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The Real Exchange Rate Performance and Economic Growth in South Africa: 1990 - 2016

By

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DECLARATION

I, the undersigned, Welcome Simthembile Gwantshu, at this moment state that this research is my original work except for quotations and references whose sources are acknowledged, and it has never been presented at any other University for any similar degree award.

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DEDICATION

I would like to dedicate this work to my late father, Mvikwa Gwantshu, who firmly believed that education is the key to success and my lovely daughter, Sinikwento Latita Sitena. Most importantly, I would like to dedicate this dissertation to my partner, Pelisa Vanda, as thanks for her encouragement, support and inspiration.

ABSTRACT

This study estimates the impact of the real exchange rate's performance on economic growth in South Africa from 1990 to 2016 based on quarterly data. A review of the literature reveals that the real exchange rate can have either a positive or a negative effect on economic growth. The empirical analysis began with testing for stationarity of the variables by applying the Augmented Dickey-Fuller (ADF) and Phillips Peron (PP) tests. This was followed by the co-integration test of the model.

The unit root test results show that all variables except the exchange rate were integrated at order one, that is I (1), while exchange rate volatility is integrated at order zero that is I(O). Also, the co-integration analysis indicated that variables are co-integrated. Employing the Vector Error Correction Model (VECM) technique to estimate the results, the relationship between real exchange rate and economic growth was estimated. Findings further show that in the short run, economic growth is positively responsive to the real exchange rate while in the long run, a negative relationship exists between the two variables.

The results in the short run suggest that the exchange rate hurts economic growth. A 1% point increase in the real exchange rate (RER) causes a reduction in economic growth by 379 per cent. A rise in the RER affects the trade balances between exports and imports, which results in more imports in the country than exports and the devaluation of the rand stipulates imports in the short run, which leads to the gross domestic product to increase.

The study recommends that the South African Reserve Bank (SARB) Monetary Committee, together with the South African government, should develop a policy that will pursue a prudent monetary policy. A stabilise real exchange rate will enhance the economic activities that will attract foreign direct investment (FDI) and create an environment conducive to investment that will boost economic growth of South Africa.

KEYWORDS: Economic growth, real exchange rate, Johansen Co-integration, Vector Error Correction Model (VECM), South Africa.

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LIST OF ACRONYMS

ACF	Auto-Correlation Function
ADP	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
ASGISA	Acceleration and Shared Growth Initiative for South Africa
CPI	Consumer Price Index
DF	Dickey-Fuller
DTI	Department of Trade and Industry
GARCH	Generalised Auto-regression Condition Heteroscedasticity
GDP	Gross Domestic Product
GEAR	Growth Employment and Redistribution
GFI	Gross Fixed Investment
INF	Inflation
J-B	Jarque-Bera
LM	Lagrange Multiplier
NGP	New Growth Path
OLS	Ordinary Least Squares
PP	Phillips Peron
R&D	Research and Development
RER	Real Exchange Rate
RIR	Real Interest Rate
SA	South Africa

SARB	South African Reserve Bank
SARS	South African Revenue Services
TFD	Total Factor Productivity
TRD	Trade Openness
VAR	Vector Auto-regression
VECM	Vector Error Correction Model

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CHAPTER 1: INTRODUCTION

1.1 Background

Before the dawn of the democracy in 1994, South Africa was confronted by sanctions. The sanctions worked in favour of South Africa because it was forced to produce goods and services that could not be imported. The manufacturing industry was thus able to supply the domestic markets. During the apartheid years, the South African economy was closed, and trade between it and other countries was minimal. Strict measures that control the inflow of money into the country were put in place, which caused the country to have a little money that circulated in the economy. The significant of this sanction led South Africa to develop a robust system of banking. Technical skills were segregated amongst the minority of the apartheid regime. For example, access to basic needs, facilities and income were not equally distributed. With the little history provided above, now the focus shifts to the South African economy since the rise of democracy. This includes GDP growth rates, inflation and real exchange rate performance.

This study looks at the performance of the South African economy before and after the democracy. For the past 25 years, the South Africa economy has been experiencing slow growth and stagnating prosperity around zero growth. The challenge of slow growth is that population growth outpaces economic growth, which leads the citizens of South African to become impoverished over the period. This is measured by GDP per Capita, which is expressed by GDP divided by the residents of the country.

During 1994 to 1999 in the first democratic government, the South African economy manifested a massive growth in Foreign Direct Investment (FDI). With the confidence of investors and the economic sanctions being withdrawn, foreign businesses could reinvest. For the last few years, the Foreign Direct Investments (FDI) are considered as an important source of inflows in many developing countries and they contribute to the economic growth of a country. The foreign investment may

occur in different forms such as direct investment, portfolio investment, private capital flows, etcetera. A country receiving FDI is not only receiving the direct benefits of foreign inflows but also indirectly it can get the benefits of sharing knowledge, skills, experiences, technology, and so on. The foreign investors come into the domestic economy with the expectation of higher returns; however, they are exposed to different types of risks including exchange rate risk, political risk and legal risk as well.

One of the important influences on FDI activity is the behaviour of exchange rates. Exchange rates, defined as the domestic currency price of a foreign currency, matter both in terms of their levels and in terms of their volatility. FDI causes a demand increase for domestic currency that causes an upward shift in exports and international trade as sanctions were lifted. The South African economy increased by an average of 2.5% and inflation averaged at 8% per year (SARB, 2008).

Since 1994 with the coming in of a new political dispensation and the beginning of democracy, there have been some expansions in economic growth in South Africa, even though the said economic growth has remained stable averaging almost 3% per annum. Democracy resulted in the South African economy growing at a steady rate between 1997 and 2010. This growth rate, although at low levels, was because of some macroeconomic policies that were adopted in South Africa, namely, GEAR, ASGISA, and NGP, to mention a few.

These macroeconomic policies have played an essential part in sustaining economic development that also actually led to a rise in the South African GDP (Mtonga, 2011; Smit and Du Plessis, 2007. However, despite this consistent growth from 1997 to 2010, it has been noted that South Africa's GDP has been growing at a decreasing rate for the last decade due to various economic and non-economic factors. Statistics indicate this decrease has been on a consistent path from 2011 to date, after the resurgence from the recession of 2008, which had a detrimental effect on most economies. Nonetheless, researchers have argued that worsening macroeconomic aggregates have been considered to have a more adverse push-effect on economic

growth. It has, therefore, become pertinent that the traditional variables that have been the focus of macroeconomic policies should not be the only focus for policymakers.

The challenge of the real exchange rate has an anticipated impact on economic growth. The relations amongst the RER, INF and GDP have been especially significant in the economy. The argument of a slowly adjusting nominal exchange rate, together with high and rising inflation creates a typical problem, which is that the central bank manages to preserve price constancy. The ambiguity of overvaluation of RER has a drawback in export improvements and means possible future growth is not realised.

1.2 Research Problem

The appreciation of the domestic currency discourages the willingness of foreign investors to invest in a country. Bhoma et al. (2013) argue that when a country's currency demand increases, the stronger it is. Other factors determine the exchange rate, and this make an environment conducive to economic growth. Foreign Direct Investment (FDI) in the past years has been deteriorating, and economic growth has been growing at a slow rate.

A stable long-term economic growth requires stable trade and foreign exchange markets to ensure a stable exchange rate system and favourable terms of trade, in addition to appropriate basic physical capital stock. However, often RER performance affects economic growth. In developing countries, RER has often taken the form of overvaluation, which adversely affects the tradable goods by lowering producers' real prices. The RER, for instance, occurs in markets in which actual ERs are not allowed to adjust to changes in economic fundamentals (Thapa, 2002), consequently reducing the incentives and profits, leading to a decline in investment and export volumes.

The general objectives of this research are to investigate the critical part of the RER that affects GDP in South Africa. There is, however, a divergence in the views of experts about the relationship between GDP and RER in South Africa within the period under investigation. Consequently, the specific objectives of the study are as follows:

1.2.1 Research Objectives

1) To review the trends and performance of the Macroeconomic variables in South Africa.

2) To estimate the impact of real exchange rates on the economic growth of South Africa.

1.3 The Relevance of the Study

The study explores how the RER had an impact on the GDP in South Africa during the period from1990 to 2016. In this arena, the research serves to shed light on the relationship that exists between RER and GDP. It is an ongoing public and academic discourse as to whether or not the exchange rate's volatility leads to negative GDP in South Africa (Wakeford, 2008). Moreover, the RER has not been the centre of the analysis of GDP. Neoclassical growth models, in the first generation, starting with Solow (1957), have not featured or practically affected policy incarnation; for example, Rostow (1960) which focuses on the determinants of savings and investments. The results of the prior research on the effect of RER on GDP are thus inconclusive (Loungani, 1992). The outcomes of this research will contribute towards the formulation of policy and planning in all spheres of government, the business community and the banking sector, as well as labour unions.

1.4 Chapters Outline

- CHAPTER 1 Introduction and background: This chapter introduces the research and presents the problem statement, the purpose of the study, research objectives and questions.
- CHAPTER 2 Review of relevant literature: In this chapter, the theory surrounding the research problem and research constructs is reviewed.
- CHAPTER 3 Theoretical framework and conceptual design are discussed.
- CHAPTER 4 Research methodology: This chapter describes the methods used for data collection and the design of the research instrument as well as justification for analysis.
- CHAPTER 5 Findings and analysis: This chapter is concerned with analysing data obtained and discussing the results of the research.
- CHAPTER 6 Conclusions and recommendations: This chapter concludes the research in terms of the problem statement and arguments generated from the findings and includes recommendations.

CHAPTER 2: REVIEW OF RELEVANT LITERATURE

The main aims of this section are to explore work done by others and the various approaches of other studies applied in this field to detect any current gaps in the literature. This chapter focuses on evaluating the available literature that focuses on the RER performance and GDP within South Africa and seeks to review research work on the various components of the subject matter. According to Becker (2000), a literature review is the collection of academic appraisal material of various scholars on a specific topic; hence, this chapter discusses the thoughts of multiple scholars.

2.1 THEORETICAL LITERATURE

2.1.1 Objective 1: To review the trends and performance of macroeconomic variables in South Africa.

Mbaye (2012) argues that the expansion of overall savings and investments ultimately depends on the capital stock increase in the economy, capital accumulation and increase in the tradable goods sector. The exchange rate and savings rates devaluation emanate from a devalued real exchange rate that increases aggregate demand from traded to non-traded goods, while an increase of interest rates demands keep the internal balance (Montiel and Serven, 2008). The rise in interest rates pressures aggregates demand in part by floating the local savings rate. At this point, causality turns the exchange rate via the real interest rate to the savings rate, causing an improvement in GDP.

The prevalent feeling of the real interest rates is that interest rates reflect a dimension of capital profitability, which directs the capital interest, and the powers behind sparing conduct (Kahn and Farrell, 2015). Keynesian perspectives are that the interest rates are resolved in financial exchanges as portfolio holders choose among innocuous and dangerous resources and settle on strategic decisions. The old-

fashioned view is that the real interest rates are made resolute by the basics of efficiency and economy (Kahn and Farrell, 2015).

Bernank (2013) argues that once the exchange rate increases those perceived as lasting and causes a decrease in private investments. Furthermore, if the devaluation of the rand persists, imports will be more costly in production, the potential output falls due to the decrease in both capital and labour productivity. The reasoning is that an increase in the capital stock means production will decrease due to the returns on capital. This happens through the equilibrium level that cannot raise the ratio of capital to production. Also, in the long run, productivity investment is not possible, and the stability on returns is temporary.

Ever since the dawn of democracy in South Africa in 1994, there have been some improvements in economic growth in South Africa, while economic growth has remained stable, averaging almost 3% per annum. This means the South African economy grew at a prolonged rate between the periods 1997 to 2010. The growth rate was positive, although at low levels, which was due to some macroeconomic policies such as GEAR, ASGISA, and NGP being adopted in South Africa. Macroeconomic policies also played an essential role in the sustainable economic growth that also actually led to an increase in the South African GDP (Mtonga, 2011, Smit and Du Plessis, 2007).

This theory includes the suggestion that the growth level will be steady in the economy. Dornbusch et al. (1999) argue that the stable state and the per capita production are persistent. Nattras (1997) states that there are assumptions that the exogenous growth model has a weakness because it assumes there are perfect competition markets.

Lydall (1998) strongly believes that with assumptions, the maximum allocation of resources will be achieved through market forces. Lydall also argues that the limitation of this theory is that neoclassical theorists have confidence that markets do not fail to clear. Thus, little government mediation is required. Lydall

(1998) demonstrates that in real economic conditions, markets must control the variables at play. At some point, some groups have power in other markets.

2.1.2 Objective 2: **To estimate the impact of the real exchange rate on the economic growth of South Africa.**

Economic growth and depreciation of the rand show that there is a positive correlation between the two. The concept is commonly known as the traditional view. This approach believes that the devaluation of the currency increases the demand for exported goods which cost less in foreign markets and domestic goods will increase in production, causing an increase in exports (Salvatore, 2005). The view that the devaluation of the rand has a positive influence on GDP is evident in that a depreciation of the currency improves trade balances, alleviates the balance of payments complications and consequently expands productivity and employment (Acar, 2000). The case for devaluation is that once a nation devalues its exchange rates, it enhances the price competitiveness on trade, which is a component of gross domestic product.

The relation between production work to development is concluded as economy wide output efficiency, caused by the manufacture of certain kinds of exported goods (exported manufactured goods), that emanates through technology and research and development (Montiel and Serven, 2008). This shift to the production of traded goods and enhancements in technology increases investments domestically, as well as exports and eventually economic growth. Eichengreen (2008) argues that the structure of the domestic output is the core analysis of the total factor productivity growth channel. A depreciated real exchange rate is equivalent to a rise in the value of tradable, comparative to non-tradable, goods and expands the cost-effectiveness of the tradable sector.

Acar (2000) explains that currency depreciation changes the demand from imported goods to the home country's products by raising the relative price of imported goods. Export manufacturing industries, on the other hand, become very

economical by increasing domestic manufacturing of exporting goods and encouraging their home country productions to employ more local factors of production.

Dabla-Norris and Floerkemeier (2005) are of the view that variations in exchange rates affect aggregate demand through enhancements in international affordability, as well as net exports. In other words, when the Rand weakens against other currencies, local people opt for domestic goods. Thus, the manufacturing sector improves the economy. However, the country exports more and imports less, resulting in favourable net exports.

Ngandu and Gebreselasie (2006) further explain that increases in exported goods, through the multiplier effect, mean that aggregate demand is estimated to rise, and eventually, local manufacturing and unemployment will decrease. Depreciation causes inflation, a general increase in price levels tend to lower the real wage which also leads to more workers being employed, and output will be increased. The criticism levelled against the Total Factor Productivity Growth (TFP) Channel is that it does not provide precise ways in which it operates except for the learning by assuming. Also, it lacks empirical support.

Mbaye (2012), for example, discusses that there is no practical examination within the TFP transmission channel regarding the insignificance of exchange rate devaluation on growth. The subsequent channel under the traditional approach, which appears to be extensive, is accepted by policies that link lowering the exchange rate that causes an increase in growth through the impact of local savings rates (Montiel and Serven, 2008). Under this channel, the lowered exchange rate increases the local rate of savings, which in turn stimulates the capital rate.

The capital accumulation approach states that exchange rates affect economic growth through their effect on savings. This approach claims that a real exchange rate devaluation improves growth through a rise in the capital stock of the economy (Mbaye, 2012). A shortcoming of this view is that a devalued exchange rate tends to

raise the local saving rate. The higher rate of savings induced by depreciation stimulates GDP by improving the rate of capital accumulation.

Montiel and Serven (2008) further argue that there is not a precise concept that depicts how the channel effect is caused. However, it is widely known in policy circles that savings are the channel of transmission. It is believed that devalued exchange rates increase the local savings rate, which tends to boost growth through an increase in capital accumulation. The capital accumulation channel depicts that there are two sources of capital accumulation.

2.2 Empirical Literature

2.2.1 Objective 1: **To review the trends and performance of macroeconomic variables in South Africa.**

Evans Agalega and Samuel Antwi, (2013) conducted research to draw the evidence of macroeconomic indicators in Ghana's economy. The study covers the period from 1980 to 2010; the main objective of the study was to examine the impact of macroeconomic indicators on GDP. The data was collected by Ghana Statistical Services and the Institute of Statistical, Social and Economic Research. Linear regression was used to regress variables, such as IR, IF against the GDP. The study reveals that there was a strong association between inflation and interest rate to GDP, and research confirms that there was an adverse correlation between IR and GDP and IF was positive.

Abid Hussain et al. (2016) researched the effect of macroeconomic indicators on economic performance in an empirical study of India and Sri Lanka. The research studied the patterns of macroeconomic indicators in Sri Lanka and India from the year 2002 to 2009 and examined the impact on GDP. The study recommends that the subject of financial markets still needs extensive analysis and more research attention.

Anwar Ali Shah et al. (2014) study the effects of macroeconomic variables on GDP. After the independence in Pakistan, the size of GDP and Per Capita GDP was reduced and improved over time in 1990. The study covers 64 districts in Pakistan, and the effects of these macroeconomic indicators were included in the year 2010-2011. The results show that the variables that have a direct impact on GDP have been classified into three factors; these are agriculture, infrastructure factors, fishing, and mining. The comparison of the above factors' scores reflects the significance of GDP.

