South Africa and the global economic crisis: Assessing the effects using a static CGE model

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Abstract:

The aim of this paper is to estimate how the global financial and economic crisis may have affected the South African economy. The key macroeconomic transmission channels of the crisis are discussed for South Africa, a developing country whose financial sector had not been significantly exposed to the toxic assets that instigated the crisis, but whose strong trade and investment links with affected countries placed further strain on domestic pressures, leading to South Africa's first recession in 17 years.

Trade and foreign capital flows are considered the most relevant transmission channels. As the relative size of remittances and foreign aid is marginal, these movements are ignored in the model.

This analysis makes use of a static computable general equilibrium model. The PEP-1-1 standard model by Decaluwé et al (2009) is given minor changes and calibrated to a 2005 SAM and used to analyse the effects of an export volume shock, a shock in world export and import prices, and a decline in capital inflows to the country. There are 54 productive sectors and commodities. Capital and labour are the only production factors included, with the latter divided further into four broad skill types. Households have been disaggregated by income deciles.

Preliminary results indicate particularly severe effects of the crisis on the South African economy. As expected, exports and imports fall considerably. Diminished capital returns and transfers reduce the income and savings of firms. Household income, savings and consumption fall dramatically in response to lower wage rates, with lower income deciles facing harsher declines. South Africa has a persistent high rate of unemployment of approximately 25 per cent and relatively inflexible wage rates; therefore the extent to which labour is affected differs for skilled and unskilled workers.

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1. Introduction

The global financial and economic crisis has changed the world economy significantly, especially since the fire-sales and bankruptcies of major investment banks in the United States in the second and third quarters of 2008.

An encouraging period of sustained global economic growth preceded the crisis. Financial markets were characterised by loose regulations and increasingly integrated and electronic systems, an environment conducive to the development of highly leveraged and complex financial instruments, and speculative investors willing to demand such products.

A slump in the US property market in the mid-2000s caused rising default rates in sub-prime mortgage loans. This severely affected the values of sophisticated financial instruments that securitised those mortgages. Financial institutions, predominantly investment banks in advanced economies, incurred considerable losses due to downward revaluations of these types of assets. Similar conditions in the real estate and mortgage markets of other advanced economies raised concerns of further devaluations. This overwhelmed global financial markets and resulted not only in the collapse of major financial institutions such as Lehman Brothers and Bear Sterns, but significant erosion of asset values and a halt in credit. This led to several bankruptcies and large declines in trade and employment.

The financial crisis this soon deteriorated into a major economic crisis that affected most countries, albeit with varying severity depending on their level of integration with the world economy. The global financial and economic crisis is widely believed to be the worst crisis since the Great Depression. World GDP declined by 0.7 per cent year-on-year in real terms in 2009, as global production and trade volumes contracted sharply.

The sharp decline in trade, aid, remittances and international finance threatened progress in the economic development of developing countries with strong linkages to the advanced economies suffering recessions. Lower export revenues and capital made it difficult for developing countries to finance their balance of payments needs, forcing them to resort to exchange rate devaluations or trade restrictions, and increasing debt in an increasingly credit constrained environment.

As the crisis deepened, governments announced fiscal and monetary stimulus plans and bail out strategies to protect economic activity and minimise job losses among vulnerable segments of the population. Global economic activity recovered in 2010, mostly as a result of this. The rebound has, however, been slow to reverse the unemployment and poverty inflicted by the crisis.

South Africa, like most developing countries, was not spared from the global economic contraction. Its financial sector remained stable due to a strong regulatory environment and limited exposure of South Africa's comparatively risk-averse financial institutions to the toxic assets. This resilience, coupled with favourable fiscal indicators and resolute progress in government's infrastructure-building programmes, seemed to put the country in a good position to face the economic crisis, at least in the short-run. However, as recessions deepened in advanced economies, South Africa suffered from the weaker demand and appetite for her exports, and lower capital flows arising from risk aversion. Declining world prices of key export goods further limited export receipts. This led to a marked slowdown in economic growth and exacerbated already weaker employment, household income and consumption. In 2009, South Africa fell into recession for the first time in 17 years. Although the recession lasted only three quarters, the South African economy struggled to attain the strong growth rates it had achieved between 2004 and 2007. It should be noted however, that domestic inflationary pressures and rising interest rates, coupled with an electricity supply crisis that pre-dated the crisis, also had a significant bearing on the weak economic performance during this time.

There is widespread interest in analysing and understanding different dimensions of the crisis. The objective of this research is to explore and present an assessment the impact of the global financial crisis in South Africa in an economy-wide modelling framework. There have been a number of studies of the impact of the global crisis on the developing countries, and on South Africa in particular (see, for example, Chitiga et al, 2010). To our knowledge, however, a static computable general equilibrium model has not yet been used to perform a comparative static analysis and assess the marginal impact of the crisis for the South African case. Therefore, we use a static CGE model to understand and estimate how the global financial crisis affected the South African economy. We use the PEP-1-1 standard model to analyse the crisis, using a 2005 SAM for South Africa with 54 activities and commodities.

Given the limited impact of the crisis on the financial side of the economy, we pay particular emphasis on the impact of the crisis on real indicators. The main hypothesis highlights the magnitude of two primary transmission channels: trade, through the decline of world prices and foreign demand; and a reduction in world savings.

The remaining sections are organised as follows. Section 2 describes the recent economic performance of the South African economy, as well as general impacts of the crisis on the country. It is followed by a brief review on recent studies using CGE models to determine the effects of the crisis on developing countries. Section 3 provides an overview and explanation of the analytical famework, and describes data and the characteristics of the model applied. This is followed by a description of the simulations that were carried out and a discussion of the findings, which are assessed at an aggregate and sectoral level. We represent the crisis as a drop in world prices, world demand and foreign direct investment. The final section concludes.

2. Context

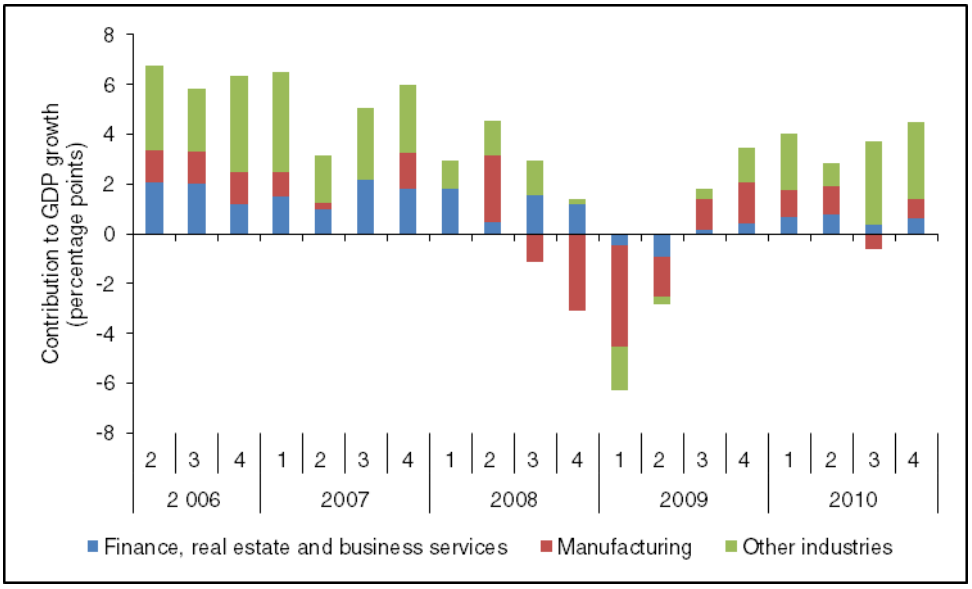
Various studies and reports have discussed how the crisis affected developing countries (see, for example, World Bank, 2009; Naude, 2009; Massa and te Velde, 2008; and Islam, 2009). Massa and te Velde (2008:1) identify the financial and real channels that may have affected developing countries. These include: stock market effects, the degrees to which the domestic foreign sector is exposed to foreign banks and affected assets, foreign direct investment, remittances, trade and aid.

This section presents a brief review of the economic performance of the South African economy over the recession and the years immediately preceding it. While the South African economy was already confronted by high inflation and interest rates and more restrained credit, the global economic crisis hastened the pressures the domestic economy was already facing. By the fourth quarter of 2008, real GDP declined, starting a trend that continued for two more quarters. The review suggests that, of the transmission channels discussed in literature, the most relevant transmission channels of the global economic crisis on the South African economy were trade and foreign investment.

Production

South Africa enjoyed its longest business cycle upswing – lasting 99 months – between September 1999 and November 2007. Between 2004 and 2007, GDP growth had been the strongest in the post-apartheid era, driven by a bourgeoning financial and business sector and, to a lesser extent, healthy growth in manufacturing. As shown in Figure 1, growth in the finance and business services industry regularly contributed a quarter of total GDP growth over this time.

Figure 1: Annualised quarter-on-quarter growth in GDP, partially segmented by industry contribution, 2006-2010



Source: Statistics South Africa, 2011

Annual GDP growth reached 5.6 per cent in 2006. However, domestic pressures and the rising impact of the global financial crisis would see that growth decelerate, to 3.6 per cent in 2008 and -1.5 per cent in 2009.

From the production side, early indications of weakening growth emerged in mid-2007 when value added in the mining sector, which has generally experienced haphazard growth[2], contracted by 9.9 per cent, starting a trend which would continue through 2010. There are various reasons for this. In 2007 and 2008, production came under pressure as a result of mine-closures due to strike action, unscheduled maintenance and safety concerns. Over the first quarter of 2008, load shedding by Eskom severely strained power supply to mines, leading to sharply lower production. Load shedding came about as a measure to manage demand, which could not be met due to unplanned maintenance at power stations and wet coal reserves, which hinder the quality of power output.

Stronger signs of a looming recession came in the third quarter of 2008, but it did not emerge completely from the effects of the global financial crisis. The trade, catering and accommodation sector contracted for the first time in seven years, driven down strongly by declining motor vehicle sales. The decline was attributed to moderating growth in real income, and lower consumer confidence and household spending, which had been negatively affected by high inflation and tighter credit conditions. Consumer inflation, which breached the inflation target band in March 2007, reached a 13.7 per cent year-on-year in August 2008. The prime interest rate rose to its highest level since the third quarter of 2003, and the introduction of the National Credit Act in June 2007 limited credit to already highly-indebted consumers. Weakening growth in credit extension and property markets affected output in the financial sector, which contracted in the first quarter of 2009, the first contraction in 17 years.

The agricultural sector, which experienced contracting output throughout 2009, was affected by lower incomes emanating from lower output and higher costs of associated inputs. Production volumes of maize moderated in comparison with the bumper crop yielded in the 2007/08 season. Output of summer crops also declined, as did the number of animals slaughtered.

[2] This is primarily due to sporadic surges in platinum-group metals output which offset the trend of declining gold output.

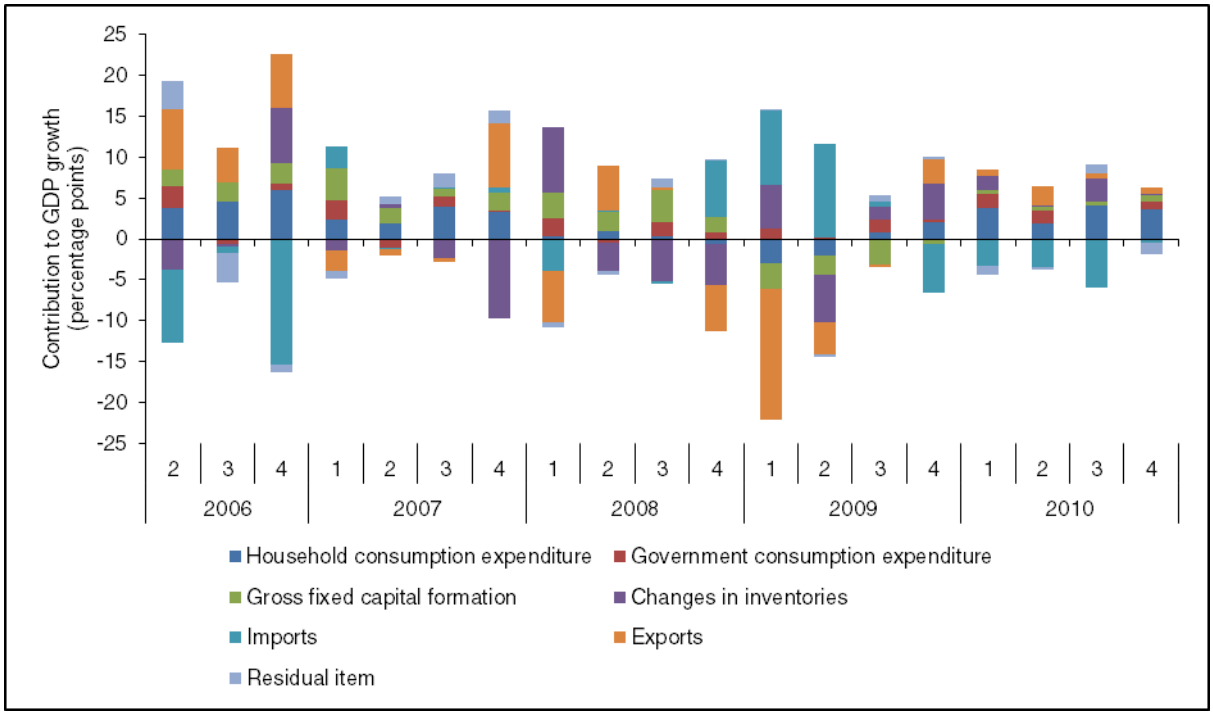
The effects of the global financial crisis on South African production became visible in the second half of 2008, when the mining sector started to feel the effects of weaker global demand and falling commodity prices, leading producers to reduce output. Falling commodity prices and deteriorating export demand also exacerbated production in manufacturing sectors, which had already been moderating due to weak domestic demand and subdued business confidence.

