THE IMPACT OF OIL PRICE VARIABILITY ON THE EXCHANGE RATE IN SOUTH AFRICA

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ABSTRACT

Economic theory asserts that exchange rate is a critical variable in the performance of exports and the economy at large. Equally important are variables that affect the exchange rate. In particular, economies that rely on commodity exports are vulnerable to fluctuations in commodity prices. Price volatility of such commodities can lead to significant fluctuations in exchange rates, a phenomenon referred to as commodity currencies. South Africa's currency has fluctuated significantly since 1994. Anecdotal evidence suggests that commodity prices may have a significant effect. Of interest is fluctuations in the oil prices, which in themselves have fluctuated greatly over the same period. This study uses a GARCH(1.1) model to investigate the impact of oil price variability on the South African exchange rate by employing the monthly data for a period spanning from January 1994 to December 2014. The results show that oil price variability affects both the level and volatility of the exchange rate. Informal evidence suggests that sovereign credit ratings are an important factor affecting the South African rand. This is supported by the results of this study. Accordingly, both variables carry important information for markets and policy makers at large.

Keywords: Exchange rates, Oil volatility, Exchange rates

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I, **Ngonisa Phillip** declare that this thesis is my own work and has not been submitted to any educational institution for the award of a degree.

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Above all, I give all the praise and glory to the Lord God Almighty for His unfailing love, strength and protection. Take all the glory oh Lord!

DEDICATION

I dedicate this thesis to the Ngonisa and Ndlovu families

Acronyms

EIA-Energy Information Administration

GARCH- generalised autoregressive conditional heteroscedasticity

IMF-International Monetary Fund

NEER-Nominal effective exchange rate of the Rand

OECD-Organization for Economic Co-operation and Development

OPEC-Organization of Petroleum Exporting Countries

REER-Real effective exchange rate of the Rand

SARB-South African Reserve Bank

ZAR-South African Rand

BRICS-Brazil Russia India China South Africa

GDP-Gross domestic product

CHAPTER ONE

INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 INTRODUCTION

Oil is a crucial commodity that stimulates growth and development in any given economy. For many decades, oil has shown to be an indispensable resource in both developed and developing countries. According to Murphy & Hall (2011), oil is an essential product that is used in many economic activities and without it, world economies come to a halt (Carollo, 2011; Ghalayini, 2011; Seyedmashhadi, Ghalambaz, & Esfandiary, 2011). There is vast literature that shows that oil is undeniably one of the essential commodities. For instance, Simanzhenkov & Idem (2003) and Ross (2012) claim that the importance of crude oil can be measured by the number of products that are derived from it. A recent study by Hou, Keane, Kennan, & Willem (2015) shows that "oil acts as an engine that drives virtually all world economies." Bouchentouf (2015) also emphasises the significance of oil by asserting that it is important for both its production and for the global economy.

Nevertheless, over the past decades, the world economy has experienced persistent fluctuations in oil prices. According to Abeysinghe (2001) and Prasad & Narayan (2015), the effects of volatility in oil prices have both "direct and indirect effects on economic activities." This implies that variability in oil prices has important implications on the global economic performance. Since 1994, the prices of oil became so volatile and difficult to predict. For instance, in January 1994, a barrel of oil was $14.22 and the prices increased to $133.90 per barrel in July 2008 thus accounting over 800% increase between January 1994 and July 2008. By March 2013, the price of oil traded at $124.92 per barrel before decreasing further to $62.16 per barrel in December 2014 (South African Reserve Bank, 2015). In the case of non-dollar oil importing emerging economies such as South Africa, such variability in oil prices is expected to have significant impact on the value of the currency.

Despite these fluctuations in the prices of oil, crude oil consumption has, on average, been on an increasing trend in South Africa. According to United States Energy Information Department (2015), the total crude oil consumption for South Africa was 410 000 barrels per day in 1994 and by 2013, the oil consumption rate increased by 47% to 604 000 barrels per day (United States Energy Information Administration, 2015). In addition, oil imports for South Africa were on an increasing trend. Between 1994 and 2009, South Africa imported 240 000 barrels per day and 500 000 barrels per day respectively, and the import bill continued escalating (The World Factbook, 2015). Nkomo

(2009) asserts that South Africa in heavily dependent on crude oil and imports over 90% of crude oil. Such dependency on crude oil coupled with increasing South Africa's population leads to increasing oil demand and ultimately crude oil import bill (British Petroleum, 2012; World Bank, 2016). The increase in the consumption and importation of crude oil is a clear indication that crude oil is important in driving the economy of South Africa.

Between December1994 and December 2014 the South African exchange rate has shown major fluctuations. For instance, the value of the South African rand traded at 3.5614 relative to the dollar in December 1994 and reached an all-time low of ZAR 11.6761 in December 2001, thus accounting for over 200% depreciation against the US dollar. By December 2008, the rand traded at 9.9227 before depreciating to 11.4975 by the end of 2014 (SARB, 2015). According to Ceccheti & Schoenholtz (2011), exchange rates play a fundamental role in the case of emerging countries in which exports and imports are important to the well-functioning of the economy. Thus, in such economies, exchange rate volatility has many uncertainties in terms of both imports and exports and the economy at large since "good overall macroeconomic performance follow from a stable exchange rate." (Ceccheti & Schoenholtz, 2011). Meanwhile, over the years, the severe fluctuations of the South African currency have attracted attention from both policy makers and academics to investigate the factors behind the volatility of the Rand. Fluctuations in the exchange rate are a cause for concern as they lead to severe exchange rate risk.

1.2 STATEMENT OF THE RESEARCH PROBLEM

In South Africa, crude oil consumption and the oil import bill have been on an upward trend since 1994. On the other hand, the prices of crude oil and the South African exchange rate have been too volatile over the years. According to literature, oil price variability adversely affects the exchange rate for oil importing countries. Studies also show that changes in oil prices culminates into inevitable wealth transfer from the net oil importing countries to net oil exporting countries (Dawson, 2003; Yanagisawa, 2010; Sibanda & Mlambo, 2014). Since oil contracts are invoiced in the United States dollar, a change in oil price should have corresponding effects on the exchange rate. This means that, economies that do not use the dollar need to go short on their domestic currency and long on the dollar in order to be able to import oil.

South Africa is one of the countries that do not use the United States dollar as a medium of exchange domestically. This means that South Africa must go short on its domestic currency and long on the US dollar in order to purchase oil. Furthermore, given the South Africa's heavy dependency on crude oil imports, its exchange rate becomes fundamental because of its role as an intermediate variable. Thus, variability in the price of oil has the potential to expose the South African exchange rate.

Literature provides evidence that oil prices are important determinants of exchange rate (Amano & Norden, 1998b; Chen & Chen, 2007; Chen & Rogoff, 2002; Engel & West, 2005; Lizardo & Mollick, 2010; Zhang, Dufour, & Galbraith, 2016). While a lot of work has been done with regard to the relationship between oil prices variability and exchange rate in developed economies (Aziz, 2009; Bayat, Nazlioglu, & Kayhan, 2015; Chen & Chen, 2007; De Schryder & Peersman, 2015; Novotný, 2012), there is still scanty literature that investigates the relationship between oil price variability and exchange rate in case of developing and emerging economies such as South Africa. Consequently, many developing economies have been left outside this important analysis. To cover this gap, this study investigates the impact of oil price variability on the exchange rate in the context of South Africa.

1.3 OBJECTIVES OF THE STUDY

The main aim of this study is to investigate the impact of oil price variability on the exchange rate in the case of South Africa. In achieving the main goal of the study, these specific goals are also achieved;

1) To examine the trends in the oil prices movements and exchange rates;
2) To econometrically investigate the impact of oil price variability on both the bilateral rand/dollar exchange rate and the nominal effective exchange rate of the South African domestic currency and;
3) Based on the empirical findings, to articulate policy implications necessary for the stability of the South African domestic currency.

1.4 RESEARCH QUESTION

This study endeavours to give answers to the following question;

Does oil price variability significantly affect the bilateral rand/dollar exchange rate and the nominal effective exchange rate of the South African currency?

1.5 RESEARCH HYPOTHESIS

In an effort to achieve the set objectives, the following hypothesis will be tested:

H_0: Oil price variability does not affect both the rand/dollar exchange and the nominal effective exchange rate of the rand

H_1: Oil price variability does affect both the rand/dollar exchange and the nominal effective exchange rate of the rand

1.6 SIGNIFICANCE OF THE STUDY

Literature shows that oil is important in driving the global economy (Bouchentouf, 2015; Simanzhenkov & Idem, 2003)**.** Furthermore, anecdotal evidence shows that changes in oil prices had an impact on the exchange rate (Adeniyi, 2012; Chen & Chen, 2007; Coleman, Cuestas, Mourelle, & Street, 2011; Nikbakht, 2009). Despite the fact that there is a large body of literature which gives evidence on the relationship between oil prices and exchange rate, evidence on the nexus between the variables is still scanty in the context of developing and emerging markets. This implies that the findings from the developed countries cannot generally suit the case of developing and emerging countries such as South Africa due to differences in political and economic structures. To bridge this gap, it is of paramount importance to conduct this study in order to comprehend the dynamic link between oil price variability and exchange rate in a developing country context. Thus, as highlighted earlier, this study investigates the effect of oil price variability on the exchange rate in South Africa.

In addition, this study adds to the available literature by employing the generalised autoregressive conditional heteroscedasticity (GARCH, 1.1) methodology to examine the relationship between movements in oil prices on the exchange rate in South Africa. Also, this study investigates the impact of variability of oil prices on the bilateral rand/dollar exchange. Furthermore, the impact of oil price variability on the nominal effective exchange rate of the South African currency is investigated. Investigating the relationship between oil price volatility on the nominal effective exchange rate is of paramount importance as it helps to accurately measure if oil price shocks affect the international competitiveness of the South African rand. In this way, the study narrows the gap and contributes to the debate on the impact of oil price variability and the behaviour of the South African rand. Moreover, the impact of other essential explanatory variables such as sovereign credit ratings and the index of industrial production on the South African exchange rate is also investigated. The impact of these variables has not been examined in the previous studies (Coleman et al., 2011; Sibanda & Mlambo, 2014; Aziz, 2009).

1.7 ORGANISATION OF THE STUDY

Chapter two follows this introductory chapter and it presents an overview of trends on the relationship between exchange rate and oil price variability. Chapter 3 reviews both the theoretical and empirical literature underpinning the relationship between exchange rate and oil price variability. Discussion of the methodology and data sources is presented in the fourth chapter. Chapter 5 estimates the regression model and interpret the results. The dissertation's findings, policy

recommendations as well as suggestions for further research and conclusion are all contained in chapter six.

CHAPTER TWO

AN OVERVIEW OF OIL PRICE VARIABILITY AND EXCHANGE RATES IN SOUTH AFRICA

2.1 INTRODUCTION

The major aim of this chapter is to present an overview of oil prices variability and the South African exchange rate for the post-apartheid era. The previous chapter has highlighted that, oil prices are invoiced in U.S. dollars and this puts so much pressure on the exchange rates of non-dollar economies such as South Africa. In addition, chapter one has also emphasised that over the last decades, oil prices were too volatile. On the other hand, both oil consumption and the oil import bill in South Africa were increasing. The knowledge of oil price variations is vital for all economic agents particularly policy makers and investors. To have a better understanding of the South Africa's exchange rates, this chapter gives a comparison between the South African rand and other selected currencies in the world.

2.2 AN OVERVIEW OF THE OIL MARKET

The oil market is one of those commodity markets that experience rapid and unexpected shocks. Factors such as industrial development, manipulation in the future derivatives and increase in population have been pointed out among the major causes of oil price shocks. Oil price changes date back to over a century ago. According to Hamilton (2011), the first oil price shock in the United States of America was witnessed in 1862 to1864 era. Prior to the shock in crude oil price, the primary sources of illuminates were oil from whales, gas and liquids derived from coal and grain alcohol. Hamilton (2011) further asserts that the discovery of crude oil by Drake Edwin in 1859 led to the substitution of whale oil, grain alcohol and liquids from coal as main sources of illuminates. The increase in the demand for oil was intensified by an introduction of a tax on alcohol that eliminated alcohol as the main substitute for petroleum. Furthermore, crude oil was relatively easy to extract compared to other sources, and this resulted in many oil producers entering the oil markets resulting in the over-supply of oil and fluctuations in the prices of oil.

The fall in oil prices persisted from 1865-1899. Subsequent to the civil war in the United States of America, the prices of many commodities fell sharply mainly due to the contraction of demand. Furthermore, the fall in oil prices was amplified by continued oil drilling (in countries such as

Russia) resulted in the increase in global oil supplies and a further decline in the oil prices (Hamilton, 2011). However, during the late 1890s, the oil price increased due to a decrease in oil production in the Appalachian field associated with a cholera epidemic in Baku (Williamson & Daum (1959) as cited in Hamilton, (2011). Oil remained an important commodity and its variability was a cause for concern. In a bid to control the supply of oil, the Organisation of Petroleum Exporting Countries was formulated in 1960 (OPEC, 2015).

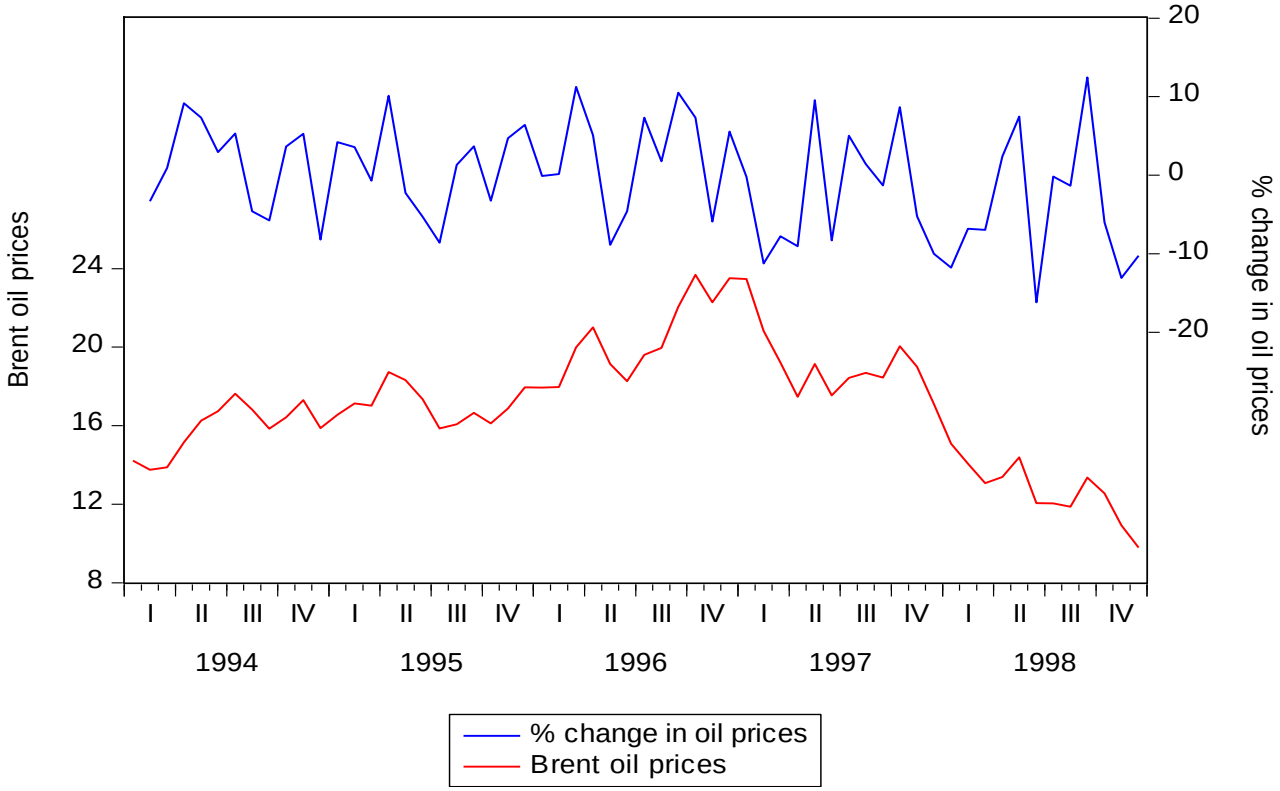
Owing to the dramatic increases in the geopolitical events between 1973 and 1974, OPEC imposed an embargo on oil exports. The oil embargo was in response to the United States of America's involvement in the Yom Kippur War in 1973 (Sullivan and Jones, 2008). The embargo involved a significant cutback on OPEC's aggregate oil production and caused significant variations in oil prices. During the 1973-1974, the global oil output decreased by almost 10%. Hamilton (2011) asserts that increases in production in Iran was not significant enough to alleviate the global supply shock as it only offset a small part of the global oil output decline. The contraction in oil supply led to increases in oil prices variability and translated to contraction in many economies including the United States economy (Hamilton, 2011).

The geopolitical tensions persisted in the Middle East through to 1978-1979. During the period, Iran experienced massive public protests with strikes in the oil production sector (Kurzman, 2009; Rosenfeld, 2011). This led to reduced supply of petroleum by 4.8 million b/d between October 1978 and January 1979 (EIA, 2015). However, the loss of oil production in Iran was made up by the expansion of oil production in Saudi Arabia. During late 1979, Iran experienced increases in oil production levels. Nonetheless, the war between Iran and Iraq reduced oil supplies by about 6% during that time resulting in high oil prices. Rapid fluctuations reduced the world aggregate demand for oil between 1981 and 1986. During the same period, a further decline in oil prices was magnified by increases in the supply of oil in Saudi Arabia. The increase in oil supply resulted in a 55% decline in oil prices (Hamilton, 2011).

In 1990, the oil production in Kuwait decreased due to a war between Iran and Kuwait (Freedman & Karsh, 1993; Khadduri & Ghareeb, 1997).The war between these countries resulted in oil supply shock in Kuwait and Iraq. Consequently, the price of oil doubled within a few months (Hamilton, 2011). However, the excess capacity in the Saudi Arabia restored the world oil production resulting in the stabilisation of oil prices during 1990 and 1991 period.

The oil market experiences major fluctuations in the price of oil. For instance, between 1994 and 1998, the oil markets experiences significant price fluctuations as shown in figure 1 below.

Figure 1: Brent oil Price



Source: Based on data from SARB (2015)

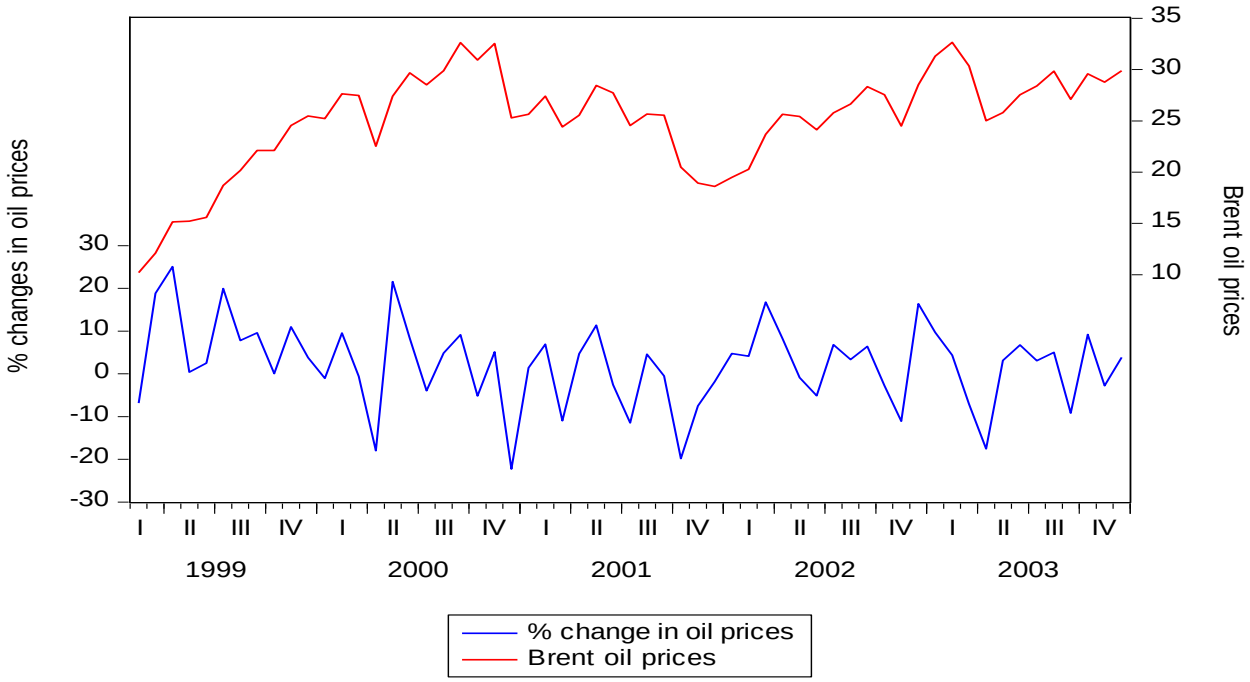
The graph above (figure 1) generally shows that oil prices were trading at above $10 per barrel with the exception of December 1998 in which a barrel was selling at $9.80. Figure 1 also shows that major oil price increases were experienced in April 1995, April and October 1996 and October 1997. Oil prices increased between March and April 1995 from $17.02 per barrel to $ 18.74 thus accounting for a 10% increase. In addition, another sharp increase in oil prices was recorded in October 1996 in which a barrel was trading at $23.68. However, despite this increase, the Brent oil prices reached an all-time low of $9.80. Thus, between a significant decrease of 51% between October 1997 and December 1998 was recorded. Overall, significant oil price variations were experienced between 1994 and 1998.

A combination of various factors could be responsible for the fluctuations in the prices of oil between 1994 and 1998. For instance, during 1990s, Asian countries popularly known as the Asian Tigers recorded phenomenal growth which resulted in the increase in the petroleum world demand (Castells, 1992). Accordingly, the price of oil increased on the world oil market. However, during the same period, the increase in oil import by these countries was short lived as the Asian Tigers the same faced serious stresses in the financial system which led to capital flight from their economies. This resulted in the loss of investor confidence and consequently led to financial and economic strains in the Asian countries. The East Asian Crisis, oil production disruptions in Iraq and Kuwait

associated with higher oil inventories demand in anticipation of attack on Saudi Arabia oil fields might have contributed in the fluctuations in the price of oil during the 1990s (Federal Reserve Bank, 2007; Kilian & Murphy 2014).

Despite showing a decreasing trend in December 1998, oil prices exhibited a different trajectory between 1999 and 2003. During this period, oil prices showed an upward trend. Figure 2 below illustrates the pattern of oil price between January 1999 and December 2003.

Figure 2: Brent oil prices (1999/1 to 2003/12)



Source: Based on data from SARB (2015)

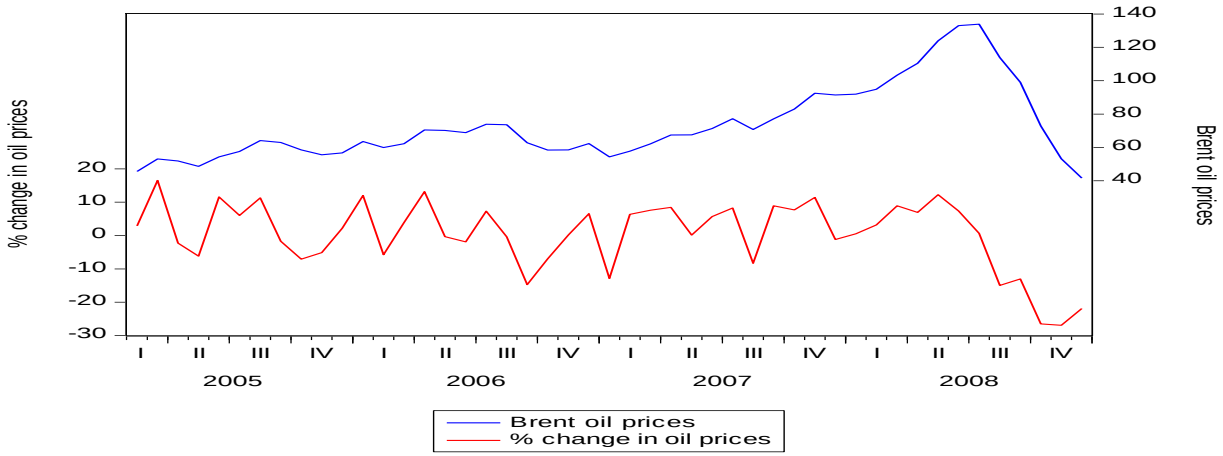
Figure 2 shows that fluctuations in the prices of oil continues from the previous year into 1999 in which significant positive changes in oil prices were experiences in March, April and July. Generally, a gradual increase in the price of oil was recorded between January 1999 and February 2000. A sharp oil price decline was recorded between March and April 2000 in which an 18% decrease in oil price was witnessed before a sharp increase of 22% recorded between April and May 2000. Figure 2 above also shows that October 2001 and April 2003 experiences significant fall in oil prices of 20% and 18% respectively. Moreover, the figure above (figure 2) shows that oil prices were never stable that, but were fluctuating from 1999 to December 2003. Also, it is interesting to note that over the period, positive oil price changes dominated negative oil price changes. Kilian (2009) asserts that there are three main shocks in the oil market; the precautionary demand, the aggregate demand and aggregate supply. Thus, fluctuations in the price of oil could be attributed to these shocks. For instance, during December 2002 and January 2003, Venezuela experienced unrest in the

oil sector which led to a decline in oil production by 2.1 million barrels per day (EIA, 2015). The impact of Venezuelan unrest may have contributed to the reduction of global oil supply. The Venezuelan general strike also known as the oil strike or oil lockout was followed by the second Persian Gulf War which led to a further decline of 2.2 million barrels per day (Kilian, 2009; Baumeister & Kilian, 2016). Moreover, the successful implemented of the OPEC quotas may have contributed to variability in the prices of oil (OPEC annual report, 2002). These events may have led to variations in oil prices between 2002 and 2003 as displayed in figure 2 above.

