of index values, cut-off values and more, see Cuyvers *et al*. (2012).

4. RESULTS

In interpreting the results from the CGE model, we follow Adams' (2005) proposal that results first focus on macroeconomic impacts, and then move down towards industry/sector level impacts and household impacts.

4.1 CGE simulation results

Before looking at the results of the simulations it is appropriate to highlight some of the macro variables of the model in the context of the importance of trade and output. Table 3 shows the structure of trade and output in the South African economy in 1998, the base year for the model. The 32 sectors are distinguished with only two of them not being tradable (electricity and building). The importance of trade in the remaining sectors varies substantially, ranging from nearly closed in trade, transportation and community services (exports constitute nearly 1% of output and imports 1% of domestic supply), to high net exporters in gold mining, other mining, leather, basic metal products and machinery (exports are above 20% of output), and high net importers in footwear, publishing and printing, machinery, electrical machinery, and transport equipment (imports are above 20% of domestic supply). The remaining sectors present a degree of openness that ranges from 2% to nearly 20% in terms of their share of exports to output and imports to domestic supply. Note that the CES substitution elasticities are higher for commerce, transportation and service sectors.

Table 3 − Trade and output indicators (R million, 1998 Prices)

Sectors	Output (*X*)	Exports (*E*)	Exports / Output (*E*/*X*) (%)	Imports (*M*)	Imports / Domestic Supply (*M*/*D*) (%)
Agriculture	48 493	6 630	14	4 707	10
Gold mining	26 352	26 303	100	2	0
Other mining	56 444	41 176	73	14 525	26
Food processing	67 007	7 664	11	9 257	15
Beverages	14 259	369	3	1 227	9
Tobacco	14 305	335	2	956	8
Textiles	10 226	2 366	23	4 203	45
Clothing	11 059	2 084	19	2 772	25
Leather	2 229	1 429	64	1 049	48
Footwear	2 608	205	8	1 708	64
Wood	10 527	2 972	28	2 199	22
Paper	23 278	6 143	26	3 447	16
Printing and publishing	14 255	633	4	6 868	52
Chemicals	89 711	25 152	28	28 071	33
Rubber	5 238	1 073	20	2 026	40
Plastic	10 283	1 209	12	2 388	26
Non-metallic minerals	13 076	1 916	15	4 055	32
Basic metal products	46 720	29 597	63	8 377	18
Fabricated metal products	26 736	4 328	16	6 632	26
Machinery	23 556	12 321	52	35 886	154
Electrical machinery	20 022	6 922	35	32 006	165
Transport equipment	50 257	18 580	37	34 905	72
Other manufacturing	20 158	7 992	40	5 754	28
Electricity	37 587	-	-	-	-
Building	45 736	-	-	-	-
Civil engineering	27 296	1 701	6	-	-
Trade	156 885	294	0	-	-
Accommodation and catering	25 593	9 909	39	8 437	37

Transport	92 997	1 682	2	5 888	6
Communication	46 785	149	0	-	-
Financial services	252 586	12 491	5	-	-
Community services	73 647	6 569	9	575	1

[Note: Manufacturing sectors are those indicated in the grey shaded area]
[Source: Compiled using the UPGEM database]

Table 4 (along with Table A1 in the Appendix) summarises the macroeconomic effects of the simulations and Tables A2-A7 (refer to the Appendix) report the sector results separately. The analysis focuses explicitly on the top five manufacturing sectors in terms of their impact on the overall economic output measured by GDP and employment. We first analyse the aggregate results. In aggregate terms, the experiment of increasing the exports of each of the manufacturing sectors, which is the same as opening the economy for these sectors, prompted more productivity and inflation, with the GDP deflator rising by 1.81% for all manufacturing sectors, and by 0.26%, 0.13%, 0.08%, 0.35% and 0.05% for each of the top five highest performing manufacturing sectors in relation to the base year and a GDP growth rate of 0.71% when the increase is applied to all sectors, and by 0.14% in the simulation where basic metal products' exports are increased. The aggregate impact on the labour market is positive across all of the reported simulations (refer to Table 4), with an overall reduction in unemployment for all types of labour.

Table 4 − Observed percentage change to selected exogenous variables (from the base case)

Selected macroeconomic variables	All Manufac.	Top 5 sectors (highest to lowest) in terms of economy-wide benefits				
		Basic metal products	Transport equipment	Machinery	Chemicals	Electrical machinery
Real GDP	0.714	0.138	0.096	0.076	0.075	0.033
GDP price deflator	1.811	0.257	0.126	0.082	0.345	0.049
Labour (Aggregate employment)	1.538	0.337	0.201	0.162	0.125	0.065
Average Real Wage Rate*	0.000	0.000	0.000	0.000	0.000	0.000
Domestic Consumption*	0.000	0.000	0.000	0.000	0.000	0.000
Consumer Price Index	1.440	0.138	0.107	0.061	0.290	0.039
Government Consumption*	0.000	0.000	0.000	0.000	0.000	0.000
Exports (Volume Index FOB)	4.599	0.802	0.596	0.387	0.608	0.214
Export Price Index	1.586	0.383	0.086	0.072	0.282	0.039
Imports (Volume Index CIF)	2.761	0.434	0.343	0.177	0.428	0.129
Import Price Index*	0.000	0.000	0.000	0.000	0.000	0.000
Balance of Trade (% of GDP)	0.011	0.003	0.001	0.001	0.002	0.000
Terms of Trade	1.586	0.383	0.086	0.072	0.282	0.039
Nominal Exchange Rate*	0.000	0.000	0.000	0.000	0.000	0.000
Real devaluation (Competitiveness)	-1.779	-0.256	-0.126	-0.081	-0.344	-0.049

*[Note: * Exogenous by assumption]*
[Source: UPGEM simulation results]

The cause-effect logic of each of the simulations is that as a result of the increase in manufactured exports, firms would escalate their demand for labour (e.g. for firms to increase production and with sticky wages in the short run, closure requires an increase in employment). The increase in aggregate employment implies a positive shift in the cost functions of firms, subject to the direct and indirect labour intensity of their specific production structures. This implies an expansion of exports so that the equality between the given world prices and the marginal costs of export supplies is restored in all

industries. In addition, domestic supply will increase because the prices of domestic products relative to the import prices increase. Total production therefore rises and is propagated through the inter-industry input-output linkages.

Since producers are assumed to maximise profits, employment expansion is the result of increased outputs (as a result of increased exports) combined with sticky (and even increasing) wage rates (average real wages assumed fixed). The employment growth in turn leads to a higher wage bill being paid to labour, with the resulting feedback of increasing household income.

As an example, in the export expansion of basic metal products, GDP ends up at 0.14 per cent[4] higher per annum than that of the base case, while employment increases even more—that is, by 0.34 per cent—as a result of the overall increase in export volumes of 0.8 per cent. Domestic consumption is assumed fixed (but will change on income group level), and the resulting general domestic price increase that needs to take place to achieve equilibrium is approximately 0.14 per cent, while the imported price index stays constant as South Africa is assumed to be a price taker in the international market. Import volumes continue to increase at 0.43 per cent due to the South African economy's (and the basic metal product sectors') high import propensity.