2.2.2 Objective 2: **To estimate the impact of real exchange rate on Economic Growth of South Africa.**

Tarawalie (2015) employed econometric techniques using quarterly data to find the relationship between real exchange rates on economic growth in Sierra Leone. He also used a bivariate Granger causality test to find causality between the real exchange rate and economic performance. The results reveal that the real effective exchange rate has a positive correlation with economic growth, and coefficients were statistically significant. These outcomes, which indicate a positive association between economic growth and real effective exchange rate, are supported by the Balassa-Samuelson hypothesis. Empirically the study matches that of Ito and Krueger (1999), who found a positive correlation between the exchange rate and GDP in Japan and Chile.

Ndlela (2013) examined the ramifications of real exchange rate misalignment in developing countries with specific reference to development execution in Zimbabwe. The examination pursued the ARDL (autoregressive circulated slack) way to deal with the cointegration technique. The first bit of leeway of the ARDL strategy is that it very well may be connected regardless of whether the factors are I (0), I(1) or partially coordinated. The significant discoveries reveal that exchange rate misalignment has a negative and very factually huge effect on development.

Likewise, the outcomes bolster the thought that the real exchange rate overvaluation was vital in the post-2000 financial development compression in Zimbabwe.

Masunda (2016) explored the effect of exchange rate misalignment on sectoral yield in Zimbabwe. To accomplish this, the attainable summed up least squares panel data techniques, utilising data from 1980 to 2003, and sectors in Zimbabwe were used as a sample. The divisions that were incorporated into the investigation were mining, producing and horticulture. The examination demonstrated that the real exchange rate misalignment is damaging to sectoral creation. The discoveries of the study were acknowledged contrarily influenced the sectoral output, even though the real exchange overvaluation unfavourably and extensively affected sectoral output.

McPherson and Rakovski (2010) studied the real and nominal exchange rates and GDP growth in Kenya for the period 1970 to 1996 and their indirect and direct relationship. Several methodologies were used as follows: VAR model test and co-integration techniques used as a single equation regression and as a system of simultaneous equations. The outcomes of the research revealed no indication of a statistically significant reliable direct link amongst changes in exchange rates and GDP. However, growth responded to fiscal, monetary policy and foreign aid. The results of this study is supported by the theories reviewed in the above section.

Acar (2014) investigated the effects of depreciation on output growth in Less Developed Countries (LDCs). Panel data used 18 sample countries in the study. Countries were divided into groups and in two separate regressions, and then analysis piloted. The first group of ten countries were analysed in the manufacturing exported goods and agricultural products and estimated for 25 years. The findings show that depreciation of the real exchange rate has a contrary impact on production in the initial years while it has an expansionary effect in the following years.

Chen (2012) conducted a study to investigate the importance of the real exchange rate on economic growth and the convergence of growth rates in the regions of China. The Generalised Method of Moments (GMM) was employed in the study. A

dynamic panel data estimation was used for 28 Chinese areas between 1992 and 2008. The result of the study was that there is evidence that the appreciation of the real exchange rate improved economic growth in those provinces. The GMM technique used in this study determines a more significant performance on finite samples.

Bond, Hoeffler and Temple (2001) claim that the strength of GMM lies in that it has the possibility of attaining constant parameter estimators in the endogenous variables and the presence of measurement error. The study reveals that economic growth improves through the appreciation of the exchange rate and supports the Balassa-Samuelson Hypothesis that the real exchange rate and economic growth have a positive association. However, their results were not consistent with Rodrick (2008). The latter found that depreciations are expansionary to growth using data for developing countries that contained 184 nation and eleven five year periods for emerging economies from 1950-1954 up until 2000-2004.

Jaussaud and Rey (2009) explored the long run determinants of Japanese Exports to China and the United States from 1971 through 2007. The investigation utilised the ARCH (Autoregressive Conditional Heteroscedasticity) and the GARCH (Generalised ARCH) model. The outcomes demonstrated that the Japanese merchandise to China and the United States relies upon the genuine conversion scale unpredictability and universal interest (Gross Domestic Product of the nation of goal). Generally, the real exchange rate instabilities and GDP have adverse effects. In particular, an actual increase in the yen's exchange rate and a more significant ambiguity has 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. Also, the results of the study are consistent with Edwards and Garlick's (2007) findings that the volumes of trade are sensitive to real exchange rate movements.

Ito and Krueger (1999), examine the Balassa-Samuelson Hypothesis by investigating the correlation between changes in the real exchange rate and the growth rate in APEC nations and economies. The study showed that with economic growth and appreciation of exchange rates, which are a hallmark of the Balassa-Samuelson hypothesis, in Japan there was a positive effect on growth, although in Chile, it was insignificant. Malaysia and Thailand exhibited a higher growth rate through the depreciation of their exchange rates. The results of Jaussaud and Rey (2009), Ito, and Krueger (1999) differ in Japan and Chile but are consistent for Thailand and Malaysia.

Razin and Collins (2007) conducted a study from a large sample of developed and developing countries looking at the misalignments of the exchange rate and economic growth. The study investigated exchange rate fluctuations about the nation's growth rates. The results show that appreciation of exchange rates reduces the economic growth and depreciation is associated with rapid economic growth. The outcomes of the study are supported by the traditional theory of exchange rates, in that depreciations are associated with rapid growth; however, the results are not consistent with the results found for developed countries. For instance, Kalyoncu, Artan, Tezekici and Ozturk (2008) assessed the long and short run effects of real exchange rate depreciation on output level in OECD countries. The findings were opposite to Razin and Collins (1997) and were not the same as in the long run, while devaluation of the currency hurt a production increase in Austria, Poland and Switzerland while another three countries viz, Finland, Sweden and Germany, found a positive relationship. Depreciation of exchange rates caused a negative impact on output for Finland in the short run while a reduction imposed positive effects on production growth in Switzerland and Hungary.

Vieira and MacDonald (2010) empirically investigated the relationship between real exchange rate misalignment and long run economic growth in 100 countries and panel data was employed in the study. The findings showed that the two-step system GMM panel growth models' coefficients were statistically significant

on real exchange misalignment and had a positive effect in different models and samples. The depreciation of the exchange rate improves economic growth in the long run. The coefficients were measurably noteworthy in developing and evolving nations. Considering everything, the analyses in the developing countries are uncertain about the effect of exchange rate on growth.

The empirical literature from developing countries shows mixed outcomes about the effect of real exchange rates on monetary development. Chen (2012), for instance, agreed with the Balassa-Samuelson theory that trade rates have a positive effect of on monetary growth. Razin and Collins (1997) on the other hand, demonstrate that trade overvaluations are aligned with lower development, which is the customary way to deal with trade rates. Jaussaud and Rey (2009) additionally affirmed the customary strategy in that Japanese fares to China and the United States were found to decrease if money increased in value. This influenced development contrarily. Vieira and MacDonald's (2010) discoveries were that a further depreciated (esteemed) real exchange rate benefits (destroys) future development. It ought to be noted, that however, there is no accord; numerous investigations affirmed that cash overvaluations are related to lower growth.

Aguirre and Calderon (2005) evaluated the growth effects of real exchange rates (RER) misalignments and their volatility. Real exchange rates misalignments are calculated as the deviances of actual exchange rates from their equilibrium. The study covered the period 1965-2003 for 60 countries using panel and time series co-integration methods. The study employed the dynamic data techniques, and the findings of the study were that real exchange misalignments negatively affect growth though the effects are non-linear; for instance, growth declines are more substantial in direct proportion with the size of the misalignments. The study is other findings were that although larger undervaluation hinder growth, small to moderate currency undervaluations enhance growth. The different result is that growth is hampered by highly volatile real exchange rate misalignments.

2.3 Summary of Reviewed Literature

2.3.1 Objective 1: **To review the trends and performance of macroeconomic variables in South Africa.**

Salient Points

The literature review focused on the theoretical literature that shows the link between macroeconomic indicators and economic growth, and this helped to identify potential variables that must be included in the study and other integral components that are relevant to the study. The first part looked at the traditional exchange rate approach, which holds that devaluation of a country's currency is expansionary in the economy; the Structuralist approach, alternatively, maintains that a currency devaluation is contractionary. The second part attempted to discuss the various theories and models that are relevant to the study.

There is ongoing public and academic discourse as to whether or not the macroeconomic indicators lead to negative economic growth in South Africa (Wakeford, 2008). The results of the previous studies on the impact of macroeconomic indicators on economic growth are inconclusive (Loungani, 1992). The outcomes of this study will help policy authorities in devising effective growth strategies, which will be informed by scientific research.

South African policy responses towards inflation resulting from consumer price shock are always followed by many controversies from various sectors of the economy. For example, during the price hikes in 2008, the policy response from the South African Reserve Bank was condemned as an ill-informed policy, as the Reserve Bank continued to increase the interest rate to reduce inflationary pressures to the detriment of domestic economic activity (South African Good News, 2008).

Similarities

The second part explored empirical studies conducted by previous researchers on the impacts of macroeconomic indicators on economic growth in developing and developed nations. The studies reviewed employed several quantitative models to test the effect of economic indicators on economic growth.

Differences

The link between the devalued exchange rate and the saving rate emanates from a devalued real exchange rate that increases aggregate demand from traded to non-traded goods, demanding an increase in the interest rate to keep the internal balance (Montiel and Serven, 2008). Bernank (1983) argues that once the exchange rate increases, those perceived as permanent, private investments also decrease. Moreover, if the devaluation of the rand persists, imports will be more severely affected in that production, capital and labour productivity both decrease and potential output falls.

Gaps Identified

The empirical literature on the effect of the exchange rate on economic development in South Africa is mindful principally because of the effect of the exchange rate on exports; for example, the studies of Todani and Munyama, 2005; Raddatz, 2008; Edwards and Garlick, 2007. The findings of these studies propose that exchange rate instability contrarily influences trade in South Africa.

Few studies have been conducted which try to explain the relationship between macroeconomic indicators and economic growth in the South African context. Most of the researchers' studies focus on a single variable about economic growth. This research will focus on a group of variables and their effects on economic growth.

2.3.2 Objective 2: **To estimate the impact of a real exchange rate on the economic growth of South Africa.**

Salient Points

The capital accumulation approach states that exchange rates affect economic growth concluded their effect on savings. This approach claims that a real exchange rate undervaluation enhances growth through an increase in the capital stock of the economy (Mbaye, 2012).

Differences

A reduced real exchange rate, proportional to an ascent in the estimation of tradable relative to non-tradable activity, improves the productivity of the tradable segment. As job creation moves from the non-tradable to the tradable division identified by higher (negligible social) profitability levels, the general efficiency in the economy increases, thus such economy-wide efficiency improvements eventually encourage development (Mbaye, 2012).

Acar (2000) explains that currency depreciation changes from demand for imported goods to the home country's products by raising the relative price of imported goods. Export manufacturing industries, on the other hand, become very economical by increasing domestic manufacturing of exporting goods and encouraging their home country productions to employ more local factors of production.

Bond et al. (2001) claim that the strength of this GMM lies in that it has the possibility for attaining constant parameter estimators even in the presence of measurement error and endogenous variables. The study reveals that exchange rate depreciation has a positive impact on growth and supports the Balassa-Samuelson Hypothesis, which postulates there is a significant association between GDP and the real exchange rate. However, Bond et al outcomes are not consistent with Rodrick (2008). The latter found that depreciations are expansionary to growth from his study

using data for developing countries that contained 184 nation and eleven five year periods from 1950-1954 until 2000-2004 for developing countries.

The capital accumulation approach states that exchange rates affect economic growth through their effect on savings. This method indicates that economic growth improves through the depreciation of the exchange rate and capital stock increases (Mbaye, 2012). The shortcoming of this view is that a devalued exchange rate tends to raise the local savings rate. The higher rate of savings induced by depreciation stimulates GDP by improving the standard of Capital Accumulation.

Montiel and Serven (2008) argue that there is not a precise concept that depicts how the channel effect is caused. However, it is widely known in policy circles that savings are the channel of transmission. It is believed that devalued exchange rates increase the local savings rate, which tends to boost growth through an increase in capital accumulation. The capital accumulation channel depicts that there are two sources of capital accumulation.

Tarawalie (2015) employed econometric techniques using quarterly data in Sierra Leone to look at the link between GDP and real effective exchange rates. He also applied a bivariate Granger causality test to find causality in the two variables. The outcomes reveal that the exchange rate has a positive correlation with economic growth, and coefficients were statistically significant. The Balassa-Samuelson hypothesis supports the results, which show a positive relationship between real effective exchange rates and GDP. Empirically the research matches with Ito and Krueger (1999), who found a correlation between the exchange rate and GDP in Japan and Chile.

Ndlela (2013) examined the ramifications of real exchange rate misalignments in developing nations with specific reference to development execution in Zimbabwe. The examination pursued the ARDL (autoregressive appropriated slack) way to deal with the co-integration technique. The first advantage of the ARDL strategy is that it very well may be connected regardless of whether the factors are I (0), I(1) or

partially coordinated. The fundamental discoveries demonstrate that exchange rate misalignment applies a negative and exceptionally huge effect on development. Likewise, the outcomes bolster the thought that real exchange rate overvaluation was a key influence in the post-2000 economic growth constriction in Zimbabwe.

Masunda (2016) researched the effect of exchange rate misalignment on sectoral yield in Zimbabwe. To accomplish this, he utilised the possible summed up least squares panel data procedures utilising data from 1980 to 2003; Zimbabwean sectors were used as a sample. The areas that were incorporated into the examination were mining, manufacturing and the agribusiness part. The analysis demonstrated that real exchange rate misalignment is dangerous to sectoral creation. The discoveries of the investigation have contrarily influenced the sectoral output, even though the exchange rate overvaluation negatively and impressively affected sectoral output.

Similarities

Studies imply that economic growth and depreciation have a positive effect. The concept is commonly known as the traditional view. This approach assumes that devaluation of the currency increases the demand for exported goods, as they cost less for foreign and markets and domestic goods manufacture will increase which causes an increase in exports (Salvatore, 2005). The view that depreciation positively affects GDP is evidence that the devaluation of the currency improves trade balances, alleviates the balance of payments complications and consequently expands productivity and employment (Acar, 2000).

Tarawalie (2015) employed econometric techniques using quarterly data in Sierra Leone to look at the link between GDP and real effective exchange rates. He also applied a bivariate Granger causality test to find causality in the two variables. The outcomes reveal that exchange rate has a positive correlation with economic growth, and coefficients were statistically significant. Balassa-Samuelson hypothesis supports the results, which show a positive relationship between real effective exchange rate and GDP.

CHAPTER 3: THEORETICAL FRAMEWORK AND CONCEPTUAL DESIGN

3.1 Theoretical Framework

3.1.1 Capital Accumulative Growth Channel

The capital accumulation approach states that exchange rates affect economic growth through their effect on savings. This method claims that economic growth improved through the capital stock increase and the devaluation of the exchange rate (Mbaye, 2012). A shortcoming of this view is that local savings rates tend to increase because of a devalued exchange rate. The greater rate of savings induced by depreciation stimulates GDP by improving the speed of capital accumulation.

3.1.2 The Total Factor Productivity Growth Channel

The Total Factor Productivity Growth Channel states that currency depreciation shifts the output components of a nation from the production of non-traded goods to imported goods. The relation between production work to development is economy-wide output efficiency, caused by the manufacture of certain kinds of exported goods (exported manufactured goods) that emanate through technology and research and development (Montiel and Serven, 2008). This change to the production of traded products and improvements in knowledge outcomes results in an increase in investments domestically, exports and ultimately economic growth.

Eichengreen (2008) argues that household structure is at the centre of the analysis through the TFP growth channels. A devalued real exchange rate, equal to an ascent in the estimation of tradable near to non-tradable goods, improves the gainfulness of the tradable division. As development moves from the non-tradable to the tradable part portrayed by (minimal social) generation levels the general yield in the economy surges, and such economy-wide yield advancement, in the long-run, raises development (Mbaye, 2012).

3.1.3 The Traditional Approach to Exchange Rates

Studies reveal that depreciation has a positive effect on economic growth. The concept is commonly known as the traditional view. The conventional approach is that devaluation of the currency increases the demand for exported goods, which cost less in foreign markets, and domestic goods will increase which causes an increase in exports (Salvatore, 2005). The view that depreciation has a positive effect on GDP is evident in that depreciation of the currency improves trade balances, alleviates the balance of payments complications and consequently expands productivity and employment (Acar, 2000). The case for devaluation is that once a nation devalues its exchange rates, it enhances the price competitiveness on trades, which are a component of gross domestic product.

3.1.4 The Harrod- Domar theory

The Harrod-Domar theory perceives growth as the result of investment and savings and equilibrium in both. The model was established by the Sir Rev. F. Harrod in 1939 and Evsey Domar in 1946. Harrod was from England while Domar was from the United States (US) and both independently formulated the model. Furthermore, the Harrod-Domar model is the predecessor of the exogenous growth model. This theory operates under the assumption that the economy under study is a closed economy, and there is no government intervention, and there is no depreciation on existing capital so that all investments are net investments and all investments (I) come from savings (S).

The Harrod-Domar model considers development to be the result of the harmony among savings and investment. The model recommends that the economy's rate of growth relies upon the dimension of reserve funds and the efficiency of the venture; for instance, the capital-yield proportion. As per the Harrod-Domar, this model incorporates the justified development and the rate of yield development at

which firms accept to have the right measure of capital and along these lines, do not increase or deteriorate the investment.

The Harrod- Domar model makes some assumptions; one of them, which is the model, shows the mathematical growth model.