In addition, the impact of the abovementioned unrests led to the increase in Brent prices to over $20 per barrel between 2002 and 2003 from the lower price levels experienced in the late 2001. Figure 2 above illustrates that monthly Brent prices increased from March 2002 to February of the following year. The decline in the prices from March to May in 2003 may also be due to weak global demand for oil accompanied by an expansion in oil supply (EIA, 2015). By December 2003, the Brent oil price traded at $29.88 per barrel thus showing an increase of $3.84 dollar per barrel between September and December 2003. On the other hand, the Brent oil price registered a 10.25 percentage increase between September and December 2003.

The prices continued increasing in the following year with oil prices trading above $30 per barrel between January and February 2004 as shown in Figure 3 below. The rise in price in 2004 was mainly due to unexpected strong demand and supply challenges. According to EIA (2009), production in non-OPEC was almost stagnant in 2004 and the spare capacity was below one million barrel per day. Between May and June 2005, oil prices significantly increased by 12% to trade at $51 per barrel. The Brent oil prices continued increased and recorded an all-time high of $ 133.90 a barrel in July 2008 as illustrated in figure 3 below.

Figure 3: Brent oil prices (2004 to 2008)



Source: Based on data from SARB (2015)

Generally, the figure 3 above shows that the 2007 and 2008 periods were characterised by a phase of increasing oil prices. The rise in the oil prices in 2007 might be mainly due to a significant decline in non-OPEC supply associated with an unmatched increase in the world demand for oil (Smith, 2009). At the same time, although OPEC members increased the production of oil, they fell short of sufficient capacity to satisfy the surge in the global oil demand (Hamilton, 2011). By November 2007, the Brent oil prices were $92.53 per barrel and increasing from $54.30 per barrel as shown in figure 3. By December 2007, the oil prices slightly decreased from the November figures to $91.45 per barrel (SARB, 2015). Thus, between November and December 2007, a decline of 1.16% was recorded. The decrease in oil prices between November and December 2007 may be due to a slight recovery in supply for both non-OPEC members and OPEC members (EIA, 2015).

The figure above (Figure 3) also shows that, in the beginning of 2008, the oil prices were increasing and by February (in the same year), the Brent prices increased to $94.82 per barrel, which is almost, double the 2007 February prices. The increase in oil price in February 2008 can be linked to the decrease in oil sales by Venezuela to ExxonMobil due to political reasons (Smith, 2009). In addition, strikes in which were experienced in Nigeria in February 2008 also adversely impacted on the global oil supply (Smith, 2009). Furthermore, the failure of Iraq to recover its oil production capacity due to wartime damage may also have contributed to oil price variability (Hamilton, 2011). In March 2008, the oil price continued on an upward trend with a barrel of oil selling at $103.28. Thus, from February to March, the price of oil showed increases of 8.9%. The Brent was selling at $41.14 higher than the March 2007 figures. The high increases in oil price in March 2008 might have been caused by the blowing up of two main oil export pipeline by saboteurs which led to a shortage of 300 000 barrels daily from Iraq exports (Reuters, 2008).

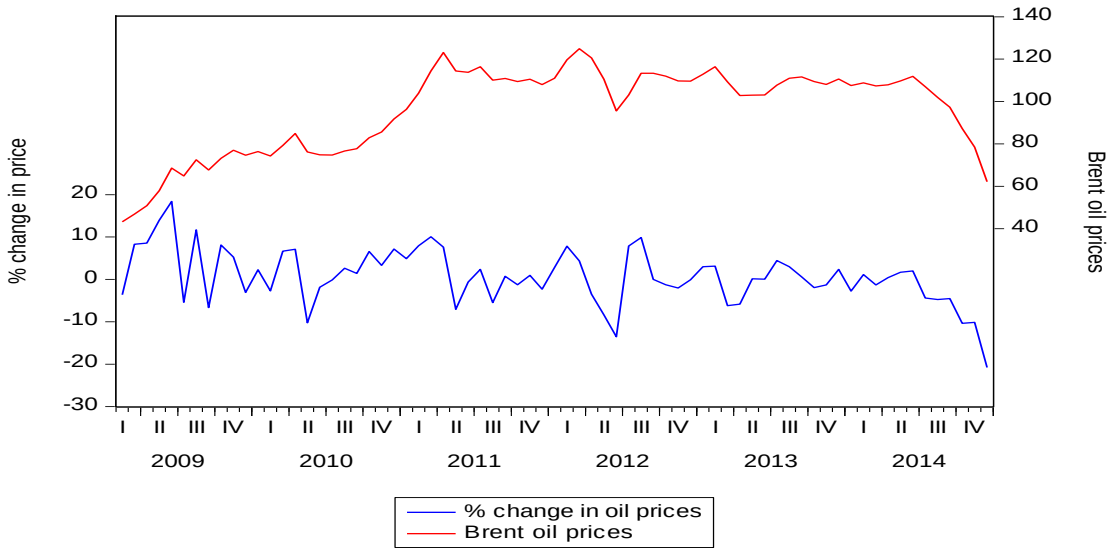
The prices for oil in April, May and June 2008 increased from $110.44, $123.94 and $133.05 respectively (figure 3). In April 2008, strikes by the Nigeria Union workers and the Scottish oil workers as well as strong oil demand pressures contributed to the increases in April prices. According to Smith (2009), the Nigerian strike led to the contraction in oil production of 780 000 barrel per day. Furthermore, the consumption of oil in China increased by 840 000 barrels per during the same period. In May, the same year, the labour strife, militant attack and sabotage forced the closure of oil production in Nigeria and about 1.36 million barrels per day were lost (Smith, 2009). In addition, the increase in oil demand was accompanied by a stagnant supply of oil which resulted in the increase in the price of oil According to Herbot (2008) excessive speculation in the future markets also contributed to increasing oil prices in 2009. Furthermore, instability in Nigeria and Iraq contributed further to the variations in the prices of oil. Moreover, the fall in value of the US dollar

coupled with declining petroleum reserves may have resulted in high upswings in the prices on oil in July 2008 (Reuters, 2008).

The bottlenecks in oil supply accompanied by strong global oil demand pressures influenced oil prices increases in July of 2008. Compared with the oil prices in July 2007, the prices in July 2008 increased and Brent oil price recorded $41.37 higher than the same period in the previous year (SARB, 2015). Thus, Brent recorded a total percentage change of 44.71% between July 2007 and July 2008. According to Masters (2008) and Lipsky (2008), the increase in oil prices could be due to the fundamentals of demand and supply and the phenomenal increase in the financialization of commodity markets during 2006-2008, including the oil markets, which fuelled speculation which significantly pushed the prices of oil. From August to the end of 2008, the prices of oil were on a downward trend. For example, oil prices decreased from $116.64, $76.61 to $41.44 barrels per day from August, October and December respectively. The fall in oil prices in the last segment of 2008 may be attributed to financial crises that led to the decline in the global oil demand and improvements in the supply of oil on the global oil market (Masters, 2008).

Oil prices continued falling through to the early stages of 2009 with Brent oil price trading at $43.24 per barrel in February as shown in Figure 4. However, sharp oil prices were recorded between January and June 2009 where oil price changed by 18.4%. A moderate price increase was recorded in from July until February 2010. A rapid oil price increase was recorded between May 2010 and April 2011 where Brent oil prices were trading at $123.15 per barrel. Some significant fluctuations in the price of oil were recorded from May 2011 to May 2014 prior to the rapid fall experienced between June and December 2014. The figure below shows that oil prices decreased by over 20% between November and December 2014.

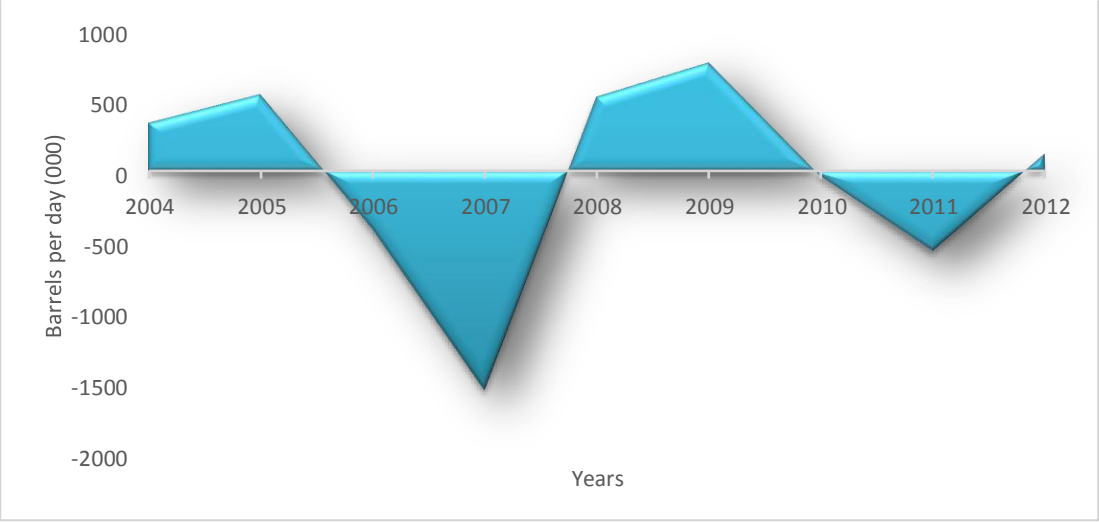
Figure 4: Oil prices (2009/1 to 2014/12)



Source: Based on data from SARB (2015)

The major factors responsible for the fluctuation in oil prices could be due to changes in the supply and demand for oil as illustrated in figure 5 below. Figure 5 illustrates the oil supply-demand balances from 2004 to 2012. The graph shows that there was an excess supply of oil in 2004, 2005, 2008 and 2009. Deficits in oil supply were recorded in 2006, 2007), 2010 and 2011. Thus, as displayed in the figure 5, the increases in the oil price in 2010, 2011 and part of 2012 may be due to increasing the demand for oil associated with a weak supply as shown in figure 5. Geo-political events in the MENA countries contributed to the increase in prices in 2010. According to EIA (2010), political instability in Libyan significantly contributed to price increases. In addition, OPEC (2011b) asserts that prices in 2011 positively moved with macroeconomic sentiments before falling again when global economic growth was slowing down. In 2012, the price increase was driven by factors such as supply disruption in the North Sea and some countries in Africa (OPEC, 2012b).

Figure 5: Oil demand and Supply balances



Source: Based on data from EIA (2015)

2.3.1 DIFFERENT MEASURES OF THE EXCHANGE RATE

Hodge (2012) postulates that there are different indicators of the South African currency exchange and these give a different picture of the observed volatility in each case. The most commonly used measure of the exchange rate is the nominal bilateral exchange rate. Nonetheless, the bilateral exchange rate does not accurately measure the international competitiveness of a currency. Thus, other exchange rate measures have been proposed. For instance, the real bilateral exchange rate which is simply defined as the nominal exchange rate adjusted for inflation differential between two countries. On the other hand, the nominal effective exchange rate is another measure of the exchange rate and it shows the changes in the external value of a currency relative to a basket of the currencies of a country's major trading partners. For instance, the nominal effective exchange rate of the Rand measures the international competitiveness of the South African Rand relative to the currencies of South

Africa's major trading partners. The real effective exchange rate, which is the fourth measure of the exchange rate, is the nominal effective exchange rate adjusted for general price differentials between countries. Motsumi, Oldfield, Mokoetla, Swart, & De Beer (2008) posit that the real exchange rate is important because it is regarded as a barometer of external competitiveness.

With this understanding of different forms of the exchange rate, this section gives an overview of the exchange rate system in South Africa. In addition, the trend of the South African domestic exchange

rate against other major currencies is also given. Moreover, the trend of the South African Rand and other currencies in the BRICS countries is provided in order to show how the South African currency performs when compared to the currencies of other emerging economies.

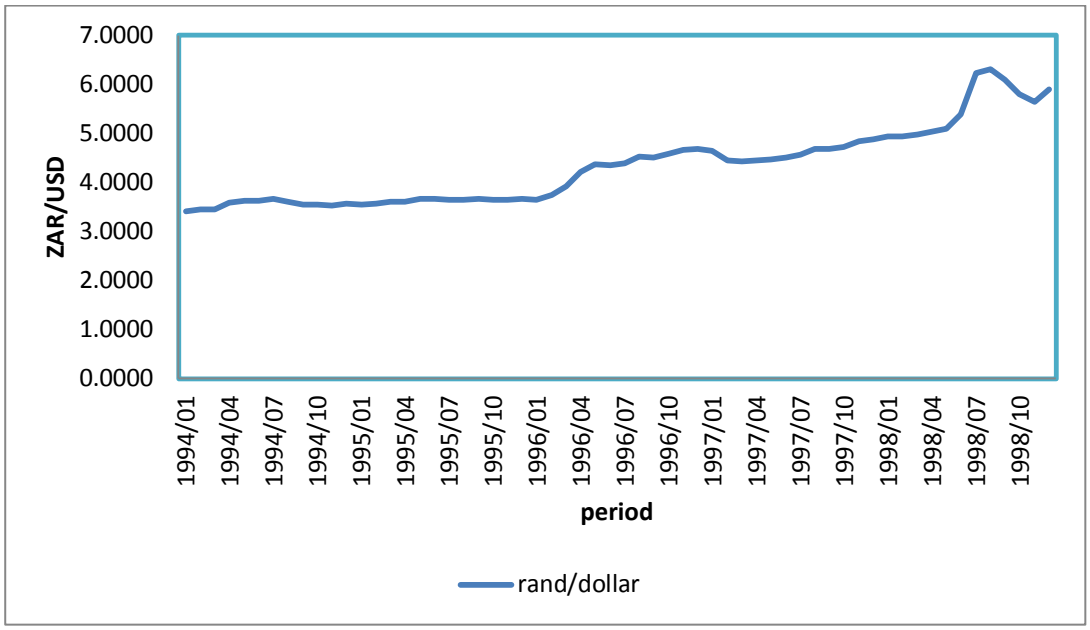
2.3.2 A brief overview of the exchange rate in South Africa

The exchange rate system of South African exchange has evolved between pre and post-apartheid regime. According to Van der Merwe (1996) the South African exchange rate system has evolved through these main categories namely; the 1945-1971 Bretton Wood system of fixed but adjustable exchange rate, the 1971-1979 era characterized by the disintegration of the Bretton Woods arrangement associated with the attempt to maintain stable exchange rate, the 1979-1985 period of important reforms to the exchange rate management and the 1985-1994 period in which authorities were forced by socio-political events to revert to more direct control measures.

2.3.3 Overview of the South African currency against the US dollar currencies

South Africa is an economy that depends on other economies. It is not an autarky thus its economy is affected by both endogenous and exogenous factors such as changes in oil prices. It is imperative therefore to examine how the South African Rand has been performing against the other currencies. For instance, in January 1994, the value of the Rand against the dollar of America was R 3.4107, implying that the value of the Rand was weaker than the dollar as displayed in figure 6 below.

Figure 6: South African Rand and the United States dollar

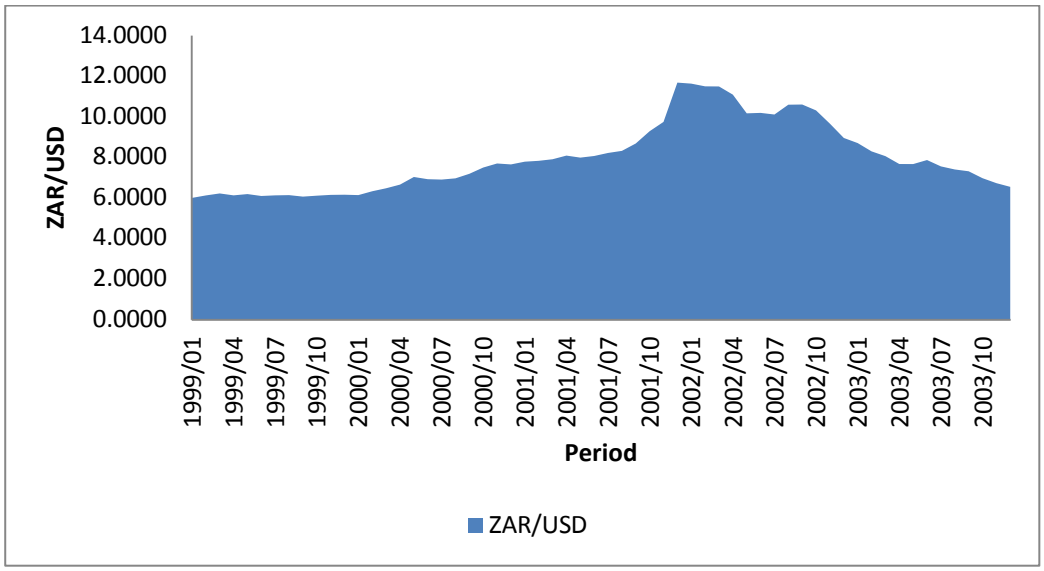


Source: Based on data from Quantec Easydata (2015).

Figure 6 above shows the historical performance of the South African Rand against the United States dollar from January 1994 to December 1998. The above graph illustrates that between January 1994 and January 1996, the value of the Rand traded below ZAR 4 against the US dollar. Nevertheless, the value of the rand depreciated by 66% against the dollar between February 1996 and July 1998, before slightly gaining by 5% between September and October 1998. The fluctuations in the value of the Rand relative to the dollar may be attributed to changes in the prices of price of minerals such as gold, platinum, uranium and coal. Furthermore, the fall in value of the rand between January and August 1998 was mainly due to the emerging market crisis. According to Hodge (2005), the Asian contagion did not spare the South African markets and many investors "dumped indiscriminately" the rand in flight to safe currencies like the US dollar.

The strength of the South African currency against the dollar continued to weaken from January 1999 through November 2001 before recording a sharp depreciation in December 2001 (as shown in figure 7). Interestingly, a significant appreciation of the South African currency was recorded between December 2001 and December 2003 in which the ZAR gained by 44% again the US dollar.

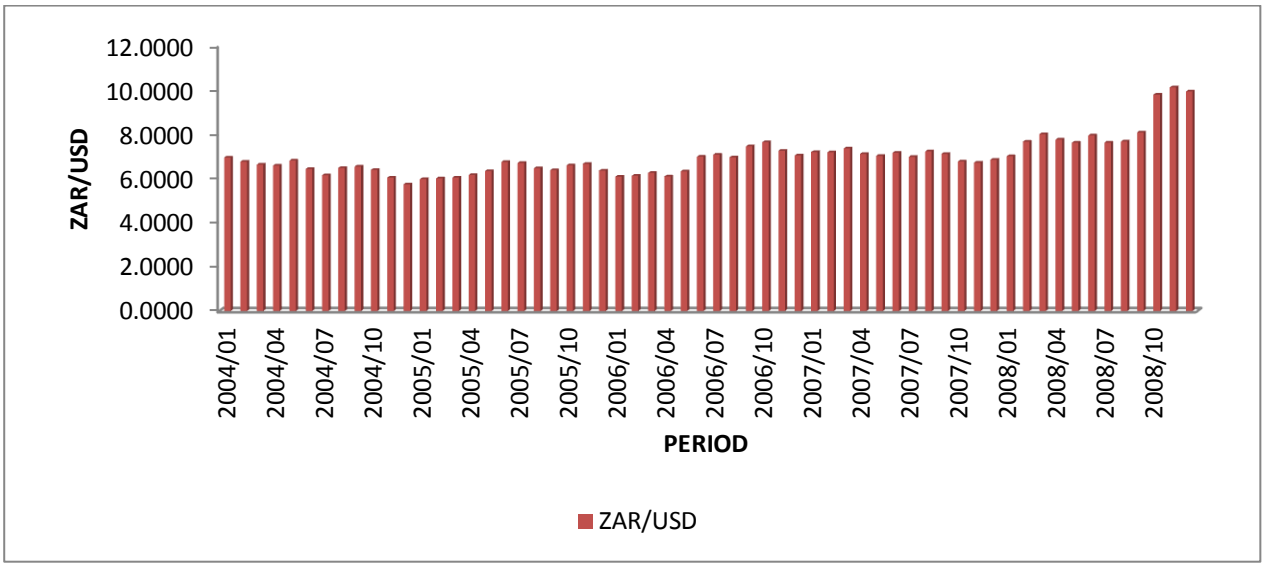
Figure 7: The South African rand and the US dollar



Source: Based on data from SARB (2015)

The tremendous fall of the rand in 2001 and 2002 against major currencies was a major concern for the government and a formal inquiry was conducted to investigate the major factors behind the collapse of the Rand (Mlambo, 2013). The inquiry identified macroeconomic factors such as the global economy, contagion from events in Argentina and a deficit in the current account as the main factors which led to the fall in the value of the Rand (Mlambo 2013). On the other hand, the appreciation of the Rand against the dollar from in 2003 may have been influenced by the fall in the foreign debt in South Africa. In addition, contributing to the Rand's appreciation was a turnaround of the current account. Furthermore, high-interest rate employed as a measure of restricting inflation in South Africa, generate a premium over international interest rate and consequently lead to capital inflow that tends to strengthen the value of the Rand (Samson, Ampofo, Quene, & Niekerk, 2003). The current account grew tremendously to R25 billion by the third quarter of 2004. Furthermore, the current account deficit was surpassed by the financial account surplus (Mlambo, 2013).

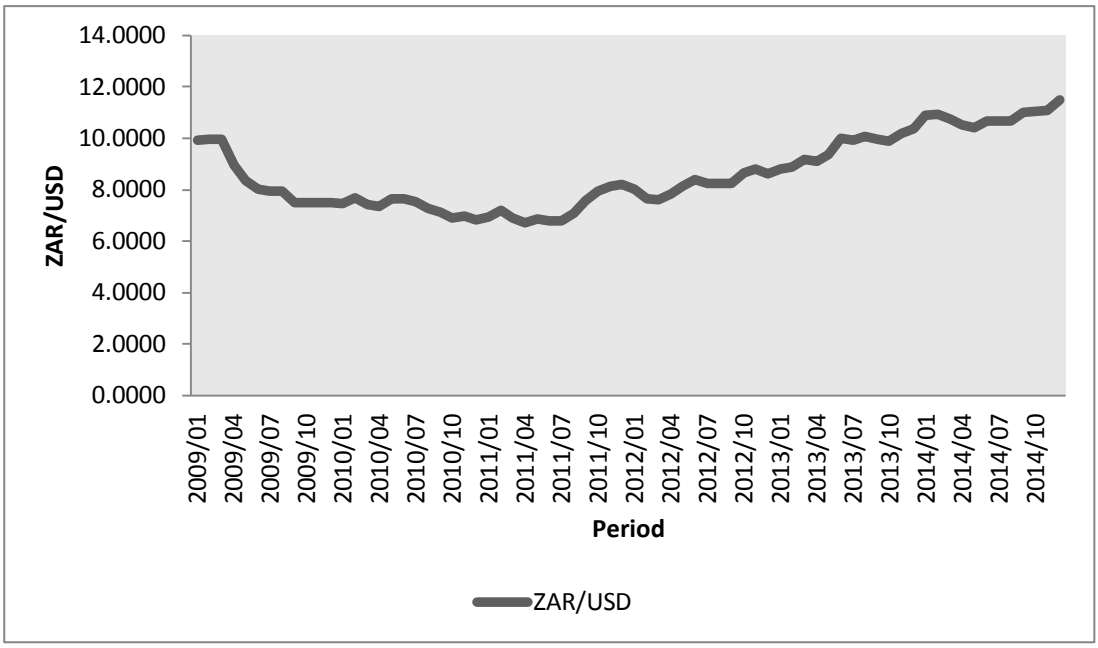
Figure 8: The South African currency and the US Dollar



Source: Based on data from SARB (2015)

Figure 8 above shows fluctuations in the value of the South African currency against the dollar of America. The graph also shows that from January 2004 to August 2008, the Rand experienced episodes of moderate appreciation and depreciation relative to the US dollar. However, significant fall in value of the rand against the dollar was recorded September, October, November and December where the ZAR traded against the dollar at 8.0753, 9.7800, 10.1112 and 9.9217 respectively. Although the changes in value of the rand were small between January 2004 and August 2008, it is clear that the value of the Rand was not stable but was too volatile. The appreciation of the ZAR against the dollar in 2004 can be due to high commodity prices, foreign direct investment and positive economic data for South African (Mlambo, 2013). The major factors behind the fall in the value of the in 2008 might be due to the financial crisis which affected the global economy can be linked to slow economic growth and low savings and investment rate in South Africa (ltaifa, Kaendera & Dixit, 2009; Fornaro, 2013).