Tables 5 to 16 present the distributional results of the 10 per cent increase in manufactured exports in terms of changes in real household consumption and the corresponding changes in household-specific, consumption-price indexes for each of the top five manufacturing sectors (as mentioned earlier).

Table 5 – All manufacturing – distributional results – real household consumption

Real Household Consumption	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.054	0.230	0.133	-0.166	0.063
q2	0.061	0.200	0.127	-0.140	0.062
q3	0.084	0.184	0.128	-0.128	0.067
q4	0.092	0.182	0.132	-0.128	0.070
d9	0.095	0.179	0.132	-0.166	0.060
d10	0.096	0.150	0.106	-0.221	0.033
Average	0.080	0.188	0.126	-0.158	0.059

Table 6 – Basic metal products – distributional results – real household consumption

Real Household Consumption	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.053	-0.239	-0.212	-0.022	-0.105
q2	0.057	-0.238	-0.207	-0.015	-0.101
q3	0.071	-0.236	-0.200	-0.013	-0.095
q4	0.079	-0.236	-0.197	-0.013	-0.092
d9	0.082	-0.240	-0.197	-0.021	-0.094
d10	0.083	-0.249	-0.203	-0.038	-0.102
Average	0.071	-0.240	-0.203	-0.020	-0.098

[4] If we translate this in terms of GDP growth and constant 2000 real GDP monetary value, it would yield approximately R2.79-billion relative to 2014 real GDP for South Africa (R1,994.6-billion x 0.14/100). In terms of forward looking growth, this can be interpreted such that if South Africa targets 6 per cent growth for a given year, the impact of this scenario would result in the economy realising only 6.2 per cent growth. (Source of data: South African Reserve Bank online statistics at www.resbank.co.za.)

Table 7 – Transport equipment – distributional results – real household consumption

Real Household Consumption	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.027	0.065	0.008	-0.020	0.020
q2	0.025	0.056	0.007	-0.021	0.017
q3	0.018	0.051	-0.002	-0.024	0.011
q4	0.014	0.050	-0.008	-0.024	0.008
d9	0.012	0.042	-0.008	-0.030	0.004
d10	0.012	0.037	-0.008	-0.046	-0.001
Average	0.018	0.050	-0.002	-0.028	0.010

Table 8 – Machinery – distributional results – real household consumption

Real Household Consumption	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.033	0.023	-0.035	-0.025	-0.001
q2	0.032	0.017	-0.036	-0.026	-0.003
q3	0.029	0.012	-0.040	-0.028	-0.007
q4	0.028	0.011	-0.042	-0.028	-0.008
d9	0.028	0.009	-0.042	-0.033	-0.010
d10	0.028	0.009	-0.041	-0.039	-0.011
Average	0.030	0.014	-0.039	-0.030	-0.007

Table 9 – Chemicals – distributional results – real household consumption

Real Household Consumption	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.039	-0.033	0.020	-0.048	-0.006
q2	0.040	-0.043	0.009	-0.042	-0.009
q3	0.045	-0.055	0.002	-0.041	-0.012
q4	0.050	-0.058	0.002	-0.041	-0.012
d9	0.052	-0.053	0.002	-0.052	-0.013
d10	0.053	-0.054	-0.003	-0.054	-0.015
Average	0.047	-0.049	0.005	-0.046	-0.011

Table 10 – Electrical machinery – distributional results – real household consumption

Real Household Consumption	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.005	0.025	-0.019	-0.002	0.002
q2	0.005	0.021	-0.020	-0.004	0.001
q3	0.004	0.018	-0.021	-0.005	-0.001
q4	0.003	0.017	-0.021	-0.005	-0.002
d9	0.003	0.018	-0.021	-0.008	-0.002
d10	0.003	0.017	-0.021	-0.009	-0.003
Average	0.004	0.019	-0.021	-0.006	-0.001

[Source: UPGEM simulation results]

Overall the group that is affected the most negatively by the increase in manufactured exports is black South Africans—across all income groups and all of the reported simulation results. This is to be expected as labour (employment) and thus household income in this group are unfavourably affected by the negative feedback effects that flow through to the production of sectors that employ this group of labour. The same applies to high-income (d10) black households which experience a 0.22 per cent decline in real consumption expenditure in the simulation where all manufacturing exports increase. But the negative impacts are not only confined to black or high-income black households. Real consumption expenditure of middle- to high-income coloured and Asian households is also negatively affected. Some further investigation is required into the SAM applied as the database to this model in

Table 11 – All manufacturing – household-specific consumption-price indexes

Household CPI	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	1.526	1.394	1.448	1.407	1.444
q2	1.519	1.425	1.455	1.381	1.445
q3	1.496	1.441	1.454	1.369	1.440
q4	1.488	1.442	1.450	1.369	1.437
d9	1.484	1.446	1.450	1.407	1.447
d10	1.483	1.476	1.477	1.463	1.475
Average	1.499	1.437	1.456	1.399	1.448

Table 12 – Basic metal products – household-specific consumption-price indexes

Household CPI	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.179	0.136	0.156	0.127	0.150
q2	0.175	0.135	0.151	0.120	0.145
q3	0.161	0.134	0.144	0.118	0.139
q4	0.153	0.133	0.141	0.118	0.136
d9	0.150	0.137	0.141	0.126	0.139
d10	0.149	0.146	0.147	0.144	0.147
Average	0.161	0.137	0.147	0.126	0.143

Table 13 – Transport equipment – household-specific consumption-price indexes

Household CPI	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.107	0.091	0.105	0.090	0.098
q2	0.108	0.100	0.107	0.092	0.102
q3	0.115	0.104	0.115	0.095	0.107
q4	0.119	0.105	0.121	0.095	0.110
d9	0.121	0.114	0.121	0.100	0.114
d10	0.122	0.118	0.122	0.117	0.120
Average	0.115	0.105	0.115	0.098	0.109

Table 14 – Machinery – household-specific consumption-price indexes

Household CPI	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.062	0.053	0.061	0.051	0.057
q2	0.063	0.059	0.062	0.052	0.059
q3	0.066	0.064	0.066	0.054	0.063
q4	0.067	0.065	0.068	0.054	0.064
d9	0.067	0.067	0.068	0.060	0.066
d10	0.067	0.067	0.067	0.065	0.067
Average	0.065	0.063	0.065	0.056	0.062

Table 15 – Chemicals – household-specific consumption-price indexes

Household CPI	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.308	0.274	0.270	0.286	0.285
q2	0.307	0.283	0.281	0.279	0.288
q3	0.302	0.296	0.288	0.279	0.291
q4	0.297	0.299	0.288	0.279	0.291
d9	0.295	0.294	0.289	0.289	0.292
d10	0.294	0.295	0.293	0.292	0.294
Average	0.301	0.290	0.285	0.284	0.290

Table 16 – Electrical machinery – household-specific consumption-price indexes

Household CPI	Population Group				
Income Group	White	Coloured	Asian	Black	Average
q1	0.040	0.035	0.040	0.034	0.037
q2	0.041	0.039	0.041	0.035	0.039
q3	0.042	0.042	0.041	0.037	0.041
q4	0.042	0.042	0.041	0.037	0.041
d9	0.042	0.042	0.041	0.040	0.041
d10	0.042	0.042	0.042	0.041	0.042
Average	0.042	0.040	0.041	0.037	0.040

[Source: UPGEM simulation results]

The sector results for each of the top five simulations appear in Tables A2-A7 (refer to the Appendix) and, as affirmed earlier, were selected for their impact on the overall economic output measured by GDP and employment. Overall, imports varied less than exports, as the former are usually more inelastic due to sectoral linkages in terms of usage of foreign goods as intermediate and capital inputs. As the results of this simulations show, as production volumes increase, production costs tend to increase, making exports more expensive and prompting a rise in domestic prices. All of the sectors that experienced drops in output saw a decline in their demand for labour, but the change in labour demand was more pronounced than the variation in output. Sectors that lend themselves more to trade,

such as the gold mining, other mining, leather, basic metal products, and machinery sectors, had the largest variation in labour demand, while the less dependent sectors showed little variation in employment. This overall result seems to support the idea that export-led growth tends to favour employment in the sectors that are already trade-oriented.

