Oil Shock Vulnerabilities & Impacts: South Africa Case Study

Prepared for

United Kingdom Department for International Development

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30 June 2013

Map No. 3768 Rev. 5 UNITED NATIONS
January 2004

http://www.ohchr.org/english/countries/maps/southafr.pdf

Department of Peacekeeping Operations
Cartographic Section

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Abbreviations

ASPO-SA	Association for the Study of Peak Oil South Africa
CTL	Coal-to-liquids
DAFF	Department of Agriculture, Forestry and Fishing
DME	Department of Minerals and Energy
DoT	Department of Transport
EIA	Energy Information Administration
FAO	Food and Agriculture Organisation
GDP	Gross domestic product
GTL	Gas-to-liquids
GVA	Gross value added
IEA	International Energy Agency
IMF	International Monetary Fund
LPG	Liquefied petroleum gas
NDA	National Department of Agriculture
OCGT	Open cycle gas turbine
ORTIA	O.R. Tambo International Airport
RE	Renewable energy
SAPIA	South African Petroleum Industry Association
SARCC	South African Rail Commuter Corporation
SARB	South African Reserve Bank
StatsSA	Statistics South Africa

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1. Introduction

This report presents a South African country case study of oil dependencies and vulnerabilities to oil price and supply shocks, and forms part of a broader study commissioned by the United Kingdom Department for International Development titled "Oil Shock Mitigation Strategies for Developing Countries".[1] South Africa had a Gross Domestic Product (GDP) per capita of $10 983 in 2011 (IMF, 2012), which places it in the upper-middle income country category of the World Bank. The total population was estimated at 50.6 million in mid-2011 (StatsSA, 2012). South Africa has the largest and most developed economy in sub-Saharan Africa, and yet nearly half of the population is classified as poor. The country relies on imports for approximately two-thirds of its petroleum fuel supply.

The case study is organised according to five subsystems of the socio-economic system, namely: energy; transport; agriculture; macro-economy; and society. Sections 2 to 5 each include a brief overview of the subsystem, an analysis of its oil dependency, and a discussion of the likely impacts of oil shocks under business-as-usual policy environments. Section 6 analyses important characteristics of contemporary South African society that increase its social vulnerabilities to oil shocks. The concluding section provides a summary of key strengths, vulnerabilities and likely impacts of oil shocks in each of the five subsystems.

2. Energy

This section presents an overview of the energy system and the role of oil products in South Africa. It begins with a summary of primary sources of energy supply, energy carriers and final consumption (demand) by major sectors, i.e. the national energy balance. The focus is then narrowed to the supply and demand for oil and petroleum products. Oil supply is discussed in terms of sources (imports and domestic production), refining and stockpiles. Demand for petroleum products is analysed according to product type, geographical region and economic sector. The final subsection briefly considers the likely impacts of oil shocks on the energy system.

2.1 Overview of the energy system

The role of oil in South Africa's energy system needs to be placed in the context of overall energy supply and demand balances, i.e. alongside other sources of primary energy and within the final energy consumption mix.

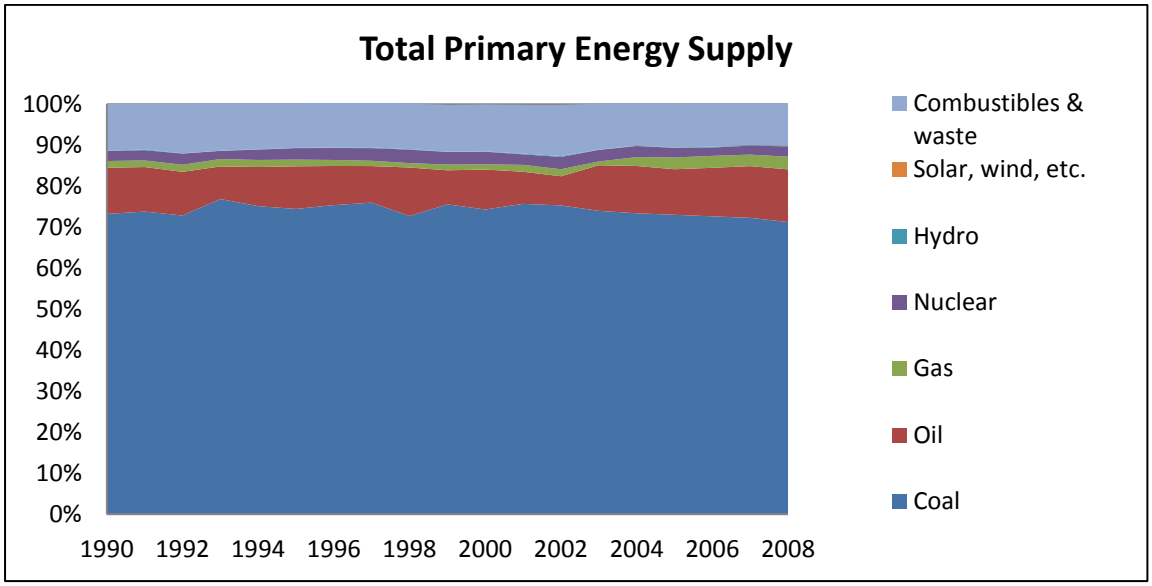
Primary energy supply

Figure 1 displays the evolution of South Africa's primary energy supply mix between 1990 and 2008. None of the relative shares has changed appreciably. Throughout the period, coal has dominated with between 72% and 77% of primary energy. Oil's share rose marginally to 13% in 2007 and 2008 from a low of 8% in 1993 and 1998. The shares of gas, nuclear, hydro and renewables (solar, wind,

[1] This case study material draws heavily from Wakeford (2012).

etc.) have never exceeded 3%, while combustible renewables and waste have provided between 10% and 12% of primary energy.

Figure 1: Shares of total primary energy supply by source, 1990-2008

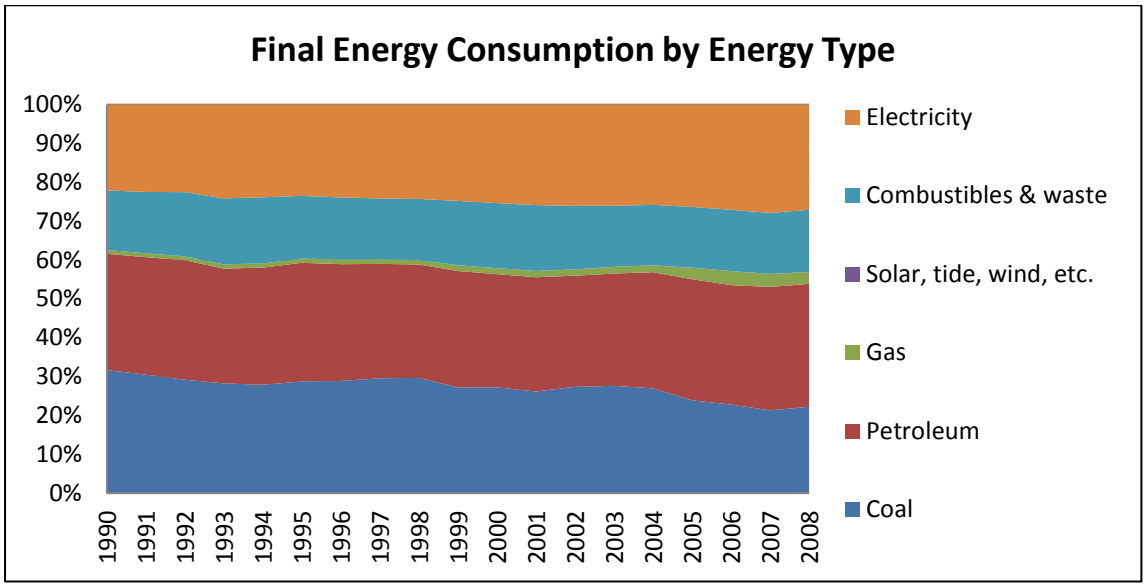


Source: IEA (2012)

Final energy consumption

Primary energy sources (e.g. oil) are converted into energy carriers (e.g. petroleum fuels), which are then consumed by end users. Coal, petroleum products, combustible materials and electricity have all contributed significant shares of final energy, while use of gas has grown somewhat but remains relatively small (see Figure 2 below). Over the period, the direct use of coal has shrunk from over 30% to 21%, having made way for more efficient energy carriers such as electricity, petroleum and gas. By 2008, petroleum accounted for over 30% of final energy consumption.

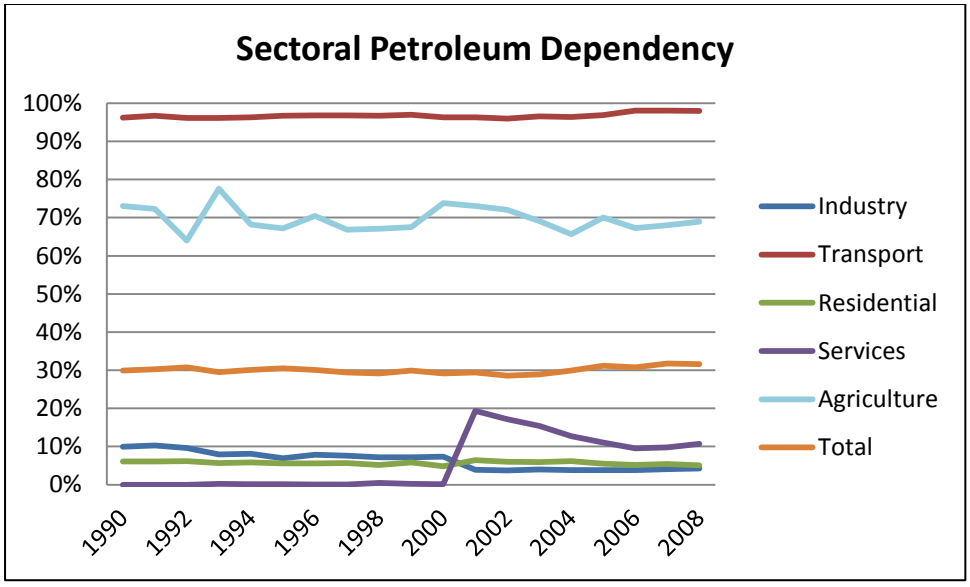
Figure 2: Shares of total final energy consumption by energy type, 1990-2008



Source: IEA (2012)

The shares of petroleum products in final energy consumption by sector and for the economy as a whole between 1990 and 2008 are displayed in Figure 3. In almost all sectors, the share of total final energy consumption accounted for by petroleum products has been fairly stable, and for the country as a whole has ranged between 29% and 32%. The underlying data for the services sector are clearly anomalous.

Figure 3: Share of petroleum products in final energy consumption by sector, 1990-2008



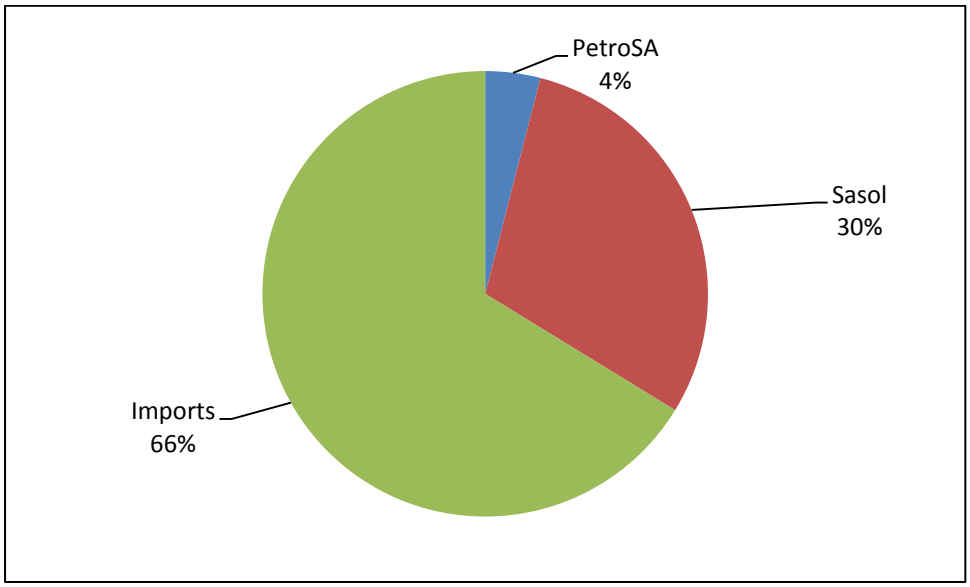
Source: Author's calculations based on IEA (2012)

2.2 Oil dependence of the energy system

Supply of oil

The sources of petroleum fuels are shown in Figure 4 below. Imported crude oil and refined products contributed approximately 66% or approximately 370 000 barrels per day (bpd) of South Africa's annual consumption of petroleum products in 2010 (EIA, 2011). The remaining 180 000 bdp was derived from Sasol's coal-to-liquids (CTL) synthetic fuels (30%) and state oil company PetroSA's production of gas-to-liquid (GTL) synthetic fuels plus a very small amount of domestic crude oil (4%). South Africa's crude oil reserves stood at a meagre 15 million barrels as of January 2011 (EIA, 2011), and were likely to be depleted within a few years in the absence of significant new oil field discoveries.