GDP contracted in the fourth quarter of 2008, by an annualised 1.7 per cent. It declined again in the following quarter, by 6.3 per cent, to mark South Africa's first technical recession since 1992. The technical recession was short-lived, as positive GDP growth resumed in the third quarter of 2009 and the business cycle was found to be in an upswing since September 2009.

Household expenditure

The trends in the demand-side components of GDP growth are presented in Figure 2.

Figure 2: Annualised quarter-on-quarter growth in GDP, segmented by expenditure component, 2006-2010



Source: South African Reserve Bank

Final household consumption spending is the largest expenditure component of GDP, accounting for between 60 and 65 per cent of GDP. Between 2004 and 2006, growth in household expenditure had been considerably strong and responsible for the bulk of GDP growth. From 2007, growth in household spending moderated, initially driven by sharply lower vehicle sales, which were affected by higher interest rates and stricter credit requirements. Income growth started to taper off as a result of slowing economic activity, and rising debt costs further strained the discretionary income of indebted households. Rising fuel, electricity and food prices placed additional pressure on budgets, forcing household to reduce their purchases. Household consumption expenditure eventually contracted in the second half of 2008. This continued until the third quarter of 2009 when household spending grew, likely as a result of falling interest rates and improving household balance sheets.

Government expenditure

In general, growth in government consumption expenditure remained positive. Rising personnel expenditure and spending related to the defence procurement programme supported growth in government expenditure. Government also boosted spending on its social security programmes.

Gross capital formation

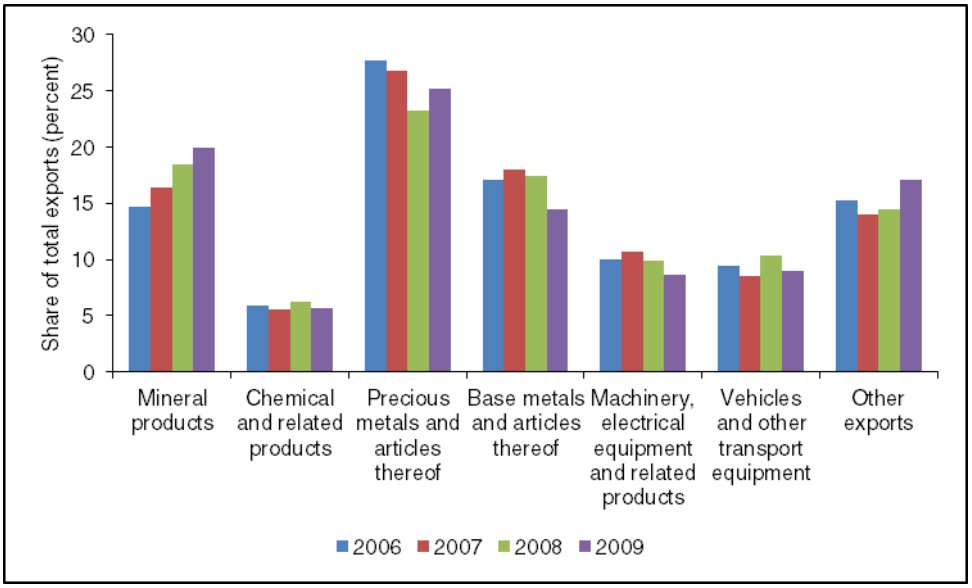
Gross fixed capital formation grew rapidly between 2003 and 2008, propelled by rising investment by public corporations, particularly on electricity, communications and transport infrastructure projects. Notable investments include those of the Airports Company of South Africa, which invested heavily on upgrading airports in time for the 2010 FIFA World Cup, and Eskom, which devoted significant capital spending on the Medupi and Kusile power stations. Capital spending by general government increased as well, as a result of transport projects and stadium construction related to the 2010 FIFA World Cup, as well as a drive to improve and maintain general infrastructure such as roads, housing, water and sanitation. Private sector fixed capital formation also grew encouragingly, driven by residential property and commercial real estate, but also boosted by initiatives such as the Gautrain rapid rail link and higher capital outlays by financial and mining companies.

As residential property demand waned in light of falling business and consumer confidence, growth in private sector capital formation started to sputter. Global economic uncertainties amplified concerns by the private sector. The threat of prolonged weak domestic and export demand caused businesses to delay new capital projects and slow down projects that had already resumed. A growing reluctance by domestic and foreign banks to finance capital projects compounded this. Government, however, reinforced its commitment to its infrastructure spending programme. In addition to investing in the infrastructure to foster future growth, this served to support employment during the downturn.

Exports

South African export products are largely concentrated in mining output or mining-related manufacturing. Figure 3 shows the largest export sections. In 2006, the six largest export sections accounted for nearly 85 per cent of exports, with precious metals, base metals and mineral produces account for nearly 60 per cent of exports in 2006.

Figure 3: Composition of selected South African exports, 2006-2009



Source: South African Revenue Service

Mineral prices rose strongly between 2005 and mid-2008, as presented in Table 1, which shows the international prices of some mineral commodities for which South Africa is a major exporter, or which comprise a large share of South African mineral exports.

Table 1: Movements in the international prices of selected mineral commodities, 2005-2010

Mineral	Unit	2005	2006	2007	2008	2009	2010
Coal	Index (2005=100)	100.0	104.4	137.6	265.9	148.8	206.0
	Annual change (%)		4.4	31.8	93.2	-44.0	38.4
Chromium	Index (2005=100)	100.0	102.2	104.0	138.4	123.6	141.4
	Annual change (%)		2.2	1.8	33.0	-10.7	14.4
Gold	Index (2005=100)	100.0	149.3	172.2	215.3	240.1	302.2
	Annual change (%)		49.3	15.3	25.0	11.6	25.8
Industrial diamond	Index (2005=100)	100.0	81.5	70.4	55.6	63.0	51.9
	Annual change (%)		-18.5	-13.6	-21.1	13.3	-17.6
Iron and steel slag	Index (2005=100)	100.0	113.6	125.0	102.3	108.0	96.6
	Annual change (%)		13.6	10.0	-18.2	5.6	-10.5
Iron ore	Index (2005=100)	100.0	121.1	134.0	158.3	208.5	222.0
	Annual change (%)		21.1	10.7	18.1	31.8	6.5
Manganese	Index (2005=100)	100.0	73.3	70.6	276.8	181.1	209.1
	Annual change (%)		-26.7	-3.7	291.9	-34.6	15.5
Palladium	Index (2005=100)	100.0	158.7	175.6	174.5	130.5	260.7
	Annual change (%)		58.7	10.7	-0.6	-25.2	99.7
Platinum	Index (2005=100)	100.0	127.2	145.5	175.5	134.2	179.6
	Annual change (%)		27.2	14.3	20.6	-23.5	33.8
Rutile	Index (2005=100)	100.0	101.1	103.8	111.7	113.4	114.9
	Annual change (%)		1.1	2.7	7.6	1.5	1.3
Vanadium	Index (2005=100)	100.0	48.3	45.5	79.4	33.4	39.9
	Annual change (%)		-51.7	-5.9	74.6	-58.0	19.7
Vermiculite	Index (2005=100)	100.0	96.5	97.9	97.9	90.9	104.9
	Annual change (%)		-3.5	1.4	0.0	-7.1	15.4

Source: US Geological Survey, World Trade Organisation

Mining exports fell as a result of lower mining output (some of the reasons for this have already been pointed out above) – the most pronounced decline occurred in the first quarter of 2008. Rising commodity prices over this period, however, helped to raise the value of exports in Rand terms. Rising demand, particularly from China, helped to boost exports of coal and metals. Higher gold prices, spurred by the turbulence caused by the sub-prime crisis and speculative oil price shocks, helped to improve the value of gold exports.

Commodity prices fell sharply from the second half of 2008 through 2009, prompting exporters to reduce output. Weakening output in Europe, the United States and Japan caused a decline in their demand for South African exports; hence, export volumes fell considerably, considering that those regions collectively account for more than half of South African exports. It is thus important to note that the decline in export receipts due to the crisis was the result of both lower commodity prices and weakening export demand. Mining exports to Asian countries slowed temporarily, but recovered soon afterwards. Restrained lending from financial institutions also forced companies to cut back employment, capital spending and production, which consequently impacted export volumes. According to the South African Reserve Bank, volumes of merchandise exports (excluding gold) fell by 22.4 per cent between 2008 and 2009, while values of merchandise exports contracted by 23.2 per cent.

Economic stimulus packages introduced in advanced economies, along with encouraging “green shoots” pointing towards recovering economic activity, provided some relief to export demand.

The precipitous declines in export revenues between the fourth quarter of 2008 and the second quarter of 2009 would significantly affect GDP growth. Figure 2 points out the contribution of the sharp declines in export revenues that contributed to declining GDP over the period.

Thus, we consider the changes in foreign demand – especially from the European Union, the United States and Japan – and world prices to have exerted considerable pressure on the competitiveness of South African exports. Depending on the extent to which FOB export prices adjust, lower demand and commodity prices could negatively affect production in export industries, as well as industries with which they have strong backward linkages. This also negatively affects factor demand and incomes, which further affects consumption.

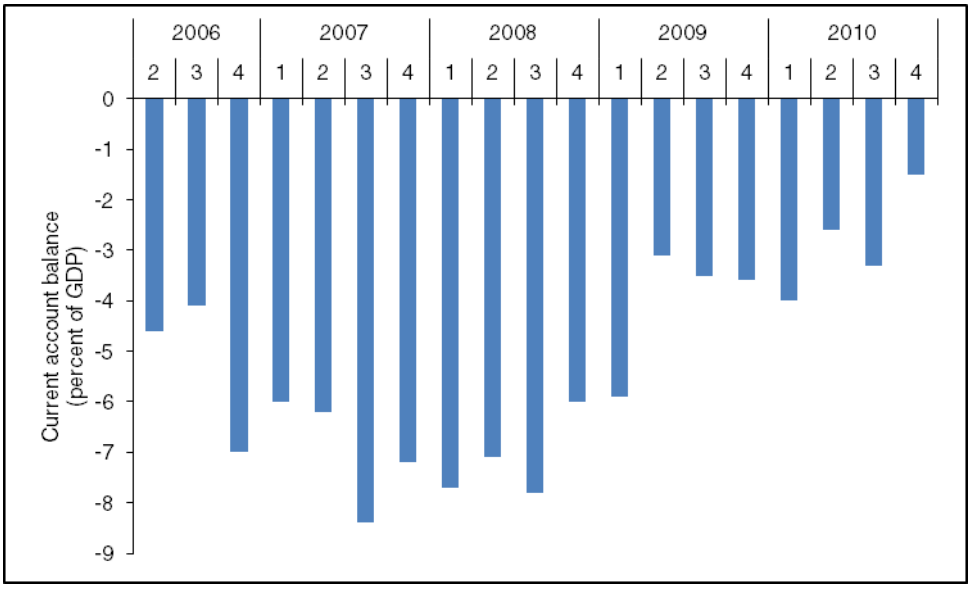
Imports

Imports of oil fell in the first quarter of 2007 but its effect on total imports was partially offset by imports related to the Government's defence procurement programme and continued strong growth in imports of capital goods.