The results of the reported simulations show further that alongside the 20% increase in exports of individual manufacturing sectors, the output of the skilled labour-intensive sectors varied more, and that labour demand varied in the same direction as output. Most of the sectors experienced upturns in domestic prices, probably due to increased production costs. In some cases, mostly where imports represent a significant share of domestic supply, the increase in exports had the effect of depressing output. Despite this negative effect, the results of the reported simulations show that a sector-specific (or focused) export-led strategy in South Africa benefits mostly skilled labour-intensive sectors with a possible side effect of increasing inequality and wage dispersion in the labour market.

4.2 DSM results

The importance of promoting manufactured exports as a means of ensuring sustainable economic growth and labour absorption was highlighted in Section 1. It was also pointed out that promoting the full range of manufactured exports requires a lot of financial and human resources, and all export opportunities do not offer profitable returns. Therefore, the top five manufacturing sectors in which an increase in exports would deliver the highest economic growth and employment growth benefits were identified in Section 4.1. In this section, the new export opportunities (cells 1 to 10 - see Table 2) within these manufacturing sectors, drawn from the results of the DSM, will be presented.

The NGP states that South Africa should be focusing on the BRICS countries and regional partners (African countries). This is reiterated in the NDP which recognises that other emerging economies (including the rest of the BRICS grouping) are a valuable source of export opportunities for South Africa. Therefore, for the purposes of this study, the DSM results for the African countries, BRICS countries and so-called next eleven (N-11)[5] (O'Neill *et al*., 2005) were considered.

Furthermore, only products in which South Africa has a revealed comparative advantage (RCA) equal to or greater than 0.7[6] were considered for this study. This follows Cuyvers *et al.*'s (2012) argument that markets for products in which the exporting country has an RCA ≥0.7 can be considered *'actual'*

[5] Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, Turkey, South Korea, Vietnam and the Philippines.

[6] $$RCAj = \left(\frac{X_{SA,j}}{X_{World,j}} \right) / \left(\frac{X_{SA,tot}}{X_{World,tot}} \right)$$

where $X_{SA,j}$ is South Africa's exports of product *j*, $X_{SA,tot}$ is South Africa's total exports of all products, $X_{World,j}$ is the world's exports of product *j* and $X_{World,tot}$ is the total world exports of all products (Balassa, 1965; Krugell & Matthee, 2009:461).

export opportunities, since the country is already producing and exporting these products to a large extent.

Tables 17 to 21 contain the top 10 new export opportunities in each of the top five sectors[7] identified in Section 4.1. The results focus on African, BRICS and N-11 countries.

Table 17 − Top 10 new export opportunities in African, BRICS and N-11 countries for Basic metal products

Country	HS 6-digit product code and description	Filter 4 cell classification
China	740311 - Copper cathodes and sections of cathodes unwrought	10
China	750210 - Nickel unwrought, not alloyed	5
Turkey	740311 - Copper cathodes and sections of cathodes unwrought	5
China	721049 - Flat rolled iron or non-alloy steel, coated with zinc, width >600mm, ne	1
China	720918 - Flat rolled prod/coils>.5mm	3
China	760200 - Waste or scrap, aluminium	10
Turkey	720839 - Flat rolled prod/coils>3mm	5
India	760110 - Aluminium unwrought, not alloyed	2
Turkey	720838 - Flat rolled prod/coils<3>4.	5
China	740721 - Bars, rods & profiles of copper-zinc base alloys	10

Table 18 − Top 10 new export opportunities in African, BRICS and N-11 countries for Transport equipment

Country	HS 6-digit product code and description	Filter 4 cell classification
China	870323 - Automobiles, spark ignition engine of 1500-3000 cc	2
Brazil	870323 - Automobiles, spark ignition engine of 1500-3000 cc	2
Ghana	870323 - Automobiles, spark ignition engine of 1500-3000 cc	7
Indonesia	870322 - Automobiles, spark ignition engine of 1000-1500 cc	2
Indonesia	870323 - Automobiles, spark ignition engine of 1500-3000 cc	2
Egypt	870322 - Automobiles, spark ignition engine of 1000-1500 cc	2
Egypt	870322 - Automobiles, spark ignition engine of 1000-1500 cc	2
China	880212 - Helicopters of an unladen weight > 2,000 kg	5
Zimbabwe	870421 - Diesel powered trucks weighing < 5 tonnes	2
Indonesia	870410 - Dump trucks designed for off-highway use	1

Table 19 − Top 10 new export opportunities in African, BRICS and N-11 countries for Machinery

Country	HS 6-digit product code and description	Filter 4 cell classification
China	840734 - Engines, spark-ignition reciprocating, over 1000 cc	5
China	840690 - Parts of steam and vapour turbines	4
Turkey	842959 - Earth moving/road making equipment, self-propelled ne	4
China	842139 - Filtering or purifying machinery for gases nes	6
China	848310 - Transmission shafts and cranks, cam and crank shafts	5
India	844790 - Tulle, lace, embroidery, trimmings etc. making machine	4
Brazil	840999 - Parts for diesel and semi-diesel engines	7
India	840820 - Engines, diesel, for motor vehicles	2
China	840999 - Parts for diesel and semi-diesel engines	7
India	842959 - Earth moving/road making equipment, self-propelled ne	4

[7] Basic metal products (SIC: 351-352, HS: 72-81); Transport equipment (SIC: 381-387, HS: 86-89); Machinery (SIC: 358-376, HS: 84); Electrical machinery (SIC: 356-357, HS: 85); Chemicals (SIC: 331-336, HS: 28-38).