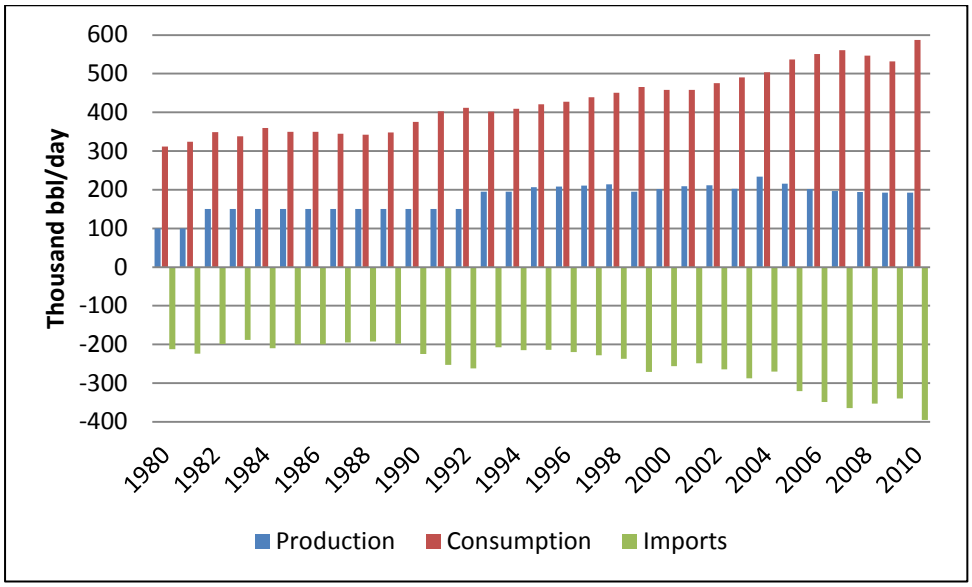
Figure 4: Sources of petroleum fuel supply in South Africa, 2010



Source: Author's calculations based on Sasol (2010), PetroSA (2010) and BP (2011)

Figure 5 displays South Africa's total annual production, consumption and imports of oil (crude oil plus refined petroleum products). Domestic production has remained relatively constant at around 200,000 barrels per day (bpd) since 1993, while consumption has followed a rising trend albeit with some cyclical downturns. Oil imports have been on a gradually rising trend since 1993.

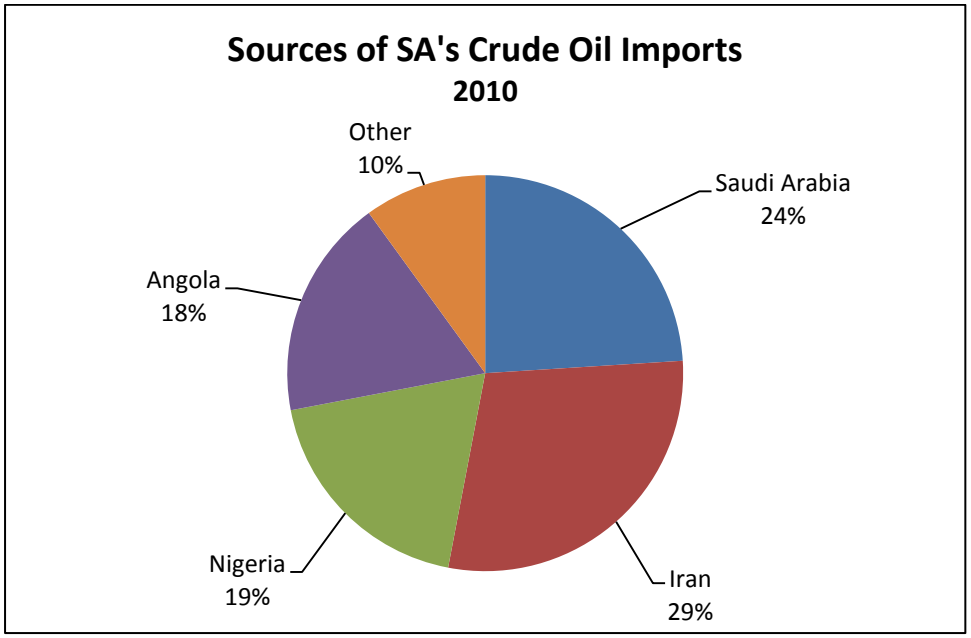
Figure 5: South African oil production and consumption, 1980-2010



Source: EIA (2012)

In 2010, South Africa relied on mostly OPEC nations for its oil imports, notably Iran (29%), Saudi Arabia (23%), Nigeria (19%) and Angola (18%) (see Figure 6) (EIA, 2011). Reliance on Iranian crude oil imports was curtailed to an extent in 2012 under pressure from the sanctions placed on the Iranian oil industry by the United States and the European Union.

Figure 6: South Africa's sources of crude oil imports, 2010



Source: EIA (2011)

South Africa has the second largest oil **refining capacity** in Africa, after Egypt. Refineries are owned and operated by several large international oil companies (BP, Shell, Chevron and Engen) as well as

by local firms Sasol and PetroSA. Total refining capacity in 2010 amounted to 703,000 barrels per day, of which 72% was comprised of crude oil refining with the balance of 28% being synthetic fuel refining capacity (see Table 1). For many years South Africa has exported refined petroleum products to other countries in Southern Africa. From 2006 demand for refined fuels in the region (including South Africa) outstripped domestic refining capacity so that increasing amounts of refined fuels had to be imported. Petroleum fuels are distributed from the refineries to approximately 200 depots, 4 600 retail service stations and directly to about 100 000 consumers, most of whom are farmers (SAPIA, 2011).

Table 1: Domestic crude oil and synthetic fuel refining capacity, 2010

Refinery	Barrels/day	Location	Company
Natref	108,000	Sasolburg	Sasol/Total
Sapref	180,000	Durban	BP/Shell
Enref	120,000	Durban	Engen
Chevref	100,000	Cape Town	Chevron
Total crude oil refining	*508,000*		
Secunda	150,000	Secunda	Sasol
Mossgas	45,000	Mossel Bay	PetroSA
Total synthetic fuel refining	*195,000*		
TOTAL	*703,000*		

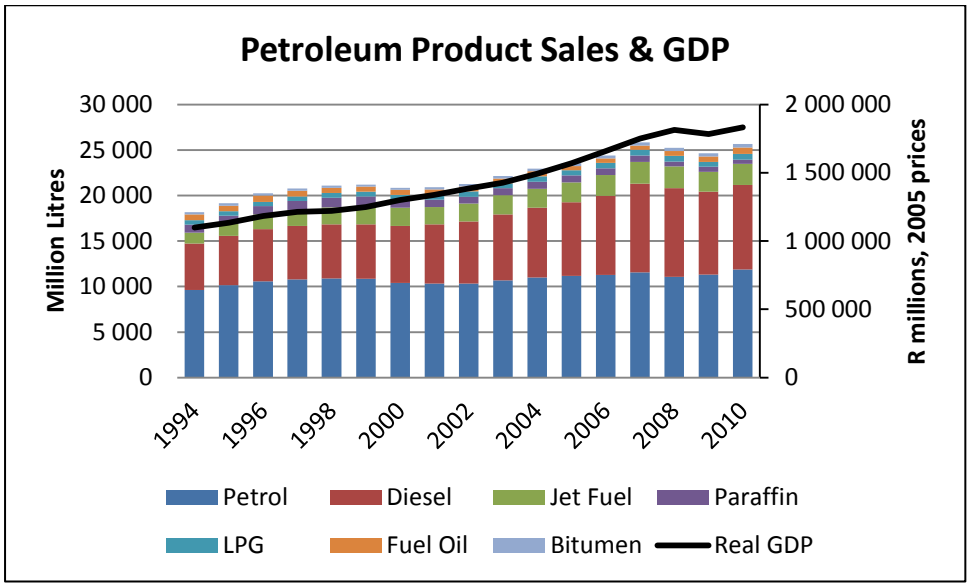
Source: SAPIA (2011)

South Africa maintains a **strategic petroleum reserve** at Saldanha Bay in the Western Cape. The facility has a maximum capacity of 45 million barrels, which translates into about 140 days' worth of crude oil imports (DME, 2007). Information on the actual volume of oil in storage is not publicly available. In December 2005 South African oil refineries underwent modifications in order to comply with cleaner fuel regulations, and shortages of refined product developed in certain areas, which brought about economic losses and inconveniences. In view of this, the DME (2007) recommended that the oil industry be required to maintain 28 days' worth of commercial petroleum product stocks.

Demand for oil

This subsection presents historical data describing the consumption of petroleum products in total, disaggregated by product type and sector, and on a per capita basis. Total annual sales of petroleum products grew largely in line with the economy (real GDP) in the period 1994 to 2010 (see Figure 7). Petrol and diesel together make up more than 80% of petroleum product sales. Liquefied petroleum gas (LPG) sales in the figures below relate mainly to household use for cooking and heating. The relative shares partly reflect demand and partly the proportions of a barrel of oil that can be refined into the various petroleum products.

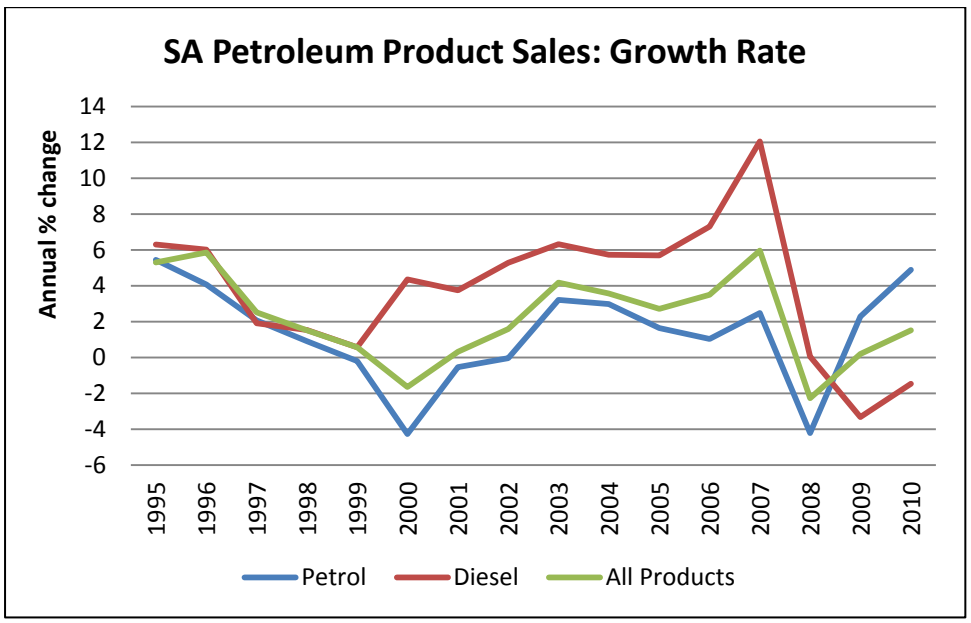
Figure 7: Annual total petroleum product sales, 1994-2010



Source: SAPIA (2011) and SARB (2012)

The average growth rate for sales of all liquid petroleum fuels was 2.8% for the period 1995 to 2007 (see Figure 8). In that period the average annual growth rate for diesel was 5.1%, and for petrol, 1.4%. However, these growth rates fell steeply during 2008 as a result of sharply rising fuel prices (crude oil traded at $100 per barrel on average for the year) as well as tighter economic conditions (i.e. rising costs of living and higher interest rates). The recession in 2009 significantly dampened demand for diesel (consumption fell by 6.6%), although petrol demand grew by 2.2%.