The output is a function of capital stock, thus:

$$Y = f(K)$$

Where,

Y = Gross Domestic Product, and

K = Level of Capital Stock

The production function illustrates constant returns to scale. That means the marginal product of capital is consistent, which implies the marginal and average products of capital are equal. Mathematically this is the assumption presented:

$$\frac{dY}{dK} = c \Rightarrow \frac{dY}{dK} = \frac{Y}{K}; \quad \text{(where c is the constant)}$$

The production of the savings rate and output equals savings, which equals investment, which means that:

$$sY = S = I$$

Where,

s =Savings rate,

S = Level of Saving, and

I = Level of investment

The change in the capital stock is equalled by investment less depreciation of the capital stock, thus:

$$\Delta K = I - \delta K$$

The conditions above are a disentangled adaptation of the well-known Harrod – Domar condition. In the hypothesis of monetary development, this infers the rate of growth of GDP is resolved together by the sparing proportion, S, and national capital/yield proportion, k. Profitability Energy and work in the economy will be out of commission without accomplishing that rate of development in national salaries or will be utilised not as much as its volume.

The Harrod-Domar model contends that there are three sorts of development; for example, justified growth, real development and the characteristic rate of development. The real growth rate has appeared as the proportion of savings out of salary concerning the portion of progress in the capital. As indicated by Harrod (1939), the underlying growth rate is the rate of development at which the economy does not extend inconclusively or go into subsidence but is a development that empowers ventures. They imply that venture and reserve funds are in harmony, and the capital stocks are entirely used.

There are various weaknesses and strengths of the Harrod-Domar model; and some of these are the following. There is no evidence to prove the growth to be sufficient enough to maintain full employment, as the model maintains. The model explains economic growth regarding booms and busts. This assertion has been widely contested, both theoretically and empirically; and economic growth and development are interchangeable in the Harrod-Domar model. Nevertheless, critics maintain that these concepts are certainly not the same. Another shortcoming of the Harrod-Domar model is that it assumes zero substitutability between labour and capital, which is noted by Vane (2000).

The strengths of the Harrod-Domar model is that it predicts economic growth well in the short run in the absence of economic shocks. Also, it is a relatively simple model. Concerningly, the pundits guarantee that the model sees monetary development and advancement as equivalent, yet financial development is just a subsection of progress.

Another analysis of this model is that it infers emerging nations ought to acquire investments to fund interest in money to trigger monetary development. In any case, history has demonstrated this frequently causes a reimbursement issue later. The most import parameter of the Harrod-Domar model is the rate of saving.

3.1.4 The Neoclassical Exogenous Growth Theory

The exogenous growth theory features the way output can expand; ensuring human capital should ceaselessly be given more assets. Assets, for this situation, incorporate physical capital, human capital and learning capital (innovation). In this way, development is driven by the amassing of the components of generation while accumulation, is the consequence of interest in the private division. The hypothesis suggests that the primary way an administration can influence financial development, in any event over the long haul, is using its effect on interests in capital, training and innovative work (R&D). Decrease of growth in these models happens when extensive use hinders speculations by making productivity past what is essential to fund their ventures or removing the motivating forces to save and collect capital.

Dornbusch et al. (1999) contend that an expansion in the rate of development of innovation, or absolute factor efficiency of the economy, builds yield per labour development. The quality of the other of these impacts (the sum by which an expansion or diminishing influences GDP per labour development) relies upon a parameter which is best translated as the "share" of national wealth that is earned by proprietors of capital (as opposed to providers of work), and on the economy's yield to capital proportion (Y/K). If the generation duplicates the capital offer - to-capital percentage, it acquires the minimal result of capital (gross of deterioration). The exogenous development model accepts that innovative advancement is exogenously decided, and its dimension is the equivalent crosswise over nations.

3.1.5 Neoclassical Endogenous Growth Model

The endogenous development hypothesis progressed during the 1980s. The essential suggestion of a development hypothesis is that to support the development rate of yield per capita, over the long haul, there must be constant advances in machine learning for new products, new markets, or new procedures. The neoclassical exogenous development model created by Solow (1956) and Swan (1956) exhibits this by postulating that if there was no innovative advancement, at that point the impacts of consistent losses would result monetary development to stop in the long run.

The Solow development model is the most renowned neoclassical development model and is the most widely recognised beginning stage for any investigation of development in a nation. It regards mechanical development as the rate of investment funds in a country, as exogenous (i.e. decided outside the framework). It highlights both work and capital as the variables of creation and accept that development consistently comes back to scale (CRS) in the two components. This is a vital assumption; it implies that if capital and work served as information sources, the yield would likewise increment. The Solow model is a dynamic model that forecasts a combination over the long haul to an unfaltering rate of development for a nation.

As in the Harrod-Domar model, the aggregate production function can be written as a function of capital alone, thus:

$$Y = f(K)$$

This capacity communicates how much yield Y can be created, given the total capital stock K, under a given dimension of innovation, with a given scope of available procedures. The endogenous development model additionally accepts that all capital and work are entirely and productively utilised, so f(K) is not just what can be created, but what will additionally be delivered. The endogenous development hypothesis further holds that arrangement measures can affect the long run development rate

of an economy. Endogenous development has for quite some time seen financial development as a rate dictated by powers which are internal to the framework, especially those powers overseeing the chances and motivations to cause innovative learning.

The rate of financial development, over the long haul, as estimated by the development rate of yield per individual, relies upon the development rate of all-out factor efficiency (TFP), which is resolved by the speed of modern development. The neoclassical development hypothesis of Solow (1956) and Swan (1956), accepts the rate of mechanical advancement dictated by a logical procedure that is discrete from, and free of, financial powers. The neoclassical hypothesis, hence, suggests that market analysts can take the long run development rate as given exogenously from outside the money related framework.

The endogenous development model accepts populace development and mechanical change. Hence, the primary outstanding determinant of growth is capital accumulation. This implies yield will develop if, and only if, the capital stock increments.

Romer (1990) contends that total yield is a developing capacity of the level of item assortment. In this hypothesis, advancement causes profitability development by making new, yet not improved, kinds of merchandise. It utilises the Dixit–Stieglitz–Ethier generation of work, in which the last yield delivered by work is measured and a continuum of inexpensive items produced.

3.1.6 The Capital Accumulation Growth Channel

The capital accumulation method is a vision that grasps that exchange rates affect economic growth through their effect on savings. This method claims that economic growth improves through the devaluation of the real exchange rate and an increase in the stock of capital (Mbaye, 2012). A shortcoming for this view is that a devaluation of the exchange rate is likely to raise the rate of local saving. The higher rate of

savings induced by depreciation stimulates GDP by improving the standard of capital accumulation.

Montiel and Serven (2008) argue that there is no agreement on how the effect of the channel is caused; this is commonly known in policy circles as the channel of transmission. A devalued exchange rate increases the local savings rate, an increase in the accumulation of capital tends to boost growth. The capital accumulation channel holds that there are two sources of capital accumulation.

Mbaye (2012) explains that in the first instrument, the tradable goods industry shares an increase in GDP, which exclusively operates in capital accumulation. Secondly, the expansion of overall investment and savings increases the capital stock in the economy. The link between the devalued exchange rate and the saving rate emanates from a depreciated real exchange rate that increases aggregate demand from traded to non-traded goods, demanding an increase in the interest rate to keep the internal balance (Montiel and Serven, 2008).

The increase in interest rates pressures aggregates demand in part by floating the local savings rate. At this point, causality turns the exchange rate via the real interest rate to the savings rate, causing an improvement in GDP. It is in this respect that capital accumulation and the neoclassical growth model are relevant to this study.

Table 3. 1: Theoretical Framework

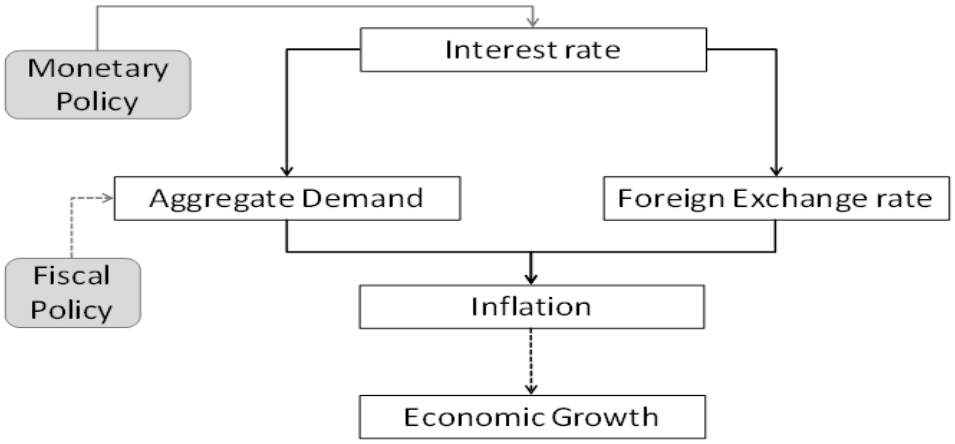
S/N	Theory	Key Variables	Measuring indicator	Claimed Causality/association	Limitations
1.	Neoclassical Endogenous Growth	Technological Growth and Savings Rate	Production Expansion	Total factor productivity (TFP)	There is no evidence to prove growth sufficient to

	Model Theory				maintain full employment.
2.	Harrod-Domar Exogenous Growth theory	Physical Capital, Human Capital and Knowledge	GDP	All these variables influence economic growth	Growth can be realised only through Research and Development. They never mention any macroeconomic indicators in their theory
3.	**The capital accumulation Growth Channel**	**Exchange rate and Savings**	**Growth increase through an increase in capital stock**	**Devaluation of the exchange rate raises savings and capital accumulation**	**This view is that a devaluation of the exchange rate tends to boost the local savings rate**

The capital accumulation approach is a view that holds that exchange rates affect economic growth through their effect on savings. This approach claims that real exchange rate undervaluation improves growth over a rise in the capital stock of the economy as a whole (Mbaye, 2012). A backdrop for this view is that a devaluation of the exchange rate is likely to raise the local savings rate. The greater rate of savings induced by depreciation stimulates GDP by improving the standard of capital accumulation.

3.2 Conceptual Design

Figure 3.1: Conceptual Design



Source: Own drawings

The above diagram presents the conceptual framework of the theories that are used in this research to support the study. Monetary policy plays a significant role in driving the GDP of the country. The central bank can influence the economy by reducing the cost of borrowing and create an environment conducive to economic growth.

Monetary policy can affect the GDP by, for instance, increasing the interest rates, and commercial banks increasing their lending rate. Business and consumers will be discouraged in borrowing and will save more money to spend in the economy. It, therefore, means that the aggregate demand will increase, and the economic growth will increase cetirus paribus. Monetary policy can also influence inflation through money supply in the economy, which causes the aggregate demand to grow and a higher inflation rate, as too much money encounters too few goods in the marketplace.

Lastly, expansionary monetary policy can influence economic growth by lowering the exchange rate, which can cause fewer imports and more exports. Also,

the aggregate demand for domestic goods will increase and employment will likewise increase.

CHAPTER 4: RESEARCH METHODOLOGY

This section presents the method applied in the investigation of the impact of the real exchange rate's performance on economic growth in South Africa. The first part of the section specifies the model and how estimation will apply to the model; this is followed by defining the data that was used, the definition of variables and expected results. The next part of this chapter looks at various tests for the model, including stationarity/unit root, Co-integration, Vector Error Correction Model (VECM) Vector Auto-Regression Model (VAR) and diagnostic testing.

4.1 Model Specification

The approach of this research is supported by the model used by Azid et al. (2005) who examined the relationship between economic growth performance and the exchange rate, in a case study of Pakistan from 1973-2003. The model was estimated using a Vector Auto-Regression (VAR) test. The equation for this model was specified as follows:

$$GDP(Y) = \beta_0 + \beta_1 RER + \beta_2 EX + \beta_3 IM + \beta_4 RM \quad \ldots\ldots (1)$$

Where

β_0, = constant term

β_1, β_2, β_3, β_4 = are the coefficients of the parameters

RER= Real exchange rate

EX= Exports

IM = Imports

RM= Real Money Supply

The study aims to investigate the impact of the real exchange rate's influence on economic growth (GDP). In this study, economic growth (GDP) is the dependent

variable that is explained by the changes in the independent variables, which are real exchange rate (RER), real interest rate (RIR) and (TRD) trade openness. The model is specified as follows:

$$GDP = \beta_0 + \beta_1 RER + \beta_2 RIR + \beta_3 EXP + \beta_4 IMP + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where:

$\beta 0$	=Constant term
$\beta 1 - \beta 4$	=Slope of the parameters
GDP	= National Gross Domestic Product
RER	=Real Exchange Rate
RIR	=Real Interest Rates
TRD	=Trade Openness
ε	=Error term
t	=Time series

The empirical model was estimated using the econometric software Eviews 9.5.

4.2 Data Sources and Variables Definition

The regression equation includes the variables that are used to estimate the impact of exchange rate volatility on economic growth in South Africa. All variables are transformed into logarithms, as they do not follow the same unit of measure. These include the following:

Gross Domestic Product: Is **GDP** in South Africa measured in billion rands; this shows the growth rate at which there is a percentage change of GDP from the previous measurement cycle.

Real Exchange Rate: RER is the nominal exchange rate that takes the inflation variances amongst the nations into consideration, and it will use an indicator of competitiveness in the foreign trade of a country.

Real Interest Rates: RIR is the nominal interest rate that takes into consideration the expected inflation and measures the change between the nominal interest rate and the expected increase.

Trade Openness: TO is the percentage of both exports and imports relative to the gross domestic product.

4.3 Research Techniques

The Johansen (1985) co-integration technique was used in this research; a test used to test if the long run co-integration amongst variables will apply a Vector Error Correlation model (VECM) and Vector Auto Regression (VAR) model if there is no co-integration. Firstly, data must be integrated of the same order. To achieve this, the unit root must be tested to look at stationary of data sets.

4.3.1 Stationarity

Stationarity is the method of the statistical parameters where the mean and standard deviation are constant over the period. Gujarati (2004) argues that the values of covariance amongst the two periods depends on the gap between times excluding the present period in which the covariance was computed. Auto-correlation function (ACF) is the essential property of stationarity that depends on its lag, which does not change at the time it was calculated. Brooks (2008) is of the view that the dependent and independent variables must have finite variance, the errors must have zero mean and be stationary.

If a set of variables is non-stationary, its mean and time-variance mean or variance must integrate of order (0) and be first difference to become stationary. The danger of running non-stationary data is that there will be a spurious regression

problem or misleading results. If variables are still non-stationary after integrated order(1) even if not stationary, it will need to be second difference that is integrated order (2) up until it become stationary.

The reasons for data to be tested for unit root are as follows: firstly, a series can intensely influence its behaviour and properties, and secondly, it can lead to a spurious regression problem, which means that in the long run, variables in a period are trending. Another shortcoming of-stationary variable is that even independent variables tend to have higher R-Squared outcomes. The usual t-ratio, t-distribution and F-statistics it will be challenging to validate through hypothesis test and about regression parameters (Brook, 2008)

4.3.2 Augmented Dickey-Fuller (ADF) Test

Gujarati (2004) states that the order of integration can be only tested using the Dickey-Fuller test. The Augmented Dickey-Fuller (ADF) and Dickey-Fuller (DF) both are the best specialised software to be used to test the unit root tests of the time series. ADF theory aims to test the hypothesis that $\emptyset=1$ in:

$$Y_t=\emptyset\ (yt\text{-}1) + \mu_t \quad \ldots\ldots 4.3$$

Thus, the assumption is expressed as follows:

H_0: Variables have a unit root

H_1: Variables are stationary

Accepting an alternative hypothesis will confirm that the variable means that the variables are stationary or do not have any unit root test. Estimates of the standard ADF are:

$$Y_t = \beta_1+\beta_2\ \Delta Y_{(et\text{-}1)} + \mu_t \quad \ldots\ldots 4.4$$

μt is an error term of the data sets, Δ is the error term and also a linear trend and first difference operator. The normality assumptions should be satisfied by the error

term, though. Gujarati (2004) also emphasises that in the equation above, if the error term is not separated, the results on ADF will be biased.

The Dickey-Fuller test is valid only if (μt) is presumed to be autocorrelated, while (Δyt), is the explanatory variable if the autocorrelation regression is not correlated. It would be so if there is autocorrelation in the regression of the dependent variable (Δyt). Thus, the nominal size of the actual test will be oversized. The explanation of this gap is to use the ADF. The substitute model in the ADF case can be presented as follows:

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \sum_{i=1}^{m} \alpha_1 \Delta yt - 1 + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.5$$

Where there is a pure white noise error term and where $\Delta Y_{(t-1)} = (Y_{(t-1)} - Y_{(t-2)})$, $Y_{(t-2)} = (Y_{(t-2)} - Y_{(t-3)})$, etc. Gujarati (2004) argues that the idea to include many error terms in equation 4.5 was to ensure that the series is uncorrelated, and the number of lagged differences are determined empirically. The same critical values in ADF will test whether δ=0 follows the same asymptotic distribution as DF statistics.

The calculated ADF values are then matched with the critical values. If the significant value is less than the estimated value, we reject the null hypothesis that states the variable is stationary, thus proving that the variables are non-stationary. Gujarati (2004) argues that the critical assumption for the ADF test is that the error term (u_t) must be (iid), i.e. is independently and identically distributed. The error terms (μt), a possible serial correlation, is adjusted by DF to take into consideration by adding the lagged difference terms in the regression.