Table 20 − Top 10 new export opportunities in African, BRICS and the N-11 countries for Electrical machinery

Country	HS 6-digit product code and description	Filter 4 cell classification
China	854140 - Photosensitive/photovoltaic/LED semiconductor devices	1
China	853720 - Electrical control and distribution boards, > 1kV	6
China	850519 - Permanent magnets & articles intended as magnets, nes	1
China	850153 - AC motors, multi-phase, of an output > 75 kW	4
China	851430 - Industrial/laboratory electric furnaces and ovens nes	3
Indonesia	852510 - Transmission apparatus for radio, telephone and TV	5
Ghana	852510 - Transmission apparatus for radio, telephone and TV	10
China	853620 - Automatic circuit breakers for < 1,000 volts	6
India	852813 - B & W television receive	5
China	851150 - Generators and alternators	5

Table 21 − Top 10 new export opportunities in African, BRICS and N-11 countries for Chemicals

Country	HS 6-digit product code and description	Filter 4 cell classification
India	310530 - Diammonium phosphate, in packs >10 kg	4
China	291521 - Acetic acid	1
Turkey	310230 - Ammonium nitrate, including solution, in pack >10 kg	1
Brazil	310230 - Ammonium nitrate, including solution, in pack >10 kg	5
China	293040 - Methionine	4
Vietnam	310530 - Diammonium phosphate, in packs >10 kg	1
China	321519 - Printing ink, other than black	1
Indonesia	310520 - Nitrogen-phosphorus-potassium fertilizers, pack >10kg	5
China	381590 - Reaction initiators, accelerators, catalysts, nes	9
China	320890 - Polymer based paint, varnish in non-aqueous medium ne	6

These results represent the product-country combinations that show the highest potential labour absorption and exports for the sectors within the manufacturing industry. Given that resources to support export expansion programmes are limited, these sectors and their respective product-country combinations were selected by means of CGE modelling and the DSM to offer the most realistic opportunities for export-led growth in the manufacturing employment sector.

5. CONCLUSION

5.1 Summary

The South African economy currently faces a number of challenges. Persistently high unemployment and entrenched poverty are forerunners, with high levels of corruption in both the public and private sectors detracting from the effort to establish South Africa as a reputable trading partner and investment destination. The South African government has produced a number of policy documents (i.e. the New Growth Path, the National Development Plan and the Industrial Policy Action Plan) that seek to address key areas in the economy. Among these key areas, manufacturing is identified as a sector that could play a more prominent role in the economy, especially in terms of its potential to deliver higher export and employment growth.

The aim of this paper was two-fold, namely to: i) identify those manufacturing sectors where an increase in exports would lead to the highest growth for the economy and employment, and ii) to identify new priority export opportunities in each of these sectors.

5.2 Results

The results from the CGE simulations indicate that the top five manufacturing sectors in terms of economic and employment growth potential are: basic metal products, transport equipment, machinery, electrical machinery and chemicals. These results confirm that a sector-specific, export-led strategy will benefit mostly skilled labour-intensive industries, with the possibility of a side effect of inequality and wage dispersion in the labour market. Once these sectors were identified, the DSM was used to identify new export opportunities within the sectors. The results focused on the African, BRICS and N-11 markets. Among these results, China appears to be a market that offers new opportunities across all five selected sectors.

5.3 Policy recommendations

The results presented in this study reveal export opportunities for cells 1 to 10 (see Table 2). As already mentioned, these cells represent opportunities in which South Africa currently has a very small market share relative to the top six competitors in the market. Successfully pursuing these export opportunities implies aggressive, cost-intensive export promotion strategies. As South Africa has a very low presence in these markets, an offensive marketing strategy would be required to establish a foothold in each market. This suggests that each export opportunity should be actively explored in co-operation with the export promotion organisation's offices abroad.

Cuyvers, Viviers, Sithole and Kuhn (2012) recommend the following export promotion strategies for new markets: providing exporters with information on a market's potential, organising high-profile trade missions supported by media campaigns in the target market, match-making with exporters of complementary products, giving incentives for piggy-back export systems, setting up meetings with key-decision makers in the target market (major importers or distributors), facilitating outgoing FDI to the target economy, informing exporters about trade barriers, and organising product-country focused seminars.

This paper provides the South African government with a realistic means of reaching some of the employment and export growth goals that form the basis of its national policy objectives. While opportunities abound, translating these opportunities into a more dynamic manufacturing sector that delivers ongoing benefits to the economy will require focused and cost-intensive export promotion strategies that have strong stakeholder input and support.

REFERENCES

Adams, P. D. (2005). Interpretation of results from CGE models such as GTAP. *Journal of Policy Modeling*, 27(8), p. 941-959.

Balassa, B. (1965). Trade liberalisation and revealed comparative advantage. New Haven, CT: Yale University Economic Growth Center.

Bohlmann, H.R. (2012). Reducing illegal immigration to South Africa: A dynamic CGE analysis. Working Papers 274, Economic Research Southern Africa.

Bohlmann. H.R. and Van Heerden, J.H. (2005). The Impact of Hosting a Major Sport Event on the South African Economy. Working Papers 200509, University of Pretoria, Department of Economics.

Cardozo, R., McLaughlin, K., Harmon, B., Reynolds, P. and Miller, B. (2003). Product-market choices and growth of new businesses. *Journal of Product Innovation Management*, 10(4), p. 331-340.

Cuyvers, L., Steenkamp, E.A. and Viviers, W. (2012). The methodology of the Decision Support Model (DSM). in Cuyvers, L. and Viviers, W. (eds). *Export Promotion: A Decision Support Model Approach*. Stellenbosch: Sun Media Metro.

Cuyvers, L., Viviers, W., Sithole, W. and Muller, M-L. (2012). Developing strategies for export promotion using a decision support model. in Cuyvers, L. and Viviers, W. (eds). *Export Promotion: A Decision Support Model Approach*. Stellenbosch: Sun Media Metro.

Department of Trade and Industry (2012). *Industrial Development.* [Online]
Available at: http://www.thedti.gov.za/industrial_development/industrial_development.jsp
[Accessed 12 April 2013].

Department of Trade and Industry (2011). *Industrial Policy Action Plan (IPAP).* Pretoria: the dti campus, Republic of South Africa.

Department of Trade and Industry (2012). *Industrial Policy Action Plan 2012/13-2014/15.* Pretoria: the dti campus, Republic of South Africa.

Dervis, K., De Melo, J. and Robinson, S. (1985). General equilibrium models for development policy. Cambridge: Cambridge University Press.

Economic Development Department (EDD) (2011). *The New Growth Path: Framework.* [Online]
Available at: http://www.economic.gov.za/communications/publications/new-growth-path-series
[Accessed 23 January 2014].

Heckscher, E. (1919). The Effect of Foreign Trade on the Distribution of Income. *Ekonomisk Tidskrift*, 2(21), p. 1-32.

Helpman, E. and Krugman, P. (1989). *Trade Policy and Market Structure.* Cambridge: MIT Press.

Hirshmann, A. (1964). The paternity of an index. *American economic review*, 54(5), p.761, Sep.

Horridge, M. (2000). ORANI-G: A generic single-country computable general equilibrium model. CoPS working paper OP-93. Centre of Policy Studies, Monash University.

Industrial Development Corporation (2012). *Sectoral trends: Performance of the primary and secondary sectors of the South African economy - statistical update.* Johannesburg: IDC Department of Research and Information.

Kemp, T. (1978). *Historical Patterns of Industrialization.* 1st edition. New York: Longman.

Kemp, T. (1989). *Industrialization in the Non-Western World.* 2nd edition. New York: Longman.

Kotabe, M. and Czinkota, M.R. (1992). State Government Promotion of Manufacturing Exports: A Gap Ananlysis. *Journal of International Business Studies*, Volume Fourth Quarter, p. 637-658.