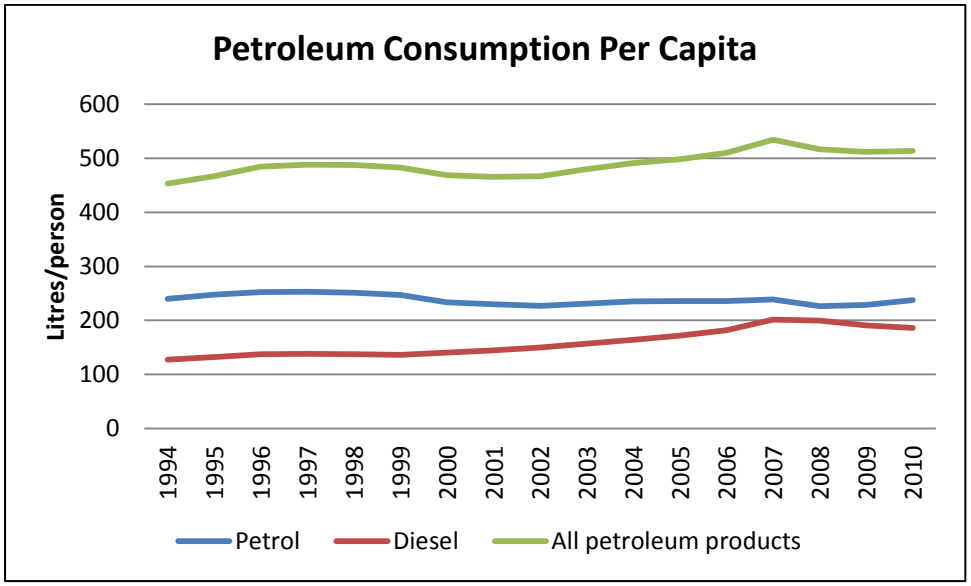
Figure 8: Annual growth in petroleum product sales, 1995-2010



Source: Own calculations based on SAPIA (2011)

Figure 9 shows the **per capita consumption** of petroleum products for the period 1994 to 2010. There has been a very slightly increasing trend over the period, with a high point reached in 2007.

Figure 9: Petroleum consumption per capita in South Africa, 1994-2010



Source: Own calculations based on SAPIA (2011) and StatsSA (2012)

2.3 Likely impact of oil shocks on the energy system

Rising oil prices will gradually dampen demand and result in less petroleum energy being consumed in the country, especially in the longer term. The prices of other energy sources, especially those that are to some extent or other substitutable for oil – such as coal and gas – are likely to rise along with the oil price. These price rises will in turn put upward pressure on the price of electricity, since coal is the feedstock for about 90% of national power generation. Furthermore, because approximately one third of the coal feeding Eskom's coal-fired power stations is transported by truck, the costs of this feedstock will rise as diesel prices rise. Higher prices of refined diesel fuel will also raise Eskom's costs of running open cycle gas turbines (OCGTs), which are used to meet peak electricity demand. The costs of buying or manufacturing, transporting and installing alternative energy infrastructure, including wind turbines and solar panels, will also increase to some extent as a result of rising fuel costs. The rising cost of alternative energy sources illustrates their dependence on an economic infrastructure that is itself dependent on oil. Thus there will be added upward pressure on electricity prices, in addition to the pressure imposed by funding requirements for Eskom's new build programme. However, the rising cost of fossil fuel energy will make renewable energy (RE) sources relatively more competitive and is likely to stimulate investment in this sector. Increased production of RE technologies could deliver economies of scale and learning, and hence reduce their prices, setting off a positive feedback loop. Thus over the longer term, one can expect a process of (partial) substitution of renewable energy for oil and coal. If economic conditions are deteriorating (as discussed in Section 5 below), however, the expansion of RE might not be rapid enough to offset declining consumption of fossil fuels, resulting in diminishing total energy consumption.

Acute physical shortages of oil products, which could arise from time to time owing to global supply interruptions, could have more serious consequences than gradually rising (or volatile) energy costs. Most immediately, Eskom's demand for diesel fuel to run its open cycle gas turbines will have to compete with transport, agriculture and other demand sectors for scarce diesel supplies. Perhaps most significantly, a sudden interruption of liquid fuel supplies could disrupt the flow of coal to power stations and thereby seriously compromise Eskom's ability to maintain sufficient power generation to keep the national electricity grid stable. Although not caused by liquid fuel shortages, a similar situation arose in early 2008 when problems in the procurement and transportation of coal resulted in insufficient stockpiles at some power stations, contributing to the electricity crisis which involved blackouts and load shedding. Power outages would in turn hamper the refining of petroleum fuels and their distribution through pipelines and at retail outlets, thus setting in motion a self-reinforcing feedback loop with very adverse consequences.

3. Transport

Effective transport systems are essential for the conduct of local, regional and international commerce and trade, and mobility is an important determinant of human welfare. This section begins with an overview of South Africa's transport system. It then details the oil dependence of the transport system, before identifying key strengths and vulnerabilities in relation to oil price and supply shocks and likely impacts of such shocks.

3.1 Overview of the transport system[2]

The transport system is characterised by infrastructure, passenger travel and freight movement. Each of these facets is considered in turn, according to various transport modes, namely road, rail, air and sea.

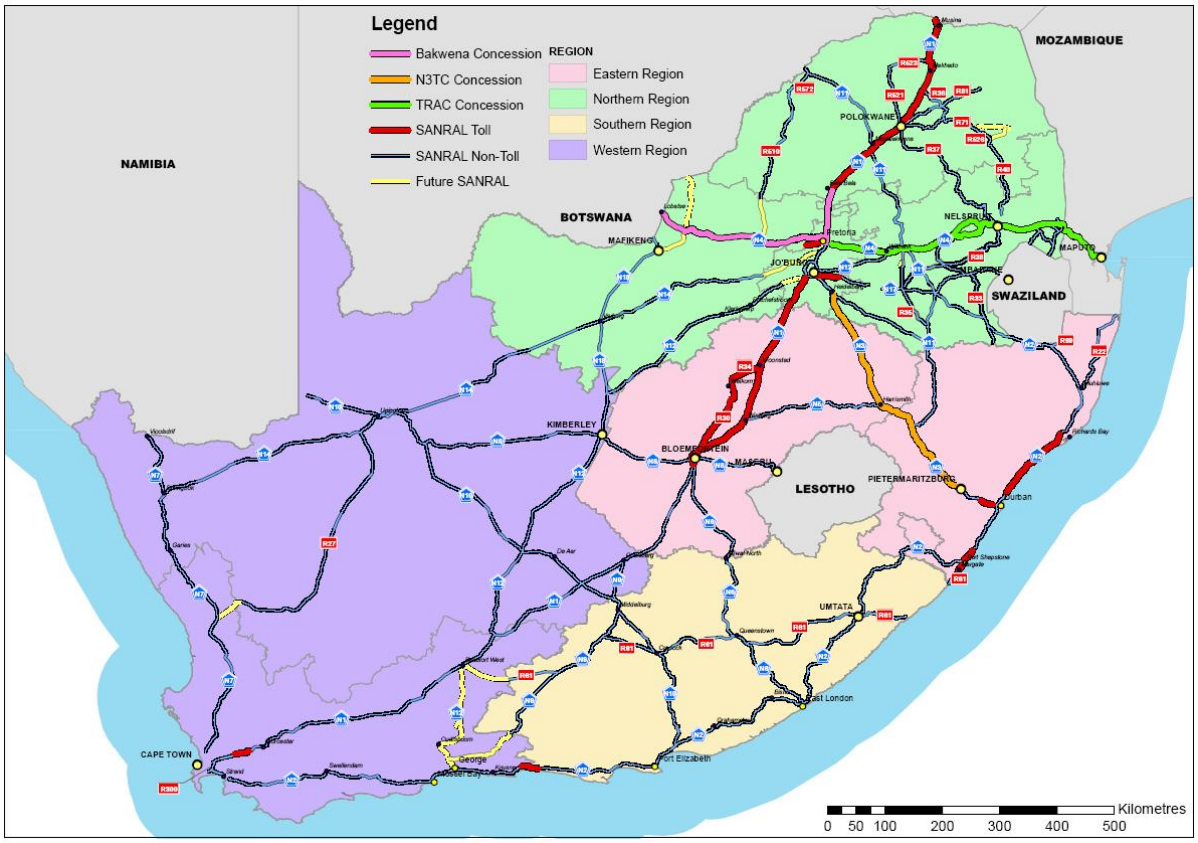
Transport infrastructure

South Africa has a transport infrastructure that is the envy of many developing countries. An extensive road network, comprising both paved and (to a much greater extent) unpaved roads, covers much of the country (see Figure 10). A rail network of 20,000 kilometres connects all of the major urban settlements in the country. Approximately 80,000 wagons and 2,300 locomotives operate on this network (ASPO-SA et al., 2008: 24). The South African Rail Commuter Corporation (SARCC) operates commuter railways in the six major metropolitan areas, but there are no light rail or underground rail systems in South Africa's cities. According to ASPO-SA et al. (2008: 9), "The public transport system is underutilised, severely under-developed and undercapitalized in relation to commuter needs." South Africa has in excess of 20 commercial airports, although many of these are small and provide limited services (ASPO-SA et al., 2008: 24). The majority of international flights land at the O.R. Tambo International Airport (ORTIA) in Johannesburg, although airports in Cape Town and Durban also offer some international flights. South Africa has a coastline of 2,954 kilometres, on which there are 18 notable ports including eight multi-purpose commercial ports

[2] This section draws substantially on ASPO-SA et al. (2008).

(ASPO-SA et al., 2008: 29). These ports are connected to the rail and road networks and serve as entry and exit points for internationally traded goods.

Figure 10: South Africa's national road network



Source: DoT (2008)

Passenger travel

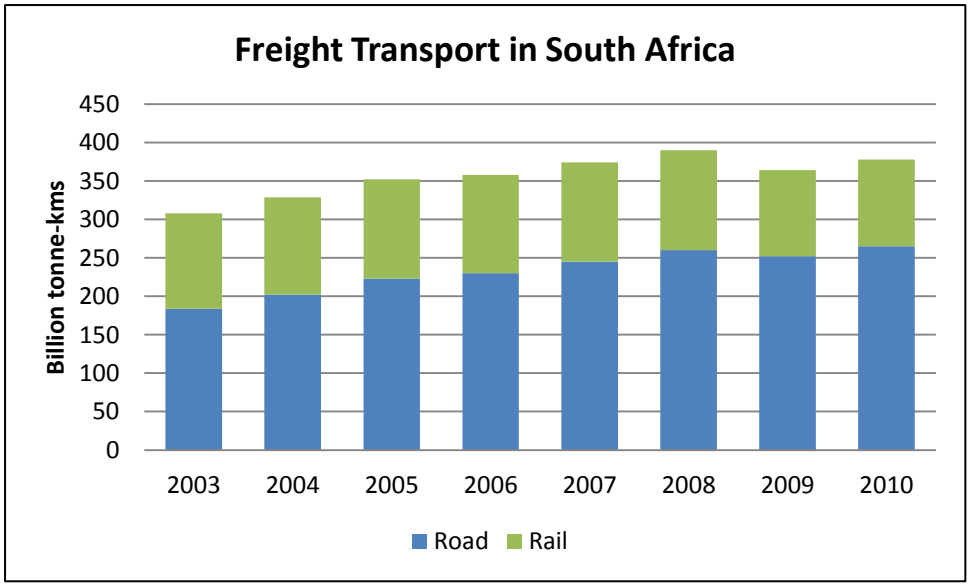
Despite the country's extensive transport infrastructure, nearly one half of South African citizens relied for their mobility on non-motorised transport in 2003 (DoT, 2005). The remaining half of the population makes use primarily of road-based motorised transport, including private motor vehicles and minibus taxis. According to the most recent data, the National Household Travel Survey, South Africa had some 10 million commuters in 2003 (DoT, 2005). At this time the country's commuters were overwhelmingly dependent on road transport, including minibus taxis (22% of commuters), cars (15%), buses (6%) and other taxis (3.7%). Just 2.3% of commuters reported use of trains. Since that survey was conducted, car ownership and the number of registered minibus taxis have increased significantly, but use of passenger trains has been static as capacity was not expanded. Passengers in general have a low regard for public bus and rail transport systems as a result of perceptions of long distances between dwellings, stations and bus stops (ASPO-SA et al., 2008: 9). In recent years, Bus Rapid Transit systems have begun being developed in Johannesburg and Cape Town, with similar systems planned for at least three other major cities. The reliance on motorised transport is substantially higher in metropolitan and urban areas compared to rural areas for almost all transport modes. Water-based passenger transport (along the coast) is negligible. As of 31 December 2011, there were approximately 8.8 million self-propelled registered vehicles on South

Africa's roads, including 5.8 million motor cars (representing approximately 120 cars per thousand people in a population of 49 million), 340 000 motor cycles, 284 000 minibus taxis, 49 000 buses, over 2 million light trucks and 333 000 heavy trucks (eNatis, 2012).