Figure 9: The South African rand and the US dollar

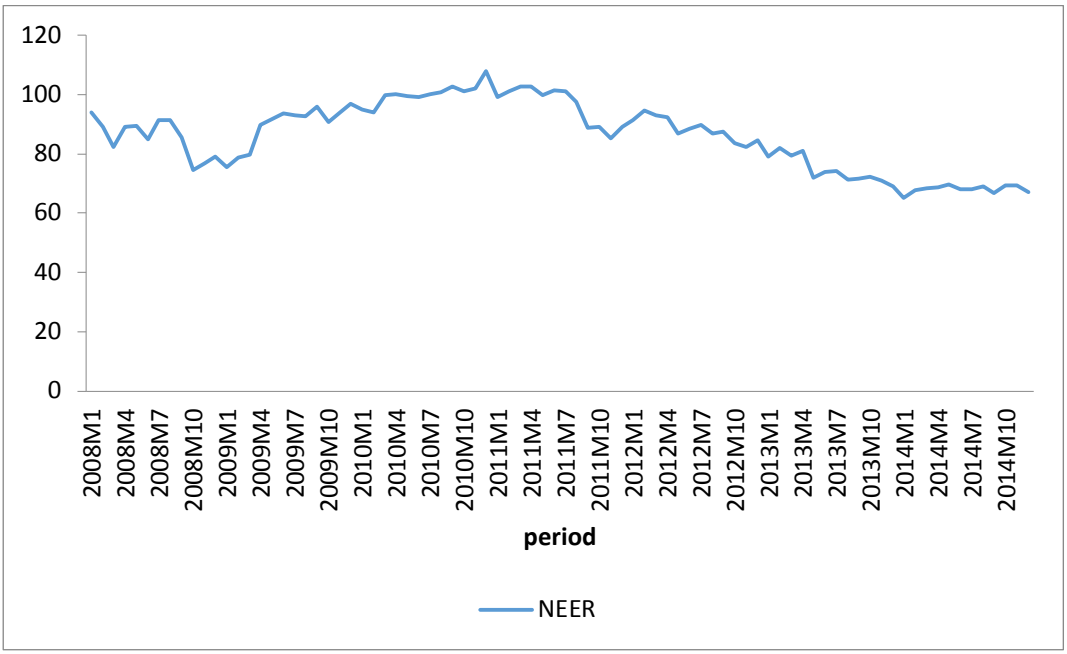


Source: Based on data from Quantec Easydata (2015).

The value of the Rand experienced significant gains relative to the dollar between January 2009 and July 2011. Afterwards, the United States dollar moderately appreciated against the currency of South Africa. Between June 2011 and December 2014, the value of the South African currency depreciated by almost 50% against the dollar.

South Africa is an open economy and trades with different countries all over the globe. Due to globalisation, it is vital to examine the performance of the Rand against South Africa's trading partners. As mentioned earlier, nominal effective exchange rate shows movements in the international value of the South African currency against a basket of South Africa's major trading partners' currencies. The succeeding section presents an overview of the international performance of the Rand as measured by nominal effective exchange rate.

Figure 10: The nominal effective exchange rate of the rand



Source: Based on data from SARB (2015).

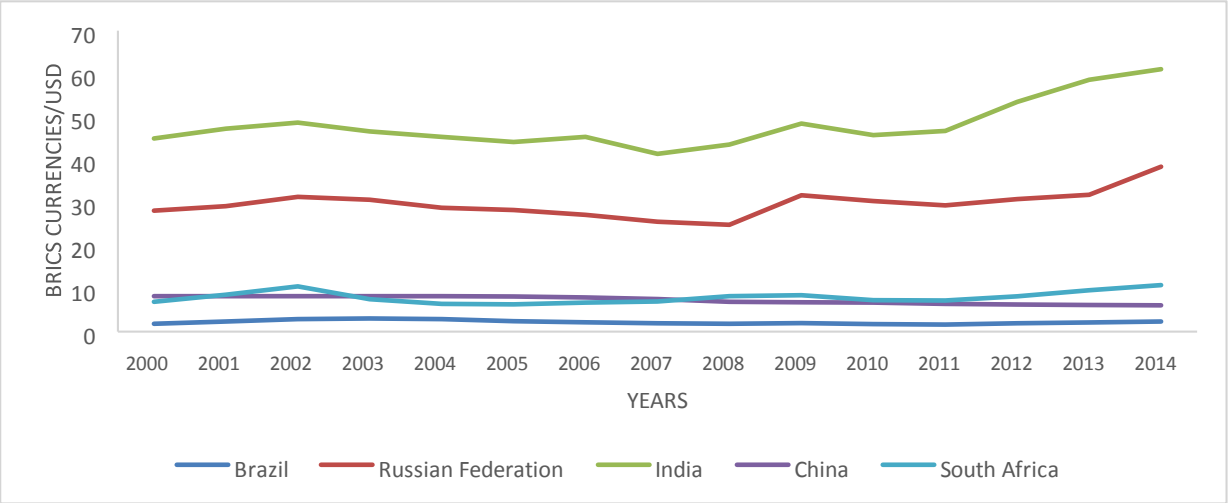
Figure 10 above shows the nominal effective exchange rate of the South African rand (NEER). The figure above illustrates that the South African currency depreciated against the currency of 20 South African trading partners between January 2008 and January 2009. In addition, the graph shows that the nominal effective exchange rate gained relative to South Africa's trading partners between February 2009 and July 2011. However, despite its appreciation in the previous period, the rand value depreciated against trading country's currency from January 2012 and December 2014. The fall in the value of the NEER might be due to weak economic growth accompanied by increasing debt and decreasing investor confidence (Boykorayev, 2008).

2.3.3.1 Rand performance in the BRICS countries

BRICS is a trading block that constitutes world's emerging markets such as Brazil, Russia, India, China and South Africa. The group acts as a counterweight to the G8 and G20 countries which are dominated by rich-world countries (The Economist, 2013). It is, therefore, important to examine the competitiveness of the South African currency in the BRICS. Figure 11 shows the performance of the BRICS currencies relative to the dollar of America. The graph (Figure 11) below also illustrates that the Indian rupee was the weakest currencies in the BRICS and the Brazilian real being the strongest currency against the dollar. Furthermore, the graph illustrates that the dollar traded at 6.94

South African Rand against the dollar. Moreover, figure 11 shows that all the BRICS currencies appreciated against the dollar in 2007 and depreciated afterwards

Figure 11: The Rand performance in the BRICS economies



Source: Based on data from Quantec (2015)

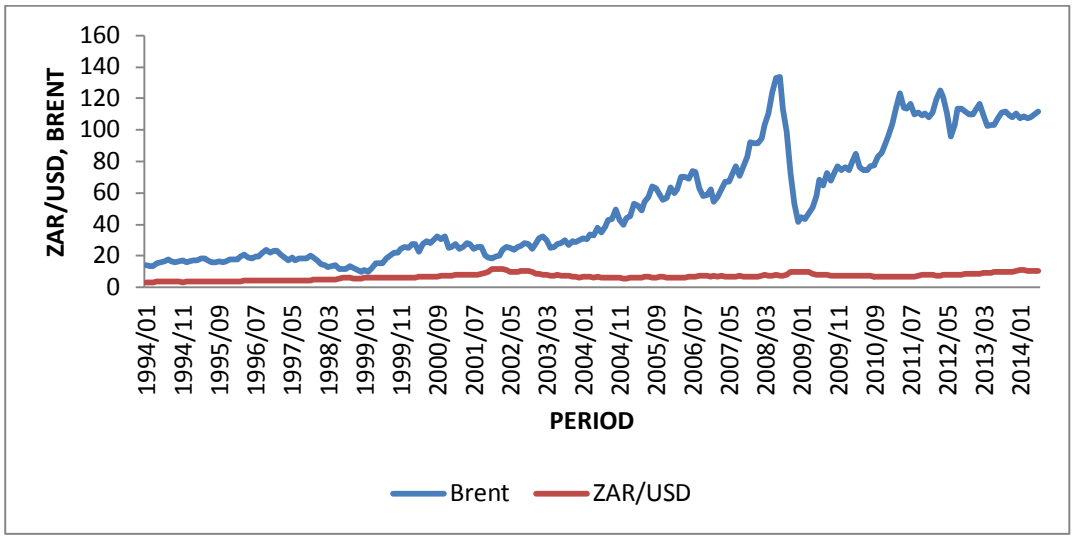
Figure 11 shows that since 2000 to 2014, the Indian rupee and the Russian ruble were the weakest currencies (relative to the dollar) in the BRICS economies. On the other hand, the Brazilian currency and the China currencies proved to be the strongest currencies in the trading block. Furthermore, figure 11 shows that in 2014, the currencies for South Africa, China and Brazil were trading at 10.85, 8.65 and 6.14 relatively to the dollar. In the same year, the Russian ruble and the Indian rupee depreciated to 38.78 and 61.03 respectively against the dollar. The depreciation of these currencies may have been caused by slow economic growth and week commodity prices. Furthermore, the depreciation of these currencies may also be due to capital flight (Junior, Lima and Gaio, 2014; Chiu, 2014) from the emerging countries following the increase in employment and economic growth in developed countries. In addition, factors such as negative current account balances, increase in consumer default rate and inflation differentials contributed to the fall in the value of the BRICS currencies during post the financial crisis period (Xie and Patterson, 2012).

2.3.3.2 Exchange rate and oil prices

The previous chapter has briefly indicated that changes in oil prices have a direct bearing on the exchange rate the movements basing on the previous studies (Amano & Norden, 1998b; Chen & Rogoff, 2002; Engel & West, 2005). Furthermore, chapter one has emphasised that the main drive of this study is to investigate the impact of oil price variability on the exchange rate in South Africa. It

is, therefore, essential to look at the trends of these variables. Moreover, examining the trend between these variables (oil prices movements and exchange rate) help to achieve the first specific objective stated in the previous chapter. Thus figure shows the patterns of both the oil prices and the bilateral ZAR/USD exchange rate.

Figure 12: Exchange rate and oil prices



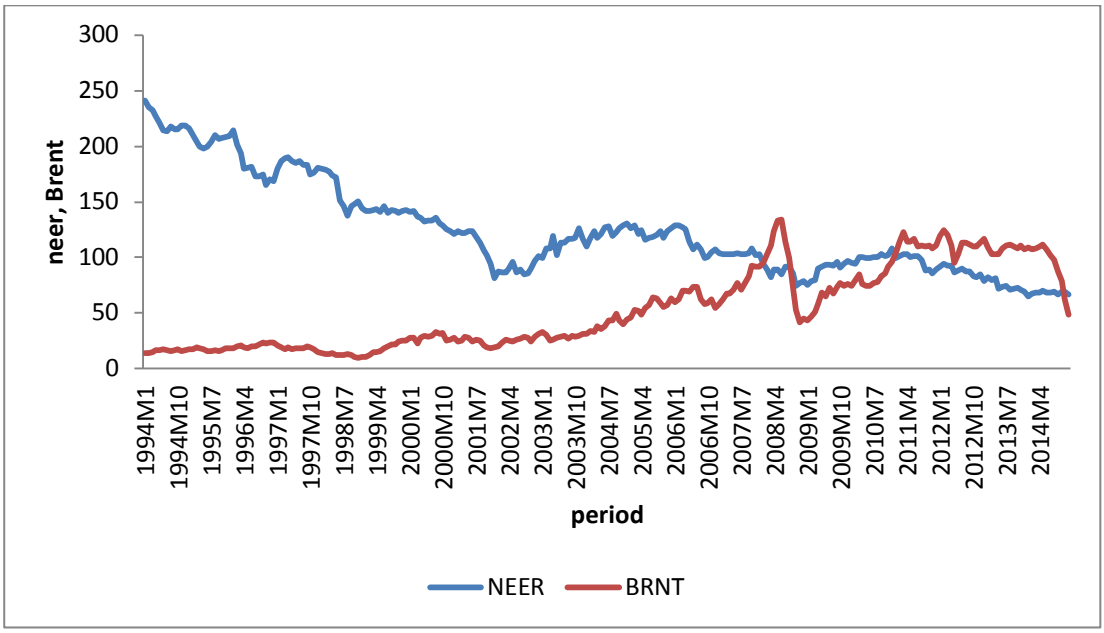
Source: Based on data from SARB (2015)

The above graph generally shows that the price of oil has been gradual increasing between early 1994 to mid-2006. Nevertheless, rapid oil price increases are recorded from October 2006 to June 2008 prior to a sharp drop in prices at the end of December 2008. Furthermore, an upward trend in oil prices is observed starting from 2009 to 2014. The major changes in oil price observed in the graph could be due to, as highlighted above, changes in demand and supply for oil, financial crisis and weak global economic expansion. On the other hand, the exchange rate pattern generally shows the fall in the value of the ZAR relative to USD over the observed period.

It is also fundamental to analyse how oil price variability affect the performance of the South African currency against the currencies South Africa's major trading partners. By analysing the pattern nominal effective exchange rate of the rand, figure 13 below illustrates that the link between oil price variability and the exchange rate is not clear. For instance, the graph from 1994 to 2008, there was an inverse relationship between the two variables as increases in oil price volatility was associated with a decline in the nominal effective exchange rate of the Rand. In addition, the trends show that the pattern of the two variables changed between 2009 and 2010 as the variables were moving in the same direction. In other words, increases in oil prices were accompanied by increases in the nominal effective exchange rate of the Rand. However, between 2011 and 2014 the behaviour of the two

variables shows a different pattern. Between 2011 and 2015, increases in oil prices were linked to fall in the nominal effective exchange rate.

Figure 13: Nominal effective exchange of the rand and oil prices



Source: Based on data from SARB (2015)

Figure 13 above illustrates the movements of oil prices and the nominal effective exchange rate of the rand. Also, the graph shows that oil prices increased in 1994 to 2008 and sharply decreased in January 2009. However, oil prices increased again from February 2009 to April 2014 before decreasing in 2015. On the other hand, the NEER was on a declining trend since 1994 to 2015. Changes in the behaviour of these variables could be due to changes in factors such as; changes in the demand and supply of oil, geopolitical events, quantitative easing and increased growth particularly in developed countries for example in the United States of America (Hamilton, 2011; Lipsky, 2008; Masters, 2008).

2.4 Conclusion

The chapter has presented a background to this study by analysing the fluctuations in the prices of oil and the exchange rate in the case of South Africa. An overview of the oil and the Rand markets is crucial as it is through such an analysis that helps us understand the causes of variability in the oil market and fluctuations of the rand. The chapter has identified that oil prices are volatile and the major oil shock was experienced in 2008. Also, the chapter has noted that the value of the South African currency has been depreciating against the dollar since 1994. Furthermore, the chapter has

indicated that the major causes of fluctuations in oil prices are due to fundamentals of demand and supply and the phenomenal increase in the financialization of the commodity markets. Moreover, this chapter has identified factors such as gross domestic product growth, globalisation, and commodity prices do play a significant role in the value of the South African Rand. However, trends did not show any clear relationship between exchange rate and oil price variability. Thus, basing on the trends above, one cannot conclude as to whether the relationship between oil price variability and the exchange rate is positive or negative. Therefore, the study will further investigate the impact of oil price volatility on the exchange rate basing on both literature and econometric techniques in the subsequent chapters.

CHAPTER THREE

LITERATURE REVIEW

3.1 INTRODUCTION

The previous chapter has presented an overview of oil prices variability and the South African Rand exchange rates for pre and post-apartheid era, and possible reasons for the behaviour of the two variables have been given. Thus, chapter two has achieved the specific objective of examining the trends in oil prices variations and exchange rates mentioned in chapter one. This chapter provides a comprehensive review of both the theoretical literature and empirical studies supporting exchange rate determination. The theoretical section (section 3.2) gives a review of the literature on how exchange rates are determined by different factors. The section (section 3.3) on empirical studies examines previous studies that have been undertaken by other researchers in different economies in investigating the relationship between oil prices and exchange rates. Lastly, section 3.5 concludes the chapter.

3.2. THEORETICAL LITERATURE REVIEW

Mankiw (2008) asserts that "exchange rates vary over the time horizon." In an effort to comprehend the behaviour of exchange rates, economists formulated a large body of theory which provides the basis for analysing and understanding the behaviour of exchange rates. Various factors such as economic growth, interest rates, monetary policies, inflation and oil prices have been pointed out in theory to be the fundamental determinants of exchange. These theories include the purchasing power parity, the elasticity theory, portfolio balance approach and the fisher effect which are provided in the subsequent section.

3.2.1 The Purchasing Power Parity (PPP)

The purchasing power parity theory postulates that the price of one currency is equal to the value of the other currency when both currencies buy the same quantity in both countries. Furthermore, this theory affirms that in the event where the currencies are in a disequilibrium state, the actions of the arbitrageurs play a significant role to restore the values of the currencies to their original state of equilibrium (Rodseth, 2000). There are four version the PPP which include; the law of one price, absolute PPP, the relative PPP and the ex-ante PPP

(Strong, 2008; Wang,2009; (Bodnar, Dumas, & Marston, 1997; Cheung, Chinn, & Fuiji, 2007; Wiley Study Guide, 2015*)*.

The first version of the purchasing power parity (the law of one price) assumes that with no transaction cost and trade restriction such as quotas and tariffs, the market price of homogeneous products in various countries should be the same when expressed in the same currency. According to this theory, the price of oil in South Africa should be the same as those in another country for example Swaziland when the prices are denominated in the same currency. The theory asserts that if there is a price differential, the actions of the arbitrageurs will restore the prices back to the original state of equilibrium.

The second version of the PPP is the absolute PPP which asserts that the price of a basket of goods and services should be the same in all countries when denominated in a shared currency (Bartolini, Bayoumi, Clark, & Symanski, 1994; Cherunilam, 2008; Hallwood & MacDonald, 2000). The absolute PPP is derived as a measure of an equilibrium exchange rate expressed as;

$$E = \frac{P}{P^*} \quad \text{.....3.1}$$

Where P is the domestic prices in domestic currency, P^* foreign prices in foreign currencies and E is the nominal exchange rate between the domestic and foreign currencies. Equation 3.1 above implies that an increase (fall) in domestic prices relative to foreign prices will result in a nominal exchange rate depreciating (appreciating). Moreover, the absolute PPP theory posits that in the event of PPP exchange rate differential, a money pump or arbitrage opportunity occurs. Arbitrageurs will take advantage of the price differential to make profits by buying lowly priced goods in one country and sell them in another country in which they are highly priced. For instance, if the prices of commodities such as oil were relatively higher in South Africa compared to other countries, the value of the South African Rand would depreciate relative to other currencies due to arbitraging actions. On the other hand, if the prices of the same commodities (for example oil) are relatively cheaper in South Africa compared to foreign countries, the value of the Rand would appreciation relative to foreign currencies. This arbitraging action tends to push the exchange rate back to the equilibrium value (Rodseth, 2000; Werner and Storner, 2010; Flath, 2014).

Nevertheless, just like the law of one price, the absolute PPP fails to hold in the world of reality in which there are transportation and information costs, tariffs and quotas which play

an important role in trade between countries (Bartolini et al., 1994; Dornbusch, 1991; Rodseth, 2000).

The relative PPP is the third version of the purchasing power parity. This theory states that the nominal exchange rate is determined by inflation differential prevailing between the domestic and the foreign countries on the same basket of commodities. The relative PPP expresses the above equation in terms of differences, that is, relating the change in the nominal exchange rate to the change in relative prices. This type of PPP is expressed in the equation below;

$$\%\Delta E = \%\Delta P - \%\Delta P^{*} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \; 3.2$$

The relative PPP assumes that the foreign price levels are constant, $\%\Delta P^{*} = 0$. This means that the relative PPP equation becomes;

$$\%\Delta E = \%\Delta P \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \; 3.3$$

Equation 3.3 above simply shows that a change in the nominal exchange rate is directly proportional to changes in the price levels (Chamberlin & Yueh, 2006). For example, changes in the prices of commodities culminate into changes in the exchange rate. Again, this theory states that if price differential occurs, an equilibrium price level in the two nations will be corrected by the actions of arbitrageurs (Flath, 2014; Kennedy, 2014; Machiraju, 2007).

The fourth version of the Purchasing Power Parity is called the Ex Ante Purchasing Power Parity. This version of the PPP is based on the theory of the relative PPP. However, in contrast to the relative PPP which suggests that actual changes in the prices of the currencies are determined by the actual relative changes in inflation or price levels (for example oil prices), the *ex-ante* PPP version stipulates that, expected changes in the spot exchange rate are determined by expected differences in the national general prices or inflation rate. Thus, this theory asserts that countries that anticipate high (low) general price levels, should expect depreciation (appreciation) of their currencies (Bodnar, Dumas, & Marston, 1997; Cheung, Chinn, & Fuiji, 2007; Wiley Study Guide, 2015*)*.

Numerous studies (Jayaraman & Choong, 2014; Mkenda, 2001) have found evidence on the empirical validity of the theory. These authors assert that the PPP is theoretically and empirically justified. Furthermore, Mkenda (2001) confirms that the PPP is evidenced in import-based and trade-weighted multilateral indices. In the context of South Africa, Akinboade and Makina (2006) give evidence on the validity of the theory. However, many

studies (Drine & Rault, 2008; Kim, 1990; Sadoveanu & Ghiba, 2012) show that the PPP is the most controversial theory. Furthermore, other studies show that this theory is weak in the short run (Adler & Bruce, 1983; Nagayasu, 2002; Patel, 1990; Taylor & Taylor, 2004).

In conclusion, the purchasing power parity theory postulates that changes in the prices of a commodity (for example oil) will have an impact on the value of a currency. For example, if the South African prices of commodities are different from other countries' prices, an arbitrage opportunity will occur and arbitraging actions will play a fundamental role in restoring the prices to a state of equilibrium. In addition, the PPP theory shows that commodity prices are primary determinants of the exchange rate.

3.2.2 The Elasticity theory

The elasticity approach gives much attention on the real exchange rate-current account balance relationship. It focuses on the analysis of the price elasticity of exported goods and imported goods (for example commodities such as crude oil) in relation to changes in exchange rates. In essence, the elasticity approach is different from the purchasing power parity in that, it asserts that changes in the exchange rate (not in the commodity prices) have an influence on the supply and demand of commodities such as oil and eventually impact of commodity prices. To explain this approach, the following equations can be utilised;

$TB = X - M = X - SM^{*}$ … 3.4

Where TB is the trade balance, X and M represents exports and imports respectively and * represents imports (for instance oil in the case of South Africa) valued in foreign currency against imports valued in domestic currency. This implies that $M = SM^{*}$ where S is the exchange rate. Thus, according to this theory, exports increase when the exchange rate increase or when the domestic currency depreciates and imports decrease when the exchange increase or when the domestic currency depreciates. This implies that, in the case of net-oil importing countries such as South Africa, a devaluation of the Rand leads to a fall in oil imports and ultimately the prices of oil are likely to change, ceteris paribus.

