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THE EFFECTS OF REAL EXCHANGE RATE MISALIGNMENT ON EXPORTS IN SOUTH AFRICA

TAPIWA PASI
3610191

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Supervisor: Professor Matthew Ocran

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Tapiwa Pasi

KEYWORDS

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Fiscal policy

ABSTRACT

The purpose of this study was to evaluate econometrically the effects of real exchange rate misalignment on South African exports between the period 1994 and 2015 using quarterly time-series data. Cointegration tests were done using the Johansen and Juselius approach. The study examined the effects of real exchange rate misalignment of the rand on South Africa's exports, namely manufactured goods exports, automotive and chemical exports, mining exports, machinery and transport equipment exports and agricultural exports, on both an aggregate and a sectoral level.

The long run impact of real exchange rate misalignment on total exports was found to be negative and significant, implying that real exchange rate misalignment negatively affects exports. In the short run, misalignment of the currency was found to enhance export growth and is not sustainable in the long run. On the sectoral level, the study found that in the long run exports are influenced by real exchange rate misalignment with varying sensitivity. Manufactured goods exports, automotive and chemical exports and machinery and transport equipment exports are all negatively affected by real exchange rate misalignment. On the contrary, mining exports and agricultural exports are positively affected by real exchange rate misalignment. Therefore, if an export-led growth path is envisaged for the South African economy, it is important for monetary and fiscal policy to be conducted in such a manner that ensures stability in the real exchange rate at an appropriate level. This will ultimately aid export competitiveness for South Africa.

Based on the findings of this study, the researcher recommends that misalignment of the currency should be avoided at all costs.

DECLARATION

I declare that *The Effects of Real Exchange Rate Misalignment on Exports in South Africa* is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Full name: Tapiwa Pasi **Date: 23 September 2019**

Signed: taps pasi ………………………………..………..

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A number of people helped in the production of this thesis, above all, God the Almighty. I would like to express my sincere gratitude to my supervisor, Professor Matthew Ocran, for his invaluable advice and guidance. Importantly, my gratitude is extended to my wife, Pearl, who not only read this work but from the outset, also provided vital encouragement without which the thesis would never have been written.

DEDICATION

"Yesterday is history, tomorrow is a mystery while today is a gift of God, which is why we call it the present" – Bill Keane.

This thesis is dedicated to my late father, Mr Tichaona Joseph Pasi, who passed away at the age of 85. He lived to see it all.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
BEER	Behavioural equilibrium exchange rate
BS	Balassa-Samuelson hypothesis
CMA	Common Monetary Area
CPI	Consumer price index
DF	Dickey-Fuller
DW	Durbin-Watson
ECM	Error correction model
ERER	Equilibrium real exchange rate
FEER	Fundamental equilibrium exchange rate
GDP	Gross domestic product
GEAR	Growth, Employment and Redistribution
GLS	Generalized least squares
JB	Jarque-Bera test
JJ	Johansen-Juselius
LDC	Least developed countries
NDP	National Development Plan
OECD	Organisation for Economic Co-operation and Development
PP	Phillips-Perron
PPP	Purchasing power parity
RMA	Rand Monetary Area
RER	Real exchange rate
SA	South Africa
SARB	South African Reserve Bank
Stats SA	Statistics South Africa
USA	United States of America
VAR	Vector autoregression
VECM	Vector error correction model
WPI	Wholesale price index
WTO	World Trade Organization
ZAR	Rand

CHAPTER ONE

INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 BACKGROUND AND PROBLEM STATEMENT

Real exchange rate (RER) misalignment is an integral topic in international economics. Different arguments have been made regarding the effects of misalignments on exports, imports, foreign investment, savings, industrial production, and economic growth.

Real exchange rate misalignment can influence a country's economic performance because the equilibrium exchange rate affects the competitiveness of a country's economy. Deviation of the actual or observed RER from the equilibrium RER is referred to as misalignment (Montiel & Serven, 2008). It is imperative for all countries to determine whether the RER is misaligned with respect to its long-run equilibrium level. Real exchange rate overvaluation can undermine the competitiveness of domestic goods and weaken the external position (i.e. current account deficit), while an undervalued RER may induce inflationary pressures since the increased price of imported goods will raise the consumer price index (Krueger, 1983; Edwards, 1989; Dollar, 1992; Aguirre & Calderon, 2005).

Other authors like MacDonald & Vieira (2010) have argued that a more depreciated real exchange rate helps long-run growth, while a more appreciated real exchange rate harms long-run growth. Their findings showed that the estimated coefficients are higher for developing and emerging countries. Also, Rodrik (2008) argued that undervaluation of the currency (a high real exchange rate) stimulates economic growth. This is true particularly for developing countries.

South Africa has been suffering from a relatively weak rand since 1994. According to Mtonga (2011), from 1994 to 1996 and in 1998, the rand RER became undervalued by an average of 10%. However, the strong recovery of the rand at the start of 2002 reversed this and pushed the RER above its equilibrium by an average of 16–17% at the end of 2003. In the first two quarters of 2004, the RER of the rand appreciated. However, this appreciation was not persistent, and it depreciated substantially against the US dollar by 3.2% in the third quarter of 2004. Much of the weakening during this period was attributed to a high inflation differential, low interest rate differential, portfolio changes in addition to a lead in import payments and lags in the receipt of exports (Sichei, Gebreselasie & Akanbi, 2005). In the last quarter of 2005, the RER of the rand strengthened by 10%. Much of this strengthening was due to capital inflow from foreign direct investment. According to the South African Reserve Bank (SARB) (2009), the rand RER declined significantly during the first quarter of 2008 and regained its value towards the end of the last quarter. It continued on a strengthening path for the first nine months of 2009 and appreciated by 22% against the basket of currencies.

According to SARB (2011), for the first nine months of 2010, the value of the rand RER increased by almost 6.3%, with an additional increase of 5.4% in the fourth quarter. From the end of March 2012 to the end of September 2013, the RER of the rand declined by no less than 22.5% (SARB, 2014). The RER of the rand experienced some strain in the third quarter of 2014, which was in line with the performance of other emerging market currencies. On balance, the rand RER declined by 2% in the third quarter of 2014 (SARB, 2015). In October 2015, the South African rand strengthened amid a slight recovery in commodity prices, with the platinum price temporarily recovering to more than US$1 000 per fine ounce over the period. Renewed platinum price weakness and prospects for a possible tightening of monetary policy in the United States of America (USA) subsequently contributed to a decline in the exchange value of the rand to R14.41/USD on 1 December 2015. This was the lowest level ever to be recorded against the US dollar.

Similar to many emerging market economies, South Africa is a small open economy that participates in international trade. As such, the country depends on imported capital goods and specialises in commodity exports (Edwards & Schoer, 2002). In order to gain from this trade, it is important for the country to maintain a very competitive exchange rate, one that is neither too weak nor too strong. An overvalued currency can be risky to the economy of South Africa. Old Mutual (2009) argues that a strong rand negatively affects exports. The rationale is that a strong rand makes exports expensive and imports cheap, which contributes to an import boom that in turn, leads to deterioration of the current account of the balance of payments. The exchange rate is also linked with the manufacturing activities in South Africa. According to the Manufacturing Circle chairperson, Stewart Jennings, "the manufacturing sector has declined from contributing 25% to South Africa's gross domestic product during its heydays in the 1960s, to only about 15% in 2011" (Prinsloo, 2011). This was blamed on what was called an overvalued rand and hence the calls from the sector to devalue the currency.

One of the macroeconomic objectives of South Africa is to maintain a sustainable economic growth that will ensure an adequate level of foreign reserves and an internationally competitive export sector that will contribute to job creation and high incomes. In view of the rand exchange rate performance against the US dollar and other major currencies over the years, the questions that immediately come to the fore concern the performance of the export sector. Does RER misalignment matter in the determination of South African exports? In particular, what is the extent of RER misalignment in South Africa? The other related question is, What is the effect of RER misalignment on exports in South Africa?

1.2 RESEARCH OBJECTIVES

The broad objective of this study was to assess the effects of RER misalignment on South African exports between the period 1994 and 2015. However, the specific objectives of the study are as follows:

1. To review the trends in the rand/US dollar real exchange rate and exports in South Africa
2. To estimate rand/US dollar real exchange rate misalignment in South Africa between 1994 and 2015
3. To investigate the effects of the rand/US dollar real exchange rate misalignment on South African exports
4. To draw policy conclusions based on the outcomes of the study

1.3 RELEVANCE OF THE STUDY

With globalisation, RER behaviour plays an extremely important role in policy evaluation and analysis. The RER level, relative to the equilibrium level, and its stability have been shown to influence export growth, consumption, resource allocation, employment and private investments significantly (Serven & Solimano, 1991; Aron, Elbadawi & Kahn, 1997). Spatafora and Stavrev (2003) note that an accurate analysis of the RER is critical for resource-dependent economies (such as South Africa) that often experience large shocks to their terms of trade and relative productivity differentials. As a result, the currency values of such economies may experience extreme volatility, and the equilibrium level should thus be monitored constantly. Therefore, government policy conduct should aim to get this macroeconomic relative price right. The ‘right’ RER is one that does not stray too far from its equilibrium value (Edwards, 1989). Real exchange rate equilibrium and misalignment is, therefore, a useful indicator of economic performance that needs to be understood.

The outward-looking trade policy adopted by South Africa in the early 1990s ensures that export growth plays a critical role in the government’s Growth, Employment and Redistribution (GEAR) strategy (Bah & Amusa, 2003). The GEAR strategy is aimed at promoting policies that support free-market activities in order to strengthen South Africa’s external competitiveness and foster long-term economic growth. The link between the exchange rate and export growth is, therefore, one of the major motivations for understanding the dynamics in the RER equilibrium and misalignment for government’s central balance in ensuring balance in the economy.

Despite the important implication of RER misalignment on economic activities, there is limited empirical evidence examining its movements in South Africa. Most studies have concentrated on examining the effects of volatility, not misalignment. For example, Obi, Ndou and Peter (2013), estimated the impact of exchange rate volatility on the competitiveness of South Africa's agricultural exports to the European Union for the period 1980–2008. Jordaan and Netshitenzhe (2015) examined the impact of changes in the exchange rate of the rand on South Africa’s export performance on an aggregate level and on different sectors of the economy. This study is going to build on these studies by adding misalignment as a variable. The findings of this study will provide especially useful information for policymakers and deepen the understanding of the impact of RER misalignment on South African exports.

The results of this study will hopefully contribute towards policy planning and formulation at all levels of government, the manufacturing sector, the business community and labour unions. The findings should also benefit researchers in the field of economics.

1.4 HYPOTHESIS

The hypothesis to be tested are as follows.

H_0: Real exchange rate misalignment has a significant impact on exports

H_1: Real exchange rate misalignment does not have a significant impact on exports

1.5 ORGANISATION OF THE STUDY

The remainder of this thesis is structured as follows: Chapter Two gives an overview of selected stylised facts on RER and South African exports between 1994 and 2015. Chapter Three reviews both the theoretical and empirical literature pertaining to the relationship between the RER and exports. Chapter Four presents a discussion on the methodology of the research. Chapter Five presents the main findings of the study. Chapter Six presents a summary, followed by conclusions and policy recommendations.

CHAPTER TWO

OVERVIEW OF SELECTED STYLISED FACTS ON REAL EXCHANGE RATE AND EXPORTS IN SOUTH AFRICA

2.1 INTRODUCTION

South Africa became more integrated with the global economy after the end of apartheid in 1994. This was a positive and necessary tenet for economic growth and development, providing a major opportunity to increase trade. However, this also exposed the South African economy to increased fluctuations in the exchange rate. With an effort to promote sustainable economic growth and increase employment, South Africa's policy document, the National Development Plan (NDP) (National Planning Commission, 2012), emphasises the need for South Africa to increase its competitiveness in order to increase exports i.e. the ability of the country to export more in value added terms than it imports. The debate regarding the ideal exchange rate level in South Africa has been ongoing for a long time, with different parties calling for revaluation of the exchange rate. Those who call for a devaluation of the rand, such as the Congress of South African Trade Unions (COSATU), argue that a weaker rand makes South African export goods more competitive. However, a stronger rand is seen to affect South African businesses negatively since cheaper import goods crowd out local products. Others argue that a stronger rand is beneficial to consumers because it increases their purchasing power, allowing them to purchase more with the wages paid out. Given such developments, this section aims to review the trends in RER and exports in South Africa over time in order to assess the effects of exchange rate changes on exports and to determine the appropriate policy action that is needed.

2.2 EVOLUTION OF EXCHANGE RATE POLICIES IN SOUTH AFRICA, 1994–2015

After the breakdown of the Bretton Woods system in 1973, many developing countries moved away from single currency pegging to more flexible exchange rate regimes. Different exchange rate regimes give rise to different tendencies for exchange rate misalignment and exchange rate volatility. Over time, South Africa has implemented different exchange rate policies, the most recent of which are now discussed chronologically.

In 1977, the De Kock Commission was established to review the exchange rate and the monetary policies of the country. The Commission submitted its findings to the government in November 1978. The Commission recommendations were guided by the principle that financial markets will function best in the national interest if they are reasonably free and competitive, and if they produce realistic, market-related interest rates. It is submitted that the Commission's recommendations are likely to influence the flow of funds between the capital market and the stock exchange market, and investment funds are also likely to be channelled into foreign securities, enabling domestic investors to improve portfolio performances. Following these findings, South Africa adopted a managed float regime with dual exchange rates between January 1979 and February 1983 (De Kock, 1985; Van der Merwe, 1996; Odhiambo, 2004). The regime featured two exchange rates: the commercial rand and the financial rand. According to the recommendations of the De Kock Commission, the mandatory buying and selling rates for the US dollar were to be abolished. The South African Reserve Bank discontinued the announcement of its predetermined buying and selling rate of the US dollar in February 1979 and in the same month introduced the managed float system without dual exchange rates. Furthermore, the exchange controls on non-residents were abolished in 1979. However, SARB decided to suspend its exchange reforms temporarily following the strong depreciation of the rand in 1985. Instead, SARB tightened capital controls (Odhiambo, 2004).

South Africa reverted to a managed float system, with dual exchange rates in September 1985. The financial rand was reintroduced, and the Common Monetary Area (CMA) replaced the Rand Monetary Area (RMA) in July 1986 (Van der Merwe, 1996; Odhiambo, 2004). In March 1992, SARB bought and sold in financial rand transactions with the aim of exiting that market. The country decided to unify the dual exchange rates in March 1995 and operated a unified floating regime from March 1995 until end of 1999. As part of the drift from the dual exchange rates to the unified floating system, SARB exited from short-term transactions and scrapped the financial rand in March 1995. From February 2000 to date, South Africa has been pursuing a purely floating exchange system.

In summary, South Africa has adopted six main regimes since 1979. Fixed exchange rate regime with rand pegged to the US dollar from June 1975 to May 1979. Dual exchange rate regime with crawling peg commercial rand and free floating financial rand from June 1979 – Jan 1983. The dual exchange rate regime under a managed float of the commercial rand and a free float of the financial rand was in effect from September 1985 to February 1995. The unitary exchange rate (managed float rand) was adopted from March 1995 to January 2000, and from February 2000 until the present, the country adopted a free-floating rand with an inflation-targeting framework of monetary policy. The six regimes are summarised in Table 2.1 below.

Table 2.1: South Africa: Exchange rate regime changes

Episode	Date	Exchange rate regime
1	June 1975 – May 1979	**Fixed exchange rate regime:** rand pegged to the US dollar
2	June 1979 – Jan 1983	**Dual exchange rate regime:** Crawling peg commercial rand and free floating financial rand
3	Feb 1983 – Aug 1985	**Unitary exchange rate:** Managed float rand
4	Sept 1985-Feb 1995	**Dual exchange rate regime:** managed float commercial and free float financial rand
5	Mar 1995 – Jan 2000	**Unitary exchange rate:** Managed float rand
6	Feb 2000- present	**Unitary exchange rate:** free floating rand, with inflation targeting framework of monetary policy

Source: Adapted from Mtonga (2011)

The current policy of the central bank is generally to stay out of the market and to allow market forces to determine the exchange rate. In recent years, however, the bank has been building up foreign exchange reserves, which involves the purchase of foreign exchange from the market, debt issuance and the growth in the monetary base (SARB, 2014). Thus, the central bank influences the equilibrium exchange rate since it interferes with the demand for foreign exchange. Although the bank ceased direct control on foreign exchange, it still influences the exchange rate by participating in the market through buying and selling other currencies. The South African Reserve Bank contends that the exchange rate, however, is not the objective or the target of the bank. The decisions by the bank regarding reserve accumulation should rather be seen as management of international liquidity, not exchange rate policy.

2.3 TRENDS IN REAL EXCHANGE RATES, 1994–2015

In a floating exchange regime, markets set the foreign exchange rate of a currency. Exchange rate affects exports and imports through changes in their relative prices (i.e. appreciation of the rand will increase the foreign price of South African exports, thus making South African exports more expensive for importers). Alternatively, a depreciation of the rand will lead to an increase in demand for South African exports. This can be expressed as follows:

Let P_d be the domestic price of South African exports and let E_x be the nominal exchange rate of the rand, expressed as the price of foreign currency (United States Dollar) in terms of rand. F is an increasing function of the ratio. Demand for South African exports, X_{DD}, in its simplest form can be expressed as follows:

$$X_{DD} = F\left[\frac{P_d}{E_x}\right]$$

If E_x increases, that is, the rand depreciates, then the ratio decreases $\left[\frac{P_d}{E_x}\right]$. Hence, it is expected that X_{DD} will increase. Alternatively, if E_x decreases (i.e. the rand appreciates), then the ratio increases, making it more expensive for foreign buyers to buy South African exports. This exchange rate is referred to as the nominal exchange rate and serves to connect the price systems in different countries and allows international traders to compare prices directly.

However, the RER, which reflects the nominal exchange rate adjusted for changes in the price level differential between the domestic economy and the rest of the world, is more significant than the nominal exchange rate – because RER compares two countries and the relative prices of baskets of goods produced or consumed. Importantly, the level of the RER relative to a level of equilibrium RER and its stability has been shown to influence export growth, consumption, resource allocation, employment, and private investments significantly. It indicates the direction of movement of the exchange rate in terms of real appreciation or depreciation and may provide some indications of the gain or loss in price or cost competitiveness. A fall in a country’s international competitiveness results in poor economic performance and outlook. Thus, the most important use of the real exchange rate is as an indicator of a country’s international competitiveness (Serven & Solimano, 1991; Aron *et al*., 1997; Burda & Wyplosz, 1997; Takaendesa, 2005).

The trend of the rand exchange rate (both nominal and real) is represented below in Figure 2.1 and Figure 2.2 respectively and indicates that the nominal exchange rate has consistently depreciated since 1994. The RER is measured in terms of the amount of foreign currency per unit of domestic currency necessary to buy a basket of goods in the country. In other words, the RER is equivalent to the nominal exchange rate multiplied by the relative prices of a basket of goods in the two countries. The RER has undergone periods of cyclical movement, with appreciation periods followed by subsequent weakening of the currency and movements in the exchange rate also indicating the presence of volatility.

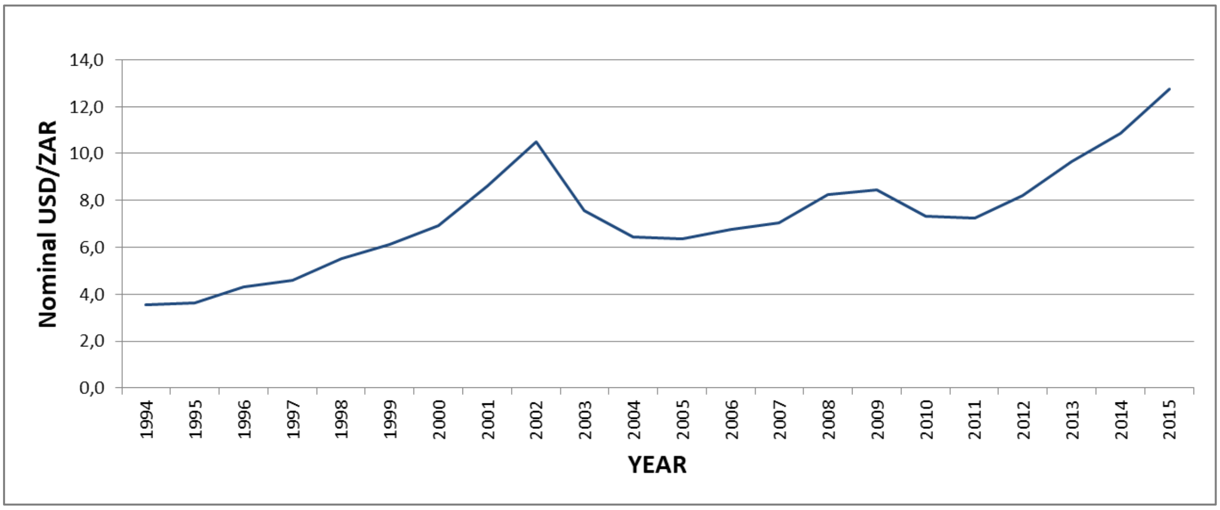
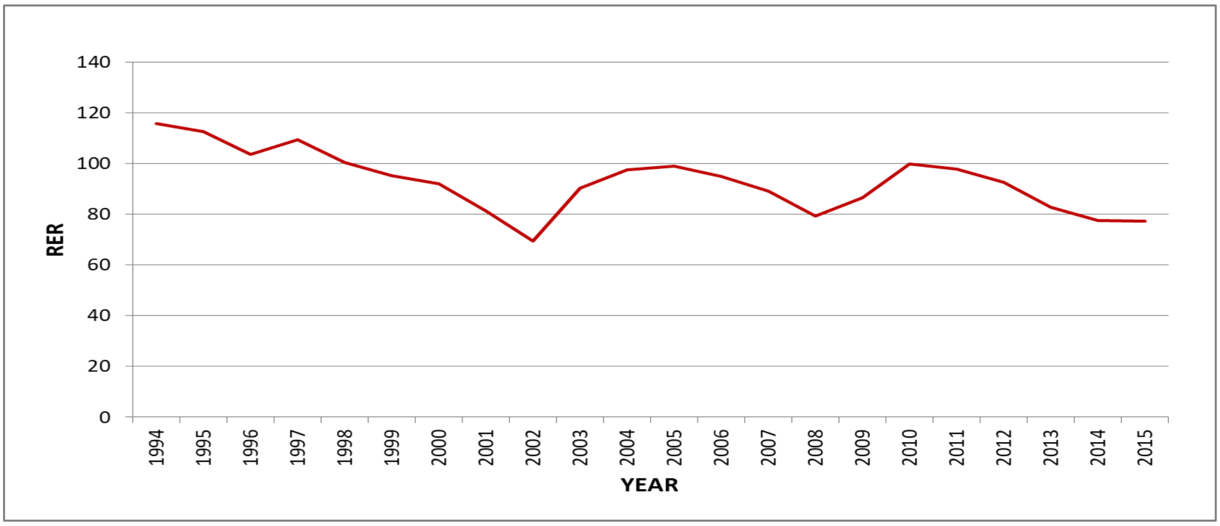


Figure 2.1: Trends in nominal exchange rates (rand per US dollar): 1994–2015

Source: Data compiled from SARB (2015)



(2010 = 100)

Figure 2.2: Trends in real exchange rates (indexed): 1994–2015

Source: Data compiled from SARB (2015)

The annual average figures were used to analyse the trends in the RER. RER of 15 major trade partners was chosen instead of the frequently used bilateral RER (usually against the US dollar) because it is a richer measure of competitiveness. In addition, South African trade is not only against the USA but is against multiple countries and thus, an average for these trading partners are a more realistic measure.

Figure 2.1 and Figure 2.2 indicates, the nominal exchange rate shows a depreciating trend, and this is confirmed by the negative trend in the RER since the end of apartheid. By the end of 2002, the rand had lost about 66% of its nominal value (Figure 2.1). However, after 2002, the nominal exchange rate exhibited some signs of recovery, echoing the positive sentiment of the international community regarding South Africa (SARB, 2009). The USD/ZAR exchange had been impacted by national and international social, political, and economic events. The 2001 September 11 attacks on the World Trade Center in New York caused the rand to fall to a record low of 10.5 to the dollar. The nominal exchange rate (USD/ZAR) appreciated to 6.4 by the end of 2005, indicating a 39% recovery. After 2005, the rand started to experience sustained periods of depreciation, leading to its worst performance against the US dollar in 2015. A slight recovery between 2010 and 2011 was recorded owing to the gains and benefits of hosting the 2010 Soccer World Cup. Since the beginning of 2015, the rand has been under severe pressure being one of the worst-performing emerging market currencies. Increased risk aversion towards emerging markets, concerns over the slowdown in China, weak commodity prices and interest rate normalisation in the USA all affected the rand. Domestically, contributing factors to the currency's weakness included poor economic growth, concerns over the balance of payments and fiscal deficits and low business confidence (Old Mutual Wealth, 2015).

In terms of the RER (Figure 2.2), the rand exchange rate was moderately stronger during the period 1994–1995. The inception of a democratic government in 1994 accompanied by the removal of sanctions attracted a large amount of foreign direct investment (FDI). These developments resulted in increased capital inflows and hence, demand for the local currency. Jordaan and Harmse (2001) explain that the increased capital inflows resulted in appreciation of the rand. The period between 1998 and 2002 saw the RER index decline from above 110 to 81 at the end of 2002, with the currency depreciating steeply between 1998 and 2002. This took place despite improved macroeconomic performance and the re-integration of the country into the global economy following the successful democratic transition in 1994. Factors involving possible contagion from the Asian financial crisis together with low global commodity prices and speculative attacks on the currency caused a severe depreciation in the currency. The extent of the currency depreciation over this period raised some questions as to whether this was a temporary deviation of the rand from its equilibrium level (MacDonald & Ricci, 2003).

The currency recovered sharply at the end of 2003, resulting in an appreciation episode from 2002 until 2005 when the RER strengthened by about 34%. This episode was driven by an appreciation in the nominal exchange rate and declines in the inflation rate. The extent and speed of the rand's recovery suggested that the currency might have been highly undervalued in 2002, thus necessitating a correction. Saayman (2007) notes that the rand's appreciation in 2003 created concerns in the mining houses and labour unions about the competitiveness of South African exports. This raised calls and exerted pressure on the SARB to weaken the currency in an effort to boost exports and employment creation. The Manufacturing Circle (2010) cited the appreciation of the rand (trend) and its volatility as one of the principal drivers of the country's observed de-industrialisation process and argued that a competitive exchange rate would boost the productive capacity of the export sector.

The inception of the global financial crisis in 2008 and the subsequent collapse in global trade flows, the decline in economic performance and the increase in the volatility of the global financial market (especially risk perception towards emerging markets such as South Africa) had a major impact on the currency. The RER declined from 94.94 at the beginning of 2007 to 79.43 in 2008 before regaining about 20% to recover and reach a level of 100.00 in 2010. The RER depreciated gradually from 2010 to the end of 2015, reaching 77.16. Such developments, especially the extent of the weakness in the nominal exchange rate, revived concerns about whether such movements reflected South Africa's economic fundamentals and whether the currency was correctly priced or if this signified a misalignment in the exchange rate.

2.4 TRENDS IN SOUTH AFRICAN EXPORTS, 1994–2015

Following the lifting of sanctions at the dawn of democracy in 1994, South Africa's exports expanded rapidly but by the mid-1990s, the pace of growth had begun to slow down (Figure 2.3). The rate of decline quickly accelerated such that by the end of 1999, the annual growth stood at only 1.3%, a figure less than half the growth demonstrated in 1994. The year 2000 experienced a good growth of 8.3% against the backdrop of improving non-commodity exports. The year 2003 recorded the lowest point for South Africa exports, which quickly rebounded after 2005 with real export growth (in U.S. dollars) falling to just 0.6% annually between 2005 and 2015 (World Bank, 2015). The global financial crisis that started to manifest itself in late 2007 intensified in 2008, resulting in the global recession of 2009 and bringing about a negative export growth rate for South Africa of -17%. The South African economy quickly recovered from the slump characterised by a strong bull-market and booming commodities markets boosted by the growth of the Chinese economy.

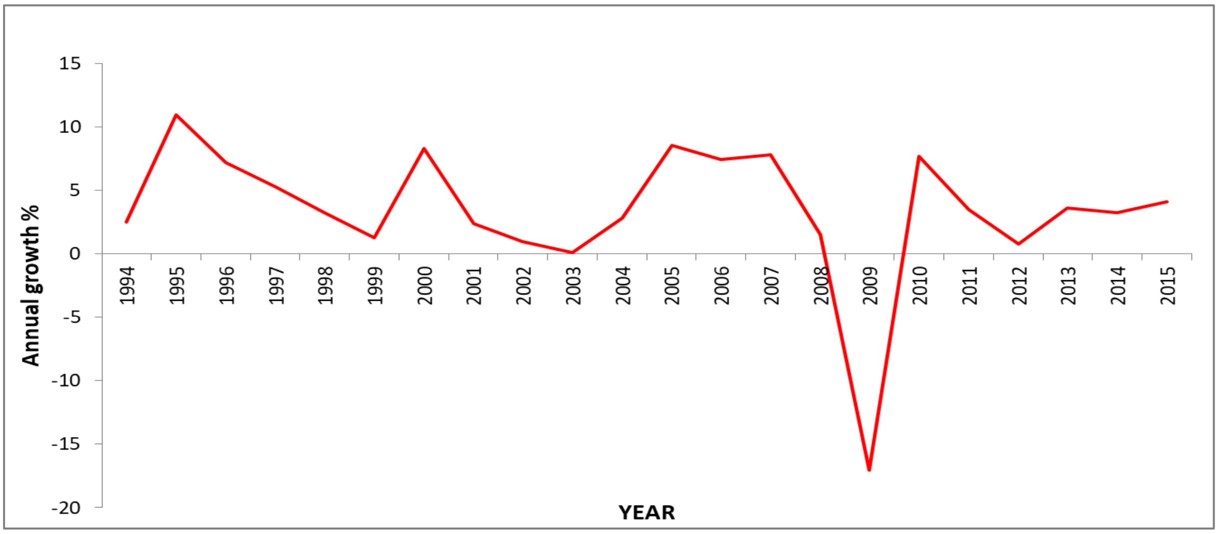


Figure 2.3: Trends in annual export growth (annual % growth)

Source: Data compiled from WTO 2015

2.4.1 Trade openness in South Africa

Trade openness is commonly measured as exports (X) plus imports (M) divided by the gross domestic product (GDP) (X+M/GDP) and can be seen as the extent to which a country is engaged in international trade. The contribution of imports and exports rose strongly as a percentage of GDP after 1994. The economy became more open, more productive and more outward orientated (Flatters & Stern, 2007). The entire economy became more outward orientated, with export orientation and import penetration increasing across primary sectors and manufacturing. Trends in trade openness are presented in Figure 2.4a.