Delayed capital projects and sluggish domestic demand discouraged imports, despite falling international prices. Weaker demand for exports also negatively affected demand for imported intermediate goods. According to the South African Reserve Bank, merchandise imports fell by 20.5 per cent in volume terms, and by 25.1 per cent in value terms, between 2008 and 2009.

As mentioned, buoyant demand for South African exports, notably from China and India, supported a favourable trade balance. Buoyant capital spending, however, boosted imports and limited the extent to which the trade deficit narrowed. Service, income and current transfers to the rest of the world were also increasing, due to rising dividend payments to non-residents. This resulted in a widening of the current account deficit to as much as 8.4 per cent of GDP in the third quarter of 2007, illustrated in Figure 4. Lower production as a result of the domestic electricity crisis prevented an improvement in early-2008.

Figure 4: Current account balance, percentage of GDP, 2006-2010



Source: South African Reserve Bank

The global economic crisis weakened exports, while domestic conditions saw slower, but not yet negative, growth in imports. Consequently, the current account balance widened further in the third quarter of 2008. Despite lower export demand, the current account balance narrowed in the following quarters, as oil prices fell and domestic conditions reduced demand for imports of capital and consumer goods, and weaker domestic output lowered service, income and current transfers to the rest of the world.

Financial account

The attractiveness of emerging market economies as an investment destination helped South Africa receive large amounts of portfolio investment from 2004. The value of portfolio investment liabilities rose by 156 per cent between 2004 and 2007. Crucially, this enabled a financial account surplus to help finance the current account deficit. Foreign direct investment also rose since 2005, through the acquisitions of sizeable shareholding in South African banks (notably of Absa Group by Barclays and of Standard Bank by the Industrial and Commercial Bank of China), communications companies (of Vodacom by Vodafone), mining and manufacturing companies, and retailers and hotel groups. Foreign liabilities related to direct investment rose by 107 per cent between 2004 and 2007. Net foreign reserves were boosted since the first quarter of 2004, as the financial account surplus more than compensated for the current account deficit.

Portfolio *outflows* were recorded in the third quarter of 2008, as risk aversion towards emerging market assets diverted funds to developed markets. As capital inflows subsided amid a wide current account deficit in 2008, reserve accumulation moderated. When the current account deficit eventually narrowed and capital inflows accelerated again, due to increased investor confidence resulting out of monetary and fiscal stimulus packages, net international reserves climbed once more.

We expect declines in foreign investment to also have had notable effects on the South African economy. Lower portfolio investment was driven by the risk aversion caused by the financial crisis, and foreign direct investment was similarly affected by a generally constrained credit environment and meagre growth prospects given the anticipated effect of the crisis on demand. The effects of these on the balance of payments stability and domestic investment are considerable, and could have long-run effects on aggregate output.

Employment

Job losses were significant. Between the third quarter of 2008 and the first quarter of 2010, employment declined by 6.2 per cent, or 852 000 jobs. The unemployment rate rose two percentage points to 25.2 per cent over the period. However, this is based on the official definition, and does not take into account the 71.7 per cent increase in discouraged work seekers over the period. The expanded definition of unemployment, which does include discouraged work seekers, rose from 27.6 per cent in the third quarter of 2008, to 32.4 per cent in the first quarter of 2010.

Owing to their large shares of employment, the manufacturing and trade industries accounted for the largest drop in employment. Quarterly Labour Force Surveys indicate that the manufacturing industry shed as many as 208 000 jobs between the third quarter of 2008 and the first quarter of 2010, while employment in the trade sector declined by 351 000 over the same period. However, the employment declines have struggled to recover. Between the first quarter of 2010 and the same quarter of 2011, the manufacturing sector increased its employment by 94 000, and the trade industry by 137 000, both of which remained below the shortfall created by the recession.

Transmission channels

In summary, the South African economy benefited from favourable production, and domestic and foreign demand since 2004. Macroeconomic stability supported this growth, but cracks emerged as inflation and interest rate increases broke the momentum of household spending, and industrial action and electricity supply constraints hurt production. In addition to these domestic pressures, the effects of the turmoil in global financial and economic markets became visible in the South African economy in mid-2008. While the recession was short-lived, the recovery has been slow, especially with respect to employment.

Based on the above discussion, we believe that the crisis effects manifested primarily through two channels: trade, which was affected by world prices and weaker export demand; and investment, which was affected by risk aversion towards emerging market economies, and a weaker environment for foreign direct investment.

Thus, a computable general equilibrium model is used to capture these transmission channels and assess how they may have affected the South African economy.

Applying CGE models to economic and financial crises

CGE models capture detailed accounts of receipts and payments in an economy, while achieving equilibrium in all markets simultaneously. As such, they are useful to analyse how industries and institutions digest external shocks, such as the global financial and economic crisis, based on how the various agents interact with each other. Various studies relating to financial and economic crises are available in CGE literature.

Yeldan (1995) traces the 1994 Turkish economic crisis first by simulating the 1990-1993 growth path, and then analysing a set of counterfactual scenarios to uncover the mechanisms behind the crisis.

Robilliard, Bourguignon and Robinson (2001) use a standard CGE model combined with a microsimulation module to assess scenarios relating to the 1997 financial crisis in Indonesia. The CGE model incorporates currency depreciation, lower domestic capital availability, and lower foreign credit availability to capture the transmission channels of the financial crisis. These are supplemented by a simulation through which the effects of the El Nino drought that occurred at the time are captured. They find that the lower availabilities of foreign and domestic credit have more severe impacts on macroeconomic variables than currency depreciation. The impact of the drought had similarly profound impacts on private consumption and imports.

In their analysis of Uruguay's integration into MERCOSUR, Terra et al (2006) use a CGE model to show the impact of five simulations – a decline in Argentine and Brazilian relative prices as a result of the Argentine financial crisis and the Brazilian currency crisis, restricted foreign savings, full enforcement of the MERCOSUR customs union, and a subsidy on employment of unskilled labour – on the Uruguayan economy. These shocks are run in a model with a competitive labour market, and in another with an efficiency wage specification. The changes in relative prices cause the main macroeconomic variables to decline. The impact is stronger for relative price shocks from Argentina than Brazil, and is particularly pronounced in the efficiency wage model. This is due, however, to higher levels of trade with Argentina than Brazil, and differences in factor intensity of exports.

The impacts of the global financial crisis soon inspired studies using CGE analysis to estimate the impact of the crisis on the wider economy, and on specific groups of people.

Francois, Holzner and Pindyuk (2011) use a multi-regional CGE model, focused on the Austrian economy, to estimate the impact of the crisis by shocking investment and private demand of major trading partners.

Bénassy-Quéré *et al.* (2009) use the MIRAGE model to assess if GDP growth, oil prices and falling investment can together replicate the large decline in world trade experienced during the crisis.

For Pakistan, Ahmed and O'Donoghue (2010) use a static CGE model and a microsimulation model to analyse the effects of, firstly, the observed changes in wage rates, self-employment and consumer prices and, secondly, a decline in foreign savings as the crisis scenario.

Willenbockel (2009) considers the effects on developing countries of a successful Doha Round agreement and increased protectionism in light of the crisis using the static, multi-region GLOBE CGE model. A successful Doha agreement would have very mild welfare gains, insufficient to overcome the

crisis. Raising import duties to the pre-Doha bound rates would have severe effects on welfare and trade, especially when unemployment is taken into account.

Willenbockel and Robinson (2009) analyse the impact of a recession in the OECD and China on trade, world prices and welfare on the rest of the world using a multi-region static CGE model, and focus mainly on countries in Asia and Africa. Holding financial flows fixed and observing only the trade channel, they find that developing countries show varying degrees of vulnerability to the crisis. The differences in export structures and degrees of openness thus play a crucially important role in determining how pronounced an effect the crisis would have on the domestic economy. In particular, net fuel exporters with a high share of fuel exports to total export receipts experience considerable welfare losses, as do countries with high degrees of openness (Willenbockel and Robinson, 2009:18).

Some studies have assessed the crisis impacts on vulnerable groups. Balma *et al* (2010) apply a CGE model to the economy of Burkina Faso evaluate the impact of the crisis, through various transmission mechanisms. Price, wage, employment and income information are then used as inputs to inform a microeconomic analysis, in which the effects on households and, in particular, children are analysed. A similar study is conducted for Cameroon by Bibi *et al* (2010).

Following a project by the Poverty and Economic Policy research network, that sought to estimate the impacts of the crisis on developing countries, a number of studies applied the PEP-1-1 to obtain these estimates.

Estrades and Llambi (2011) apply the PEP-1-1 model to analyse the effects of the crisis and policy responses on the Uruguayan economy. They shock world export and import prices, external demand and the current account balances for their crisis scenario, and find sharp impacts on exports and investment. Labour demand falls for semi-skilled and unskilled labour, and the negative effects on household incomes are biased towards poorer households. They also run a microsimulation module and find that the crisis exacerbates extreme poverty and increases the Gini coefficient slightly. However, their broader measure of poverty falls, as the negative impact on household income is more than compensated for by lower consumer prices. Three policy responses are run – an injection in real government consumption is found to be the most beneficial for macroeconomic aggregates.

Cicowiez and Machicado (2010) also apply the PEP-1-1 model, to the Bolivian case. The crisis scenario used incorporates reductions in the world export prices of agriculture and mining, world demand for textiles, foreign savings and remittances. The shock in the world price of mining delivers the harshest impact on the Bolivian economy.

In his analysis of the Colombian economy, Arguello (2010) uses the PEP-1-1 model to determine the impact of the crisis by implementing observed shocks on remittances and exports. Two specifications are run: one that assumes perfect labour mobility and another that restricts this. Akin to Cicowiez and Machicado's (2010) analysis for Bolivia, international prices tend to define the impact on trade variables.

Chitiga, Mabugu and Maisonnaive (2010) use the PEP-1-t dynamic model to examine how falling export demand, world prices and foreign direct investment would affect the South African economy. Activities are grouped into four categories according to how the crisis is expected to affect them. A moderate scenario and severe scenario are run. In the severe scenario, shocks are at least four times more intense for world prices and demand compared with the moderate scenario, and double that for foreign transfers to firms. The shocks, notably the severe scenario, show sharp declines in a number of production, price and factor variables. Again, the declines in world prices show the largest effect on the economy.

Corong and Taningco (2010) also use the PEP-1-t dynamic model. Their crisis scenario focuses on the trade channel, incorporating shocks in world import and export prices, and export demand.

3. Analytical Framework

This study applies the PEP-1-1 single-country, static computable general equilibrium (CGE) model to estimate the effects of the global crisis on the South African economy. While some details of the model are discussed here, the full documentation is available in Decaluwe *et al* (2009). The model is calibrated to a 2005 SAM for South Africa, using various production and demand elasticities.

Social Accounting Matrix

The main data source for the PEP-1-1 model applied to South Africa is the 2005 SAM for South Africa by Quantec Research. The accounts in the SAM are presented in Table 2. Production is split across 54 activities and commodities. Four of these correspond to primary sectors, 30 to industrial sectors and 20 to service sectors. This level of industrial disaggregation allows us to identify specific subsectors that were affected by the crisis. Four types of labour are identified according to their skill level. Capital is the only other factor of production. There are four types of institutions: households, firms, government and the rest of the world. Households are divided into 12 representative households corresponding to income deciles. The tenth decile, however, is divided further into three percentile ranges.

Table 2: Description of accounts included in the 2005 SAM for South Africa

Set	Elements
Activities/Commodities	Agriculture, forestry and fishing (1 element) Mining and quarrying (3 elements) Manufacturing (27 elements) Electricity, gas and water (2 elements) Construction (1 element) Trade, catering and accommodation (2 elements) Transport and communication services (7 elements) Finance, insurance and business services (2 elements) Community, social and personal services (9 accounts, including 7 categories of general government services)
Factors of production	4 labour types: highly skilled; skilled; semi- and unskilled; informal Capital
Institutional agents	Households (12 elements; by income decile, with tenth decile divided into three percentile ranges) Enterprises (1 element) Government (1 element) Rest of the world (1 element)

Source: 2005 SAM for South Africa

While the PEP-1-1 model allows for various specific types of tax accounts, only four are considered in the SAM: direct taxes, customs and excises, value-added tax, and production taxes.