The ADF test has its shortcomings like any other unit root tests. Gujarati (2002) also states that, as with any other unit root test, the ADF has its weaknesses of low power. The power is subjected to the size of the sample data more than its frequency. This may lead to finding unit root where it does not exist. ADF is also weak in detecting a false null hypothesis on its ability. Clemente et al. (1998) argue that another weakness of ADF is that it does not take into consideration the error

term (μt) for possible autocorrelation. Also, a well-known shortcoming of the DF style is integrated order (1) of the stationary test; it confuses the structural breaks in the data as the signal of stationarity.

Thus, the Augmented Dickey-Fuller Test was preferred over the Dickey-Fuller test, based on the weakness mentioned above, and for the fact that it does not take into consideration the autocorrelation of the error term and therefore the estimated coefficients from OLS will be not efficient (Blungmart, 2000)

4.3.3 Phillips-Peron (PP) test

Phillips and Peron established a further concept of non-stationarity or unit root. The process of the tests is the same as the ADF tests, but it includes the autocorrection of the DF technique that allows residuals to be autocorrelated. According to Gujarati (2004), the Philips-Peron (PP) uses a non-parametric statistical method to consider the serial correlation of the error term by not including the past periods of variance in the terms. Brooks (2008) also, believes that this technique suffers the same weaknesses as the ADF tests.

Criticism of Augmented Dickey-Fuller and Philips-Peron test

Brooks (2008) argues that the most significant criticism of the unit root tests is that their influence is small if the non-stationarity is a root near to the stationary margin. For instance, in an auto regression model (1), data creating means coefficient 0.95 in the data validation procedure, that is $Yt= 0.95\ Y_{(t-1)}-1+\mu t$, then the Ho: of non-stationarity should be not be accepted. It always an argument that these tests are inadequate in determining, for instance, whether, especially with small sample sizes.

Brooks (2008) further argues that this problem emanates from the classical hypothesis testing framework. Ho will undoubtedly be rejected, therefore it means that accepting the null hypothesis is because of not enough information in the sample size and to reject the null hypothesis was correct.

4.3.4 Co-integration test

According to Brooks (2008) if two data sets of order I(1) are linearly combined, this means the combination will also be incorporated into the order I(1). To be specific, if data sets, which are not in the same order of integration, are combined, the combination tends to follow the most extensive data sets. The reason for conducting a co-integration test is to find out if the variables begin to move in the same direction or not in the long run. If the variables are found to be co-integrated, the appropriate Vector Error Correction Model (VECM) will be used instead of a Vector Auto regression Model (VAR) (Gujarati, 2004).

The equilibrium relationship exists if the series seems to be moving together over some time. The series, therefore, shows that although the data sets have unit root in the short run if cointegration exists, they will be moving in the same direction over the period and their variance will not have a unit root.

The Vector Autoregressive model (VAR) is a broad context that is used to define stationary variables and their interrelated dynamic. Brook (2008) argues that if the time series has a unit root; then the VAR context needs to be adjusted to permit reliable estimates of the relations between the data sets. VECM in the case of the VAR for variables that have unit root and become stationary after first difference, for example, I(1), will take into consideration whether any variables are found to be co-integrated amongst other variables.

The procedure of VECM can attest that it is a requirement to conduct a co-integration test. A VECM is to be used on purpose on unit root data sets that have a long run association. Brooks (2008) strongly believes that VECM has a co-integration that is relative to prevent the long run association of the endogenous variables to their co-integration relationship while permitting the adjustments of short run dynamics. Brooks (2008) furthermore argues that the correction term from the long run equilibrium deviation is steadily corrected from the estimated changes over the

series of the limited short run. Consequently, the existence of a co-integration relations procedure is a central part of the VECM condition.

There are numerous methods of analysis of co-integration, such as the Engle-Granger methodology, which is residual-based, and the Johansen and Julius (1990) procedure, which is built on extreme possibility estimates of a VAR method.

Engle-Granger(1987) and Brooks (2008) proposed a four-step procedure of that defines whether any two I(1) variables are associated with order I(1) and the method are as follows: the first one is the analysis to test each variable separately to decide its order of integration, secondly to estimate the long run symmetry association, thirdly the estimation of ECM. The ECM can be used to determine the equilibrium regression; then the fourth step is to assess the model's sufficiency.

The Engle-Granger methodology has some shortcomings, and the issues are as follows: the coincident bias of equation, the impracticality of execution assumption that there is a real co-integration relationship and lack of power in the unit root test (Brooks, 2008).

Considering the shortfalls mentioned above of the Engle-Granger method, this research plan is to make use of VECM by Johansen (1991). The rationality behind this method is that it relates to the determined probability estimate of a VECM to concurrently define the short run and long run determination of the factor of the explanatory variable in a model. This method also makes available the speed of adjustment coefficient that looks at the rate in which GDP returns to its equilibrium subsequent to a shock, in the short-term, in the economy (Gujarati, 2004).

4.3.5 Johansen Method Built on VAR

The Johansen and Julius method (1990) is the method that the Vector Auto Regression method is built on for its maximum likelihood estimates. This method is to test long run equilibrium relations that allow the given sets of data of all co-

integration vectors to be identified. According to Gujarati (2004), the procedure to conduct Johansen tests are as follows:

- Test order integration
- Specifying the VAR (k) order
- Test for cointegration
- Normalisation
- Test of hypothesis

Testing the order of integration of the variables in the analysis is a requirement. The first condition for the co-integration test is that data sets should be cointegrated in the same order before the test is to be conducted. For the vector autoregressive (VAR) model representation of order k, the specification is as follows:

$$y_t = \prod 1\, Y_{t-1} + \prod 2\, Y_{t-2} + \prod k\, Y_{t-k} + u_t \quad \text{.....4.6}$$

Where

Kt is a D-vector of deterministic variables and is a vector of innovations, while yt is a vector of unit root I(1) variable. To conduct the Johansen test, the equation above is for the VAR model that needs to be transformed to VECM only if one or more variables turn to co-integration in the long run. This can be written as the following VECM equation (4.7):

$$\Delta y_t = \mu + \pi_k Y_{t-k} + \sum_{i=0}^{q} \Gamma_i \Delta Y_{t=i} + \mu_t \quad \text{.....4.7}$$

Where

q=k-1, ΔYt is all I (0), Γ is n x n coefficient matrices that symbolise the coefficients in the short run. Then, π is the matrix, r represents the number of co-integrated equations amongst the variables. The Johansen test is established on the analysis of the π matrices. Then, if r is equal to zero, this means that there is no co-integration equation in the system. Gujarati, 2004) argues that if for example, π has decreased

the rank (r≤(n-1)), this implies that the above equation can be stated as the following equation:

$$\Pi = \alpha\beta \ldots\ldots 4.8$$

Where

α= (n x r) matrices of the speed of adjustment or error correction of parameters and ß = is the long run coefficients. Estimated ß are initiated by resolving the eigenvalue challenges so that the eigenvectors equivalent to the r biggest eigenvalues form the estimated ß matrix. The size of the eigenvalues shows a measure of how high the correlation is between the co-integration and unit root part of the model. The following steps are first to find how various co-integration vectors find respectively to its relations. The two test statistics are applied; namely, the λ max statistic and the λ trace statistic. The λ max statistic is of the form:

$$\lambda max\ (r+1) = -TIn(\lambda\_(r+1)) \ldots\ldots 4.9$$

and

$$\lambda trace\ (r) = -T\sum\_(i=r+1)\ ^g(In(1-\lambda\_i) \ldots\ldots 4.10$$

Where

R represents the number of co-integration equations in the Ho, and λi is the value estimated in the i^th order of eigenvalue in the matrix. Automatically, the greater the value of λi, the bigger the negative outcome will be in the (1 - λi), and therefore, the higher the test statistics will be. Eigenvectors will be connected with different co-integration vectors. A meaningful real eigenvalue shows a major co-integration vector.

λmax conducts a distinct test on individual eigenvalues which have a null hypothesis equal to several co-integration vectors; that is r with the alternative hypothesis of r + 1.

λtrace is a combined test where the null hypothesis agrees with several co-integration vectors; that is <=r against the alternative hypothesis of more than r. It first starts with probability eigenvalues; after that continuously, the highest values are distant.

Null Hyphothesis =λtrace = 0

when other alternative Hyphothesis λk= 0, for k = 1 . . . . g.

Johansen (1990) creates the t-statistics and critical values for the two statistics automatically. The statistical significance is substantial and non-standard. Values depend on the importance of g-r; the number of unit root components depends on the value of g-r, and the constants are included in the equations. Deterministic trends and intercepts can also be added in the VAR or the cointegration vectors.

If the critical values for the Johansen test are less than t-statistics significant values from Johansen's tables, then the null hypothesis can be rejected and there are r co-integration vectors in the equation, where r represents the number of co-integrated equations; alternatively, (r+1) for λ_trace test or more than r λ_max (Osterwald-Lenum, 1992).

4.3.6 Diagnostic test

This part of the research is significant in the analysis of the impact of the real exchange rate's influence on the economic growth of South Africa. The validation of estimated parameters results are produced by the model. These comprise the Lagrange multiplier and the heteroscedasticity residual normality test. The multivariate extension, which leads to the additional test stated, will be used in this research. A brief discussion of those diagnostic tests follows below.

4.3.7 Heteroscedasticity

According to Brooks (2008), there are some prescribed statistical tests for heteroscedasticity. White noise tests are one of such famous tests. One of these is

White's (1980) heteroscedasticity extensive test. The test is beneficial since it has some assumptions such as it assumes that the regression model estimates are linear and standard. Immediately after running the regression, the regression residuals will be attained, and the residuals will be tested regarding the joint significance of the regression for each of the regressors. If the White test is accepted, then it is homoscedastic, and if the alternative explanation is accepted, then we have heteroscedasticity.

4.3.8 Residual normality test

The Bera-Jarque (BJ) test is the most prominent test that is used to test normality (Brooks, 2008). The mean and variance must be characterised by a normally distributed random variable of the entire distribution. Skewness and kurtosis (Urzua, 1997) explain the comparisons of the third and fourth times of residual. Kurtosis methods explain how big the tail of the normal distribution is and skewness measures the rate at which a distribution is non-symmetric of values and mean.

This method computes the Jarque-Bera statistic; residuals are transformed into small sample corrections before they are estimated. The first condition of the joint test is that the null hypothesis of the residuals must be normally distributed. A substantial Jarque-Bera statistic, consequently, indicates the residual that is non-normal. A co-integration test cannot be validated if the normality is lacking. The most important part of testing the co-integration analysis is that the residuals are not correlated and homoscedastic.

The shape of a normal distribution is a bell shape, and the coefficient of kurtosis of 3 defines it. The excess kurtosis can be determined by a ratio equal to the factor of kurtosis minus 3; a normal distribution is said to be mesokurtic and symmetric if the excess kurtosis is zero.

4.3.9 Lagrange multiplier (LM) test

The Lagrange Multiplier (LM) test will be executed in this research to test the residual serial correlation of the specified order lag. Gujarati (2004) states that the lag order should be analogous to VAR. The statistical value for an optimal lag order (k) is calculated by computing an auxiliary regression of the residuals (μt) on the original right-hand independent variables in the equation and the past periods of residuals (μt-k). Johansen (1995) explains the formula for the Lagrange Multiplier test statistics and gives full details on this test. The LM test's null hypothesis is that there is no serial correlation to the alternative hypothesis of autocorrelation residuals.

4.3.10 Impulse response analysis

Impulse response analyses recommend that the responsiveness of the descriptive variable in the VECM be compared to shocks for each variable. It shows the sign, level, and constancy of real shocks to the asset report channel. A shock is spread to all different endogenous factors in the framework, yet it additionally influences various factors. The enhancements to the VAR framework after some time are watched, a unit or one-time stun is connected for every factor from the conditions independently. The impulse response investigation is utilised on the VECM given that the framework is NIL stable; the stun ought to bit by bit decrease (Brooks, 2008). There are a few different ways of performing a drive reaction examination, yet the Cholesky orthogonalisation strategy to motivate a reaction investigation in augmentation of multivariations of the Cholesky factorisation system, is favoured in this examination. This methodology is preferred because, in contrast to other technologies, when evaluating the residual covariance grid used to infer the Cholesky factor, it likewise consolidates a small degree of freedom.

4.3.11 Variance decomposition

Additional data on the linkages to be decided regarding sheet channels, can likewise be gotten from a variance decomposition analysis. It measures the extent of estimated blunder changes in a variable that is clarified by developments and other variables. Difference deteriorations performed on the VECM give the proportion of the developments in the explanatory variables that are due to their stuns versus stuns reactions to different factors (Brooks, 2008). Creeks (2003) saw that claim arrangement stuns clarify the majority of the conjecture blunder fluctuation of the method in a VECM. A similar factorisation system and data utilised in assessing impulse responses, is connected in the variance decomposition.

4.6 Summary

The above chapter gives a clear direction to execute in the next section for applied regression analysis, model specification, and variables analysis and estimate techniques about the impact of the real exchange rate's influence on the South African GDP. Johansen and Juselius (1990) cointegration techniques and VECM were used. The study used some diagnostic tests to confirm the parameters and estimated outcomes that are achieved through the estimated model.

CHAPTER 5: RESULTS AND DATA ANALYSIS

The chapter starts by providing insight into macroeconomic variables and their trends and later estimates the impact of the real exchange rate and other variables proposed in the study, on the economic growth of South Africa. It is followed by the effect of these variables on the economy, conceptualised with existing literature.

This section presents a review of the trends and performance of the macroeconomic variables in South Africa. The quarterly data was collected for the period from 1990 to 2016. The data that is used below is in a mixed form, some in percentages and others in real numbers. A simple Excel method to generate graphs was used in this section.

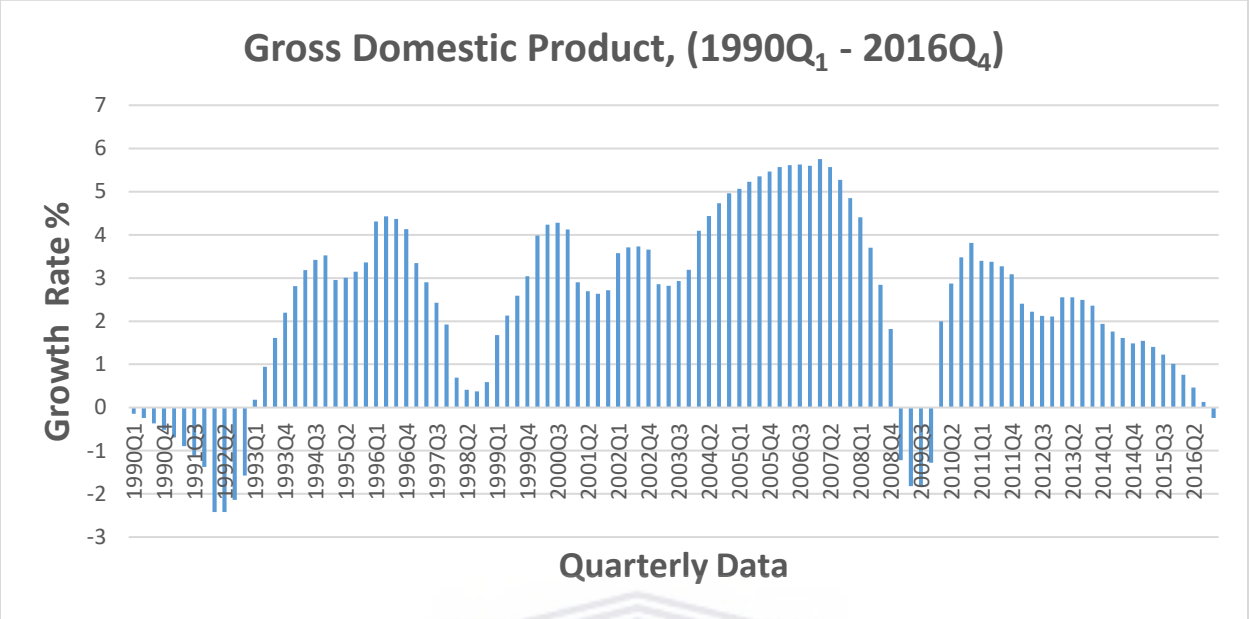
5.1 Objective 1: **To review the trends and performance of the macroeconomic variables in South Africa.**

5.1.1 Economic Growth in South Africa

Gross Domestic Product (GDP) is the total rand amount of all goods and services produced over a specified period. The growth rate is explained as the percentage increase or decrease of the GDP's previous measurement cycle. Gary (2008) states that GDP growth emanates from government expenditure, investment, exports, imports and other variables. If imports tend to be higher than exports, this would be harmful to the economic performance, leading to a decrease in the GDP rate.

The 3% average growth rate for the initial ten years after politically sanctioned racial segregation was a failure concerning the desires of some in South Africa. This development was considerably beneath what was regarded as important to help enduring progress to a voter based system in South Africa (GEAR, 1996). Growth rates of GDP have been mainly because of domestic consumption. Lee (2005) argues that where there is a higher demand for commodities, the higher the economic growth. GDP growth trends are portrayed in Figure 5.1 below.

Figure 5.1: Gross Domestic Product Trends of South Africa from 1990Q1 to 2016Q4



Source: SARB (2018)

Figure 5.1 shows the yearly growth of the South African real GDP from 1990Q1 to 2016Q3. In the year 1994, the GDP rate was meagre. There were also very low growth rate percentages that were experienced by the South African economy in 1995.