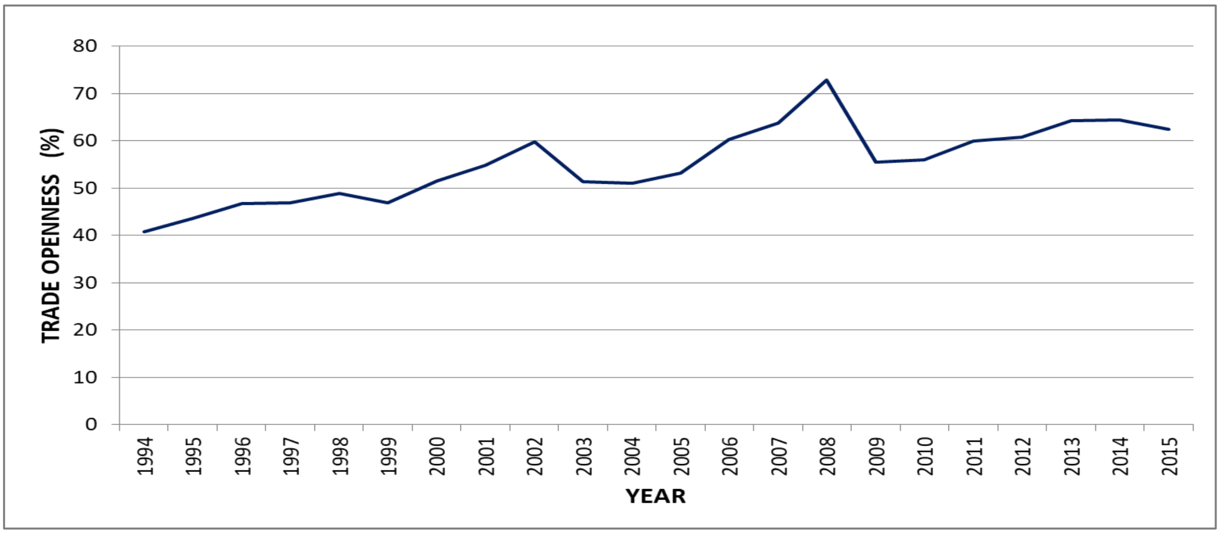


Figure 2.4a: Trends in trade openness in South Africa: 1994–2015 (% of GDP)

Source: Data compiled from SARB (2016)

Since 1994, the level of trade openness has on average been rising, falling slightly in 1999 but rising again between 2000 and 2002. Another major decrease in trade openness was in 2003, but the trade activities of the economy rapidly recovered, and the level of trade openness increased again from 2005 until 2008 when it significantly fell in 2009. Thereafter, the growth was at a slower pace, culminating in a slight decline in 2015. In Figure 2.4a, trade openness is divided into three categories, namely the period 1994–1999 that was characterised by a slow and steady increase in openness, the period 2000–2008 that was characterised by a rapid increase in openness and the period 2009–2015 that was characterised by a sharp decrease and a slow growth in openness.

Trade openness reduced South Africa's overdependence on primary products to more sophisticated manufactured goods and the service industry. South Africa is naturally endowed with many rich mineral resources such as gold, platinum and diamonds. Edwards and Lawrence (2006) argue that this endowment was the major reason for South Africa's reluctance to develop an internationally competitive manufacturing industry. Exports were dominated by resource-based and relatively low value-added commodities while imports were primarily dominated by higher value-added goods. The mining sector contributed more than 50% of total exports before 1994. However, much has changed through the concerted efforts of the government to diversify trade, which opened many markets for South African products regionally and overseas. Table 2.2 shows the export share of selected products in the South African export basket.

Table 2.2: Export share of selected products in South African export basket (2000–2010)

Product	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agricultural products	9,3%	8,2%	9,1%	8,7%	7,5%	7,3%	6,2%	5,8%	6,1%	8,3%	7,5%	7,3%	7,2%	8,0%	8,1%	8,5%
Fuels & mining products	15,5%	23,1%	14,7%	18,6%	20,1%	21,2%	25,0%	26,5%	25,0%	27,0%	24,3%	27,1%	24,9%	26,0%	22,4%	21,5%
Manufactures	39,8%	35,3%	39,0%	36,9%	36,5%	36,1%	34,1%	33,6%	33,2%	31,2%	30,1%	28,9%	29,5%	28,7%	30,0%	29,3%
Machinery& transport Equip	13,0%	13,4%	14,4%	13,4%	12,8%	13,3%	14,1%	13,9%	14,2%	13,4%	12,3%	12,4%	13,2%	12,8%	13,2%	13,8%
Automotive products	4,9%	5,4%	6,6%	6,3%	6,0%	6,0%	6,1%	6,1%	6,7%	6,3%	5,9%	5,5%	5,9%	5,7%	6,2%	6,9%
Chemicals	5,8%	5,2%	6,0%	4,9%	5,1%	5,5%	5,0%	4,5%	5,0%	5,1%	4,6%	4,7%	5,1%	4,9%	5,0%	4,9%
Iron and steel	7,8%	5,6%	6,6%	8,0%	9,1%	8,1%	7,1%	7,7%	7,6%	6,3%	6,0%	5,2%	4,6%	4,4%	4,8%	4,0%
Textiles & clothing	1,3%	2,6%	1,4%	1,2%	0,9%	0,6%	0,6%	0,4%	0,4%	0,4%	0,6%	0,6%	0,6%	0,7%	0,6%	0,7%
Others	2,6%	3,0%	3,3%	2,0%	1,8%	1,6%	1,8%	1,9%	1,6%	1,8%	1,7%	1,7%	2,0%	2,0%	2,4%	2,1%

Source: Data compiled from WTO (2015)

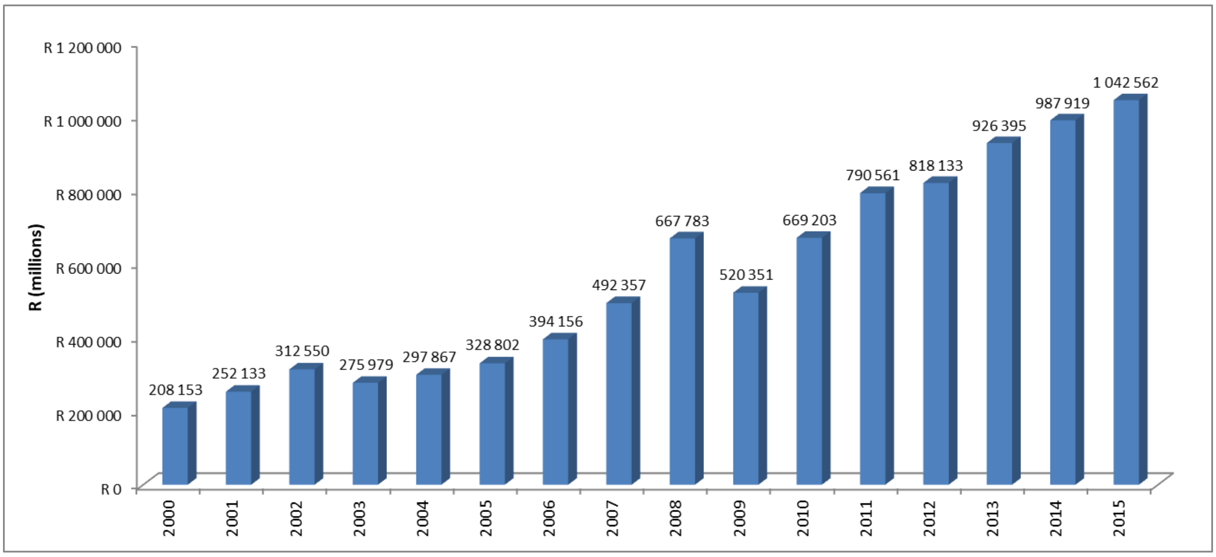


Figure 2.4b: Total South African exports – (R Million)

Source: Data compiled from WTO (2015)

Figure 2.4b clearly shows that South Africa's exports to the rest of the world have been increasing since 2010 in rand terms.

Table 2.2 shows that the South African economy is now hugely diversified in regard to exports, which has improved trade with the rest of the world. By the year 2000, the manufacturing sector was the most dominant contributor to the export basket with a share of 39.8% compared with mining and agriculture, which contributed 15.5% and 9.3%

respectively. By 2015, the contribution of the mining sector grew to 21.5%. Machinery and transport equipment were also key contributors in the export basket.

The government is aware of the need to reignite export growth, which is shown by different policies aimed at stimulating export growth. Policies include the New Growth Path (National Treasury, 2013), the National Development Plan 2030 (National Planning Commission, 2012) and the Industrial Policy Action Plan 2012/13–2014/15 (Department of Trade and Industry, 2016). These and recent Monetary Policy Committee statements (SARB, 2014) all identify export growth as a priority.

2.5 RELATIONSHIP BETWEEN REAL EXCHANGE RATE AND SOUTH AFRICAN EXPORTS

This section shows the movement of the volume of South Africa's total exports in US dollar terms in relation to the RER of the rand. Figure 2.5 demonstrates the year-on-year moving average of the volume of South Africa's total exports and RER. The data shows that for most periods in which the rand was depreciating (e.g. between 2011 and 2014), exports were increasing, concurring with theoretical literature. However, there were also periods in which exports declined despite a depreciating rand like between 2008 and 2009, which is contrary to the literature. This suggests that other factors may also be driving the movement of export volumes such as industrial labour action, electricity issues and other industry-related concerns that hinder competitiveness.

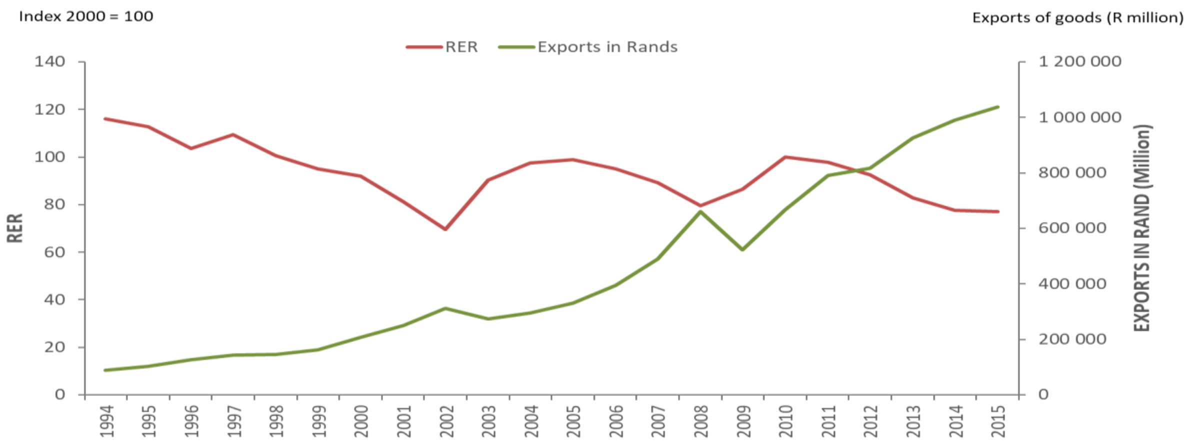


Figure 2.5: Year-on-year volume of South African total exports in Rand (million) and real exchange rate: 1994–2015

Source: Data compiled from SARB (2015) and WTO 2015

Another link between RER and exports was analysed. Figure 2.6 shows the yearly average of South African total exports as a percentage of the GDP and the RER.

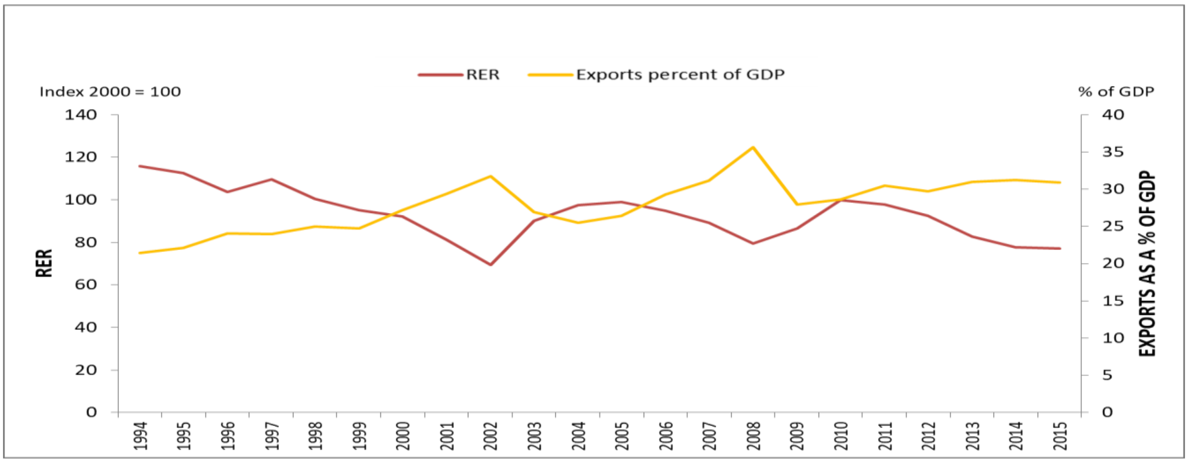


Figure 2.6: South African exports: 1994–2015 (% of GDP and RER)

Source: Data compiled from SARB (2015) and WTO 2015

Figure 2.6 demonstrates the periods in which the rand depreciation resulted in an increase in exports relative to the GDP. This can be seen in the periods 1994–2002 and 2006–2008. This outcome is supported by literature, which states that a weak exchange rate is good for exports (Ramzi, 2010). However, in the period 2011–2015, the rand depreciation did not result in a sizeable export increase. This indicates that in addition to the exchange rate, other factors affect export performance such as rising operating costs (e.g. higher costs of electricity, fuel and harbour charges); infrastructure backlogs (e.g. electricity, rail transport, ports); and safety and industrial action-related production stoppages (Anand, Perrelli & Zhang, 2015).

To summarise, Figure 2.6 shows two peak periods in exports (i.e. 2002 and 2008) that correspond with deep rand depreciation levels, thereby supporting the theoretical literature view regarding the link between RER and exports.

It is also worth focusing on the relationship between different exports within the basket and movements in the RER over time. The study focused on agricultural exports (Figure 2.7), mining exports (Figure 2.8), manufactured goods exports (Figure 2.9), machinery and transport equipment exports (Figure 2.10) and automotive and chemical exports (Figure 2.11). For the greater part of the period under review, it can be seen that South African exports tended to rise with a depreciating RER, confirming theoretical literature. However, there were also periods that demonstrated the contrary, bringing issues of competitiveness, pricing and logistics into perspective.

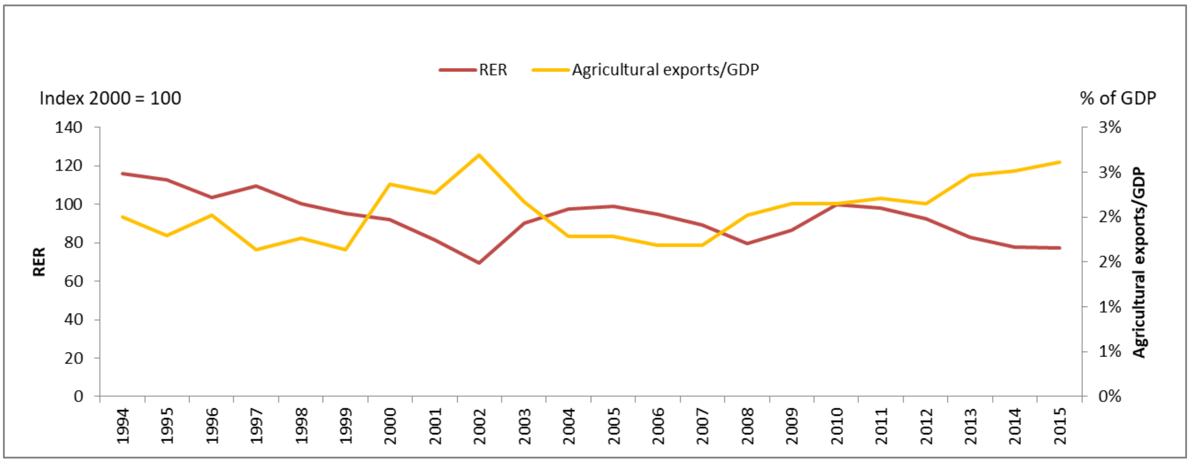


Figure 2.7: South African agricultural exports: 1994–2015 (% of GDP and RER)
Source: Data compiled from SARB (2015) and WTO 2015

Figure 2.7 shows that from 2012 to 2015, South Africa's agricultural exports increased while the RER depreciated. This can be interpreted to mean that a weaker rand/US dollar exchange rate boosted agricultural exports, *ceteris paribus*.

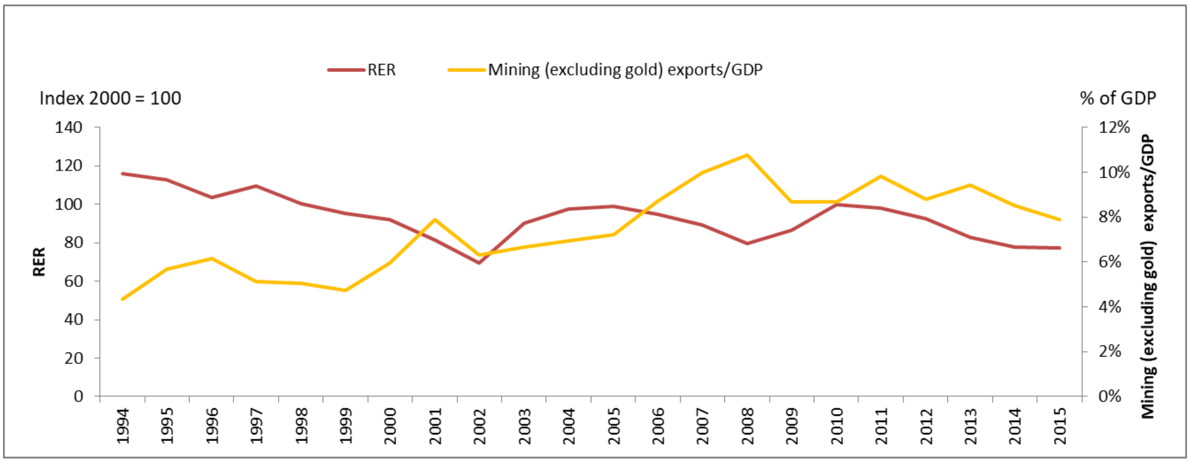


Figure 2.8: South African mining exports (excluding gold): 1994–2015 (% of GDP and RER)

Source: Data compiled from SARB (2015) and WTO 2015

Figure 2.8 shows that mining exports (excluding gold) declined together with the RER from 2011 to 2015, which is contrary to literature. This could be the result of the rand being a commodity currency, hence indicating a resource-dependent economy (Spatafora & Stavrev, 2003). There is thus no value addition in the minerals exported and consequently, South Africa is a price taker in the world market.

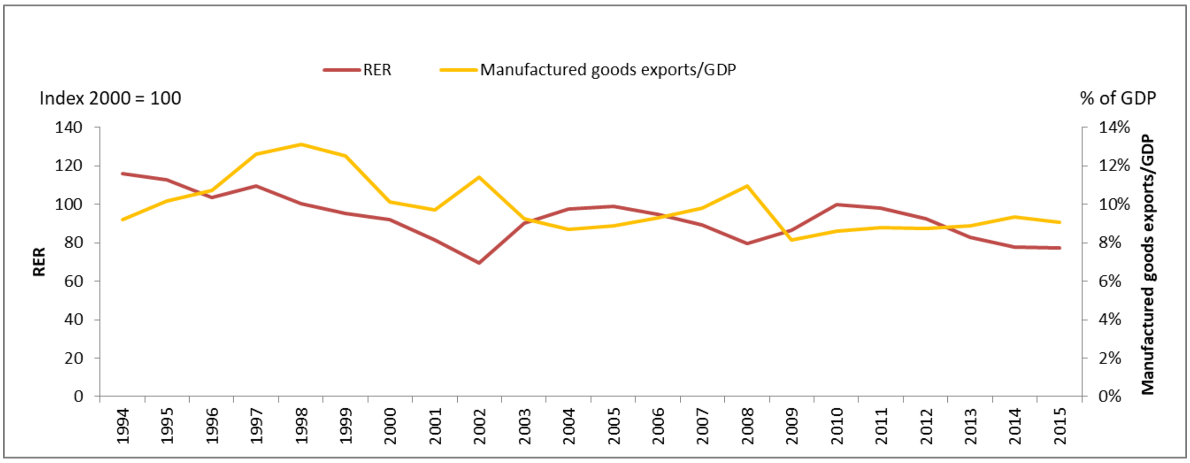


Figure 2.9: South African manufacturing exports: 1994–2015 (% of GDP and RER)

Source: Data compiled from SARB (2015) and WTO 2015

Figure 2.9 demonstrates that exports of manufactured goods slightly benefitted from the RER depreciation between 2010 and 2014. However, for most of the periods under review, this movement is contrary to economic literature. Factors other than the rand/US dollar exchange rate seemingly affected the exports of South African manufactured goods. Manufacturing exports are highly capital intensive, which in turn affects the comparative advantage of the industry. Technological developments may also affect competitiveness of the economy. The South African manufacturing sector is confronted by challenges such as global competition, local costs, cheap imports, and productivity and efficiency concerning local businesses within the sector (Manufacturing Circle, 2010).

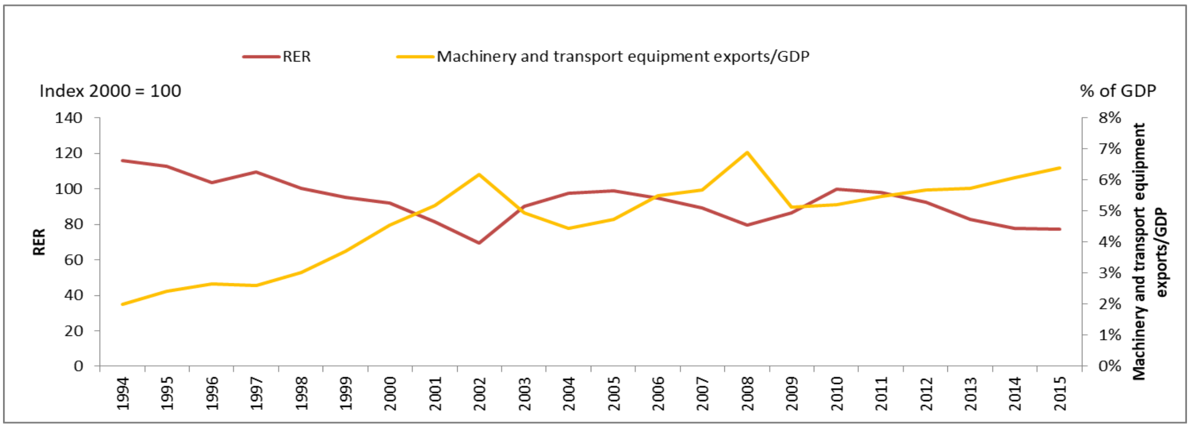


Figure 2.10: South African machinery and transport equipment exports: 1994–2015 (% of GDP and RER)

Source: Data compiled from SARB (2015) and WTO 2015

Exports of machinery and transport equipment responded positively to the RER depreciation from 2011 to 2015.

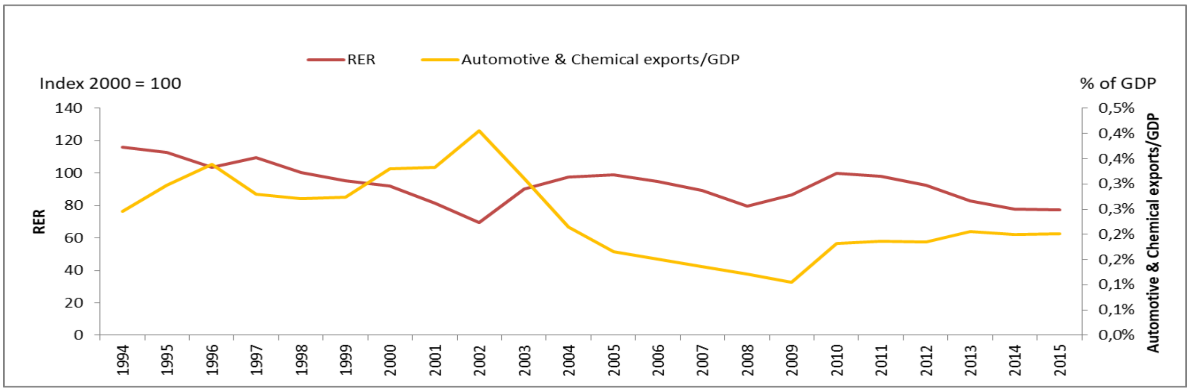


Figure 2.11: South African automotive and chemical exports: 1994–2015 (% of GDP and RER)

Source: Data compiled from SARB (2015) and WTO 2015

The relationship between automotive and chemical exports and RER is contrary to economic theory. These industries have been drastically affected by cheap Chinese products flooding the world market (Manufacturing Circle, 2010).

A simple correlation test (presented in Table 2.3) confirms the negative relationships between the RER and total exports as a percentage of the GDP and between the RER and agricultural products, mining products and machinery and transport equipment products. This means that if the RER depreciates, exports of these products are expected to increase. The relationships between RER and manufactured goods and automotive and chemical exports are insignificant.

Table 2.3: Correlation results between RER and exports as percentage of GDP

Export	RER	Agricultural products	Mining products	Manufactured goods	Machinery and transport equipment	Automotive and chemical products	Exports as percentage of GDP
RER	1						
Agricultural products	-.68***	1					
Mining products	-.521**	,253	1				
Manufactured goods	,120	-,326	-.534**	1			
Machinery and transport equipment	-.863***	.541***	.812***	-,396	1		
Automotive and chemical products	,052	,222	-.686***	.490**	-,412	1	
Exports as percentage of GDP	-.840***	.513**	.839***	-,229	.954***	-,384	1

*** Correlation is significant at the 0.01 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).
* Correlation is significant at the 0.1 level (2-tailed).

Source: Data compiled from SARB (2015) and WTO 2015

2.6 CONCLUSION

The exchange rate system evolved over time in South Africa, and vital changes led to the adoption of the current free-floating exchange rate system.

The RER depreciated between 1994 and 2015, which means that the South African rand lost value against the US dollar and other major currencies in this period. However, within this period, the rand also strengthened significantly after major losses, notably in 2002 and 2008.

A depreciating exchange rate is expected to boost exports by enhancing the price competitiveness of local products in export markets and to provide a degree of protection against import competition in the domestic market (Williamson, 1994). Export growth was positive for most of the periods except in 2009 (down 17%) when the growth was worsened by the global economic recession. Major growth in exports was recorded in 1995 (up 10.9%), 2000 (up 8.3%), 2005 (up 8.6%), 2007 (up 7.8%) and 2010 (up 7.7%). Generally, South African exports have benefitted from a weaker rand, and South Africa's exports to the rest of the world have been increasing since 2010 in rand terms.

The data show that for most periods in which the RER was depreciating, total exports were increasing, thus conforming to theoretical literature. However, there were also periods that were contrary to the literature such as between 2011 and 2014. During this time, exports declined despite a depreciating rand. This suggests that other factors may also have driven the movement of export volumes such as industrial labour action, electricity issues and other industry-related concerns that hinder competitiveness.

In the periods under review, South Africa's agricultural exports were increasing while the RER was depreciating. This can be interpreted to mean that a weaker rand/US dollar exchange rate boosted agricultural exports. Fuels and mining exports both declined together with the RER from 2011 to 2015, which is contrary to literature. This could be the result of the rand being a commodity currency, hence indicating a resource-dependent economy (Spatafora & Stavrev, 2003). Exports of manufactured goods slightly benefitted from RER depreciation between 2010 and 2014. But for most of the periods under review, this movement is contrary to economic literature. Exports of machinery and transport equipment responded positively to the RER depreciation between 2011 and 2015, but the relationship of automotive and chemical exports with RER is contrary to economic theory.

While a weaker rand brought an element of competitiveness in South Africa’s exports, it is important to highlight that not all export categories responded positively.

CHAPTER THREE

LITERATURE REVIEW

3.1 INTRODUCTION

This chapter provides a literature review of relevant aspects regarding the effect of RER misalignment on exports. In order to provide a conceptual framework and appropriate policy recommendations, it is important to present the theoretical framework that underpinned this study. In addition to the various theories that are discussed in this chapter, empirical literature is presented. The aim of presenting empirical literature is to explore work done by others and the various methods of research applied in this field in order to identify any existing gaps in the literature.

3.1.1 Basic concepts and definitions of exchange rate

The foreign exchange rate is merely the price of one currency in terms of another or against a basket of other currencies. In other words, it is the rate at which currencies are exchanged, for example, the units of rand needed to buy a unit of the dollar or the reverse. In a floating exchange rate regime rates are determined by the forces of demand and supply in the foreign exchange market. However, exchange rates may be pegged against another currency, or fixed to the value of gold. Exchange rates can also be different for the same country. In some cases, there is an onshore rate and an offshore rate. Generally, a more favourable exchange rate can often be found within a country's border versus outside its borders. Exchange rates can have what is called a spot rate, or cash value, which is the current market value. Alternatively, an exchange rate may have a forward value, which is based on expectations for the currency to rise or fall versus its spot price. Forward rate values may fluctuate due to changes in expectations for future interest rates in one country versus another. Typically, an exchange rate is quoted using an acronym for the national currency it represents. For example, the acronym USD represents the U.S. dollar, while ZAR represents the rand. To quote the currency pair for the rand and the dollar, it would be USD/ZAR.

The nominal exchange rate is the same as the spot exchange rate. The nominal exchange rate has largely overshadowed other measures of the exchange rate because it is directly observable and enables traders and the common man to compare the prices of goods directly. However, an appreciation or depreciation in the currency as measured by the nominal exchange rate reveals little about the real competitiveness of the currency over time since it does not consider inflation differentials. For this purpose, the RER is constructed.