Accumulation accounts include a savings-investment account and an inventory change account.

According to the SAM, GDP in 2005 was R1 523.5 billion. Table 3 breaks this down according to consumption category. As mentioned above, household final consumption expenditure makes the largest contribution to GDP. In the SAM, this is 63.55 per cent.

Table 3: GDP and expenditure components, 2005

Component	R millions	Percent of GDP
Household consumption	967 954	63.55
Government consumption	307 396	16.85

Gross fixed capital formation	256 621	0.89
Changes in inventories	13 587	20.18
Exports	412 732	27.10
Imports	(435 036)	(28.56)
GDP (final demand)	1 523 524	

Source: 2005 SAM for South Africa

Using the factor cost approach, gross value added is found to be R1 353.0 billion – the difference between this and GDP at market prices is made up of indirect taxes: VAT, customs and excises. The share of each industry's value added to total is summarised in Table 4, and the ten largest contributors to value added are highlighted. The table shows that value added is concentrated largely in the services sector, accounting for more than two-thirds of total value added. Manufacturing, electricity, water and consumption make up 23.6 per cent of overall value added, while agriculture and mining constitute the rest.

Table 4: Relative share of value added, by activity, 2005

Activity	%	Activity	%	Activity	%
Agriculture, forestry and fishing	2.68	Glass and glass products	0.17	Railway transport	0.68
Coal mining	1.38	Nonmetallic minerals	0.60	Road transport	3.36
Gold and uranium mining	1.30	Basic iron and steel	1.18	Transport via pipeline	0.07
Other mining	4.34	Basic nonferrous metals	0.66	Water transport	0.40
Food	1.92	Metal products excluding machinery	1.06	Air transport	0.14
Beverages and tobacco	1.16	Machinery and equipment	0.84	Transport support services	1.58
Textiles	0.29	Electric machinery	0.52	Communication	3.87
Wearing apparel	0.38	Television, radio and communication equipment	0.17	Finance and insurance	9.23
Leather and leather products	0.06	Professional and scientific equipment	0.10	Business services	11.32
Footwear	0.07	Motor vehicles, parts and accessories	1.69	Medical, dental and other health and veterinary services	2.28
Wood and wood products	0.46	Other transport equipment	0.21	Community, social and personal services	3.96
Paper and paper products	0.64	Furniture	0.24	Government – general administration	1.92
Printing, publishing and recorded media	0.50	Other industries	1.41	Government – defence	0.96
Coke and refined petroleum products	1.41	Electricity, gas and steam	1.92	Government – law and order	2.63
Basic chemicals	1.02	Water supply	0.41	Government – education	5.87
Other chemicals and man-made fibres	1.19	Building construction	2.48	Government – health	2.08
Rubber products	0.19	Wholesale and retail trade	13.47	Government – social	1.00
Plastic products	0.67	Catering and accommodation services	1.09	Government – economic	0.75

Source: 2005 SAM for South Africa

Collectively, government is the largest employer, as 26 per cent of labour payments accrue to its seven constituent activities. The wholesale and retail trade industry is the largest employer outside government, and accounts for 12.8 per cent of total payments to labour. Finance and insurance, which contributes 9.2 per cent to gross value added, is responsible for 8.4 per cent of labour payments.

According to the SAM, Government employs 27 per cent of highly-skilled labour, 37 per cent of skilled labour, and 10.4 per cent of semi-skilled and unskilled labour. The trade and catering industry accounts for 12.5 per cent of highly skilled labour, 13.7 per cent of skilled labour, and 29.4 per cent of informal labour. Finance and insurance employs 14.2 per cent of highly skilled labour, while community, social and personal services accounts for 21.6 per cent of semi-skilled and unskilled labour.

The labour intensity of activities is perhaps more significant than the distribution of labour across activities. The distribution of labour reveals little about what kind of labour is employed by each activity. Table 5 seeks to answer this, by marking the skills categories which make up at least one third of total employment in that industry.

Table 5: Skills intensity of activities, 2005

Activity	HS	SK	SU	Activity	HS	SK	SU
Agriculture, forestry and fishing		X		Motor vehicles, parts and accessories	X	X	
Coal mining			X	Other transport equipment	X	X	
Gold and uranium mining	X		X	Furniture		X	
Other mining			X	Other industries		X	
Food		X	X	Electricity, gas and steam	X		
Beverages and tobacco	X			Water supply	X		X
Textiles		X		Building construction			X
Wearing apparel		X	X	Wholesale and retail trade		X	
Leather and leather products		X	X	Catering and accommodation services		X	
Footwear		X	X	Railway transport		X	
Wood and wood products			X	Road transport		X	
Paper and paper products	X	X		Transport via pipeline		X	
Printing, publishing and recorded media	X	X		Water transport		X	
Coke and refined petroleum products	X			Air transport		X	
Basic chemicals	X	X		Transport support services		X	
Other chemicals and man-made fibres	X			Communication	X	X	
Rubber products			X	Finance and insurance	X		
Plastic products			X	Business services	X	X	
Glass and glass products		X		Medical, dental and other health and veterinary services	X	X	
Nonmetallic minerals			X	Community, social and personal services			X
Basic iron and steel			X	Government – general administration	X	X	
Basic nonferrous metals			X	Government – defence	X	X	
Metal products excluding machinery	X	X		Government – law and order	X	X	
Machinery and equipment	X	X		Government – education	X	X	
Electric machinery		X		Government – health	X	X	
Television, radio and	X	X		Government – social	X	X	

communication equipment							
Professional and scientific equipment	X	X		Government – economic	X	X	

Source: 2005 SAM for South Africa

Most sectors are more capital intensive than labour intensive. Notable exceptions include general government, gold and uranium mining, and community, social and personal services.

The trade structure of South African industries is presented in Table 6. Other mining makes up 12.8 per cent of total exports, while basic iron and steel contributes 10.5 per cent. The share of machinery and equipment exports to the total amounts to 7.1 per cent, while that for motor vehicles is 6.7 per cent. Gold mining contributes 6.6 per cent to total exports. The major import commodities are motor vehicles, which form 15.3 per cent of total exports, machinery and equipment, at 12.8 per cent, and other mining, at 11.1 per cent.

Export intensities show that industries producing gold, basic iron and steel, machinery and equipment, professional and scientific equipment and furniture are highly dependent on exports. Thus, they are vulnerable to sweeping changes in world demand and prices. Similarly, the majority of consumption of machinery and equipment, audio-visual equipment, professional equipment and transport equipment are imported goods, as indicated by large import intensities.

Table 6: Import and export shares and intensity, 2005

Activity	Export share (% of total exports)	Import share (% of total imports)	Export intensity (export share of production, %)	Import intensity (import share of consumption, %)
Agriculture, forestry and fishing	4.14	1.09	21.64	7.11
Coal mining	5.01	0.26	48.43	4.95
Gold and uranium mining	6.58	0.00	98.55	0.53
Other mining	12.82	11.08	47.66	47.78
Food	2.38	2.52	7.94	9.24
Beverages and tobacco	2.29	0.42	20.03	4.93
Textiles	0.70	1.15	15.13	25.04
Wearing apparel	0.54	1.27	13.79	25.98
Leather and leather products	0.44	0.26	36.46	25.22
Footwear	0.05	0.72	5.41	46.47
Wood and wood products	0.61	0.50	11.51	11.21
Paper and paper products	1.45	0.96	14.91	11.43
Printing, publishing and recorded media	0.22	1.10	4.28	21.23
Coke and refined petroleum products	2.59	1.30	13.72	9.70
Basic chemicals	4.60	4.32	30.60	30.30
Other chemicals and man-made fibres	2.09	3.95	11.13	20.17
Rubber products	0.48	0.91	22.51	37.61
Plastic products	0.36	0.73	5.57	11.09
Glass and glass products	0.19	0.29	12.46	17.32
Nonmetallic minerals	0.46	0.87	7.94	14.20
Basic iron and steel	10.48	1.24	60.19	15.71
Basic nonferrous metals	2.94	1.10	46.29	25.61
Metal products excluding machinery	1.79	1.66	16.15	18.49
Machinery and equipment	7.11	12.83	67.23	76.30
Electric machinery	0.97	2.25	13.86	26.82
Television, radio and communication equipment	0.88	5.26	47.12	87.25
Professional and scientific equipment	0.90	2.40	92.56	86.09
Motor vehicles, parts and accessories	6.72	15.32	18.89	37.64

Other transport equipment	0.68	3.24	27.40	64.94
Furniture	1.71	0.56	51.24	20.30
Other industries	1.94	3.01	17.33	25.63
Electricity, gas and steam	0.11	0.00	0.93	0.02
Building construction	0.02	0.09	0.06	0.26
Wholesale and retail trade	1.01	0.05	1.25	0.06
Catering and accommodation services	1.45	2.49	17.27	32.86
Railway transport	0.58	0.35	15.39	10.29
Road transport	1.93	0.37	7.42	1.60
Transport via pipeline	0.04	0.00	16.04	0.00
Water transport	0.53	2.80	13.52	46.71
Air transport	0.65	2.18	20.37	47.47
Transport support services	0.80	1.21	9.87	14.91
Communication	2.21	2.00	6.92	6.71
Finance and insurance	0.61	1.40	1.25	13.92
Business services	4.61	1.97	6.12	1.80
Medical, dental and other health and veterinary services	0.11	0.20	0.60	1.12
Community, social and personal services	1.22	2.29	5.68	7.03

Source: 2005 SAM for South Africa

The 2005 SAM has four tax types. A summary of their revenues is provided in Table 7.

Table 7: Tax revenues by tax type, 2005

	Direct taxes	VAT	Customs and excises	Production taxes
Revenue (2005)	223 216	153 167	17 136	28 663
Share of total taxes (%)	52.87	36.28	4.06	6.79
Percent of GDP	14.65	10.05	1.12	1.88

Source: 2005 SAM for South Africa

Table 8: Consumption structure of household deciles, 2005

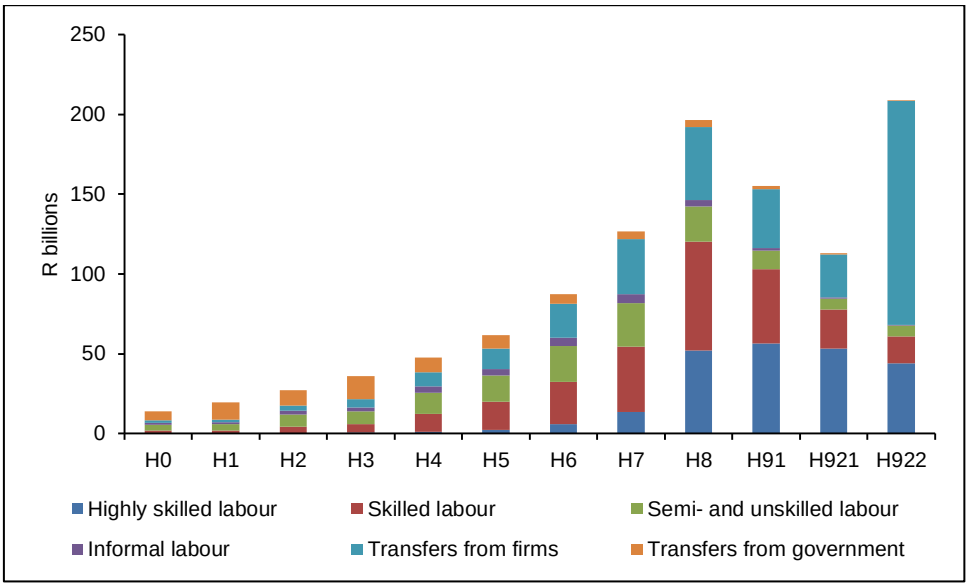
	H0	H1	H2	H3	H4	H5	H6	H7	H8	H91	H921	H922
AGFF	5.22	4.92	4.49	4.10	3.62	3.19	2.72	2.30	1.75	1.30	0.98	0.96
MFFD	35.72	33.68	30.74	28.12	24.79	21.88	18.65	15.83	12.07	9.02	6.83	6.69
MFBV	16.60	15.64	14.28	13.05	11.50	10.15	8.64	7.32	5.57	4.14	3.12	3.06
MFCL	4.60	5.37	5.87	6.07	6.10	6.00	5.53	4.79	3.71	3.07	2.12	1.75
MFPT	1.38	1.17	1.10	1.09	1.27	1.67	2.48	3.51	4.94	4.94	6.01	5.10
MFOC	4.23	4.00	4.05	3.82	3.71	3.79	3.91	4.21	4.01	3.91	3.64	3.06
MFVH	0.08	0.09	0.21	0.26	0.52	1.05	1.92	3.55	6.42	8.21	8.72	10.61
MFOT	0.52	0.57	0.81	1.14	1.32	1.76	2.15	2.81	3.48	4.86	5.47	5.75
EWEL	5.80	4.87	3.79	3.12	2.73	2.52	2.24	2.24	2.29	2.10	1.66	1.04
TATR	4.04	4.00	3.88	3.73	3.52	3.38	3.15	2.92	2.54	2.23	2.01	1.88
TACA	0.89	1.15	1.32	1.66	2.06	2.11	2.40	2.61	2.97	3.26	3.25	3.49
TRRD	4.82	5.31	6.35	7.09	7.78	7.96	7.66	7.07	5.49	4.33	4.03	3.49
TRCM	2.95	3.55	4.75	5.62	6.46	6.74	6.54	6.00	4.50	3.47	3.21	2.76
BSNS	0.71	0.86	1.23	1.59	1.97	3.44	4.49	5.30	9.85	14.29	18.88	22.19
CSMD	3.48	3.93	4.43	4.76	5.60	6.17	7.59	8.77	8.88	8.44	7.42	4.98
CSPS	2.81	3.64	4.18	5.23	6.51	6.67	7.56	8.24	9.36	10.29	10.25	11.03
Other	6.13	7.25	8.51	9.55	10.55	11.51	12.38	12.54	12.17	12.13	12.39	12.17