Freight movement

Freight transport is also heavily road-based (see Figure 11). In 2010, road freight accounted for 70% of ton-kilometres and rail for the remaining 30% (CSIR, 2012: 30). Mining products, such as coal and iron ore, account for almost half of all freight tonnage, manufacturing for another 45% and agricultural products for just 6% (GCIS, 2007: 578). Since the mid-1990s, rail freight volumes on corridors have declined while road freight volumes have grown steadily, apart from a dip in the recession year of 2009. Logistics costs in 2010 amounted to 12.7% of GDP, approximately half of which were transport costs (CSIR, 2012: 30). Relatively small volumes of freight are transported by air. South Africa lacks any significant navigable rivers and hence makes very limited use of water-borne freight transport.

Figure 11: Land freight transport in South Africa, 2003-2010



Source: CSIR (2012)

3.2 Oil dependence of the transport system

The transport sector utilised 83% of all petroleum energy, 2% of all electricity, and 25% of total final energy consumed in South Africa in 2009 (based on IEA, 2012). Within the transport sector itself, 98% of the energy consumed is derived from petroleum products, and only 2% from electricity (these shares have hardly changed since 1990). Clearly, the transport sector is overwhelmingly dependent on liquid petroleum fuels, i.e. petrol, diesel and jet fuel. Table 2 shows the consumption of energy disaggregated by energy carrier and by transport mode. Road transport dominates energy consumption with 79% of petroleum fuels and 78% of all energy. Aviation (including international and domestic air transport) accounted for 9.3% of petroleum consumption within the transport sector in 2009, while 11.4% was consumed for internal navigation. Rail used predominantly

electricity (79% of electricity consumed by the transport sector) plus a small amount of diesel and coal, but less than 2% of total energy consumed by transport.

Table 2: Energy consumption by the transport sector, 2009

Transport Sector	Coal		Petroleum		Electricity		Total	
	TJ	%	TJ	%	TJ	%	TJ	%
International aviation	-	-	36 118	4.0	-	-	36 118	3.9
Domestic aviation	-	-	47 559	5.3	230	1.7	47 789	5.2
Road	-	-	711 364	79.1	86	0.7	711 450	77.8
Rail	2035	100.0	1 788	0.2	10442	79.3	14 265	1.6
Pipelines	-	-	-	-	355	2.7	355	0.0
Internal navigation	-	-	102 857	11.4	195	1.5	103 052	11.3
Non-specified	-	-	-	-	1856	14.1	1 856	0.2
Total	2 035	100	899 684	100	13 165	100	914 885	100

Source: DoE (2012)

3.3 Likely impact of oil shocks on the transport system

The major vulnerabilities to oil shocks inherent in South Africa's transport system include infrastructural, modal (passenger and freight), and geographical dimensions.

Transport **infrastructure** in South Africa, although extensive relative to many other developing countries, suffers from several problems. A major weakness of the road network is the deficit in road maintenance in many areas, with an estimated backlog of R75 billion in April 2010 (Davenport, 2010). Some four fifths of the country's roads were older than the 20-year lifespan for which they were designed (Davenport, 2010). According to the CSIR (2010: 5), "The percentage of bad and very bad roads in the secondary road network of South Africa increased from 8% in 1998 to 20% in 2008." Road maintenance costs are vulnerable to oil price shocks, since the bitumen used for surfacing paved roads is derived from crude oil. Although the rail network has significant spare capacity for moving freight, it has been neglected in terms of maintenance and upgrading (ASPO-SA, 2008: 50-51). Much of the nation's rolling stock is very old and needs to be replaced (Situma, 2007; Mahlalela, 2010). The well-developed port infrastructure could serve the economy well if more freight is shifted from road to sea. However, since manufacturing production is concentrated in Gauteng, there is limited scope for such modal transfer, especially considering the lack of inter-modal facilities (ASPO-SA, 2008). Many of the country's airports were upgraded or expanded in preparation for the FIFA Soccer World Cup in 2010, but this expenditure will be of doubtful use for the future when air travel is likely to be severely constrained internationally and domestically by rising fuel costs. Public transport in several major cities also received a significant boost as part of the preparations for the Soccer World Cup, when construction began on Bus Rapid Transit (BRT) systems in Johannesburg and Cape Town. However, provision of infrastructure to facilitate non-motorised transport in cities, such as walk-ways and bicycle paths, is sorely lacking.

The **mobility** of the more than half of South Africa's population that relies on motorised transport is highly vulnerable to oil price shocks, given the overwhelming reliance on liquid petroleum-fuelled

vehicles. Poorer transport users tend to spend a much higher proportion of their incomes on transport and therefore are more vulnerable to rising fuel and transport costs than their wealthier counterparts. Public transport users will face increasing fares and if these become unaffordable, commuters may have to walk or even be unable to travel to their places of work. Motorists will respond to higher fuel prices with a range of behavioural adaptations, starting with reduced discretionary driving and later shifting to public transport, which may become over-subscribed. While air travel will be particularly vulnerable to rising fuel prices (since fuel accounts for a relatively high proportion of total costs), business travellers can adapt to some extent by telecommuting. Many of those travelling by air for other purposes (e.g. tourism) are likely to have to shift mode and/or reduce their travel distances.

The heavy reliance of **freight** on road transport presents a major challenge to the economy, both in terms of future fuel supply constraints and the impact of rising costs. Lane (2009) catalogues a range of vulnerabilities that characterise freight transport in South Africa, including inadequate technology, equipment and facilities; outdated infrastructure; lack of inter-modal facilities; capacity bottlenecks; monopoly ownership of certain infrastructure; skills shortages; and a lack of information. Given the overwhelming dependence of freight movement on road transport, rising fuel prices would have a significant impact on the trend in freight and logistics costs. The CSIR (2010: 16) estimated that a tripling in the fuel price would raise logistics costs by 53% under conditions pertaining in 2008. Consequently, transport costs as a share of GDP would rise from 7.4% to 12.8% (CSIR, 2010: 17). Some industries and retailers might absorb a portion of the added freight costs internally, but in general higher freight costs will be passed along the value chain to final consumers in the form of higher retail prices for goods. Businesses with a high degree of reliance on freight movement (i.e. where transport costs are a significant proportion of the final costs of goods) will find that rising fuel costs steadily erode their profit margins. For international trade, rising fuel costs will act like a tariff barrier, favouring local trade over long-distance trade (see Rubin, 2009). Being highly energy intensive, air freight is much more sensitive to fuel prices than other modes of freight transport. In the long term, costs of air freight may become prohibitively high, resulting in the collapse of markets for all but the highest-value goods.

Vulnerabilities can also be identified on a **geographical** basis. Most obviously, there are substantial distances between major metropolitan areas and towns. The bulk of liquid fuels are consumed in metropolitan areas, due to the high concentration of vehicles found here and the phenomenon of urban sprawl. Areas in the hinterland that have no rail access are also highly vulnerable, with a danger that both people and assets could become stranded. Many parts of the country are accessible only by roads (ASPO-SA et al., 2008: 56). Both industry and population are concentrated in the interior of the country, far from ports (and at a much higher altitude), which means that two long-distance corridors (Gauteng-Durban and Gauteng-Cape Town) carry large freight volumes (Lane, 2009). Finally, South Africa is far from most of its trading partner countries, which makes international trade especially vulnerable to rising transport costs.

Short term, sudden **shortages** of fuel could have a drastic impact on transport. For example, a sudden interruption of jet fuel supplies could have serious implications as the Department of Minerals and Energy (DME, 2007: 21) warned that “indications are that there is not enough space in South African airports to park all airplanes that are, at any one time, heading for or in South Africa.”

For road passengers (whether using private or public vehicles), localised fuel shortages could result in disabling immobility. Shortages are likely to result in extensive queuing and possibly even conflict at filling stations, while hoarding responses are also possible. In the case of freight, fuel shortages would result in disruptions to logistics chains. The longer the production chains involved, the greater the potential for disabling disruptions. Just-in-time delivery systems are particularly at risk of logistics failures (Rubin, 2009), with the result that shortages of various commodities could arise at the retail level.

4. Agriculture

Agriculture, which is classified as one of the primary economic sectors, is a quantitatively small but qualitatively very important sector of the economy. It represents the base layer of the economy in that the population and labour force must have food in order to carry out economic activities. Economic and social stability depend on a healthy, functioning system of agricultural production and food distribution. Section 4.1 provides a brief overview of the agricultural system in South Africa, while Section 4.2 describes its dependence on oil and explores the issue of national food security. Section 4.3 summarises the anticipated impacts of oil shocks.

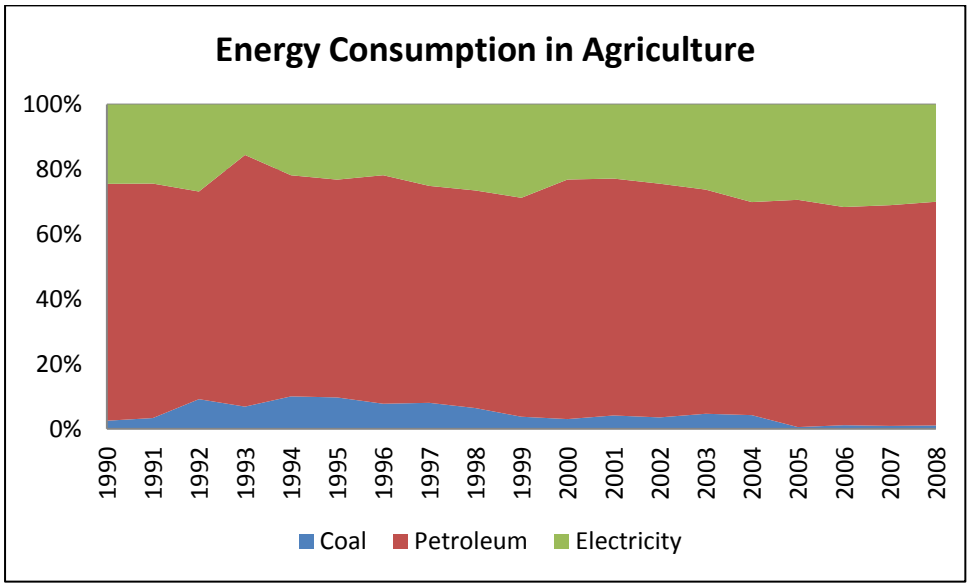
4.1 Overview of agriculture

South Africa has a total land area of 127 million hectares, of which just over 100 million hectares (82%) is classified as farmland (DAFF, 2012). The vast majority of this farmland (84 million hectares or 69% of the total land area) is suitable for grazing only. Approximately 16.7 million hectares (14%) of the country's land area receives sufficient rainfall to be potentially arable, although only about a fifth of this land is of high quality (GCIS, 2009: 47). Water scarcity is a limiting factor for agriculture, and only about 1.35 million hectares (1.5% of agricultural land and less than 10% of arable land) is under irrigation (DAFF, 2012). South Africa's agricultural economy is made up of two parts: an industrialised commercial sector, and a largely rural subsistence or smallholder sector (GCIS, 2009: 47). Commercial farmers account for at least 95% of total marketed agricultural produce (Food and Agriculture Organisation (FAO), 2005: 2). The commercial agriculture sector produces a wide range of commodities, including livestock products (meat and dairy products), field crops (grains such as maize, wheat and sorghum; sugar; oil seeds; and cotton) and horticultural produce (fruits and vegetables). Maize occupies half of all the land under crops (FAO, 2005: 13), is the most important food crop by volume of output, and is the staple food for the majority of South Africans. Subsistence farming occurs predominantly in the rural, former 'homeland' areas of South Africa (Pauw, 2007: 196) and contributes less than 5% of total agricultural output (FAO, 2005: 2). Subsistence farming involves a small share of the South African population relative to other sub-Saharan African countries, where it remains a major contributor to livelihoods (Baiphethi & Jacobs, 2009: 462). Nevertheless, there are approximately four million South Africans involved in subsistence farming, mostly to secure an "extra source of food" (Aliber & Hart, 2009: 439).

4.2 Oil dependence of agriculture

The agriculture, forestry and fishing sector accounted for 3% of total final energy consumption in 2008, which was commensurate with its 2.9% contribution to gross domestic product. As seen in Figure 12, the relative contributions of coal, petroleum and electricity to total energy consumption in agriculture have not changed substantially over the past two decades, although the already small share of coal has diminished further. In 2008, approximately two thirds (69%) of the energy used by the agricultural sector was in the form of liquid petroleum fuels, while electricity contributed 30% and coal just 1%. Energy and oil intensity varies according to the type of farming practiced, namely industrialised commercial or subsistence farming. Organic farming has grown fairly rapidly in recent years, but this has been from a very small base and the sector comprises a miniscule proportion of commercial farms in South Africa (Niemeyer & Lombard, 2003: 1).