Kumar, V., Stam, A. and Joachimsthaler, E.A. (1994). An Interactive Multicriteria Approach to Identifying Potential Foreign Markets. *Journal of International Marketing*, 2(1), p. 29-52.

National Planning Commission (2011). *National Development Plan 2030: Executive Summary*. Cape Town: The Presidency, Republic of South Africa.

Naudé, W.A. and Coetzee, Z.R. (2004). Globalisation and inequality in South Africa: Modelling the labour transmission mechanism. *Journal of Policy Modeling*, 26, p. 911-925.

O'Neill, J., Wilson, D., Purushothaman, R. and Stupnytska, A. (2005). How solid are the BRICs? Global Economics Paper No. 134. Goldman Sachs.

Ohlin, B. (1933). *Interregional and International Trade.* Cambridge: Harvard University Press.

ONDD (2011). *Country risk explanation.* [Online]
Available at:
http://www.ondd.be/webondd/Website.nsf/weben/Country+risks_Explanations(Visitors)?OpenDocument
[Accessed 23 October 2012].

Papadopoulos, N. and Denis, J. (1988). Inventory, taxonomy and assessment of methods for international market selection. *International Marketing Review.* Issue Autumn, p. 38-51.

SARS (2013). *South African Revenue Service: Trade Statistics.* [Online]
Available at: http://www.sars.gov.za/uploads/documents/83155_RSAFebruary2013.pdf
[Accessed 4 April 2013].

Singh, T. (2011). *International Trade and Economic Growth Nexus in Australia: A Robust Evidence from Time-Series Estimators.* Oxford: Blackwell.

Statistics South Africa (Stats SA) (2001). *Social Accounting Matrix for South Africa*. Pretoria: Statistics South Africa.

Statistics South Africa (Stats SA) (2012). *Compendium of industrial statistics.* Pretoria: StatsSA.

Statistics South Africa (Stats SA) (2013). *Economic growth.*
Available at: http://beta2.statssa.gov.za/?page_id=735&id=1
[Accessed 24 January 2014].

Statistics South Africa (Stats SA) (2014). *Manufacturing: Production and Sales (Preliminary).* Pretoria: Statistics South Africa.

Szirmai, A. (2012). Industrialisation as an engine of growth in developing countries, 1950-2005. *Structural Change and Economic Dynamics,* Issue 23, p. 406-420.

Tsen, W. (2009). Terms-of-Trade and Trade Balance: Evidence of Asian Economies. *The International Trade Journal,* XXIII(4), p. 422-457.

Van Heerden, J.H., Gerlagh, R., Blignaut, J., Horridge, M., Hess, S., Mabugu, R. and Mabugu, M. (2006). Searching for triple dividends in South Africa: Fighting CO_2 pollution and poverty while promoting growth. *Energy Journal*, 27 (2), p. 113-142.

Van Heerden, J.H., Blignaut, J. and Horridge, M. (2008). Integrated water and economic modelling of the impacts of water market instruments on the South African economy. *Ecological Economics,* 66 (1), p. 105-116.

Wells, H. and Thirlwall, A. (2003). Testing Kaldor's growth laws across the countries of Africa. *African Development Review,* Issue 15, p. 89-105.

Xiong, Z., Zhou, S. and Li, Y. (2012). An Empirical Study on the Relationship between Foreign Trade and Employment in Southwest Minority Region of China. *Advances in Information Sciences and Service Sciences,* 4(8), p. 124-130.

APPENDIX

Table A 1 − Observed percentage change to selected exogenous variables (from the base case)

Selected macroeconomic variables	All 20 manufacturing sectors in terms of economy-wide benefits																			
	Food processing	Beverages	Tobacco	Textiles	Clothing	Leather	Footwear	Wood	Paper	Printing and publishing	Chemicals	Rubber	Plastic	Non-metallic minerals	Basic metal products	Fabricated metal products	Machinery	Electrical machinery	Transport equipment	Other manufacturing
Real GDP	-0.004	-0.003	-0.003	0.013	0.014	0.005	0.001	0.016	0.022	0.003	0.075	0.004	0.008	0.009	0.138	0.023	0.076	0.033	0.096	0.012
GDP Price Deflator	1.811	0.138	0.014	0.014	0.017	0.014	0.013	0.002	0.023	0.069	0.006	0.345	0.012	0.007	0.016	0.257	0.027	0.082	0.049	0.126
Labour (Total Employment)	-0.013	-0.006	-0.007	0.027	0.031	0.010	0.002	0.038	0.051	0.007	0.125	0.007	0.018	0.022	0.337	0.052	0.162	0.065	0.201	0.026
Average Real Wage Rate*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Domestic Consumption*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Consumer Price Index	0.136	0.014	0.015	0.016	0.013	0.012	0.002	0.020	0.058	0.006	0.290	0.011	0.006	0.010	0.138	0.019	0.061	0.039	0.107	0.123
Government Consumption*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Exports (Volume Index FOB)	0.086	-0.002	-0.004	0.066	0.065	0.035	0.006	0.075	0.137	0.016	0.608	0.024	0.036	0.053	0.802	0.117	0.387	0.214	0.596	0.166
Export Price Index	0.076	0.005	0.005	0.010	0.007	0.009	0.001	0.017	0.056	0.003	0.282	0.008	0.004	0.010	0.383	0.022	0.072	0.039	0.086	0.137
Imports (Volume Index CIF)	0.108	0.007	0.006	0.031	0.024	0.022	0.004	0.031	0.080	0.007	0.428	0.015	0.013	0.028	0.434	0.056	0.177	0.129	0.343	0.146
Import Price Index*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Balance of Trade (% of GDP)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.003	0.000	0.001	0.000	0.001	0.001
Terms of Trade	0.076	0.005	0.005	0.010	0.007	0.009	0.001	0.017	0.056	0.003	0.282	0.008	0.004	0.010	0.383	0.022	0.072	0.039	0.086	0.137
Nominal Exchange Rate*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Real Devaluation (Attractiveness)	-0.137	-0.014	-0.014	-0.017	-0.014	-0.013	-0.002	-0.023	-0.069	-0.006	-0.344	-0.012	-0.007	-0.016	-0.256	-0.027	-0.081	-0.049	-0.126	-0.155

*[Note: * Exogenous by assumption]*

[Source: UPGEM simulation results]

Table A 2 − All manufacturing sectoral results—percentage change in relation to base