The nominal exchange rate is considered appropriate if the actual RER is on a par with the long-run ERER. There is arguably some consensus that the ERER is a rate that is consistent with the attainment of both the external and the internal balance of the economy (Williamson, 1994; Mkenda, 2001). Usually, the nominal exchange rate is the only variable that is directly observable, while the actual RER needs to be constructed and the ERER estimated.

In most research, the exchange rates are measured in real terms because this is considered more suitable for estimating misalignment of the exchange rate compared with the nominal exchange rate (Edwards, 1989). In addition, the RER also reflects a country’s economic comparativeness (Williamson, 1985; Salvatore, 2001; Driver & Westaway, 2004).

3.1.2 Defining real exchange rate

The RER is defined as the nominal exchange rate adjusted for inflationary effects in the two countries of concern (Madura, 2006). To observe whether the RER is at equilibrium or not, a benchmark for the equilibrium RER is necessary.

The RER can be categorised into two broad groups, namely external RER and internal RER. According to Kemme and Roy (2006), the external RER is defined as the nominal exchange rate adjusted for differences in price levels between countries (i.e. the ratio of foreign to domestic aggregate price levels measured in a common currency). The external RER can also be defined as a bilateral RER that gives the price of a foreign goods basket in terms of a domestic goods basket and is the trade-weighted RER.). The weights of different currencies in the basket are determined by the countries’ trade volumes in the domestic economy. The internal RER refers to the ratio of the relative domestic price of tradable to non-tradable goods produced in the domestic economy. The external RER is usually the RER used in estimating the equilibrium exchange rate of a country’s currency (Salvatore, 2001).

3.1.3 Defining equilibrium real exchange rate

The equilibrium RER is one of the most important concepts in open-economy macroeconomics. The equilibrium RER is a hypothetical RER that can be modelled using different approaches. These approaches include the price-based approach such as purchasing power parity (PPP); the trade equation approach, which allows the estimation of the equilibrium RER by using the values taken by fundamentals; and the structural general equilibrium approach, which is known as the macroeconomic balance proposed by Williamson (1994). A fundamental equilibrium exchange rate (FEER), permits the estimated equilibrium RER to show the full range of macroeconomic interactions in the economy. This concept was mentioned by Bayoumi, Clark, Symansky and Taylor (1994). The last approach is the reduced-form general equilibrium approach. This approach is similar to the structural general equilibrium approach and incorporates the full general equilibrium interaction of the fundamentals in a dynamic structure that generates a time series rather than simply a point estimate for the equilibrium exchange rate. This approach was developed as the natural real exchange rate (NATREX) approach proposed by Stein (1994) and Faruqee (1995). Developments of the reduced-form approach is the behavioural equilibrium exchange rate (BEER) approach studied by Edwards (1989, 1994) and the fundamentals exclusive of real interest differential (FERID) by MacDonald (1995). The basis of the BEER approach is that the equilibrium RER is determined by the fundamental factors that influence the equilibrium RER in the traded sector and the shock factors that influence the RER.

3.2 THEORETICAL LITERATURE

This section investigates the theoretical determinants of the RER, in order to determine equilibrium RER and ultimately ascertain the degree of misalignment. In order to ascertain the impact of RER misalignment on exports, the conventional trade theories were reviewed in order to identify the explanatory variables.

3.2.1 Purchasing power parity

One of the common theories regarding RER in the long run is PPP. Purchasing power parity provides the long-run framework for the monetary and portfolio approaches to exchange rate determination. According to Hoontrakul (1999), the PPP theory (sometimes called the inflation theory of exchange rates) can be traced back to the School of Salamanca in 16th-century Spain and to the writings of Gerard de Malynes in 1601 in England. Cassel (1918) was first to name the PPP theory and argued that without PPP, there would be no meaningful way of discussing the over or undervaluation of exchange rates.

The PPP theory can be classified into two versions, absolute and relative PPP. The absolute PPP follows the ‘law of one price’, which states that in the absence of transaction costs, taxes and transportation costs, identical goods in two different economies should sell for the same price when expressed in an equivalent currency. If not, arbitrage will occur. Rogoff (1996) further clarifies PPP by noting that goods market arbitrage forces prices to converge towards a single price, which is the PPP value. If the PPP holds in the long run, then exchange rates will be adjusted to ensure the equal relative purchasing power of currencies. The relative PPP is the more commonly used version of PPP theory because it focuses on changes in the price levels in two countries (Salvatore, 2001). The relative PPP theory refers to rates of change in price levels (i.e. inflation rates), and the exchange rate of a currency will be equal to the difference in inflation rates between the home and the foreign country.

Both the absolute and the relative PPP theories postulate that the equilibrium RER is constant over time. However, many empirical studies cast doubt on the validity of these theories. Slow (or no) mean reversion to PPP has been observed in data. Invalidation of the PPP theories can arise from two main causes. Firstly, a given tradable good does not obey the law of one price. Several factors can explain the violation of the law of one price. For example, the increasing importance of differentiated characteristics, especially in manufactured goods, causes finite elasticities of demand under an environment of imperfect competition. Transportation costs, trade restrictions and taxes may vary the prices of tradable goods across countries. The presence of medium-term labour contracts could be another source because such contracts keep wages and unit production costs sticky so that producers are often inclined not to adjust prices in response to exchange rate changes. The role of market segmentation and market-specific costs (i.e. costs specific to a particular destination) could be another reason. These costs include distribution, networking and service costs, legal costs, advertising and market strategy, inventory and holding costs and other governmental regulations (beyond trade restrictions) (Kasa, 1992; Faruqee, 1995; Corsetti & Dedola, 2002). Secondly, there are major differences in the production function, consumer preferences and factor endowments across countries and thus, the relative prices of non-tradables across countries can be different.

Inadequacy of the PPP theories has motivated a number of studies to identify alternatives in understanding the factors that influence the movements of the equilibrium RER.

Additionally, PPP is rejected as an operational concept in both the long-run and short-run periods. MacDonald (2000) points out that one of the reasons that the PPP theories do not hold true is due to their rigid definition of the equilibrium exchange rate. That is to say, PPP does not consider the real determinants of the RER. Goldfajn and Valdes (1996) also point to the weakness of PPP and assert that real side variables have a significant influence on the RER. Furthermore, PPP is heavily dependent on the theory of arbitrage. The arbitrage theory counts against PPP since the theory applies only when the law of one price holds. However, some studies favour the PPP. For example, Pippenger (1993) study confirms that the relative PPP holds in the long-run and nominal foreign exchange rates follow a random path. Becketti, Hakkio and Jones (1995) also conclude that the relative PPP holds in the long run. In other words, neither form of PPP holds in the short to medium term.

3.2.2 Interest parity

The interest parity (IP) theory assumes that the actions of international investors motivated by cross-country differences in rates of return on comparable assets induce changes in the spot exchange rate. In other words, IP suggests that transactions on a country's financial account affect the value of the exchange rate on the foreign exchange market. The theory of IP can be traced back to 1923 and was developed by Keynes who linked the exchange rate, interest rate and inflation. This theory has two variations, covered interest parity (CIP) and uncovered interest parity (UIP).

Clark and MacDonald (1998) underpin the equilibrium RER on the basic concept of UIP. They assume that the unobservable expectation of the RER is determined by a vector of long-run economic fundamentals. The authors include four key fundamentals, which are the terms of trade, productivity differentials, net foreign assets and government expenditure (or government debt) (Clark & MacDonald, 1998). Thus, the equilibrium RER is determined as a function of both the (long-run) economic fundamentals and the interest rate differential.

3.2.3 The behavioural equilibrium exchange rate model

The BEER approach is not a normative measure; it focuses on the RER and the medium-term equilibrium rates of the fundamental determinants (i.e. internal and external balance proxies). Internal (full employment and low employment condition) and external balance (sustainable current account) positions. The equilibrium RER is consistent with the prevailing levels of economic fundamentals in a single equation of the BEER model (Siregar & Rajan, 2006).

The internal balance is defined as a situation in which demand and supply of non-tradable goods are equal. The external balance implies reaching a steady state of change in the total net foreign assets in the economy (Faruqee 1995; Baffes, Elbadawi & O'Connell, 1999; Jongwanich 2009). Real exchange rate equilibrium is attained when the country simultaneously reaches internal and external equilibria.

The internal and external balance approach only includes long-run economic fundamentals, while the UIP includes the real interest rate differentials classified as medium-term fundamentals.

3.2.4 The fundamental equilibrium exchange rate model

Popularised by Williamson (1985), the FEER was defined as that which is expected to generate a current account surplus or deficit equal to the underlying capital flow over the cycle, given that the country is pursuing internal balance as best as it can and not restricting trade for reasons relating to balance of payments. Thus, the FEER approach is based on the equilibrium exchange rate consistent with a country’s sustainable position of macroeconomic balance that has both an internal and external dimension. The internal balance is said to be reached when the economy is at full employment and operating in low inflation. The external balance is characterised as a country’s current account balance sustainable over the medium term, ensuring the desired net flows of resources.

To determine the FEER, the current account position is first set as a function of the equilibrium RER, full employment output of the local and foreign economies. The current account is then equated to the level of capital account equilibrium over the medium term.

The FEER is a normative measure of the equilibrium RER since it involves some notion of ideal economic circumstances of internal and external balances. In addition, to determine the

FEER, trade elasticity needs to be calculated to determine the response of exports and imports to relative price changes. Different forms of current account equations could lead to different values of the trade elasticity. Relying too much on trade elasticity may generate an inaccurate estimate of the FEER trajectory.

The BEER is adopted to avoid the normative measure that could emerge from applying the full multi-country macroeconomic model, although this could have advantages in terms of ensuring internal consistency of the macroeconomic linkages. In contrast to the FEER, the BEER approach is not a normative measure since the BEER is not subject to the explicit assumption of 'sustainable external and internal balance'. The equilibrium rate under the BEER approach is consistent with the prevailing level of economic fundamentals.

3.3 TRADE THEORIES

The primary aim of this section is to present the related international trade theories and their developments, with particular emphasis placed on the traditional comparative advantage models.

Pioneered by Adam Smith in 1776, the classical economic trade theory suggests that a country has the absolute advantage if it has the ability to produce more goods or services than other countries using the same amount of resources. In the early 19th century, David Ricardo developed the theory of comparative advantage, which is the starting point for international trade theories. A country has the comparative advantage in producing a product in terms of other products if it has a lower opportunity cost than other countries. Moreover, if each country exports the goods in which it has a comparative advantage, both countries can benefit from trading across their borders (Krugman & Obstfeld, 2008). However, the Ricardian model is approached merely by comparing the differences in the productivity of labour. Developing the trade theory of David Ricardo (1817), two Swedish economists, Eli Heckscher and Bertil Ohlin, try to explain why certain countries have comparative advantages for certain goods with the assumption of no differences in technological knowledge between the two countries. Following the Heckscher-Ohlin (H-O) model, a country will export products that use nationally abundant and cheap factor(s) and import products that involve the country's scarce factor(s) (Blaug, 1992). The H-O theory also refers to the factor-proportions theory because it emphasises the proportions of the different production factors that are used in producing goods in different countries.

In practice, when goods are exchanged directly with other goods based on their relative prices, it is more convenient to use money or terms of money in the transactions. Each country thus has its own currency, and its money price changes can have effects that spill across its boarders into other countries. This is the reason that exchange rate management is regarded as an important task for all governments.

3.3.1 Comparative advantage

Traditional comparative advantage models suggest that differences in resource endowment and technology are key factors in determining comparative advantage and the trade pattern of a country. David Ricardo introduced the theory of comparative advantage in 1817. Ricardo reasoned that even if Country A had the absolute advantage in the production of products, specialisation and trade could still occur between two countries. Comparative advantage occurs when a country cannot produce a product more efficiently than the other country; however, it can produce that product better and more efficiently than it does other goods.

These models are based on perfect competitive market assumptions, and they underestimate the role of policy in redefining comparative advantage and reshaping the trade pattern of a country. In fact, the models predict that any policy-induced trade pattern is sub-optimal. However, since many of the assumptions regarding perfectly competitive are not met, the policy conclusions drawn from these models are not necessarily the best for a country, particularly in the long run. Therefore, in situations where there are market failures, government policy interventions are justifiable on efficiency grounds to achieve a socially efficient production and trade pattern.

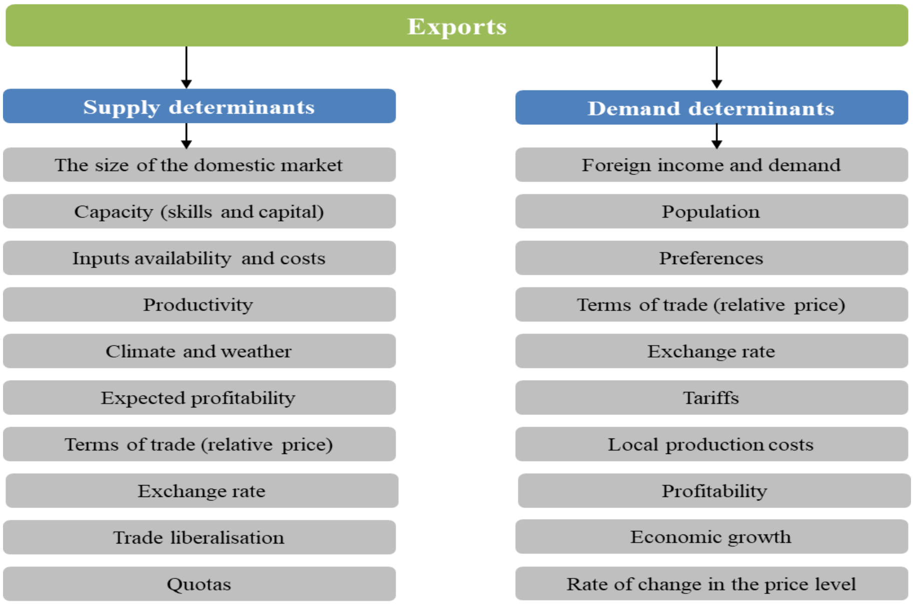
The effects of the RER and specialisation can be linked in the traditional Ricardian model to a range of goods (Ramzi, 2010). In this model, the technology of each country is described by the units of labour required to produce a given merchandise. The wage rate prevailing in each respective country is, therefore, the key variable that determines the goods that the country will export/import. To determine which country will produce which goods, the wage rate prevailing in each respective country needs to be introduced. For a given wage ratio, an improvement in the technology at home will shift the cut-off point, and production at home and exports will be more diversified. Similarly, the change in the wage ratio between the two countries will have a similar impact on the specialisation pattern. If it is assumed that goods and labour markets are competitive, one policy instrument that the government can use to alter wage ratios between the two countries is the RER.

Devaluation of the RER not only increases the profitability of the goods for which the country has a traditional comparative advantage, but it can also shift the cut-off point for the range of goods that can be profitably produced in the home economy. In other words, as devaluation reduces the wage ratio in the two countries, it increases the demand for home labour and hence increases the range of goods produced at home. This occurs for two reasons (Krugman, 2008). Firstly, since domestic labour is cheap relative to foreign labour, goods produced at home are cheaper, and thus more goods can be produced at home and exported. Secondly, as wage costs fall in foreign currency terms, more goods are produced at home, and this replaces imports or expands import substitute production. This implies that even in situations where the opportunities for significant technological advances are limited, the RER could be manipulated to re-shape the trajectory of the country's comparative advantage (Elbadawi & Helleiner, 2004). Although devaluation results in an increase in the profitability of the tradable sector and thus increases in investment, employment and diversification into new lines of tradable products, devaluation will also lead to an increase in the real wage rate in response to higher employment in the tradable sector. The latter effect would counteract the expansion effect of devaluation on the tradable sector. However, if a devaluation-induced increase in profits in the tradable sector is translated into higher accumulation of capital and learning, the resulting technological progress may dominate the contractionary effect of an increase in real wage rate and thus could accommodate higher steady-state real wages without the loss of competitiveness of the tradable sector (Ramzi, 2010). Thus, the effect of devaluation on the expansion of the tradable sector and export diversification ultimately depends on the balance between these opposing effects.

3.4 RER MISALIGNMENT AND EXPORTS

3.4.1 Determinants of exports

Before engaging in a detailed discussion about the relationship between RER misalignment and exports, it is crucial to establish what the actual drivers of exports are. The performance of exports is determined by various economic factors, which can broadly be divided into supply and demand factors. In addition to these, there are other supporting factors that have implications on the extent of trade patterns, such as economic policies, e.g. trade liberalisation and exchange rate regimes. These policies determine the extent to which the nations should engage and benefit from trade (Ngandu, 2008).



Source: Smith (2007)

These determinants show that while demand and supply are determined by various factors, some of the explanatory variables are common for both elements. For example, expected profitability is one of the common variables. If suppliers expect their profit margins to increase when they export high volumes of their products, they will tend to expand production and export more when their expectations increase. Similarly, if the importers (demand units) on the other hand expect their profit margins from the imported goods (either by reselling the goods directly to their local markets or using them as intermediate goods to produce other goods) to increase, they would import more when their expectations increase (Ngandu, 2008).

Another common variable, which is of interest to this research, is the exchange rate. Because international trade involves transactions between various countries, with different economic fundamentals and currency units, the exchange rates should influence trade activities.

If the trading countries are not using a common currency, the transactions will be priced in foreign exchange, either the currency of the importing or exporting country, or a generally accepted currency such as the US dollar. Accordingly, the movement of the exchange rate used to complete the transactions will have implications on the price of the goods being traded, which in turn will affect demand and supply patterns of exports (Mtonga, 2006).

There are other factors that also contribute towards the performance of exports according to De Grauwe (1983), a standard export function shows that the demand for exports (EXP) is a function of foreign demand (FD), terms of trade (TOT) – a proxy of the relative price of domestic and foreign goods as well as the exchange rate. Therefore, with exports (EXP) as an dependent variable, the following equation can be constructed:

EXP = f (FD, TOT, ExRate)

An increase in FD, particularly in the major trade partners would stimulate expenditure and other economic activity in these countries, which will boost economic growth and push demand for exports. TOT and ExRate involve the pricing of exports. Economic theory suggests that the higher the cost of a product, ceteris paribus, the lower the quantity demanded and vice versa. Therefore, if the cost of exports in one country increases relative to those of other competitors, the quantity of exports demanded will decline (Edwards and Golub, 2004).

3.4.2 Effects of RER misalignment on exports

Extensive theoretical and empirical literature linked to the effects of misalignment of the real exchange rate on export growth consistently remains dominant in most international finance policy discussions (Edwards, 1989). Several research findings from numerous studies indicate that prevalence of misalignment of the exchange rate for protracted periods depressingly affects competitiveness of the tradables sector.

Theoretically, RER misalignment has a negative effect on economic performance. In fact, it reduces the export of tradable goods and the profitability of production. RER misalignment deteriorates domestic investment and foreign direct investment, consequently growth, by increasing uncertainty. RER misalignment leads also to a reduction in economic efficiency and a misallocation of resources (Edwards (1989), Cottani, et al. (1990) and Ghura and Grennes (1993)). Studies have also shown that undervaluation can improve growth, Levy-Yeyati and Sturzenegger (2007) state that undervaluation increases output and productivity through an expansion of savings and capital accumulation. Rodrik (2009) illustrates that undervaluation rises the profitability of the tradables sector and leads to an extension of the share of tradables in domestic value added. Larger profitability encourages investment in the tradables sector and helps economic growth. Korinek and Serven (2010) illustrates that real exchange rate undervaluation can increase growth through learning-by-doing externalities in the tradables sector.

Many studies have investigated the empirical link between RER misalignment and export, for example Nabli and Véganzonès-Varoudakis (2002) using a panel data of 53 countries found a negative relationship. The same results were found by Jongwanich (2009) for a sample of Asian developing countries. Sekkat and Varoudakis (2000) found that REER volatility does not have a systematic negative impact on manufactured export while REER misalignment exerts a significant negative influence on export for a panel of Sub-Saharan African countries. Jian (2007) also found that exchange rate misalignment has a negative influence on China's export.

Based on these two contrasting views, the relationship between RER misalignment and export performance remains an empirical issue. The empirical examination conducted in this study would provide evidence as to whether RER misalignment improves export performance or otherwise.

3.5 EMPIRICAL LITERATURE

Many researchers have examined the impact of RER misalignment on exports using different methods and countries and came to different conclusions depending on the country, method and time of study. This section presents the various studies done, the methods used, the countries of research and the results obtained. The section presents empirical literature from developed countries, developing countries and other emerging economies. Finally, empirical literature from South Africa is given.

3.5.1 Empirical literature from developed countries

Shirvani and Wilbratte (1997) presented an empirical reassessment of the relationship between the real exchange rate and the trade balance, using Johansen-Juselius (JJ) multivariate cointegration approach to analyse the bilateral trade between the USA and other

G-7 countries. The authors found that long term, the exchange rate did affect the trade balance in the USA. However, they found that short term, the trade balance did not respond significantly to exchange rate shocks, needing up to two years to make an impact (Shirvani & Wilbratte, 1997). The study used quarterly data from 1980Q1 to 1996Q1

Baharumshah (2001) using quarterly data from 1980:1 to 1996:4 also used the JJ multivariate cointegration approach and estimates from an unrestricted VAR model and found that devaluation of the ringgit and baht caused an increase in exports to the USA and Japan from Malaysia and Thailand. The study also found that the real effective exchange rate is an important variable in the trade balance equation and devaluation improves the trade balances of both economies in the long-run.

Using various approaches, Frait, Komarek, and Melecky (2005) analysed the misalignment of the RER in five new European Union member states, namely the Czech Republic, Hungary, Poland, Slovakia and Slovenia. Using quarterly time series data covering the period from 1995Q1 to 2004Q1. In addition to the behavioural model, the authors utilised pure statistical techniques such as the Hodrick-Prescott and Band-Pass filters. The main finding of the paper was that the real convergence of these countries had been accompanied by sustained appreciation of the RER, causing depressing effects on the volume of trade (import and exports) (Frait *et al.*, 2005).

Olimov and Sirajiddinov (2008) documented a quantitative analysis of exchange rate volatilities and misalignment in Uzbekistan for the period 1994–2005 using a two-step Engle-Granger technique. The results suggest that RER volatility and misalignment have depressing effects on the volume of trade, especially on the exports of Uzbekistan.

Jaussaud and Rey (2009) investigated the long-run determinants of Japanese exports to China and the USA during the period 1971–2007 using cointegration relationships. The results indicate that Japanese sectoral exports to China and the USA depended on RER fluctuations and external demand (GDP of the country of destination). Generally, the RER fluctuations and the GDP had the expected negative effects. In particular, a real appreciation of the yen and a greater uncertainty reduced Japanese exports. The results of this study are supported by the traditional approach, which holds that currency depreciation improves exports and hence growth and vice versa.

Berman, Martin and Mayer (2009) analysed French export firms for the period 1995-2005. The authors found that high-performance French firms react to currency depreciations by increasing their export price rather than their export volume, while low productivity export firms do the opposite.

Dincer and Kandil (2011) examined the effects of exchange rate fluctuations on 21 exporting firms in Turkey from 1996Q1–2002Q4. Building on a theoretical model that decomposes movements in the exchange rate into anticipated and unanticipated components, the empirical analysis traced the effects through demand and supply channels. The first component of the study revealed that anticipated exchange rate appreciation, in line with movements in underlying fundamentals, has significant adverse effects on export growth across many firms. The second component revealed that random (unanticipated) currency fluctuations (exchange rate shocks) determine both aggregate demand and supply. Unanticipated currency appreciation, a positive shock to the exchange rate, decreases the cost of buying intermediate goods, thus increasing the output supplied.

Berg and Miao (2010) used a FEER model with the Washington Consensus (WC) view, that holds that real exchange rate misalignment implies macroeconomic imbalances that are themselves bad for growth. The study used five-year average for each data series, yielding a dataset consisting of observations on 181 countries over eleven 5-year time periods from 1950– 54 through 2000–04. Their findings suggest that the WC and the views of Rodrik (2007) are observationally equivalent for main growth regressions, but there are some identification problems since the determinants of RER misalignments are also likely to be independent variables in the growth regression model. However, the empirical findings of Berg and Miao (2010) support the view of Rodrik (2008) (who argues that undervaluation relative to purchasing power parity is good for growth because it promotes the otherwise inefficiently small tradable sector.) in the sense that undervaluation promotes long-run growth while overvaluation has the opposite effect – a result that it is not consistent with the WC viewpoint.

Vieira and MacDonald (2010) empirically investigated the relationship between RER misalignment and long-run economic growth in almost 100 countries using panel data techniques, including fixed and random effects, panel cointegration and the system generalised method of moments (GMM). The study used time series data from 1980 to 2004. The results for the two-step system GMM panel growth models indicated that the coefficients for RER misalignment are positive for different model specifications and samples, which means that a more depreciated RER harms the country's competitiveness and long-run growth. The estimated coefficients are higher for developing and emerging countries.

3.5.2 Empirical literature from developing and other emerging market economies

Nabli and Veganzones-Varoudakis (2002) showed that the eight countries of the Middle East and North Africa (MENA) region were characterised by a significant overvaluation of their currency during the period 1970–1990 and that this overvaluation generated a cost for the region in terms of competitiveness. To determine the overvaluation, the study developed an indicator of misalignment based on the estimation of an equilibrium exchange rate - following Edwards (1989).

Jongwanich (2009) examined ERER misalignments and export performance in developing Asian countries (Hong Kong, China, India, Indonesia, Korea, Malaysia, Singapore and Thailand) during the period 1995–2008 using a reduced-form model of export performance. The study identifies that RER misalignment could have a negative impact on export performance in developing Asia. This implies that the negative impacts of RER appreciation on export activities could become even more significant when such appreciation is associated with RER misalignment. In other words, the positive effects of RER depreciation on exports could be reduced when such depreciation is not consistent with economic fundamentals. Real exchange rate misalignment in terms of real overvaluation could adversely affect export performance since real overvaluation reflects a loss in a country's competitiveness. Meanwhile, persistent real undervaluation could result in an economic overheating, thereby putting pressure on inflation and generating expected currency appreciation. This could also have a negative implication on export performance.

In a study by Diallo (2011), panel data cointegration techniques were used to study the impacts of RER misalignment and RER volatility on total exports for a panel of 42 developing countries from 1975 to 2004. The results show that both RER misalignment and RER volatility affect exports negatively. The results also illustrate that RER volatility is more harmful to exports than misalignment. These outcomes are corroborated by estimations on subsamples of low-income and middle-income countries.

Masunda (2011) investigated the impact of RER misalignment on sectoral output in Zimbabwe. To achieve this, the feasible generalized least squares (GLS) panel data techniques were employed. Data from a sample of Zimbabwean sectors that included the agricultural, manufacturing and mining sectors for the period between 1980 and 2003 were analysed. The study indicated that RER misalignment is harmful to sectoral output and significantly affects exports.

Genc and Artar (2014) examined the effect of exchange rates and trade in emerging market countries (EME). The study concluded that there is a cointegrating relationship between the REER and the exports of the EME in the long run.

3.5.3 Empirical literature from South Africa

Poonyth and Van Zyl (2000) investigated the short-run and the long-run relationship between the RER and South Africa's agricultural exports using an error correction model (ECM) methodology. The empirical findings established the short-run relationship between real agricultural exports and the RER, confirming a strong linkage between the macro sector and the South African agricultural sector. This linkage is a unidirectional causal flow from the exchange rate to agricultural exports.

Real exchange rate misalignment causes an increase in unit labour cost (ULC). This would result in a deterioration of the competitiveness of the country and hence affect exports. Asfaha and Huda (2002) investigated the effect of RER misalignment on ULC in South Africa for the period 1985–2000. The investigation revealed that RER misalignment causes an increase in ULC. Through its effect on the competitiveness of the tradable sector versus the rest of the world and the subsequent impact on investment, RER misalignment affects exports.

Edwards and Wilcox (2003) assessed the impact of exchange rate movements on the South African trade balance. In particular, the authors investigated whether a nominal depreciation of the currency could improve the trade balance through promoting export production and import substitution. The study followed much international empirical research and used the elasticity approach to analyse the responsiveness of exports and imports to exchange rate movements. The research drew upon Bridge Resource Management (BRM), which defines a set of necessary conditions regarding the size of import demand, import supply, export demand and export supply elasticities for a nominal depreciation to improve the trade balance. The study found that export and imports remained relatively stable during the 1970s and early 1980s but grew strongly from the mid-1980s (Edwards & Wilcox, 2003).

Bah and Amusa (2003) used ARCH and GARCH models to examine the effect of real exchange rate volatility on South African exports to the U.S. for the period 1990:1-2000:4.The findings are that Rand's real exchange rate variability exerts a significant and negative impact of exports both in the long and short-run.

Sekantsi (2007), using GARCH and ARDL bounds testing procedure proposed by Pesaran et al. (2001), empirically examines the impact of real exchange rate volatility on trade in the context of South Africa's exports to the U.S. for South Africa's floating period (January 1995-February2007) The results indicate that real exchange rate volatility exerts a significant and negative impact on South Africa's exports to the U.S.

Edwards and Garlick (2008) reviewed the theoretical and empirical relationship between exchange rate and trade flows in South Africa from 1970 to 2005. Trade volumes were found to be sensitive to RER movements, but nominal depreciations were demonstrated to have a limited long-run impact on trade volumes and the trade balance since real effects are offset by domestic inflation. Policy should not focus on the exchange rate, but on the fundamental determinants of the profitability and competitiveness of domestic exporters and import competing industries: productivity enhancement, infrastructure, constraints to business operations and production costs, including labour costs.

Elbadawi *et al*. (2012) evaluated the relationship between RER misalignment and economic performance measures, focusing on economic growth, export diversification and sophistication using the system Generalized Method of Moments (S-GMM) dynamic panel estimation method for a sample of 83 countries in Sub-Saharan Africa, which included South Africa. The study covered the period 1980-2004. The authors found that countries that have experienced some growth associated with a measure of export diversification were also likely to have avoided disequilibrium RER overvaluation. Elbadawi *et al*. (2012) also point out that overvaluation is bad for growth and export diversification, but undervaluation is good for both. For South Africa, the concern would be that recent overvaluation could have undermined the gains achieved in terms of export diversification and sophistication and possibly harm one of the most important channels for dynamic growth and poverty reduction Elbadawi et al. (2012).