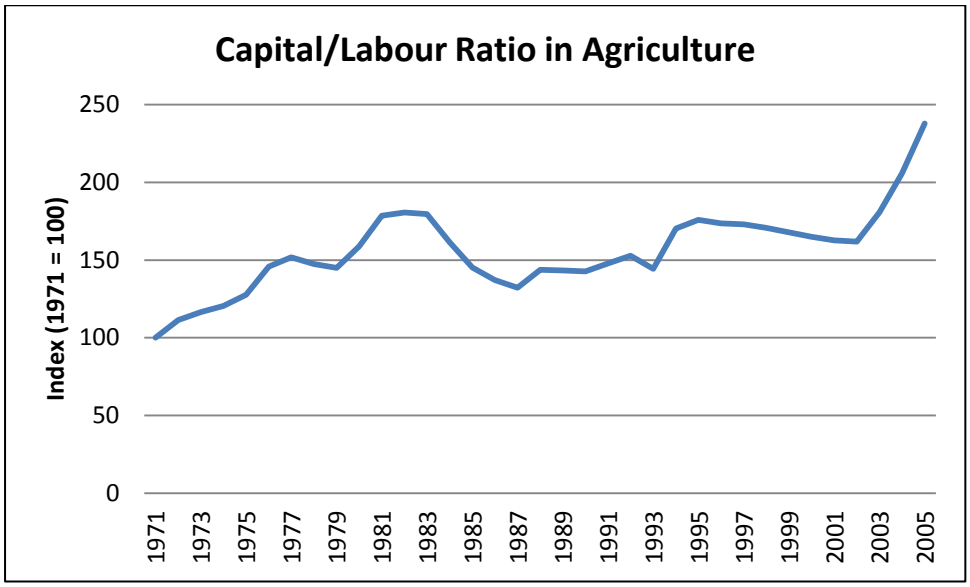
Figure 12: Energy consumption in agriculture, 1990-2008



Source: IEA (2012)

The industrialised, commercial agricultural system in South Africa is highly dependent on fossil fuel energy at every stage of the value chain, from primary production on farms, to processing in factories, to wholesale and retail distribution. At the production stage, this energy intensity results primarily from the extensive use of liquid petroleum fuels – especially diesel – to power farm vehicles and machinery such as tractors, planters and harvesters. Electricity is also consumed to power irrigation systems and other machinery, including refrigerators. The relative capital intensity (as measured by the capital/labour ratio) of commercial agriculture has increased considerably over the past several decades as farmers have progressively replaced human labour with machinery (see Figure 13; Institute for Natural Resources, 2008: 67).

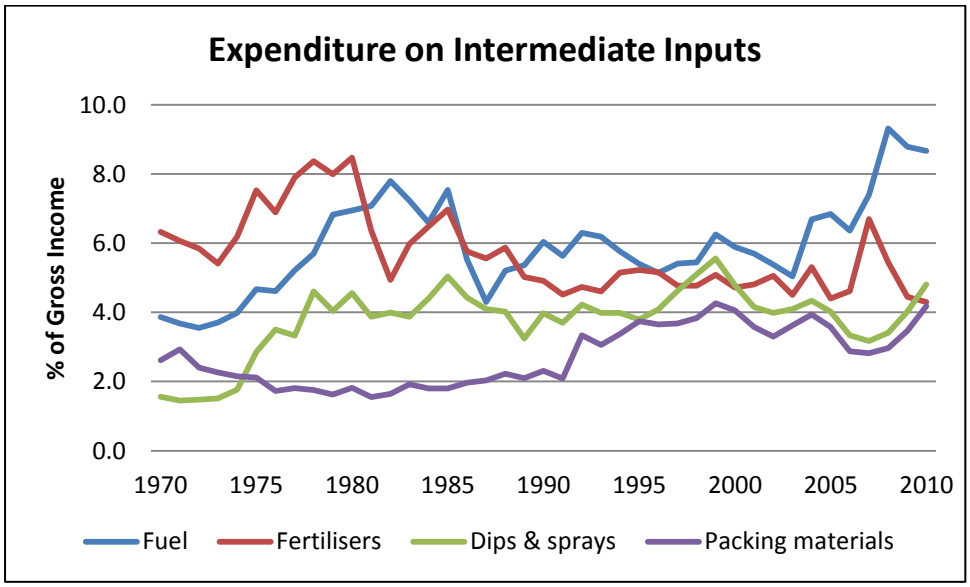
Figure 13: Capital-labour ratio in agriculture, 1971-2005



Source: Author's calculations based on DAFF (2012) and SARB (2012)
Note: The employment series from DAFF (2012) had several missing values, which were replaced with linearly interpolated figures.

In addition to the direct use of fossil fuels, commercial agriculture consumes significant quantities of energy indirectly in the form of fertilisers and pesticides, whose manufacture involves the use of natural gas (or gasified coal) and oil, respectively. Intermediate input costs as a proportion of gross income in the agricultural sector have generally risen since the 1970s, with the exception of fertiliser costs (see Figure 14). Most noticeable is the rising trend in the proportionate cost of fuel, from a low of 4.3% in 1988 to a high of 9.3% in 2008. Total input costs rose from an average of 33% of gross income in the 1970s to 60% in 2010 (DAFF, 2012).

Figure 14: Input costs as a percentage of gross income in agriculture, 1971-2010



Source: DAFF (2012); Note: Figures are for the year ending in June.

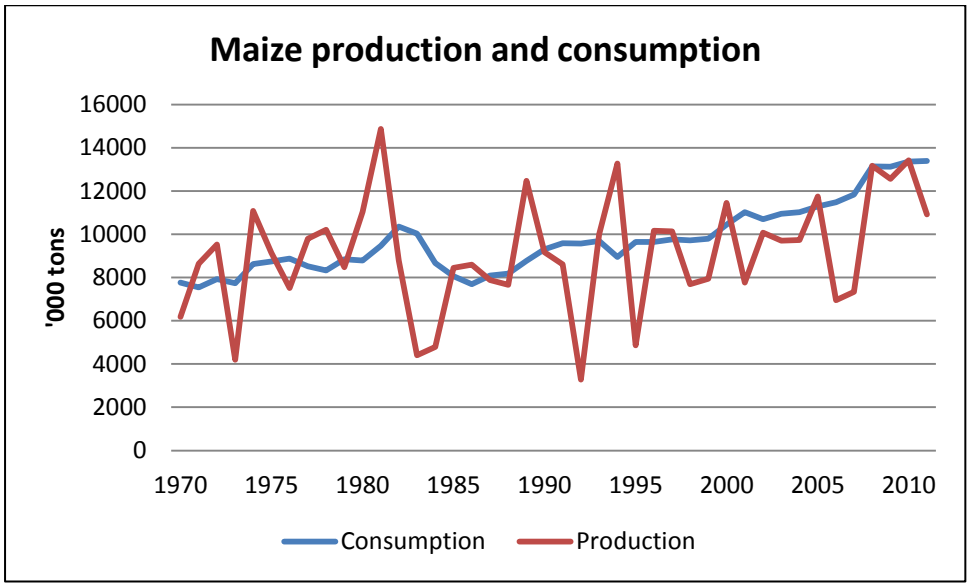
Traditional subsistence farming is generally much less dependent on oil than commercial farming, for several reasons. First, subsistence production is small-scale and labour intensive rather than large-scale and capital intensive (mechanised), and therefore uses little or no petroleum fuel directly. Second, traditional farming has at least until recently been mostly organic, i.e. farmers do not use chemical fertilisers and pesticides derived from fossil fuels (Modi, 2003: 676). Nevertheless, some subsistence farmers may rely to an extent on purchases of fertilisers, seeds and other inputs whose prices may be affected by oil prices. Third, most smallholder produce is consumed locally rather than being transported to distant markets.

National food security

The dependence of agriculture on oil has significant implications for national food security. According to the Food and Agricultural Organisation (FAO, 1996, in Hendriks & Msaki, 2009: 184), "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." Food security can be analysed on different scales of aggregation. The remainder of this subsection considers food security at the national level, while household level food security is discussed in Section 6.2. At the national level, food security has two determinants: (1) the capacity of the country to be self-sufficient in food production; and (2) the ability of the country to afford food imports where necessary or desirable.

South Africa has the capacity to be self-sufficient (i.e., domestic production exceeds consumption) in most agricultural products (GCIS, 2009). On average, South Africa produces sufficient quantities of the main staple crop, maize, to meet domestic human and commercial consumption (see Figure 15). Historical exceptions to this have largely been the result of droughts. However, South Africa does rely on imports for some significant agricultural products. Major agricultural net imports include rice, wheat, poultry and vegetable oils (NDA, 2009c: 10). Approximately one third to one half of the country's wheat requirement is imported, although this is partly because imports are cheaper than domestic production on marginal lands and there is no import tariff protection. All of the rice consumed domestically is imported, but rice is generally consumed by the wealthy minority and does not represent a broad staple food. Agricultural imports, mostly of processed foods, grew more rapidly than exports in the early 2000s so that by 2008 South Africa had become a net food importer in value terms for the first time (NDA, 2009b: 8).

Figure 15: Maize production and consumption in South Africa, 1970-2011



Source: DAFF (2012)
Note: Commercial consumption refers to maize used as animal feed.

Continued national food self-sufficiency clearly depends on access to affordable, quality inputs (such as fertilisers, pesticides, and machinery) for agricultural production. South Africa became a net importer of fertilisers in the 2000s (FAO, 2005: 19). Domestic fertiliser prices are influenced heavily by prevailing international prices, the rand-dollar exchange rate and freight costs (FAO, 2005: 28) and are therefore susceptible to rising oil prices both directly (through higher transport costs) and indirectly (through the impact of oil prices on the exchange rate and international prices). Fertilisers are mostly delivered to farms by road and rarely by rail (FAO, 2005: 30), further entrenching dependence on oil. The majority of farming equipment, such as tractors and harvesters, is imported and therefore farmers face the risk of rising international prices and/or a depreciating exchange rate.

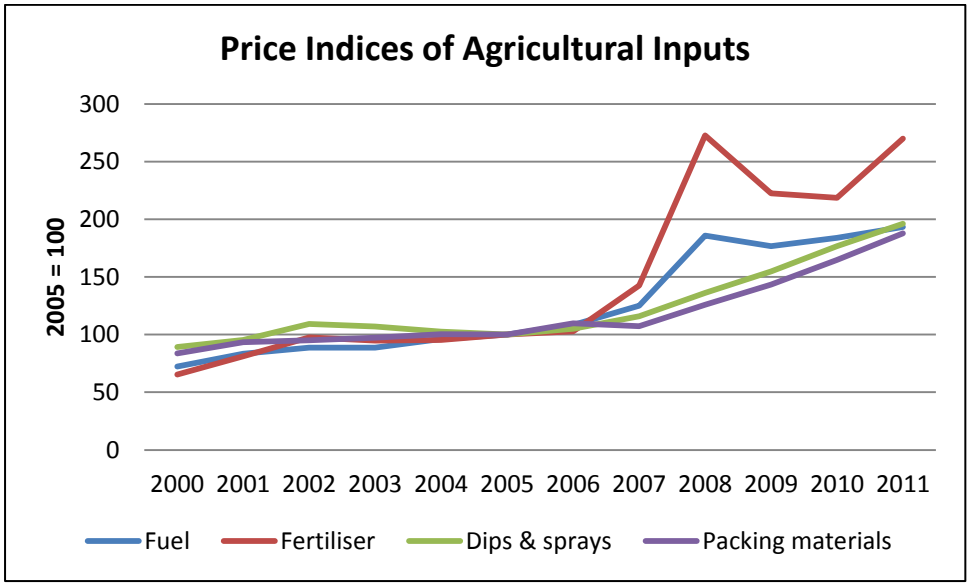
The second important determinant of national food security is South Africa's capacity to import food products. This depends on international food prices as well as the strength of the domestic economy, in particular the balance of payments and the level of the exchange rate (see Section 5 below). These aspects of the macro-economy are likely to come under pressure from any future oil price shocks.

4.3 Likely impact of oil shocks on agriculture

Rising fuel prices will raise direct input costs for fuel and chemical products that use oil (and oil substitutes) in their manufacture, including pesticides, fertilisers and packing materials (see Figure 16). In addition, rising transport costs will add to the prices of chemical inputs, and raise the costs of transporting produce to food processors, wholesalers and markets. If production costs rise faster than sales prices, then agricultural output will decline. Given the highly concentrated nature of the food processing and retail sectors in South Africa (Mather, 2005), individual farmers are not able to pass on all cost increases to consumers, which exposes farmers to possible bankruptcy if costs rise

too much. For exporters, higher world commodity prices could offset higher input costs, although higher transport costs might dampen foreign demand. Profitability would depend greatly on exchange rate movements. The short-term volatility in oil prices will create a great deal of uncertainty for farmers, who will face difficult choices about whether to plant crops, and which crops to plant. Persistent higher oil prices and shortages of oil might encourage farmers to revert to more labour-intensive and organic methods of production that rely less on petroleum based fuels and pesticides.