Source: 2005 SAM for South Africa

The SAM data highlight the differences in the size (Figure 5a) and composition (Figure 5b) of household income among the income deciles. Government transfers make up sizeable contributions to the household income of the first four income deciles. The highest percentile range, representing the 97th to 100th percentile, has 67.3 per cent of its income defined as transfers from firms which, as mentioned earlier, is a proxy for distributed capital earnings.

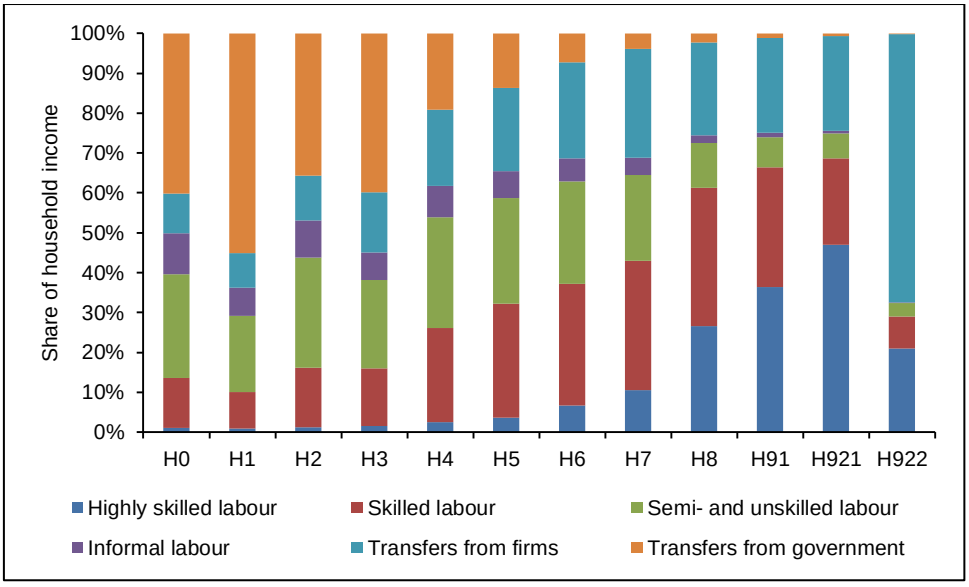
Further, Figure 5b suggests the predominant types of labour that constitute the income deciles. The first and second deciles are composed mainly of semi- and unskilled workers. The third through eighth deciles comprise mainly of skilled, semi-skilled and unskilled formal workers. The ninth decile and 91st-95th percentiles are mostly made up of skilled and highly-skilled formal workers. The 96th-100th percentiles are dominated by highly skilled workers.

Figure 5a: Income distribution by household decile and income source, 2005



Source: 2005 SAM for South Africa

Figure 5b: Composition of income by household decile and income source, 2005



Source: 2005 SAM for South Africa

Elasticities and parameters

In addition to the SAM, various elasticities are used in the model. The CES elasticity parameter for composite labour is set at 0.8 for all sectors. The CES parameter for value added is borrowed from the Development Policy Research Unit (2008:87). Following Chitiga et al (2011:10), the

transformation elasticity parameter for exports and local sales is fixed at 1.3 across all sectors, and the Frisch parameter is assigned the value of -3.34. Income elasticities are taken from those determined by the United States Department of Agriculture for broad consumption groups. The most conservative estimate by Behar and Edwards (2004:10) is used to inform the price elasticity of world demand for export goods. Armington elasticities are informed by Gibson (2003).

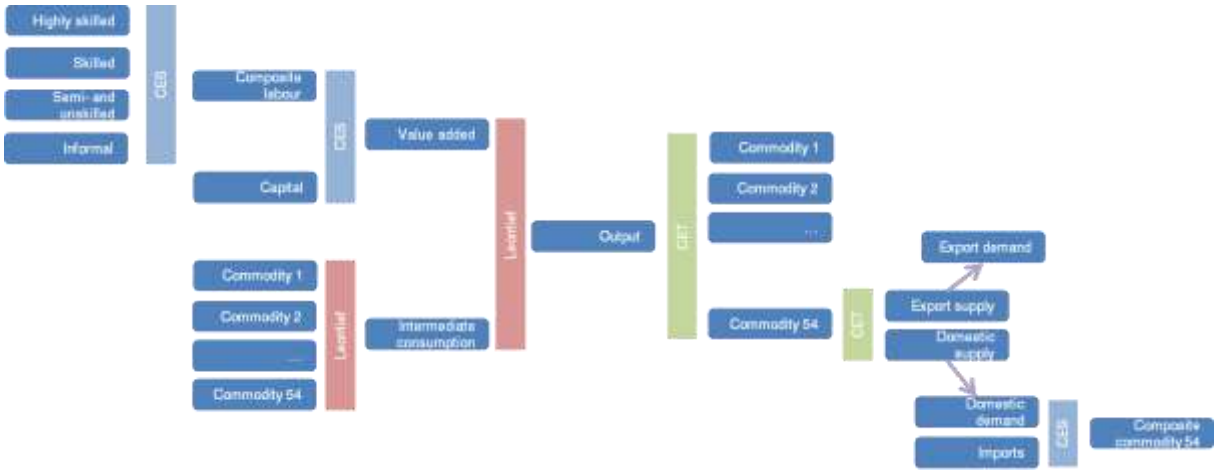
Model[3]

The static, single country PEP-1-1 Standard Model (Decaluwe *et al.*, 2009) is used for the analysis.

Figure 6 presents the key production and supply relationships in the PEP-1-1 model. In the model, firms operate in a perfectly competitive environment, and maximise profits subject to their production technology, which exhibits constant returns to scale. Production follows a nested structure: sectoral output is a Leontief function of value added and intermediate inputs. On the second level, intermediate inputs are determined by a Leontief function of commodities, while value added is a CES function of composite labour and capital. Composite labour and capital adjust to the point where the values of their marginal products are equal to their prices. Finally, composite labour and capital are themselves CES functions of specific labour and capital groups (although, there is only one capital group in the SAM). Demand for each kind of labour adjusts in a way that minimises the total labour cost, given relative wage rates. Typically, elasticities of substitution are higher at lower levels of the hierarchy.

Industries may produce more than one commodity, and these are determined by a CET function. For each commodity, total domestic output is an aggregate of output of different activities for that commodity. This aggregate is split into domestic supply and exports via a CET function. Domestic demand is assumed to be for a composite commodity made up of domestic production earmarked for local supply, and imports. The imperfect substitutability between imports and domestic supply is captured by a CES aggregation function. Armington elasticities limit the extent of specialisation.

Figure 6: Structure of production and supply in the PEP-1-1 model



Source: Adapted from Decaluwe et al (2009)

Households earn their income from labour effort and transfers from firms, government and the rest of the world. In the SAM, capital returns are distributed to firms and the rest of the world only. This suggests that transfers from firms to households represent the distribution of capital returns. Labour income is divided among households according to fixed shares determined in calibration. Households pay direct income tax and transfers to the government. Transfers to the rest of the world are also

[3] This section is extensively informed by the model documentation (Decaluwe et al, 2009).

paid, although according to the SAM this is only true for the tenth income decile. Households' savings are a fixed proportion of disposable income. The remaining discretionary income is used to purchase goods and services, where demand is determined by a linear expenditure system. The linear expenditure system is derived from the assumption that households follow Stone-Geary utility functions. This deviates from the commonly used Cobb-Douglas utility functions, but allows for greater flexibility of substitution possibilities in response to changes in relative prices.

Firm income comprises of capital returns and transfers from other institutions, particularly government and the rest of the world. Firms are subject to direct taxes, and the remaining disposable income is transferred to the other intstitutions or saved.

Government revenue is the sum of direct taxes on household and firm income, and a number of indirect taxes including VAT, customs duties and excises, and taxes on production. Direct taxes are a linear function of total firm or household income. Further, government receives transfers from firms, households and the rest of the world. The government spends on government services and transfers, and the difference between government revenue and spending yields the budget balance.

The rest of the world receives income from import payments, receipts for capital and two types of labour, and transfers from government and certain households. The original PEP-1-1 model has been modified slightly to allow labour payments to the rest of the world. The foreign agents pay for exported goods, and transfers to domestic households and firms. Foreign savings are the difference between foreign receipts and payments.

Investment demand is composed of gross fixed capital formation and changes in inventories. Gross fixed capital formation is divided among commodities in fixed shares.

World import and export prices are exogenous, but exporters can adjust their FOB prices to affect their competitiveness and global market share. A CET function determines how output is divided between the export and local market, given the imperfect substitutability that exists. Similarly, given the imperfect substitutability between locally produced goods and imported goods in domestic demand is represented by a CES function.

With respect to prices, activities' unit costs are determined as a weighted sum of the price of value added and the price of aggregate intermediate consumption. Similarly, the price of value added is a weighted sum of the prices of composite labour and capital used by the industry; the price of aggregate intermediate consumption is the combination of the prices of intermediate inputs used by the industry.

The model has been modified slightly to account for the different structure of the 2005 SAM for South Africa, and to reflect labour payments to the rest of the world as mentioned above.

The following assumptions are made for the model closure rules. First, capital is assumed to be fixed and sector-specific. Total government expenditure on goods and services is also assumed to be fixed, while the budget deficit is allowed to fluctuate. Foreign savings are assumed fixed. Investment is endogenous, and varies according to the level of savings.

Given the scarcity of skilled and highly-skilled labour in South Africa, the labour supply of those factors is fixed, but wages are allowed to fluctuate in response to the crisis scenarios. Also, given the relatively rigid wage arrangements and the strength of organised labour in South Africa, the wage rates of semi- and unskilled labour and informal labour tend to be rigid downwards. As such, we assume those rates to be fixed in the model. However, the supply of these factors is allowed to adjust. Therefore, if producers cannot adjust labour demand to lower production by reducing wages, they are forced to retrench workers. Since unemployment is not explicitly included in the model and labour supply and demand are equal in equilibrium, variable labour supply implies the existence of a broader

pool of semi-skilled, unskilled and informal labour. Thus, positive or negative changes in labour supply imply a negative or positive impact on the 'unemployed' section of the broader pool.

The nominal exchange rate is the model's numeraire.

The PEP-1-1 model is run using the General Algebraic Modelling System (GAMS).

4. Scenarios

With the aim of analysing the effects of the global crisis on South Africa, we simulate the two main channels through which the crisis has affected the South African economy: the trade and foreign investment channels.

It is important to note that domestic and other factors, such as the global food price surge that occurred before the financial crisis, had affected the South African economy. Therefore, the crisis scenario omits the majority of the domestic factors, as it involves external shocks that we consider South Africa unable to influence significantly. However, residual effects of other external factors, such as the subsequent recovery in global food prices, may not be completely excluded from the observed world prices used in the simulations. Notwithstanding, we believe the crisis scenario presented is a reliable approximation of the observed changes in exogenous variables caused by the global financial and economic crisis.