Jordaan and Netshitenzhe (2015) examined the impact of changes in the exchange rate of the rand on South Africa's export performance on an aggregate level and on different sectors of the economy. The study used the Johansen maximum cointegration technique and an ECM to analyse the long-run effects and the short-run dynamics of the effects of changes in the exchange rate on South Africa's export volume, total exports, manufacturing exports and mining and agricultural exports for the period 1988–2014. The results show that while there is a long-run equilibrium relationship between the REER and all the dependent variables (excluding export volumes), a real depreciation of the domestic exchange rate only has a positive long-run effect on manufacturing and mining export performance. In the short run, while the ECM shows that REER depreciation may increase total exports and mining and manufacturing exports, this is not the case for export volumes and agricultural exports. The results also show that manufacturing and mining exports are affected more by their previous values than the exchange rate. In addition, the paper found that compared with the exchange rate, an increase in world income has a much larger impact on total exports from South Africa (Jordaan & Netshitenzhe, 2015).

3.6 CONCLUSION

The RER misalignment measure is found to be negatively and significantly associated with export. This means that an undervaluation of the RER can be used to promote export, while an overvaluation will tend to reduce export. However, results also suggest that variability may be a more important variable than the level of misalignment. Different estimation techniques have been used, leading to different interpretations. Some of the popular approaches include the single equation model, and the cointegration approach.

The elasticities approach is criticised for having the export supply function dependent only on the nominal prices rather than on the relative prices. Furthermore, this approach ignores the feedback effects that currency depreciations have on macroeconomic variables arising from price changes and production fluctuations. The main shortcomings of the PPP approach is that it chooses a single equilibrium rate for all periods and accounts for the monetary sources of exchange rate fluctuations without capturing the exchange rate fluctuations attributed to real factors. For this reason, this study used a single equation model, which is a reduced form of the equilibrium RER that uses time-series techniques to estimate the equilibrium RER equation from the observed macroeconomic fundamentals. Conventional theories were used for exports.

From the review of the empirical literature on South Africa, it is clear that few studies have concentrated on the effect of RER misalignment on exports. The focus of most studies is on exports and real exchange rate volatility, real exchange rate on economic growth and elasticity of the exports to exchange rate changes. Furthermore, it is clear that the findings of these studies for both developed and developing countries are conflicting. Hence, the effect of RER misalignment on exports is still a debatable issue. This study will also contribute to the ongoing debate concerning the effect of RER misalignment on exports in South Africa by using robust econometric techniques.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter sets out the analytical framework used in this study by providing the model employed to examine the effects of RER misalignment on exports in South Africa during the period 1994–2015. The chapter also includes information on estimation techniques, diagnostic tests and data sources used in the study.

4.2 MODEL SPECIFICATION

To investigate the effect of RER misalignment on exports, the study proceeded in three steps. The first step was to estimate the equilibrium RER. The second step determined the RER misalignment, which was the difference between the equilibrium RER and the actual RER. The third step tested the impact of RER misalignment (determined in step two) on exports.

4.2.1 Modelling the real exchange rate

To compute the RER misalignment, the study followed a reduced-form single equation model, employing the modified version of Edwards (1994). The empirical applications of the model of Edwards (1994) and subsequent revisions to developing countries have yielded generally significant results. In the case of developing countries such as South Africa, the equilibrium RER model has been used in most of the literature (Clark, Bartolini, Bayoumi & Symansky, 1994; Chinn, 1998; Hinkle & Montiel, 1999; Goh & Kim, 2006).

The study computes the equilibrium RER by estimating empirically a long-run RER equation. The single equation model that links RER to a set of fundamentals could be specified as follows:

$$\text{InRER}_t = \alpha + \beta_0\text{InRER}_{t-1} + \beta_1\text{InOPEN} + \beta_2\text{InTOT} + \beta_3\text{InPROD} + \beta_4\text{InGOV} + \beta_5\text{InM2} + \varepsilon_t \quad \text{(Eq. 4.1)}$$

Where:

RER is measured in terms of the amount of foreign currency per unit of domestic currency necessary to buy a basket of goods in the country. In other words, it is equivalent to the nominal exchange rate multiplied by the relative prices of a basket of goods in the two countries.

α: Constant term

OPEN: The degree of openness of the economy is traditionally viewed as the degree of trade liberalisation. The ratio of total trade (imports + exports) to the GDP is a commonly used measure of international trade liberalisation. A low level of openness or protection of the domestic market by restricting cross-border trade (e.g. import tariffs and non-tariff barriers) leads to higher domestic prices, thus leading to an appreciation of the RER. Removing the existing restrictions will depreciate the exchange rate because it reduces the price of non-tradables. Improved openness will also increase competition and bring prices more into line with world prices. In addition, improved openness tends to depreciate the RER. However, policies that promote exports could appreciate the RER if they improve the trade balance and if the resulting income effect dominates the price effect and increases the demand for and the price of non-tradables relative to tradables (Chowdhury, 2004).

TOT: This is defined as the ratio of the price index of a country's exports to its imports. The variable is used as a proxy for the international economy environment of a country Baffes, Elbadawi and O'Connell (1997). The price for export primary commodities is determined in world commodity markets and is subject to significant volatility that affects the terms of trade. Consider the effects of a worsening in the international terms of trade generated by an increase in the international price of imports. However, if the international price of imports is reduced, this can lead to an appreciation of the RER. As a result, an improvement in the terms of trade will positively affect the trade balance and thus lead to an appreciation of the RER.

PROD: The impact of the productivity differential on the real exchange rate is expected to follow the well-known Balassa-Samuelson doctrine, which states that relatively larger increases in productivity in the traded goods sector are associated with a real appreciation of the currency of a country (Balassa, 1964; Samuelson, 1964). If productivity grows faster in the tradable sector than in the non-tradable sector, this will put upward pressure on wages in the non-tradable sector and lead to a higher relative price of non-tradables. The result is a RER appreciation for the country, which would, therefore, be able to sustain the higher relative productivity gain without losing external competitiveness.

The Balassa-Samuelson relative productivity differential effect is proxied by the ratio of the domestic consumer price index (CPI) to the wholesale price index (WPI) relative to South Africa's trading partners. However, the use of these proxies is problematic because of South Africa's unlimited supply of labour. Furthermore, South Africa has a large unemployed and underemployed labour force while components of the CPI (such as utility prices) are still under the control of the municipal and provincial governments. For the above reasons, there may not be a strong Balassa-Samuelson effect in South Africa. Nevertheless, a rise in real GDP per capita is the one proxy for productivity gain in low-income countries (AIShehabi & Ding, 2008). Therefore, per capita real GDP is used as an explanatory variable in the model (Drine & Rault, 2003; Goh & Kim, 2006; Yang, Yin & He, 2007) with the expectation of a positive sign on this variable since Balassa (1964) found that per capita real GDP is positively correlated with real appreciation.

GOV: This measures the impact of government expenditure on RER and depends on its level and distribution between tradable and non-tradable goods. An increase in public debt is likely to cause a rise in government expenditure on non-tradable goods and induce an RER appreciation. However, if government expenditure falls more on tradables than non-tradables, this raises the demand for imports that result in a trade deficit, causing the ERER to depreciate. Hence, the effect of government expenditure is a priori indefinite on RERs Accordingly, Edwards (1989) found that increasing government expenditure induced an RER appreciation in 12 developing countries.

M2: Money supply (M2 to GDP) is a proxy for financial development Dufrenot and Yahuoe (2005). An increase in money supply leads to a rise in domestic aggregate demand for money, thus increasing the demand for imports and worsening the current account and causing the equilibrium long-run RER to depreciate.

Ɛ: Error term with mean zero and constant variance

After estimating Equation 4.1 and determining the short- and long-run determinants of RER, the RER misalignment was obtained by subtracting the equilibrium from the actual exchange rate. That is, the ERER was derived from the multiplication of the long-run estimated coefficients in Equation 4.1 by the permanent values of the RER fundamentals. The actual fundamental variables were not chosen because they may have exhibited a substantial degree of short-term 'noise', whereas the long-run ERER would not do so (Baffes *et al.*, 1999). Therefore, the analysis used the Hodrick-Prescott (HP) filter to smooth out the estimated

ERER. As such, the HP filter allowed the ‘long-run’, ‘permanent’ or ‘sustainable’ values of the economic fundamentals to be obtained by decomposing the time series into a trend and stationary component. Hence, the ERER equation can be depicted via the following model:

$$\mathrm{lne}_t = \beta F_t \qquad \text{(Eq. 4.2)}$$

Where:

e is the equilibrium exchange rate, F is the vector of permanent or sustainable values of fundamentals obtained using the HP filter, and β is the vector of long-run parameters of Equation 4.1.

Therefore, the degree of RER misalignment (RER_MIS) was calculated as a percentage difference between the RER and its computed equilibrium value. In Equation 4.3, a positive value of RER_MIS_t represents an overvaluation and negative undervaluation.

$$RER\_MIS_t = [\frac{RER_t}{ERER_t}] - 1 \qquad \text{(Eq. 4.3)}$$

4.2.2 Real exchange rate, real exchange rate misalignment and export performance

The main objective of this study was to ascertain the impact of RER misalignment on export performance. Exchange rate misalignment has been found to have an adverse impact on the volume of exports and export diversification (Elbadawi *et al*., 2012). Indeed, RER misalignment and particularly overvaluation harmed the competitiveness of exported goods. Following Elbadawi *et al*. (2012) and Nabli and Venganzones-Varoudakis (2002), the study assessed the export performance impact of RER misalignment using their model as a theoretical framework. Accordingly, in addition to the RER and its degree of misalignment and using small country assumptions, the study included the log terms of trade and log factor productivity of South Africa (estimated using GDP per capita) Drine & Rault, (2003). To capture the adverse impact of domestic absorption on export, the log share of government consumption to the GDP was included. On the basis of actual export volume data and covering the period 1994–2015, the following aggregate export supply was estimated (Diallo, 2011; Wondemu & Potts, 2016).

$$\mathrm{InEXGDP}_t = \alpha + \beta_1 \mathrm{InRER}_t + \beta_1 \mathrm{InRER\_MIS}_t + \beta_3 \mathrm{InTOT}_t + \beta_4 \mathrm{InPROD}_t + \beta_5 \mathrm{InGOV}_t + \varepsilon_t \qquad \text{(Eq. 4.4)}$$

Where RER_MIS is the calculated misalignment, EXGDP represents the ratio of exports to GDP at time t; TOT is the log of the terms of trade index; PROD is the factor productivity (estimated using GDP per capita); GOV is the log of government consumption to GDP; and Ɛ is the random error term.

To determine if the result was sensitive to aggregation using more disaggregated data, the study also estimated product level export functions. An export function was estimated for each of the following: manufactured goods; automotive and chemical products; mining products; products relating to machinery and transport equipment; and agricultural products. Accordingly, the following product level export models were estimated.

(I) Manufactured goods exports to GDP (MAN_EXGDP_t)

$$\mathrm{InMAN\_EXGDP_t} = \alpha + \beta_1 \mathrm{InRER_t} + \beta_1 \mathrm{InRER\_MIS_t} + \beta_3 \mathrm{InMAN\_PROD_t} + \mathcal{E}_t \quad \text{(Eq. 4.5)}$$

(II) Automotive and chemical exports to GDP (AC_EXGDP_t)

$$\mathrm{InAC\_EXGDP_t} = \alpha + \beta_1 \mathrm{InRER_t} + \beta_1 \mathrm{InRER\_MIS_t} + \beta_3 \mathrm{InAC\_PROD_t} + \mathcal{E}_t \quad \text{(Eq. 4.6)}$$

(III) Mining exports to GDP (MIN_EXGDP_t)

$$\mathrm{InMINING\_EXGDP_t} = \alpha + \beta_1 \mathrm{InRER_t} + \beta_1 \mathrm{InRER\_MIS_t} + \beta_3 \mathrm{InMINING\_PROD_t} + \mathcal{E}_t \quad \text{(Eq. 4.7)}$$

(IV) Machinery and transport equipment exports to GDP ($MACH\_EXGDP_t$)

$$\mathrm{InMACH\_EXGDP_t} = \alpha + \beta_1 \mathrm{InRER_t} + \beta_1 \mathrm{InRER\_MIS_t} + \beta_3 \mathrm{InMACH\_PROD_t} + \mathcal{E}_t \quad \text{(Eq. 4.8)}$$

(V) Agricultural exports to GDP ($AGRIC\_EXGDP_t$)

$$\mathrm{InAGRIC\_EXGDP_t} = \alpha + \beta_1 \mathrm{InRER_t} + \beta_1 \mathrm{InRER\_MIS_t} + \beta_3 \mathrm{InAGRIC\_PROD_t} + \mathcal{E}_t \quad \text{(Eq. 4.9)}$$

Regarding the sign, there is the consensus that an overvalued currency will always harm exports. The production (PROD) variable for each export function (equations 4.5 to 4.9) is expected to carry a positive sign since it is obtained from indices of physical volume production (represented as an index with 2010 being the base period).

Table 4.1: Definitions of variables

Variable Name	Symbol	Description	Data Source
Real exchange rate	RER	Real exchange rate is defined as the ratio of the domestic price index of the home country (South Africa) to the price index of its main trading partners.	SARB Online
Terms of trade	TOT	Terms of trade is defined as the ratio of the export unit value index to the import unit value index. It is the best proxy to present a country's international economy environment.	UNCTAD
Openness	OPEN	The degree of openness of the economy is traditionally viewed as the degree of trade liberalisation. The ratio of total trade (imports + exports) to the GDP is used to measure international trade	Stats SA
Government expenditure	GOV	Government expenditure refers to the purchase of goods and services, which include public consumption, public investment and transfer payments consisting of income transfers and capital transfers.	IMF and World Bank
Productivity	PROD	The relative productivity differential (technological progress) is well known as a proxy for the Balassa-Samuelson effect.	Stats SA, IMF, World Bank and OECD
Money supply	M2	Money supply (M2 to GDP) is a proxy for financial development.	SARB online
Gross domestic product	GDP	Gross domestic product is the monetary value of all the finished goods and services produced within the country in a specific time period.	Stats SA
Export	EX	Export is a function of international trade whereby goods produced in one country are shipped to another country for sale or trade. The sale of such goods adds to the producing nation's gross output.	Stats SA and WTO
Manufactured goods exports to GDP	MAN_EXGDP	This signifies the ratio of manufactured goods exports to GDP.	World Bank
Automotive and chemical exports to GDP	AC_EXGDP	This signifies the ratio of automotive and chemical exports to GDP.	World Bank
Mining exports to GDP	MIN_EXGDP	This signifies the ratio of mining exports to GDP.	World Bank
Machinery and transport equipment exports to GDP	MACH_EXGDP	This signifies the ratio of machinery and transport equipment exports to GDP.	World Bank
Agricultural exports to GDP	AGRIC_EXGDP	This signifies the ratio of agricultural exports to GDP.	World Bank
Misalignment	RER_MIS	Misalignment is obtained by subtracting the equilibrium real exchange rate from the observed real effective exchange rate.	Own calculation
Production	PROD	Production indicates production for each respective measure obtained from indices of physical volume production (represented as an index with 2010 being the base period).	Stats SA
Manufactured goods production	MAN_PROD	This demonstrates the index of manufactured goods production.	Stats SA
Automotive and chemical production	AC_PROD	This demonstrates the index of automotive and chemical production.	Stats SA
Mining production	MINING_PROD	This demonstrates the index of mining production.	Stats SA
Machinery and transport equipment production	MACH_PROD	This demonstrates the index of machinery and transport equipment production.	Stats SA
Agricultural production	AGRIC_PROD	This demonstrates the index of agricultural production.	Stats SA

4.3 DEFINITION OF VARIABLES

Real Exchange Rate (RER) = Consumer Price Index (CPI)-based trade-weighted RER, given as an index form, and the reference base is 2000=100. The CPI-based RER index was chosen because it is a frequently used indicator of the competitiveness of a country against its major trading partners. In the case of the index, an increase in the RER index represents an appreciation of the rand relative to its trading partners. The performance of the South African rand is usually assessed on how the currency performs against the US dollar. Apart from the rand to the US dollar exchange rate, the other most important exchange rates are the rand to the euro and the rand to the pound sterling (GBP). The US dollar is the most widely traded currency, and most international trade transactions are recorded in US dollars. Owing to the importance of the US dollar, this study uses the South African rand/US dollar (ZAR/USD) exchange rate to measure the misalignment.

Terms of Trade (TOT) = The ratio of the export unit value index to the import unit value index. It is the best proxy to present a country's international economy environment.

Openness (OPEN) = $\frac{\text{IMP+EXP}}{\text{GDP}}$, where IMP and EXP refer to importation and exportation respectively, and GDP refers to the gross domestic product of South Africa.

Government Expenditure (GOV) = $\frac{\text{Total government expenditure}}{\text{GDP}}$

Productivity (PROD) = Per capita real GDP is used as a proxy for the productivity variable. It is calculated as follows: $\text{Real GDP} = \frac{\text{Nominal GDP}}{\text{GDP deflator/100}}$ and $\text{Per capita real GDP} = \frac{\text{Real GDP}}{\text{Population}}$

Money Supply (M2) = M2 (i.e. money plus quasi-money) for South Africa is used.

Manufactured goods exports to GDP (MAN_EXGDP) $= \frac{\text{Manufactured goods exports}}{\text{GDP}}$

Automotive and chemical exports to GDP (AC_EXGDP) $= \frac{\text{Automotive \& chemical exports}}{\text{GDP}}$

Mining exports to GDP (MIN_EXGDP) $= \frac{\text{Mining exports}}{\text{GDP}}$

Machinery and transport equipment exports to GDP (MACH_EXGDP) $= \frac{\text{Machinery and transport equipment exports}}{\text{GDP}}$

Agricultural exports to GDP (AGRIC_EXGDP) $= \frac{\text{Agricultural exports}}{\text{GDP}}$

All variables are used in their natural log form. Logarithmically transforming variables in a regression model is a very common technique to manage situations in which a non-linear relationship exists between the independent and dependent variables. Using the logarithm of one or more variables instead of the un-logged form makes the effective relationship non-linear while still preserving the linear model. Logarithmic transformations are also a convenient means of transforming a highly skewed variable into one that is more approximately normal. EViews software was employed to generate the results (Quantitative Micro Software, 2009). Annual data were expressed in quarterly form using the linear-match last method where necessary.

4.4 ECONOMETRIC AND ESTIMATION ISSUES

Before examining the exchange rate misalignment, we checked the time series properties of the RER and its fundamentals, employing unit root and cointegration tests. In investigating the unit root properties of the time-series data, the variables were subjected to the Augmented Dickey-Fuller (ADF) unit root test. Since unit root tests are sensitive to lag length, we use the Akiake Information Criterion (AIC) to select the optimal lag length.

Having identified the order of integration of the variables, the next step is to test whether a long-run relationship exists between the variables, by using the cointegration test. In addition, the cointegration analysis allows for the identification of the long-run determinants of the RER. Hence, the study employs the Johansen (1995) and the Johansen and Juselius (1990) cointegration technique. Before undertaking these tests, the relevant order of the vector autoregressive (VAR) model is specified.

After establishing the long-run relationship between the variables, the cointegration equation can be used to identify the long-run coefficients of the RER, hence deriving the equilibrium RER. We normalised on the RER equation since this is where our focus lies. Having identified the long-run determinants of the RER, the next step is to use the Error Correction Model (ECM) to identify the short-run determinants of the RER. The ECM also allows for an examination of how fast the RER adjusts to changes in its underlying equilibrium.

After identifying the RER determinants, we proceed to compute the RER misalignment using equation (4.3). The actual RER series are generated through multiplication of the long-run parameters by sustainable values of the fundamentals obtained via the Hodrick-Prescott (HP) filter.

To examine the impact of RER misalignment on export performance, we estimated the models of exports, as represented in equations (4.4) to (4.9). Before estimating these equations, we checked the long-run relationship between the variables for each equation under investigation.

4.4.1 Testing for stationarity

Stationarity is defined as a quality of a process in which the statistical parameters (mean and standard deviation) of the process do not change with time (Challis & Kitney, 1991). The assumption of the classical regression model necessitates that both the dependent and the independent variables are stationary, and the errors have a zero mean and finite variance. According to Granger and Newbold (1974), the effects of non-stationarity include spurious regression, high R^2 and a low Durbin-Watson (DW) statistic. Some of the basic reasons why data must be tested for non-stationarity follow.

Firstly, the stationarity of a series can strongly influence the behaviour and properties of the series; for instance, persistence of shocks will be infinite for non-stationary series. Secondly, if two variables are trending over time, a regression of one could have a high R^2 even if the two are totally unrelated. This is known as spurious regressions. Thirdly, if the variables in the regression model are not stationary, then it can be proved that the standard assumptions for asymptotic analysis will be invalid. In other words, the usual ‘t-ratios’ will not follow a t-distribution, so it would be impossible to undertake hypothesis tests about the regression parameters validly (Bowerman & O'Connell, 1979).

To test for non-stationary time series formally, the most popular test is the ADF test devised by Dickey and Fuller (1979).

4.4.2 Augmented Dickey-Fuller test

The Dickey-Fuller (DF) test is named after the American statisticians, David Dickey and Wayne Fuller, who developed the test in 1979. The test is used to determine whether a unit root, a feature that if present can cause issues in statistical inference in an autoregressive model. The augmented test, the ADF test, modifies the work done by Dickey and Fuller (1979). The aim of the DF theory was to test the hypothesis that Ø = 1 in the following equation:

$$Y_t = \emptyset y_{t-1} + \mu_t \qquad \text{(Eq. 4.10)}$$

Testing for a unit root means the hypotheses are formulated as follows:

H_0: α = 0 (Which implies the series, Y_t is non-stationary or has at least one unit root)

H_1: $\alpha < 0$ (Meaning that Y_t is stationary)

where Y_t is the time series tested for the existence of a unit root and the lagged first-differenced terms are added to control for the possibility that the error term is auto-correlated

The rejection of the null hypothesis under these tests means that the series does not have a unit root problem.

The standard DF test estimates the following equation:

$$\Delta Y_t = \beta_1 + \beta_{2t} \varphi Y \mathcal{E}_{t-1} + \mu_t \qquad \text{(Eq. 4.11)}$$

Where:

Y_t is the relevant time series

Δ is a first difference operator

t is a linear trend

μ_t is the error term

The error term should satisfy the assumptions of normality, constant error variance and independent error terms. According to Gujarati (2004), if the error terms are not independent in Equation 4.11, results based on the DF tests will be biased.

The main weakness of the DF test is that it does not account for possible autocorrelation in the error process or term (μ_t). Clemente, Montanes and Reyes (1998) note that a well-known weakness of the Dickey-Fuller style unit root test with I(1) as a null hypothesis is its potential confusion of structural breaks in the series as evidence of non-stationarity.

Blungmart (2000) states that the weakness of the DF test is that it does account for possible autocorrelation in the error process, ε_t. If ε_t is autocorrelated, then the OLS estimates of coefficients will not be efficient and the t-ratios will be biased. In view of the above-mentioned weaknesses, the ADF test was postulated and is preferred to the DF test.

The presence of serial correlation in the residuals of the DF test biases the results (Mahadeva & Robinson, 2004). When using the DF test, the assumption is that the error terms μ_t are uncorrelated. However, in cases where the μ_t are correlated, Dickey and Fuller (1979) developed a test known as the ADF test to cater for the above-mentioned problem.

The DF test is only valid if there is no correlation of the error terms. If the time series is correlated at higher lags, the ADF test constructs a parameter correction for higher order correlation by adding the lag differences of the time series.

For any time series, Y_t, the ADF test equation can be written as follows:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \varepsilon_t \qquad \text{(Eq. 4.12)}$$

Testing for a unit root means to test, $H_0 : a = 0$, which implies the series, Y_t is nonstationary or has at least one unit root against the alternative $H_1 : a < 0$, implying that Y_t is stationary.

Where:

ε_t is a pure white noise error term and where $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2}), \Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc. According to Gujarati (2004), the number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term in (Eq. 4.12) is serially uncorrelated. In both the ADF and the DF tests, the test is whether $\delta = 0$ and whether the ADF test follows the same asymptotic distribution as the DF statistic so the same critical values can be used.

The calculated value of the ADF is then compared with the critical value. If the calculated value is greater than the critical value, the null hypothesis that the series have unit root is rejected, thus confirming that the series are stationary. In summary, Gujarati (2004) states that an important assumption of the DF test is that the error terms are independently and identically distributed. The ADF test adjusts the DF test to address possible serial correlation in the error terms by adding the lagged difference terms of the regressand.

4.4.3 Cointegration and vector error correction model

When dealing with time series data, there is need to check if the individual time series are either stationary or that they are co-integrated. If that is not the case, there is great chance of engaging in spurious (or nonsense) regression analysis (Gujarati, 2010). Alternatively, if they are integrated of different orders, the norm used to be to difference all the variables to be included in the regressions. The remaining cases of both I(1) or both I(2) variables is the case of interest here because an estimation of regressions based on first differenced variables could result in committing a 'sin' of misspecification and loss of long-run information embodied in the data. However, Harris (1995) shows that it is not necessary for all the variables in the model to have the same order of integration, especially if theory a priori suggests that such variables should be included. Thus, a combination of I(0), I(1) and I(2) can be tested for cointegration.

In most cases, if two variables of I(1) are linearly combined, their combination would also be I(1). More generally, if variables with differing orders of integration are combined, the combination would have an order of integration equal to the largest (Brooks, 2008). The exception to this rule is when the series are cointegrated. Brooks (2008) shows that a linear combination of I(1) variables will only be I(0), that is, stationary, if the variables are cointegrated. Although both variables may be trending upward in a stochastic fashion, they may be trending together. As Gujarati (2004) explains "the movement resembles two dancing partners, each following a random walk, whose random walks seem to be in unison". Therefore, synchrony is intuitively the idea behind cointegrated time series. In other words, cointegration means that despite being individually non-stationary, a linear combination of two or more time series can be stationary.

Cointegration has practical economic implications. Many time series are non-stationary individually but move together over time. That is, there are some influences in the series (e.g. market forces), which implies that the two series are bound by some relationship in the long run. Brooks (2008) shows that a cointegrating relationship may also be seen as a long-term or equilibrium phenomenon since it is possible that cointegrating variables may deviate from the relationship in the short run, but their association would return in the long run. This concept is particularly important in this study, which seeks to identify and distinguish the variables that have a long-term relationship with the RER.

The VAR model is a general framework used to describe the dynamic interrelationship among stationary variables. Dolado, Gonzalo and Marmol (1999) state that if the time series are not stationary, then the VAR framework needs to be modified to allow consistent estimation of the relationships among the series. The VECM is formulated if the variables in the VAR are cointegrated.

In order to justify the use of the VECM, there is need to test for cointegration. A VECM is intended to be used with non-stationary series that are known to be cointegrated. Brooks (2008) contends that the VECM has cointegration relations built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. Brooks (2008) also states that the cointegration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of estimated partial short-run adjustments. Thus, the presence of a cointegration relationship(s) forms the basis of the VECM specification.

There are several methods for testing cointegration, but two often stand above the rest, namely the Engle-Granger approach, which is residual-based, and the Johansen and Juselius (1990) technique, which is based on maximum likelihood estimation on a VAR system. Brooks (2008) argues that problems of the Engle-Granger approach include lack of power in unit root tests, simultaneous equation bias and the impossibility of performing hypothesis tests about the actual cointegration relationships.

In view of the above-mentioned shortfalls of the Engle-Granger approach, this study applied the VECM by Johansen (1995) and Johansen and Juselius (1990). The rationale behind this is that this approach applies maximum likelihood estimation to a VECM to determine the long-run and short-run determinants of the dependant variable in a model simultaneously. This approach also provides the speed of adjustment coefficient, which measures the speed at which the RER reverts to its equilibrium following a short-term shock to the system (Greene, 2000).

4.4.4 Johansen-Juselius procedure

If there is evidence of more than one cointegration relationship, the single-equation approaches may not be able to detect the additional cointegrating relationships. In order to examine cointegration in systems of equations, Johansen and Juselius (1990) JJ developed a procedure that overcame this limitation by being able to identify multiple linearly independent cointegration relationships. The advantage of this procedure is that it provides not only a cointegration test but also reveals the number of cointegrating vectors. The JJ procedure has become one of the standard testing procedures for investigating cointegration.

According to Greene (2000), the following steps are used when implementing the JJ procedure:

Step 1: Tests for the order of integration of the variables under examination – all the variables should be integrated of the same order before proceeding with the cointegration test.

Step 2: Involves setting the appropriate lag length of the model in addition to the estimation of the model and the determination of the rank of Π matrix which contains information about the long-run properties of the model.

Step 3: Involves the choice of the appropriate model in regard to the deterministic components in the multivariate system – an analysis of the normalised cointegrating vector(s) and speed of adjustment coefficients is conducted.

Step 4: Includes the determination of the number of cointegrating vectors – causality tests on the ECM to identify a structural model and to determine whether the estimated model is reasonable are performed in this last step.

After ascertaining the existence of cointegrating relationships, the VECM is estimated to test for the short-run dynamics. In the specification of a VAR model we start with a model of arbitrary lag length and then check the values of the AIC and/or SC criteria, as well as diagnostic test results regarding autocorrelation, normality and heteroskedasticity of the residuals. The study considers the following VAR of order P:

$$Y_t = A_1 Y_{t-1} + \cdots A_p Y_{t-p} + Bx_t + \varepsilon_t \qquad \text{(Eq. 4.13)}$$

Where:

Y_t is a vector of non-stationary I(1) variables; x_t is a d-vector of deterministic variables; and ε_t is a vector of innovations. The Johansen (1995) and Johansen and Juselius (1990) procedure of reduced rank regression is a multivariate regression model with a coefficient matrix with reduced rank. Its algorithm involves calculating eigenvectors and eigenvalues. For notational simplicity, we rewrite the VEC model as:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-1} + Bx_t + \varepsilon_t \qquad \text{(Eq. 4.14)}$$

Where:

$$\Pi = \sum_{i-1}^{p} A_i - I, \Gamma_i = -\sum_{j=i+1}^{p} A_j \qquad \text{(Eq. 4.15)}$$

Johansen-Juselius method is to estimate the Π matrix from an unrestricted VAR and to test whether the restrictions implied by the reduced rank of Π can be rejected (Green, 2007).