Conversely, in 1996, there was a dramatic increase in the economic growth rate of South Africa, and it further went up to 5.59% (DTI, 2013). According to SARB (2011), the increased growth rate was due to the attainment of democracy in the year of 1994, and this opened doors for South Africa to be engaged in international trading and creating investor confidence in the country. Du Plessis and Smit (2007) argue that an improvement in economic performance leading to the achievement of 5.5% GDP growth rate in 2006 was mainly as a result of sizeable foreign capital inflow against the existence of low inflation rates and interest rates. This steady growth rate was the recovery from the year 1995, where there was a slow GDP rate ranging between 1.5% and 1.6%.

However, from 1996 South African economic growth started to take a downward trend up until it reached -0.9 in 1998. In the South African economy from this period,

growth maintained a decent GDP rate; it was always fluctuating around 4.3% up to 6.4% except in 2001, where the GDP rate was 1.1%. The fiscal authority maintained the fluctuations and monetary policy, which was adopted by the SARB in 2000. These policies helped to stabilise the economy and increase investment in the South African economy.

Since 2008, there was a considerable decrease in South African economic growth that led to a significant drop in GDP in 2009 of -6.3%. This was due to an increase in foreign goods prices in 2008, which caused a high inflationary rate in 2009, which increased the price of commodities. According to Kahn (2008), the South African total output decreased by more than 1.6 % due to the high cost of production. However, this slow growth rate was mainly as a result of the global economic downturn. There was a very high decline in the GDP growth rate from 2009 at the rate of -1.54%, and this was because of the global recession that also affected South Africa.

5.1.2 Interest Rates

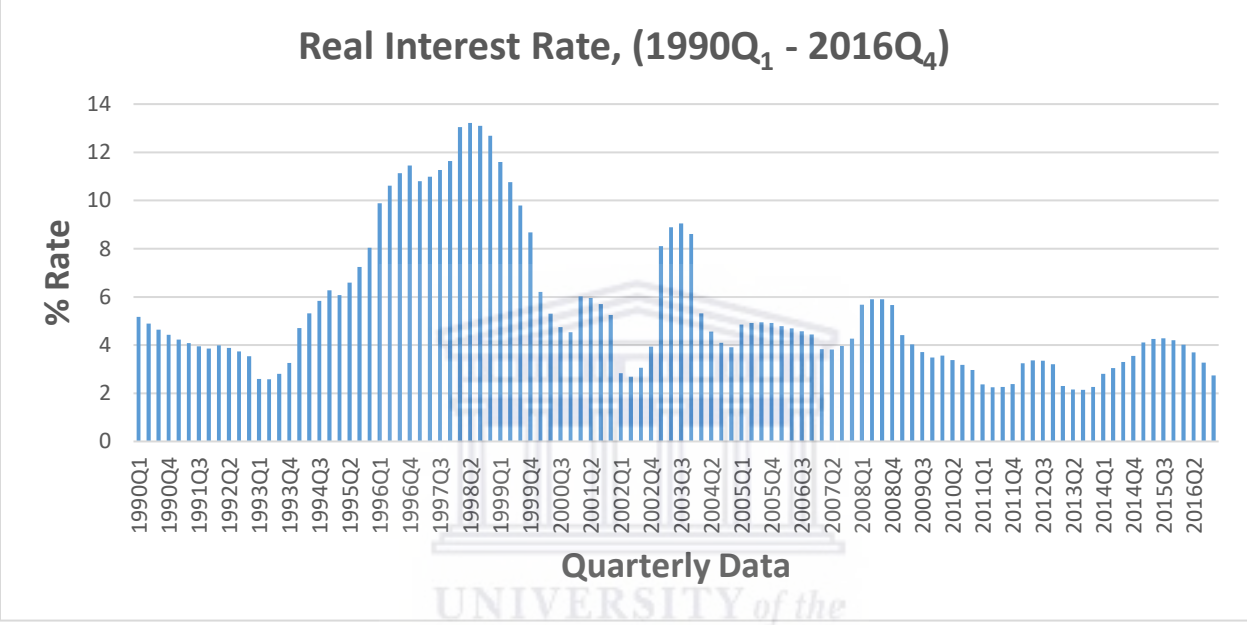
Davidson (2007) argues that real interest rates lie at the heart of the transmission mechanism of monetary policy. However, the propensity to save and productivity of capital determine the real interest rates in the end. The SARB uses interest rates in its inflation-targeting framework. The relations between RIR and GDP became significant. In South Africa, they placed much attention on real interest rates more, especially after the Asian crisis in 1997/8, when short-term real interest rates became favourable.

Real interest rate targets are an essential tool of fiscal policy as they are considered when focusing on variables like investment, inflation, and unemployment. Central banks of countries usually reduce interest rates as they increase the investments and consumption of the economy of a country. The truncated interest rate, as a macroeconomic policy, can be perilous (Du Plessis et al., 2008).

Fishers (1997) refers to the real interest rate as the nominal rate minus the inflation rate. Interest rates and inflation have an association and are regularly

referenced in macroeconomics. The rate at which prices of products increase or decrease is referred to as inflation. It is contended that the real interest discrepancies possibly imitate numerous issues, namely aggregate demand, inflation, productivity, and tenacious monetary policy (MacDonald, 1997). The figure below gives an overview of real interest rates in South Africa from 1994 to 2015.

Figure 5.3: Trends of Real Interest Rates from 1990Q1 to 2016Q4



Source: World Bank (2018)

The figure above demonstrates the trend of the real interest rate from the period 1990Q1 to 2016Q2. The graph indicates that there was a decrease of 7.58% in the rate of interest in 1990 to 5.75% in 1995. The reduction in the interest rate discouraged savings and encouraged borrowing, and this affected the economic growth negatively. From 1995 to 1996, there was a slight increase in the interest rate from 10.11% to 13.37%, and then it started to decrease in 1996 to 9.84%. In 1997 to 1998, the real interest rate increases were from 11.42% to 15.14%.

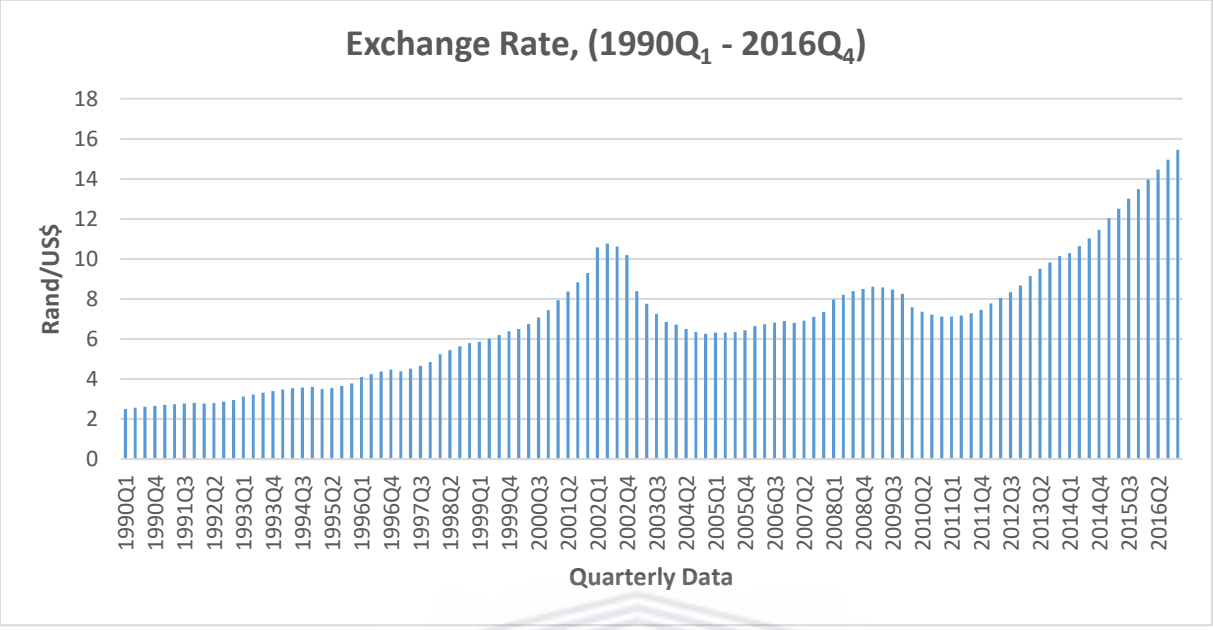
Once the real interest falls, consumers and businesses have to answer to the inducement by consuming more, especially the consumption of durables or increasing investment, and that is if their outlook is weak. Moreover, cumulating expected

inflation is another way of depressing real interest rates. There was a decrease in the rate of interest from 10.9% to 6.16% from 1999 to 2000. In 2000, the real interest rate was relatively low at 5.98% and continued to decrease to 5.28% in 2002. However, in 2003 it rose to 8.34% and continued to decline again to 6.5% in 2006. The real interest rate was relatively steady at 6.43% from 2006 to 2007. In 2008, real interest dropped to 2.02%, and in 2009, the rate of interest rose to 5.16% and continued to rise in 2010 to 5.23%.

5.1.3 Real Exchange Rate

It is crucial to know the issues accountable for their variations, as real exchange rates have significant effects on production, employment, and trade. Historically, numerous international monetary systems and unique types of foreign exchange rate regimes existed. These several types of exchange rates served to manage not only international trade relations but also domestic economic affairs. Real exchange rates have become more noticeable in the globalised economic environment, and are very valuable for both endorsing trade and maintaining monetary stability. The figure below shows the trend of the exchange rate from 1990 to 2016 on a quarterly basis.

Figure 5. 4: Trends of the Real exchange Rate from 1990Q1 to 2016Q4



Source: World Bank (2018)

The graph shows the real exchange rate from 1990Q1 to 2016Q3. From the period 1990Q1 to 1995Q3, the currency appreciation was due to the democratic government. The economy experienced a relatively massive inflow of investments into the economy after the democratic elections in 1994, leading to a stable and relatively high appreciation of the rand between 1994 and 1996; it was just below R6 to $1. It increased capitals inflows; this implies that an upsurge in capital inflows results in indebtedness of the Rand.

In 1998, the real exchange rate appreciated from R5.53 to R7.56. In 2003 it continued to depreciate to R10.54. This means the Rand in South Africa depreciated significantly, which increased exports. According to Savvides (2010), this depreciation was mainly attributed to the attacks on America in 2001 and an unstable political uncertainty in Zimbabwe, which led to substantial capital extractions from South Africa. Calvo and Reinhart (2000) are of the view that the exchange rate has an impact on the real economy and is more susceptible to terms of trade swings and sudden stops of capital inflows. The greater exchange rates have a noteworthy consequence on the financial stability of a country. MacCauley (2003) states that

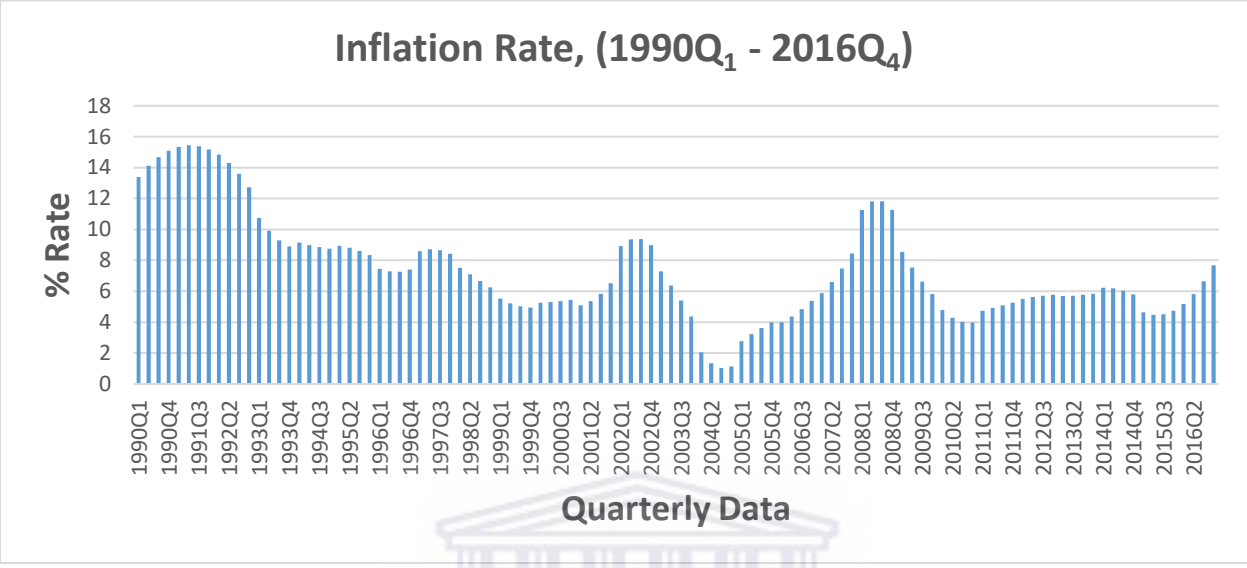
exchange rate changes can generate misperceptions and a commitment to the inflation target becomes the objective of monetary policy, mainly when a conflict between the goals arises. An inflation-targeting framework requires flexibility of the exchange rate.

An expansion of the South African rand from R8.61 in 2001 gave the principal test toward the South African levelling regime. The monetary approach adjusted in 2002 as the forecasts exhibited a substantial pass-through from the exchange rate to expansion. The repurchase (repo) rate expanded by 100 premise focuses on four events during 2002 (Regnier, 2007).

The rand depreciated from R6.77 to R8.26 from 2006 to 2008. The appreciation of Rand went much further in 2008 to 30.98%. Savvides (2010), states that the reason for the recognition was triggered by the exchange rate and world price crisis. In 2009 to 2010, the real exchange rate of the Rand started to depreciate from 25.02% to 24.85%, but in 2010, there was an appreciation of 25.62%.

5.1.4 Inflation Rate

Figure 5. 5: Trends of the Inflation Rates from 1990Q1-2016Q4



Source: World Bank (2018)

Inflation in South Africa was significantly high during the 1990s despite disinflation with the major trading partners. This can be explained by the feebler financial policy stance and growth in broad money, which was extensively greater in SA than other partners in trading during this period. From 1980-1990, it was around about 14%. CPI inflation reached a peak of 18.6% in 1986. Later in the early 1990s, however, a decline in the inflation trend became evident with an average of 7% between 1994 and 2002.

The decrease reflected a stronger monetary discipline of targeting inflation. The exogenous factors that cause the uplift in inflation such as the decrease in the currency in the second part of 2001, the increase in the exchange rate and an increase in prices (Van der Merwe cited in Koller, 2005). Other possible rectifications for these high rates in inflation were high food prices; in February 2008, CPI climbed to a five-year record of 9.4% year-on-year. High inflation hurts economic performance. Generally, inflation lowers the content of information of price changes, so that when

households and businesses observe a price change, they find it more difficult to tell the difference if it is a relative or an absolute price change.

Total factor productivity, via a decrease in the effectiveness of the allocation of resources, and capital accumulation, via a deterioration in investment due to the lower productivity, can be affected as a result. Also, the rate of growth is adversely affected. From an investor's perspective, inflation can be a severe problem for many types of investments. Those whose investments are on a fixed-income (bond) are the ones most affected by inflation. This is because when inflation rises; interest rates generally rise as well, which in turn drives down bond prices. Bonds with longer maturities are hit the hardest. Also, as the prices of goods and services rise, the purchasing power of interest paid on the bonds too declines. Over the long-term, government bonds have lagged behind stocks in providing inflation protection.

High rates of inflation have served to reduce South Africa's competitiveness concerning its trading partners and competitors (Cawker and Whiteford, 1993:32). Inflation affects the current account deficit. This is because price increases make South African exports expensive relative to competitors. Thus, an increase in prices leads to a downfall in export demand. Competition occurs in imports when their prices fall relative to the prices of domestic competitors; thus, a depreciation in currency is caused by persistent inflation.

5.2 Objective 2. **To estimate the impact of real exchange rate on the economic growth of South Africa.**

This section provides an analysis of the results by applying the framework and the analytical technique proposed in chapter one. The section presents an overview of the estimated effects and findings. This section has five sub-sections, namely: Stationarity and Unit root tests, co-integration tests, the diagnostic check and impulse response as well as variance decomposition.

5.2.1 Unit Root Test Results

The first step in the process is to test whether the data has a unit root. As stated in chapter 4, the Augmented Dickey-Fuller (ADF) tests (Dickey and Fuller, 1981) and Phillips-Perron are employed in this chapter to detect an order of integration, as variable needs to be differenced once to make it stationary. The outcomes of the tests mentioned above are presented in table 5.1, figure 5.6 and 5.7, respectively.

All the variables were tested for stationarity under all deterministic trend assumption of Constant, Constant and trend, and none. The table that follows shows variables become stationary after first difference and most of the variables have unit root in levels; the variables show unit root in levels as the value of t-statistics is smaller (less harmful) than the critical Mackinnon values for all deterministic trend assumptions. The null hypothesis of non-stationarity is therefore accepted. However, after first differencing the t-statistics become more substantial (more negatives) than the critical Mackinnon values for all deterministic trend assumptions. The null hypotheses of the unit root are then rejected, and the alternative hypothesis of no unit root in the series is accepted. All variables are consequently integrated into the same order I (1).