Figure 16: Price indices of intermediate goods in agriculture, 2000-2011



Source: DAFF (2012)

Any physical shortage of liquid fuels arising in rural areas would compromise the production of agricultural commodities. Since key farming operations, such as planting and harvesting, are highly time-dependent, fuel shortages at such critical times could be devastating to output. Fuel shortages would also curtail the distribution of farming products to processing facilities and markets in towns and cities. The likelihood of fuel shortages emerging in rural areas is greater than that in urban areas due to the location of South Africa's oil refineries in or near to just four major urban centres (Cape Town, Durban, Mossel Bay, and Sasolburg and Secunda near Johannesburg).

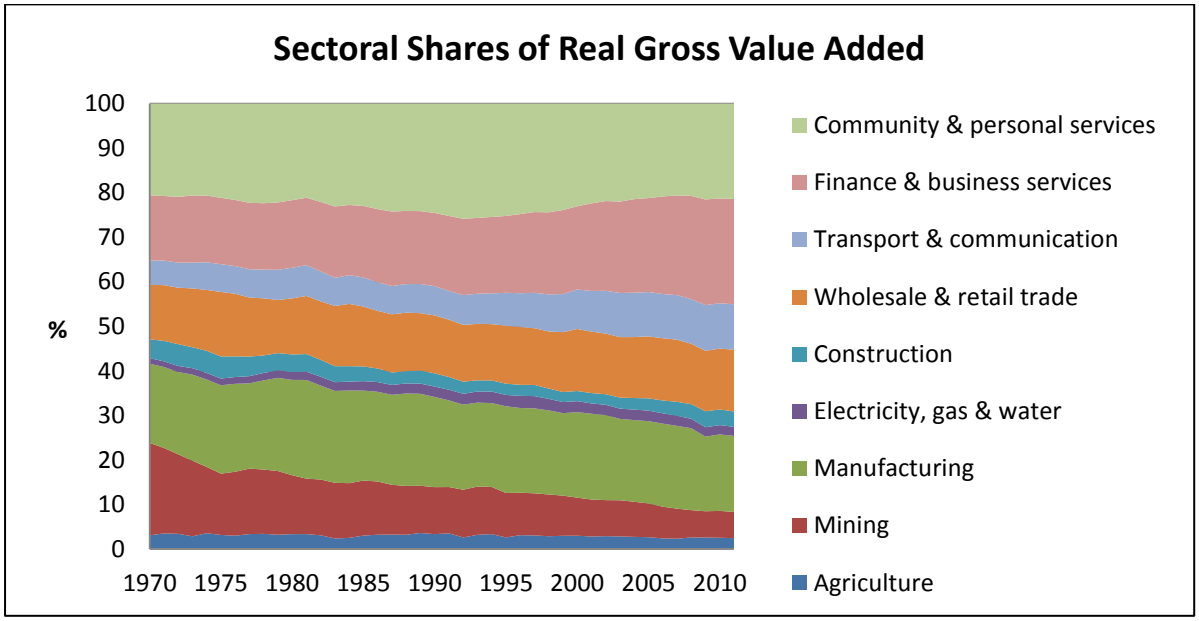
5. Macro-economy

This section begins with a brief overview of the structure of South Africa's macro-economy. It then details the economy's energy intensity and oil dependency. The third subsection lists the main macroeconomic strengths and vulnerabilities to oil shocks. The fourth subsection discusses the likely macroeconomic impacts of oil price shocks in South Africa, drawing on historical experience.

5.1 Overview of the macro-economy

The evolution of the broad structure of the South African economy between 1970 and 2011 is represented in Figure 17, which shows the relative contributions to gross value added (GVA) by the nine one-digit economic sectors. The most significant shift has been the decline in the relative importance of mining, from over 20% of GVA in 1970 to less than 6% in 2011. The largest gains were in transport (almost doubling in relative size from 5.4% in 1970 to 10.2% in 2011) and financial services (15% to 24%). Other sectoral shares have not changed notably. In 2011 the tertiary sectors together contributed 69.1% of GVA, secondary sectors 22.6% and primary sectors just 8.3%. The largest sector was finance, real estate and business services (23.7%). Agriculture was the second smallest sector with just 2.5% of GVA. Overall, the economy is reasonably well diversified across the range of sectors. This diversity is partly a legacy of South Africa's isolationist past in the apartheid era, and is likely to boost the economy's resilience to the anticipated impacts of higher oil prices. Nevertheless, the South African government has articulated a conception of a "Second Economy", existing alongside the formal (first) economy and reflecting endemic "structural inequalities, disadvantage and marginalisation" in society (The Presidency, 2008: 40).

Figure 17: Sectoral shares of real gross value added, 1970-2011



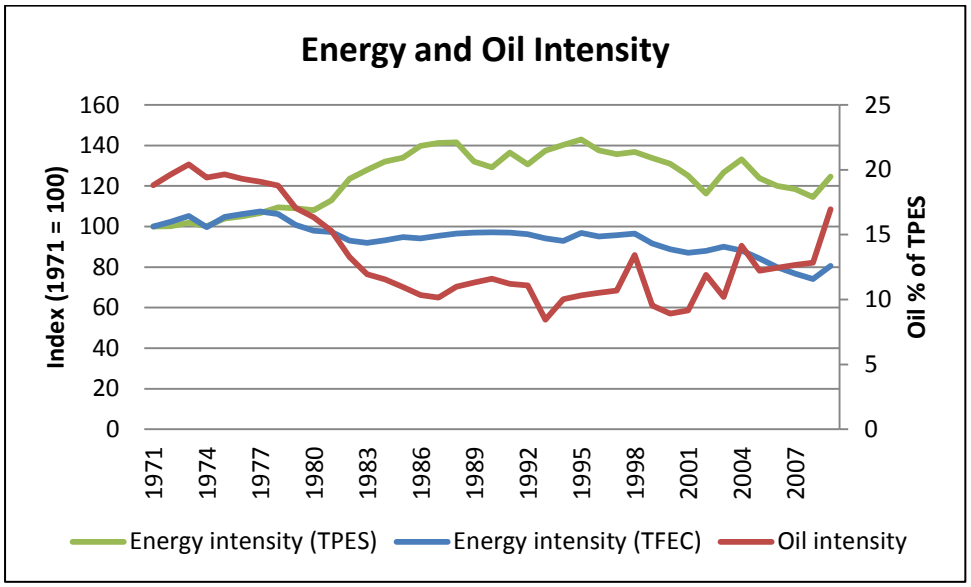
Source: SARB (2012)

5.2 Oil dependence of the macro-economy

The South African economy is characterised by high *energy intensity*, especially in its mining and manufacturing sectors. Only ten countries in the world had higher primary energy intensities in 2008 (EIA, 2011). This is mainly attributable to the country's abundant coal reserves, which historically have been exploited to generate amongst the cheapest electricity in the world. South Africa's energy intensity, measured as the ratio of total primary energy supply to real GDP, rose by 40% between the 1970s and 1980s, but since the mid-1990s has declined by approximately 20% (see Figure 18).

However, when measured by the ratio of total final energy consumption to real GDP, energy intensity has gradually fallen by a cumulative 20% since the late 1970s. This partly reflected a change in the composition of the economy away from mining and manufacturing to services, which are less energy intensive, but to some extent was a result of improvements in energy efficiency. The discrepancy between the two measures of energy intensity highlights the fact that South Africa's energy sector has over the past four decades become less efficient at converting primary energy sources into final, usable energy carriers, by a factor of one third. This trend was driven mainly by the substitution of domestically produced synthetic liquid fuels derived from coal for imported oil (the steepest drop in the index around 1979 coincides with the construction of the third Sasol CTL plant as well as the impact of the second oil price shock). In other words, a lower quality energy source (coal) has been substituted for a higher quality source (oil).

Figure 18: South Africa's energy intensity and oil resource intensity, 1971-2009



Source: IEA (2012), SARB (2012) and author's calculations
Note: The energy intensity indexes are derived from the ratios of total primary energy supply (TPES) and total final energy consumption (TFEC) to real GDP, respectively; oil intensity is the percentage share of oil in total primary energy supply (TPES).

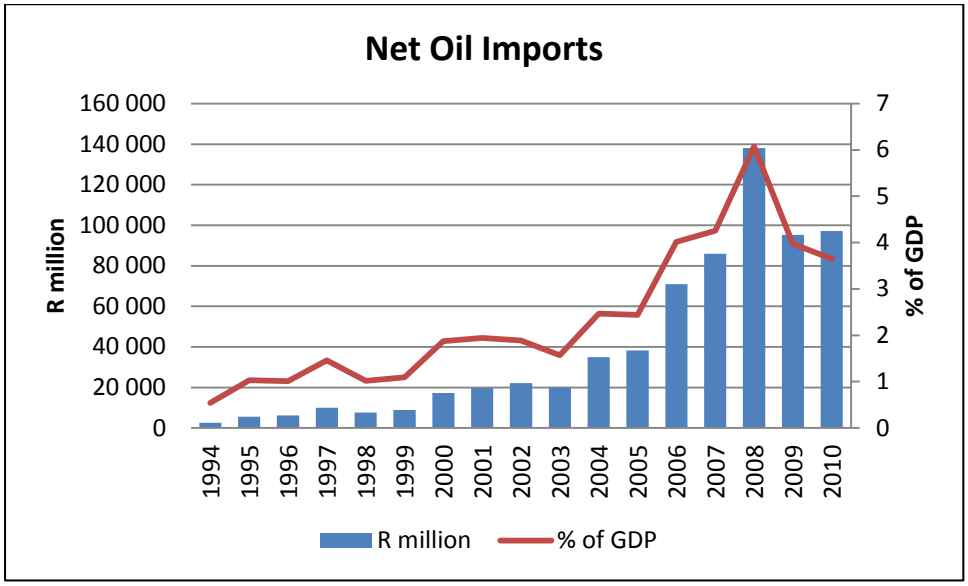
South Africa's *oil resource dependence* is low relative to many other developing countries, partly as a result of the heavy use of domestic coal reserves. According to IEA figures, oil in 2009 constituted approximately 16.9% of South Africa's primary energy supply, down from around 20 percent in the early 1970s (see Figure 1 above). Again, this decrease was mainly attributable to the construction of another CTL plant in 1979.

Because South Africa's domestic oil reserves are very limited, the country has a very high degree of *oil import dependence*: about 95 percent of crude oil requirements are imported. However, thanks to a strong domestic liquid fuels industry (Sasol's coal-to-liquids and PetroSA's gas-to-liquids facilities), only 70 percent of the country's *liquid fuel* requirements are met by imported oil. On the other hand, the synthetic liquid fuels produced by Sasol and PetroSA are currently priced on an

import parity basis. If this does not change, then consumers are just as vulnerable to oil *price* shocks, even though synfuels provide a partial buffer for oil *supply* shocks.

The nominal value of South Africa's crude and refined oil imports rose fairly rapidly between 2004 and 2008 (see Figure 19), thanks to a combination of rising consumption (driven by economic growth and an expanding population) as well as a steadily rising oil price.[3] In 2008 the country spent nearly R138 billion, or 6% of GDP, on oil imports, which represented the single largest import item on the balance of payments. In 2009, as a result of the recession and lower oil price, oil imports fell to R95 billion (4% of GDP). In comparison, net coal exports in 2009 amounted to R33 billion (1.4% of GDP).