	Sectoral % Change	Value Added		Exports		Imports		Employment	
		Volume	Price	Volume	Price (LCU)	Volume	Price (FCU)*	Volume	Nominal Wage
1	Agriculture	-0.074	0.961	-3.849	0.986	2.543	0.000	-0.256	1.440
2	Gold mining	-0.902	0.178	-0.912	0.229	2.029	0.000	-1.345	1.440
3	Other mining	-0.282	0.286	-1.308	0.330	3.274	0.000	-0.710	1.440
4	Food processing	0.991	1.423	10.000*	1.433	2.544	0.000	1.921	1.440
5	Beverages	-0.004	1.403	10.000*	1.337	3.387	0.000	-0.014	1.440
6	Tobacco	0.001	1.408	10.000*	1.464	3.695	0.000	0.004	1.440
7	Textiles	2.387	1.461	10.000*	1.473	2.643	0.000	2.966	1.440
8	Clothing	0.978	1.334	10.000*	1.340	3.950	0.000	1.120	1.440
9	Leather	5.599	1.680	10.000*	1.698	3.395	0.000	8.932	1.440
10	Footwear	-0.455	1.067	10.000*	1.064	2.585	0.000	-0.729	1.440
11	Wood	3.278	1.653	10.000*	1.641	4.301	0.000	4.326	1.440
12	Paper	3.066	2.329	10.000*	2.364	4.034	0.000	6.620	1.440
13	Printing and publishing	-0.002	1.496	10.000*	1.448	1.584	0.000	-0.004	1.440
14	Chemicals	2.615	2.275	10.000*	2.313	3.415	0.000	6.761	1.440
15	Rubber	1.718	1.901	10.000*	1.903	2.472	0.000	3.520	1.440
16	Plastic	2.251	1.597	10.000*	1.538	3.529	0.000	2.816	1.440
17	Non-metallic minerals	0.849	1.598	10.000*	1.611	2.930	0.000	1.685	1.440
18	Basic metal products	6.535	3.431	10.000*	3.421	8.621	0.000	14.663	1.440
19	Fabricated metal products	1.867	1.987	10.000*	1.990	5.115	0.000	3.046	1.440
20	Machinery	4.175	1.968	10.000*	1.983	1.347	0.000	6.210	1.440
21	Electrical machinery	2.524	1.734	10.000*	1.747	1.255	0.000	4.435	1.440
22	Transport equipment	2.541	1.484	10.000*	1.496	2.964	0.000	3.843	1.440
23	Other manufacturing	2.292	3.684	10.000*	3.657	5.121	0.000	8.268	1.440
24	Electricity	0.813	2.370	0.000	0.000	0.000	0.000	2.715	1.440
25	Building	0.038	1.314	0.000	0.000	0.000	0.000	0.059	1.440
26	Civil engineering	-0.340	1.290	-5.024	1.297	0.000	0.000	-0.605	1.440
27	Trade	0.833	1.709	-6.575	1.715	0.000	0.000	1.573	1.440
28	Accommodation and catering	-0.522	0.528	-1.786	0.452	0.927	0.000	-2.129	1.440
29	Transport	0.703	1.711	-6.562	1.711	2.711	0.000	1.546	1.440
30	Communication	0.259	1.579	-6.097	1.585	0.000	0.000	0.594	1.440
31	Financial services	0.021	1.460	-5.655	1.466	0.000	0.000	0.065	1.440
32	Community services	-0.027	1.401	-5.386	1.394	2.852	0.000	-0.032	1.440

*[Note: * Exogenous by assumption (i.e. all exogenous variables not directly shocked will be zero)]*

[Source: UPGEM simulation results]

Table A 3 − Basic metal products sectoral results—percentage change in relation to base year

	Sectoral % Change	Value Added		Exports		Imports		Employment	
		Volume	Price	Volume	Price (LCU)	Volume	Price (FCU)*	Volume	Nominal Wage
1	Agriculture	-0.025	-0.014	0.027	-0.007	-0.072	0.000	-0.087	0.138
2	Gold mining	-0.121	0.025	-0.121	0.030	-0.021	0.000	-0.182	0.138
3	Other mining	-0.014	0.116	-0.469	0.118	1.549	0.000	-0.035	0.138
4	Food processing	-0.059	0.077	-0.311	0.078	0.100	0.000	-0.113	0.138
5	Beverages	-0.033	0.109	-0.422	0.106	0.256	0.000	-0.128	0.138
6	Tobacco	-0.033	0.109	-0.436	0.109	0.253	0.000	-0.127	0.138
7	Textiles	-0.232	0.116	-0.467	0.117	-0.005	0.000	-0.288	0.138
8	Clothing	-0.186	0.125	-0.506	0.127	0.348	0.000	-0.213	0.138
9	Leather	-0.309	0.085	-0.351	0.088	-0.010	0.000	-0.487	0.138
10	Footwear	-0.117	0.082	-0.340	0.085	0.185	0.000	-0.188	0.138
11	Wood	-0.192	0.110	-0.448	0.112	0.169	0.000	-0.252	0.138
12	Paper	-0.153	0.099	-0.404	0.101	0.080	0.000	-0.325	0.138
13	Printing and publishing	-0.053	0.119	-0.486	0.122	0.139	0.000	-0.086	0.138
14	Chemicals	-0.107	0.095	-0.381	0.095	0.146	0.000	-0.273	0.138
15	Rubber	-0.136	0.110	-0.450	0.113	0.080	0.000	-0.277	0.138
16	Plastic	-0.170	0.116	-0.479	0.120	0.054	0.000	-0.212	0.138
17	Non-metallic minerals	-0.153	0.118	-0.478	0.120	0.170	0.000	-0.303	0.138
18	Basic metal products	6.174	2.217	10.000*	2.200	4.597	0.000	13.829	0.138
19	Fabricated metal products	-0.092	0.497	-1.946	0.492	1.564	0.000	-0.149	0.138
20	Machinery	-0.678	0.260	-1.026	0.258	0.226	0.000	-0.999	0.138
21	Electrical machinery	-0.459	0.198	-0.789	0.198	0.021	0.000	-0.800	0.138
22	Transport equipment	-0.448	0.159	-0.633	0.159	0.150	0.000	-0.673	0.138
23	Other manufacturing	-0.111	0.082	-0.292	0.073	0.123	0.000	-0.390	0.138
24	Electricity	0.504	0.800	0.000	0.000	0.000	0.000	1.678	0.138
25	Building	0.010	0.178	0.000	0.000	0.000	0.000	0.016	0.138
26	Civil engineering	-0.047	0.172	-0.690	0.173	0.000	0.000	-0.083	0.138
27	Trade	0.112	0.182	-0.736	0.185	0.000	0.000	0.211	0.138
28	Accommodation and catering	-0.056	0.055	-0.195	0.049	0.113	0.000	-0.232	0.138
29	Transport	0.224	0.235	-0.933	0.235	0.462	0.000	0.491	0.138
30	Communication	0.010	0.156	-0.629	0.158	0.000	0.000	0.023	0.138
31	Financial services	0.003	0.146	-0.594	0.149	0.000	0.000	0.010	0.138
32	Community services	0.019	0.141	-0.569	0.143	0.310	0.000	0.023	0.138

*[Note: * Exogenous by assumption (i.e. all exogenous variables not directly shocked will be zero)]*

[Source: UPGEM simulation results]

Table A 4 − Transport equipment sectoral results—percentage change in relation to base year