The approach further posits that, for currency devaluation to be effective, the Marshal Learner condition must be satisfied. The Marshal-Learner conditions state that, for a domestic currency to improve the trade balance, the summation of the export elasticity (E_x) and import elasticity (E_m) must be greater than one. In short, $E_m + E_m > 1$. Thus, an improvement in the

trade balance of the domestic country occurs when the domestic currency depreciates, conditional on the summation of the elasticities of the exports and imports of the domestic country being above a unit. On the other hand, the trade balance deteriorates in a country if the summation of the exports and import elasticity is below one. The other important aspect of the elasticity approach is that, it posits that trade balance does not improve instantaneously in response to a depreciation in the domestic currency but improves over time. The main demerit of this approach is that it does not consider that changes in export or import volumes have impact on national income. Furthermore, empirical studies have shown little or no evidence of this approach in countries such as Japan, Canada and Mexico and in most developing countries (Baek, Mulik, & Koo, 2006; Bahmani-Oskooee & Kantipong, 2001; Saqib, Ahmad Raza Cheema, Faraz Riaz, Muhammd Yousaf, & Shehzadi, 2014). In the case of South Africa, Schaling & Kabundi, (2014) argue that the J-curve effect is invalid in the short-run but in the long run.

3.2.3 The Absorption Approach

The absorption approach concentrates on the trade balance as the difference between aggregate income and expenditure (absorption). Contrary to the elasticity approach, which focuses mainly on the price effects of an exchange rate change on export and imports, the absorption theory mainly concentrates on the relationship of real expenditure to real income and on the relationship of both these to the general price levels. This theory postulates that the effect of exchange rate movement is on the absorption which ultimately determines the trade balance at a given level of income (Ito & Krueger, 2007). Absorptions (A) represents total expenditures on the final goods and services of a nation and these include consumption (C), investment (I), government expenditure (G) and imports (M). Thus, the absorption theory is expressed as:

$A = C + I + G + M$ … 3.5

The approach suggests that receipts from expenditure on final goods and services formulate the total income of a nation (Y^e). This implies that, the aggregate national income is expressed as;

$Y^e = C + I + G + X$, where X is the export expenditures. The theory posits that trade balance is the difference between a nation's income and the total absorption. Trade balance can be expressed as;

$$Y^e - A = (C + I + G + X) - (C + I + G + M)$$

$$= X - M$$

The equation above shows that changes in the level of income can influence expenditure on both domestic and foreign goods. Ceteris paribus, increase in the South African income, for example, can lead to an increase in the importation of commodities such as oil and may eventually depreciate the domestic currency. Furthermore, suppose a devaluation/depreciation of a currency (in the domestic country) which results in imports becoming relatively expensive. The absorption approach argues that a reduction in the demand for imports would be experienced due to the devaluation which is results in imports becoming relatively expensive. Thus, the demand is switched to the domestic markets where goods are relatively cheaper. Thus, the absorption theory incorporates the expenditure switching process. The expenditure switching process occurs when a country switches between the domestic and foreign sectors due to a change in the relatively cost of commodities. For instance, a devaluation of the South African Rand relative to foreign currencies could raise the prices of imports and this induces a switch from the foreign imports to domestic goods, ceteris paribus (D'Souza, 2009; Kenen, 1994).

Thus, the switch from the American goods and services to South African commodities induces an increase in demand for domestic (South African) products thereby pushing the domestic prices of goods and services upwards. Furthermore, an increase in domestic product prices results in the South African individuals cutting back their spending. The cutback in the domestic expenditure leads to a decline in the absorption which means trade balance ($Y^e - A$) increases and this indicates an improvement in the trade balance of South Africa (Montiel, 2009).

3.2.4 The monetary theory

The monetary approach owes its foundation from the purchasing power parity theory. Thus, the monetary approach ascertains that prices are everywhere a monetary phenomenon and thus changes in the supply of money have a direct bearing on the prices levels (for instance commodity prices) and ultimately on the nominal exchange rates (Salvatore, 2011). In addition, this theory is based on the purchasing power parity because the advocates of this theory argue that changes in inflation levels are determined by changes in the stock of money, and the PPP assumes that the exchange rate is determined by the relative stock of currencies. The monetary theory is expressed as;

$$M = P.\ K\ (i, Y) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ 3.6$$

$$M^{*} = P^{*}.K\ (i^{*}, Y^{*}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ 3.7$$

$$P^{*} = E.P \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ .3.8$$

In the above, equation 3.6 is the domestic money market, equation 3.7 is the foreign money market and equation 3.8 is the purchasing power parity. Also, equation 3.6 and 3.7 show the equilibrium relationship between the money supply (M) and the money demand in both the domestic and foreign markets respectively. In addition, equations 3.6 and 3.7 show that money demand is a product of real demand for money [K ( )] and the inflation rate (P). The monetary approach further stipulates that money demand is positively related to the level of economic activity (Y) and inversely related to the market rate of interest (i). In other words, the theory asserts that money demand increases with the level of income and decreases in relation to a given interest rate.

The third equation ($P^{*}=E.P$) expresses the equilibrium purchasing power parity relationship. This shows that changes in prices determine the exchange rate. Given PPP, the exchange rate (E) will be equal to the product of foreign prices and the exchange rate. Put differently, the exchange rate is in equilibrium when the foreign price level equilibrates the domestic price level multiplied by the exchange rate. Making the exchange subject of the formula, the exchange rate will thus be equal to;

$$E = \frac{M^{*} * K(i, Y)}{M * K(i^{*}, Y^{*})} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.9$$

Thus the above equation shows the relationship between exchange rate (E), money supply (M) and money demand [K(i, Y)] or [K(i^{*}, Y^{*})]. Thus, changes in money supply or money demand will influence the exchange rate. For example, an expansionary monetary policy will reduce the interest rate, raise prices and eventually lead to the depreciation of the currency, ceteris paribus. On the other hand, holding other things constant, a contractionary monetary policy raises interest rates, reduces prices levels and ultimately leads to appreciation of the currency.

3.2.5. The portfolio balance approach

The portfolio balance approach identifies short-term securities in the asset market as fundamental variables that explain movements in the exchange rate. In addition, this theory

assumes that changes in the stock prices caused by the current account imbalances, determine the long run exchange rate. In the short-run, however, the portfolio balance approach stipulates that, asset movement between countries driven by the main aim to maximise expected returns and minimise perceived risk reduces the flow of funds caused by the demand for goods and services in determining exchange rates (de Jong, 2013).

Furthermore, the theorem assumes that an individual's portfolio balance comprises of foreign bonds, domestic money and domestic bond. In this approach, domestic and foreign bonds are believed to have fixed prices and the theory assumes that there is perfect mobility in the financial markets. Furthermore, the approach asserts that, demand depends on the level of domestic interest rate,,the expected yield on foreign bonds, $r^* + e^{*e}$, national income, Y, and financial wealth, W. The expected foreign bonds yield is a summation of the foreign interest, r^*, and the expected percentage change of the expected rate, e^*(Bilson& Marston, 2007; de Jong, 2013).

According to de Jong (2013), the portfolio balance comprises of two types, the preferred habitat approach and the small country approach. In the preferred habitat approach, economic agents are assumed to be exchange rate risk averse. This model also postulates that the domestic inhabitants and the foreign residents both hold domestic and foreign currency assets. Nevertheless, if the expected yields are at equilibrium, both residents prefer to keep assets valued in their domestic currency.

The small country portfolio balance approach asserts that only domestic residents hold assets valued in the domestic currency. Thus applying the assumptions of the small country, the following models are put forward;

$$M = m(r, r^* + e^{*e}, Y).\, W \quad \ldots\ldots 3.10$$

$$B = b(r, r^* + e^{oe}, Y).\, W \quad \ldots\ldots 3.11\ e.$$

$$F = f(r, r^* + e^{oe}, Y).\, W \quad \ldots\ldots 3.12$$

$$W = M + B + e.\, F \quad \ldots\ldots . \quad 3.13$$

The approach assumes that the domestic money, domestic bonds and the foreign bonds are equal to the supply of various assets. This, therefore, implies that equations 3.10 to 3.12 show that the domestic individual portfolio is always in equilibrium. Equation 3.13 represents the private wealth and also shows that equations 3.10, 3.11 and 3.12 are mutually dependent (Bilson& Marston, 2007; Kendall, Donghyun, & Tan, 1997; Radaelli, 2002). In addition, the portfolio balance approach provides an analytical framework for evaluating the effects of

monetary and fiscal policy on the exchange rate (Ugur, 2002). For instance, a restrictive monetary policy reduces nominal financial wealth. This decline in wealth leads to a decrease in demand for both domestic and foreign bonds through equations 3.11 and 3.12. Eventually, the sale of foreign bonds results in the appreciation of the domestic currency.

Many studies provide evidence in support of the portfolio balance approach. Recently, for instance, Aima & Zaheer (2015) empirically tested the portfolio approach and provide evidence that the approach is valid. Other authors (Frankel, 2007; Magud, Reinhart, Rogoff, & Magud, 2007) show that the portfolio balance approach is an important theory that explains fluctuations in the exchange rate. Furthermore, in the context of South Africa, Mlambo (2013) shows that the portfolio balance approach is able to explain the movements in the exchange rate. This study employs this approach owing to its empirical relevance in the case of South Africa.

The reviewed theoretical literature shows that there is no consensus between the theories regarding the relationship between exchange rate and commodity prices. For example, the versions of the purchasing power parity theory postulate that changes in the prices affect the exchange rate through the actions of the arbitrageurs. In addition, the monetary approach assumes that inflation is always a monetary phenomenon implying that the effect of changes in money supply is transmitted to exchange rates through changes in commodity prices. Other theories, however, for example, the elasticity approach conjectures that changes in the exchange rate are responsible for the changes in the prices of exports and imports.

3.3. EMPIRICAL LITERATURE REVIEW

The available literature on the relationship between oil prices and exchange rate comprise of studies which have been done both at country levels as well as cross-country. A number of these studies have relied on methods which seek to establish a long term relationship using Johansen cointegration, Engle Granger, Autoregressive Distributive Lag (ARDL), Error Correction models. Interestingly, some studies have also employed the causality models to investigate the direction of causality between oil prices and exchange rates (Amano & Norden, 1998b; Chen & Chen, 2007; Lizardo & Mollick, 2010; Prasad & Narayan, 2015; Zhang, Dufour, & Galbraith, 2016; Hasanov, 2010; Zrada, 2010; Prasad and Narayan, 2015). However, literature available has however been dominated by studies mainly from developed economies. Furthermore, the results of these studies are inconclusive. In this section of the study, empirical review showing the association between prices of oil and

exchange rates is presented. This review is aimed at showing the previous works on the relationship between oil price variability and exchange rate. The literature is categorised into four main groups; the empirical literature on developed countries; the empirical literature on emerging and developing countries combined and also studies that have investigated the impact of oil prices and exchange rate in both developed and developing countries. Lastly, empirical studies that have been conducted in the case of South Africa are also given.

3.3.1 EMPIRICAL LITERATURE ON DEVELOPED COUNTRIES

Bayat, Nazlioglu, & Kayhan (2015) investigated the causality between the prices of oil and exchange rates in the framework of the Czech Republic, Hungary and Poland. Basing on the causality analysis (frequency domain causality analysis), the authors assert that movements in the prices of oil have a direct bearing on the exchange rate in the long run in Poland and Czech but not in the context of Hungary. On the other hand, Ding & Vo (2012) found that prior to the 2008 crisis, both the oil markets and exchange rate markets simultaneously respond to shocks and therefore no interaction is observed in daily data. Nonetheless, the authors mention that there is a bi-directional association between the two markets during turbulent times. The implication is that shocks that affect one market have the power to affect the other market. In other words, innovations that affect the exchange rate market also affect the oil market and vice versa. Studies (Coudert, Mignon, & Penot, 2008; Min & Yanbin, 2009; Coudert, Couharde, & Mignon, 2013) advocate that there is a unidirectional relationship in which prices of oil granger cause the dollar exchange rate and not the other way round (Coudert, et al., 2008).

A recent study by Bopo (2015) contends that there is only a one-way causality from the exchange rate to the prices of oil and not the other way round. The author shows that a negative transition is observed from the exchange rate to the prices of oil and not from the oil prices to the exchange rate. This is in contrast to the findings by Coudert, Mignon, & Penot (2008a) and Min & Yanbin (2009) who argue that there is a uni-directional causality from the crude oil prices to the exchange rate. In the interpretation of Ferraro, Rogo, & Rossi, (2015) oil prices can help predict exchange rates. In Aloui, Ben Aïssa, & Nguyen (2013)'s view, an increase in oil prices leads to the fall in the exchange rate. In addition, other studies emphasise that changes in the prices of oil granger cause the exchange rate meaning that variations in crude oil prices have the power to change the exchange rate (Al-Mulali & Sab, 2012; Aziz, 2009; Mendez-Carbajo, 2009). Furthermore, Aziz (2009) posits that there is a positive and statistically significant relationship between prices of oil and exchange rate in

net oil importing countries. Aziz (2009) emphasises that oil prices have a positive impact on the real exchange rate in net oil importers implying that increases in the prices of oil results in the real exchange rate depreciation in these countries.

Nonetheless, Fratzscher, Schneider, & Robays (2014); Novotný (2012); Razgallah & Smimou (2011), challenge the view that oil prices determine the value of the US currency. They suggest that an appreciation of the United States dollar culminates to a significant decline in the demand for oil and consequently leads to a fall in oil prices. In their opinion, they believe that US dollar exchange rate strongly impact on the demand for oil and not the other way round. Furthermore, Novotny (2012) provides evidence that since 2002, the direction of causality has been from exchange rate to the prices of oil. Moreover, Novotny (2008) examined the effects of the US industrial production and interest rates on the nominal effective exchange rate Nonetheless, other studies argue that there is a bi-directional causality between the two variables. For instance, Fratzscher et al., (2014) shows that a bi-directional causality between the prices of oil and exchange rate is observed. In contrast, Akram (2004) points out that, there is a negative relationship between oil prices and the exchange rate and not the other way round.

Zhang, Dufour & Galbraith (2016) investigated the high-frequency causal "relationship between exchange rates" of Canada and Australia, and the prices of crude oil, gold and copper. The authors provide evidence that crude oil has a significant predictive power for the exchange rate. Furthermore, Zhang et al., (2016) emphasise that there is a stronger causation from commodities to currency rather than *vice versa*. Their results concur with the findings by Chen & Rogoff (2002), who point out that the US dollar price of Australia and New Zealand commodity exports influence real exchange rates. In a contrasting view, Engel & West (2005) show that exchange rates granger cause prices. These authors are of the view that, exchange rates lead oil prices because exchange rates are passed on to prices of imported consumer goods. Nevertheless, not all studies concur that there is a nexus between oil price variability and exchange rates. For instance, Zrada (2010) using monthly data and by employing the VARs and causality contends there is no evidence that crude oil price volatility and exchange rate can influence each other. Furthermore, Zrada (2010) shows that gold has an influence on exchange rate.

By investigating the oil price-exchange rate relationship in the case of the Group of Seven (G7 countries), Chen & Chen (2007) disagree with the notion that there is no relationship between the two variables. The authors insinuate that prices of oil significantly affect exchange rates. In addition, the authors affirm that oil prices are a predominant source of

exchange rate fluctuations and have an ability to forecast future exchange rate returns. The findings by Chen & Chen (2007) concur with the findings by Amano & Norden (1998) who employed cointegration and causality model and posit that, "oil prices may have been the dominant source of persistent real exchange shocks and that energy prices may have important implications for future work on exchange rate behaviour." In contrast, Zhang, Fan, Tsai, & Wei (2008) by employing the cointegration tests, ARCH type and causality challenge the view that oil price variations determine the exchange rate. Instead, they are of the opinion that, oil prices do not dictate the movement in exchange rate but it is the exchange rate movements which define changes in the prices of oil. Also Coudert, Couharde & Mignon (2011) through the using panel smoothing regression methodology and including variables such as real effective exchange rate and commodity terms of trade, argue that exchange rate explain oil prices. In addition, Zhang et al., (2008) and Courdert (2011) argue that, because the US dollar is frequently used as the invoicing currency of international oil trading, fluctuations in the dollar has a direct bearing on the prices of oil. Hence, they assert that "a fall in the value of the dollar leads to an increase in the price of oil and the opposite holds." Thus, Zhang et al., (2008) maintain that the price of the dollar granger causes international oil prices. In addition, Courdert (2011) argue in the long run, exchange rates move together with the prices of commodity and respond to oil prices somewhat less than commodity prices.

Nonetheless, other studies (Lizardo & Mollick, 2010; Nurmakhanova & Kretzschmar, 2010; Selmi, Bouoiyour, & Ayachi, 2012) believe that oil price fluctuations are a dominant factor in explaining changes in the prices of currencies. Lizardo and Mollick (2010) examined the fluctuations in oil prices and the United States dollar using monthly data for a period spanning from 1970 to 2008. The authors found that the prices of oil significantly explain fluctuations in the exchange rate of the dollar. In addition, Lizardo and Mollick maintain that an increase in the real oil prices results to a significant depreciation of the United States dollar (USD) relative to the currencies of net oil exporter countries. Kretzschmar and Nurmakhanova (2010) confirm that oil prices have an effect on the exchange rate. In addition, Kretzschmar and Nurmakhanova (2010) highlight that currencies of oil importing countries, for instance, Japan, depreciates against the USD when there is an increase in the prices of oil. Selmi, et al., (2012) emphasise there is an adverse relationship between oil prices and movements in exchange rates in both net exporting countries as well as net oil importing countries. In sharp contrast, Tiwari, Mutascu, & Albulescu (2013) allege that changes in the prices of oil have no influence on the real exchange rate.

In contrast to Tiwari, et al., (2013)'s view that the prices are not a determinant of the exchange rate, Aloui et al., (2013) expounds on the prices of oil in determining changes in the currency values. These authors propose that real oil price increases lead to a significant depreciation of the United States dollar. Their findings are in line with the findings by Aloui et al., (2013) which affirm that increases in oil prices lead to the depreciation of the dollar. Furthermore, Lizardo & Mollick (2010) using VARs advocate that currencies for net oil importing countries, for instance, Japan depreciate against the USD when there is an increase in the prices of oil. Furthermore, Lizardo & Mollick (2010) include variables such as money supply, real output and industrial production as determinants of exchange rates.

Interestingly, many studies oppose the view increases in the prices of oil culminates to the fall in value by asserting that oil prices increases are directly associated with the appreciation of the dollar. For instance, using the VAR methodology, Coudert, Mignon, & Penot (2008) found that an increase in oil prices is associated with an appreciation in the value of the dollar. This is in sharp contrast to the findings by Aloui, Aisa and Nguyen (2012); Lizardo and Mollick, (2010). However, Courdet et al., (2008) shows that oil prices granger causes the dollar exchange rate and the direction is unidirectional. In other words, changes in the prices of oil would result in changes in the dollar rate. On the other hand, Novotný (2012) gives evidence that oil prices have no power to determine the exchange rate. The author investigated the nexus between Brent crude oil prices and the USD exchange rate using monthly data from January 1982 to September 2010. Basing on his results, Novotny (2012) posits that, the coefficients of correlation of the USD exchange rate and commodity prices have been negative. In addition, Novotny (2012) argues that, since 2002, the direction of causality has been from the exchange rate to the prices of oil. This implies that a percentage depreciation of the USD leads to a 2.1 percentages increase in the Brent crude oil price and *vice versa*.

Cuaresma & Breitenfellner (2008) investigated the influence of changes in the US dollar/euro rate of exchange on crude oil price over 1965-2007 periods. Basing on their study, the authors postulate that exchange rates are fundamental in projecting the prices of commodities. This is in line with the findings by Schmidbauer & Angi (2008) who suggest that there is a strong impact of the USD news on the West Texas Intermediate crude oil price volatility. Furthermore, Schmidbauer & Rosch (2008) posit that, the sharp ascent of volatility is experienced when oil prices decrease (increase) and the USD depreciates (appreciates). In addition, Breitenfeller & Cuaresma (2008) also show evidence that direction of causality is not clear. On the other hand, Clements & Fry (2008) suggests that there is a bi-directional

causality between the currencies and the commodities, to mean that currencies are driven by commodities or commodities are determined by currencies. Furthermore, evidence has shown that booming prices of commodities represent the improvement in the terms of trade and can be regarded as the transfer of wealth from commodity importing countries to commodity exporting countries (Chaban, 2009).

In examining the relationship between the prices of crude oil, share prices and exchange over a period 2006 to 2010, Yanagisawa (2010) employed the vector auto-regression mechanism. In the study, the author indicates that the causal relationship among the variables (crude oil prices, share prices and exchange rates) is not fixed but changes over time. For example, in 2008, a bidirectional relationship is observed in any combination of the variables. Nevertheless, in 2010, the author argues that the bidirectional causality among the variable is lost. Yanagisawa mentions that the reasons for the changes may be due to changes in the degree of confidence in the price forecast based on fundamentals, momentum covering the market, markets participants' mix, among other factors.

Harri, Nalley & Hudson (2009) investigated the link between exchange and oil prices using monthly data ranging from January 2000 to September 2008. They employed the cointegration tests and found out a relationship exist between the variables suggesting that the prices of the variables are related. In addition, basing on the results of granger causality, the authors stress that crude oil granger causes commodity prices and price of currencies. This implies that fluctuations in the prices of crude oil are translated into prices of commodities and exchange rate thereby causing changes in commodity prices and prices of currencies. In addition, Dibooğlu (1996) found evidence that real-world price, productivity and government spending may account for deviations from the purchasing power parity.

3.3.2. EMPIRICAL LITERATURE ON EMERGING AND DEVELOPING COUNTRIES

Basing on literature, chapter one of this study has highlighted that oil price increases culminate in wealth transfer from importing to exporting countries. A recent study by Goel & Sharma (2015) gives evidence of the wealth effect in the case of India. The authors examined the nexus between the real exchange rate and world oil prices in the context of India. The authors found that there is a relationship between oil prices and real exchange rate. Furthermore, Goel and Sharma (2015) notes that increases in oil prices result in fall in the values of the Indian rupee relative to the United States dollar in real terms and this implies an

increase in the nominal exchange rate. The authors further argue that oil price increase transfers wealth from India to oil exporter countries. Consequently, the shifts in wealth to oil exporting nation exerts a downward pressure on the rupee value on the international market. Their findings are consistent with the findings by the African Development Bank (2007) which show that oil price increases are associated with a comprehensive pass through to the consumers of oil and would lead to 6% reduction of the median net importing African country. Furthermore, African Development Bank (2007) found that, for the net oil exporting country, an increase in the price of oil would lead to a 4% increase in GDP under managed float and 9 per cent under fixed exchange rate regime.

In the case of net oil importing country like Pakistan, Shair, Ali, & Siraj (2015) analysed the impact of fluctuations of oil prices in developing net oil importing currency such as the Pakistani rupee. The authors postulate that an increase in oil prices is associated with the fall in demand for the Pakistani rupee and an increase in the demand for the USD. This is so because oil contracts are invoiced in the USD and for the Pakistan to be able to import crude oil must demand more of the dollar when oil prices increase. In the same vein, (Kiani, 1996) suggests that high oil prices put downward pressure on the Pakistani rupee.

In examining the relationship between oil prices and the black market exchange rate USD/Algerian dinar, Safaa & Benmessaoud (2015) found out that, a strong connection exist between the two variables in the Algerian context. Also, the authors state that there is unilateral trend causality in the short-run and long-run which runs from the oil prices to the exchange rate. Thus, their results imply that the dinar depends on prices of oil. This means that oil price variability would lead to fluctuations in the exchange rate of the Algerian dinar. Hiri (2014) confirms that prices of oil significantly impact on the real effective exchange rate in the long run. This implies that a percentage increase in the price of oil would lead to 7.307 % appreciation in the value of the Algerian currency. Nevertheless, Benhabib, Kamel, & Maliki (2014) challenge the view that increase in oil price lead to the appreciation of the dinar. The authors contend that there is no evidence that high oil prices lead to an appreciation of the Algerian Dinar. Furthermore, Benhabib et al., (2014) provide evidence that higher oil prices lead to the depreciation of the Algerian dinar by about 0.35% relative to the US.

In assessing the dynamic impact of fluctuations in crude oil prices on macroeconomic variables in Sudan, Ebaidalla (2014) used quarterly data for the period covering 1999:Q42009:Q4. The author argues that shocks in oil prices have significant effects on the main macroeconomic variable such as real gross domestic product, inflation and exchange

rate. Furthermore, Ebaidalla (2014) suggests that the link between oil prices and the macro variables is asymmetric. The findings by Ebaidalla (2014) are consistent with the results by Hasanov (2010) who postulate oil prices positively and significantly affect the long run real exchange rate in the context of Azerbaijani.