Table 5. 1: Stationarity Test

		Augmented Dickey-Fuller			Phillips-Perron			
Variables		Constant	Constant & trend	None	Constant	Constant & trend	None	Order of integration
LGDP		-0.0372	-0.1789	-1.3734	-3.0125	-2.9969	-1.7437	I(0)
LXR		-0.9990	-2.2594	-2.2594	-0.8095	-1.8073	2.1642	I(0)
LRIR		-1.8300	-3.1435	-0.7133	-1.8089	-1.8089	-0.8136	I(0)

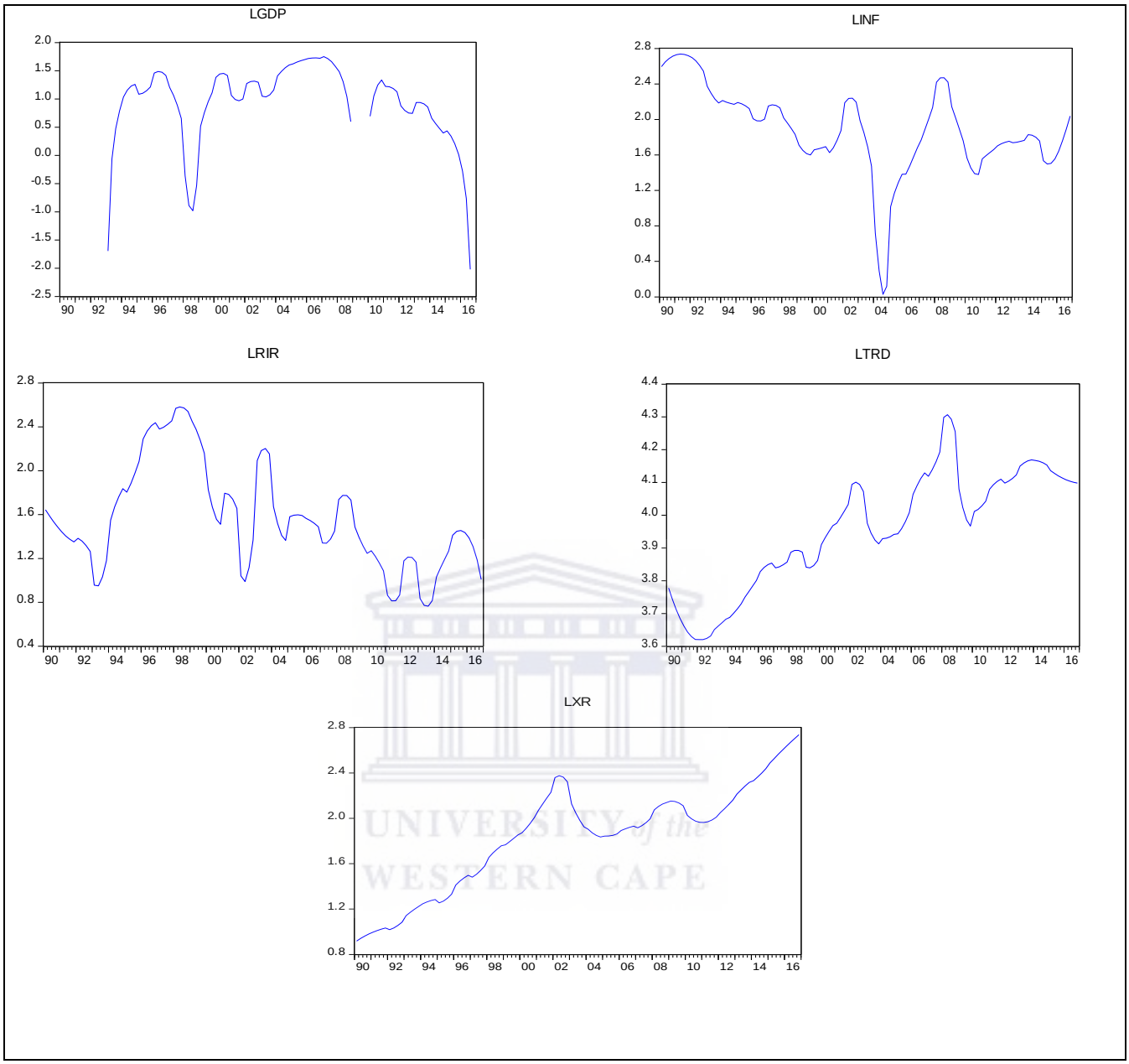
LINF		-3.3271	-3.4617	-0.9725	-2.4445	-2.4346	-0.8436	I(0)
LTRD		-1.9281	-3.0123	0.9638	-1.1264	-2.4728	-2.4728	I(0)
DLGDP		-5.3913	-5.6890	-5.4304	-5.5023	-5.5023	-5.6328	I(1)
DLXR		-2.7321	-2.7095	-2.0896	-4.5272	-4.5049	-4.0623	I(1)
DLRIR		-3.7030	-3.7429	-3.7152	-6.2802	-6.7506	-6.1155	I(1)
DLINF		-5.5341	-3.6088	-5.5578	-4.6245	-4.6245	-4.6730	I(1)
DLTRD		-3.9581	-4.0121	-3.8186	-5.0229	-5.0664	-4.9061	I(1)
Critical Value	1%	-3.4956	-4.0505	-2.5878	-3.4925	-4.0460	-2.5867	
	5%	-2.8900	-3.4544	-1.9440	-2.8886	-3.4523	-1.9438	

Source: Own computation using Eviews 9.5 Econometric Software

*represents a stationarity variable at 1% level of significance

**represents a stationarity variable at 5% level of significance

Figure 5.6: Plots Illustration of Variables in Levels



Source: Author's computation using Eviews 9.5 Econometric Software

All variables were tested for unit root and are trending upwards through their fluctuations. The results confirm the initially reported findings in the table above that all variables possess unit root in levels. There were no variables that were stationary at levels; the null hypothesis of unit root, therefore, was accepted on all variables used in this study. The figure above shows that the Gross Domestic Product (GDP), Trade Openness (TRD), the Real Exchange Rate (RER) and the Real Interest

Rate (RIR) show trendy behaviour. The gross domestic product and real exchange rate show the growth trend by upward sloping while the real interest rate (RIR) and TRD show a fluctuating pattern. Figure 5.1 shows that all the differenced variables fluctuate around the zero mean; hence the variables are integrated of order one I (1) except the dependent variable GDP which is integrated in order of I (2) and Trade Openness in order of I(0).

Figure 5.7: Graphical Illustration of Variables after First Differencing

Source: Author's computation using Eviews 9.5 Econometric Software

The results above confirm the findings in the above table, which reveals that all variables become stationary after first differencing. All the variables have a unit root process, as they seem to revolve around their means. It means that the variables have a constant variance, which is required for the stationarity process even though their variations are time-variant. After establishing, most of the variables are integrating of the same order (1). It is crucial to find if there are long run associations between the explanatory and dependent variables. The pair-wise test for correlation is as follows.

5.3 Pair-wise correlation

With the five variables used in this research, it is essential to conduct a pair-wise correlation Matrix test to find out whether there is a correlation between variables. Results from the pair-wise correlation matrix are presented in the table

Table 5.2: Pair-wise Correlation Results

Variables	DLGDP	DLINF	DLRIR	DLTRD	DLXR
DLGDP	1.000000	-0.153602	-0.161320	0.061631	-0.054803
DLINF	-0.153602	1.000000	0.085471	0.301994	0.305747
DLRIR	-0.161320	0.085471	1.000000	-0.364098	-0.275097
DLTRD	0.061631	0.301994	-0.364098	1.000000	0.600936
DLXR	-0.054803	0.305747	-0.275097	0.600936	1.000000

Source: Own table with data from Eviews 9.5 econometric Software

The pair-wise correlation outcomes above show that all variables are correlating with an explanatory variable DLGDP. DLTRD and DLGDP are more slightly correlated than other variables. The positive correlation between the two variables makes sense as it goes hand in hand with the theory of trade. The theory advocates that an increase in trade openness encourage growth in the economy. The negative correlation between the variable DLRER and DLRIR with the dependent variable DLGDP is consistent with the theory that advocates a rise in the interest rates will lower investment and thereby reduce the exports through an increase of real

exchange rate (Appleyard and Field, 2005). The results also show that among the variables, there is no multicollinearity problem.

In support of the remark that all variables are correlating with DLGDP, and not just one specific variable, this confirms that if all variables correlate, there is less likelihood of the multicollinearity problem. In this regard, DLGDP agrees with the recommended explanatory variables.

5.4 Co-integration

Co-integration indicates the presence of a long run association amongst variables. It means they are integrating of the same order, but a linear combination of at least one or more variables are integrating of order I(0).

The first criterion to be met when using the Johansen co-integration test is to indicate an optimal lag to be used. The Johansen test finds the deterministic trend assumption in the VAR model and removes the serial correlation on the residuals. The optimal lag is obtained from an information criterion approach, as well as how many lags should be included in the model. Table 5.3 shows the different lag-order selection information criteria. An optimum lag length is expected to produce uncorrelated and homoscedastic residuals. To conclude the conflicting results, all lags selected were considered and a lag length with robust diagnostics used. Lag 2 is the optimal lag for the data set.

Table 5.3: Lag Order Selection Criterion

VAR Lag Order Selection Criteria						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-96.44118	NA	7.93e-06	2.444366	2.590079	2.502905
1	480.7783	1070.986	1.32e-11	-10.86213	-9.987849	-10.51089
2	554.4989	127.9007*	4.11e-12*	-12.03612*	-10.43327*	-11.39218*
3	560.1946	9.195507	6.65e-12	-11.57095	-9.239541	-10.63432
4	568.3668	12.20912	1.03e-11	-11.16547	-8.105487	-9.936137
* indicates lag order selected by the criterion						

The results of the Johansen cointegration technique are reported in the table below.

Table 5.4: Co-integration rank test results

Unrestricted Cointegration Rank Test (Trace)					
Hypothesised		Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	
None *	0.554569	120.3796	69.81889	0.0000	
At most 1 *	0.373862	54.87395	47.85613	0.0095	
At most 2	0.151579	54.86951	29.79707	0.6437	
At most 3	0.041610	3.636411	15.49471	0.9307	
At most 4	0.002391	0.193880	3.841466	0.6597	
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values					

Table 5.4 shows that trace test results reflect that co-integrated equations exist at 5% level of significance. The null hypothesis of no co-integrating vectors is rejected since the trace test statistic of 120.37 is more than the critical 69.82 at 5% level of significance. In the same analogue, Ho: = there is at most one co-integration vector, and it falls under the rejection region, meaning we reject the null hypothesis as the trace test value statistic of approximately 54.87 is greater than the critical 29.79 at 5% level of significance. The null hypothesis that there is at most two co-integration

vectors can be accepted as the trace statistic of about 16.95 is less than the critical value of 29.78 at 5 % significant and even at most, three cointegration vectors are accepted since the trace statistic of approximately 3.636 is less than the critical value of 15.494 at 5 % significance. At most four cointegration vectors are rejected since the trace statistic of roughly 0.193 is less than the critical value of 3.841 at 5% significant.

Table 5.5: Co-integration Eigenvalue test results

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)					
Hypothesized		Max-Eigen	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	
None *	0.554569	65.50569	33.87687	0.0000	
At most 1 *	0.373862	37.92294	27.58434	0.0017	
At most 2	0.151579	13.31460	21.13162	0.4237	
At most 3	0.041610	3.442531	14.26460	0.9130	
At most 4	0.002391	0.193880	3.841466	0.6597	
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values					

The maximum eigenvalue test results in table 5.5 reveal that the co-integrating equation exists at a 5% level of significance. The null hypothesis of no co-integrating vectors is rejected as the critical eigenvalue of 65.50 is more than the critical value 33.876 at 5% level of significance. At most, one co-integrating vector is not accepted using the same analysis, as a test statistic of about 37.922 is more than the critical value of 21.58 at 5% level of significance. At most two, the null hypothesis failed to reject since the statistical value of 13.31 is less than the critical value of 21.131 at 5% level of significance. At most, three, the null hypothesis is accepted since the statistical value of about 3.44 is less than the critical values 14.26 at 5% level of significance. At most, four, the null hypothesis of approximately 0.1938 is less than the critical value of 3.841 at 5% significance.

There is a long run relationship between the variables based on the results of co-integration using the trace and eigenvalues. The results imply that the Vector Error Correction Model (VECM) can now be used.

5.5 Vector Error Correction Model (VECM)

The outcomes indicate that there is a co-integration equation, which implies that a VECM model can be used.

5.5.1 Short-run and long-run co-integration equation

In the econometric investigation, the error-correlation is that co-integrated with time series variables must reflect a short-run adjustment mechanism. The following section investigates the link between short-run and long-run changing aspects, which is the co-integration vector. Appropriate sign and significance will be examined to determine the parameters of the error-correlation term implied by co-integrating vectors for GDP.

Table 5. 6: Results from the long-run and short-run co-integration equation

Short-run Analysis			
Variables	Coefficient	Standard error	t-statistic
Constant	-0.030535	-	-
DLGDP	1.000000	-	-
DLINF	-1.424798	0.68517	-2.07948
DLRIR	-2.120526	0.64942	-3.26526
DLXR	-3.796998	1.65710	-2.29135
DLTRD	-0.191582	3.74617	-0.05114
Long-run Analysis			
Variables	Coefficient	Standard error	t-statistic
DLGDP	0.862636	0.13957	6.18050
DLINF	-0.069999	0.17416	-0.40191
DLRIR	0.261365	0.18737	1.39490
DLXR	-1.460937	1.21756	-5.40191
DLTRD	2.627216	1.85748	1.41440

The long-run impact of XR, RER, INF, RIR, and TRD on GDP is presented in Table 5.6 above. The co-integration vector shows that a unit root stationary long-run relationship, where the level of DLGDP is influenced by inflation, trade openness, interest rates and real exchange rate. Table 5.7 shows that real exchange rate has an adverse effects relationship in the long run with the dependent variable GDP and is substantial because the absolute t-value is less than 2. Most of the other variables viz, RIR and TRD also had a positive relationship with the dependent variable, and

they are statistically significant although the INF has a positive relationship with the dependent variable and is significant.

In Table 5.6, the coefficient of DLGDP of 0.8626 shows that the speed of adjustment is about 86.26 %. Therefore, this means that if there is a deviation from equilibrium, only 86.26% is adjusted in the first quarter, as the variables revert to their equilibrium. Economic growth has a significant pressure to revert to its long-run equilibrium as in each period there is a disruption. The absolute statistical value is 6.180, and is statistically significant, and the speed of adjustment is substantial. It confirms that the higher speed of adjustments means that model is well fitted.

The results indicate that a 1% increase in the real exchange rate will cause the GDP to decrease by nearly 14.61% in the long run. The effect is significant since the t-statistic value is almost 2. The analogue can confirm that an increase in the exchange rate or the devaluation of the rand against the dollar will affect the demand and supply of imported goods. Table 5.6 shows that in the short run, the exchange rate harms economic growth. A 1% increase in the real exchange rate will cause a decrease in GDP by 379%. An increase in the real exchange rate can impact the weak currency and stipulate imports and a trade deficit in the short run, which leads to gross domestic products falling. Subsequently, it will decrease foreign reserves, worsen the trade balance and affect employment and output.

A 1% increase in the interest rates increases the GDP by approximately 0.261% in the long run. It underpins the theory that investments will be increased and improve the portfolio of investments of South Africa, thereby encouraging Foreign Direct Investment. In the short run, the real interest rates hurt GDP, and it is statistically significant at approximately 21.20%, and its absolute t-value is more than 2. An increase in real interest rates is expected to lead to a decrease in economic growth due to an inverse relationship between investments and interest rates.

The results indicate that that 1 % increase in TRD decreases economic growth in the short run by 19.15 %. However, in the long run, trade openness has a positive and

significant impact on economic growth. The improvement of higher quality exports increased by almost by 26.27 %. Hausmann et al. (2007) confirm the results that high-quality exports enhance economic growth.

The outcomes indicate that a 1% increase in inflation will have a negative relationship with GDP. The results suggest that in the short run, a decrease in inflation will increase the GDP by 14.24% and in the long run, economic growth by 0.6 %. This is confirmed by a reduction in prices, an increase in the purchasing power, and that leads to economic growth. An increase in inflation affects investment because of ambiguity, it also affects the balance of payment, and exports become more expensive.

5.6 Diagnostic test

In this section, a diagnostics test is performed to validate the estimated parameters and evaluates the outcomes generated by the model. The serial correlation was tested in the model, normality distribution, auto regression, conditional heteroscedasticity and stability. Challenges faced by the residuals from estimated models cause the model to be biased and inefficient. For this research, VECM also adheres with a diagnostic test. Table 5.7 below represents the results of the diagnostic test. The null hypothesis for the diagnostics test is that there is no serial correlation for the LM test; the null hypothesis is there is no normality for the Jarque-Bera test, and the null hypothesis is that there is no heteroscedasticity against its alternative explanation in the model.