To the extent that weakening economic conditions in South Africa in 2008 and 2009 were also influenced by domestic pressures, the crisis scenario provides an interesting counterfactual that excludes the domestic triggers, as well as policy responses to mitigate the effect of the downturn.

The global crisis affects exports through a decline in world prices and a contraction in external demand. Based on the industrial disaggregation used in the SAM, six exporting industries each account for more than 5.0 per cent of total exports and collectively make up about half of all exports at the benchmark. All of these, except for gold mining, experienced (sharply) declining export values between 2008 and 2009. To isolate the world export price and external demand effects, we use the export price variations between 2008 and 2009 of major economies – notably Japan for office and telecom equipment, and Germany for other merchandise – as a proxy for world export prices. We use export price indices reported by the World Trade Organisation (2011:266) to obtain these changes. In the absence of data relating to the world prices of the services sectors, we assume no change in world prices.

We also apply demand shocks, based on the current price value of exports in the Quantec Research *Standardised Industry* database. However, insofar as this represents the value of exports rather than the volume of exports, we deflate the current values with the real effective exchange rate published by the South African Reserve Bank, in an attempt to remove foreign exchange and inflation effects.

Declining world import prices serve as a positive external shock. Akin to the world export price shocks, world import price variations are obtained from the World Trade Organisation (2011:267).

Table 10: Trade shares, trends and shocks applied to commodities in the PEP-1-1 model

	Shares at benchmark (per cent)		Current prices, 2008-2009 (percentage variation)		Shocks applied to model (percentage variation)		
Commodity	Exports	Imports	Exports	Imports	World export price	World import price	Export demand
AGFF	4.2	1.1	-0.1	-13.1	-11.1	-10.3	+7.7
MNCL	5.3	0.2	-29.4	-65.6	-26.0	-30.3	-23.9
MNGD	7.1	0.0	+6.7	-	-7.2	-13.3	+15.1
MNOT	13.5	11.1	-27.9	-33.4	-26.0	-30.3	-22.3
MFFD	2.0	2.5	+11.8	-9.8	-11.1	-10.3	+20.5
MFBV	1.9	0.4	+2.5	+10.5	-11.1	-10.3	+10.4
MFTX	0.6	1.2	-6.8	-8.0	+1.0	-5.1	+0.5
MFCL	0.4	1.3	-20.9	+9.6	-4.7	-2.9	-14.7
MFLT	0.5	0.3	-12.7	-17.1	-5.5	-7.7	-5.9
MFFT	0.0	0.7	+23.9	+1.2	-5.5	-7.7	+33.5
MFWD	0.6	0.5	-27.6	-24.2	-5.5	-7.7	-22.0
MFPP	1.4	1.0	-10.3	-11.2	-5.5	-7.7	-3.3
MFPR	0.2	1.1	-36.6	-5.5	-5.5	-7.7	-31.7
MFPT	2.3	1.3	-19.4	-23.2	-26.0	-30.3	-13.1
MFBC	4.8	4.3	-31.5	-33.8	-6.9	-10.5	-26.2
MFOC	1.8	4.0	-6.5	-4.0	-6.9	-10.5	+0.8
MFRB	0.5	0.9	-13.8	-14.2	-5.5	-7.7	-7.1
MFPL	0.4	0.7	-15.9	-13.7	-6.9	-10.5	-9.4
MFGL	0.2	0.3	+49.2	-14.0	-5.5	-7.7	+60.8
MFMN	0.5	0.9	-17.8	-25.2	-26.0	-30.3	-11.5
MFFE	10.5	1.2	-29.6	-31.9	-17.5	-25.4	-24.1
MFNF	3.1	1.1	-19.1	-43.9	-26.0	-30.3	-12.8
MFMT	1.8	1.7	-17.9	-21.6	-5.5	-7.7	-11.5
MFMC	6.8	12.8	-30.7	-28.2	-4.6	-6.4	-25.3
MFEL	0.9	2.6	-20.4	-20.3	-4.6	-6.4	-14.2
MFTV	0.9	5.3	-15.8	-16.1	-1.3	-4.6	-9.3
MFPF	0.7	2.4	+6.8	-12.9	-5.5	-7.7	+15.1
MFVH	6.6	15.3	-34.1	-29.9	-4.6	-6.4	-29.0
MFTR	0.7	3.2	-32.7	-40.9	-4.6	-6.4	-27.5
MFFR	1.3	0.6	-14.3	-23.2	-5.5	-7.7	-7.6
MFOT	1.5	3.0	+4.5	-22.5	-5.5	-7.7	+12.6
EWEL	0.1	0.0	+57.7	+38.3	0.0	0.0	+70.0
CONS	0.0	0.1	+39.7	+22.3	0.0	0.0	+50.6
TATR	1.1	0.1	-2.8	+10.3	0.0	0.0	+4.7
TACA	1.6	2.5	-0.6	+12.2	0.0	0.0	+7.1
TRRL	0.6	0.4	-5.1	+7.7	0.0	0.0	+2.3
TRRD	2.1	0.4	-5.1	+7.7	0.0	0.0	+2.3
TRPP	0.0	-	-5.1	+7.7	0.0	0.0	+2.3
TRWT	0.6	2.8	-5.1	+7.7	0.0	0.0	+2.3
TRAR	0.7	2.2	-5.1	+7.7	0.0	0.0	+2.3
TRSP	0.9	1.2	-5.1	+7.7	0.0	0.0	+2.3
TRCM	2.4	2.0	+0.1	+12.1	0.0	0.0	+2.3
BSFN	0.7	1.4	-14.7	-3.6	0.0	0.0	-8.0
BSNS	5.0	2.0	-5.9	+2.2	0.0	0.0	+1.4
CSMD	0.1	0.2	-6.3	+1.2	0.0	0.0	+1.0
CSPS	1.3	2.3	-2.5	+6.4	0.0	0.0	+5.1

Source: Own calculations based on Quantec Research, World Trade Organisation and South African Reserve Bank.

The three shocks summarise the trade transmission channel. The price and demand shocks take into account observed changes in world prices and export demand.

For export commodities, declining world export prices and external demand cause production of those commodities to fall. They also result in lower production and imports in sectors which provide intermediate inputs, and for which there are strong backward linkages. Factor demands and returns are also impacted negatively, which eventually affect household income and employment.

As credit became more constrained and investors more risk averse, the financial crisis will have caused significant disinvestment. We simulate foreign disinvestment as a negative shock on foreign savings. We consider the 13.8 per cent decline in foreign direct and portfolio investment liabilities between 2008 and 2009 (South African Reserve Bank, 2011:S-78) and use this to inform the reduction of foreign savings in the model.

The combined scenario incorporates the three shocks that make up the trade scenario and the foreign disinvestment scenario. We use this to estimate the external shock that South Africa faced as a result of the global crisis.

At this stage, we do not consider the effects of policy responses or the impact of preparations for the 2010 FIFA World Cup.

To refresh, the scenarios simulated are summarised in Table 11.

Table 11: Simulation scenarios

	Description	Variables shocked
World export prices	Observed changes in world export prices	PWX
World import prices	Observed changed in world import prices	PWM
External demand	Decrease in external demand	EXDO
Foreign investment	Decline in foreign savings	SROW
Combined	Crisis scenario incorporating all of the above shocks	PWX, PWM, EXDO, SROW

After each simulation is run, GAMS yields a complete set of solved variables, including prices, volumes and value indicators. Many of these are presented in the following section.

5. Results

In this section, the results obtained from the simulations are analysed and discussed. First, the effects of the crisis scenario on key macroeconomic variables are presented. The effects are then discussed on a sectoral basis, particularly in terms of output, exports, imports and domestic supply. Thereafter, the impact of the crisis on production factors is given attention, before an analysis of the impacts on households, firms and government is provided. In most cases, results are presented as percentage deviations from the baseline.

The harshest impacts are caused by falling world export prices and demand. These affect export volumes, which results in lower production and factor demand. This negatively affects the incomes of the owners of capital and labour, although the severity will depend on the sources of their income. Notwithstanding, lower income consequently results in lower demand for produced goods. Despite lower world import prices, which would ordinarily increase import volumes, lower domestic production and demand bring about a decline in import volumes. Lower foreign savings reduce the amount available to finance the current account deficit. Imports fall because of this constraint, as well as the lower export receipts.

Macroeconomic variables

The crisis effects on aggregate demand is summarised in Table 12. GDP is 10.1 per cent lower than the baseline, which falls due to large contractions in gross fixed capital formation, household consumption expenditure and exports. Gross value added falls, by 9.9 per cent, and is widespread. Apart from general government, value added only increases in a few small industries, such as textiles, air transport services and professional equipment. It does increase in some larger industries, such as petrochemicals, basic chemicals and catering and accommodation, but these increases are marginal.

Household consumption falls by -8.5 per cent, driven by the effects of the world export price shocks and export demand shocks – they sharply lower production of exported goods and subsequently, production. This reduces labour demand or wages, which impacts on household incomes.

A similar explanation is provided for gross fixed capital formation. Lower production resulting from the world export price and demand shocks cause capital returns, and thus firm revenue, to fall. Government revenues also fall. The decline in revenue results in lower household, firm and government savings. Further, foreign savings decline according to the explicit shock in foreign investment. To the extent that investment is savings driven, and the assumption that changes in inventories are held fixed in volume (changes in inventories falls in value terms because of price effects), gross fixed capital formation falls dramatically, by 28.2 per cent.

Government consumption is an exogenous variable and assumed to be fixed. Thus, there are no changes in household consumption.

The export price shock affects exports substantially more than the shock in world export demand. Where world export prices fall, FOB export prices must also fall for domestic exported commodities to remain competitive. In most instances, however, the FOB export price does not match the decline in world export prices. The resulting decline in competitiveness reduces export demand considerably. Export demand does increase for some key exports, such as gold, business services and basic chemicals; this is, however, insufficient to offset the declines in export demand in other sectors. In the combined scenario, export values fall by 14.1 per cent.

Because foreign savings are held fixed, the decline in export receipts must be met with a decline in import payments to prevent a balance of payments crisis. In addition to this restraint, lower production and income means will weaken the demand for imports. Imports thus reduce by 13.9 per cent compared with its baseline.

Considering the shocks in isolation, the changes in export prices appears to have the most pronounced effects. The shocks on world export prices cause GDP to fall 12.7 per cent below the baseline value. The shocks on world import prices help to mitigate this for most macroeconomic variables, except capital returns and exports. The effects of lower export demand and foreign savings are negative, but mild in comparison with the changes in world prices.

Table 12: Effects on GDP and expenditure components

Component	Baseline (R millions)	Combined scenario	Export demand	Import prices	Export prices	Foreign savings
Household consumption	967 954	-8.51	-2.07	6.27	-10.86	-1.02
Government consumption	307 396	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	256 621	-28.17	-5.71	16.59	-30.64	-6.26
Changes in inventories	13 587	-10.53	-1.19	-1.12	-7.03	-0.87
Exports	412 732	-14.09	-2.59	0.32	-13.01	0.64
Imports	(435 036)	-13.93	-2.11	-0.77	-10.42	-1.28

GDP	1 523 524	-10.09	-2.39	7.07	-12.68	-1.17
GVA at basic prices	1 352 951	-9.93	-2.39	7.30	-12.75	-1.13
Total labour returns	680 058	-6.28	-1.72	5.63	-8.60	-0.89
Total capital returns	644 230	-11.08	1.97	2.29	-15.05	0.05

Source: Own calculations

Caution needs to be exercised when comparing these results to those reported in official sources. It has already been mentioned that the combined simulation attempts to isolate only those effects that were caused by the global crisis, and ignores other domestic effects. Notwithstanding, some results are presented in Table 13, which also shows the annualised growth in each quarter between the fourth quarter of 2008 and the same quarter a year later. The results of the combined scenario are typically more severe than the percentage changes in any single quarter.

Table 13: Comparison of baseline impacts with observed changes

Component	Combined scenario	2008:04	2009:01	2009:02	2009:03	2009:04
Household consumption	-8.51	-1.1	-4.8	-3.3	1.1	3.2
Government consumption	0.00	4.0	7.1	0.6	8.2	1.2
Gross fixed capital formation	-28.17	8.9	-13.9	-10.6	-14.0	-3.2
Exports	-14.09	-19.0	-48.2	-16.3	-1.5	13.7
Imports	-13.93	-20.2	-27.6	-35.3	-2.3	25.0
GDP	-10.09	-1.7	-6.3	-2.8	1.8	3.5
GVA at basic prices	-9.93	-1.7	-6.1	-1.8	2.0	3.4

Source: Own calculations, South African Reserve Bank

Production and value added

Production falls for most industries. This is driven mainly by the decline in world export prices which, unmatched by the decline in FOB export prices, causes a decline in export demand and thus output. Production does not decline in the same proportion as export demand, because domestic supply will absorb some of the losses from export demand, according to the imperfect substitutability between the two.