However, the notion that variations in oil prices affect exchange rate is not evident in all developing countries. The findings by Coleman, Cuestas, Mourelle, & Street (2011) prove that prices of oil are indeed cointegrated in some African countries but not in others. Coleman et al., (2011) point out that, there is evidence of cointegration in countries such as South Africa, Kenya, Madagascar, Mauritius, Seychelles and Morocco. Moreover, the authors assert that oil price variability impact on exchange rates in the observed countries differently. For countries, such as Morocco and South Africa, Coleman et al., (2011) argue that there is a negative relationship between oil price shocks and the exchange rate.

On the other hand, they found that increases in oil prices lead to an appreciation of currencies for Kenya, Madagascar, Mauritius and Seychelles. Nevertheless, the authors postulate that there is no cointegration between changes in oil prices and the exchange rate in countries that are in the CFA Franc zone, for example, Nigeria, Senegal, Burkina Faso among others. In contrast, other authors by using VARs believe that there is cointegration between oil prices and exchange rate in the case of Nigeria (Englama, Duke, Ogunleye, & Volatility, 2010; Muhammad, Suleiman, & Kouhy, 2011; Olomola & Adejumo, 2006). Muhammad, et al., (2011) and Englama, et al., (2010) found out that, an increase in the price of oil results in the depreciation of the Nigerian naira relative to the US dollar. Nevertheless, Iwayemi & Fowowe (2011) are of the opinion that shocks in oil price have no significant impact on the exchange rate in Nigeria.

In the context of China, Huang & Guo (2007) expound on the impact of real world oil prices impact on the exchange rate in China. Through the four-dimensional structural vector autoregressive model, the authors point out oil price fluctuations culminates to a minor appreciation of China's the long-term real exchange rate mainly because of China's lesser dependence on oil imports than other currencies included in the RMB basket peg regime and the strict government energy regulations. Furthermore, Huang & Guo (2007) argue that monetary shocks have little effect on the exchange rate in China. Bénassy-Quéré, Mignon, & Penot (2007) justifies that oil prices affect the exchange rate in China. The authors postulate that a rise in the oil price by 10% is associated with a 4.3% appreciation of the dollar against

the Chinese currency in the long run. Furthermore, Bénassy-Quéré et al., (2007) concludes that the direction of causality runs from the oil price to the dollar. However, in the case of UAE, AlMulali & Sab (2012) understand that there is bi-directional short run causality between the real value of the dirham and the oil prices. Furthermore, the authors show that oil prices granger cause the exchange in both the short and the long run.

In identifying the primary variables that influence the real exchange rate for net oil producing emerging countries Eslamloueyan (2015) developed and estimated a model of the real exchange rate specifically for the MENA countries. The authors advocate that oil prices and the United States externally financed debts per GDP are the major factors of real exchange over the long run in the MENA countries. Interestingly, Farzanegan & Markwardt (2007) understands that oil price fluctuations have a significant effect on the real exchange rate to mean that, oil price shock significantly increases price levels and appreciates the domestic currency in the mid-run, which is a clear indication of the Dutch disease. In addition, they argue that the economy of Iran is prone to oil price shocks than the positive shocks in oil prices. Aflatooni (2009) affirms that oil prices play an important role in determining exchange rates.

3.3.3. EMPIRICAL LITERATURE ON BOTH DEVELOPED AND DEVELOPING COUNTRIES

Volkov & Yuhn (2015) investigated the impact of shocks in oil prices on exchange rate movements in five major oil-exporting countries, which include Brazil, Canada, Mexico, Norway and Russia using monthly data from September 1998 to August 2012. The authors argue that the behaviour of exchange rates between emerging markets and advanced economies exhibit noticeable differences. For instance, Russia and Brazil show different patterns from those of Canada and Norway in the direction and magnitude of shocks in oil prices. In addition, Volkov and Yuhn mention that exchange rate volatility that is due to shocks in oil prices is significant in Brazil, Russia and Mexico but weak in Canada and Norway. Ito (2010) shows that oil price volatility affects the movements in the exchange rate in Russia.

Coudert, Couharde and Mignon (2013) examined the relation between the exchange rate and the terms of trade in the context of commodity producing countries. Their study included 69 commodity exporting countries of which 52 are commodity exporters and 17 are exporters of oil over the 1980 to 2012 period and the panel smooth transition regression methodology was utilised. Coudert et al., (2013) show that exchange rates are sensitive to the fluctuations in the

terms of trade triggered by changes in oil prices. Cashin, Céspedes, &Sahay (2003) understand that there is cointegration between real exchange rates and the prices of commodities for about 33% of countries that export commodities. In addition, Cashin et al., (2003) suggest that the long-run real exchange rate is not constant by varies due to fluctuations in the real price of commodities in the observed commodity currencies.

Korhonen & Juurikkala (2007) assessed the primary determinants of equilibrium real exchange rate in the case of OPEC countries using data for a period spanning from 1975 to 2005. The results of their study are in consensus to the notion that prices of oil have a statistical strong and important effect on the real exchange rates in oil sufficient countries. This indicates that higher oil price leads to an appreciation of the real exchange rate. The authors emphasise that when there is an increase in oil prices, the equilibrium exchange rate of oil supplying countries appreciates. The findings by Korhonen and Juurikkala are consistent with the findings by Nikbakht (2009).

Nikbakht (2009) investigated the long run relationship between oil prices and the exchange rate in OPEC economies and demonstrated that variations in oil prices may have been a major factor influencing real exchange rate in oil producing countries. Furthermore, the author shows that there is a positive and long-run relationship between oil prices and exchange rate. This implies that increases in the prices of oil are associated with exchange rate appreciation for OPEC member countries. Moreover, Aflatooni (2009) provides evidence that oil price changes are a major determinant of exchange rates in the OPEC countries.

Dauvin (2014) studied the relationship between energy prices and the effective real exchange rate of commodity exporting countries. Dauvin (2014) considered 10 energy-exporting countries and 23 commodity-exporting countries over the period of 1980 -2011. The author suggests that there is evidence of a "threshold beyond which the real effective exchange rate reacts to oil prices through the terms of trade," for both energy and commodity exporters.

Drawing insights from models of political economy, Rickne (2009) argues that the extent to which real exchange rates of oil exporter countries co-move with the oil price depends to a greater extent on the county's political and legal institutions. Rickne (2009) maintains that robust institutions protect the real exchange rates from oil price variability by generating a smooth pattern of fiscal expenditure over the price cycle. This means that real exchange rate co-move less with the prices of oil in economies with extraordinary bureaucratic excellence and solid legal systems. Furthermore, Rickne (2009) shows that productivity differential positively affect the real exchange.

In contrast to Dauvin (2010) and Rickne (2009), De Schryder & Peersman (2015) ascertain that oil prices have no influence on exchange rates. The authors argue that it is the exchange rate that influences the behaviour of oil prices. By investigating the role of the United States dollar on the demand for oil using a sample of 65 oil importing countries over the period of 1971-2008, they claim that an appreciation of the United Sates dollar exchange rate results to a significant decline in the demand for oil in a sample of countries observed. In other words, de Schryder and Peerson suggest that non-US dollar regions (countries that do not use the dollar for local transaction purposes) experience a decline in oil demand when there is an appreciation of the US dollar exchange rate. Thus, USD exchange rate strongly affects the demand for oil.

3.3.4 EMPIRICAL LITERATURE IN THE CASE OF SOUTH AFRICA

In the context of South Africa, Sibanda & Mlambo (2014) examined the influence of changes in oil prices on the nominal exchange rate of the Rand by using the GARCH test for a period of 1994 to 2012. Using monthly time series data, the study by Sibanda & Mlambo (2014) shows that oil price volatility significantly and positively affects the exchange rate in South Africa. This implies that increases in oil prices variability culminates in the depreciation of the South African currency relative to the dollar. In addition, Sibanda & Mlambo (2014) show that interest rate are also important determinants of the exchange rate in South Africa.

Also in the case of South Africa, Ali, Mukhtar, Tijani & Auwal (2015) investigating the dynamic relationship of exchange rates and crude oil price using the Engle-Granger, TAR and MTAR model. Using monthly data spanning from January 1960 to December 2013, these authors found conflicting results. Based on the Engle-Granger approach, they found that exchange rate and crude oil prices are cointegrated in South Africa. However, the results of the TAR and MTAR model show no evidence of cointegration between the two variables.

3.4. General evaluation of empirical literature from developed, developing and emerging countries

Empirical literature analysis for developed and developing as well as emerging countries was conducted and it was clearly observed that there is no general consensus with regard to the relationship between oil prices and exchange rate. Whilst some studies found that oil prices strongly influence the behaviour of the exchange rate, others found that, exchange rates are

important in determining the prices of crude oil. Likewise, some studies show that there is no dependence and cointegration between the variables. Furthermore, it was also observed that various studies employed different methodologies to achieve their objectives. Nonetheless, due to different approaches that were applied by different studies accompanied by different time horizons and most importantly, the fact that the studies were conducted in different countries, different findings could be obtained. Investigating the impact of oil prices on the exchange rate is important. Nevertheless, a majority of studies have examined the impact of oil prices on different currencies against the US dollar and thus lack information on the effects of oil prices on other forms of exchange rates such as the nominal effective exchange rate. Additionally, a number of these studies have relied on methods which seek to establish a long term relationship using Johansen cointegration, Engle Granger, Autoregressive Distributive Lag (ARDL), Error Correction models (Hasanov, 2010; Amano & Norden, 1998a; Olomola & Adejumo, 2006). Since oil prices are volatile (as shown in the previous chapter), the use of effective volatility models such as the GARCH is crucial in examining the relationship between oil prices and exchange rate. The GARCH model is discussed in the following chapter (Chapter 4, section 4.5.1). Furthermore, the literature discussed above show that much research has been done in developed countries and a few specific studies with much attention on emerging and developing countries such as South Africa. To the best of our knowledge, literature is scanty on the impact of oil price variability on the exchange rate in South Africa. As highlighted in chapter one, this study narrows this gap by investigating the of oil price variability on the exchange rates in South Africa.

3.5 CONCLUSION

The chapter has reviewed the literature relating to the relationship between exchange rate and oil prices variability. The chapter has considered different theories that explain the relationship between the variables. Thus, a consideration was given to theories such as; the PPP theory, elasticity theory, the absorption theory, the monetary theory and the portfolio balance theory. The reviewed theoretical literature shows that there is no consensus between the theories regarding the relationship between exchange rate and commodity prices. Furthermore, the chapter provides empirical studies that examined the nexus between the exchange rate and oil price variability. Findings from different studies conducted to examine the relationship between oil price variability and exchange rate are inconclusive. Thus, there is neither general consensus on the relationship nor on the direction of causality between the variables in both developed and developing economies as well as emerging economies. This

study, therefore, draws on relevant aspects of the foregoing studies but defines its scope somewhat differently so as to achieve the intended objectives as highlighted in the following chapter.

CHAPTER FOUR

DATA AND METHODOLOGY

4.1 INTRODUCTION

This chapter discusses the methodology important in achieving the main aim of this study as well as the objectives highlighted in chapter one. Having discussed the theories and empirical evidence underpinning the relationship between oil price movements and exchange rate in the previous chapter, this chapter presents the methodology necessary to examine the effect of the variability of oil prices on the exchange rate in South Africa. This chapter consists of six main sections. Following this introduction is section 4.2, which outlines the methodological approaches. The theoretical model is discussed in section 4.3. Sections 4.4 and 4.5 discuss the model specification and the estimation technique respectively. The GARCH (1.1) methodology, definition of variables, apriori expectations and data sources are presented in section 4.5. Section 4.6 discusses the econometrics tools. Lastly, the chapter conclusion is presented in section 4.7.

4.2 Methodological approaches

The study acknowledges the existence of three main types of research methodologies which include; quantitative, qualitative and mixed research. Quantitative research is primarily used for description, explanation and prediction. Basically, this kind of research type is based on quantitative data, particularly on the analysis of variables (Balnaves & Caputi, 2001; Newman & Benz, 1998). Furthermore, quantitative research focuses attention on the measurements and amounts displayed by events or people and uses a number of statistical methods (Thomas, 2003; Wyse, Hayward, & Pandya, 2015). In contrast, qualitative research is exploratory research. This kind of research is used in order to comprehend the underlying reasons, opinions and motivations (Thomas, 2003). Furthermore, in contrast to the quantitative research, qualitative research is used primarily for the purposes of description and exploration and to gain an understanding of how people think and experiences their lives. The mixed research is the combination of the qualitative and quantitative approaches.

In this study, we summarise large volumes using statistical methods. Furthermore, the study makes use of secondary data sources in achieving the aim and objectives outlined in the first chapter. In order to achieve the outlined goals and objectives, the most appropriate methodological approach is the quantitative approach because it plays an important role in ensuring that the research aim and objectives of this study are attained. In addition, the fact that the study uses secondary not primary data validates the use of the quantitative approach instead of the qualitative or mixed research approaches.

4.3 Theory of exchange rate determination

The literature proposes various approaches to understanding exchange rate variations as highlighted in the previous chapter. These exchange rate theories include the PPP, the absorption approach, the monetary theory and the balance of payment approach. The purchasing power parity is not relevant in the short-run (Beggs, 2015; Berg, Hendrik, 2016; Frenkel, Hommel, & Rudolf, 2013; Rochon& Vernengo, 2001). Furthermore, evidence shows that the power of the commodity arbitrage in keeping prices in line was found to be weak (Dimitriou & Simos, 2013; Sadoveanu & Ghiba, 2012). Thus, the PPP is discounted in this study.

On the other hand, other exchange rate models such as the tradition flow models assert that exchange rate is in equilibrium when a country is running a current account deficit if the interest rate in the domestic country is high enough to maintain an offsetting net capital. This means that at a constant interest rate differential, there is a steady, potentially infinite accumulation of domestic assets by foreigners (Butgereit, 2010; Evans, 2011; Henderson, 2006). However, over the past years, the monetary sectors have experienced instabilities. These tremendous developments in the financial sector imply that exchange rates are subject to more fluctuations rather than those driven by underlying money factors. Also, in reality, bonds are imperfect substitutes and not perfect substitutes. The imperfect nature of the assets may be due to various factors such as liquidity, tax treatment, default risk and exchange rate risk. Thus, due to the mentioned weaknesses, the monetary approach is invalidated in this study.

The general form of the bilateral exchange rate (ZAR/USD) and the nominal effective exchange rate models used in this study are based on the works of Aziz (2009), Novotný, (2012) and Sibanda & Mlambo (2014), with some modifications. The theoretical

underpinning of these empirical approaches is based on the asset or the portfolio balance model which expands the monetary approach. The models are augmented with other variables to take into account macroeconomic activities and institutional settings in South Africa. The models also tackle Hiri (2014)'s view that prices of oil significantly impact on the exchange rate. In consonance with Hiri, Chen & Chen (2006) and Aziz (2009) argue that oil prices may have been the dominant source of exchange rate and that there is a link between oil prices and exchange rates. In addition, the model also incorporate Jang & Zhang (2011)'s view that sovereign credit ratings greatly affect the exchange rate.

Based on the theoretical considerations discussed above, the models are specified as;

$$ZAR/USD_t = f(Brntvol_t, Dint_t, M_3, iip_t, SCR_t) \quad 4.1$$

$$NEER_t = f(Brntvol_t, Dint_t, M_3, iip_t, SCR_t) \quad 4.2$$

And the empirical models are specified in equation 4.3 and 4.4 below as;

$$ZAR/USD_t = \beta_0 + \beta_1 lnBrntvol_t + \beta_2 SACPI_t + \beta_3 \text{lnD}int_t + \beta_4 M3_t + \beta_5 IIP_t + \beta_6 SCR_t + e_t \quad 4.3$$

$$NEER_t = \beta_0 + \beta_1 lnBrntvol_t + \beta_2 SACPI_t + \beta_3 \text{lnD}int_t + \beta_4 M3_t + \beta_5 IIP_t + \beta_6 SCR_t + e_t \quad 4.4$$

Where, ZAR/USD in equation 4.3 is the rand/dollar exchange rate as a function of log of Brent oil price variability (lnBrntvol), inflation (CPI), log of the interest rate differentials (lnDint), broad money supply ($M3_t$), IIP is the index of industrial production, a measure of industrial output, and sovereign credit rating (SCR). In equation 4.4, NEER is the normal effective exchange rate expressed as a function of the same variables that determine the rand/dollar exchange rate. To remove the underlying trend, some variables included in the model are logged. In both equations, β_0 is a constant term; $\beta_2 - \beta_6$ are coefficients and e_t is a stochastic disturbance term. The variable employed for the purpose of achieving the stated objectives ought to be defined and *a-priori* relationships highlighted. This is done in section 4.4.2.

4.4.1 DATA

In order to achieve the objectives stated in the first chapter, this study employs monthly time series data from the SARB, World Bank and Quantec Easydata. The data period covers a period spanning from January 1994 to December 2014.

4.4.2 Definition of variables and apriori expectations

Exchange rate refers to the price at which one currency can be exchanged for another or it can be defined as the number of units of one currency that can be bought by a number of units of another currency. In this study, the bilateral Rand/dollar exchange rate and the Rand nominal effective exchange are tested against Brent oil price volatility as well as the above mentioned explanatory variables. The increase in the Rand/dollar exchange rate implies a depreciation of the South African currency relative to the United States dollar and the opposite is true. To accurately measure the international competitiveness of the South African Rand, we employ the nominal effective exchange rate and it is measured in foreign currency terms, thus an increase (decrease) in this variable indicates an appreciation (depreciation) of the Rand.

Brntvol measures the variability of the Brent oil prices. As mentioned previously, the impact of a change in oil prices on the exchange rate is empirically ambiguous. Some studies argue that oil prices positively affect the exchange rate in net oil importing countries and negatively affect the exchange rate in net oil exporting countries (Aziz, 2009; Chen & Chen, 2007; Kin & Courage, 2014). On the other hand, some studies show that the exchange rate is the one that influences oil prices (Cuaresma & Breitenfellner, 2008; De Schryder & Peersman, 2015; Schmidbauer & Angi, 2008). However, in the context of net oil importing countries, we expect that changes in oil price will lead to the over-supply of non-dollar currencies on the foreign exchange market because oil is traded in US dollars. This implies that variability in the prices oil results in changes in the exchange rate for South Africa. This means that high oil prices demand more of the dollar relative to the Rand and the opposite holds. In calculating the variability of oil prices, the mean of each year has been subtracted from the monthly actual figures and the differences squared. We expect a positive relation between oil price variability and the bilateral Rand/dollar. On the other hand, we expect a negative relationship between Brntvol and the nominal effective exchange rate of the Rand.

SACPI is the South African consumer price index which is a proxy for inflation. This study investigates the impact of inflation on both the Rand/dollar exchange as well as the nominal effective exchange rate. Theory suggests that, if investors anticipate that the rate of inflation is going to be high, the currency of that country is expected to depreciate and the opposites hold. Dornbusch (1991) states that a monetary expansion causes the exchange rate to depreciate. This is so because monetary expansion leads to low interest rate or low borrowing costs and ultimately high rate of inflation which adversely affect the value of currency. In addition, Du Toit (2014) suggests that a country with a lower inflation rate would display an

appreciating currency as the purchasing power increases relative to other currencies. On the other hand, a country experiencing higher levels of inflation typically displays a weakening or depreciating currency relative to other currencies. Thus, basing on theory and empirical evidence, a positive relationship between inflation and the bilateral exchange rate is expected in the context of South Africa. On the other hand, we expect a negative relationship between inflation and the nominal effective exchange rate.

Interest rate differential (Dint) is the difference between the domestic interest rate and the foreign interest rate. Interest rates refer to the price of loanable funds. In a financial system in which there are surplus and deficit units, suppliers of funds (surplus units) would like to earn income on the funds invested or lent out. On the other hand, borrowers (deficit units) would be willing pay a price for the right to use funds from the surplus units. Literature suggests that increases in the domestic interest lure capital inflows and this leads to the appreciation of the domestic currency, ceteris paribus. On the other hand, lower domestic interest rates relative to foreign interest rate result in capital flight from the domestic country to foreign countries and this lead to a fall in the value of the domestic currency. Thus, domestic interest rates are expected to have a negative relation with the bilateral Rand/dollar exchange rate and positively related to the Rand nominal effective exchange rate.

Broad money supply (M3) is expected to have a positive relation with the bilateral Rand/dollar exchange rate. This is so because an increase in money supply leads to fall in domestic interest rate causing capital outflow and depreciation of the Rand relative to the dollar. On the other hand, a negative relationship between the nominal effective exchange rate and money supply is expected. This means that an increase in money supply, for instance, leads to a fall in the domestic interest rate and consequently resulting in the depreciation of the Rand nominal effective rate.

Index of industrial production (iip) is used as a proxy for output as mentioned earlier in this chapter. The index shows the growth in the different sectors of the economy. The study expects a negative relationship between the index of industrial production and rand/dollar exchange rate. This means that an increase in the index of industrial production is expected to result in the decrease in the bilateral exchange rate and thus, the appreciation of the rand and the opposite holds. On the other hand, a positive relationship between output and the nominal effective exchange rate is expected.

Sovereign credit rating is another fundamental variable included in this study. Given the changing episodes of the South African sovereign grades, we investigate the impact of

sovereign credit ratings on the exchange rate. This variable is important and yet its relationship with exchange rates has received little attention in literature. The rating agencies in their rating methodologies examine the performance of major macroeconomic and socioeconomic indicators and they will be able to determine the ability and willingness of the government to meet its financial obligations fully and timeously. Moreover, sovereign credit rating agencies take into account the economic structure and performance (real GDP, gross investment and savings, inflation, per capita income), external payments and debts (levels of official reserves, current account balances and external debt ratio) and government finances (expenditure by government, debt interest payment to revenue, government expenditure). In addition, the rating agencies also take into consideration the vulnerability to events such as external vulnerability risk, political risk and socioeconomic risk (Fin24, 2016). This study uses the ratings by Moody's because unlike the S & P ratings, Moody's is not "interested in the default probability per se but rather in the expected losses" (Salmon, 2016).

Furthermore, SCR presents investors with insight into the degree of risk associated with investing in a particular country. Sovereign credit ratings are important to understanding the fluctuations in the exchange rate because, a sovereign upgrade, for instance, may mean that the country is less risk and this may instil confidence in investors. Consequently, this may attract foreign direct investment and lead to the appreciation of the domestic currency. On the other hand, a rating downgrade may erode confidence in investors resulting in the capital flight from the downgraded country. Thus, it is imperative to investigate the impact of the sovereign grade on the exchange rate in South Africa.

Since the study uses two measure of the exchange rate, the study expects SCR to have a negative relationship with the rand/dollar exchange rate. This implies that an upgrade of the sovereign is expected to decrease the rand/dollar exchange rate and lead to the appreciation of the Rand. On the other hand, a positive relationship between the SCR and the NEER is expected. This implies that a sovereign upgrade is expected to increase the NEER and this implies that, when there is an upgrade of the sovereign, the Rand is expected to strengthen relative to major currencies of South Africa's trading partners. The opposite is true in the event of a downgrade. A downgrade is expected to have a negative impact on the NEER.

Following the works of Ntswane (2014) and Gande & Parsley (2005), in measuring SCR, the study uses the numeric scale whereby 20 represent the highest and safest grade (Aaa) whilst zero represents the lowest or default grade (C). Also, to capture the issue of outlooks (or

watchlisting) the study will have a scale with 0.25, 0, -0.25 (-0.1 for negative and 0.1 for positive RUR) representing positive, stable and negative outlooks respectively. For example, if the rating Aaa and negative outlook, the SCR value is the summation of the two, that is, 20 plus -0.25 which is equal to 19.75.

4.5 ESTIMATION TECHNIQUE

The link between exchange rate and other fundamental variables (such as oil price, inflation and interest rates) has been modelled through various approaches. For instance, the relationship has been investigated using VARs (Huang & Guo, 2007; Lizardo & Mollick, 2010; Olomola & Adejumo, 2006; Zrada, 2010). Other studies have used causality tests (Amano & Norden, 1998a; Bénassy-Quéré et al., 2007; Zhang et al., 2008). In addition, other studies such (Oyetunji, 2013; Prasad & Narayan, 2015; Simatele, 2004; Sohaili et al., 2015) employed the general autoregressive conditional heteroscedastic (GARCH) methods. In this study, the latter approach will be used to model heteroscedasticity in errors in the exchange rate equation. Most importantly, the approach is chosen because it allows us to simultaneously test the effect of oil price variability on both the conditional mean and the conditional variance exchange rates. Furthermore, the data allows the use of this approach.