	Sectoral % Change	Value Added		Exports		Imports		Employment	
		Volume	Price	Volume	Price (LCU)	Volume	Price (FCU)*	Volume	Nominal Wage
1	Agriculture	-0.016	-0.001	-0.013	0.003	-0.026	0.000	-0.057	0.107
2	Gold mining	-0.063	0.011	-0.063	0.016	-0.015	0.000	-0.096	0.107
3	Other mining	-0.026	0.001	-0.022	0.006	-0.037	0.000	-0.065	0.107
4	Food processing	-0.039	0.059	-0.231	0.058	0.081	0.000	-0.075	0.107
5	Beverages	-0.014	0.079	-0.279	0.070	0.174	0.000	-0.052	0.107
6	Tobacco	-0.013	0.080	-0.313	0.078	0.188	0.000	-0.051	0.107
7	Textiles	-0.095	0.088	-0.353	0.088	0.154	0.000	-0.118	0.107
8	Clothing	-0.141	0.097	-0.388	0.097	0.275	0.000	-0.162	0.107
9	Leather	-0.200	0.067	-0.271	0.068	0.174	0.000	-0.315	0.107
10	Footwear	-0.088	0.065	-0.261	0.065	0.157	0.000	-0.140	0.107
11	Wood	-0.131	0.078	-0.312	0.078	0.120	0.000	-0.173	0.107
12	Paper	-0.075	0.078	-0.312	0.078	0.126	0.000	-0.160	0.107
13	Printing and publishing	-0.004	0.103	-0.423	0.106	0.185	0.000	-0.007	0.107
14	Chemicals	-0.063	0.059	-0.224	0.056	0.076	0.000	-0.160	0.107
15	Rubber	0.041	0.099	-0.402	0.101	0.419	0.000	0.084	0.107
16	Plastic	0.057	0.093	-0.371	0.093	0.266	0.000	0.071	0.107
17	Non-metallic minerals	-0.041	0.081	-0.326	0.082	0.195	0.000	-0.082	0.107
18	Basic metal products	-0.075	0.065	-0.267	0.067	0.424	0.000	-0.164	0.107
19	Fabricated metal products	-0.001	0.090	-0.359	0.090	0.276	0.000	-0.001	0.107
20	Machinery	-0.187	0.071	-0.278	0.070	0.059	0.000	-0.275	0.107
21	Electrical machinery	-0.079	0.059	-0.236	0.059	0.106	0.000	-0.138	0.107
22	Transport equipment	3.631	0.463	10.000*	0.478	1.613	0.000	5.502	0.107
23	Other manufacturing	-0.058	0.037	-0.153	0.038	0.072	0.000	-0.206	0.107
24	Electricity	0.023	0.126	0.000	0.000	0.000	0.000	0.076	0.107
25	Building	0.011	0.088	0.000	0.000	0.000	0.000	0.018	0.107
26	Civil engineering	-0.023	0.088	-0.355	0.089	0.000	0.000	-0.041	0.107
27	Trade	0.291	0.204	-0.808	0.203	0.000	0.000	0.550	0.107
28	Accommodation and catering	-0.037	0.039	-0.129	0.032	0.076	0.000	-0.154	0.107
29	Transport	0.041	0.127	-0.511	0.128	0.174	0.000	0.089	0.107
30	Communication	0.055	0.148	-0.589	0.148	0.000	0.000	0.126	0.107
31	Financial services	0.019	0.132	-0.528	0.132	0.000	0.000	0.057	0.107
32	Community services	-0.013	0.109	-0.431	0.108	0.216	0.000	-0.015	0.107

*[Note: * Exogenous by assumption (i.e. all exogenous variables not directly shocked will be zero)]*

[Source: UPGEM simulation results]

Table A 5 − Machinery sectoral results—percentage change in relation to base year

	Sectoral % Change	Value Added		Exports		Imports		Employment	
		Volume	Price	Volume	Price (LCU)	Volume	Price (FCU)*	Volume	Nominal Wage
1	Agriculture	-0.010	-0.002	-0.001	0.000	-0.020	0.000	-0.034	0.061
2	Gold mining	-0.039	0.007	-0.039	0.010	-0.005	0.000	-0.059	0.061
3	Other mining	-0.015	0.003	-0.020	0.005	0.002	0.000	-0.039	0.061
4	Food processing	-0.024	0.034	-0.131	0.033	0.044	0.000	-0.046	0.061
5	Beverages	-0.011	0.045	-0.159	0.040	0.096	0.000	-0.041	0.061
6	Tobacco	-0.010	0.045	-0.178	0.045	0.106	0.000	-0.040	0.061
7	Textiles	-0.088	0.050	-0.192	0.048	0.010	0.000	-0.110	0.061
8	Clothing	-0.081	0.055	-0.218	0.055	0.151	0.000	-0.092	0.061
9	Leather	-0.134	0.038	-0.151	0.038	0.000	0.000	-0.211	0.061
10	Footwear	-0.056	0.037	-0.145	0.036	0.081	0.000	-0.089	0.061
11	Wood	-0.075	0.046	-0.184	0.046	0.075	0.000	-0.099	0.061
12	Paper	-0.054	0.044	-0.175	0.044	0.053	0.000	-0.114	0.061
13	Printing and publishing	-0.014	0.057	-0.232	0.058	0.085	0.000	-0.023	0.061
14	Chemicals	-0.034	0.037	-0.142	0.036	0.062	0.000	-0.087	0.061
15	Rubber	0.039	0.064	-0.256	0.064	0.294	0.000	0.080	0.061
16	Plastic	0.042	0.057	-0.238	0.060	0.181	0.000	0.053	0.061
17	Non-metallic minerals	-0.039	0.045	-0.178	0.045	0.085	0.000	-0.077	0.061
18	Basic metal products	0.039	0.072	-0.289	0.072	0.810	0.000	0.086	0.061
19	Fabricated metal products	0.177	0.092	-0.329	0.082	0.469	0.000	0.288	0.061
20	Machinery	4.942	0.661	10.000*	0.675	0.504	0.000	7.361	0.061
21	Electrical machinery	-0.035	0.041	-0.160	0.040	0.129	0.000	-0.060	0.061
22	Transport equipment	-0.116	0.046	-0.172	0.043	0.044	0.000	-0.174	0.061
23	Other manufacturing	-0.032	0.023	-0.096	0.024	0.058	0.000	-0.115	0.061
24	Electricity	0.027	0.092	0.000	0.000	0.000	0.000	0.091	0.061
25	Building	0.004	0.054	0.000	0.000	0.000	0.000	0.007	0.061
26	Civil engineering	-0.014	0.055	-0.220	0.055	0.000	0.000	-0.025	0.061
27	Trade	0.088	0.094	-0.376	0.094	0.000	0.000	0.165	0.061
28	Accommodation and catering	-0.022	0.022	-0.071	0.018	0.038	0.000	-0.091	0.061
29	Transport	0.035	0.075	-0.299	0.075	0.109	0.000	0.076	0.061
30	Communication	0.041	0.090	-0.359	0.090	0.000	0.000	0.093	0.061
31	Financial services	0.022	0.090	-0.358	0.090	0.000	0.000	0.069	0.061
32	Community services	0.032	0.065	-0.258	0.065	0.180	0.000	0.038	0.061

*[Note: * Exogenous by assumption (i.e. all exogenous variables not directly shocked will be zero)]*

[Source: UPGEM simulation results]

Table A 6 − Chemicals sectoral results—percentage change in relation to base year