Figure 19: Net crude and refined oil imports, 1994-2010



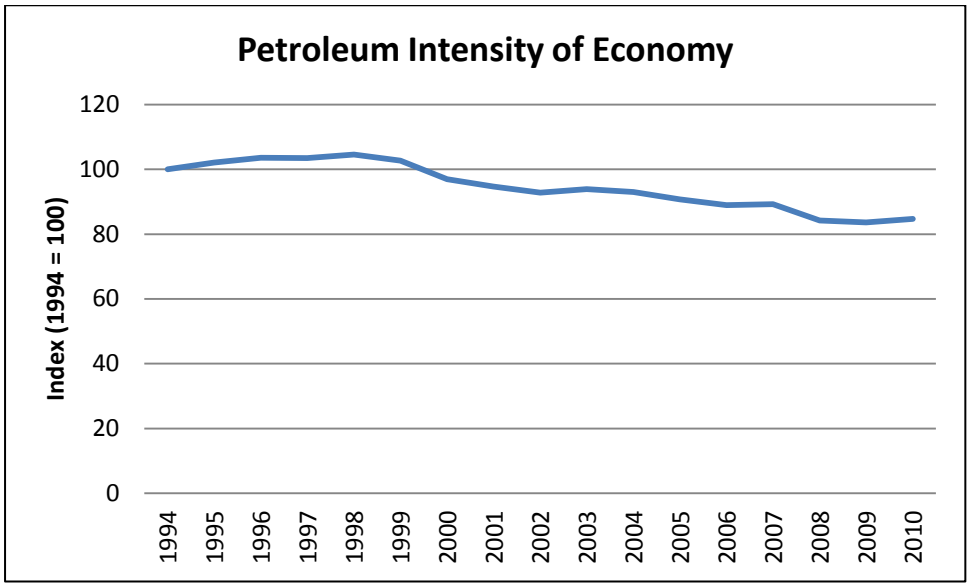
Source: DTI (2010) and SARB (2012)

A final measure of the oil dependence of the South African macro-economy is provided by the ratio of petroleum product consumption to real GDP. Figure 20 shows that this measure of petroleum dependency increased slightly from 1994 (by 4.5%) to reach a peak in 1998, after which it declined nearly monotonically by an average of 2% per annum and a cumulative 20 percentage points by 2009. This is an illustration of *relative resource decoupling* (Fischer-Kowalski & Swilling, 2011):[4] although absolute consumption of petroleum products rose between 1998 and 2009, consumption relative to real GDP fell considerably. This relative decoupling can partly be explained by the growth in the financial services sector (which has very low petroleum intensity). Nevertheless, this decoupling achievement bodes well for the potential to reduce future petroleum consumption while attenuating negative impacts on economic activity.

[3] Unfortunately, oil import data for earlier years are unobtainable as they were classified information under the Apartheid regime; therefore comparisons with the 1970s oil price shocks are not possible.

[4] Fischer-Kowalski and Swilling (2011: 4) define *resource decoupling* as "reducing the rate of use of (primary) resources per unit of economic activity."

Figure 20: Petroleum intensity of the economy, 1994-2010



Source: Author's calculations based on SAPIA (2011) and SARB (2012)

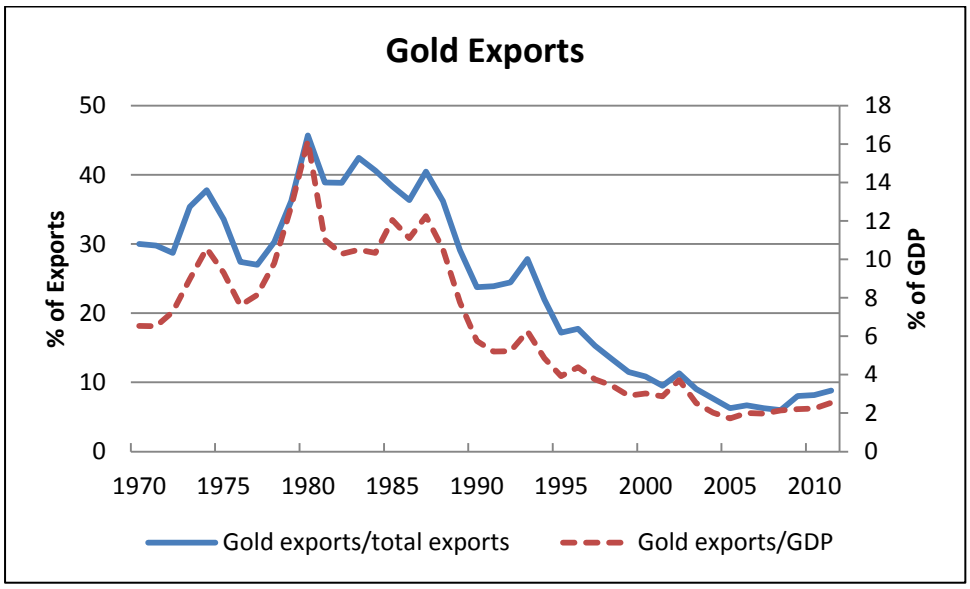
5.3 Strengths and vulnerabilities of the macro-economy

The major strengths and vulnerabilities of the South African macro-economy in the face of international oil price shocks, as of 2012, are as follows:

- The large current account deficit, which reached 7.2% of GDP in 2008 when oil prices spiked and stood at 3.3% in 2011, represents a significant risk in terms of potential currency volatility, speculative attacks and exchange rate depreciation.
- The financial account of the balance of payments has relied heavily on short-term portfolio inflows and is highly vulnerable to sudden capital flight, which therefore poses a significant currency risk.
- There has been a long-term decline in output of gold from South African mines since the early 1980s, mainly as a result of depletion of ores, such that by 2008 gold exports accounted for just 9% of total exports and 2.5% of GDP (see Figure 21 below). Thus while gold and other mineral exports can still be expected to provide some level of shock absorption for future oil price hikes, as they did in the past, this potential is substantially reduced relative to the 1970s.
- While the National Treasury had achieved a fiscal surplus in 2006 and 2007, the fiscal deficit rose to 5% of GDP in 2009 as a consequence of the Global Financial Crisis and ensuing recession in SA, and remained above 4% in 2010 and 2011. Consequently, the ratio of public debt to GDP rose from an historical low of 27% in 2008 to 38.6% in 2011; although this was still considerably below the peak of 50% in 1995 (SARB, 2012). The large fiscal deficit and debt leave little fiscal space for responding to future shocks.
- Total foreign debt was a moderate 27.3% of GDP in 2011 (SARB, 2012), which equalled the average for the period 1985 to 2010 and was comparatively low by international standards.

- The ratio of household debt to disposable income peaked at 80.3% in 2008 before declining to 75.9% in 2011 (SARB, 2012). This exposes consumers to fall-out from oil price shocks such as higher costs of living, higher interests rates and falling real incomes.
- The headline consumer inflation rate stood at 4.9% in mid-2012, comfortably inside the South African Reserve Bank's inflation target range of 3 to 6%, and therefore did not represent a major threat in the short term (StatsSA, 2012). The Reserve Bank reduced its benchmark repurchase rate to a historical low of 5% in June 2012; there is still some monetary policy space for responding to deflationary shocks.
- A major vulnerability is the unemployment rate, whose official figure stood at 24.9% in the second quarter of 2012 (StatsSA, 2012). The so-called broad rate of unemployment, which includes discouraged worker seekers (i.e. those who wanted to work but did not actively search for jobs in the week preceding the survey), was well over 30%.

Figure 21: Ratios of net gold exports to total exports and GDP, 1970-2011



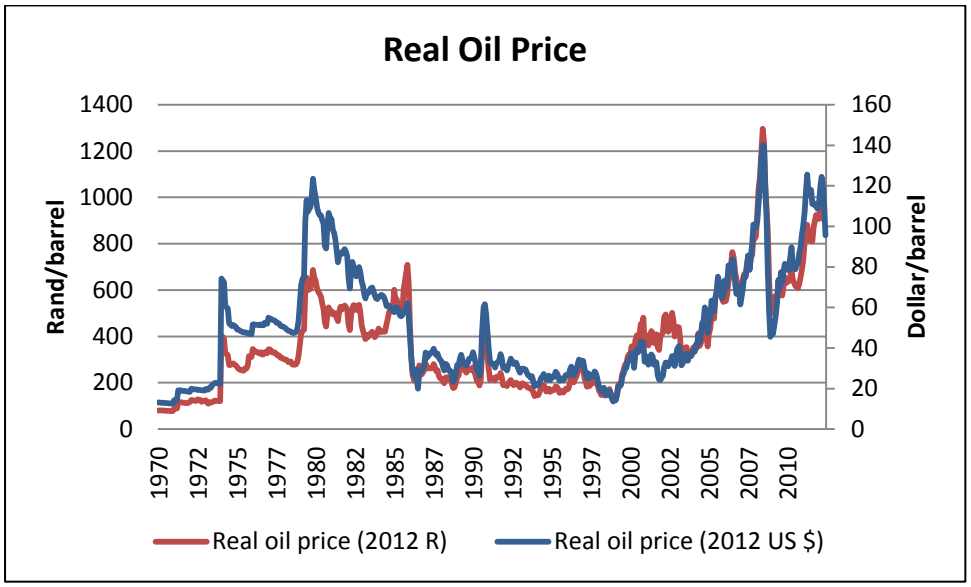
Source: SARB (2012) and author's calculations.

5.4 Likely impact of oil shocks on the macro-economy

The direct impacts of oil price shocks occur via higher fuel prices and have reverberations on several important macroeconomic variables. South Africa is a price taker on the international oil market. Domestically, the downstream liquid fuels industry is subject to extensive government regulation. Prices of petroleum fuels (petrol, diesel, paraffin and LPG) are administered by the State, which imposes various levies and taxes and determines retail and wholesale margins, over-and-above a 'basic fuel price'. The basic fuel price is determined by an import parity pricing formula which depends on the international spot price of refined oil (SAPIA, 2011). Sasol and PetroSA's synthetic liquid fuels (converted from coal and gas, respectively) are accorded the same status in the domestic market as fuels that are refined from imported crude oil. The basic fuel price is influenced by two primary factors: the dollar price of crude oil traded on international markets; and the rand/dollar

exchange rate. Volatility in both of these variables has historically had a significant impact on the rand denominated price of oil (see Figure 22). Notably, the oil price shocks of 1973 and 1979 were somewhat muted in rand terms, thanks to the relative strength of the rand then (which was supported by a high gold price). The rand oil price in 2008 was almost double that of 1979 in real (inflation-adjusted) terms.

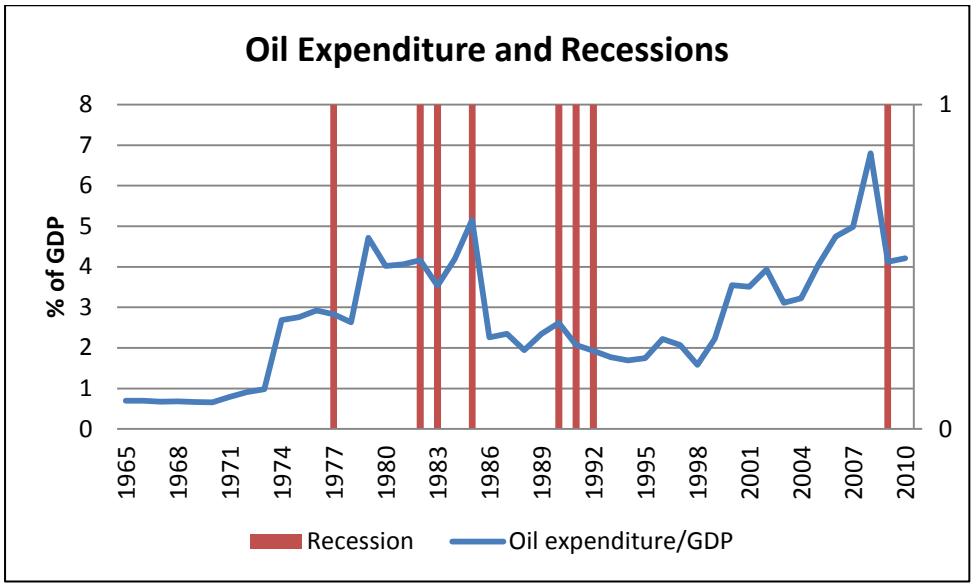
Figure 22: Real oil price in 2012 dollars and rands, 1970-2012



Source: IMF (2012) and own calculations

Wakeford (2012) undertook a comprehensive review of historical experience and various empirical estimates of the impact of oil price shocks on South Africa, and found the results to be broadly consistent. In general, crude oil price shocks resulted in: a depreciation of the exchange rate; a boost for some export commodities, such as coal and uranium, at least initially; higher rates of producer and consumer price inflation; lower (or negative) growth in real GDP; falling employment and real wages; and greater poverty and inequality. The sectors most adversely affected include agriculture, light manufacturing and private services, while the sectors benefitting most in relative terms were domestic synfuels, electricity, and coal and gold mining. The oil price shocks of the 1970s and 2008 can arguably be identified as at least major contributing factors to the ensuing recessions (see Figure 23), mainly via their impact on global demand for South Africa's export commodities. The economic impact of world oil price shocks appeared to occur with a time lag of around 2-3 years in the 1970s but about one year in 2007/08. It is notable that in the latter period (1) gold provided a much smaller buffer and (2) South Africa's economy was much more integrated into the global economy, which could have shortened the impact time lag. It seems that South Africa's vulnerability to global oil shocks has increased over time as a result of the country's re-integration to the world economy.