4.5.1 GENERALISED AUTOREGRESSIVE CONDITIONAL HETEROSCEDASTIC (GARCH) MODEL

In investigating the impact of oil price variability, we employ the GARCH (1.1) model. The GARCH model take into account the distributional form of the exchange rate unlike the widely used SVAR models which assume constant variance and account for exchange rate volatility sources through the impulse response and variance decomposition analysis (Chipili, 2009). Furthermore, compared to the ARCH models, the GARCH is more parsimonious and avoids over fitting (Brooks, 2008).

The GARCH (1.1) technique is used for modelling variance and it "allows the conditional variance to be dependent upon previous own lags" (Asteriou & Hall, 2007; Brooks, 2008).The models for this study are expressed in equation 4.5 through to 4.8.

$$\Delta Rand/Dollar = \alpha + \Delta lnBrntVol_t + (h_t) + \Delta lnDint_t + \Delta SACPI_{t-1} + \Delta M3_t + \Delta IIP_t + \Delta lnSCR_t + \varepsilon_t \quad \text{.....4.5}$$

$$NEER = \alpha + \Delta lnBrntVol_t + (h_t) + \Delta lnDint_t + \Delta SACPI_t + \Delta M3_t + \Delta IIP_t +$$

$$\Delta lnSCR_t + \varepsilon_t \ldots\ldots 4.6$$

$$\varepsilon_t|\Omega_t \sim iid\ (0, h_t) \ldots\ldots 4.7$$

$$\ln(h_t) = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} + \varphi lnBrntvol_{t-1} \ldots\ldots 4.8$$

Equations 4.5 and 4.6 are the conditional mean equations and test the effect of oil price variability on Rand/dollar exchange rate and the nominal effective exchange rate of the Rand. In order to assess whether the means explicitly depend on the variance, the variance has been introduced in the mean equations as a "regressor through g which is a suitable function entering the equation as either the variance itself or its square root" (Simatele, 2004).

Equation 4.6 represents the distribution of the disturbance term which is conditional on the information set,Ω_t, and is independently distributed with a zero mean and a constant variance, h_t. The fourth equation (equation 4.8) is the variance equations which is made up of three variables, the mean, ω, news about the volatility from the previous period which is represented by $\alpha\varepsilon_{t-1}^2$. The last variable in the mean equation is the last period forecast which is represented by h_{t-1}. For the model to be stable and the variance to be positive, $\omega > 0$, $\alpha > 0$ and $\beta \geq 0$. It is important to note that oil price variability is also included in the variance equation. This inclusion of the variable in the variance equation will help us seeing the effect of oil price variability on the exchange rate in South Africa.

Furthermore, in estimating the model, the quasi–maximum likelihood method is utilised as this method provides "consistent estimates of the parameters even if when the normality assumption is violated" (Bollerslev & Wooldgrige, 1992).

4.6 ECONOMETRIC TOOLS

The study utilises Eviews9. This econometric software allows for variance modelling techniques such as the GARCH (1.1). Furthermore, the software permits the presentation of a variety of graphical and tabular formats as well as conducting a number of diagnostic tests.

4.7 CONCLUSION

The chapter has laid down model employed in order to achieve the main aim of investigating the impact of oil price variability on the exchange rate in South Africa. The selection of the variables which are likely to influence the behaviour of the exchange rates was done

following both theoretical and empirical literature. The fundamental variables included in this study are oil price variability, interest rate differentials, inflation rate, index of industrial production, money supply and sovereign credit ratings. The GARCH (1.1) model has been chosen as the estimation technique for the impact of oil price variability on both the Rand/dollar exchange rate and the nominal effective exchange rate. The regressions will be shown and interpreted in the succeeding chapter.

CHAPTER FIVE

EMPIRICAL ANALYSIS AND INTERPRETATION OF RESULTS

5.1 INTRODUCTION

The previous chapter laid down an important analytical framework and estimation technique to employed in this study. This chapter presents the main results of regression using monthly data for a period spanning from January 1994 to December 2014. The influence that the variability of oil prices has on the South African exchange rate is estimated using other significant macroeconomic variables outlined in the previous chapter. This chapter is organised in five sections. The first section is about descriptive statistics. The second section tests the collinearity of the variables. The ARCH test and Stationarity tests are conducted in section three and four respectively. The fifth section presents the empirical results. The results show that oil price variability affects both the level and volatility of the exchange rate. In addition, the empirical findings show that sovereign credit rating and index of industrial production among others are important determinants of exchange rates in South Africa. Moreover, the sixth section gives the diagnostics checks and section 5.8 concludes the whole chapter.

5.2 Descriptive statistics

Many financial and economic series exhibit leptokurtosis and time-varying volatility (Brooks, 2008; Mlambo, 2013; Xuezheng, Russell, & Tiao, 2001). In this regard, it is, therefore, fundamental to conduct descriptive statistics to determine if these variables exhibit these characteristics. Table 5.1 below displays the descriptive statistics of these variables. The table clearly shows that the statistics associated with skewness and kurtosis are suggestive of non-normality of the variables.

Table 5. 1: Descriptive statistics

	ZAR/USD	NEER	LBRNTVOL	SACPI	SCR	M3	IIP	LDINT
Mean	7.045640	124.2316	52.86304	5.571737	12.26964	13.21813	97.56270	7.504942
Median	6.985550	113.2450	38.14500	5.500000	12.25000	13.76500	97.25000	6.907500
Maximum	11.67610	241.0400	133.9000	13.00660	14.00000	27.25000	117.3000	16.60000
Minimum	3.410700	65.17000	9.800000	-3.700000	10.90000	0.120000	75.10000	2.000000
Std. Dev.	2.055593	43.07588	36.41620	3.157307	1.076645	5.981706	8.654844	2.993265
Skewness	0.144965	0.883645	0.582108	-0.633777	0.122675	0.048564	-0.072266	0.578631
Kurtosis	2.534522	2.808797	1.875503	3.785608	1.621638	2.150779	2.349862	2.872567

A normally distributed series has a skewness of 0 and kurtosis of 3 and is symmetric. Table 5.1 above shows that ZAR/USD, NEER, Brntvol, SCR, M3 and Dint are positively skewed. Furthermore, the above table shows that SACPI and IIP are negatively skewed. A positive skew show that tail on the left is shorter than the right hand tail an indication that a majority of the values lie to the left of the mean or implying that "larger positive values are more likely than large negative values " (Lewis, 2004). The opposite is true for a negative skew. The kurtosis coefficient measures the peakedness of distribution. A kurtosis value greater than 3 is said to be leptokurtic and less than 3 is platykurtic. Table 5.1 above shows that the kurtosis values for the ZAR/USD, NEER, Brentvol, SCR, M3, Dint and IIP are platykurtic. Only SACPI has a kurtosis value of greater than 3 and thus it is said to be leptokurtic. Consequently, the descriptive statistics show that the mean equation should be subjected to the autoregressive conditional heteroscedasticity (ARCH) test. The evidence of the ARCH effect underscores the appropriateness of GARCH (1. 1) estimation.

5.3 Testing for collinearity

When two exogenous variables are linearly correlated, it is not easy to separate individual effects of each variable on the endogenous variable. To avoid misleading results due to multi-collinearity, it is necessary to check for multi-collinearity. Correlation tables are presented in table 5.2a and table 5.2b to check for multi-collinearity. If the r coefficient is closer to plus or minus one, it means that there is a stronger evidence of multi-collinearity. The rule of thumb is that that if the correlation between the two variables is greater than 80%, multi-collinearity may be severe and pose a serious problem (Mlambo, 2013).

Table 5. 2: The correlation matric (The relationship between ZAR/USD and the variables used in the study)

	ZAR/USD	LBRNTVOL	IIP	LDINT	M3	SACPI	SCR
ZAR/USD	1.000000	0.376618	0.596381	-0.201407	-0.21814	-0.06908	0.49389
LBRNTVOL	0.376618	1.000000	0.444423	-0.211848	-0.03226	-0.15313	0.44772
IIP	0.596381	0.444423	1.000000	-0.553654	0.08497	-0.35624	0.76536
LDINT	-0.201407	-0.211848	-0.553654	1.000000	0.02820	0.59862	-0.52520
M3	-0.218141	-0.032265	0.084970	0.028208	1.00000	0.01620	-0.25027
SACPI	-0.069082	-0.153135	-0.356247	0.598626	0.01620	1.00000	-0.33617
SCR	-0.493893	0.447727	0.765368	-0.525205	-0.25027	-0.33617	1.00000

Table 5. 3: The correlation matric (The relationship between ZAR/USD and the variables used in the study)

	NEER	**LBRNTVOL**	**IIP**	**LDINT**	**M3**	**SACPI**	**SCR**
NEER	1.000000	-0.469870	-0.786476	0.368564	0.240771	0.269239	-0.735921
LBRNTVOL	-0.469870	1.000000	0.444423	-0.211848	-0.032265	-0.153135	0.447727
IIP	-0.786476	0.444423	1.000000	-0.553654	0.084970	-0.356247	0.765368
LDINT	0.368564	-0.211848	-0.553654	1.000000	0.028208	0.598626	-0.525205
M3	0.240771	-0.032265	0.084970	0.028208	1.000000	0.016201	-0.250272
SACPI	0.269239	-0.153135	-0.356247	0.598626	0.016201	1.000000	-0.336178
SCR	0.735921	0.447727	0.765368	-0.525205	-0.250272	-0.336178	1.00000 0

Tables 5.2 and table 5.3 display the correlation analysis results. Table 5.2 shows the relationship between the bilateral ZAR/USD and oil price variability, index of industrial production, interest rate differential, money supply, SA inflation and sovereign credit ratings. In addition, table 5.2 shows that interest rate differential, money supply, SA inflation and sovereign credit ratings negatively affect the ZAR/USD exchange while oil price variability and index of industrial production positively affect ZAR/USD exchange rate. On the other hand, table 5.3 illustrates the relationship between NEER and the abovementioned explanatory variables. The results presented in table 5.3 show that interest rate differential, money supply, SA inflation and sovereign credit ratings have a positive impact on the NEER

while, variability in oil prices and index of industrial production negatively affect the nominal effective exchange rate. Nevertheless, these preliminary results are insufficient to arrive at a conclusion. Thus, further test will be conducted in the next sections.

Moreover, as evidenced in both tables above, the highest correlation coefficient values are below 80% or 0.8. Since the coefficients are below 80% or 0.8, the above results clearly indicate that the regressors are not highly correlated implying that the individual impact of the independent variable on the dependent variable can be observed easily.

5.4 Testing for ARCH effect

It is of paramount importance to make sure that prior to the estimation of the GARCH model, the Engel (1982) test for ARCH is computed in order to be sure that the model is applicable for the data (Brooks, 2008). Thus, testing for the ARCH effect is a prerequisite to GARCH (1.1) estimation technique. Table 5.4 below illustrates the ARCH test results.

Table 5. 4: Heteroscedasticity: ARCH test

F-statistic	1891.704	Prob. F(1.217)	0.0000
Obs*R-squared	196.4634	Prob. Chi-Square(1)	0.0000

In the above table, the ARCH test for autocorrelation in the squared residuals is interpreted using the Obs*R-squared value. The p-value shows that the null hypothesis of homoscedasticity is the residuals is rejected. In other words, the zero p-value strongly shows the absence of homoscedasticity in the residuals or the presence of heteroscedasticity in the residuals. In other words, both the F-version and the LM statistics are significant and this is a good indication of the presence of ARCH in the oil prices. Thus, the presence of heteroscedasticity validates the use of GARCH (1.1) model.

5.5 STATIONARITY TEST

Gujarati (2004:807) postulates that, prior to conducting formal tests on the unit root, it is logical to plot the time series under series graphically. This is especially important because graphical plots provide information on the time series properties. Furthermore, graphical plots involve visual plots of series and make a comparison of different variables possible. When

using the graphical plots, if a variable fluctuates around the zero mean, it is said to be mean reverting and it indicates stationarity and non-stationary otherwise. Figure 5.1 below displays variables at level series. In addition, figure 5.1 illustrates that all variables are nonstationary at level series as they are found not to be mean reverting. There is a danger of spurious results if variables are not stationary. In order to obtain stationarity, we, therefore, difference the data. Thus, figure 5.2 illustrates data fluctuating around the zero mean. Thus, we can now conclude from the graphical displays that all variables became stationary or mean reverting after differencing once.

5.5.1 INFORMAL TESTS RESULTS

Figure 5. 1: Level Series

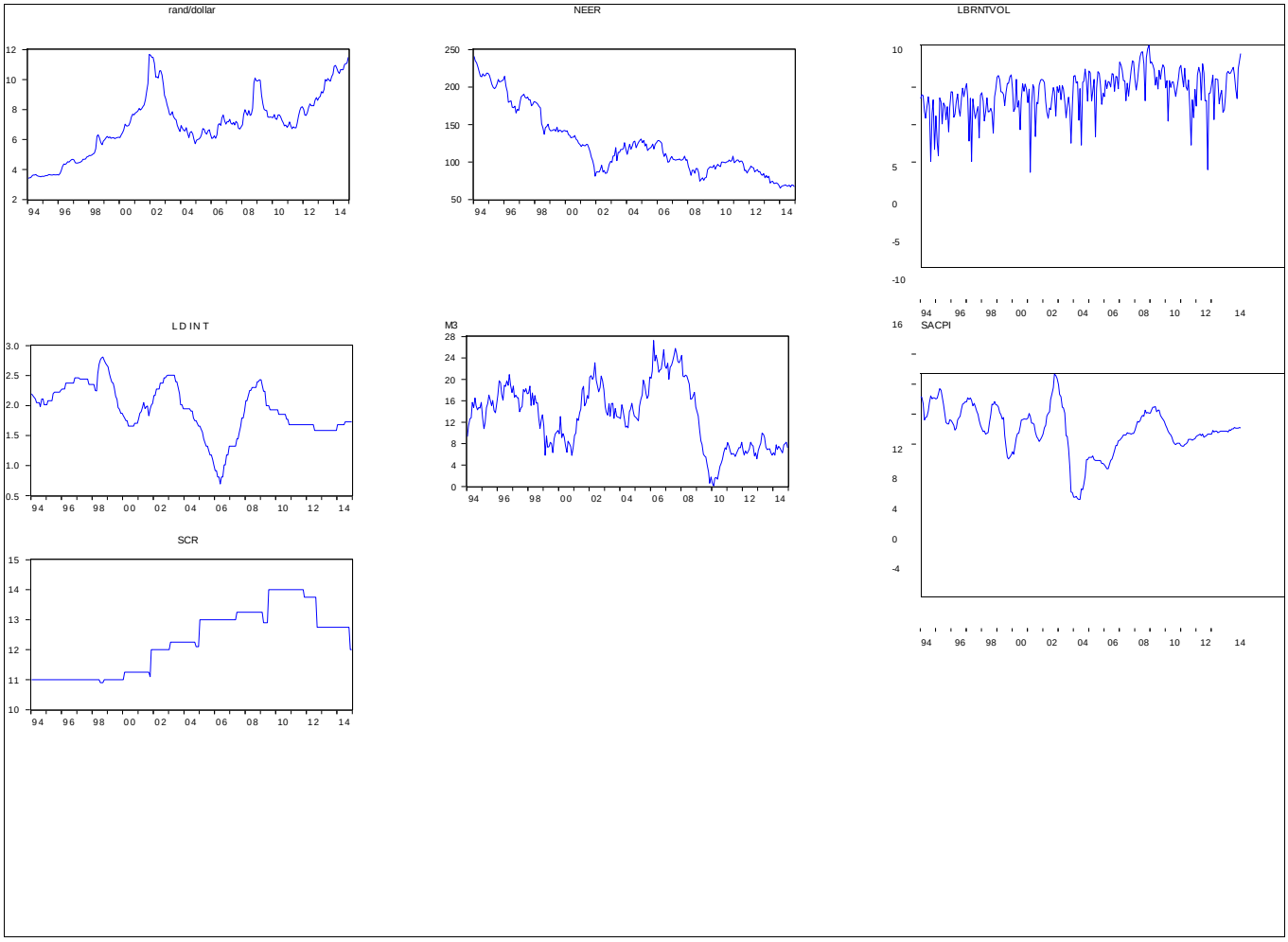
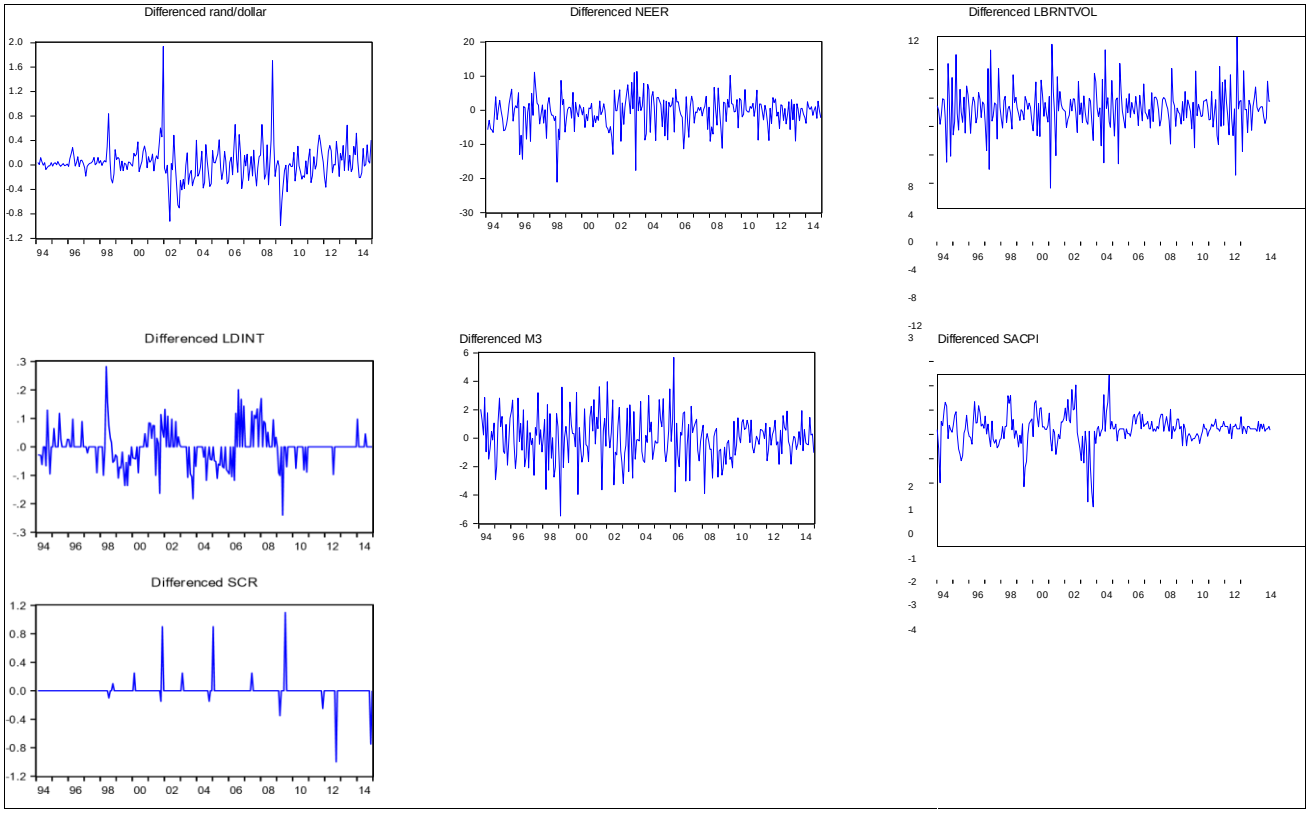


Figure 5. 2: Differenced data



Nevertheless, it is subjective to come up with solid decisions regarding stationarity by solely basing on the informal tests (Chuma, 2015). In addition to graphical unit root analysis, formal econometric tests are carried to unambiguously decide on the actual nature of the time series (Mlambo, 2013). Thus, this study employs the standard formal procedure of stationarity test by employing the Augmented Dicky-Fuller (ADF) test. The common weakness of the ADF is its low power, thus the study uses the Philips Peron (PP) test to complement the ADF**.** The tables below (table 5.5 and table 5.6) present the stationarity results.

5.5.2 FORMAL TESTS RESULTS

Table 5. 5: Stationarity tests (Level series)

AUGMENTED DICKEY-FULLER				PHILIPS PERON		
Variable	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None
ZAR/USD	-2.074872	-2.229376	0.137570	-1.963848	-2.018451	0.226005
NEER	-2.654696*	-2.402785	-2.728801***	-2.632404*	-2.455232	-2.669874***
SACPI	-2.304080	-2.253515	-1.427934	-2.898240**	-2.989777	-1.719967*
LDINT	-2.492434	-3.009458	-0.644832	-2.079129	-2.407844	-0.705750
IIP	-2.109158	-2.615805	1.044929	-2.132460	-2.787078	0.911767
M3	-2.063096	-2.271772	-0.862642	-1.896963	-2.153853	-0.814174
LBRNTVOL	-5.912356***	-10.85989***	-4.841540***	-8.669629***	-10.85989***	-7.311055***
SCR	-0.547176	-3.169010*	1.469079	-0.267949	-3.004153	2.100804

*** Statistically significant at 1% ** Statistically significant at 5% *Statistically significant at 10%

The results obtained from the ADF test of unit root reveal that the null hypothesis that variables are non-stationary in levels could not be rejected at 1% level of significance indicating that all the variables have the unit root problem at levels save for LBRNTVOL. On the other hand, the results from the Phillips-Peron test also concur with the ADF output and display that the null hypothesis that variables are not stationary at level series cannot be rejected at 1% significance level. These results also show that the alternative hypothesis cannot be accepted except for LBRNTVOL at all the models. In addition, the table above shows that ZAR/USD, IIP, M3, LDINT and SCR are not stationary at levels as confirmed by both the unit root tests. According to the ADF test, NEER is stationary at 10% and 1%. These results are also confirmed by the Phillips-Peron test. The above test also displays that only LBRNTVOL is stationary at all the levels of significance. These findings are consistent with the informal stationarity tests explained previously. In most cases, the formal unit root tests (ADF and PP test) usually yield the same findings. However, in the event that conflicting results are obtained (for example, in the case of SCR and SACPI), the PP test takes precedence over ADF test results as the former is considered to be more advanced over the later (Brooks, 2008).

Since most variables are not stationary in levels, they are differenced. Table 5.6 shows the results after differencing the data once. As illustrated in Table 5.6, both the two tests show that all the variables are stationary at all significance levels.

Table 5. 6: Stationarity tests (Differenced data)

	AUGMENTED DICKEY-FULLER			PHILIPS PERRON		
Variable	Intercept	Trend and intercept	None	Intercept	Trend and intercept	None
ZAR/USD	-10.36021***	-10.35650***	-10.34738***	-10.32203***	-10.31787***	-10.30905***
NEER	-15.05828***	-15.19821***	-14.83228***	-15.06120***	-15.19113***	-14.86071***
SACPI	-4.906778***	-4.936731***	-4.889308***	-9.091843***	-9.089233***	-9.102702***
LDINT	-6.841267***	-6.827016***	-6.851676***	-13.72449***	-13.70676 ***	-13.73631 ***
IIP	-21.02894***	-21.03913***	-20.96778***	-20.79783***	-20.84194***	-20.52779***
M3	-4.077228***	-4.148767***	-4.084453***	-16.62132***	-16.63866***	-16.65588***
LBRNTVOL	-9.481932***	-9.455608***	-9.502607***	-67.54597***	-65.75114***	-65.56230***
SCR	-15.48974***	-15.46309***	-15.35265***	-16.24917***	-16.26060***	-15.57285***

*** Statistically significant at 1% ** Statistically significant at 5% *Statistically significant at 10%

Source: Author's computation using Eviews9 econometric Software

It is important to realise that, after first differencing, the null hypothesis that the series are non-stationary is rejected and the alternative hypothesis that series are stationary could not be rejected at 1% level of significant as confirmed by both ADF and PP tests. Thus, it can be confirmed that all the variables are stationary. Thus, stationarity of the variables helps eliminate the danger of obtaining spurious regressions.

5.6 PRESENTATION OF RESULTS

After stationarity is achieved in the variables, this section presents the empirical findings from the GARCH model. Table 5.7 below shows the GARCH (1 1) results for both the nominal effective and rand/dollar exchange rate in the context of South Africa.