4.4.5 Impulse response analysis

Brooks (2008) stresses that impulse response analysis traces out the responsiveness of the dependent variable in the VAR to shocks to each of the other variables. In this study, impulse response analysis shows the sign, magnitude, and persistence of real and nominal shocks to the RER. If a series is stationary, then its movement should be inherently temporary, whereas movements in the non-stationary fundamentals are permanent. To obtain the “sustainable” or “permanent” components of the fundamentals, Baffes, Elbadawi and O’Connell (1997) discussed two methods that can be used, namely, the counterfactual method and the time series decomposition techniques. In practice, the second method is more widely used and the Hodrick-Prescott (HP) filter Hodrick & Prescott (1997). Brooks (2008) further states that impulse response analysis is applied on the VECM, and provided the system is stable, the shock should gradually die out. This study applied the generalised impulse response analysis.

4.4.6 Variance decomposition analysis

After performing the impulse response analysis, further information on the link between exports and exchange rate was found using variance decomposition analysis. Brooks (2008) explains that variance decomposition analysis provides the proportion of the movements in the dependent variable due to its own shocks versus shocks to other variables.

4.5 DIAGNOSTIC CHECKS

The diagnostic tests are very important in the analysis of the impact of RER misalignment on exports in South Africa because they validate the parameter estimation outcomes achieved by the estimated model. Diagnostic checks test the stochastic properties of the model such as residual autocorrelation, heteroscedasticity and normality. These diagnostic tests were applied in this study and are briefly discussed in the following section.

4.5.1 Heteroscedasticity

A serious problem associated with heteroscedasticity is that the standard errors are biased. Because the standard error is central to conducting significance tests and calculating confidence intervals, biased standard errors lead to incorrect conclusions about the significance of the regression coefficients. The OLS assumes that $V(\varepsilon_j) = \sigma^2$ for all j. That is, the variance of the error term is constant, a condition termed homoscedasticity. If the error terms do not have constant variance, they are said to be heteroscedastic. The current study employed the White heteroscedasticity test (White, 1980). According to Greene (2000), the White test computes the White (1980) general test for heteroscedasticity in the error distribution by regressing the squared residuals on all distinct regressors, cross-products and squares of regressors. The test statistic, a Lagrange multiplier (LM) measure, is distributed Chi-squared (*p*) under the null hypothesis of homoscedasticity. The null hypothesis for the White test is homoscedasticity. Failure to reject the null hypothesis indicates homoscedasticity. Rejection of the null hypothesis indicates heteroscedasticity.

4.5.2 Residual normality test

The assumption of normality is $\varepsilon_t \sim N(0, \sigma^2)$. The test is based on the null hypothesis that residuals are normally distributed. The null is that the skewness (α_3) and kurtosis (α_4) coefficients of the conditional distribution of Y_t (or, equivalently, of the distribution of ε_t) are 0 and 3 respectively:

H_0: $\alpha_3 = 0$, (if $\alpha_3 < 0$ then $f(Y_t / X_t)$ is skewed to the left)

$\alpha_4 = 3$ (if $\alpha_4 > 0$ then $f(Y_t / X_t)$ is leptokurtic)

The above assumptions can be tested using the Jarque-Bera (JB) test. The JB test follows the null hypothesis that the distribution of the series is symmetric. The null hypothesis of normality would be rejected if the residuals from the model were either significantly skewed or leptokurtic (or both).

4.6 CONCLUSION

To compute the RER misalignment, the study followed a reduced-form single equation model, employing the modified version of Edwards (1994). This model has been found to be suitable for developing countries such as South Africa. The study computed the ERER by estimating empirically a long-run RER equation (i.e. the single equation model that links RER to a set of fundamentals). Following Edwards (1989, 1994) and Elbadawi (1994), the set of fundamentals affecting the RER were specified as terms of trade, trade openness, government expenditure, productivity and money supply (M2). The study assessed the impact of RER misalignment on export performance using Elbadawi *et al*. (2012) and Nabli and Venganzones-Varoudakis (2002) model as a theoretical framework. To determine further if the result was sensitive to aggregation using more disaggregated data, the study estimated product-level export functions. One export function was estimated for each of the following: manufactured goods; automotive and chemical products; mining products; products relating to machinery and transport equipment; and agricultural products.

For the econometric estimation, the study employed the Johansen (1995) and the Johansen and Juselius (1990) cointegration technique. The advantage of the JJ procedure is that it provides not only a cointegration test but also reveals the number of cointegrating vectors. The JJ approach has become one of the standard testing procedures for investigating cointegration. In the investigation of the unit root properties of the time series data, the variables were subjected to the ADF test. Diagnostic checks, which test the stochastic properties of the model such as residual autocorrelation, heteroscedasticity and normality, were employed in the study.

Chapter Four outlined the methodology used in the study. The following chapter presents and discusses the empirical results.

CHAPTER FIVE

MAIN FINDINGS

5.1 INTRODUCTION

Results from this chapter explain the effects of RER misalignment on South African exports using quarterly data for the period 1994 to 2015. The chapter is structured as follows: the results of the unit root tests are presented and followed by the results of the cointegration tests and the estimates of the long-run ERER of the rand. This leads to the estimation of the VECM, which is followed by diagnostic checks and the impulse response and variance decomposition analyses. In addition, the chapter reports on how rand RER misalignment affects exports, which is the main thrust of the study.

5.2 UNIT ROOT/STATIONARITY TEST RESULTS

Before applying any empirical analysis, one should make sure that there is no spurious regression by checking the properties of series. We first check the time series properties by testing the stationarity of each variable. Two unit root tests were applied, Augmented Dicky-Fuller ADF and Phillips-Perron (PP) - to test the stationarity. If the time series variables are not stationary (have unit root), then the first difference should be taken for that variable to obtain stationary series.

In this regard, the results of Augmented Dickey-Fuller and the Phillips-Peron tests are presented in appendices B3 and B4, respectively.

The calculated value of ADF was compared with the critical value. If the calculated value is greater than the critical, we then reject the null hypothesis that the series have unit root, thus confirming that the series are stationary. The ADF tests variables in (a) intercepts, (b) trends and intercepts and (c) no trend and no intercept. For variables in levels, the test in intercepts revealed that all variables were not stationary. For the intercept, all the data in levels was not stationary as reflected by the non-rejection of the null hypothesis at both 1% and 5 % significance levels. All the differenced variables were stationary at 1% significant level; hence the null hypothesis of unit root is rejected. For the test under trend and intercept and trend and no intercept data series were all non-stationary in levels but became stationary at 1% significant level when first differenced.

Phillips-Peron test according to Brooks (2008) is similar to ADF tests, but it incorporates an automatic correction to the DF procedure to allow for auto correlated residuals. For variables in levels, the test in intercepts revealed that none of the variables were stationary. All differenced variables on intercept were stationary at 1% significance level. On trend and intercept all variables were non-stationary in levels but all variables on trend and intercept were stationary at 1% significance level when first differenced. For the test under no trend and no intercept, all variables in levels were non-stationary. When first differenced, all the variables were stationary at 1% significance. Both methods used to test for stationarity significantly revealed that the data series were non-stationary in levels and stationary when first differenced. Therefore, the series are integrated of the same order I(1).

Having identified the order of integration of the variables, the next step is to test whether a long-run relationship exists between the variables, by using the cointegration test.

5.3 TESTS FOR COINTEGRATION

Once the variables have been established as I(1) integrated processes, tests for cointegration are undertaken to establish a long-run equilibrium relationship among the variables. The purpose of the cointegration test is to determine whether a group of non-stationary series are cointegrated or not. The specification of a VECM requires the selection of a lag length for the VAR model, which is followed by the selection of the number of cointegration vectors and the appropriate deterministic specification. In addition, the cointegration approach allows researchers to integrate the long-run and short-run relationship between variables within a unified framework (Andren, 2007). The study employs the Johansen-Juselius cointegration test. Before undertaking these tests, the relevant order of the vector autoregressive (VAR) model was specified.

5.3.1 Selecting the lag length of the vector autoregression model

The information criteria approach was applied in this study as a direction to choose the lag order. It is a requirement of the JJ technique to show an indication of the lag order and the deterministic trend assumption of the VAR model.

Given that the results of the JJ procedure are sensitive to lag length and the assumption regarding the deterministic trend of the cointegrating equation and the VAR, it is important to ensure appropriate lag length and trend assumption for each model.

For the RER Misalignment model, the AIC chose an optimal VAR lag length of 2. For the misalignment and exports model, an optimal VAR lag length of 5 was chosen. For the misalignment and manufactured goods exports model, an optimal VAR lag length of 5 was selected. For the misalignment and automotive and chemical exports model, an optimal VAR lag length of 5 was chosen. For the misalignment and mining exports model, the AIC chose an optimal VAR lag length of 3. For the misalignment and machinery and transport equipment exports model, the AIC chose an optimal VAR lag length of 3. For the misalignment and agricultural exports model, an optimal VAR lag length of 5 was selected. The results are presented in appendices B5 to B11.

The JJ cointegration test employed the information criteria approach and was conducted using the specified lag for each of the VAR models.

5.3.2 Johansen cointegration tests

The results of trace and maximum eigenvalue statistics obtained from the Johansen cointegration test using the assumption of a linear deterministic trend in the data are presented in Table 5.1.

The null hypothesis of the trace test is that the number of cointegrating equations is greater than the number of variables involved. If the test statistic is smaller than the critical values of the trace tests, the null hypothesis is not rejected. The maximum eigenvalue test was conducted on a null hypothesis of the number of cointegration equations (r) against the alternative hypothesis of the number of cointegration equations plus one (r +1). If the test statistic is smaller than the critical values of the maximum eigenvalue test, the null hypothesis is not rejected.

For situations where the two tests show contrasting results, the Pantula principle was applied, i.e. when one of the tests (either Trace or Max Eigenvalue) fails to reject the null hypothesis of no cointegration. That means one keeps rejecting the null hypothesis of no cointegration until you cannot anymore and the test that first fails to reject the null is the test that is used. For all the models, it is assumed that the series follows a linear trend in levels and therefore the Π matrix was restricted by including an intercept term in the cointegrating equation and in the VAR.

Table 5.1: Johansen cointegration tests

Model		Trace Statistic						Max-Eigen Statistic					
	H0	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4	r ≤ 5	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4	r ≤ 5
	H1	r = 1	r = 2	r = 3	r = 4	r = 5	r = 6	r = 1	r = 2	r = 3	r = 4	r = 5	r = 6
RER Misalignment		154.115*	95.670*	67.051*	40.839*	18.839*	3.116	58.444*	28.619	26.211	21.999*	15.722*	3.116
		(95.753)	(69.818)	(47.856)	(29.797)	(15.494)	(3.841)	(40.077)	(33.876)	(27.584)	(21.131)	(14.264)	(3.841)
Misalignment and Exports		115.526*	75.966*	43.714	23.261	8.355	2.796	39.560	32.251	20.453	14.905	5.559	2.796
		(95.753)	(69.818)	(47.856)	(29.797)	(15.494)	(3.841)	(40.077)	(33.876)	(27.584)	(21.131)	(14.264)	(3.841)
Misalignment and Manufactured goods exports		56.863*	27.834*	13.118*				29.029*	14.715*	13.118*			
		(29.797)	(15.494)	(3.841)				(21.131)	(14.264)	(3.841)			
Misalignment and Automotive & Chemical exports		77.131*	26.517*	8.675*				50.614*	17.842*	8.675*			
		(29.797)	(15.494)	(3.841)				(21.131)	(14.264)	(3.841)			
Misalignment and Mining exports		54.333*	26.901*	9.226*				27.431*	17.674*	9.226*			
		(29.797)	(15.494)	(3.841)				(21.131)	(14.264)	(3.841)			
Misalignment and Machinery and transport equipment exports		94.008*	42.832*	12.818*				51.176*	30.014*	12.818*			
		(29.797)	(15.494)	(3.841)				(21.131)	(14.264)	(3.841)			
Misalignment and Agricultural exports		51.069*	22.753*	5.887*				28.315*	16.865*	5.887*			
		(29.797)	(15.494)	(3.841)				(21.131)	(14.264)	(3.841)			

Note:

* indicates the rejection of the null hypothesis at the 5% level

r denotes the number of cointegrating vectors

The critical values (at 5%) are in parentheses. For all the models, it is assumed that the series follows a linear trend in first difference and, therefore, the Π matrix was restricted by including an intercept term in the cointegrating equation and in the VAR.

(a) RER Misalignment equation

For this equation, the null of no cointegration (r = 0) was rejected by both the trace and the max-eigen tests. The trace (test) statistic of 154.115 is greater than the 5% critical value of approximately 95.753. The maximum eigenvalue test of 58.444 is greater than the 5% critical value of approximately 40.077. The results of the JJ cointegration tests indicate that under the trace statistics there are five cointegration relations between the RER and its determinants. On the other hand, the maximum eigenvalue statistic shows one cointegration relationships. For consistency, therefore, we conclude that there is a long-run relationship between the RER and its major fundamentals. Since variables can have either short- or long-run effects, a VECM was used to disaggregate these effects.

(b) Misalignment and total exports equation

For this equation, the null of no cointegration (r = 0) was rejected only by the trace test.

The results of the JJ cointegration tests indicate that under the trace statistics there are two cointegration relations between misalignment and total exports. On the other hand, the maximum eigenvalue statistic shows no cointegration relationships. The Pantula principle was applied, i.e. when one of the tests (either Trace or Max Eigenvalue) fails to reject the null hypothesis of no cointegration. Therefore, it can be concluded that there is one significant long-run relationship between the given variables (using the trace test). Since variables can have either short- or long-run effects, a VECM was used to disaggregate these effects.

(c) Misalignment and manufactured goods exports

For this equation, the null of no cointegration (r = 0) was rejected by both the trace and the max-eigen tests. The results of the JJ cointegration tests indicate that under the trace statistics there are three cointegration relations between the misalignment and manufactured goods exports. On the other hand, the maximum eigenvalue statistic also shows three cointegration relationships. Therefore, it can be concluded that there is one significant long-run relationship between the given variables. Since variables can have either short- or long-run effects, a VECM was used to disaggregate these effects.

(d) Misalignment and automotive and chemical exports

The results of the JJ cointegration tests indicate that under the trace statistics there are three cointegration relations between the misalignment and automotive and chemical exports. On the other hand, the maximum eigenvalue statistic also shows three cointegration relationships. For this equation, the null of no cointegration was not rejected in both tests, thus a VECM was used to disaggregate these effects.

(e) Misalignment and mining exports

For this equation, the null of no cointegration was not rejected in both tests. The results of the JJ cointegration tests indicate that under the trace statistics there are three cointegration relations between the misalignment and mining exports. On the other hand, the maximum eigenvalue statistic also shows three cointegration relationships. This suggests both long-run relationships and short-run dynamics between variables. Thus, a VECM was used to disaggregate these effects.

(f) Misalignment and machinery and transport equipment exports

For this equation, the null of no cointegration was not rejected in both tests. The results of the JJ cointegration tests indicate that under the trace statistics there are three cointegration relations between the misalignment and machinery and transport equipment exports. On the other hand, the maximum eigenvalue statistic also shows three cointegration relationships. This suggests both long-run relationships and short-run dynamics. Thus, a VECM was used to disaggregate these effects.

(g) Misalignment and agricultural exports

For this equation, the null of no cointegration was not rejected in either of the tests. The results of the JJ cointegration tests indicate that under the trace statistics there are three cointegration relations between the misalignment and agricultural exports. On the other hand, the maximum eigenvalue statistic also shows three cointegration relationships. This suggests both long-run relationships and short-run dynamics. Thus, a VECM was used to disaggregate these effects.

Table 5.1 indicates the existence of cointegration in the models. It is appropriate to estimate the restricted VAR model that restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationship, namely the VECM.

5.4 ESTIMATING LONG-RUN EQUILIBRIUM RER OF THE RAND

After establishing the long-run relationship between the variables, the cointegration equation can be used to identify the long run coefficients of the RER, hence deriving the equilibrium RER. The results of the long run cointegrating vector coefficients of RER are presented in Table 5.2.

Table 5.2: Results of the long run cointegration equation: RER

Variable	Coefficient	Standard error	t-statistic
Constant	-18.26225		
LNRER	1.00000		
LNOPEN	-4.14497	0.44899	9.23168
LNTOT	-1.07805	0.59427	1.81407
LNPROD	1.50381	0.86472	-1.73906
LNGOV	3.46878	0.69631	4.98163
LNM2	-0.51570	0.10986	-4.69386

The long-run equilibrium equation can be shown as follows:

$$LNRER^{LR} = -18.262 - 4.145LNOPEN - 1.078LNTOT + 1.504LNPROD + 3.469LNGOV - 0.516LNM \quad \text{(Eq. 5.5)}$$

Equation 5.5 is referred to as the ERER (equilibrium real exchange rate). It can be seen from Equation 5.5 that all parameters of the cointegrating vector are statistically significant at the 95% significance level and are correctly signed.

The coefficients of the economic fundamentals that carry the expected signs are acceptable and statistically significant at the conventional level. As discussed in the theoretical section, the expectations that the degree of openness and money supply (M2) have negative effects on the ERER while government expenditure, terms of trade and productivity have positive effects on the RER are supported empirically. This finding supports many empirical studies (e.g., Baffes et al., 1997; Aguirre & Calderon, 2006; Elbadawi et al., 2012).

The outputs of the equation indicate that an increase in trade openness is associated with a depreciation of the RER by 4.15%. The estimate for GOV suggests that a 1% increase in government expenditure would increase the RER by 3.47% in the long run. Moreover, a one unit increase in the productivity differential leads to a 1.5% appreciation in the RER.

Furthermore, a 1% increase in the money supply (M2) causes a 0.51% depreciation in the currency.

Having identified the long-run determinants of the RER, the next step is to use the Error Correction Model (ECM) to identify the short-run determinants of the RER. The ECM also allows for an examination of how fast the RER adjusts to changes in its underlying equilibrium. The results of the ECM analysis are presented in Table 5.3.

Table 5.3: Results of the Error Correction Model: RER

Variable	Coefficient	Standard error	t-statistic
Error Correction	-0.23220	0.04656	-4.98662
D(LNRER)	0.06390	0.09738	0.65620
D(LNOPEN)	0.17524	0.44198	0.39650
D(LNTOT)	-0.49422	0.76872	-0.64291
D(LNPROD)	-1.74190	1.77582	-0.98090
D(LNGOV)	0.41032	0.66811	0.61415
D(LNM2)	0.87312	0.35069	2.48973

In Table 5.3, the coefficient of D(LNRER) of 0.0639 shows that the speed of adjustment is approximately 6.4 percent. This means that if there is a deviation from equilibrium, only 6.4 percent is corrected in one quarter as the variable moves towards restoring equilibrium. The coefficient of lagged dependent variable is positive, indicating that the short-run dynamics of the RER is positively influenced by the previous situation of the RER.

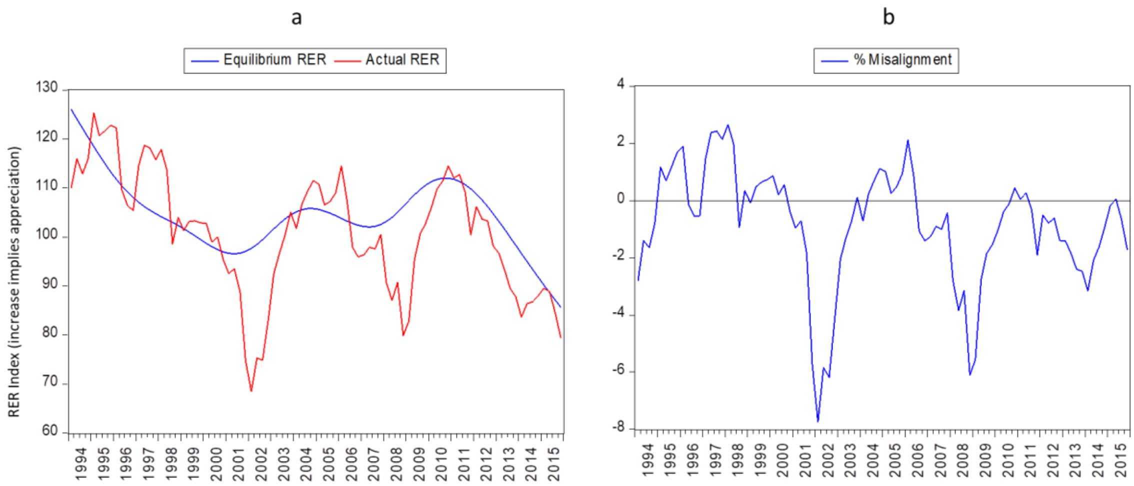
After identifying the RER determinants, we proceed to compute the RER misalignment using equation (4.3). The actual RER series are generated through multiplication of the long run parameters of Table 5.2 by sustainable values of the fundamentals obtained via the HP filter.

5.4.1 Examining the extent of rand exchange rate misalignments

The level of the ERER is defined as the trend part of the ERER cointegrating relationships. Following Baffes *et al*. (1999) and Wang, Hui and Soofi (2004), the trend is extracted using the HP filter. Misalignment in the exchange rate, defined as the deviation of the actual RER from the HP-Filtered equilibrium level is, therefore, estimated as follows:

$$\mathrm{RER\_MIS}_t = \mathrm{RER}_t - \mathrm{RER\_HP}_t \qquad \text{(Eq. 5.6)}$$

Figure 5.1(a) shows the actual RER and the equilibrium (HP-Filtered) RER over the period 1994Q1–2015Q4, with the extent of misalignment (expressed as the percentage deviation of the actual RER from the HP-Filtered estimated equilibrium RER) presented in Figure 5.1(b).



Note: Periods of positive and negative misalignment

Figure 5.1: Actual real exchange rate versus equilibrium real exchange rate and misalignment: 1994Q1–2015Q4

As shown in Figure 5.1, RER misalignment of the rand ranged between 7.75% and 2.66% from 1994Q1 to 2015Q4. Accordingly, peak periods of positive misalignment (i.e. greater than 2% misalignments) were between 1997 and 1998Q1. Misalignment greater than 2% was also recorded in 2006Q1, while periods of noticeable negative misalignment (i.e. more than -2% misalignments) were recorded in the years 2002, 2008, 2013 and 2014. The extent of the negative misalignment is rather modest, reaching a maximum of -7.75% in 2002Q1.

The data clearly show that when a gap between the actual RER and its equilibrium level arises, the actual RER will tend to converge to its equilibrium level. Depending on the causes of the gap, the adjustment requires that the RER either moves progressively towards a new equilibrium level or returns from its temporary deviation to the original equilibrium value (MacDonald & Ricci, 2003). The misalignment graph indicates that after some time of deviation (positive/negative), the South African rand usually reverts to its equilibrium level. The RER misalignment has been established as demonstrated and its effect on export performance is assessed in the following section.

5.5 EFFECTS OF MISALIGNMENT ON EXPORTS

As mentioned before, this study estimated aggregate exports using the export to GDP ratio (1994Q1–2015Q4) and the volume index of exports in five key sectors, namely manufactured goods exports, automotive and chemical exports, mining exports, machinery and transport equipment exports and agricultural exports.

Before estimating these equations, we checked the log run relationship between the variables for each equation under investigation. The results of cointegration are presented in Tables 5.1. We estimated the models using both cointegration and VECM techniques. The results of the impact of RER misalignment for each export model is detailed below.

5.5.1 RER misalignment and total exports

The results of the long run effects of real exchange rate misalignment on export performance are presented in Table 5.4.

Table 5.4: RER misalignment and total exports (long-run estimated equation results of cointegrating coefficients)

Variable	Coefficient	Standard error	t-statistic
Constant	5.321		
LNEXGDP	1.000		
LNRER	0.879	0.135	6.483
LNTOT	0.050	0.227	0.222
LNPROD	-0.876	0.075	-11.676
LNGOV	-1.178	0.222	-5.288
RER misalignment	-4.121	0.620	-6.638

The results in Table 5.4 show that all the variables are statistically significant, except terms of trade (LNTOT). These results indicate that total exports are positively influenced by the RER. The long-run analysis also indicates that exports are affected negatively by productivity and government expenditure. This implies that the domestic economic environment plays a significant role in encouraging/discouraging South African exports in the long run. The impact of RER misalignment on exports is found to be negative and significant, implying that misalignment of the RER discourages the performances of exports in South Africa. The study shows that RER misalignment decreases exports by about 4.1%. This result confirms many empirical studies on RER misalignment and export performance (Nabli & Venganzones-Varoudakis, 2002; Elbadawi *et al*., 2012). This finding implies that exchange rate misalignment has a detrimental impact on export performance.

Table 5.5: Results of the ECM: RER misalignment and total exports

Variable	Coefficient	Standard error	t-statistic
Error Correction	-0.157	0.048	-3.295
D(LNEXGDP)	0.651	0.152	4.294
D(LNRER)	4.169	1.826	2.283
D(LNTOT)	-0.246	0.365	-0.674
D(LNPROD)	0.247	1.019	0.242
D(LNGOV)	0.329	0.353	0.931
D(RER misalignment)	-19.028	8.418	-2.260

The results of the ECM in Table 5.5 reveal that total exports are positively influenced by the RER, productivity, and government expenditure. The sign of RER misalignment is negative and significant, confirming the long-run analysis.

5.5.2 Real exchange rate misalignment and manufactured goods exports

The results of the long run effects of real exchange rate misalignment on manufactured goods exports are presented in Table 5.6

Table 5.6: RER misalignment and manufactured goods exports (long-run estimated equation results)

Variable	Coefficient	Standard error	t-statistic
Constant	-5.764		
LNMAN_EXGDP	1.000		
LNRER	-0.022	0.192	-0.115
LNMAN_PROD	0.793	0.131	6.018
RER misalignment	-3.234	1.142	-2.831

The results suggest that the share of manufactured goods exports to the GDP is negatively affected by RER misalignment, with a decrease of about 3.2%. The results also show that the share of exports is determined by factors that affect the level of production. Real exchange rate misalignment discourages manufactured exports.

Table 5.7: Results of the ECM: RER misalignment and manufactured goods exports

Variable	Coefficient	Standard error	t-statistic
Error Correction	-0.125	0.025	-4.923
D(LNMAN_EXGDP)	0.632	0.107	5.887
D(LNRER)	4.228	1.636	2.583
D(LNMAN_PROD(-1))	0.072	0.024	2.976
D(RER misalignment)	-19.526	7.567	-2.580

The results of the ECM in Table 5.7 reveal that manufactured goods exports are negatively affected by RER misalignment, confirming the long-run analysis.

5.5.3 Real exchange rate misalignment and automotive and chemical exports

The results of the long run effects of real exchange rate misalignment on automotive and chemical exports are presented in Table 5.8.

Table 5.8: RER misalignment and automotive and chemical exports (long-run estimated equation results)

Variable	Coefficient	Standard error	t-statistic
Constant	-19.001		
LNAC_EXGDP	1.000		
LNRER	-4.624	2.465	-1.875
LNAC_PROD	8.145	1.118	7.287
RER misalignment	-21.092	14.876	-1.418

The share of automotive and chemical exports to the GDP is adversely affected by both RER and misalignment. The periods when the RER is in misalignment caused automotive and chemical exports to decrease by as much as 21%. This means that the presence of RER misalignment significantly reduces South Africa's automotive and chemical exports.

Table 5.9: Results of the ECM: RER misalignment and automotive and chemical exports

Variable	Coefficient	Standard error	t-statistic
Error Correction	0.0009	0.003	0.251
D(LNAC_EXGDP)	0.840	0.116	7.204
D(LNRER)	-0.537	2.863	-0.187
D(LNAC_PROD)	-0.004	0.028	-0.148
D(RER misalignment)	2.312	13.210	0.175

In the short run, the results of the ECM in Table 5.9 show that automotive and chemical exports are positively affected by RER misalignment.

5.5.4 Real exchange rate misalignment and mining exports

The results of the long run effects of real exchange rate misalignment on mining exports are presented in Table 5.10.

Table 5.10: RER misalignment and mining exports (long-run estimated equation results)

Variable	Coefficient	Standard error	t-statistic
Constant	16.287		
LNMINING_EXGDP	1.000		
LNRER	-0.528	0.788	-0.669
LNMINING_PROD	-3.410	1.093	-3.120
RER misalignment	21.709	5.237	4.145

The share of mining exports to the GDP appears to benefit positively from RER misalignment, showing a boost of as much as 21%. This finding is particularly important for South Africa given the high share of commodities in the country's total goods exports. Although mining companies are global price takers, it is expected that the rand depreciation should increase their profitability since some of the costs are local. This increase in profitability should raise mining output, resulting in mining exports benefitting from the depreciation. However, several reasons such as technology and ease of hiring labour may affect the rate of output growth and hence, exports.

Table 5.11: Results of the ECM: RER misalignment and mining exports

Variable	Coefficient	Standard error	t-statistic
Error Correction	-0.018	0.009	-2.101
D(LNMINING_EXGDP)	0.769	0.115	6.679
D(LNRER)	-3.466	1.761	-1.967
D(LNMINING_PROD)	-0.058	0.052	-1.120
D(RER misalignment)	16.432	8.115	2.024

The results of the ECM in Table 5.11 reveal that mining goods exports are positively affected by RER misalignment, confirming the long-run analysis.

5.5.5 Real exchange rate misalignment and machinery and transport equipment exports

The results of the long run effects of real exchange rate misalignment on machinery and transport equipment exports are presented in Table 5.12.

Table 5.12: RER misalignment and machinery and transport equipment exports (long-run estimated equation results)

Variable	Coefficient	Standard error	t-statistic
Constant	-2.769		
LNMACH_EXGDP	1.000		
LNRER	1.504	0.231	6.503
LNMACH_PROD	-1.310	0.073	-17.835
RER misalignment	-1.571	1.501	-1.046

The results show that the share of machinery and transport equipment exports to GDP is marginally affected by RER misalignment. This also suggests that South Africa has relatively low exports in this sector.

Table 5.13: Results of the ECM: RER misalignment and machinery and transport equipment exports

Variable	Coefficient	Standard error	t-statistic
Error Correction	0.005	0.018	0.267
D(LNMACH_EXGDP)	0.826	0.121	6.834
D(LNRER)	-1.124	1.539	-0.730
D(LNMACH_PROD)	0.002	0.018	0.143
D(RER misalignment)	5.519	7.077	0.779

In the short run, the results of the ECM in Table 5.13 show that machinery and transport equipment exports are positively affected by RER misalignment.