Figure 5.7: Residual Normality Test

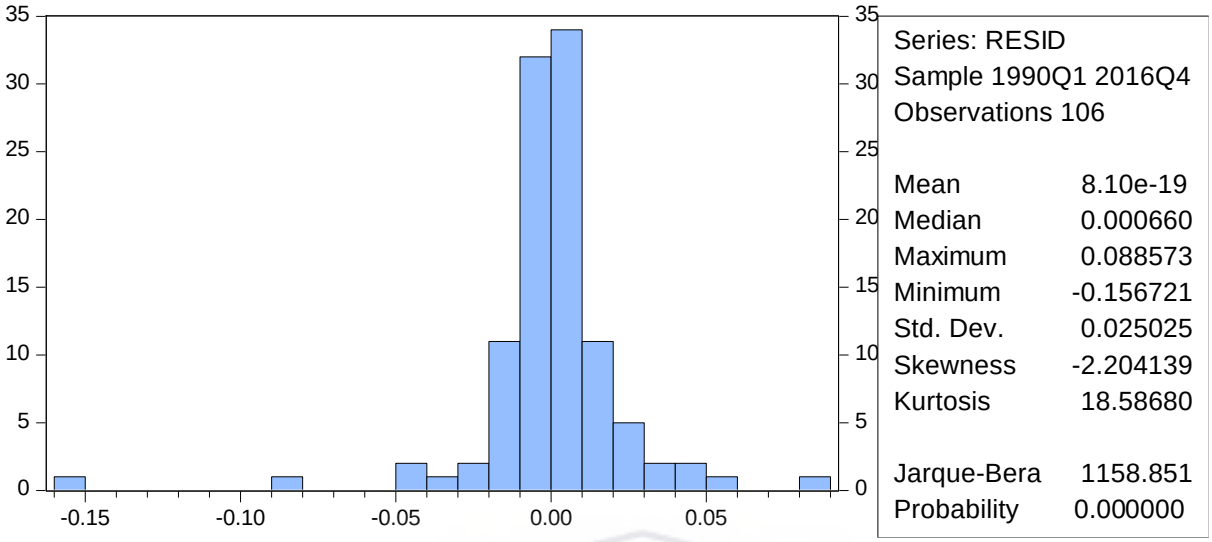


Table 5.7: Diagnostic test Results

Test	Null hypothesis	t-statistic	Probability
Langrage multiplier (LM)	No serial correlation	24.15221	0.5106
White (CH-sq)	No conditional heteroscedasticity	489.3051	0.3745

5.6.1 Heteroscedasticity

The Whites test results for heteroscedasticity with the null hypothesis of no conditional heteroscedasticity are presented on the above table 5.7, which indicates a Ch-sq of 489.3051 at the probability of 0.3745, which means it is accepted that there is no heteroscedasticity on the null hypothesis. The alternative hypothesis was that there is heteroscedasticity. Based on the results above, the residuals are homoscedastic.

5.6.2 Residual Normality test

The Jarque-Bera test was used to test normality on residuals. Based on the results of table 5.7, the Jarque-Bera statistics of 1158.85 with the probability of 0.0000 means the null hypothesis is accepted at 5% significance level. Therefore, it means that residuals are distributed normally.

5.6.3 Langrage Multiplier (LM) test

Table 5.7 shows that the serial correlation test that is produced by the LM statistic of 24.15221 with the probability of 0.5106 advocates that the null hypothesis is accepted.

5.6.4 Impulse Response Analysis

Impulse response functions are meant to find out the sensitivity of the explanatory variable in the vector error correction model to individual shocks from the other variables. In the VECM system over 16 years, a unit shock is applied to the error for each equation. Nevertheless, the main objective is to investigate the trends of macroeconomic indicators and the impact of the real exchange rate performance on the economic growth of South Africa. Only the dependent variable, namely GDP will trace its sensitiveness. Impulse is depicted in figure 5.8 with a discussion of Figure 5.9 impulse response results. The research focused on both objectives, but only economic growth was responsive to the real exchange rate and the reaction of GDP to explanatory variables is reported in figure 5.7.

Real exchange rates show the adverse effects in the first quarter onwards except for the fifth quarter and the eight quarter. The gross inflation shows a positive impact of the first quarter except for the fourth and eight quarter, but with all the other quarters, there is a significant relationship and economic developments. On the third and the eighth quarter, there is a negative influence and the real exchange rate will have a positive impact on economic growth, while economic growth is affected

negatively by the interest rate in the first quarter up to the tenth quarter excepts the third and fourth quarter.

5.7 Variance Decomposition Analysis

The variance decomposition gives insights in explaining the differences in the explanatory variable and the independent variables to determine the importance of dependent variables in the equation. Variance decomposition indicates an approach of defining the relative significance of shocks of the real exchange rate in clarifying deviations in GDP. A summary is displayed in Table 5.8 as the outcomes of variance decomposition cover the 10-quarter periods.

Table 5.8: Variance Decomposition of GDP

Periods	S. E	GDP	INFL	TRD	RER	RIR
1	0.010564	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.015234	96.36342	1.783953	0.475691	0.058925	1.318008
3	0.016030	87.27163	1.973813	7.544311	0.053583	3.156667
4	0.016429	83.08426	1.977719	7.720680	0.661651	6.555695
5	0.018952	84.84720	1.868866	6.618728	1.069738	5.595470
6	0.021611	84.23713	3.291618	5.151754	1.057605	6.261891
7	0.022032	81.25870	3.813547	7.391321	1.170221	6.366212
8	0.022276	79.49986	3.922246	8.158348	1.500454	6.919093
9	0.024155	81.90014	3.626512	7.102958	1.421198	5.949192
10	0.026100	82.82777	3.880602	6.088053	1.245798	5.957773

The research permits the variance decomposition for ten quarters to determine the long-run effects relative to economic growth. For year one, all the variances in GDP are described by their innovation, as is suggested by Brooks (2008). For the 5th quarter forecast of error variance, GDP explains about 85% of its variation whereas other variables only explain the remaining 15%, thus the exchange rate, explains 1.87%, INF explains 6.62%, RER explains about 1.07%, and RIR describes 5.60%.

However, after ten quarters, GDP explains about 83% of its variation, while other variables explain the remaining 17%. The exchange rate increased by about 3.88%, while INF decreased to about 6.09%, RER increased to 1.25%, and RIR increased to 5.96. These results show that all variables have a substantial impact on GDP in the short run and are like those from the impulse response analysis. Economic growth explains most of its variations, followed by inflation, then real interest rates. The real exchange rate does not reveal much about the deviations on GDP.

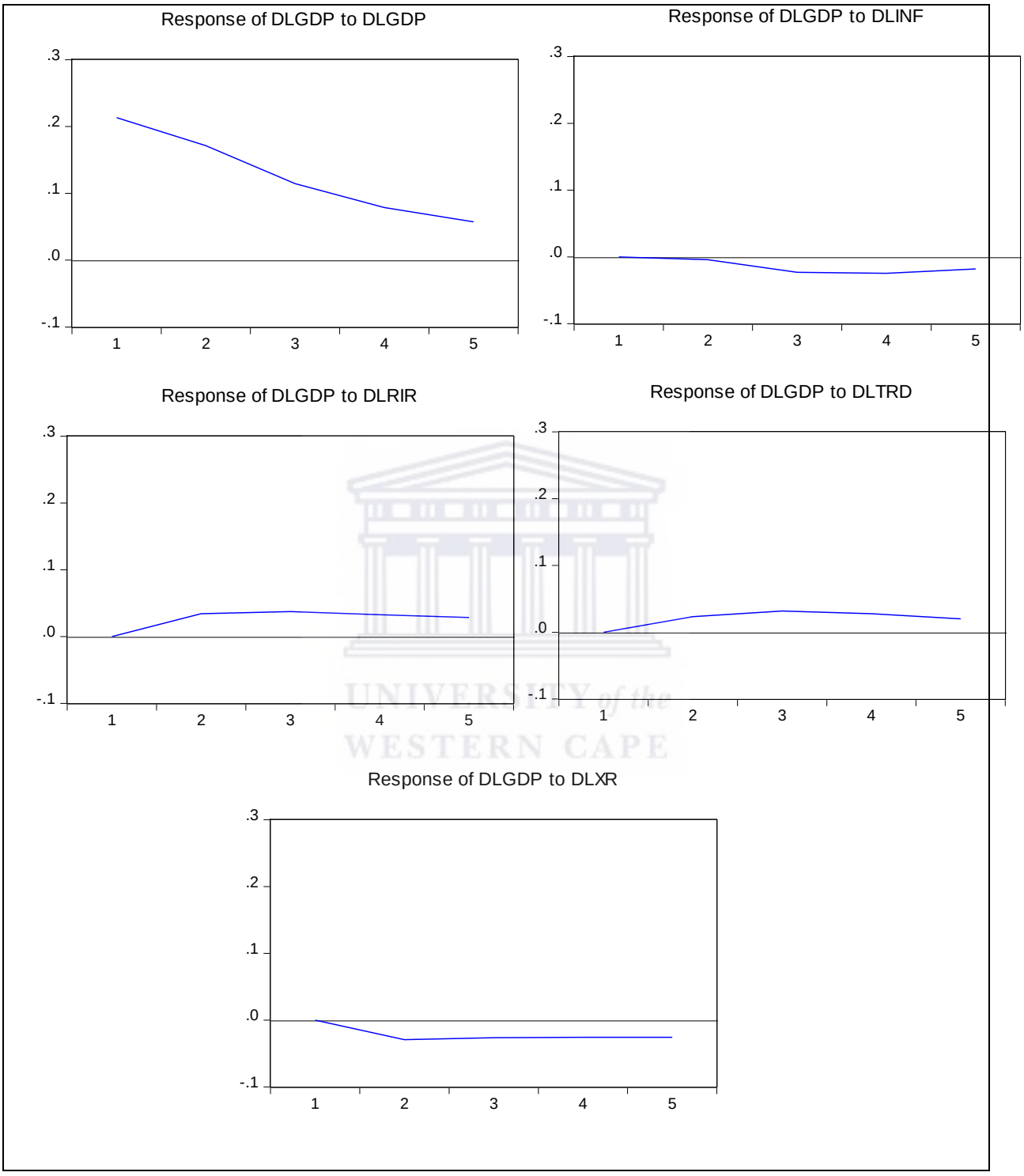
5.8 Summary

This section was separated into four divisions. The first section presented the stationarity tests where the Dickey-Fuller and the Philips-Peron tests were used. Both methods showed that the data series has a unit root in levels except the exchange rate and become stationary when data is differenced once apart from GDP. Co-integration tests then followed in the second section. The co-integration tests were conducted using the Johansen maximum likelihood method. To define the connection between the variables, the pair-wise correlation matrix was used in this research. The results in the pair-wise correlations show that all variables are correlated with GDP and also confirm that there is no multicollinearity problem. Lag order criteria were employed as to examine the direction in the lag order and the decision was made to adopt three-lag order. The trace and maximum eigenvalues were used to test for co-integration.

The third section presented the VECM model since variables can either have short-run or long-run effects. In the long run, the other variables were not significant, and only the exchange rate had a significant effect on economic growth in South Africa. The results indicate that the real exchange rates have a positive long-run effect on economic growth while INF, RER, and RIR have an adverse long-run impact on economic growth.

The last section presented the results of the diagnostic tests carried out in the study. Some residual diagnostics tests were carried out, and these revealed how well the model fitted. Diagnostic checks were executed on the GDP model to confirm the estimated parameters of the results accomplished by the model. Variance decomposition and impulse response are consistent with the economic growth theory. Variance decomposition shows that GDP itself explains most of its variation followed by INF, RIR, RER and RER.

Figure 5.8: Impulse Response



CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Summary and Conclusion

The main objective of the study was to analyse the impact of the real exchange rate's performance on economic growth between the period of 1990 and 2016 through evaluating the pertinent literature that revolves around the subject matter and using a concrete methodology. An analysis of the results showed the stationarity test proved that the variables have a unit root at level except for the exchange rate and the variables become stationary at first differencing except the GDP, which becomes stationary at the second differencing.

The Johansen-Juselius that was employed suggested the use of VECM. The model shows that real exchange rate affects economic growth positively in the long run while in the short run, it affects economic growth negatively. Diagnostic tests were performed on the residuals. To check the responsiveness of the dependent variable, the impulse response was used to analyse the shocks to each of the other variables.

Variables were significant, but not all variables showed shocks in other variables, and they are also not persistent. Variance decomposition analysis was done to check for the variables that could explain most of the variations in the dependent variable. It was observed that GDP explains much of its variations followed by the exchange rate rather than other variables. The null hypothesis presented in this study was that the real exchange rate has adverse effects on the economic growth of South Africa. The null hypothesis is accepted based on the regression results.

6.2 Policy Recommendations

The study proposed the following recommendations based on the findings. There are two policy options to respond to the real exchange rate in the economy, namely, monetary policy and fiscal policy. The SARB (2008) uses inflation targeting where it employs the interest rate (Repo) to influence monetary policy. The Monetary Policy Committee (MPC) is responsible for the flexible inflation-targeting framework but also conducts monetary policy, sets monetary policy. It allows inflation to be maintained within a target range. Exchange rate shocks inevitably lead to high rates of inflation. Monetary policy intervention in cases where inflation is high may be commendable (Huang, 2010). However, the exclusive use of monetary policy to curb inflation during goods price shocks may result in unintended consequences; namely, depreciation of the rand, which makes importing of goods even more expensive.

According to Eltony (2011), fiscal policy can be used more effectively to stabilise the domestic economy after a price shock. It also indicates that government expenditure should be appropriately applied to control local prices (CPI) and the balance of payment problems, which is the level of imports.

Since the results show government expenditure regarding gross fixed investment, significantly influenced almost all the other variables, thus it is essential that government spending is not increased rapidly to levels, which may become unsustainable if the real exchange rate falls in the future. There should be uniformity on how the government spends its money and at the same time, other economic activities should have a balance that will not upset importation and other strategic economic activities, since an exchange rate shock may hit anytime while the government has/is spending more on other activities. Such a situation would affect the economy profoundly as the government is forced to shift focus to goods importation to keep the economy running (Bacon and Kojima, 2008).

Given the economic harm, if there should be an occurrence of a rising exchange rate. it appears to be sensible to assume that the country needs to expand its key businesses and upgrade the intensity of non-energy segments by expanding remote direct ventures (FDI) from the rest of the world, driven by the improvement of speculation conditions through the World Trade Organisation (WTO) (Kojima, 2009).

Apart from monetary and fiscal policy interventions, it is also equally important to promote regional integration. According to Aburto (2010), regional integration of the devaluation of rand by optimising it to all district, expands the effectiveness, and lowers generation costs owing to economies of scale. The smoother load pattern that arises means less investment in reserve requirements and the consumption profiles of participants are not perfectly correlated.

6.3 Reflections and Implications of Study Findings for the Current Study

The researcher noticed that after a review of the study in its totality, it became apparent that real exchange rates were a significant variable in explaining changes in economic growth. The different theories that were considered in this study had different foundations and assumptions, but the basic idea in most of them was that policymakers could use real exchange rates as a tool to achieve high levels of economic growth in the long run and not the short run

6.4 Reflection and Methodology Issues and Limitations of the Study

The study is limited to the data during the period 1990 to 2016 quarterly and did not include any data before the implementation of an inflation targeting policy in South Africa. It is recommended that future studies look at a comparative analysis of the impact of the exchange rate during the period before inflation targeting and during the period after the imposition of inflation targeting policy in South Africa.