Table 5. 7: Oil price variability, ZAR/USD and NEER

Variable	ZAR/USD	NEER
Oil price volatility	0.100164***(0.004680)	-0.229124**(0.103193)
Interest rate Differential	-0.047888 (0.045182)	-2.12608**(0.946737)
Index of Industrial Production	0.010938*** (0.045182)	-0.0748 (0.063415)
Money Supply	-0.005900* (0.003413)	-0.04838 (0.054977)
S.A. inflation rate	-0.000186 (0.004873)	0.369294**(0.147705)
Sovereign credit ratings	-0.076252*** (0.004873)	0.413326*(0.442707)
ZAR/USD (-1)	0.983021*** (0.012961)	
NEER(-1)		0.972801*** (0.011016)
	Variance Equation	
RESID(-1)^2	0.248207***(0.056467)	0.069718**(0.030647)
GARCH(-1)	0.657805***(0.067434)	0.903338***(0.038308)
Oil Price Volatility	0.081323***(0.000571)	-0.18052*(0.093285)

*** Statistically significant at 1% ** statistically significant at 5% *statistically significant at 10%. The figures in parenthesis represent standard errors.

5.6.1 INTERPRETATION OF THE RESULTS

The results of GARCH (1.1) are presented in table 5.7 above. The results show that oil price variability affects both the level and volatility of the exchange rate. As expected, an evaluation of the ZAR/USD exchange rate shows that oil price variability is positive and statistically significant in explaining the level of the exchange rate in South Africa. This implies that a unit increase in the variability of oil prices culminates into a 10% increase in the ZAR/USD. This means that, increase in the volatility of oil prices will, on average, lead to 10% depreciation of the rand relative to the dollar. Furthermore, the results show that a unit increase in oil price variability leads to 23% depreciation of the NEER. These findings corroborate with the results by Amano & Norden, (1998b); Aziz, (2009); Sibanda & Mlambo (2014); Mendez-Carbajo, (2009); Prasad Bal & Narayan Rath (2015); Zhang et al., (2008) who also found that oil prices are important in explaining variation in exchange rates. Nevertheless, the results are contrary to the findings by Zrada (2010); De Schryder & Peersman (2015); Fratzscher et al., (2014) who argue that oil prices are not fundamental in explaining variation in the exchange rate but exchange rate explain variations in oil prices.

In addition, the results show that index of industrial production is significant in explaining variations in the ZAR/USD exchange rate. The findings show that a unit change in the index of industrial production lead to 0.010938 changes in the value of the exchange rate. For instance, a unit increase

in the index of industrial production leads to at least 1% increase in the ZAR/USD exchange rate. This implies that increase in the index of industrial production leads to a depreciation of the rand against the dollar. According to theory, the increase in output is expected to lead to an appreciation of the domestic currency. However, these findings are contrary to the general belief that an increase in output results to an appreciation of the currency. This may be due to the fact that, in the short-run, increasing output in the South African manufacturing industry is heavily dependent upon the imported inputs resulting in an increase in demand for imports. This leads to an increase in demand for foreign currency (for instance the dollar) at the expense of the domestic currency.

The influence of M3 on the nominal exchange rate is theoretically ambiguous and can either be positive and negative. Shair et al., (2015) mentions that money supply causes the exchange rate to either overshoot or undershoot. The impact can be positive in a case where an increase in M3, for instance, results in a decrease in interest rate and increased capital outflows thereby depreciating the domestic currency. Conversely, it can be negative in a case where an increase in money supply, raise output in the short-run, then the fall in the interest rate that is produced by an increase in M3, will be reduced by an outward shift in the demand for money (since an increase in real output increase the demand for money). The results show that increase in M3 will decrease the exchange rate by about 0.005, and resulting in an appreciation of the rand relative to the dollar and the opposite is true. These results are supported by Levin (1997) and Shair et al., (2015). On the other hand, inflation and interest rate differential are insignificant in explaining changes in ZAR/USD but are significantly affect the nominal effective exchange rate of the rand.

Interestingly, changes in the sovereign credit rating have greater impact on the exchange rate than money supply, index of industrial production and inflation. The empirical results show that sovereign credit ratings significantly affect both the ZAR/USD and the nominal effective exchange rate. The results show that a one notch upgrade of the South African sovereign credit rating leads to an appreciation of the rand relative to the dollar by about 8%, and the opposite is true when their a credit rating downgrade. Furthermore, a notch upgrade of the sovereign credit quality leads to about 41% appreciation of the nominal effective exchange rate of the rand. On the other hand, a one notch downgrade results to a depreciation of the nominal effective exchange rate by 41% on average.

Furthermore, the empirical findings show that the previous values of ZAR/USD and NEER play a fundamental role in explaining the changes in the present values of ZAR/USD and NEER. For instance, about 98% variations in the ZAR/USD are explained by the previous values of the rand relative to the dollar exchange rate. On the other hand, about 97% of the changes in the nominal effective exchange rate are explained by previous values of the NEER.

Moreover, the coefficients on both the lagged squared residual and lagged variance terms in the variance equation are statistically significant. Most importantly, the sum of the coefficients on the

lagged squared error and lagged conditional variance are all close to 1 (approximately 0.90 for ZAR/USD and 0.96 for the NEER). The implication of these values is that "shocks to the conditional variance will be highly persistent" (Brooks, 2008).

5.7 Diagnostics checks

It is important to conduct diagnostic checks because they validate the parameter evaluation achieved by the estimated model. Gujarati (2004) postulates that these checks ought to be conducted so that "the model finally chosen is a good model in the sense that all the estimated coefficients have the right signs and are statistically significant on the basis of the t and F tests. In this study, we employ the correlogram of squared residual and the heteroscedasticity test as the diagnostic tests.

Table 5. 8: Diagnostics

	Coefficient		Probability
$\boldsymbol{Q(5)^a}$	8.33		0.14
$\boldsymbol{ARCH(1)^b}$	F-statistic	1.497532	0.2222
	Obs*R-squared	1.500548	0.2206
$\boldsymbol{ARCH(1-3)^c}$	F-statistic	1.093099	0.3527
	Obs*R-squared	3.288853	0.3492
$\boldsymbol{ARCH(1-5)^d}$	F-statistic	1.635861	0.1512
	Obs*R-squared	8.107483	0.1504

[a] Measures autocorrelation in the squared residuals with 5 lags[b-d] Measure heteroscedasticity with lag 1-5 using the ARCH-LM test of heteroscedasticity

In order to check for the absence of correlation in the residuals after the application of the GARCH (1.1) technique, correlogram of squared residuals was conducted. Table 5.8 shows the results from the correlogram of squared residuals. The table shows that the Q-stats are all significant at all lags and as a result, the null hypothesis of no serial correlation is not rejected. In addition, the p-values are all greater than 0.05, an indication that there is no serial correlation in the residuals and this indicates that the equation was specified correctly (Mlambo, 2013).

Table 5. 9: ARCH test

Heteroscedasticity Test: ARCH			
F-statistic	1.497530	Prob. F(1,248)	0.2222
Obs*R-squared	1.500545	Prob. Chi-Square(1)	0.2206

Table 5.9 above presents the results of the ARCH test. Both the F and the LM statistics are insignificant suggesting the absence of ARCH. The p-values for the F-stat and the LM stat are higher than 10% and this implies that there is no more heteroscedasticity in the residuals. This provides strong evidence that the GARCH (1.1) can eliminate the problem of heteroscedasticity.

5.8 Conclusion

The chapter presented the results from econometrics analysis as outlined in the previous chapter. Stationarity tests were conducted in order to avoid spurious regressions using both the informal and formal tests of a unit root. After stationary tests, the GARCH (1. 1) technique was estimated. The empirical results show that oil price variability affects both the level and volatility of the exchange rates. Furthermore, the presented results also show that index of industrial production and money supply are statistically significant in explaining variations in the rand/dollar exchange rate. Interestingly, the findings show that changes in the sovereign grade affect the exchange rate in South Africa. The following chapter will articulate policy recommendation necessary for the stability of the South African domestic currency basing on the empirical results presented in this chapter thereby achieving the third objective stated in the opening chapter.

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATIONS

6.1 INTRODUCTION

The first chapter of this study highlighted that the core aim motivating this study has been to investigate the impact of oil price variability on the exchange rate in the context of South Africa by employing monthly data spanning from January 1994 to December 2014. In achieving the central objective, many assessments were conducted. The study provided an overview of the rand relative to the dollar as well as the NEER in chapter 2. It was observed that the exchange rate in South Africa is volatile. Furthermore, chapter 2 has also indicated that variability in oil price is a common experience in the market for oil with factors such as demand and supply factors being singled out as the most fundamental variables in explaining the fluctuations in the prices of oil.

Chapter 3 has reviewed different theories of exchange rate determination which include the PPP, monetary approach, portfolio balance model amongst others. The reviewed theories postulate that factors such as price levels, money supply and interest rates play a fundamental role in explaining the behaviour of exchange rates. However, these theories are not in consensus regarding the relationship between exchange rate and commodity prices. As highlighted in chapter three, some theories postulate that prices determine exchange rate whilst others assume that exchange rate influences price movements. Furthermore, an empirical literature review was conducted and an assessment of literature showed that there are mixed opinions with regard to the relationship between exchange rates and oil price volatility. Some of the empirical studies show that oil prices have a greater influence on exchange rates (Dauvin, 2014; Huang& Guo, 2007; Korhonen & Juurikkala, 2007; Salah et al., 2015; Volkov & Yuhn, 2015). Conversely, other studies (Coudert, 2011; De Schryder & Peersman, 2015; Rickne, 2009; Tiwari et al., 2013) reveal that there is a negative relationship between oil prices and exchange rates. Interestingly, some studies show that there exists no relationship between oil prices movements and exchange rates.

Thus, an extensive literature review and the availability of data have played a fundamental role in the selection of the variables to include in the model. This study has included variables such as oil price variability, money supply, inflation rate, interest rate differentials, index of industrial production and sovereign credit ratings. As mentioned earlier, the selection of the variables was dictated by literature

and the availability of data. Moreover, monthly data for some major determinants of exchange rate, for example GDP, GDP per capita are not available thus these variables were not included in the study.

Descriptive statistics were employed in chapter five in order to examine the statistical properties of the main variables. ZAR/USD, NEER, Brentvol, SCR, M3, Dint and IIP are platykurtic. Only SACPI has a kurtosis value of greater than 3 and thus it is said to be leptokurtic.

The central objective of investigating the impact of oil price variability on the exchange rate in South Africa was achieved the previous chapter. Furthermore, chapter 5 has achieved the main objective mentioned in chapter 1. The achieved specific objective is given below;

To econometrically investigate the impact of oil price variability on both the bilateral rand/dollar exchange rate and on the nominal effective exchange rate of the rand.

The above objective was achieved through the estimation of GARCH (1.1) model. Prior to the employment of the estimation technique, unit root tests were carried out using the ADF and Phillip Peron tests and all the time series were found to be stationary after first differencing. In addition, the ARCH-LM test was conducted in order to test for the presence of the ARCH effect.

The GARCH(1.1) results presented in chapter five show that oil prices variability is statistically significant in explaining both the level and the variance of the exchange rate. Furthermore, variations in oil prices were found to be positive and significant in explaining movements in the rand/dollar exchange rate. On the other hand, the findings show that oil price variability is negatively related to the nominal effective exchange rate of the rand. These results corroborate with other studies (Aziz, 2009; Chen & Rogoff, 2002; Lizardo & Mollick, 2010; Prasad Bal & Narayan Rath, 2015) which show that oil price variations are positively related to the exchange rate. Nevertheless, other findings (De Schryder & Peersman, 2015; Fratzscher et al., 2014; Novotný, 2012) show that oil price volatility are negatively related to the exchange rate. However, the presented results contradict the finding by Zrada (2010) by arguing that there is a relationship between oil price variability and exchange rate in South Africa.

Another important finding of this study is that sovereign credit is negatively related to the nominal rand/dollar exchange rate and positively related to the nominal effective exchange rate of the rand. This implies that a sovereign rating upgrade could lead to an appreciation of both the rand relative to the dollar and the appreciation of the nominal effective exchange rate. Furthermore, the study also shows that the index of industrial production is positively related to the rand/dollar exchange rate and is insignificant in explaining the fluctuations in the nominal effective exchange rate. The index of industrial production sign was expected to be negatively related to the rand/dollar exchange rate and

positively related to the nominal effectively exchange rate. The relationship exhibited by the index of industrial production may imply that most South African industries are heavily dependent on the imported raw materials and this may lead to the increase in the supply of the rand on the foreign currency market. Lastly, money supply was found to be negatively related to the nominal rand/dollar exchange rate. Moreover, the results show that increase in money supply leads to the appreciation of the rand relative to the dollar.

The diagnostic checks on the model revealed a stable and robust model. The correlogram of squared residuals shows that there was no serial correlation in the residuals. On the other hand, the heteroscedasticity test shows that the problems of the ARCH were eliminated by the GARCH (1.1) model.

6.2 CONCLUSION, POLICY RECOMMENDATIONS AND AREAS OF FURTHER STUDY

The findings from this study have a number of policy implications and recommendations necessary for the stability of the South African currency. The existence of a positive and statically significant relation between oil prices and exchange rate implies that increases in oil price variability lead to a wealth transfer from South Africa to net oil exporting countries. In order to control wealth transfer and the depreciation of the South African currency, authorities ought to implement measures that are aimed at reducing the country's dependency on oil. Perhaps, the South African energy sector should consider looking for alternative sources of oil such as the use of solar and wind energy which may play a significant role in reducing the nation's dependency on oil imports.

The value of the South African currency can also be strengthened through expansionary monetary policy measures. Coupled with high expectations, contractionary monetary policy stance can lead to the increase in the demand for domestic assets, domestic output and exports thereby leading to the appreciation of the rand against the dollar. On the other hand, measures to control inflation should also be implemented in order to protect the value of the Rand.

As highlighted in the previous chapter, the positive relationship between the index of industrial production and the rand/dollar exchange rate implies that a unit increase in the index leads to a depreciation of the Rand relative to the dollar and the opposite is true. On the other hand, the negative relationship between the index of industrial production and the nominal effective exchange rate confirm that the index leads to the fall in the value of the rand. This relationship means that the industries in South Africa might be heavily dependent on imported inputs in their production processes. Thus, policies aimed at promoting the use of domestic inputs should be implemented. In addition, measures that enhance the importation of production technology instead of importing

production inputs should be emphasised in South Africa so as to improve the value of the South African rand.

Furthermore, authorities should put in place measures that improve the quality of the sovereign credit rating. Policies that are aimed at boosting economic growth, capital inflows, reducing the government deficit, political stability and the current account deficit are all important in order to improve the sovereign rating and thus strengthen the value of the rand.

6.3 Possible areas for further study

The study has investigated the relationship between oil prices variability and exchange rate using monthly data. However, the findings of this study can be improved by employing high frequency data such as weekly data or daily data. Furthermore, disentangling different oil price shocks (supply side shock, demand side shock and the precautionary demand) is also crucial to understand which of these shocks has a significant impact the South African exchange rate.

REFERENCE LIST

Adeniyi, O. (2012). Oil Price-Exchange Rate Nexus in Nigeria : Further Evidence from an Oil Exporting Economy. *International Journal of Humanities and Social Science*, *2*(8), 113–121.

Abeysinghe, T. (2001). Estimation of direct and indirect impact of oil price on growth. *Economics Letters*, *73*(2), 147–153

Adler, M., & Bruce, L. (1983). Deviations from purchasing power parity. *Journal of Finance*, *38*(5), 1471–87.

Aflatooni, A. (2009). Oil Prices and Exchange Rates: The Case of OPEC.

African Development Bank. (2007). The Impact of High Oil Prices on African Economies African Development Bank Economic Research Working Paper. *Economic Research Working Paper Series The*, *93*(93).

Aima, K., & Zaheer, A. (2015). Portfolio balance approach: an empirical testing. *Journal of Economics and International Finance*, *7*(6), 137–143. https://doi.org/10.5897/JEIF2014.0579

Akram, F. (2004). Oil prices and exchange rates: Norwegian evidence. *The Econometrics Journal*.

Ali, H.S., Mukhtar, U, Tijani, B, A., Auwal, A, M. (2015). Dynamic relationship of exchange rate and crude oil prices in South Africa: Are there asymmetries, *University of Putra Malaysia*

Al-Mulali, U., & Sab, C. N. B. C. (2012). Oil prices and the real exchange rate in oil exporting countries. *International Journal of Economics and Finance*, *4*(6), 198–205. https://doi.org/10.5539/ijef.v4n6p198

Aloui, R., Ben Aïssa, M. S., & Nguyen, D. K. (2013). Conditional dependence structure between oil prices and exchange rates: A copula-GARCH approach. *Journal of International Money and Finance*, *32*(1), 719–738. https://doi.org/10.1016/j.jimonfin.2012.06.006

Amano, R. A., & Norden, S. van. (1998a). *Exchange rates and oil prices*. *Review of International Economics* (Vol. 6). https://doi.org/10.1111/1467-9396.00136

Amano, R. A., & Norden, S. van. (1998b). Oil prices and the rise and fall of the US real exchange rate. *Journal of International Money and Finance*, *17*(2), 299–316. https://doi.org/10.1016/S0261-5606(98)00004-7

Aron, J., Elbadawi, I., & Kahn, B. (1997). Determinants of the Real Exchange Rate in South Africa and Brian Kahn. *Social Research*.

Asteriou, D., & Hall, S. G. (2007). *Applied Econometrics: A Modern Approach* (Revised Ed). England: Palgrave Macmillan.

Aziz, M. I. A. (2009). Oil Price and Exchange Rate: A Comparative Study between Net Oil Exporting and Net Oil Importing Countries. *ESDS International Annual Conference 30th November, Institute of Materials, London*.

Baek, J., Mulik, K., & Koo, W. W. (2006). The J-Curve Phenomenon: Myth or Reality? *American Agricultural Economics Association Annual Meeting*.

Bahmani-Oskooee, M., & Kantipong, T. (2001). Bilateral J-Curve between Thailand and her trading partners. *Journal of Economic Development*, *26*(2), 107–117. https://doi.org/10.1007/BF02708163

Balnaves, M., & Caputi, P. (2001). *Introduction to Quantitative Research Methods: An Investigative Approach*. London: SAGE.

Bartolini, Bayoumi, Clark, & Symanski. (1994). Exchange rates and Economic fundamentals: A framework foor analysis. *IMF Staff Papers*, (115).

Bayat, T., Nazlioglu, S., & Kayhan, S. (2015). Exchange rate and oil price interactions in transition economies: Czech republic, Hungary and Poland. *Panoeconomicus*, *62*(3), 267–285. https://doi.org/10.2298/PAN1503267B

Beggs, M. (2015). *Inflation and the Making of Australian Macroeconomic Policy, 1945–85*. University of Sydney: Palgrave Macmillan.

Bénassy-Quéré, A., Mignon, V., & Penot, A. (2007). China and the relationship between the oil price and the dollar. *Energy Policy*, *35*(11), 5795–5805. https://doi.org/10.1016/j.enpol.2007.05.035

Benhabib, A., Kamel, S. M., & Maliki, S. (2014). The relationship between oil price and the Algerian exchange rate. *Topics in Middle Eastern and African Economies*, *16*(1), 127–141.

Berg, Hendrik, van den. (2016). *International Finance and Open-Economy Macroeconomics: Theory, History, and Policy* (2nd ed.). United States of America: World Scientic Publishing.

Bilson, J. F., & Marston, R. (2007). *Exchange Rate Theory and Practice*. Chicago: University of Chicago Press.

Bodnar, G. ., Dumas, B., & Marston, R. . (1997). *Pass-through and Exposure*. Paris: Chamber de Commerce et d'Industrie.

Bollerslev, T., & Wooldgrige, J. . (1992). Quasi maximum likelihood estimation and inference in dynamic models with time varying co-variances. *Econometric Review*, *11*.

Bopo, M. (2015a). Volatility transmission between the oil price , the exchange rate and the stock market index. *Universite Laval*.

Bopo, M. (2015b). Volatility transmission between the oil price , the exchange rate and the stock market index.

Bouchentouf, A. (2015). *Investing in Commodities For Dummies*. Wiley.

Brooks, C. (2008). *Introductory Econometrics for Finance*. U.K: Cambridge University Press.

Butgereit, F. (2010). *Exchange Rate Determination Puzzle: Long Run Behavior and Short Run Dynamics*. Hamburg: Diplomica Verlag.

Carollo, S. (2011). *Understanding Oil Prices: A Guide to What Drives the Price of Oil in Today's Markets*. United Kingdom: Wiley.

Cashin, P., Céspedes, L., & Sahay, R. (2003). Commodity currencies. *Finance and Development*, *40*(1), 45–48. https://doi.org/10.1016/S0022-1996(02)00072-7

Castells, M. (1992). “Four Asian Tigers with a Dragon Head: A Comparative Analysis of the State, Economy and Society in the Asian Pacific Rim.” *States and Development in the Asian Pacific Rim*.

Chaban, M. (2009). Commodity currencies and equity flows. *Journal of International Money and Finance*, *28*(5), 836–852. https://doi.org/10.1016/j.jimonfin.2008.08.004 Chamberlin, G., & Yueh, L. (2006). *Macroeconomics*. London: Thomson.

Chen, S., Jackson, J. D., Kim, H., & Resiandini, P. (n.d.). What Drives Commodity Prices?

Retrieved from http://media.cla.auburn.edu/economics/workingpapers/

Chen, S. S., & Chen, H. C. (2007). Oil prices and real exchange rates. *Energy Economics*, *29*(3), 390–404. https://doi.org/10.1016/j.eneco.2006.08.003 Chen, Y.,

& Rogoff, K. (2002). By, *60*(October), 133–160.

Cherunilam. (2008). *International Economics*. Tata McGraw-Hill Education.

Cheung, Y. W., Chinn, M. ., & Fuiji, E. (2007). The overvaluation of Renminbi undervaluation. *Journal of International Money and Finance*, *26*, 762–785.

Chuma, S. (2015). The Impact of Financial Development on Income Inequality in South Africa. *University of Fort Hare*.

Clements, K. W., & Fry, R. (2008). Commodity currencies and currency commodities. *Resources Policy*, *33*(2), 55–73. https://doi.org/10.1016/j.resourpol.2007.10.004

Coleman, S., Cuestas, J. C., Mourelle, E., & Street, M. (2011). Investigating the oil price exchange rate nexus : Evidence from Africa. *Sheffield Economic Research Paper Series*.

Coudert, V. (2011). Does Euro or Dollar Pegging Impact the Real Exchange Rate ? The Case of Oil and Commodity. https://doi.org/10.1111/j.1467-9701.2011.01400.x

Coudert, V., Mignon, V. erie, & Penot, A. (2008a). Oil Price and the Dollar To cite this version : Oil Price and the Dollar ⁎. *Energy Studies Review*, *15*(2).

Coudert, V., Mignon, V., & Penot, A. (2008b). Oil Prices and the Dollar. *Energy Studies Review*, *15*(2).

Cuaresma, J. C., & Breitenfellner, A. (2008). Crude Oil Prices and the Euro-Dollar Exchange Rate : A Forecasting Exercise. *Working Papers in Economics and Statistics*, 1–29.

Cushman, D. . (2007). A portfolio balance approach to the Canadian–US exchange rate. *Review of Financial Economics*, *16*(3), 305–320.

D’Souza, E. (2009). *Macroeconomics*. India: Pearson Education.

Dauvin, M. (2014). Energy prices and the real exchange rate of commodity-exporting countries. *International Economics*. https://doi.org/10.1016/j.inteco.2013.11.001

Dawson, J. C. (2003). The Effect of Oil Prices on Exchange Rates : A Case Study of the Dominican Republic. *The Park Place Economist*, *XIV*, 23–30.

de Jong, E. (2013). *Exchange Rate Determination and Optimal Economic Policy Under Various Exchange Rate Regimes*. Springer.

De Schryder, S., & Peersman, G. (2015). The U.S. dollar exchange rate and the demand for oil. *Energy Journal*, *36*(3), 263–285. https://doi.org/10.5547/01956574.36.3.ssch

Dibooğlu, S. (1996). Real disturbances, relative prices and purchasing power parity. *Journal of Macroeconomics*. https://doi.org/10.1016/S0164-0704(96)80004-8

Dimitriou, D., & Simos, T. (2013). Testing purchasing power parity for Japan and the US: A structural-break approach. *Japan and the World Economy*, *28*, 53–59. https://doi.org/10.1016/j.japwor.2013.07.001

Ding, L., & Vo, M. (2012). Exchange rates and oil prices: A multivariate stochastic volatility analysis. *The Quarterly Review of Economics and Finance*, (52), 15–37.

Dornbusch, R. (1991). *Exchange rates and inflation*. MIT Press.