5.5.6 Real exchange rate misalignment and agricultural exports

The results of the long run effects of real exchange rate misalignment on agricultural exports are presented in Table 5.14.

Table 5.14: RER misalignment and agricultural exports (long-run estimated equation results)

Variable	Coefficient	Standard error	t-statistic
Constant	-5.684		
LNAGRIC_EXGDP	1.000		
LNRER	0.478	0.379	1.258
LNAGRIC_PROD	0.623	0.253	2.459
RER misalignment	11.113	2.709	4.101

The share of South Africa's agricultural exports to GDP is positively affected by RER misalignment (about 11.1%). This has powered exports to other African countries and Europe, which were led by competitive industries such as beverages, cereals, fruits, sugar and vegetables.

Table 5.15: Results of the ECM: RER misalignment and agricultural exports

Variable	Coefficient	Standard error	t-statistic
Error Correction	-0.021	0.021	-0.974
D(LNAGRIC_EXGDP)	0.795	0.115	6.899
D(LNRER)	0.841	2.094	0.402
D(LNAGRIC_PROD)	-0.021	0.149	-0.141
D(RER misalignment)	-3.538	9.701	-0.364

In the short run, the results of the ECM in Table 5.15 show that agricultural exports are negatively affected by RER misalignment.

5.6 DIAGNOSTIC CHECKS

The models were subjected to thorough diagnostics tests. The models were tested for normality, serial correlation, autoregressive conditional heteroscedasticity and stability. Diagnostic checks were performed in order to validate the parameter evaluation of the outcomes achieved by the model. Any problems in the residuals from the estimated model would make the model inefficient, and the estimated parameters would be biased. For the purposes of this study, the VAR models were subjected to diagnostic checks. These diagnostic checks were based on the null hypothesis that there is no serial correlation for the LM test; there is normality for the JB test; and there is no heteroscedasticity for the White heteroscedasticity test.

The results for the diagnostic checks for serial correlation and heteroscedasticity show that the data are fairly well behaved. Results indicate the presence of non-normal residuals (appendices B9 to B24).

5.6.1 Impulse response analysis

Impulse response analysis traces out the responsiveness of the dependent variables in a VAR model to shocks from each of the variables (Brooks, 2008). The ordering of the variables is dictated by the need to have meaning impulse response functions from the VECM. The VECM orthogonalisation is the Cholesky - dof adjusted, which is a lower triangular. Results of the impulse response analysis for each model are presented for the initial ten quarters below.

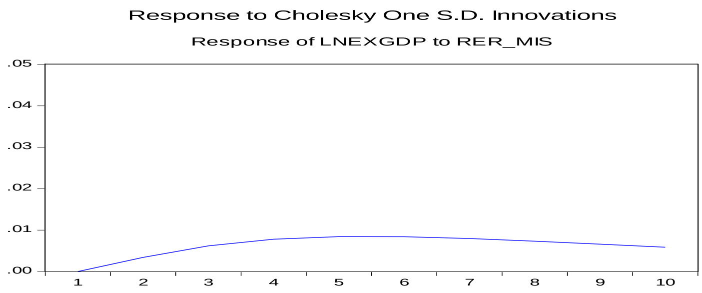


Figure 5.2: Impulse response of total exports to misalignment

Figure 5.2 plots the impulse response of total exports to RER misalignment. The results show that RER misalignment causes total exports to increase initially in the short run (five periods) before they start declining, confirming that RER misalignment is bad for exports in the long run.

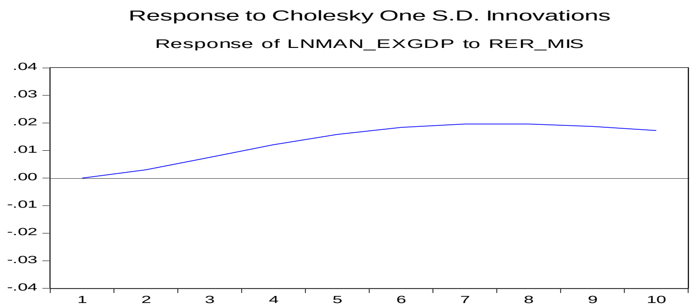


Figure 5.3: Impulse response of manufactured goods exports to misalignment

Figure 5.3 shows the impulse response of manufactured goods exports to RER misalignment. Initially, a positive shock on RER misalignment will lead the manufactured goods exports to go up by the shock amount – until Period 7. As time passes, the effects of a shock in RER misalignment start to decay, albeit at a very slow pace. This indicates that manufactured goods exports tend to benefit from RER misalignment over long periods.

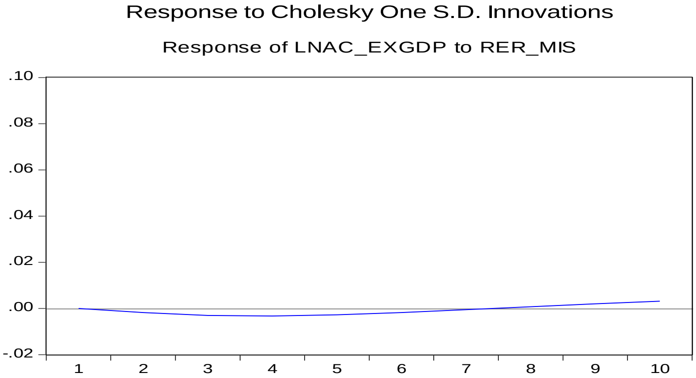


Figure 5.4: Impulse response of automotive and chemical exports to misalignment

Figure 5.4 shows the impulse response of automotive and chemical exports to RER misalignment. The impulse response shows that a shock to RER misalignment causes automotive and chemical exports to decrease within a short time, but the effect of such a shock is mean reverting to 0.

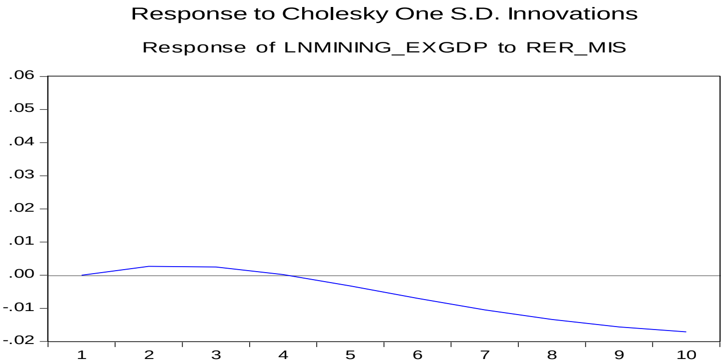


Figure 5.5: Impulse response of mining exports to misalignment

Figure 5.5 shows the impulse response of mining exports to RER misalignment. An examination of the impulse response records indicates a positive response for the first four quarters only. Thereafter, the response is negative.

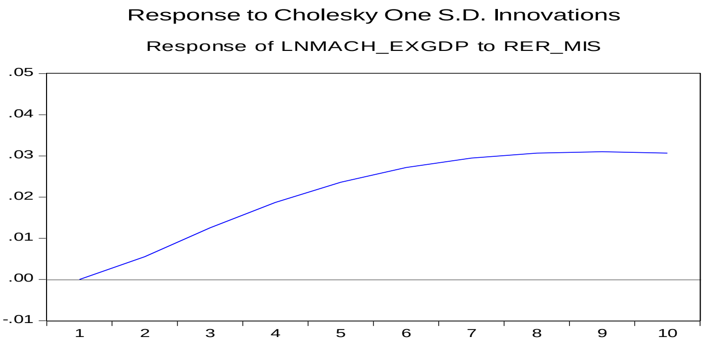


Figure 5.6: Impulse response of machinery and transport equipment exports to misalignment

Figure 5.6 shows the impulse response of machinery and transport equipment exports to RER misalignment. A positive shock on RER misalignment results in machinery and transport equipment exports increasing for a long period without the shock dying out after a short time.

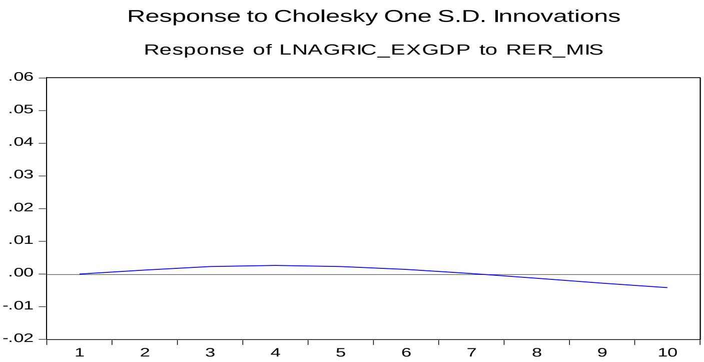


Figure 5.7: Impulse response of agricultural exports to misalignment

Figure 5.7 shows the impulse response of agricultural exports to RER misalignment. The response of agricultural exports to RER misalignment is positive for approximately six periods, after which the shock dies out and the response eventually becomes negative.

5.6.2 Variance decomposition analysis

Variance decomposition analysis provides a means of determining the relative importance of shocks in explaining variations in the variable of interest (Andren, 2007). In addition, variance decomposition provides a way of determining the relative importance of shocks to fundamentals in explaining variations in RER misalignment and exports. The method also provides information about the relative relevance of each random innovation in affecting the variables in the VAR model. The results of the variance decomposition analysis for each model over a ten-quarter horizon are presented below.

Table 5.16: Variance decomposition of misalignment and total exports

Period	S.E.	LNEXGDP	RER_MIS
1	0.017151	100	0
2	0.03441	99.025257	0.974742
3	0.051883	98.144943	1.855056
4	0.068387	97.631911	2.368088
5	0.083303	97.382846	2.617153
6	0.096383	97.289102	2.710897
7	0.1076	97.279195	2.720804
8	0.117055	97.310997	2.689002
9	0.124918	97.36077	2.639229
10	0.131383	97.415586	2.584413

Table 5.16 presents the forecast variance decomposition to assess the importance of RER misalignment in accounting for variation in total exports. The results show that in the short run, RER misalignment accounts for small variations in total exports (less than 2%). Over time, the effect of RER misalignment increases. These results can be interpreted as RER misalignment negatively affects South African exports in the long run.

Table 5.17: Variance decomposition of misalignment and manufactured goods exports

Period	S.E.	LNMAN_EXGDP	LNMAN_PROD	RER_MIS
1	0.018103	100	0	0
2	0.034934	98.979302	0.267314	0.753382
3	0.051167	95.505509	1.971204	2.523285
4	0.065859	90.425585	4.675745	4.898669
5	0.078791	84.369575	8.154823	7.4756
6	0.089855	78.168389	11.893612	9.937998
7	0.099105	72.37373	15.541969	12.0843
8	0.106648	67.339771	18.831785	13.828442
9	0.112651	63.202778	21.63077	15.16645
10	0.117317	59.954563	23.90003	16.145405

Table 5.17 presents the forecast variance decomposition to assess the importance of RER misalignment in accounting for variation in manufactured goods exports. The results reveal that manufactured goods exports were 100% explained by the shock in the first quarter, but this steadily reduced to 60% in the long run (10th quarter), with manufacturing production accounting for 24% and RER misalignment for 16%.

Table 5.18: Variance decomposition of misalignment and automotive and chemical exports

Period	S.E.	LNAC_EXGDP	LNAC_PROD	RER_MIS
1	0.030333	100	0	0
2	0.061835	99.895558	0.02604	0.0784
3	0.094337	99.850815	0.012651	0.136533
4	0.125964	99.836255	0.02029	0.143454
5	0.155711	99.823542	0.051261	0.125195
6	0.183066	99.808457	0.091881	0.099661
7	0.207806	99.782381	0.139671	0.077946
8	0.229879	99.746883	0.188235	0.064881
9	0.249341	99.70249	0.235717	0.061792
10	0.266317	99.65188	0.279969	0.06815

Table 5.18 presents the forecast variance decomposition to assess the importance of RER misalignment in accounting for variation in automotive and chemical exports. Real exchange rate misalignment has a minimal effect on automotive and chemical exports.

Table 5.19: Variance decomposition of misalignment and mining exports

Period	S.E.	LNMINING_EXGDP	LNMINING_PROD	RER_MIS
1	0.022571	100	0	0
2	0.044815	99.429364	0.212614	0.358021
3	0.066577	98.539916	1.159158	0.300924
4	0.086767	97.316544	2.505917	0.177537
5	0.104934	95.824848	3.957033	0.218118
6	0.120969	94.162996	5.339114	0.497889
7	0.134937	92.431105	6.567241	1.001653
8	0.146994	90.716195	7.610726	1.673078
9	0.157336	89.085423	8.469917	2.444658
10	0.166173	87.584499	9.161416	3.254084

Table 5.19 presents the forecast variance decomposition to assess the importance of RER misalignment in accounting for variation in mining exports. Real exchange rate misalignment affects mining exports only in the long run.

Table 5.20: Variance decomposition of misalignment and machinery and transport equipment exports

Period	S.E.	LNMACH_EXGDP	LNMACH_PROD	RER_MIS
1	0.019293	100	0	0
2	0.038376	97.910732	0.006528	2.082738
3	0.058015	94.156802	0.250749	5.592447
4	0.076811	90.442681	0.428050	9.129268
5	0.094107	87.126927	0.497817	12.375254
6	0.109692	84.218773	0.530157	15.251069
7	0.123503	81.721499	0.545983	17.732516
8	0.135582	79.611163	0.550943	19.837892
9	0.146046	77.843326	0.549943	21.606730
10	0.155047	76.370266	0.546231	23.083501

Table 5.20 presents the forecast variance decomposition to assess the importance of RER misalignment in accounting for variation in machinery and transport equipment exports. Real exchange rate misalignment accounts for about 23% of variation in machinery and transport equipment exports in the long run.

Table 5.21: Variance decomposition of misalignment and agricultural exports

Period	S.E.	LNAGRIC_EXGDP	LNAGRIC_PROD	RER_MIS
1	0.024452	100	0	0
2	0.047637	99.857344	0.077209	0.065445
3	0.069491	99.760452	0.101112	0.138434
4	0.088565	99.745235	0.080509	0.174254
5	0.104343	99.768069	0.058185	0.173745
6	0.116862	99.773353	0.074044	0.152602
7	0.126460	99.708986	0.160597	0.130415
8	0.133619	99.531809	0.341723	0.126466
9	0.138853	99.211485	0.631201	0.157313
10	0.142644	98.733685	1.031437	0.234877

Table 5.21 presents the forecast variance decomposition to assess the importance of RER misalignment in accounting for variation in agricultural exports. Real exchange rate misalignment has a minimal effect on agricultural exports in both the short and the long run.

5.7 CONCLUSION

The DF test and the PP test were used to test for stationarity. Both methods revealed that the data series were non-stationary in levels and stationary when first differenced. Therefore, the series were integrated of the same order I(1).

Cointegration tests were done using the Johansen and Juselius approach. A maximum of 5 lags were used to permit adjustments in the model and to accomplish well-behaved residuals. The trace and the maximum eigenvalue cointegration test were used to test for cointegration. The results indicated that both the trace and the maximum eigenvalue test rejected zero in favour of at least one cointegration vector. The results were significant at the 5% level. The study found evidence of a long-run cointegrating relationship among the variables in the models. The VECM model was presented since variables can have either short- or long-run effects.

Regarding misalignment of the RER of the rand, the estimates suggested that the extent of the misalignments was not great, moving in a narrow band between -7.75% and 2.66% of the long-run equilibrium level over the period 1994Q1–2015Q4 when the HP filter was used. After the estimation of the misalignment, Chapter Five examined the impact of this misalignment on South Africa's export performance on both an aggregate level and on different sectors of the economy. The study estimated the aggregate export model using the export to GDP ratio and the volume index of exports in five key sectors (i.e. manufactured goods exports, automotive and chemical exports, mining exports, machinery and transport equipment exports and agricultural exports).

The study showed that RER misalignment has had a negative and significant impact on total export performance. Real exchange rate misalignment decreased exports by about 4.1%. On the sectoral level, South African exports demonstrated different responses to the presence of misalignment. Manufactured goods exports were negatively affected by RER misalignment, which caused a decrease of about 3.2%. The periods in which RER was in misalignment caused automotive and chemical exports to decrease by as much as 21%. Machinery and transport equipment exports were marginally affected by RER misalignment (-1.6%). On the contrary, mining and agricultural exports were positively affected by rand RER misalignment by 21.7% and 11.1% respectively. These results confirm many empirical studies on RER misalignment and export performance (Nabli & Venganzones-Varoudakis, 2002; Elbadawi *et* *al*., 2012). The findings imply that exchange rate misalignment has a detrimental impact on export performance.

The main findings were outlined in Chapter Five. Conclusions, policy recommendations and limitations of the study are presented in the final chapter.

CHAPTER SIX

CONCLUSIONS, POLICY RECOMMENDATIONS AND LIMITATIONS

6.1 SUMMARY OF THE STUDY AND CONCLUSIONS

The purpose of this study was to evaluate econometrically the effects of RER misalignment on South African exports for the period 1994–2015. Chapter One provided an introduction and background to the study. This chapter also presented the necessary groundwork for the study, including the objectives, hypothesis and problem statement and indicated the organisation of the thesis. Chapter Two provided an overview of selected stylised facts regarding RER and exports in South Africa, focusing on RERs and export trends in the country over the period 1994–2015. Chapter Three analysed the applicable theoretical and empirical literature. The methodology of the study was given in Chapter Four, followed by Chapter Five in which the main findings were presented. Chapter Six presents the conclusions, policy recommendations and limitations of the study.

This study examined the effect of RER misalignment of the rand on South Africa's export performance on both an aggregate level and on different sectors of the economy. The study initially addressed the questions: Does a long-run equilibrium level exist for the rand RER and, if so, what is it? and Is there a persistent departure of the RER of the rand from its equilibrium level? This allowed the RER misalignment to be calculated and used in the export function.

Real exchange rate misalignment is one of the important issues in international macroeconomics because variations in exchange rates have a significant impact on resource allocation and economic competitiveness. In order to achieve the research objectives of this study, economic fundamentals believed to be associated with South Africa's RER were identified in Chapter Three.

The study revealed that the extent of the rand exchange rate misalignment was not great, moving in a narrow band between -7.75% and 2.66% of the long-run equilibrium level over the period 1994–2015. The impact of the exchange rate misalignment on total exports was found to be negative and significant, implying that RER misalignment discourages export performances in South Africa. The study showed that a unit change in the misalignment decreases total exports by about 4.1%. This result confirms many empirical studies on RER misalignment and export performance (Edwards & Wilcox, 2003 Mtonga, 2006; Jongwanich, 2009; Elbadawi *et al.*, 2012; Ebaidalla, 2014) and implies that exchange rate misalignment has a detrimental impact on export performance.

For manufactured goods exports, the results suggest a unit increase in RER misalignment causes a decrease in exports of about 3.2%. The periods in which RER was in misalignment demonstrated a decrease in automotive and chemical exports of as much as 21%. Machinery and transport equipment exports were marginally affected by RER misalignment (-1.6 percent). On the contrary, mining and agricultural exports were positively affected by rand RER misalignment (21.7% and 11.1% respectively).

Based on the above findings, many policy implications can be drawn.

6.2 POLICY IMPLICATIONS AND RECOMMENDATIONS

The findings of this study yielded some important policy implications for the policymakers who are responsible for economic policy decisions in South Africa. The study identified a policy mix centred on exchange-rate policy, trade policy, monetary policy and fiscal policy.

6.2.1 Exchange rate policy

Real exchange rate misalignment was computed, and the results showed that there were periods of rand misalignment. This suggests that it is important for policymakers to monitor the RER regularly and ensure that it does not diverge widely from its equilibrium value. The impact of RER misalignment on exports was found to be negative and significant, implying that misalignment of the RER discourages export performance in South Africa. The results confirm the negative effect of RER misalignment on the competitiveness of the South African economy. This was shown on the export performance at sectoral level such as in the manufacturing sector.

It is vital for the country to achieve a high level of exports and remain competitive in order to maintain a sustainable level of growth. Exchange rate policy in this regard plays a significant role in the expansion of exports.

6.2.2 Trade policy

As discussed in the theoretical section, the expectations that the degree of openness has negative effects on the ERER and terms of trade has positive effects on the RER are supported empirically (Edwards & Garlick, 2008).

Estimation results in this study indicated that an increase in trade openness is associated with a depreciation of the RER of about 4.14%. For trade openness to be successful, there are many factors that should be considered such as terms of trade; trade diversification; balance of trade; and the nature of goods imported and exported. In order for trade openness to be sustainable and profitable in the long run, South Africa has to diversify trade.

The overreliance on primary produce such as mining and agriculture products reduces the gains from trade. There is need to diversify into value-addition products that fetch high prices on the world market, for instance, the need to expand the already viable car manufacturing industry and other value-adding industries. South Africa should also improve its service industry in order to compete with developed countries.

In line with trade policy, tariff policy should be implemented to maintain the exchange rate at a sustainable stable level. This would increase domestic demand for local industry, strengthening and enabling it to compete with international industries in the long run and thus improve trade balance and ultimately economic growth. Trade policy in this regard plays a significant role in the expansion of exports and economic growth.

6.2.3 Monetary policy

Monetary policy is the deliberate manipulation of money supply and its price (interest rates) to achieve desired changes in the economy. Estimation results in this study revealed that a 1% increase in the money supply (M2) caused a 0.51% depreciation in the currency in the long run. Money supply can be used to adjust the rand exchange rate, thus demonstrating that monetary policy is effective.

The policy framework of inflation targeting currently being used by the central bank is relevant and effective in the current South African economic climate. The government uses the repo rate to control both money supply and inflation. Given the long run relationship between money supply (M2) and the rand exchange rate, this study recommends that the current monetary policy in South Africa should be maintained.

6.2.4 Fiscal policy

The results show that the macroeconomic policy variables such as trade openness and government spending play significant roles in influencing the RER in the long run. Based on this finding, policymakers should pay considerable attention to policy factors that misalign the RER in South Africa such as trade openness and government expenditure. Thus, tightened fiscal policy should be implemented to maintain the exchange rate at a sustainable stable level. Moreover, since the country is abundant with potential agricultural and mineral resources, further efforts should be made in terms of improving the exchange rate in order to promote the competitiveness of commodities and to create a conducive investment environment that will attract foreign investors.

Regarding non-policy factors such as productivity and terms of trade, there is the need for further efforts by policymakers to enhance the growth of both the GDP and export performance.

6.3 LIMITATIONS OF THE STUDY AND AREAS FOR FURTHER RESEARCH

Most empirical studies suffer from certain limitations or weaknesses that are specific to the study. Similarly, this study is affected by certain limitations, which are briefly described below.

The first limitation is the unavailability of quarterly data for some variables suggested by the theoretical model regarding the impact of RER misalignment on exports. Some of the secondary data used in this study were obtained from diversified sources that are also subject to error and hence, absolute reliability of the data is not guaranteed.

As discussed in Chapter Four, the study used the real GDP per capita as a proxy for the technological progress (productivity). Usually, the relative productivity differential effect is proxied by the ratio of South Africa's CPI to the WPI relative to South Africa's trading partners. Nevertheless, this ratio is limited by incomplete data because more complete data could not be found for South Africa's trade-weighted index. Therefore, following the studies of Drine and Rault (2003) and Goh and Kim (2006), the real GDP per capita was analysed instead of the ratio of tradable to non-tradable productivity in this study. This might have led to different results regarding the estimation of the rand ERER.

In regard to the exchange rate, not only do misalignment affect exports but also the volatility thereof. The rand has been volatile since the adoption of the free-floating system. In order to boost the evidence regarding RER misalignment and its impact on export performance in South Africa, the study makes several suggestions for future research. Firstly, a recommended area for further research is the impact of exchange rate volatility on export growth and competitiveness in South Africa. Secondly, it would be important to identify the channels through which RER misalignment affects economic indicators such as growth and export performance. Thirdly, empirical studies need to be conducted to examine the impact of RER misalignment on economic performance during the periods selected by the current study. Finally, a study to investigate the impact of RER misalignment on private capital flow such as FDI and capital flight would be useful. To enrich the analysis, there are several possible extensions. As highlighted in Edwards and Schoer (2002) and Edwards and Golub (2004), the performance of export firms depends on factors beyond the RER, such as ULCs. The exercise could be repeated using a sector-specific ULC-based RER.

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APPENDICES

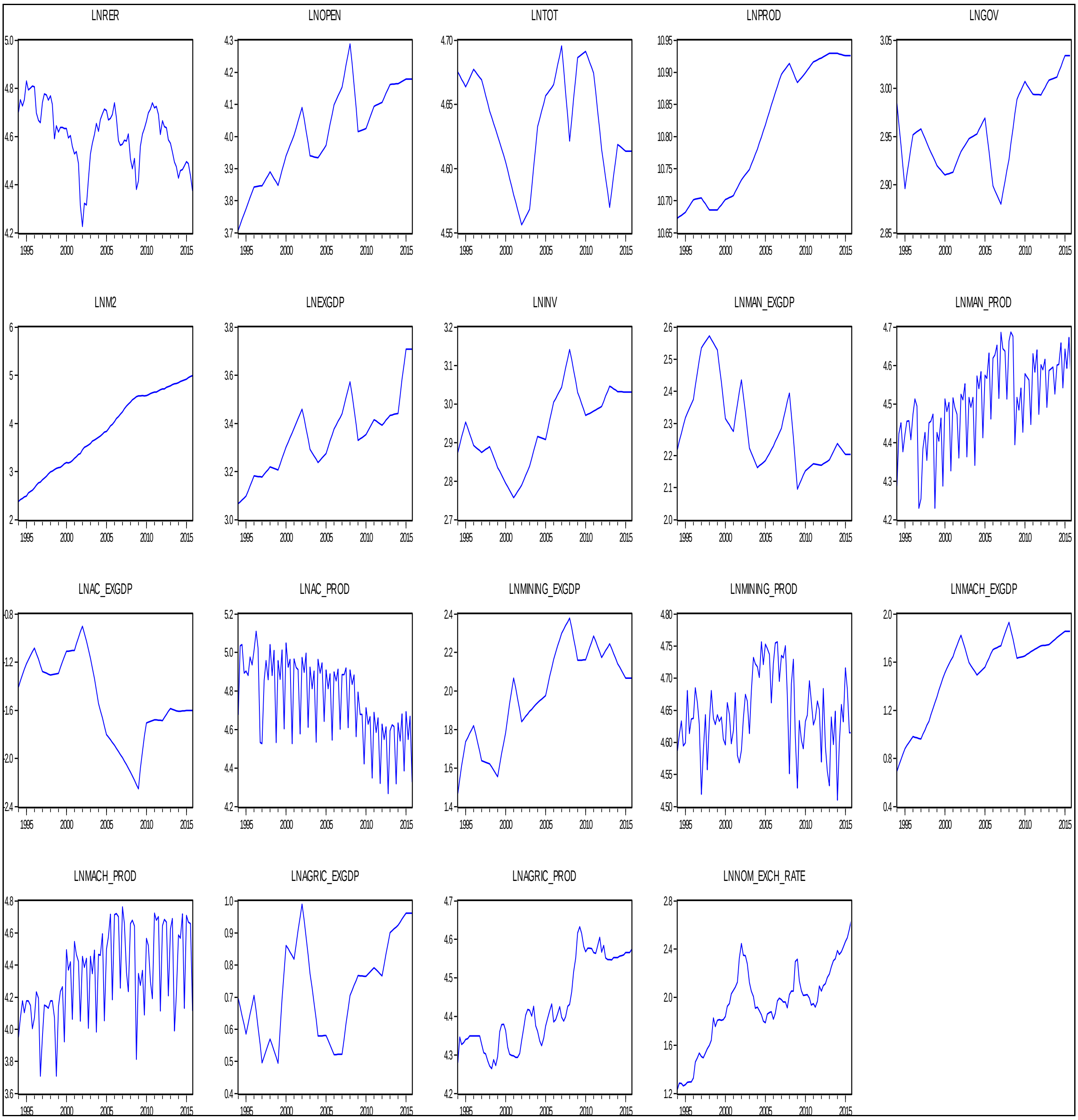
Appendix A: South African logarithm data used in regression