Figure 23: Oil expenditures and recessions in South Africa, 1965-2010



Source: Wakeford (2012)

In the medium term future, it can be expected that South Africa will suffer similar types of negative consequences from oil price and supply shocks as it did in 2008-2009. Given that both the global and South African economies are in a much weaker state in 2012 than they were immediately prior to the 2008 oil shock, future oil shocks might have even more severe socioeconomic effects.

6. Society

This section provides an overview of several important features of contemporary South African society that are relevant to understanding potential social vulnerabilities to oil price and supply shocks. Section 6.1 presents data on the extent of poverty and inequality. Section 6.2 discusses food security at the household level. Section 6.3 highlights some relevant features of human settlement patterns. Finally, Section 6.4 discusses the issue of social cohesion and several factors that may undermine it.

6.1 Poverty and inequality

Poverty renders people more vulnerable to economic shocks, including rising transport and food costs. Furthermore, a society characterised by a high degree of inequality can be expected to experience greater social stresses and tensions in times of economic adversity. South Africa has no official income poverty line. However, The Presidency's (2008) report *Towards a Fifteen Year Review* sets two benchmark poverty lines, at R322 per month and R174 per month (both in 2000 rands). The *poverty headcount rate* is the proportion of individuals living in households with an income less than the poverty line. In 2005, 48% of households earned less than R322 per month; 93% of these people were African. As shown in Table 3, poverty rates varied greatly by population group; at the upper poverty line, the poverty rate was highest for Africans (56%) and lowest for whites (0.4%). The *poverty gap* is defined as the gap between the average income of poor people and the poverty line. Poverty rates were higher amongst women and those living in rural areas.

Table 3: Headcount poverty rate and poverty gap ratio, 2005

	Headcount rate		Poverty gap ratio	
Poverty line	**R322/month**	**R174/month**	**R322/month**	**R174/month**
African	56.3%	27.2%	24.4%	8.6%
Coloured	34.2%	12.3%	13.0%	3.9%
Indian/Asian	8.4%	1.6%	2.2%	1.1%
White	0.4%	0.1%	0.1%	0.0%
Total	**48%**	**22.7%**	**20.6%**	**7.2%**

Source: The Presidency (2008)

Social grants, in the form of the Child Support Grant, the Old-Age Grant and the Disability Grant, reached 15.6 million recipients as of March 2012 and helped considerably to reduce the poverty rate from earlier years (The Presidency, 2008: 468; Engineering News, 2012). Despite the extensive social grants programme, household income and expenditure are highly unequally distributed in South Africa. The country's Gini coefficient, a measure of income inequality, stood at 0.679 in 2008 (The Presidency, 2009).[5] This was amongst the highest national rates of inequality in the world.

Table 4: Annual household expenditure on energy, transport and food, 2005/6

Income	Energy		Transport		Food		Total
Group	R	%	R	%	R	%	R
Decile 1	606	5.3	910	8.0	3,735	32.8	11,381
Decile 2	809	5.8	1,143	8.1	4,638	33.2	13,982
Decile 3	924	5.5	1,315	7.8	5,190	30.9	16,784
Decile 4	1,012	4.9	1,770	8.7	6,108	29.7	20,547
Decile 5	1,062	4.7	2,121	9.3	6,600	28.9	22,819
Decile 6	1,082	3.8	2,778	9.8	7,392	26.1	28,374
Decile 7	1,185	3.3	4,029	11.3	7,904	22.2	35,654
Decile 8	1,544	2.8	5,567	10.1	9,225	16.8	55,055
Decile 9	2,311	2.1	10,349	9.6	11,990	11.1	108,024
Decile 10	3,179	1.3	17,384	7.0	18,267	7.3	248,823
Total	1,371	2.4	4,737	8.4	8,105	14.4	56,152
Rural	1,167	4.6	2,276	8.9	6,334	24.8	25,576
Urban	1,481	2.0	6,055	8.3	9,054	12.5	72,529

Source: StatsSA (2008)
Notes:

- *Energy includes electricity, gas, liquid and solid fuels used in homes.*
- *Transport includes operation costs including fuel (5.0% of the CPI basket) plus transport services (3.4% of the CPI basket).*
- *Food includes foodstuffs plus non-alcoholic beverages.*

[5] The Gini coefficient ranges between 0 (complete equality) and 1 (complete inequality).

Poorer households are in general more vulnerable to increases in energy, transport and food prices. Table 4 shows annual expenditures on household energy, transport and food in rands and as a percentage of total expenditure (exclusive of taxes) for the 10 income deciles in 2005/6. Food is the largest expenditure item for poorer households, although energy and transport costs are also significant.

6.2 Household food security

Food security is a vital condition for human well-being and social stability. National food security (e.g. self-sufficiency in the majority of agricultural commodities, including the main staple, maize) is no guarantee of food security for individual citizens of the country (Leroy et al, 2001: 6). According to Maxwell (1996, cited by Hendriks, 2005: 103), there were at least 250 definitions of food security as of 1996, including "food supply, access, adequacy, utilisation, safety and, in some cases, cultural acceptability of food for all people at all times." These various dimension of food security at the household level may perhaps be distilled to two basic dimensions: the physical availability and the economic affordability of nutritious foodstuffs. The incidence of food insecurity in South Africa is not known with any degree of certainty owing to a lack of nationally representative surveys of food security (Hendriks, 2005: 109). Nevertheless, the available evidence indicates that in the region of 59% to 73% of households experience food insecurity, approximately 16% have an inadequate energy intake, about 30% experience hunger, and approximately 22% of the population could be stunted and 3.7% afflicted by wasting (Hendriks, 2005: 115). While the determinants of food insecurity are numerous and complex, two basic drivers can be identified, reflecting the principal dimensions referred to above. These are: (1) inadequate income (i.e. poverty) in relation to the cost of food products; and (2) a lack of access to land, water and other productive inputs required for own food production. Somewhat ironically, however, hunger and malnutrition in South Africa are more common in agricultural areas, especially amongst smallholder farmers, agricultural workers and the landless (Hendriks & Msaki, 2009: 185). This is essentially because the incidence of poverty is higher in rural areas (Pauw, 2007).

Oil price shocks carry two major threats to household food security. The first is rising food prices, since food prices are linked to oil prices through input and transport costs. The second threat is of falling employment levels and incomes as a result of the negative macroeconomic consequences of oil shocks. These factors act together to reduce the food purchasing power of households (see Hendriks, 2005: 116).

6.3 Settlement patterns

Human settlement patterns play an important role in South African society's dependence on liquid fuel based transport and therefore in its vulnerability to oil supply disruptions and price shocks. The two predominant features of the country's settlement patterns are inequality and inefficiency, and the two aspects are closely linked for historical reasons. Inefficiency in the spatial configuration of settlements relates largely to the phenomenon of urban sprawl, which occurs in virtually all cities and metropolitan areas around the country. Approximately 60% of South Africans live in urban areas (RSA, 2011: 21). Two forms of urban sprawl characterise South Africa's cities. First, as a result of apartheid-based urban settlement patterns characterised by remotely located townships, many

lower-income citizens tend to reside in informal or formal settlements that are located on urban peripheries. This pattern was perpetuated by an on-going process of urbanisation, which accelerated after the democratic transition. The key problem is that these settlements are located far from social and economic opportunities (The Presidency, 2008: 99). The large distances impose high travel costs, which are particularly burdensome for residents who are generally poor to begin with. Second, the majority of more affluent citizens reside in sprawling suburbs that are highly dependent on private motor vehicles. Both groups generally need to travel substantial distances to access economic and social opportunities and are therefore vulnerable to rising fuel and transport costs and fuel shortages. Nevertheless, rural areas are in some ways more dependent on motorised travel than urban areas, as distances to towns may be larger than distances typically travelled within cities, and there are less extensive or even non-existent public transport services. In both urban and rural areas, the persistent inequality in spatial development patterns also contributes to vulnerabilities in social cohesion, which is discussed in the following section.

6.4 Social cohesion

The ability of a society to withstand social and economic shocks depends *inter alia* on the degree of social cohesion. Social cohesion in South Africa is affected by numerous factors including the ethnic composition of the society, the political dispensation, inequality and poverty, migration and immigration, and rates of crime and violence. South Africa has enjoyed a stable democracy since 1994 with free and fair elections held every five years since then. The African National Congress has maintained power throughout this period with a strong majority in the National Assembly. There has been no widespread, serious political violence in the democratic era. Nevertheless, social tensions persist after more than eighteen years of democracy, reflecting in part the legacy of a conflict-ridden Apartheid past and also the persistence of income inequality and poverty (The Presidency, 2008: 29). Domestic economic and social stresses have been further compounded in recent years by an increased rate of immigration from other African countries (The Presidency, 2008: 99). Immigration has been driven both by push factors (such as political, social and economic upheavals in their home countries) as well as pull factors (e.g. the relative size and strength of South Africa's economy in the context of Southern Africa). This immigration placed extra strain on already over-stretched social services and aggravated social tensions, as evidenced by the so-called 'xenophobic' violence that erupted in many parts of the country in May 2008 (Sharp, 2008). More generally, South African society is characterised by unacceptably high rates of crime**,** especially violent crimes such as murder, rape, assault and robbery (The Presidency, 2009: 59). The causes of crime are complex and multifarious, and include the high rate of unemployment, especially among young males, as well as the related high incidence of inequality and poverty.

7. Summary

South Africa's strengths and vulnerabilities vis-à-vis oil shocks in each of the five socioeconomic subsystems are summarised in Table 5. These subsystems are not isolated from one another, but are connected by many linkages and feedbacks, which in many ways intensify the dependencies on oil and magnify the vulnerabilities to oil shocks.

Table 5: Summary of strengths, vulnerabilities, and likely impacts of oil shocks

Subsystem	Strengths	Vulnerabilities	Impacts
Energy	• relatively low oil dependence (17% of primary energy) • domestic synthetic fuels production (34% of liquid fuels) • electricity minimally dependent on imported oil • large coal & uranium reserves • abundant solar resources • substantial wind resources	• high oil import dependency (66% of petroleum fuels) • risk of dependence on Iran & Saudi Arabia for 50% of crude oil imports • import parity pricing for locally produced synthetic fuels • fuel distribution bottlenecks • insufficient strategic stocks • road dependence of coal deliveries	• possible interruptions to supply of crude oil and refined fuel imports • possible disruptions to supply of coal to power stations • higher cost of fuel for open cycle gas turbines
Transport	• extensive road network • rail network connects major urban centres • several major ports to facilitate cheaper transport and trade (for coastal settlements) • potential for greater bicycle use • development of integrated rapid transit systems in metropolitan areas	• extremely high dependence on petroleum fuels (98%) • very high reliance on roads for freight and passenger transport • inadequate public transport • large distances between major cities • large distances from trading partner countries • poor maintenance of road and rail networks • aged rail rolling stock • lack of domestic locomotive manufacturing capacity • violent elements in taxi industry	• rising costs of passenger & freight transport • constrained mobility of passengers • rising costs of road maintenance • possible interruptions to freight logistics
Agriculture	• self-sufficient in most commodities, including main staple maize (most years) • some subsistence agriculture • some underutilised land available	• high petroleum dependence (67% of energy) • highly oil-intensive farming • key input prices linked to oil • small percentage (13%) of land area is arable • generally poor soil quality • low rainfall & recurring droughts	• rising input costs (diesel, fertilizers, pesticides, packaging materials) • disruptions to farming activities • possible rise in commercial farm bankruptcies • higher transport costs curb agricultural exports

		• little organic agriculture • net food importer since 2008 • net importer of wheat and rice • attrition of farming skills • fuel shortages can be catastrophic	
Macro-economy	• reasonably well diversified economy • relatively moderate inflation (4.9% in 2012) • domestic public debt not excessive (but rising from 2009) • foreign debt relatively low (27%)	• high energy intensity of industry • large current account deficit (3.3% of GDP) • currency exposed to rapid capital flight • large fiscal deficits and growing public debt • very high household indebtedness (76%) • very high rate of unemployment (25%) • skills shortages	• rising oil import bill and current account deficit • exchange rate depreciation • rising inflation • rising unemployment • slowing economic growth (or recession)
Society	• successful political transition in 1994 • 18 years of stable democracy with a strong constitution • improvements in access to social services • extensive government grants provide a social safety net	• deep & widespread poverty • high degree of inequality • high degree of food insecurity • high levels of crime • service delivery protests • migration and immigration pressures	• rising cost of living • rising rates of poverty and inequality • deteriorating household food security • constrained mobility • increasing social tensions & strife

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