Wages fall for highly skilled and skilled workers, but in a number of instances this is insufficient to prevent a decline in labour demand, given the lower level of output. Wages for semi-skilled, unskilled and informal workers are inflexible; therefore labour demand will fall for those types of labour. This causes a decline in the price of value added in all but two sectors, as well as a reallocation of labour.

As value added falls, intermediate consumption will also fall in accordance with the Leontief function that defines output. The backward linkages will cause further – albeit decaying – declines in value added and intermediate consumption.

The simulation results on value added are represented in Table 14, which show the impact of the crisis on the value added of the largest contributors to gross value added. Production volumes in the construction industry, which contributes 2.5 per cent to gross value added, falls by 12.9 per cent as a result of the crisis simulations. Production volumes fall by 6.5 per cent in the 'Other mining' segment, and in the community, social and personal services industry, by 5.4 per cent.

A reallocation of labour towards government services results in an increase in production in those segments. Lower prices for government services raise demand for such services. In the Law and order, Education and Health segments, value added rises by 5.2 per cent, 5.0 per cent, and 6.5 per cent respectively.

Table 14: Effects on value added, selected industries

Industry	Baseline (Volume)	Volume	Price
Agriculture, forestry and fishing	35509	-1.10	-8.40
Other mining	57413	-6.46	-42.63
Building construction	32787	-12.89	-15.79
Wholesale and retail trade	178443	-2.62	-8.12
Road transport	44551	-0.76	-4.49
Communication	51295	0.04	-4.58
Finance and insurance	122208	-2.35	-9.22
Business services	149945	-1.24	-9.16
Medical, dental and other health and veterinary services	30187	0.45	-3.74
Community, social and personal services	52506	-5.39	-4.46
Government: Law and order	34844	5.22	-3.97
Government: Education	77775	5.01	-3.97
Government: Health	27576	6.48	-4.44

Source: Own calculations

Exports, imports and domestic supply

Exports

The effects of the combined scenario on exports volumes and FOB export prices for the largest export commodities are presented in Table 15. The world export price shocks are shown alongside the simulation effects on FOB export prices. Where FOB prices decline by more than the associated shock in world export prices, exports increase because the price of South African export commodities is relatively cheaper than the world price. Similarly, where FOB prices do not match the price decline in world export prices, export volumes decrease because of the lower competitiveness.

This is not clear when looking at the results of the combined scenario. Shocks in world export demand affect export volumes directly. Due to the shocks in world export demand, which vary among different commodities, the effects on export volumes can be better or worse. It is thus important to remember that not all sectors suffer lower world demand. An increase in world demand is simulated for 24 sectors. If exports should increase as a result of improving competitiveness, sharp declines in world demand will push export volumes lower. This is true for all commodities in Table ##, except agriculture, gold mining and business services. Agricultural exports fall due to the decline in competitiveness; however, a 7.7 per cent increase in world demand helps to cushion the decline in export demand. Strong demand for gold propels exports higher, despite a weaker domestic response to declining world prices. Business services, for which world prices are not assumed to have changed, enjoy an increase in competitiveness and demand, which cause export volumes to rise by 9.7 per cent.

Table 15: Effects on exports, selected industries

Industry	Baseline (Volume)	Volume	FOB export prices	World export prices	World export demand
Agriculture, forestry and fishing	15 889	-1.69	-9.74	-11.1	7.7
Coal mining	20 264	-17.75	-26.95	-26	-23.9
Gold and uranium mining	27 158	4.49	-5.69	-7.2	15.1
Other mining	51 774	-10.68	-27.70	-26	-22.3
Basic chemicals	18 363	0.71	-11.60	-6.9	-26.2
Basic iron and steel	40 237	-10.27	-19.77	-17.5	-24.1
Basic nonferrous metals	11 881	-9.69	-26.43	-26	-12.8
Machinery and equipment	26 124	-2.96	-8.67	-4.6	-25.3

Motor vehicles, parts and accessories	25 229	-4.17	-9.25	-4.6	-29.0
Business services	19 007	9.72	-1.31	0	+1.4

Source: Own calculations

The decline in foreign savings causes export volumes to increase, although these effects are not significant.

Imports

The impact of the crisis on import volumes and prices for the largest import commodities are presented in Table 16. Lower world import prices will cause a decline in CIF import prices, which are denominated in local currency, and have domestic taxes and margins applied to them. In isolation, this causes imports to rise, because they are relatively cheaper than domestically produced goods. However, because the world export price shock has such pronounced effects on domestic production, the price of domestic goods will also fall. So, the flux in the prices of domestic and imported goods gives rise to a situation where importers substitute towards relatively cheaper goods. Thus, in the combined scenario, importers will import more if the decline in import prices dominates the decline in domestic prices. For example, imports of food rise, by 1.6 per cent, because the 9.8 per cent decline in import prices is larger than the 8.1 per cent decline in domestic prices. This only occurs in seven of the imported commodities. For most other sectors, the opposite is true. For example, the domestic price of vehicles falls by 9.0 per cent, while import prices only fall by 6.8 per cent. Consequently, import volumes of vehicles fall, by 6.8 per cent, because importers substitute locally produced vehicles for the relatively more expensive imported vehicles.

It is also important to remember that lower production causes intermediate demand to fall. Lower household income and total savings cause final demand to fall. These further erode import volumes.

Table 16: Effects on import, selected industries

Industry	Baseline (Volume)	Volume	CIF import prices	World import prices
Other mining	48 188	4.40	-28.57	-30.3
Food	10 964	1.56	-9.83	-10.3
Basic chemicals	18 785	-1.82	-10.33	-10.5
Other chemicals	17 179	-0.36	-9.94	-10.5
Machinery and equipment	55 831	-13.09	-6.83	-6.4
Television, radio and communication equipment	22 874	-6.80	-5.10	-4.6
Motor vehicles, parts and accessories	66 629	-5.88	-6.68	-6.4
Other transport equipment	14 112	-0.43	-6.61	-6.4
Other manufacturing	13 086	-5.80	-7.94	-7.7
Water transport	12 185	-8.49	0.00	0

Source: Own calculations

Domestic supply

Table 17 presents the results of the combined scenario on volumes and prices of domestically supplied goods. Domestic supply falls because of lower production. It is also affected by weaker demand from households and investment sectors, due to lower incomes and savings. Further, attractive import prices promote substitution away from domestic goods, causing a reduction in demand for domestic goods, and subsequently a decline in their prices.

Table 17: Effects on domestic supply, selected industries

Industry	Baseline (Volume)	Volume	Price
Food	107 690	-0.28	-8.05
Motor vehicles, parts and accessories	110 390	-3.97	-9.03
Building construction	150 770	-12.12	-14.80
Wholesale and retail trade	340 593	-2.64	-8.68
Road transport	99 608	-1.59	-8.66
Communication services	120 910	-0.46	-6.62
Business services	468 382	-2.25	-9.70
Medical, dental and other health and veterinary services	77 387	0.39	-7.13
Community, social and personal services	131 878	-1.22	-6.50
Government: Education	95 706	5.01	-4.79

Source: Own calculations

Labour and capital

Labour

The effects of the combined scenario on labour demand and the wage rate is summarised in Table 18. The wage rate, which is allowed to fluctuate for highly skilled and skilled labour, falls by 6.6 per cent and 4.8 per cent, respectively. The wage rate is not flexible for semi-skilled, unskilled and informal labour, so employment falls in those categories, by 7.9 per cent for formal semi- and unskilled workers, and by 8.5 per cent for informal labour.

Table 18: Changes in wages and employment, by labour type

	Wage rate	Employment
Highly skilled labour	-6.63	Assumed fixed
Skilled labour	-4.78	
Semi- and unskilled labour	Assumed fixed	-7.91
Informal labour		-8.55

Source: Own calculations

Composite labour demand falls strongly in the coal and other mining industries, as well as related manufacturing (minerals, iron and steel, other metals) and construction. This comes as lower production leaves firms with excess labour which needs to be retrenched to remain profitable. In the 17 industries which experience increasing value added, composite labour demand rises as well.

How the crisis scenario affects specific labour types is shown in Table 19, but cognisance of industries' labour composition (Table 5) must be kept. The agricultural industry is a comparatively large employer of semi-skilled, unskilled and informal workers. Despite a relatively low decline in value added (-1.1 per cent), the rigidity of the wage rate causes labour demand of these skills groups to fall by 5.6 per cent. Similar trends are observed for the mining segments, food manufacturing, construction, retail trade, business services and road transport, all of which are relatively large employers of this kind of labour. Skilled and highly skilled workers are mostly found in services sectors, particularly in government, retail, finance and business services. Noticeable declines in value added in the trade, business services and financial services industries mean that labour demand in those sectors fall; however, the higher production in government services absorbs this labour.

Table 19: Changes in labour demand, by labour type and activity

Percentage deviation from baseline	Highly skilled	Skilled	Semi-skilled, unskilled and informal	Composite
Agriculture, forestry and fishing	-0.24	-1.80	-5.57	-3.17
Coal mining	-16.46	-17.76	-20.92	-19.05
Gold and uranium mining	1.47	-0.11	-3.94	-1.46
Other mining	-13.75	-15.10	-18.36	-16.43
Food	2.09	0.50	-3.36	-0.57
Beverages and tobacco	0.16	-1.40	-5.19	-2.14
Textiles	6.64	4.98	0.94	4.02
Wearing apparel	2.52	0.92	-2.95	-0.55
Leather and leather products	2.74	1.14	-2.75	-0.26
Footwear	2.69	1.09	-2.79	-0.48
Wood and wood products	-4.27	-5.76	-9.38	-7.28
Paper and paper products	1.06	-0.51	-4.33	-1.12
Printing, publishing and recorded media	-0.83	-2.38	-6.13	-2.48
Coke and refined petroleum products	7.39	5.71	1.65	5.86
Basic chemicals	3.33	1.71	-2.19	1.11
Other chemicals and man-made fibres	-0.17	-1.72	-5.50	-2.12
Rubber products	0.89	-0.68	-4.50	-1.65
Plastic products	-5.06	-6.54	-10.13	-7.82
Glass and glass products	3.63	2.01	-1.90	1.01
Nonmetallic minerals	-17.32	-18.60	-21.73	-19.89
Basic iron and steel	-12.60	-13.96	-17.27	-15.09
Basic nonferrous metals	-20.40	-21.64	-24.65	-22.75
Metal products excluding machinery	-4.60	-6.08	-9.69	-6.33
Machinery and equipment	-6.29	-7.75	-11.29	-8.22
Electric machinery	-5.99	-7.46	-11.01	-8.13
Television, radio and communication equipment	0.77	-0.80	-4.61	-1.05
Professional and scientific equipment	10.41	8.69	4.51	8.51
Motor vehicles, parts and accessories	-5.26	-6.73	-10.32	-7.27
Other transport equipment	1.58	0.00	-3.84	-0.35
Furniture	-0.23	-1.78	-5.56	-2.81
Other industries	1.10	-0.48	-4.30	-1.06
Electricity, gas and steam	-0.54	-2.09	-5.85	-2.59
Water supply	0.98	-0.60	-4.42	-1.53
Building construction	-18.38	-19.65	-22.73	-21.28
Wholesale and retail trade	-3.30	-4.81	-8.47	-5.25
Catering and accommodation services	6.36	4.70	0.68	4.24
Railway transport	1.21	-0.37	-4.20	-1.33
Road transport	1.28	-0.30	-4.13	-1.67
Transport via pipeline	-2.32	-3.84	-7.53	-4.77
Water transport	3.61	1.99	-1.92	0.84
Air transport	7.76	6.08	2.01	5.06
Transport support services	1.37	-0.21	-4.04	-1.42
Communication	1.77	0.19	-3.66	0.12
Finance and insurance	-3.91	-5.41	-9.04	-4.92
Business services	-2.73	-4.24	-7.92	-4.05
Medical, dental and other health and veterinary services	2.51	0.92	-2.96	0.87
Community, social and personal services	-2.28	-3.80	-7.50	-6.74
Government – general administration	9.37	7.66	3.53	7.89
Government – defence	8.57	6.88	2.77	7.10
Government – law and order	7.49	5.81	1.74	6.03

Government – education	7.27	5.60	1.54	5.82
Government – health	8.41	6.72	2.62	6.94
Government – social	9.46	7.76	3.62	7.98
Government – economic	10.37	8.65	4.48	8.88

Source: Own calculations

Capital

Given the declines in production of most sectors and the assumption of capital mobility, the lower rental rates of capital in most industries are not unexpected. However, some industries which show an increase in value added (basic chemicals, glass and medical services, for example) do not necessarily show an increase in the rate of return to capital.