PERIOD	LNRER	LNOPEN	LNTOT	LNPROD	LNGOV	LNM2	LNEXGDP	LNINV	LNMAN_ EXGDP	LNMAN_ PROD	LNAC_EX GDP	LNAC_ PROD
1994Q1	4,701201	3,707947	4,675349	10,67281	2,984671	2,379546	3,066657	2,874694	2,218871	4,286341	-1,40579	4,6775
1994Q2	4,753628	3,725211	4,672455	10,67504	2,963209	2,415914	3,074428	2,894945	2,24451	4,423648	-1,35418	5,035
1994Q3	4,726499	3,742183	4,669552	10,67727	2,941276	2,442347	3,082139	2,914793	2,269508	4,452019	-1,3051	5,0402
1994Q4	4,752837	3,758872	4,666642	10,67949	2,918851	2,476538	3,089792	2,934256	2,293896	4,377014	-1,25832	4,8926
1995Q1	4,830933	3,775286	4,663722	10,68171	2,895912	2,493205	3,097386	2,953347	2,317703	4,422449	-1,21363	4,9038
1995Q2	4,792916	3,79262	4,667135	10,68671	2,910174	2,557227	3,119055	2,9385	2,332235	4,455509	-1,17927	4,882
1995Q3	4,801604	3,809658	4,670536	10,69169	2,924236	2,587764	3,140265	2,92343	2,346559	4,45667	-1,14605	4,9754
1995Q4	4,810334	3,826411	4,673926	10,69664	2,938103	2,61007	3,161035	2,90813	2,36068	4,407938	-1,11389	4,9359
1996Q1	4,806609	3,842887	4,677305	10,70156	2,95178	2,66026	3,181382	2,892592	2,374605	4,473922	-1,08274	5,0106
1996Q2	4,697321	3,843851	4,675256	10,70226	2,953347	2,714695	3,180447	2,888147	2,417161	4,513055	-1,12786	5,1108
1996Q3	4,667356	3,844814	4,673203	10,70296	2,95491	2,766319	3,179511	2,883683	2,457979	4,495355	-1,17511	5,0226
1996Q4	4,65788	3,845776	4,671145	10,70365	2,956472	2,785011	3,178575	2,879198	2,497196	4,229749	-1,22471	4,5337
1997Q1	4,741539	3,846738	4,669084	10,70435	2,95803	2,827314	3,177637	2,874694	2,534933	4,254193	-1,27689	4,5272
1997Q2	4,776681	3,857672	4,663062	10,69975	2,953086	2,862201	3,188107	2,878496	2,5445	4,383276	-1,28414	4,8552
1997Q3	4,771844	3,868489	4,657003	10,69513	2,948116	2,901422	3,198469	2,882284	2,553977	4,426044	-1,29145	4,9579
1997Q4	4,751608	3,87919	4,650908	10,69049	2,943122	2,949688	3,208724	2,886057	2,563365	4,354141	-1,29881	4,8583
1998Q1	4,769564	3,889777	4,644775	10,68582	2,938103	2,99072	3,218876	2,889816	2,572665	4,452019	-1,30622	5,0402
1998Q2	4,732971	3,879293	4,639958	10,68572	2,933591	3,010621	3,215871	2,876526	2,561903	4,455509	-1,30312	4,882
1998Q3	4,591059	3,868698	4,635117	10,68561	2,929058	3,044522	3,212858	2,863058	2,551024	4,473922	-1,30004	5,0106
1998Q4	4,644312	3,857989	4,630253	10,68551	2,924505	3,068053	3,209835	2,849405	2,540025	4,229749	-1,29696	4,5337
1999Q1	4,618485	3,847164	4,625365	10,6854	2,919931	3,08191	3,206803	2,835564	2,528904	4,426044	-1,29389	4,9579
1999Q2	4,637274	3,871305	4,620354	10,68952	2,9175	3,086487	3,231397	2,825537	2,479675	4,404277	-1,24487	4,8614
1999Q3	4,637557	3,894877	4,615319	10,69362	2,915064	3,11795	3,255401	2,815409	2,427896	4,463607	-1,19815	5,0126
1999Q4	4,633913	3,917906	4,610257	10,6977	2,912622	3,161247	3,278841	2,805177	2,373289	4,287716	-1,15351	4,6032
2000Q1	4,632409	3,940416	4,60517	10,70177	2,910174	3,186353	3,301745	2,794839	2,315528	4,513055	-1,11077	5,0492
2000Q2	4,594919	3,956662	4,598825	10,70332	2,910855	3,178054	3,321884	2,785474	2,305554	4,48074	-1,10856	4,9229
2000Q3	4,604827	3,972648	4,592439	10,70486	2,911535	3,190476	3,341624	2,77602	2,29548	4,504244	-1,10634	4,9635
2000Q4	4,558494	3,988382	4,586013	10,70641	2,912215	3,222868	3,360983	2,766476	2,285303	4,326778	-1,10413	4,5272
2001Q1	4,527762	4,003873	4,579545	10,70795	2,912894	3,273364	3,379974	2,75684	2,275022	4,516339	-1,10193	4,9656
2001Q2	4,538263	4,026244	4,573757	10,71411	2,918311	3,306887	3,40028	2,765218	2,317734	4,490881	-1,04797	4,9214
2001Q3	4,487504	4,048126	4,567935	10,72023	2,923699	3,353407	3,420183	2,773526	2,358697	4,473922	-0,99677	4,9119
2001Q4	4,313613	4,069539	4,56208	10,72632	2,929058	3,370738	3,439697	2,781765	2,398047	4,360548	-0,94806	4,5778
2002Q1	4,226565	4,090504	4,55619	10,73237	2,934389	3,449988	3,458837	2,789937	2,435907	4,525044	-0,90162	4,9733
2002Q2	4,321648	4,054867	4,559283	10,73646	2,937706	3,499533	3,41961	2,802603	2,386702	4,51086	-0,96185	4,8971
2002Q3	4,31562	4,017913	4,562367	10,74053	2,941012	3,523415	3,378781	2,815109	2,33495	4,552824	-1,02595	4,9972
2002Q4	4,419416	3,979541	4,565441	10,74458	2,944307	3,552487	3,336214	2,827462	2,280373	4,363099	-1,09444	4,6121
2003Q1	4,527157	3,939638	4,568506	10,74862	2,947592	3,583519	3,291754	2,839663	2,222644	4,517431	-1,16797	4,9236
2003Q2	4,571822	3,938081	4,584967	10,75657	2,948903	3,62966	3,278465	2,85934	2,207928	4,492001	-1,24914	4,8122
2003Q3	4,609059	3,93652	4,601162	10,76446	2,950212	3,65584	3,264996	2,878637	2,192992	4,517431	-1,33748	4,9031
2003Q4	4,654448	3,934958	4,617099	10,77229	2,951519	3,681351	3,251343	2,897568	2,17783	4,341205	-1,43439	4,5358
2004Q1	4,622534	3,933393	4,632785	10,78006	2,952825	3,713572	3,237501	2,916148	2,162435	4,572647	-1,54171	4,9642
2004Q2	4,670197	3,943473	4,638798	10,7897	2,956991	3,740048	3,247074	2,914115	2,167744	4,540098	-1,60051	4,8926
2004Q3	4,694225	3,953453	4,644775	10,79926	2,961141	3,777348	3,256557	2,912079	2,173026	4,583947	-1,66298	4,9452
2004Q4	4,714066	3,963334	4,650717	10,80872	2,965273	3,819908	3,26595	2,910038	2,17828	4,412798	-1,72961	4,6415
2005Q1	4,707666	3,973118	4,656623	10,81809	2,969388	3,835142	3,275256	2,907993	2,183507	4,574711	-1,801	4,9104
2005Q2	4,668796	4,006105	4,658829	10,82841	2,952172	3,881564	3,301561	2,933059	2,19505	4,566429	-1,82287	4,8122
2005Q3	4,675216	4,038039	4,661031	10,83862	2,934654	3,94739	3,327192	2,957511	2,206461	4,632785	-1,84522	4,8888
2005Q4	4,691619	4,068984	4,663227	10,84873	2,916824	3,981549	3,352182	2,98138	2,217743	4,4613	-1,86809	4,5454
2006Q1	4,740738	4,099	4,665418	10,85875	2,898671	4,036009	3,376563	3,004692	2,228899	4,619073	-1,89149	4,9001
2006Q2	4,678465	4,113003	4,673039	10,86844	2,893976	4,104295	3,392661	3,014677	2,243028	4,62791	-1,91576	4,8528
2006Q3	4,583221	4,126812	4,680602	10,87804	2,88926	4,143135	3,408504	3,024563	2,25696	4,653008	-1,94063	4,9134
2006Q4	4,563972	4,140433	4,688109	10,88755	2,884521	4,191169	3,4241	3,034352	2,270701	4,515245	-1,96614	4,6022
2007Q1	4,567992	4,153871	4,695559	10,89697	2,87976	4,238445	3,439456	3,044046	2,284256	4,68675	-1,99232	4,8851
2007Q2	4,583939	4,189276	4,677561	10,90128	2,891621	4,304065	3,474525	3,069447	2,313018	4,643429	-2,02115	4,8851
2007Q3	4,58088	4,22347	4,659232	10,90557	2,903343	4,361824	3,508406	3,094219	2,340977	4,637637	-2,05084	4,9193
2007Q4	4,610547	4,256534	4,640561	10,90984	2,914929	4,404277	3,541177	3,118392	2,368174	4,513055	-2,08144	4,6092
2008Q1	4,507366	4,28854	4,621536	10,9141	2,926382	4,445001	3,572907	3,141995	2,394652	4,664382	-2,11301	4,9097
2008Q2	4,466667	4,226834	4,63817	10,90666	2,942331	4,493121	3,517275	3,115292	2,327805	4,687671	-2,14621	4,8347
2008Q3	4,508242	4,161068	4,654532	10,89916	2,95803	4,525044	3,458365	3,087856	2,256167	4,67656	-2,18054	4,8828
2008Q4	4,380741	4,090671	4,67063	10,89161	2,973487	4,554929	3,395766	3,059646	2,178998	4,394449	-2,2161	4,5633
2009Q1	4,416878	4,014941	4,686474	10,884	2,988708	4,568506	3,328985	3,030617	2,095372	4,517431	-2,25296	4,7941
2009Q2	4,558357	4,017509	4,687694	10,88778	2,993354	4,574711	3,335325	3,016025	2,109955	4,48526	-2,08542	4,6784
2009Q3	4,610838	4,02007	4,688914	10,89155	2,99798	4,576771	3,341624	3,001217	2,124329	4,541165	-1,94195	4,6793
2009Q4	4,633594	4,022625	4,690132	10,89531	3,002584	4,572647	3,347885	2,986187	2,138499	4,427239	-1,81651	4,4224
2010Q1	4,663173	4,025173	4,691348	10,89905	3,007167	4,576771	3,354106	2,970927	2,152471	4,578826	-1,70507	4,7131
2010Q2	4,698152	4,043007	4,687119	10,90335	3,003824	4,594109	3,369879	2,973614	2,157872	4,570579	-1,6982	4,6289
2010Q3	4,713436	4,060529	4,682872	10,90763	3,000471	4,61611	3,385407	2,976295	2,163243	4,563306	-1,69137	4,6663
2010Q4	4,739974	4,077749	4,678607	10,9119	2,997106	4,633758	3,400697	2,978968	2,168585	4,447346	-1,68459	4,349
2011Q1	4,719236	4,094678	4,674323	10,91615	2,99373	4,649187	3,415758	2,981633	2,1739	4,630838	-1,67786	4,6895
2011Q2	4,725289	4,097672	4,659753	10,91775	2,993605	4,654912	3,409909	2,984798	2,172892	4,582925	-1,67994	4,585
2011Q3	4,692227	4,100658	4,644968	10,91934	2,99348	4,673763	3,404027	2,987952	2,171884	4,640537	-1,68203	4,6606
2011Q4	4,609457	4,103635	4,62996	10,92093	2,993354	4,703204	3,398109	2,991097	2,170875	4,473922	-1,68412	4,3202
2012Q1	4,665663	4,106602	4,614724	10,92252	2,993229	4,714025	3,392157	2,994231	2,169865	4,602166	-1,68622	4,6279
2012Q2	4,641132	4,120865	4,603719	10,92432	2,997106	4,717606	3,402613	3,007661	2,173954	4,589041	-1,65985	4,5486
2012Q3	4,637155	4,134927	4,592591	10,92612	3,000969	4,74667	3,412961	3,020913	2,178026	4,61611	-1,63415	4,6141
2012Q4	4,586664	4,148793	4,581338	10,92792	3,004816	4,763028	3,423203	3,033991	2,182082	4,492001	-1,6091	4,2683
2013Q1	4,57155	4,16247	4,569957	10,92972	3,008648	4,784153	3,433342	3,046901	2,186121	4,587006	-1,58467	4,5941
2013Q2	4,53545	4,163015	4,582388	10,92972	3,009389	4,80484	3,435518	3,043331	2,199098	4,591071	-1,59084	4,624
2013Q3	4,494271	4,16356	4,594665	10,92972	3,010128	4,817859	3,43769	3,039749	2,211909	4,596129	-1,59705	4,6151
2013Q4	4,474506	4,164104	4,606794	10,92972	3,010867	4,827513	3,439857	3,036154	2,224558	4,526127	-1,60329	4,3175
2014Q1	4,426751	4,164648	4,618777	10,92972	3,011606	4,847332	3,442019	3,032546	2,237049	4,601162	-1,60958	4,6338
2014Q2	4,458949	4,168331	4,617494	10,92874	3,017249	4,874434	3,515344	3,032305	2,228716	4,603168	-1,60768	4,5412
2014Q3	4,463391	4,172	4,616209	10,92776	3,022861	4,884316	3,583658	3,032064	2,220314	4,658711	-1,60579	4,6803
2014Q4	4,477931	4,175656	4,614922	10,92678	3,028441	4,90305	3,647602	3,031823	2,21184	4,54223	-1,6039	4,3845
2015Q1	4,494865	4,179298	4,613634	10,9258	3,033991	4,920711	3,707701	3,031582	2,203293	4,642466	-1,60201	4,6923
2015Q2	4,48704	4,179298	4,613634	10,9258	3,033991	4,951593	3,707701	3,031582	2,203293	4,593098	-1,60201	4,5497
2015Q3	4,437756	4,179298	4,613634	10,9258	3,033991	4,975353	3,707701	3,031582	2,203293	4,672829	-1,60201	4,6681
2015Q4	4,374871	4,179298	4,613634	10,9258	3,033991	4,994506	3,707701	3,031582	2,203293	4,544358	-1,60201	4,3268

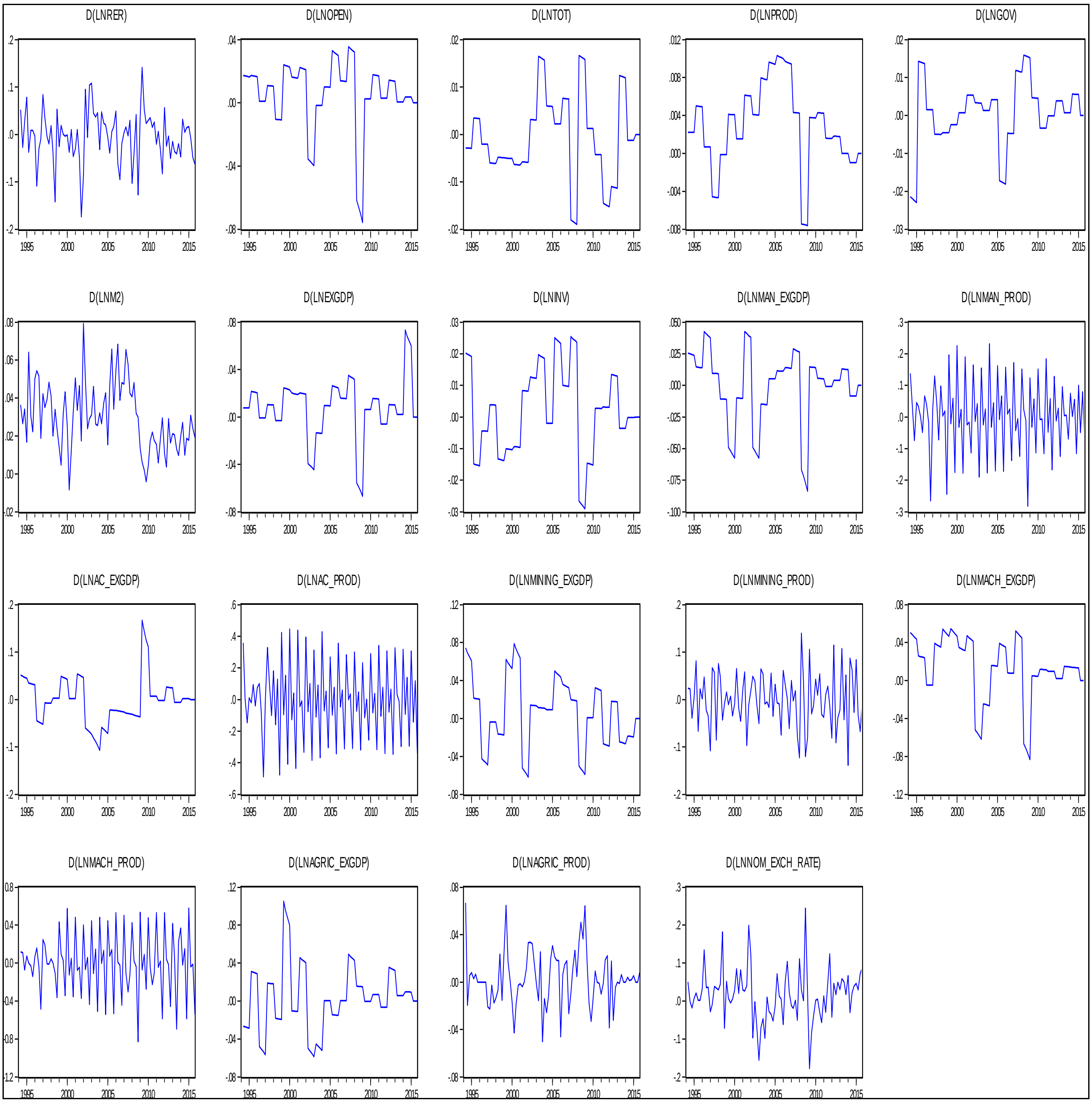
PERIOD	LNMINING _EXGDP	LNMINING _PROD	LNMACH _EXGDP	LNMACH _PROD	LNAGRIC _EXGDP	LNAGRIC _PROD	LNNOM_E XCH_RATE	LNCPI	LNEXPORTS _R_MILL	LNGROWTH_ OF_EXPORTS	LNGDP_R _MILL	LNIMPGDP	LNIMPORTS _R_MILL
1994Q1	1,4673224	4,5872099	0,692077	3,951244	0,696314	4,27944	1,2348899	2,269373	9,92573816	0,91228271	11,69691	2,9595868	9,7665217
1994Q2	1,5417535	4,6111523	0,742724	4,069027	0,669688	4,346399	1,2853684	1,967672	9,93207501	1,526599634	11,71358	2,9875741	9,88328485
1994Q3	1,6110264	4,6335633	0,790929	4,177459	0,642334	4,326778	1,2828764	2,211274	10,090382	1,90434383	11,72925	3,0147993	10,06773
1994Q4	1,6758099	4,5943114	0,836917	4,104295	0,61421	4,332048	1,2646915	2,282246	10,0660315	2,177871849	11,77982	3,041303	10,0186004
1995Q1	1,7366506	4,5992527	0,880883	4,175925	0,585273	4,339902	1,2714445	2,298309	10,0766002	2,392425797	11,81414	3,0671223	10,2230316
1995Q2	1,7581175	4,6806486	0,906722	4,177459	0,616584	4,342506	1,2922584	2,365967	10,2139091	2,303084968	11,83769	3,0799585	10,1646973
1995Q3	1,7791333	4,6141299	0,931909	4,147885	0,646944	4,348987	1,2941791	2,046057	10,2403169	2,204972264	11,87353	3,0926321	10,2764295
1995Q4	1,7997166	4,636475	0,956478	4,005513	0,676409	4,348987	1,2958225	1,880991	10,094521	2,096175741	11,90483	3,1051471	10,2499101
1996Q1	1,8198847	4,6374437	0,980458	4,07244	0,705031	4,348987	1,3276054	1,873544	10,1491751	1,974081026	11,92887	3,1175073	10,3056138
1996Q2	1,7772463	4,6851821	0,975562	4,232656	0,65669	4,348987	1,4620973	1,80495	10,2530875	1,905831925	11,96858	3,1204909	10,3287553
1996Q3	1,7327086	4,662023	0,970643	4,19419	0,605892	4,348987	1,4978357	2,031869	10,4733365	1,832581464	11,99028	3,1234656	10,4786954
1996Q4	1,6860945	4,6277142	0,965698	3,708682	0,552375	4,348987	1,5344988	2,213098	10,5135248	1,753538256	12,01564	3,1264315	10,4184048
1997Q1	1,6372008	4,5193944	0,96073	3,955082	0,495831	4,328098	1,5065189	2,262804	10,3427098	1,667706821	12,04414	3,1293887	10,5511142
1997Q2	1,6335085	4,5861912	0,999959	4,15104	0,514847	4,305416	1,4973884	2,238828	10,5270167	1,566008355	12,06853	3,1405899	10,5518988
1997Q3	1,6298025	4,6431401	1,037708	4,143135	0,533508	4,302713	1,5355761	2,153969	10,5108045	1,452784102	12,09027	3,1516671	10,5318295
1997Q4	1,6260827	4,5575543	1,074083	4,131961	0,551827	4,284965	1,5700732	1,929878	10,5424425	1,32508363	12,11127	3,1626229	10,5526828
1998Q1	1,622349	4,6335633	1,109181	4,177459	0,569816	4,271095	1,5993876	1,70396	10,3942125	1,178654996	12,12622	3,17346	10,4932168
1998Q2	1,6058586	4,6806486	1,163616	4,177459	0,551546	4,264087	1,6436461	1,63335	10,4631033	1,01250959	12,15903	3,1552968	10,5347593
1998Q3	1,5890917	4,6374437	1,21524	4,07244	0,532935	4,287716	1,8261609	2,045712	10,5921246	0,813149973	12,16473	3,1367977	10,7741531
1998Q4	1,5720389	4,6277142	1,264329	3,708682	0,513972	4,272491	1,7542307	2,206111	10,5458676	0,563892345	12,18449	3,1179499	10,6055945
1999Q1	1,5546903	4,6431401	1,311121	4,143135	0,494642	4,295924	1,8058267	2,136058	10,570804	0,231111721	12,20877	3,09874	10,5526828
1999Q2	1,6169842	4,6325908	1,365752	4,235555	0,599713	4,360548	1,8130316	1,986366	10,5896101	1,106084304	12,22622	3,1222548	10,5463935
1999Q3	1,6756241	4,6392817	1,417552	4,264087	0,694786	4,37827	1,8079608	1,209159	10,5878462	1,565486025	12,26924	3,1452293	10,6327256
1999Q4	1,731015	4,6052702	1,4668	3,921973	0,781599	4,379524	1,812542	0,671242	10,7106328	1,879083297	12,29536	3,1676878	10,7215037
2000Q1	1,7834981	4,5962303	1,513736	4,495355	0,861475	4,363099	1,840867	1,025922	10,7411679	2,117459609	12,31967	3,189653	10,7130835
2000Q2	1,8624272	4,6617395	1,548582	4,369448	0,850872	4,320151	1,9254159	1,594798	10,8295306	1,921324674	12,35699	3,2014244	10,760665
2000Q3	1,9355797	4,6438138	1,582254	4,418841	0,840155	4,301359	1,9459101	1,886969	10,8576519	1,677096561	12,39905	3,2130589	10,9343562
2000Q4	2,0037437	4,5978434	1,61483	4,062166	0,829323	4,298645	2,0280167	1,947813	10,9992625	1,353254507	12,42481	3,2245596	10,9764401
2001Q1	2,0675565	4,6188758	1,646377	4,54542	0,818371	4,297285	2,0574515	2,004269	10,9740432	0,871293366	12,44816	3,2359296	10,877481
2001Q2	2,0153341	4,6769326	1,693661	4,467057	0,864177	4,293195	2,0839314	1,857443	11,0739553	0,712949808	12,46327	3,2606893	10,965263
2001Q3	1,9602335	4,5800575	1,73881	4,422449	0,907976	4,293195	2,1242954	1,563534	11,0133694	0,524728529	12,47862	3,2848508	11,0310112
2001Q4	1,9019189	4,5682987	1,782009	4,050044	0,949937	4,304065	2,3231717	1,45939	11,0981673	0,292669614	12,51363	3,3084423	11,0627245
2002Q1	1,839992	4,587617	1,823418	4,453184	0,990208	4,337291	2,4446054	1,752094	11,2138453	-0,010050336	12,57677	3,33149	11,1892707
2002Q2	1,8539553	4,6363781	1,77128	4,38577	0,940316	4,370713	2,3470803	2,058133	11,3007219	-0,261364764	12,6144	3,3000871	11,1136412
2002Q3	1,8677263	4,674603	1,716273	4,442651	0,887802	4,403054	2,3453572	2,371831	11,2426903	-0,597837001	12,64604	3,267666	11,1671905
2002Q4	1,8813102	4,6642878	1,658064	4,007333	0,832378	4,417635	2,2767543	2,607763	11,2977501	-1,108662625	12,6711	3,2341584	11,1635098
2003Q1	1,894712	4,6138326	1,596256	4,454347	0,7737	4,416428	2,1211831	2,43449	11,1450451	-2,207274913	12,68708	3,1994891	11,0576922
2003Q2	1,9060559	4,6786065	1,571714	4,346399	0,728489	4,400603	2,0506562	2,114889	11,1385229	-0,235722334	12,70266	3,2105412	11,0389138
2003Q3	1,9172724	4,7321552	1,546555	4,493121	0,681137	4,426044	2,0039095	1,479253	11,1626585	0,385262401	12,71941	3,2214725	11,091331
2003Q4	1,9283646	4,7228643	1,520747	3,983413	0,63143	4,375757	1,9061293	1,479253	11,094679	0,765467842	12,74236	3,2322855	11,0899581
2004Q1	1,939335	4,7178737	1,494255	4,465908	0,579123	4,361824	1,9160399	1,479253	11,1277041	1,040276712	12,78184	3,2429829	11,0600542
2004Q2	1,9486752	4,701389	1,510148	4,4613	0,579361	4,335983	1,8887349	1,479253	11,1991732	1,450442181	12,80784	3,2535671	11,2747952
2004Q3	1,9579289	4,7566029	1,525792	4,59512	0,579598	4,324133	1,8533248	1,479253	11,2058567	1,740466175	12,82957	3,2640404	11,2694516
2004Q4	1,9670978	4,7213519	1,541195	4,053523	0,579835	4,343805	1,800554	0,5036	11,2865266	1,965012251	12,8624	3,2744051	11,3365462
2005Q1	1,9761834	4,7531591	1,556364	4,49981	0,580073	4,374498	1,7875841	0,659418	11,1700125	2,148267733	12,88009	3,2846636	11,2285712
2005Q2	2,0264926	4,7460619	1,595702	4,574711	0,565589	4,395683	1,8594181	0,621293	11,3732035	2,115351492	12,91196	3,3241363	11,3933533
2005Q3	2,0743916	4,7370753	1,63355	4,716712	0,550893	4,41401	1,8724174	0,873801	11,3612883	2,081314786	12,93784	3,36211	11,4551904
2005Q4	2,1201008	4,6621175	1,670018	4,183576	0,535977	4,432007	1,8776313	0,722868	11,3612883	2,046078638	12,96933	3,3986943	11,4169651
2006Q1	2,1638116	4,7230421	1,705203	4,714921	0,520835	4,38577	1,815476	0,716538	11,2638229	2,009555414	12,98142	3,4339872	11,4342069
2006Q2	2,199777	4,7546241	1,7132	4,722064	0,521148	4,391977	1,8651648	0,932951	11,4366922	2,021878634	13,01689	3,4460911	11,5740206
2006Q3	2,2344937	4,756431	1,721134	4,70048	0,521459	4,406719	1,9690685	1,324862	11,5909045	2,034051839	13,06488	3,4580502	11,7083278
2006Q4	2,2680455	4,6951937	1,729006	4,25703	0,521771	4,424847	1,9907469	1,526925	11,6661614	2,046078638	13,09512	3,469868	11,8618202
2007Q1	2,300508	4,7350574	1,736816	4,761319	0,522083	4,398146	1,978239	1,636923	11,6118654	2,05796251	13,13818	3,4815477	11,7578305
2007Q2	2,3203958	4,7318909	1,789046	4,659658	0,571236	4,388257	1,9588264	1,794035	11,7275529	1,834180185	13,15694	3,5172753	11,8321062
2007Q3	2,3398958	4,7502225	1,838683	4,355426	0,618085	4,399375	1,9610802	1,837688	11,729729	1,545432582	13,18173	3,5517702	11,9000229
2007Q4	2,3590227	4,6741364	1,885973	4,234107	0,662837	4,426044	1,9101349	1,978562	11,7916929	1,137833002	13,23091	3,5851149	11,9123054
2008Q1	2,3777907	4,5511363	1,931127	4,658711	0,705672	4,430817	2,0214151	2,194517	11,8309427	0,438254931	13,25675	3,6173835	11,973636
2008Q2	2,3274579	4,6906137	1,864424	4,67935	0,721324	4,464758	2,0509135	2,297003	12,0585582	0,438254931	13,28344	3,5498329	12,1249168
2008Q3	2,2744568	4,7293328	1,792952	4,643429	0,736735	4,515245	2,0516849	2,413053	12,1157649	0,438254931	13,31186	3,4773865	12,1905528
2008Q4	2,2184886	4,608963	1,715975	3,813307	0,751912	4,551769	2,2964664	2,309263	12,0321358	0,438254931	13,32105	3,3992789	12,1159291
2009Q1	2,1592012	4,5286131	1,632576	4,347694	0,766861	4,61611	2,3151064	2,168978	11,7926762	0,438254931	13,32491	3,3145496	11,9233118
2009Q2	2,1598967	4,633952	1,637297	4,275276	0,766408	4,632785	2,1370027	2,091576	11,7372683	0,438254931	13,33215	3,3132765	11,706599
2009Q3	2,1605917	4,6033686	1,641996	4,365643	0,765954	4,615121	2,0543801	1,854108	11,7782085	0,438254931	13,35928	3,3120018	11,760098
2009Q4	2,1612863	4,5900565	1,646674	4,089332	0,765499	4,581902	2,0139693	1,756247	11,8145104	0,428530381	13,38436	3,3107255	11,8552378
2010Q1	2,1619803	4,6327854	1,651329	4,566429	0,765045	4,567468	2,0163686	1,683184	11,8873126	2,043814364	13,3994	3,3094475	11,8705999
2010Q2	2,1943697	4,642466	1,663173	4,522875	0,771906	4,576771	2,0208851	1,444091	11,9994174	1,927891644	13,42991	3,3294328	11,9019902
2010Q3	2,2257429	4,6959245	1,674879	4,295924	0,77872	4,576771	1,9903371	1,209557	12,0788073	1,796747011	13,44951	3,3490265	11,9949812
2010Q4	2,2561616	4,664382	1,68645	4,19268	0,785487	4,575741	1,9331143	1,228568	12,11297	1,645769842	13,47994	3,3682437	11,9430832
2011Q1	2,2856823	4,6269317	1,697888	4,722953	0,79221	4,565389	1,9466242	1,313992	12,0725984	1,467874348	13,49543	3,3870985	12,0182359
2011Q2	2,2587908	4,6366689	1,707765	4,680278	0,785718	4,564348	1,9170697	1,533636	12,1517748	1,188605327	13,52076	3,3991119	12,0577466
2011Q3	2,2311561	4,664382	1,717545	4,701389	0,779184	4,582925	1,9665528	1,691939	12,2517628	0,799756916	13,55242	3,4109827	12,1869408
2011Q4	2,202736	4,6510991	1,727231	4,114147	0,772607	4,60517	2,0909995	1,835617	12,2838667	0,154864711	13,57081	3,4227142	12,2638226
2012Q1	2,1734845	4,569543	1,736824	4,645352	0,765986	4,566429	2,0488535	1,838961	12,1827017	-2,207274913	13,58057	3,4343097	12,2199756
2012Q2	2,1917761	4,6839814	1,738717	4,684905	0,801599	4,583947	2,0949457	1,765929	12,21632	0,207014169	13,5956	3,4522073	12,2400392
2012Q3	2,2097391	4,5930976	1,740606	4,667206	0,835988	4,551769	2,1122717	1,652753	12,238201	0,854415328	13,61336	3,4697902	12,3037437
2012Q4	2,2273851	4,554929	1,742492	4,20916	0,869233	4,547541	2,1620579	1,731892	12,2691413	1,244154594	13,63527	3,4870692	12,3227884
2013Q1	2,2447251	4,5325995	1,744374	4,625953	0,901408	4,547541	2,1927702	1,753827	12,239314	1,523880024	13,66013	3,5040548	12,3389413
2013Q2	2,2200503	4,6395716	1,75923	4,688592	0,907049	4,546481	2,2515023	1,727399	12,3394665	1,409766717	13,68834	3,5030016	12,3981382
2013Q3	2,1947513	4,597138	1,773869	3,990834	0,912657	4,552824	2,3016847	1,838749	12,4076656	1,280933845	13,69691	3,5019473	12,5142924
2013Q4	2,1687955	4,6482297	1,788297	4,216562	0,918235	4,552824	2,3191472	1,683246	12,4172651	1,133013715	13,72703	3,5008919	12,4501554
2014Q1	2,142148	4,50976	1,80252	4,587006	0,923781	4,552824	2,3862827	1,778731	12,3932574	0,959350221	13,72993	3,4998354	12,4988542
2014Q2	2,1236462	4,597138	1,816332	4,568506	0,9335	4,55703	2,355557	1,890951	12,3725189	1,46672161	13,75529	3,5072077	12,4512516
2014Q3	2,1047956	4,658711	1,829957	4,717606	0,943126	4,558079	2,3778781	1,840708	12,4395229	1,8017098	13,76912	3,5145261	12,5415801
2014Q4	2,0855828	4,6318121	1,843398	4,130355	0,952659	4,560173	2,4169846	1,736834	12,4680907	2,052198805	13,79837	3,5217913	12,5435087
2015Q1	2,0659936	4,7158167	1,856661	4,707727	0,962103	4,565389	2,463087	1,419165	12,3652109	2,252343877	13,80804	3,5290041	12,4966505
2015Q2	2,0659936	4,6830567	1,856661	4,668145	0,962103	4,565389	2,4925441	1,499102	12,4762524	2,252343877	13,81966	3,5290041	12,4473311
2015Q3	2,0659936	4,6151205	1,856661	4,656813	0,962103	4,565389	2,5647955	1,520242	12,5134103	2,252343877	13,82512	3,5290041	12,5596829
2015Q4	2,0659936	4,6151205	1,856661	4,114147	0,962103	4,57368	2,653594	1,581724	12,4992645	2,252343877	13,84237	3,5290041	12,5455048