	Sectoral % Change	Value Added		Exports		Imports		Employment	
		Volume	Price	Volume	Price (LCU)	Volume	Price (FCU)*	Volume	Nominal Wage
1	Agriculture	-0.054	0.016	-0.105	0.026	-0.036	0.000	-0.188	0.290
2	Gold mining	-0.175	0.033	-0.175	0.044	-0.035	0.000	-0.264	0.290
3	Other mining	-0.052	0.090	-0.394	0.099	1.131	0.000	-0.131	0.290
4	Food processing	-0.092	0.158	-0.610	0.153	0.239	0.000	-0.177	0.290
5	Beverages	-0.036	0.201	-0.768	0.193	0.494	0.000	-0.138	0.290
6	Tobacco	-0.035	0.202	-0.833	0.209	0.528	0.000	-0.134	0.290
7	Textiles	-0.510	0.301	-1.116	0.281	0.074	0.000	-0.632	0.290
8	Clothing	-0.328	0.237	-0.950	0.239	0.682	0.000	-0.375	0.290
9	Leather	-0.746	0.213	-0.858	0.216	0.068	0.000	-1.173	0.290
10	Footwear	-0.243	0.192	-0.773	0.194	0.481	0.000	-0.390	0.290
11	Wood	-0.434	0.206	-0.830	0.209	0.204	0.000	-0.570	0.290
12	Paper	-0.283	0.211	-0.828	0.208	0.209	0.000	-0.602	0.290
13	Printing and publishing	-0.053	0.253	-0.753	0.189	0.182	0.000	-0.087	0.290
14	Chemicals	2.569	1.330	10.000*	1.376	1.834	0.000	6.639	0.290
15	Rubber	-0.324	0.301	-1.150	0.290	0.283	0.000	-0.657	0.290
16	Plastic	0.080	0.434	-1.672	0.422	1.030	0.000	0.100	0.290
17	Non-metallic minerals	-0.225	0.204	-0.820	0.206	0.341	0.000	-0.446	0.290
18	Basic metal products	-0.407	0.105	-0.439	0.110	-0.116	0.000	-0.885	0.290
19	Fabricated metal products	-0.245	0.189	-0.766	0.192	0.297	0.000	-0.398	0.290
20	Machinery	-0.462	0.164	-0.665	0.167	0.067	0.000	-0.681	0.290
21	Electrical machinery	-0.344	0.167	-0.674	0.169	0.031	0.000	-0.599	0.290
22	Transport equipment	-0.433	0.164	-0.655	0.165	0.163	0.000	-0.651	0.290
23	Other manufacturing	-0.161	0.100	-0.414	0.104	0.175	0.000	-0.567	0.290
24	Electricity	0.031	0.300	0.000	0.000	0.000	0.000	0.104	0.290
25	Building	0.000	0.236	0.000	0.000	0.000	0.000	0.000	0.290
26	Civil engineering	-0.068	0.241	-0.969	0.244	0.000	0.000	-0.121	0.290
27	Trade	0.005	0.284	-1.135	0.286	0.000	0.000	0.009	0.290
28	Accommodation and catering	-0.098	0.104	-0.363	0.091	0.187	0.000	-0.404	0.290
29	Transport	0.152	0.381	-1.507	0.380	0.627	0.000	0.333	0.290
30	Communication	0.014	0.286	-1.147	0.289	0.000	0.000	0.032	0.290
31	Financial services	-0.007	0.276	-1.106	0.278	0.000	0.000	-0.020	0.290
32	Community services	-0.055	0.279	-1.101	0.277	0.495	0.000	-0.065	0.290

*[Note: * Exogenous by assumption (i.e. all exogenous variables not directly shocked will be zero)]*

[Source: UPGEM simulation results]

Table A 7 − Electrical machinery sectoral results—percentage change in relation to base year

	Sectoral % Change	Value Added		Exports		Imports		Employment	
		Volume	Price	Volume	Price (LCU)	Volume	Price (FCU)*	Volume	Nominal Wage
1	Agriculture	-0.005	0.003	-0.016	0.004	-0.001	0.000	-0.018	0.039
2	Gold mining	-0.023	0.004	-0.023	0.006	-0.003	0.000	-0.034	0.039
3	Other mining	-0.009	0.001	-0.011	0.003	0.000	0.000	-0.022	0.039
4	Food processing	-0.012	0.021	-0.081	0.020	0.030	0.000	-0.023	0.039
5	Beverages	-0.004	0.028	-0.104	0.026	0.067	0.000	-0.016	0.039
6	Tobacco	-0.004	0.028	-0.115	0.029	0.074	0.000	-0.016	0.039
7	Textiles	-0.036	0.028	-0.110	0.028	0.034	0.000	-0.045	0.039
8	Clothing	-0.042	0.030	-0.121	0.030	0.088	0.000	-0.048	0.039
9	Leather	-0.072	0.021	-0.084	0.021	0.007	0.000	-0.113	0.039
10	Footwear	-0.027	0.022	-0.087	0.022	0.059	0.000	-0.044	0.039
11	Wood	-0.028	0.028	-0.112	0.028	0.073	0.000	-0.037	0.039
12	Paper	-0.021	0.026	-0.102	0.026	0.047	0.000	-0.044	0.039
13	Printing and publishing	-0.014	0.031	-0.124	0.031	0.033	0.000	-0.023	0.039
14	Chemicals	-0.008	0.026	-0.101	0.025	0.078	0.000	-0.021	0.039
15	Rubber	-0.020	0.025	-0.100	0.025	0.035	0.000	-0.041	0.039
16	Plastic	0.124	0.041	-0.164	0.041	0.237	0.000	0.155	0.039
17	Non-metallic minerals	-0.013	0.028	-0.113	0.028	0.070	0.000	-0.025	0.039
18	Basic metal products	0.008	0.033	-0.133	0.033	0.341	0.000	0.016	0.039
19	Fabricated metal products	-0.012	0.032	-0.127	0.032	0.085	0.000	-0.019	0.039
20	Machinery	-0.074	0.027	-0.107	0.027	0.012	0.000	-0.109	0.039
21	Electrical machinery	3.157	0.616	10.000*	0.625	0.599	0.000	5.556	0.039
22	Transport equipment	-0.066	0.025	-0.098	0.025	0.025	0.000	-0.100	0.039
23	Other manufacturing	-0.019	0.014	-0.057	0.014	0.044	0.000	-0.066	0.039
24	Electricity	0.012	0.052	0.000	0.000	0.000	0.000	0.038	0.039
25	Building	0.001	0.040	0.000	0.000	0.000	0.000	0.001	0.039
26	Civil engineering	-0.009	0.034	-0.135	0.034	0.000	0.000	-0.016	0.039
27	Trade	0.009	0.042	-0.167	0.042	0.000	0.000	0.017	0.039
28	Accommodation and catering	-0.013	0.015	-0.049	0.012	0.027	0.000	-0.053	0.039
29	Transport	0.018	0.043	-0.173	0.043	0.064	0.000	0.039	0.039
30	Communication	0.013	0.053	-0.209	0.052	0.000	0.000	0.029	0.039
31	Financial services	0.004	0.044	-0.174	0.044	0.000	0.000	0.012	0.039
32	Community services	0.022	0.041	-0.163	0.041	0.115	0.000	0.026	0.039

*[Note: * Exogenous by assumption (i.e. all exogenous variables not directly shocked will be zero)]*

[Source: UPGEM simulation results]