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APPENDIX

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-96.44118	NA	7.93e-06	2.444366	2.590079	2.502905
1	480.7783	1070.986	1.32e-11	-10.86213	-9.987849	-10.51089
2	554.4989	127.9007*	4.11e-12*	-12.03612*	-10.43327*	-11.39218*
3	560.1946	9.195507	6.65e-12	-11.57095	-9.239541	-10.63432
4	568.3668	12.20912	1.03e-11	-11.16547	-8.105487	-9.936137

* 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

Unrestricted Cointegration Rank Test (Trace)					
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	
None *	0.554569	120.3796	69.81889	0.0000	
At most 1 *	0.373862	54.87395	47.85613	0.0095	
At most 2	0.151579	16.95101	29.79707	0.6437	
At most 3	0.041610	3.636411	15.49471	0.9307	
At most 4	0.002391	0.193880	3.841466	0.6597	

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)					
Hypothesized		Max-Eigen	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	
None *	0.554569	65.50569	33.87687	0.0000	
At most 1 *	0.373862	37.92294	27.58434	0.0017	
At most 2	0.151579	13.31460	21.13162	0.4237	
At most 3	0.041610	3.442531	14.26460	0.9130	
At most 4	0.002391	0.193880	3.841466	0.6597	
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values					

Short-run Analysis			
Variables	Coefficient	Standard error	t-statistic
Constant	-0.030535	-	-
DLGDP	1.000000	-	-
DLINF	-1.424798	0.68517	-2.07948
DLRIR	-2.120526	0.64942	-3.26526
DLXR	-3.796998	1.65710	-2.29135
DLTRD	-0.191582	3.74617	-0.05114

Long-run Analysis			
Variables	Coefficient	Standard error	t-statistic
DLGDP	0.862636	0.13957	6.18050
DLINF	-0.069999	0.17416	-0.40191
DLRIR	0.261365	0.18737	1.39490
DLXR	-1.460937	1.21756	-5.40191
DLTRD	2.627216	1.85748	1.41440

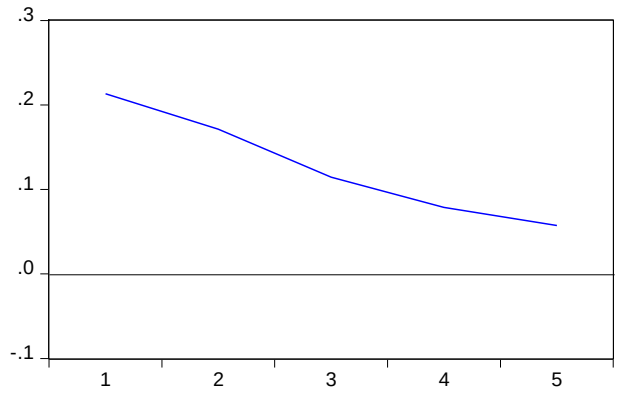
Vector Error Correction Estimates					
Sample (adjusted): 1993Q4 2016Q3					
Included observations: 85 after adjustments					
Standard errors in ( ) & t-statistics in [ ]					
Cointegrating Eq:	CointEq1				
LGDP(-1)	1.000000				
LINF(-1)	-1.424798				
	(0.68517)				
	[-2.07948]				
LRIR(-1)	-2.120526				
	(0.64942)				
	[-3.26526]				
LTRD(-1)	-0.191582				
	(3.74617)				
	[-0.05114]				
LXR(-1)	-3.796998				

	(1.65710)				
	[-2.29135]				
C	12.99936				
Error Correction:	D(LGDP)	D(LINF)	D(LRIR)	D(LTRD)	D(LXR)
CointEq1	-0.000850	0.040314	0.032057	0.004267	0.003856
	(0.02043)	(0.01353)	(0.01500)	(0.00201)	(0.00289)
	[-0.04159]	[2.97939]	[2.13730]	[2.12236]	[1.33481]
D(LGDP(-1))	0.862636	-0.076999	-0.025922	-0.005381	-0.014585
	(0.13957)	(0.09242)	(0.10245)	(0.01373)	(0.01973)
	[6.18050]	[-0.83313]	[-0.25303]	[-0.39183]	[-0.73915]
D(LGDP(-2))	-0.165668	-0.055639	-0.016931	-0.000142	-0.005992
	(0.11812)	(0.07821)	(0.08670)	(0.01162)	(0.01670)
	[-1.40258]	[-0.71137]	[-0.19529]	[-0.01226]	[-0.35886]
D(LINF(-1))	-0.069999	0.479665	-0.028135	0.007084	0.005783
	(0.17416)	(0.11533)	(0.12784)	(0.01714)	(0.02462)
	[-0.40191]	[4.15919]	[-0.22008]	[0.41338]	[0.23488]
D(LINF(-2))	-0.133906	-0.040961	0.055714	0.010289	0.000282
	(0.17567)	(0.11633)	(0.12894)	(0.01729)	(0.02484)
	[-0.76225]	[-0.35212]	[0.43208]	[0.59521]	[0.01134]
D(LRIR(-1))	0.261365	-0.060951	0.407132	-0.008203	-0.011219
	(0.18737)	(0.12407)	(0.13753)	(0.01844)	(0.02649)
	[1.39490]	[-0.49125]	[2.96028]	[-0.44489]	[-0.42352]
D(LRIR(-2))	-0.028215	-0.006990	0.052054	-0.002227	0.001559
	(0.18311)	(0.12125)	(0.13440)	(0.01802)	(0.02589)
	[-0.15409]	[-0.05765]	[0.38730]	[-0.12363]	[0.06024]
D(LTRD(-1))	2.627216	-0.790717	-0.790418	0.314379	-0.231853
	(1.85748)	(1.22997)	(1.36340)	(0.18278)	(0.26260)
	[1.41440]	[-0.64287]	[-0.57974]	[1.72002]	[-0.88293]
D(LTRD(-2))	-0.608028	-0.883482	-0.515224	-0.068044	-0.127899
	(1.87726)	(1.24307)	(1.37791)	(0.18472)	(0.26539)
	[-0.32389]	[-0.71073]	[-0.37392]	[-0.36836]	[-0.48193]
D(LXR(-1))	-1.460937	0.347989	0.458619	0.036946	0.641654

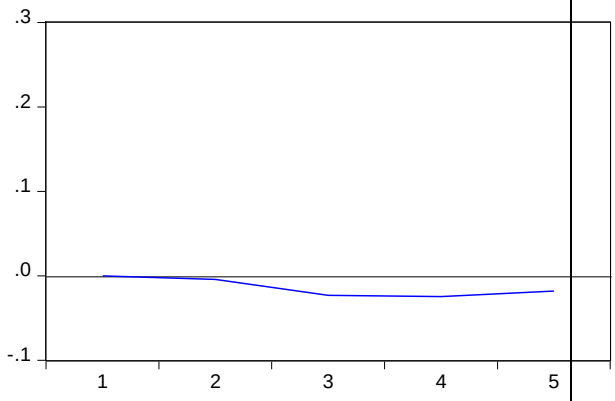
	(1.21756)	(0.80623)	(0.89369)	(0.11981)	(0.17213)
	[-5.19989]	[0.43162]	[0.51317]	[0.30838]	[3.72777]
D(LXR(-2))	0.764060	1.139049	0.628101	0.027209	0.196058
	(1.27525)	(0.84444)	(0.93604)	(0.12549)	(0.18028)
	[0.59914]	[1.34889]	[0.67102]	[0.21683]	[1.08749]
C	-0.030535	-0.006285	-0.005314	0.004458	0.006905
	(0.02842)	(0.01882)	(0.02086)	(0.00280)	(0.00402)
	[-1.07443]	[-0.33397]	[-0.25473]	[1.59402]	[1.71870]
R-squared	0.636991	0.569388	0.237387	0.297405	0.474323
Adj. R-squared	0.552154	0.474364	0.122473	0.191535	0.395111
Sum sq. resids	3.361735	1.474029	1.811172	0.032551	0.067188
S.E. equation	0.214595	0.142099	0.157514	0.021116	0.030338
F-statistic	5.150958	3.887322	2.065776	2.809146	5.988043
Log likelihood	16.67347	51.71292	42.95900	213.7637	182.9642
Akaike AIC	-0.109964	-0.934422	-0.728447	-4.747381	-4.022686
Schwarz SC	0.234881	-0.589577	-0.383602	-4.402536	-3.677842
Mean dependent	-0.037018	0.008188	0.008585	0.007711	0.019654
S.D. dependent	0.266615	0.166814	0.168147	0.023485	0.039007
Determinant resid covariance (dof adj.)	2.86E-12				
Determinant resid covariance	1.34E-12				
Log-likelihood	558.9757				
Akaike information criterion	-11.62296				
Schwarz criterion	-9.755049				

Variance Decomposition of LGDP:						
Period	S.E.	LGDP	LINF	LRIR	LTRD	LXR
1	0.214595	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.445461	98.75913	0.040074	0.503501	0.251009	0.446286
3	0.680763	97.06464	0.377755	1.081415	0.614429	0.861765
4	0.909701	95.42763	0.884261	1.587932	0.892195	1.207980
5	1.130496	93.98342	1.392475	2.005685	1.066187	1.552234
6	1.343941	92.73866	1.841683	2.338604	1.163608	1.917444
7	1.551282	91.65803	2.225533	2.599184	1.210575	2.306683
8	1.753638	90.70223	2.553201	2.802698	1.225677	2.716193
9	1.951892	89.83951	2.835129	2.963668	1.221076	3.140619
10	2.146685	89.04718	3.079632	3.094205	1.204521	3.574459

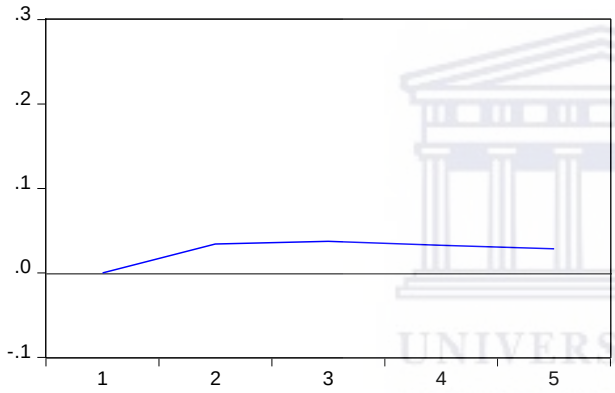
Response of DLGDP to DLGDP



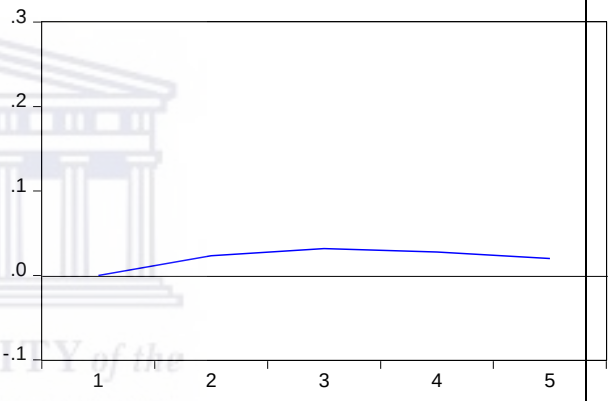
Response of DLGDP to DLINF



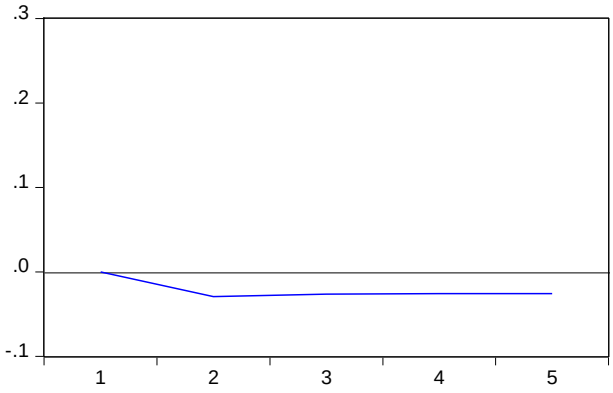
Response of DLGDP to DLRIR



Response of DLGDP to DLTRD



Response of DLGDP to DLXR



	GDP	INF	RIR	TRD	XR
1990Q1	-0,1466	13,4	5,1765	43,716	2,5039
1990Q2	-0,2433	14,117	4,8927	42,233	2,563
1990Q3	-0,3661	14,68	4,6408	40,941	2,6169
1990Q4	-0,5151	15,088	4,4207	39,841	2,6656
1991Q1	-0,6902	15,341	4,2325	38,933	2,7091
1991Q2	-0,8915	15,44	4,0761	38,217	2,7474
1991Q3	-1,1189	15,384	3,9516	37,693	2,7805
1991Q4	-1,3725	15,174	3,8589	37,36	2,8083
1992Q1	-2,4189	14,844	3,992	37,355	2,7672
1992Q2	-2,418	14,31	3,8855	37,352	2,8102
1992Q3	-2,1365	13,608	3,7333	37,486	2,8735
1992Q4	-1,5745	12,737	3,5353	37,757	2,9571
1993Q1	0,1836	10,749	2,6	38,508	3,1326
1993Q2	0,9406	9,9204	2,5872	38,918	3,2282
1993Q3	1,612	9,3034	2,8054	39,328	3,3156
1993Q4	2,1978	8,8975	3,2544	39,739	3,3946
1994Q1	2,815	9,1493	4,7093	39,965	3,477
1994Q2	3,1827	8,9871	5,3102	40,451	3,5348
1994Q3	3,418	8,8575	5,8321	41,012	3,5797
1994Q4	3,5208	8,7604	6,2749	41,648	3,6117
1995Q1	2,9554	8,9441	6,077	42,512	3,5054
1995Q2	3,0077	8,8128	6,5864	43,236	3,5617
1995Q3	3,1417	8,6148	7,2413	43,973	3,6552
1995Q4	3,3577	8,35	8,0419	44,724	3,7861
1996Q1	4,3055	7,4499	9,8804	45,971	4,1041
1996Q2	4,4251	7,279	10,615	46,555	4,2494
1996Q3	4,3665	7,2686	11,139	46,959	4,372
1996Q4	4,1297	7,4189	11,451	47,184	4,4719
1997Q1	3,3427	8,594	10,8	46,486	4,3967
1997Q2	2,8983	8,7199	10,99	46,647	4,512
1997Q3	2,4247	8,6607	11,27	46,926	4,6657
1997Q4	1,9216	8,4164	11,64	47,322	4,8575
1998Q1	0,6956	7,5217	13,049	48,766	5,2362
1998Q2	0,4113	7,0935	13,218	49,023	5,445
1998Q3	0,3752	6,6665	13,097	49,025	5,6327
1998Q4	0,5873	6,2406	12,686	48,772	5,7992
1999Q1	1,6748	5,5286	11,603	46,592	5,8526
1999Q2	2,1322	5,2198	10,764	46,496	6,0135
1999Q3	2,5868	5,0271	9,7866	46,814	6,1899

1999Q4	3,0387	4,9505	8,6719	47,545	6,3819
2000Q1	3,9833	5,2478	6,2091	49,911	6,4974
2000Q2	4,2314	5,3	5,3031	50,979	6,7574
2000Q3	4,2786	5,3651	4,7437	51,972	7,0698
2000Q4	4,1248	5,443	4,5306	52,889	7,4347
2001Q1	2,9002	5,0815	6,0205	53,29	7,9422
2001Q2	2,6924	5,366	5,9578	54,231	8,3759
2001Q3	2,6316	5,8441	5,6991	55,272	8,826
2001Q4	2,7177	6,516	5,2442	56,413	9,2925
2002Q1	3,5762	8,9231	2,8312	59,986	10,583
2002Q2	3,706	9,3657	2,6891	60,394	10,759
2002Q3	3,7327	9,3853	3,0556	59,969	10,629
2002Q4	3,6562	8,982	3,9309	58,711	10,192
2003Q1	2,8554	7,281	8,1065	53,282	8,3884
2003Q2	2,821	6,3817	8,8827	51,694	7,7613
2003Q3	2,9319	5,4093	9,0509	50,608	7,2512
2003Q4	3,188	4,364	8,6113	50,024	6,858
2004Q1	4,0905	2,0493	5,3212	50,825	6,7171
2004Q2	4,4367	1,3364	4,5628	50,894	6,5036
2004Q3	4,7277	1,0289	4,0935	51,112	6,353
2004Q4	4,9635	1,1269	3,9133	51,48	6,2651
2005Q1	5,068	2,7646	4,8579	51,582	6,3169
2005Q2	5,2239	3,2199	4,9217	52,416	6,3238
2005Q3	5,3551	3,6269	4,9404	53,566	6,3628
2005Q4	5,4614	3,9857	4,9139	55,032	6,4338
2006Q1	5,5702	3,986	4,7873	58,186	6,6386
2006Q2	5,6163	4,3725	4,6926	59,735	6,733
2006Q3	5,6267	4,8349	4,5748	61,052	6,8188
2006Q4	5,6015	5,3732	4,4339	62,136	6,8959
2007Q1	5,7526	5,8676	3,8259	61,503	6,7955
2007Q2	5,5714	6,6056	3,8165	62,716	6,9228
2007Q3	5,2699	7,4674	3,9615	64,289	7,109
2007Q4	4,8479	8,4531	4,2611	66,224	7,3541
2008Q1	4,4045	11,254	5,678	73,583	7,9621
2008Q2	3,7022	11,811	5,9016	74,214	8,2033
2008Q3	2,8399	11,815	5,8946	73,181	8,3818
2008Q4	1,8176	11,266	5,657	70,484	8,4977
2009Q1	-1,2189	8,5428	4,4193	59,146	8,6073
2009Q2	-1,8195	7,537	4,0285	55,91	8,5751
2009Q3	-1,8384	6,6271	3,7149	53,8	8,4576
2009Q4	-1,2756	5,8131	3,4787	52,817	8,2548
2010Q1	2,0002	4,7697	3,5632	55,22	7,5827
2010Q2	2,8738	4,2775	3,3841	55,585	7,3629

2010Q3	3,4766	4,0113	3,1848	56,171	7,2113
2010Q4	3,8085	3,9711	2,9655	56,98	7,128
2011Q1	3,3981	4,7359	2,3734	59,088	7,126
2011Q2	3,377	4,916	2,2548	59,91	7,1741
2011Q3	3,2736	5,0905	2,2572	60,524	7,2851
2011Q4	3,0881	5,2594	2,3805	60,929	7,4593
2012Q1	2,4044	5,4954	3,2475	60,219	7,7766
2012Q2	2,2208	5,624	3,3634	60,57	8,0448
2012Q3	2,1215	5,7179	3,3512	61,075	8,3441
2012Q4	2,1063	5,7771	3,2106	61,734	8,6743
2013Q1	2,5523	5,6808	2,3044	63,441	9,1518
2013Q2	2,5547	5,7189	2,1624	64,051	9,4976
2013Q3	2,4905	5,7706	2,1473	64,457	9,828
2013Q4	2,3597	5,8359	2,2589	64,66	10,143
2014Q1	1,935	6,2292	2,8006	64,515	10,293
2014Q2	1,7618	6,196	3,0445	64,369	10,637
2014Q3	1,613	6,0506	3,2937	64,079	11,025
2014Q4	1,4885	5,793	3,5484	63,643	11,457
2015Q1	1,5458	4,6402	4,1067	62,544	12,037
2015Q2	1,407	4,4716	4,253	62,025	12,516
2015Q3	1,2294	4,5039	4,2854	61,568	12,999
2015Q4	1,0132	4,7374	4,2039	61,174	13,483
2016Q1	0,7583	5,1719	4,0086	60,841	13,971
2016Q2	0,4648	5,8074	3,6995	60,571	14,462
2016Q3	0,1326	6,644	3,2765	60,363	14,955
2016Q4	-0,2383	7,6817	2,7396	60,217	15,451