Appendix B: Empirical results

Appendix B1: Graphical test for stationarity of variables in levels for 1994–2015



Appendix B2: Graphical test for stationarity of variables first differenced for 1994–2015



Appendix B3: Stationarity results of the Augmented Dickey-Fuller test

Variable	Series	Level			1st difference			Stationarity
		None	Intercept	Trend and intercept	None	Intercept	Trend and intercept	
RER	LNRER	-0.693	-2.205	-2.572	-7.681***	-7.682***	-7.643***	I(1)
Openness	LNOPEN	0.850	-1.773	-3.719	-3.033***	-3.157**	-3.152	I(1)
Terms of Trade	LNTOT	-0.262	-2.784	-2.775	-3.594***	-3.582***	-3.562**	I(1)
Productivity	LNPROD	1.291	-1.082	-2.149	-9.166***	-9.113***	-9.067***	I(1)
Government Expenditure	LNGOV	0.663	-2.188	-3.212	-3.871***	-3.897***	-3.797**	I(1)
Money Supply	LNM2	1.742	-2.000	-0.301	-9.371***	-5.442***	-5.878***	I(1)
Total Exports GDP ratio	LNEXGDP	1.126	-0.949	-3.361	-2.605***	-2.857***	-2.876	I(1)
Manufactured goods exports to GDP	LNMAN_EXGDP	-0.393	-2.641	-3.886	-3.249***	-3.238**	-3.208*	I(1)
Manufactured goods Production	LNMAN_PROD	0.700	-0.866	-2.872	-3.592***	-3.642***	-3.628**	I(1)
Automotive & Chemical exports to GDP	LNAC_EXGDP	-0.103	-1.968	-2.256	-3.286***	-3.281**	-3.267*	I(1)
Automotive & Chemical Production	LNAC_PROD	-1.545	-0.464	-1.809	-4.024***	-4.435***	-4.376***	I(1)
Mining exports to GDP	LNMINING_EXGDP	0.127	-1.943	-2.966	-3.699***	-3.682***	-3.655**	I(1)
Mining Production	LNMINING_PROD	0.176	-5.186	-5.145	-9.464***	-9.409***	-9.364***	I(1)
Machinery & transport equipment exports to	LNMACH_EXGDP	0.671	-2.114	-2.477	-3.183***	-3.339**	-2.870	I(1)
Machinery & transport equipment Production	LNMACH_PROD	1.542	-1.819	-1.601	-2.920***	-3.147**	-3.268*	I(1)
Agricultural exports to GDP	LNAGRIC_EXGDP	-0.046	-2.484	-3.265	-2.316***	-11.030***	-10.944***	I(1)
Agricultural Production	LNAGRIC_PROD	0.734	-0.881	-3.020	-7.244***	-7.259***	-7.227***	I(1)
Critical values								
	1%	**-2.591**	**-3.508**	**-4.068**	**-2.591**	**-3.508**	**-4.068**	
	5%	**-1.944**	**-2.895**	**-3.462**	**-1.944**	**-2.895**	**-3.462**	
	10%	**-1.614**	**-2.584**	**-3.157**	**-1.614**	**-2.584**	**-3.157**	

Note:

*** represents stationary variables at 1% significance level

** represents stationary variables at 5% significance level

* represent stationary variables at 10% significance level

Lag lengths for the ADF tests were chosen using Schwarz Info Criterion (SIC)

Appendix B4: Stationarity results of the Phillips-Perron test

Variable	Series	Level			1st difference			Stationarity
		None	Intercept	Trend and intercept	None	Intercept	Trend and intercept	
REER	LNREER	-0.625	-2.015	-2.491	-7.665***	-7.665***	-7.625***	I(1)
Openness	LNOPEN	1.317	-1.934	-2.699	-4.021***	-4.115***	-4.124***	I(1)
Terms of Trade	LNTOT	-0.449	-1.902	-1.885	-3.910***	-3.902	-3.885**	I(1)
Productivity	LNPROD	2.862	-0.714	-1.227	-2.172***	-9.112***	-9.067***	I(1)
Government Expenditure	LNGOV	0.335	-1.251	-2.808	-3.938***	-3.896***	-3.797**	I(1)
Money Supply	LNM2	6.316	-2.011	-0.375	-2.173**	-5.407***	-5.874***	I(1)
Total Exports GDP ratio	LNEXGDP	1.606	-0.884	-2.178	-3.886***	-4.048***	-4.035***	I(1)
Manufactured goods exports to GDP	LNMAN_EXGDP	-0.130	-1.764	-2.825	-4.050***	-4.030***	-4.013**	I(1)
Manufactured goods Production	LNMAN_PROD	0.733	-5.954***	-8.945	-34.57***	-43.497***	-43.234***	I(1)
Automotive & Chemical exports to GDP	LNAC_EXGDP	-0.072	-1.286	-1.636	-3.425***	-3.419**	-3.401*	I(1)
Automotive & Chemical Production	LNAC_PROD	-0.565	-6.456***	-10.814	-49.84***	-58.171***	-59.753***	I(1)
Mining exports to GDP	LNMINING_EXGDP	0.741	-2.151	-1.884	-3.881***	-3.935***	-3.941**	I(1)
Mining Production	LNMINING_PROD	0.161	-5.024***	-4.979	-25.24***	-25.034***	-30.052***	I(1)
Machinery & transport equipment exports to	LNMACH_EXGDP	1.403	-2.589	-2.070	-3.429***	-3.638***	-3.774**	I(1)
Machinery & transport equipment Production	LNMACH_PROD	0.027	-7.039***	-9.096	-38.15***	-39.130***	-40.716***	I(1)
Agricultural exports to GDP	LNAGRIC_EXGDP	0.265	-1.320	-1.995	-4.263***	-4.272***	-4.262***	I(1)
Agricultural Production	LNAGRIC_PROD	1.088	-1.199	-2.494	-7.268***	-7.287***	-7.254***	I(1)
Critical values								
	1%	**-2.591**	**-3.507**	**-4.066**	**-2.591**	**-3.507**	**-4.066**	
	5%	**-1.944**	**-2.895**	**-3.462**	**-1.944**	**-2.895**	**-3.462**	
	10%	**-1.614**	**-2.584**	**-3.157**	**-1.614**	**-2.584**	**-3.157**	

Note:

*** represents stationary variables at 1% significance level

** represents stationary variables at 5% significance level

* represents stationary variables at 10% significance level

Appendix B5: Lag order selection criteria: RER Misalignment equation

In order to test for cointegration, the following VAR was specified:

$$X_t = A_0 + A_1X_{t-1} + A_2X_{t-2} + \varepsilon_t$$

Where X_t = RER, OPEN, TOT, PROD, GOV, M2

Lag	LogL	LR	FPE	AIC	SC	HQ
0	705.1159	NA	1.58e-15	-17.05161	-16.87551	-16.98091
1	1571.685	1585.188	2.53e-24	-37.30940	-36.07669	-36.81449
2	1748.991	298.3928	8.17e-26*	-40.75589*	-38.46657*	-39.83676*
3	1779.406	46.73520	9.70e-26	-40.61967	-37.27374	-39.27633

Note:

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike Information Criterion

SC: Schwarz Information Criterion

HQ: Hannan-Quinn Information Criterion

Appendix B6: Lag order selection criteria: Misalignment and Total Exports equation

In order to test for cointegration, the following VAR was specified:

$$X_t = A_0 + A_1X_{t-1} + A_2X_{t-2} + \ldots + A_5X_{t-5} + \varepsilon_t$$

Where X_t = EXGDP, RER, TOT, PROD, GOV, RER_MIS

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1461.718	NA	9.89e-24	-35.94365	-35.76628	-35.87249
1	1702.573	440.0811	6.30e-26	-41.00180	-39.76023*	-40.50367*
2	1713.009	17.52158	1.20e-25	-40.37058	-38.06482	-39.44548
3	1736.554	36.04484	1.70e-25	-40.06306	-36.69310	-38.71099
4	1795.334	81.27574	1.04e-25	-40.62553	-36.19136	-38.84648
5	1874.824	98.13610*	4.00e-26*	-41.69936*	-36.20099	-39.49334

Appendix B7: Lag order selection criteria: Misalignment and Manufactured goods exports equation

In order to test for cointegration, the following VAR was specified:

$X_t = A_0 + A_1X_{t-1} + A_2X_{t-2} + \ldots + A_5X_{t-5} + \varepsilon_t$

Where X_t = MAN_EXGDP, RER, MAN_PROD, RER_MIS

Lag	LogL	LR	FPE	AIC	SC	HQ
0	361.3232	NA	3.21e-08	-8.739589	-8.651539	-8.704238
1	409.9999	92.60447	1.22e-08	-9.707314	-9.355111	-9.565910
2	414.2900	7.847873	1.37e-08	-9.592440	-8.976085	-9.344983
3	462.3053	84.31957	5.31e-09	-10.54403	-9.663526*	-10.19052
4	480.3923	30.43899	4.27e-09	-10.76567	-9.621006	-10.30610*
5	491.0293	17.12300*	4.13e-09*	-10.80559*	-9.396781	-10.23998

Appendix B8: Lag order selection criteria: Misalignment and Automotive and chemical exports equation

In order to test for cointegration, the following VAR was specified:

$X_t = A_0 + A_1X_{t-1} + A_2X_{t-2} + \ldots + A_5X_{t-5} + \varepsilon_t$

Where X_t = AC_EXGDP, RER, AC_PROD, RER_MIS

Lag	LogL	LR	FPE	AIC	SC	HQ
0	254.3698	NA	4.36e-07	-6.130971	-6.042920	-6.095620
1	315.9861	117.2213	1.21e-07	-7.414296	-7.062093	-7.272892
2	318.7231	5.006713	1.41e-07	-7.261540	-6.645185	-7.014083
3	368.1722	86.83738	5.27e-08	-8.248103	-7.367596*	-7.894592
4	382.2409	23.67663*	4.68e-08	-8.371730	-7.227071	-7.912167*
5	391.9474	15.62509	4.63e-08*	-8.388962*	-6.980150	-7.823345

Appendix B9: Lag order selection criteria: Misalignment and Mining exports equation

In order to test for cointegration, the following VAR was specified:

$X_t = A_0 + A_1X_{t-1} + A_2X_{t-2} + \ldots + A_3X_{t-3} + \varepsilon_t$

Where X_t = MINING_EXGDP, RER, MINING_PROD, RER_MIS

Lag	LogL	LR	FPE	AIC	SC	HQ
0	397.3970	NA	1.18e-08	-9.738196	-9.649513	-9.702616
1	437.6455	76.52187	5.47e-09	-10.50976	-10.15503*	-10.36744*
2	447.9661	18.85749	5.30e-09	-10.54237	-9.921590	-10.29331
3	463.0789	26.49401*	4.57e-09*	-10.69331*	-9.806473	-10.33750

Appendix B10: Lag order selection criteria: Misalignment and Machinery and transport equipment exports equation

In order to test for cointegration, the following VAR was specified:

$X_t = A_0 + A_1X_{t-1} + A_2X_{t-2} + \ldots + A_3X_{t-3} + \varepsilon_t$

Where X_t = MACH_EXGDP, RER, MACH_PROD, RER_MIS

Lag	LogL	LR	FPE	AIC	SC	HQ
0	261.2289	NA	3.42e-07	-6.376022	-6.287339	-6.340441
1	314.1729	100.6590	1.15e-07	-7.461060	-7.106327	-7.318736
2	321.9665	14.24011	1.19e-07	-7.431272	-6.810489	-7.182205
3	374.7186	92.47892*	4.05e-08*	-8.511569*	-7.624736*	-8.155760*

Appendix B11: Lag order selection criteria: Misalignment and Agricultural exports equation

In order to test for cointegration, the following VAR was specified:

$X_t = A_0 + A_1X_{t-1} + A_2X_{t-2} + \ldots + A_5X_{t-5} + \varepsilon_t$

Where X_t = AGRIC_EXGDP, RER, AGRIC_PROD, RER_MIS

Lag	LogL	LR	FPE	AIC	SC	HQ
0	478.7159	NA	1.59e-09	-11.74607	-11.65739	-11.71049
1	519.9832	78.45878	7.17e-10	-12.54279	-12.18806*	-12.40047*
2	524.5172	8.284344	8.01e-10	-12.43252	-11.81174	-12.18346
3	536.0154	20.15727	7.55e-10	-12.49421	-11.60737	-12.13840
4	545.4389	15.82221	7.51e-10	-12.50466	-11.35178	-12.04211

5	567.1650	34.86917*	5.52e-10*	-12.81889*	-11.39996	-12.24960

Appendix B12: Diagnostic checks results: RER Misalignment

Test	Null Hypothesis	t-Statistic	Probability
Lagrange Multiplier (LM)	No serial correlation	28.349	0.814
Breusch-Pagan-Godfrey	No conditional heteroscedasticity	5.495	0.358
Jarque-Bera (JB)	There is a normal distribution	2.497	0.286

Appendix B13: Diagnostic checks results: Misalignment and Total Exports

Test	Null Hypothesis	t-Statistic	Probability
Lagrange Multiplier (LM)	No serial correlation	12.542	0.981
Breusch-Pagan-Godfrey	No conditional heteroscedasticity	45.959	0.293
Jarque-Bera (JB)	There is a normal distribution	7.663	0.0216

Appendix B14: Diagnostic checks results: Misalignment and Manufactured goods exports

Test	Null Hypothesis	t-Statistic	Probability
Lagrange Multiplier (LM)	No serial correlation	18.761	0.902
Breusch-Pagan-Godfrey	No conditional heteroscedasticity	5.759	0.056
Jarque-Bera (JB)	There is a normal distribution	13.077	0.017

Appendix B15: Diagnostic checks results: Misalignment and Automotive and chemical exports

Test	Null Hypothesis	t-Statistic	Probability
Lagrange Multiplier (LM)	No serial correlation	10.812	0.928
Breusch-Pagan-Godfrey	No conditional heteroscedasticity	13.465	0.001
Jarque-Bera (JB)	There is a normal distribution	9.922	0.007

Appendix B16: Diagnostic checks results: Misalignment and Mining exports

Test	Null Hypothesis	t-Statistic	Probability
Lagrange Multiplier (LM)	No serial correlation	10.375	0.832
Breusch-Pagan-Godfrey	No conditional heteroscedasticity	2.618	0.269
Jarque-Bera (JB)	There is a normal distribution	8.712	0.012

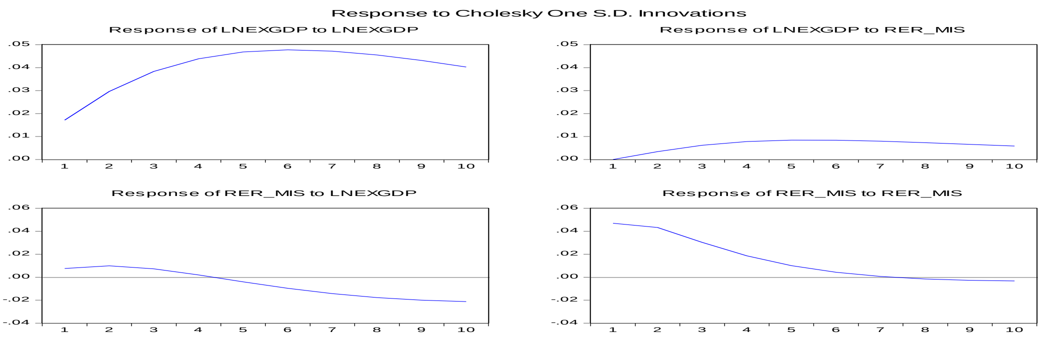
Appendix B17: Diagnostic checks results: Misalignment and Machinery and transport equipment exports

Test	Null Hypothesis	t-Statistic	Probability
Lagrange Multiplier (LM)	No serial correlation	10.718	0.959
Breusch-Pagan-Godfrey	No conditional heteroscedasticity	13.208	0.0014
Jarque-Bera (JB)	There is a normal distribution	2.628	0.268

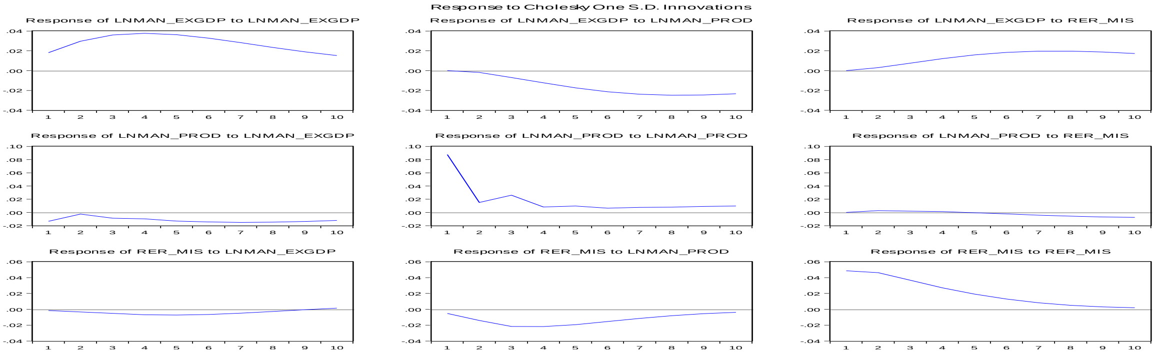
Appendix B18: Diagnostic checks results: Misalignment and Agricultural exports

Test	Null Hypothesis	t-Statistic	Probability
Lagrange Multiplier (LM)	No serial correlation	10.009	0.834
Breusch-Pagan-Godfrey	No conditional heteroscedasticity	4.220	0.121
Jarque-Bera (JB)	There is a normal distribution	5.324	0.069

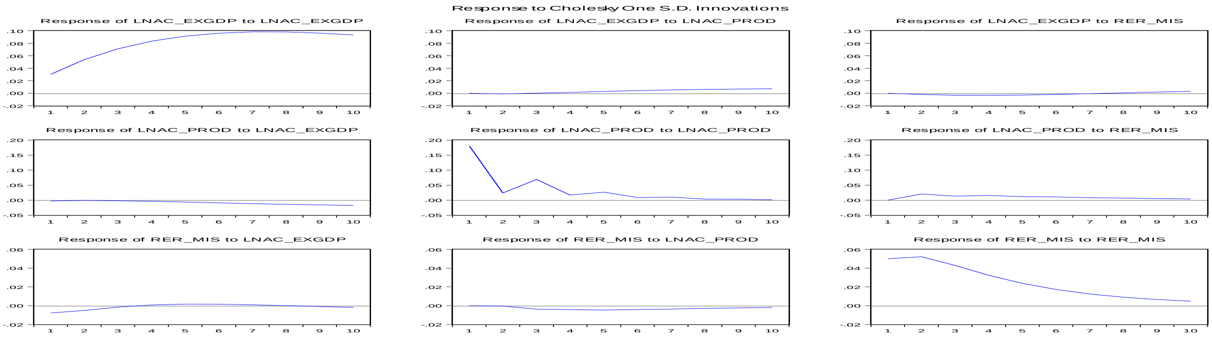
Appendix B19: Impulse response of misalignment and total exports



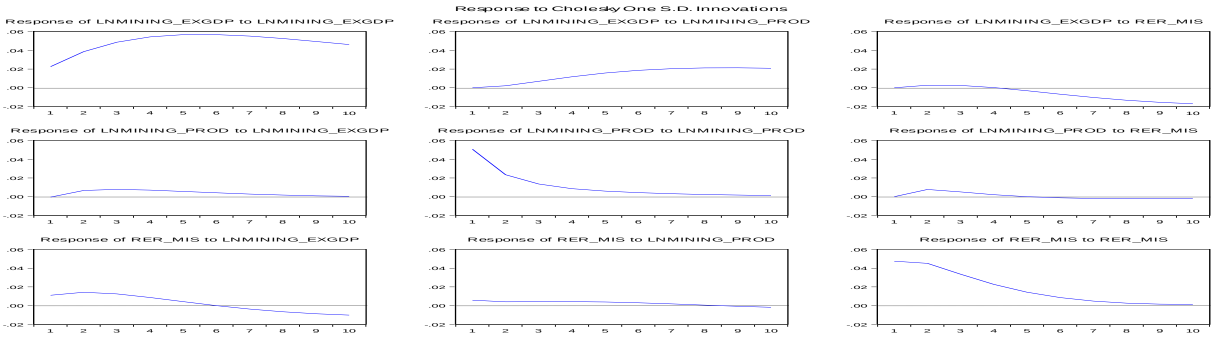
Appendix B20: Impulse response of misalignment and manufactured goods exports



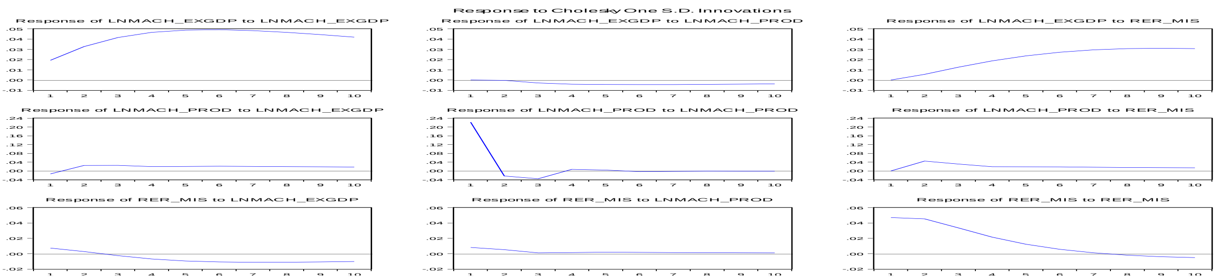
Appendix B21: Impulse response of misalignment and automotive and chemical exports



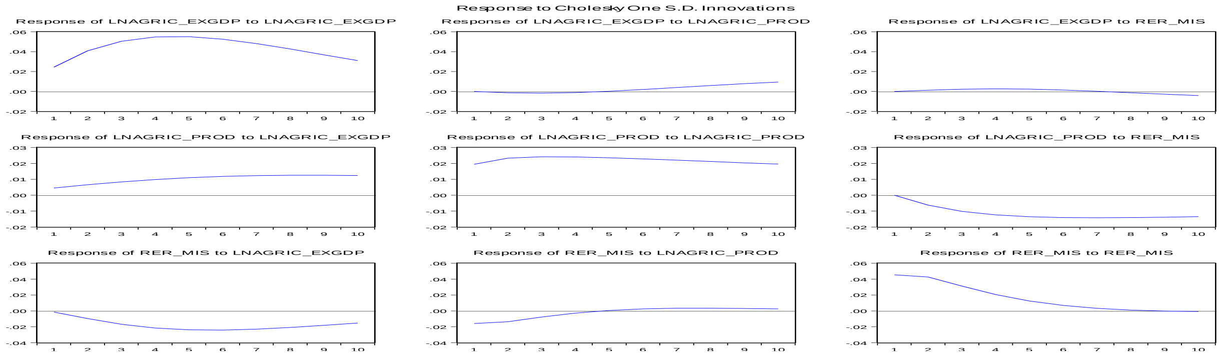
Appendix B22: Impulse response of misalignment and mining exports



Appendix B23: Impulse response of misalignment and machinery and transport equipment exports



Appendix B24: Impulse response of misalignment and agricultural exports



Appendix B25: VECM results

Cointegrating Eq:	CointEq1
LNRER(-1)	1.000000
LNOPEN(-1)	-4.144971
	0.448994
	[-9.23168]
LNTOT(-1)	-1.078051
	0.594273
	[-1.81407]
LNPROD(-1)	1.503814
	0.864729
	[1.73906]
LNGOV(-1)	3.46878
	0.696314
	[4.98163]
LNM2(-1)	-0.515705
	0.109868
	[-4.69386]
C	-18.262252

Error Correction:	D(LNRER)	D(LNOPEN)	D(LNTOT)	D(LNPROD)	D(LNGOV)
CointEq1	-0.232202	-0.039654	0.007508	-0.007002	0.002962
	0.046564	0.014578	0.006226	0.002029	0.005586
	[-4.98662]	[-2.72001]	[1.20588]	[-3.45054]	[0.53038]
R-squared	0.333846	0.615740	0.558709	0.805871	0.596789
Adj. R-squared	0.274063	0.581255	0.519106	0.788449	0.560604
Sum sq. resids	0.164078	0.016083	0.002933	0.000311	0.002361
S.E. equation	0.045864	0.014359	0.006132	0.001998	0.005502
F-statistic	5.584302	17.855369	14.107739	46.256547	16.49249
Log likelihood	147.22679	247.09726	320.26394	416.67539	329.5936
Akaike AIC	-3.237832	-5.560401	-7.261952	-9.504079	-7.47892
Schwarz SC	-3.009521	-5.332090	-7.033640	-9.275767	-7.25061
Mean dependent	-0.004404	0.005280	-0.000683	0.002915	0.000823
S.D. dependent	0.053830	0.022190	0.008843	0.004345	0.008300

Determinant resid covariance ((	1.07219E-25
Determinant resid covariance	5.96787E-26
Log likelihood	1765.30302
Akaike information criterion	-39.797744
Schwarz criterion	-38.256642

Appendix B26: Export of products in the South African export basket to the rest of the world (2000-2015) – (R Million)

Product	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agricultural products	22 702	27 576	35 006	32 060	30 086	33 411	33 572	39 327	58 171	56 349	72 761	80 658	86 236	107 541	123 415	122 200
Fuels and mining products	37 933	77 420	56 531	69 029	80 783	97 616	135 317	180 203	236 430	183 600	235 573	301 541	297 311	352 161	343 608	310 830
Manufactures	97 173	118 345	148 594	136 530	146 551	166 057	185 259	229 083	314 936	212 740	291 375	321 150	351 061	388 613	458 896	422 779
Iron and steel	19 147	18 752	25 353	29 329	36 464	37 347	38 267	52 634	73 241	43 162	58 586	57 591	55 024	59 907	73 741	57 711
Chemicals	14 267	17 416	22 650	18 125	20 378	25 189	26 492	30 621	47 317	34 590	44 783	52 520	60 362	66 212	76 410	71 025
Pharmaceuticals	750	664	1 009	794	781	847	915	1 108	1 620	1 637	3 011	3 553	3 754	4 423	4 850	4 787
Machinery and transport equipment	31 727	45 035	55 280	49 504	51 232	60 976	76 514	94 628	134 157	91 007	119 383	137 821	156 783	172 585	202 831	199 110
Office and telecom equipment	2 839	3 792	4 185	3 571	3 860	3 866	5 109	6 279	7 365	6 066	7 663	8 311	10 078	11 771	16 406	13 531
Electronic data processing and office equipment	979	1 224	1 293	991	813	994	1 809	1 813	2 232	1 822	2 696	2 971	3 844	3 891	4 655	4 187
Telecommunications equipment	1 687	2 189	2 240	2 027	2 356	2 038	2 405	3 457	3 488	2 978	3 502	4 163	5 832	7 503	10 775	7 774
Automotive products	11 858	18 080	25 258	23 474	23 896	27 718	33 220	37 881	63 958	42 918	57 142	61 696	70 892	77 259	94 336	99 823
Textiles	1 645	1 991	2 587	2 254	1 943	1 987	2 046	2 342	2 488	1 907	3 040	3 255	3 499	4 094	4 416	4 161
Total exports R (millions)	**208 153**	**252 133**	**312 550**	**275 979**	**297 867**	**328 802**	**394 156**	**492 357**	**667 783**	**520 351**	**669 203**	**790 561**	**818 133**	**926 395**	**987 919**	**1 042 562**

Appendix C: Editor's declaration

I, Lydia Searle, confirm that l edited **Tapiwa Pasi's** Master's thesis entitled **'The Effects of Real Exchange Rate Misalignment on Exports in South Africa'**. During the process of editing, changes were recommended. It is the responsibility of the candidate to effect these changes since he remains the author of this document.

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