Table 20: Changes in the rates of return to capital

Activity	Percent deviation from baseline	Activity	Percent deviation from baseline	Activity	Percent deviation from baseline
Agriculture, forestry and fishing	-11.08	Glass and glass products	-1.77	Railway transport	-5.60
Coal mining	-63.82	Nonmetallic minerals	-35.83	Road transport	-5.61
Gold and uranium mining	-9.56	Basic iron and steel	-28.62	Transport via pipeline	-10.65
Other mining	-58.01	Basic nonferrous metals	-39.53	Water transport	-2.15
Food	-4.50	Metal products excluding machinery	-15.42	Air transport	4.05
Beverages and tobacco	-7.74	Machinery and equipment	-18.36	Transport support services	-5.43
Textiles	3.10	Electric machinery	-17.99	Communication	-4.52
Wearing apparel	-3.93	Television, radio and communication equipment	-6.34	Finance and insurance	-12.49
Leather and leather products	-3.56	Professional and scientific equipment	11.16	Business services	-10.90
Footwear	-3.73	Motor vehicles, parts and accessories	-16.71	Medical, dental and other health and veterinary services	-2.67
Wood and wood products	-15.24	Other transport equipment	-4.99	Community, social and personal services	-16.61
Paper and paper products	-5.98	Furniture	-8.52	Government – general administration	5.90
Printing, publishing and recorded media	-8.89	Other industries	-5.97	Government – defence	4.80
Coke and refined petroleum products	6.06	Electricity, gas and steam	-8.06	Government – law and order	3.30
Basic chemicals	-1.99	Water supply	-5.94	Government – education	3.01
Other chemicals and man-made fibres	-8.09	Building construction	-31.21	Government – health	4.57
Rubber products	-6.56	Wholesale and retail trade	-11.74	Government – social	6.04
Plastic products	-16.80	Catering and accommodation services	1.79	Government – economic	7.30

Source: Own calculations

Institutions/Agents

Households

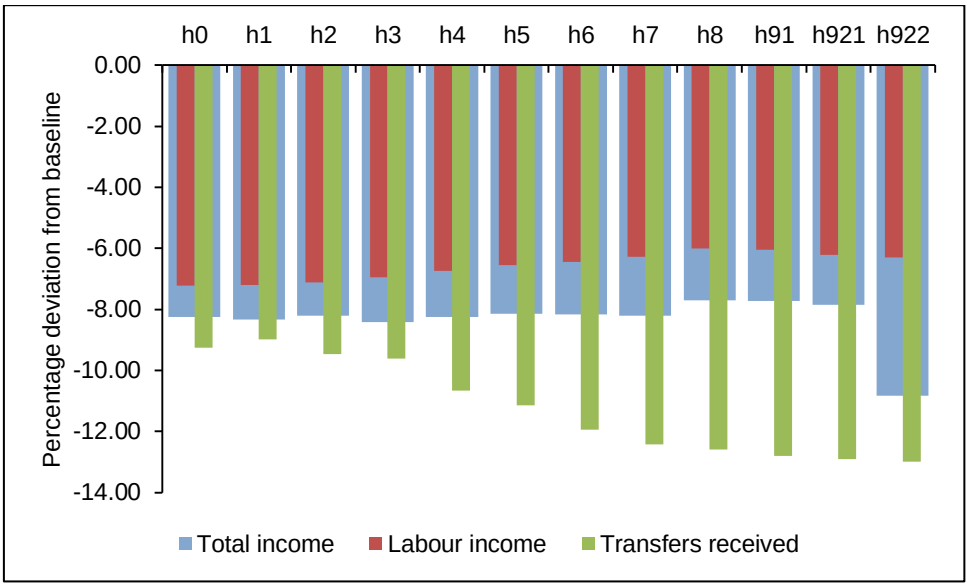
Relative to the nominal exchange rate, households in all income categories are affected severely by the crisis. Lower income deciles suffer larger relative declines in labour income. Labour income falls by 7.2 per cent in each of the first two deciles, while the upper three deciles show moderate losses of beween 6.0 per cent and 6.3 per cent. Lower demand for semi-skilled, unskilled and informal labour, from which the first six income deciles derive between 50 and 73 per cent of their labour income, is partly responsible for this. Assuming no unemployment of skilled and highly-skilled workers, the lower wage rates of those labour categories erode household incomes in the upper deciles. In the three groups that make up the tenth decile, highly skilled labour makes up between 48 and 65 per cent of labour income. The 6.6 per cent decline in the wage rate for highly skilled labour means that, in relative terms, the tenth income decile suffers sharper labour income losses than the eighth and ninth decile. The changes in world export prices are responsible for the majority of the declines in labour income.

Transfer income also falls in all households, and the decline is relatively sharper than that of labour income. Lower world export prices and demand, as mentioned, cause production to decrease as a result of lower export demand. Lower foreign savings reduces investment demand, which also causes production to fall. Lower production means that less capital is used; however, because capital is immobile, the rental rate of that capital falls instead. The returns to capital thus fall, affecting firms and the rest of the world, which are the only two agents to receive capital income in the SAM. Firms distribute more than 60 per cent of their after-profit earnings to households and government (as dividends), so transfers from firms to these agents fall also. More than 60 per cent of transfers by firms to households are received by the highest income decile, and in particular, the 98^{th}-100^{th} percentiles. Transfer income falls by between 12.8 per cent and 13.0 per cent in the groups that make up the tenth decile. Remembering that transfers from firms makes up more than two-thirds of total income of households in the 98^{th}-100^{th} percentiles, this decline is significant, and causes total income of that household group to contract by 10.8 per cent.

While lower transfers from firms affect mainly wealthier households, lower transfers from government affect poorer households. Transfers from government – which represent distributions from social protection and other programmes – make up at least one third of total income in the first four income deciles. So, the 8.3 per cent decline in government transfers will have a larger effect on those households than on wealthier ones.

The declines in labour income and transfer receipts are illustrated in Figure 7.

Figure 7: Effects on nominal income, by household and income type



Source: Own calculations

Table 21: Changes in prices and household consumption of selected commodities

	Prices	h0	h1	h2	h3	h4	h5	h6	h7	h8	h91	h921	h922
Food	-8.2	0.1	-0.1	0.0	-0.3	-0.1	0.0	0.0	0.0	0.5	0.5	0.5	-2.0
Beverages and tobacco	-8.2	0.0	-0.1	0.0	-0.3	-0.2	0.0	-0.1	0.0	0.5	0.5	0.5	-1.9
Road transport	-8.5	0.2	0.0	0.1	-0.2	-0.1	0.1	0.1	0.1	0.7	0.7	0.7	-2.3
Communication services	-6.2	-0.7	-0.8	-0.7	-1.0	-0.9	-0.7	-0.7	-0.7	0.0	0.0	0.0	-2.9
Business services	-9.5	0.7	0.5	0.6	0.2	0.4	0.5	0.5	0.5	1.3	1.3	1.3	-2.5
Medical, dental and other health and veterinary services	-7.1	-0.4	-0.6	-0.5	-0.9	-0.7	-0.5	-0.5	-0.5	0.3	0.3	0.3	-3.1
Community, social and personal services	-6.8	-0.8	-1.0	-0.9	-1.2	-1.1	-0.9	-0.9	-0.8	-0.1	0.0	0.0	-3.4

Source: Own calculations

Firms

Firm income is impacted severely by the lower rates of return to capital. Capital returns make up 88.3 per cent of firm income, so the 13.8 per cent decline in capital returns drives lower total firm income.

Saving by firms, which is a residual after taxes and transfer payments are deducted from total income, fall by 13 per cent. Firm savings make up 80.6 per cent of total investment accumulated, so the 13 per cent decline will have severe effects on gross fixed capital formation, as discussed in the macroeconomic section above.

Table 22: Firm income and savings

	Baseline (R millions)	Combined scenario
Total income	664 653	-13.13
Capital income	586 608	-13.76
Transfer income	78 045	-8.34
Saving	217 736	-13.01

Source: Own calculations

Government

Lower household and firm incomes cause income taxes to fall, by 8.5 per cent and 13.8 per cent, respectively. Lower production causes indirect taxes on that production to decline by 10.3 per cent. Finally, lower output and demand cause taxes on products to fall, by 11.5 per cent. This causes overall government revenue to fall by 11.1 per cent.

In the assumptions, the value of government consumption is fixed, so the decline in government revenue causes government dissaving. Worsened by deteriorating GDP, the budget deficit thus widens from 0.9 per cent of GDP to 3.6 per cent of GDP.

Table 23: Government revenue and fiscal indicators

	Baseline	Scenario
Total revenue	430 473	-11.09
Household income taxes	124 286	-8.52
Firm income taxes	98 930	-13.76
Taxes on production	28 663	-10.29
Taxes on products	170 303	-11.46
Budget balance (% of GDP)	-0.88	-3.63
Tax revenue (% of GDP)	27.72	27.42
Transfer receipts (% of GDP)	0.54	0.53
Government consumption (% of GDP)	20.18	22.44

Source: Own calculations

6. Concluding remarks

Over the decade preceding the global financial and economic crisis, South Africa enjoyed a business cycle upswing lasting a record 99 months and improved significantly its fiscal balances and inflation situation. This enviable macroeconomic stability, coupled with a conservative and well-regulated financial sector, seemed to put the country in a good position to face the crisis. However, as the crisis intensified beyond financial assets to threaten real economic activity, lower world prices and demand soon saw South African export receipts and inward investment weaken.

This paper uses the PEP-1-1 static computable general equilibrium model of South Africa to estimate the economy-wide effect of the global financial and economic crisis on the South African economy. Benchmark data is taken from a 2005 SAM for South Africa. The simulation applies four shocks – lower world import prices, lower world export prices, lower world demand for exports and lower foreign savings – that broadly correspond with the key transmission channels of the crisis to South Africa and mimic observed changes. While these are certainly not the only ways in which the crisis affected the country, we believe them to be the most significant. This enables a ‘crisis-only’ counterfactual, which omits the domestic economic conditions that existed before the crisis.

The results of the crisis scenario indicate that the global economic crisis had significant negative effects on the South African economy. GDP falls by 10.1 per cent relative to the baseline; the decline in household consumption expenditure is responsible for the bulk of the decline, but gross fixed capital formation is 28.2 per cent lower than its baseline value. Exports also fall considerably, by 14.1 per cent, compared with its baseline. Lower production causes wage rates and employment to decline. Highly skilled labour experience the largest declines in wage rates, while informal labour sees the sharpest drop in employment levels. As expected, households' incomes drop. Households in lower income deciles experience the largest declines in labour remuneration; however, households in the highest decile suffer larger declines, owing to sharp drops in firm income which accrue to them. To the extent that most semi-skilled, unskilled and informal workers fall under lower income deciles, lower employment (as opposed to lower wages) places them in a more severe situation.

Effects on sectoral variables, such as value added, imports and exports are also presented. Production falls in most industries, primarily as a result of lower export competitiveness. Export prices do fall, but not by at least as much as the shocks. Production volumes fall significantly in the construction, mining and community services industries. In many instances, the extent to which sectors are exposed to foreign demand fluctuations generally define how they will fare against the crisis. Similarly, the effects on capital and labour largely depend on how intensively they are used in production.

Returns to capital decline severely in a number of sectors, including mining, agriculture, mining-related manufacturing, vehicle and machine manufacturing, construction and financial and community services. Employment falls in most industries as well, and is particularly sharp in the mining and related manufacturing industries, as well as the construction sector. General government services tend to absorb much of the excess labour supply. This, however, places some risks on fiscal sustainability.

Of the individual shocks that constitute the crisis scenario, the decrease in world prices appears to have the harshest effects, causing very large contractions in production. The effects of the declines in world demand and foreign savings are considerably milder, but remain negative.

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