Drine, I., & Rault, C. (2008). Purchasing Power Parity for developing and developed countries. What can we learn from non-stationary panel data models? *HAL ArchivesOuvertes*.

Ebaidalla, E. M. (2014). The Effects of Oil Price Volatility on the Sudanese Economy. *Eastern Africa Social Science Research Review*, *30*(1), 1–26. https://doi.org/10.1353/eas.2014.0000

EIA (2010) Market Prices and Uncertainty Report, *EIA Publication, August, 2010.*

EIA (2012) World Crude Oil Prices, *available at, www.eia.gov/dnav/pet/pet_pri_wco_k_w.htm*

Engel, C. N. M., & West, K. . (2005). "Exchange rates and fundamentals",. *Journal of Political Economy*, 485–517.

IEA (2009) Medium-Term Oil Market Report available at, *www.iea.org/publications/freepublications/publication /mtomr2009.pdf*

Englama, A., Duke, O. O., Ogunleye, T. S., & Volatility, E. R. (2010). Oil Prices and Exchange Rate Volatility in Nigeria: An Empirical Investigation. *Economic and Financial Review*, *48*(3), 31–48.

Eslamloueyan, K. (2015). Woodbury School of Business Working Paper 4-11 Determinants of the Real Exchange Rate in Oil- Producing Countries of MENA : A Panel Data Investigation. *Emerging Markets Finance and Trade*, *51*(4).

Evans, M. D. (2011). *Exchange rate dynamics*. New Jersey: Princetown University Press.

Farzanegan, M. R., & Markwardt, G. (2007). The Effects of Oil Price Shocks on the Iranian Economy.

Ferraro, D., Rogo, K., & Rossi, B. (2015). Can Oil Prices Forecast Exchange Rates ? Motivation Can Oil Prices Forecast Exchange Rate Movements ?, (January), 1–65.

Flath, D. (2014). *The Japanese Economy*. Oxford: OUP Oxford.

Frankel, J. (2007). On the rand: Determinants of the South African exchange rate. *South African Journal of Economics*, *75*(3), 425–441. https://doi.org/10.1111/j.18136982.2007.00130.x

Fratzscher, M., Schneider, D., & Robays, I. Van. (2014). *Oil Prices , Exchange Rates and Asset Prices*. *ECB Working Paper Series*.

Freedman, L., & Karsh, E. (1993). *The Gulf Conflict, 1990-1991: Diplomacy and War in the New World Order*. Princetown University Press.

Frenkel, M., Hommel, U., & Rudolf, M. (2013). *Risk Management: Challenge and Opportunity*. Springer.

Gande, A., & Parsley, D. . (2005). News spillovers in the sovereign debt market. *Journal of Financial Economics*, 691–734.

Ghalayini, L. (2011). The Interaction between Oil Price and Economic Growth. *Middle East Finance and Economics*, (13).

Goel, S., & Sharma, R. (2015). THE INTERNATIONAL JOURNAL OF BUSINESS & MANAGEMENT Dynamics of Exchange Rate and Crude Oil Price- Evidence from India Abstract : *THE INTERNATIONAL JOURNAL OF BUSINESS & MANAGEMENT*, *3*(1), 95–99.

Grandes, M., Peter, M., & Pinaud, N. (2003). The Currency premium and local-currency denominated debt costs in South Africa. *Working Paper*.

Hallwood, P. C., & MacDonald, R. (2000). *International money and finance* (3rd ed.). Oxford: Blackwell.

Hamilton, J. D. (2011). Historical Oil Shocks. *National Bureau of Economic Research*, *53*(9), 1689–1699. https://doi.org/10.1017/CBO9781107415324.004

Harri, A., Nalley, L., & Hudson, D. (2009). The Relationship between Oil, Exchange Rates, and Commodity Prices. *Journal of Agricultural and Applied Economics*, *41*(2), 501– 510.

Hasanov, F. (2010). Discussion Papers 1041. *Deutsches Institut Für Wirtschaftsforschung*, (August).

Henderson, C. (2006). *Currency Strategy: The Practitioner's Guide to Currency Investing, Hedging and Forecasting* (2nd ed.). England: Wiley Finance.

Herbot. (2008). Speculation but not manipulation. *Spiegel Online news*

Hiri, A. (2014). The Real Effective Exchange Rate Misalignment: Application of Behavioral Equilibrium Exchange Rate BEER to Algeria 1980-2009. *International Journal of Economics, Finance and Management Sciences*, *2*(5), 277. https://doi.org/10.11648/j.ijefm.20140205.12

Hodge, D. (2012). The exchange rate, Dutch Disease and Manufacturing in South Africa: What do the Data say? *ERSA Working Paper*, (281).

Hou, Z., Keane, J., Kennan, J., & Willem, D. (2015). Drivers , impacts and policy implications, (March). HUANG, Y., & GUO, F. (2007). The role of oil price shocks on China's real exchange rate.

China Economic Review, *18*(4), 403–416. https://doi.org/10.1016/j.chieco.2006.02.003

Ito, K. (2010). The Impact of Oil Price Volatility on Macroeconomic Activity in Russia. *Atlantic Review of Economics (2011-2013)*, *9*(5), 1–21. https://doi.org/10.1007/s00168010-0417-1

Ito, T., & Krueger, A. O. (2007). *Changes in Exchange Rates in Rapidly Developing Countries: Theory, Practice, and Policy Issues*. Chicago: University of Chicago Press.

Iwayemi, A., & Fowowe, B. (2011). Impact of oil price shocks on selected macroeconomic variables in Nigeria. *Energy Policy*, *39*(2), 603–612. https://doi.org/10.1016/j.enpol.2010.10.033

Jayaraman, T. K., & Choong, C. (2014). Purchasing Power Parity Theory and Its Validity in Pacific Island Countries Purchasing Power Parity Theory and Its Validity in. *Bank of Valleta Review*, (48), 41–52.

Kendall, J. ., Donghyun, P., & Tan, R. (1997). *East Asian Economic issues* (3rd ed.). World Scientic Publishing.

Kenen, P. B. (1994). *Exchange Rates and the Monetary System: Selected Essays of Peter B. Kenen*. E. Elgar.

Kennedy, J. M. M. (2014). *International Economics*. PHI Learning Pvt Ltd.

Kilian, L.(2009). 'Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market', *American Economic Review,* 99: 1053-1069.

Khadduri, M., & Ghareeb, E. (1997). *WAR IN TH GULF, 1990-91 The Iraq-Kuwait Conflict and Its Implications*. https://doi.org/10.1017/CBO9781107415324.004

Khalifa, A., Hammoudeh, S., & Otranto, E. (2012). "Volatility Spillover, Interdependance, Comovements across the GCC, oil and US Markets and Portfolio Management Strategies in a RegimeChanging Environment." *Working Paper*.

Kiani, A. (1996). Impact of High Oil Prices on Pakistan ' s Economic Growth, *2*(17), 209–217.

Kilian, L., & Murphy, D.P. (2014), The role of inventories and speculative trading in the global market for crude oil. Journal of Applied econometrics., 29, 454-478

Kim, Y. (1990). Purchasing power parity in the long run: A cointegration approach. *Journal of Money, Credit and Banking*, *22*(4), 39–44.

Sibanda, K., & Mlambo, C.(2014). The Impact of Oil Prices on the Exchange Rate in South Africa, *5*(2), 193–199.

Korhonen, I., & Juurikkala, T. (2007). Equilibrium exchange rates in oil-dependent countries Bank of Finland, BOFIT Institute for Economies in Transition.

Kurzman, C. (2009). *The Unthinkable Revolution in Iran*. London: Harvard University Press.

Levin, J. H. (1997). Money Supply Growth and Exchange Rate D y n a m i c s, *12*(September).

Lewis, C. D. . (2004). *Operational Risk with Excel and VBA: Applied Statistical Methods for Risk Management*. New Jersey: John Wiley and Sons.

Lipsky, J. (2008). Commodity Prices and Global Inflation.

Lizardo, R. A., & Mollick, A. V. (2010). Oil price fluctuations and U.S. dollar exchange rates. *Energy Economics*, *32*(2), 399–408. https://doi.org/10.1016/j.eneco.2009.10.005

Macdonald, R., & Ricci, L. (n.d.). Ronald MacDonald and Luca Ricci Strathclyde University and IMF, *2002*(November 2002).

Machiraju, H. R. (2007). *International Financial Markets And India*. New Age International.

Magud, N. E., Reinhart, C., Rogoff, K., & Magud, E. (2007). FEDERAL RESERVE BANK OF SAN FRANCISCO Capital Controls : Myth and Reality A Portfolio Balance Approach to Capital Controls Capital Controls : Myth and Reality A Portfolio Balance Approach to Capital Controls. *Control*.

Masters, W. (2008). *Testimony before the committee of Homeland Security and Government affairs*. Washington: United States Senate.

Mendez-Carbajo. (2009). Energy dependence, oil prices and exchange rates: The Dominican economy since 1990. *Empircal Economics*, *40*(2), 509–520.

Min, P., & Yanbin, S. (2009). Exchange Rate Change to International Oil Prices, 1–4.

Mkenda, B. . (2001). Long-run and Short-run Determinants of real exchange rate in Zambia. *Working Paper Series in Economics*.

Mlambo, C. (2013). Effects of Exchange Rate Volatility on the Stock Market : a Case Study of South Africa ., (January).

Montiel, P. J. (2009). *International Macroeconomics*. John Wiley and Sons.

Motsumi, L., Oldfield, M., Mokoetla, A., Swart, P., & De Beer, B. C. (2008). Note on the revision of South Africa's nominal and real effective exchange rate. *SARB Quaterly Bulletin*, (December), 61–65.

Muhammad, Z., Suleiman, H., & Kouhy, R. (2011). Exploring oil price — exchange rate nexus for Nigeria. *Dundee Business School,University of Abertay Dundee, Scotland*., 383–395.

Murphy, D. J., & Hall, C. A. S. (2011). Energy return on investment, peak oil, and the end of economic growth. *Annals of the New York Academy of Sciences*, *1219*(1), 52–72. https://doi.org/10.1111/j.1749-6632.2010.05940.x

Nagayasu, J. (2002). "Does the Long-Run PPP Hypothesis Hold for Africa?" Evidence from Panel Co-Integration Study. *Bulletin of Economic Research, 54*, 181–187.

Newman, I., & Benz, C. . (1998). *Qualitative-quantitative Research Methodology: Exploring the Interactive Continuum*. United States of America: SIU Press.

Nikbakht, L. (2009). Oil Prices and Exchange Rates : the Case of. *Intelligence*, 83–92.

Novotný, F. (2012). The Link Between the Brent Crude Oil Price and the US Dollar Exchange Rate. *Prague Economic Papers*, *21*(2), 220–232. https://doi.org/10.18267/j.pep.420

Ntswane, L. (2014). The Impact of Sovereign Credit Ratings on Capital Flows and Financial Markets in Africa, (PhD Thesis), University of Witswatersrand.

Nurmakhanova, M., & Kretzschmar, G. (2010). Kazakhstan - The Real Currency and Growth Challenge for Commodity Producing Countries, *6*(1), 1–20. Retrieved from http://www.wbiconpro.com/219-Mira.pdf

Olomola, P. A., & Adejumo, A. (2006). Oil Price Shock and Aggregate Economic Activity in Nigeria. *International Research Journal of Finance and Economics*, *4*(3), 48–61.

OPEC Annual Report (2002): Available at the OPEC website

OPEC (2011b) Monthly Oil Market Report for December 2011 available

at,206www.opec.org/opec_web/static_.les_project/media/downloads/publications/MOMR_December_2011.pdf

OPEC (2012a) World Oil Outlook available at, www.opec.org/opec_web/static_.les_project/media/downloads/publications /WOO_2012.pdf

OPEC (2012b) Monthly Oil Market Report for December 2012 available at, www.opec.org/opec_web/static_.les_project/media/downloads/publications

/MOMR_December_2012.pdf

OPEC Annual Statistical Bulletin (2015): Available at the OPEC website

Oyetunji, B. (2013). Oil Price and Exchange Rate Volatility in Nigeria, 1–59. https://doi.org/10.1017/CBO9781107415324.004

Patel, J. (1990). Purchasing power parity as a long-run relation. *Journal of Applied Econometrics*, *5*(4), 367–379.

Prasad Bal, D., & Narayan Rath, B. (2015). Nonlinear causality between crude oil price and exchange rate: A comparative study of China and India. *Energy Economics*, *51*, 149–156. https://doi.org/10.1016/j.eneco.2015.06.013

Radaelli, G. (2002). *Exchange rate determination and control*. Routledge.

Razgallah, B., & Smimou, K. (2011). Oil Prices and the Greenback: It Takes Two to Tango. *Applied Financial Economics*, (519–528).

Rickne, J. (2009). Oil Prices and Real Exchange Rate Volatility in Oil-Exporting Economies : The Role of Governance Oil Prices and Real Exchange Rate Volatility in Oil-Exporting Economies : The Role of Governance, (810).

Rochon, L.-P., & Vernengo, M. (2001). *Credit, Interest Rates and the Open Economy: Essays on Horizontalism*. Kalamazoo: E. Elgar.

Rodseth, A. (2000). *Open Economy Macroeconomics*. Cambridge University Press.

Rosenfeld, E. (2011). Muharram Protest in Iran, 1978. Retrieved from http://content.time.com/time/specials/packages/article/0,28804,2080036_2080037_2080043,00.html

Ross, M. L. (2012). *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations*. United Kingdom: Princetown University Press.

Sadoveanu, D., & Ghiba, N. (2012). Purchasing Power Parity: Evidence from Four CEE Countries. *Journal of Academic Research in Economics*, *4*(1).

Safaa Salah, Y., Si, K., #2, M., & Benmessaoud, N. (2015). The black market exchange rate and Oil prices in Algeria. *SSRG International Journal of Economics and Management Studies*, *2*, 1–5. Retrieved from www.internationaljournalssrg.org

Salmon, F. (2016). The difference between S&P and Moody's. Retrieved from http://blogs.reuters.com/felix-salmon/2011/08/09/the-difference-between-sp-andmoodys/

Salvatore, D. (2011). *Introduction to International Economics* (third). Wiley.

Samson, M., Ampofo, S., Quene, K. Mac, & Niekerk, I. (2003). The fundamental determinants of the rand exchange rate: a historical and forward-looking analysis. *Economic Policy Research Institute Working Paper*, (36).

Saqib, S., Ahmad Raza Cheema, D., Faraz Riaz, M., Muhammd Yousaf, M., & Shehzadi, A.

(2014). Time Series Investigation of J-Curve of Pakistan with Saudi Arabia. *Journal of Finance and Economics*, *2*(6), 210–214. https://doi.org/10.12691/jfe-2-6-2

Schaling, E., & Kabundi, A. (2014). the Exchange Rate, the Trade Balance and the J-Curve Effect in South Africa. *Sajems*, *17*(5), 601–608.

Schmidbauer, H., & Angi, R. (2008). Volatility Spillovers Between Crude Oil Prices and Us Dollar To Euro Exchange Rates ∗, 1–10.

Selmi, R., Bouoiyour, J., & Ayachi, F. (2012). Another Look at the Interaction Between Oil Price Uncertainty and Exchange Rate Volatility: The Case of Small Open Economies. *Procedia Economics and Finance*, *1*(12), 346–355. https://doi.org/10.1016/S22125671(12)00040-8

Seyedmashhadi, P., Ghalambaz, F., & Esfandiary, A. (2011). THE IMPORTANCE OF OIL INDUSTRY IN THE OUTPUT AND EMPLOYMENT OF IRAN'S ECONOMY AND ITS INFLUENCE ON OTHER ECONOMICAL ACTIVITIES. *QUARTERLY JOURNAL OF ECONOMIC GROWTH AND DEVELOPMENT RESEARCH*, *5*(1).

Shair, G., Ali, A., & Siraj, W. (2015). Crude oil prices and Pakistani Rupee - US dollar Exchange Rate : An analysis of Preliminary Evidence. *European Journal of Business and Management Online)*, *7*(7), 2222–2839.

Simanzhenkov, V., & Idem, R. (2003). *Crude oil chemistry*. Germany: Marcel Dekker Inc.

Simatele, M. (2004). Financial Sector Reforms and Monetary policy in Zambia. *Economic Studies: Department of Economics, School of Economics and Commercial Law*.

Sohaili, K., Fattahi, S., & Moradi, F. (2015). The effect of oil revenues uncertainty and the real exchange rate uncertainty on investment in Iran. *Gazi Univertesi Gazi Egitim Fakultesi Dergisi*, 1300–1876. Retrieved from www.gugef.com

Taylor, a. M., & Taylor, M. P. (2004). The purchasing power parity debate. *The Journal of Economic Perspectives*, *18*(4), 135–158.

Thomas, M. R. (2003). *Blending Qualitative and Quantitative Research Methods in Theses and Dissertations*. Corwin Press.

Tiwari, A. K., Mutascu, M. I., & Albulescu, C. T. (2013). The influence of the international oil prices on the real effective exchange rate in Romania in a wavelet transform framework. *Energy Economics*, *40*, 714–733. https://doi.org/10.1016/j.eneco.2013.08.016

Ugur, M. (2002). *An Open Economy Macroeconomics Reader*. Psychology Press.

Van der Merwe, E. . (1996). *Exchange rate management policies in South Africa: recent experience and prospects*. South Africa Reserve Bank.

Virginie Coudert, C. C. & V. M. (2013). Working Paper Revisiting commodity currencies. *CEPII Working Papers*, *40*, 1–23.

Volkov, N., & Yuhn, K. . (2015). Oil Price Shocks and Exchange Rate Movements.

Welfens, P. ., & Ryan, C. (2011). *Financial market integration and growth: structural change and economic dynamics in the European union*. Germany: Springer Science & Business Media.

Wiley Study Guide for 2015 Level 1 CFA Exam: Complete Set. (2015). John Wiley and Sons.

Wyse, D., Hayward, L., & Pandya, J. (2015). *The SAGE Handbook of Curriculum, Pedagogy and Assessment*. SAGE.

Xuezheng, B., Russell, J. ., & Tiao, G. . (2001). Kurtosis of GARCH and Stochastic Volatility Models with Non-normal Innovations. Retrieved November 10, 2015, from http://faculty.chicagobooth.edu/jeffrey.russell/research/kurtosis.pdf

Yanagisawa, A. (2010). Relationship among crude oil prices , share prices and exchange rates, (November), 1–12.

Zhang, H. J., Dufour, J. M., & Galbraith, J. W. (2016). Exchange rates and commodity prices: Measuring causality at multiple horizons. *Journal of Empirical Finance*. https://doi.org/10.1016/j.jempfin.2015.10.005

Zhang, Y. J., Fan, Y., Tsai, H. T., & Wei, Y. M. (2008). Spillover effect of US dollar exchange rate on oil prices. *Journal of Policy Modeling*, *30*(6), 973–991. https://doi.org/10.1016/j.jpolmod.2008.02.002

Zrada, J. (2010). Oil prices and the US dollar exchange rate Correlation or Causality, 1–33.

APPENDICES

Appendix 1: Data

ZAR/USD

		NEER	BrntVol	SACPI	Dint	SCR	M3	iip
1994M1	3.4107	241.04	2.578701	9.96564	9	11	9.31	78
1994M2	3.452	235.31	4.309084	9.93151	8.75	11	11.35	77.3
1994M3	3.4586	232.37	3.786267	9.12162	8.5	11	12.62	79.7
1994M4	3.5789	226.88	0.456751	6.90789	8.25	11	12.84	77.1
1994M5	3.6346	221.16	0.188501	7.21311	7.75	11	15.7	75.1
1994M6	3.6318	214.64	0.835701	7.34095	7.75	11	14.75	79.3
1994M7	3.6705	213.73	3.255017	8.09061	7.75	11	16.53	80.3
1994M8	3.5968	217.7	0.988367	9.17874	7.25	11	15.05	79
1994M9	3.557	214.98	0.000584	10.1124	8.25	11	14.32	82.6
1994M10	3.542	215.63	0.365017	9.71338	8.25	11	14.78	82.9
1994M11	3.5256	218.54	2.173167	9.85692	7.5	11	14.65	84.1
1994M12	3.5614	218.32	0.002934	9.82567	7.5	11	15.71	85.5
1995M1	3.5404	215.78	0.255867	9.6875	7.5	11	12.79	84
1995M2	3.5629	209.77	0.007084	9.81308	8	11	10.79	85.7
1995M3	3.6013	203.99	0.001284	10.3715	8	11	11.91	85.5
1995M4	3.6035	199.83	2.836417	11.0769	8	11	14.73	85.9
1995M5	3.6574	197.83	1.598117	10.8563	8	11	15.55	87.3
1995M6	3.6627	199.65	0.086534	10.0304	9	11	17.08	86.4
1995M7	3.6404	203.99	1.430017	8.98204	9.25	11	16.15	88.2
1995M8	3.6402	210.17	0.971867	7.66962	9.25	11	15.09	88.4

1995M9	3.6616	206.97	0.156684	6.55977	9.25	11	16.06	87.8
1995M10	3.6502	207.37	0.875784	6.38607	9.25	11	14.17	88.2
1995M11	3.6476	208.68	0.030917	6.36758	9.25	11	13.75	86.5
1995M12	3.6632	209.33	0.817517	6.92641	9.5	11	15.16	86.8
1996M1	3.6413	214.42	6.316844	6.83761	9.75	11	17.07	87
1996M2	3.742	201.39	6.166944	6.52482	9.75	11	19.75	84.3
1996M3	3.9293	194.05	0.214678	6.17111	9.75	11	19.38	88.9
1996M4	4.213	179.71	0.309878	5.54017	10.75	11	17.26	90.4
1996M5	4.3729	180.82	1.698678	5.7931	10.75	11	16.09	90.4
1996M6	4.3519	181.58	4.766944	6.90608	10.75	11	18.91	91.3
1996M7	4.3963	173.11	0.711211	7.14286	10.75	11	18.69	90.2
1996M8	4.5289	172.59	0.243378	7.39726	10.75	11	19.73	92
1996M9	4.5039	174.63	2.581378	8.34473	10.75	11	18.89	90.3
1996M10	4.5799	165.51	10.41138	9.00409	10.75	11	20.89	91.3
1996M11	4.6577	170.47	3.336711	9.11565	11.75	11	18.88	90.9
1996M12	4.6873	168.99	9.404444	9.31174	11.75	11	17.53	86.5
1997M1	4.6402	180.11	18.95877	9.33333	11.75	11	18.75	91
1997M2	4.4557	186.86	2.938367	9.85353	11.75	11	16.66	92.5
1997M3	4.4319	188.92	0.008867	9.64333	11.5	11	17.05	89.7
1997M4	4.4417	190.44	2.708767	9.84252	11.5	11	16.58	98
1997M5	4.4668	186.41	0.000584	9.5176	11.5	11	16.55	92.4
1997M6	4.5005	185.23	2.451834	8.78553	11.5	11	13.94	92.3
1997M7	4.5611	186.8	0.470367	9.10256	11.5	11	14.69	93
1997M8	4.6856	183.05	0.181334	8.67347	11.5	11	14.9	92.1

1997M9	4.689	183.18	0.443334	8.08081	11.5	11	18.1	91.5
1997M10	4.7145	174.98	0.872667	7.63454	10.5	11	17.68	93.6
1997M11	4.8394	176.62	0.013417	6.85786	10.5	11	18.27	91.2
1997M12	4.8706	180.36	4.063584	6.17284	10.5	11	17.3	88.9
1998M1	4.9417	180.21	5.620851	5.73171	10.5	11	17.44	90.2
1998M2	4.9337	178.75	1.797834	5.33333	10.5	11	18.74	90.2
1998M3	4.9746	177.25	0.130201	5.42169	9.5	11	15.13	89.1
1998M4	5.0459	174.16	0.450017	5.01792	9.43	11	17.49	89.3
1998M5	5.0927	172.37	2.791684	5.11905	12.5	11	15.25	88.2
1998M6	5.391	151.31	0.434501	5.22565	14.71	11	16.97	89.9
1998M7	6.2285	145.77	0.461267	6.58049	15.85	10.9	15.57	88.8
1998M8	6.3198	137.12	0.704201	7.62911	16.35	10.9	15.6	86.8
1998M9	6.0966	145.87	0.410667	8.99533	16.6	10.9	12.86	89.5
1998M10	5.7991	147.48	0.025334	8.95349	15.72	11	10.84	87
1998M11	5.6511	150.59	3.237001	9.33489	14.98	11	12.56	87.1
1998M12	5.903	144.18	8.521534	8.95349	14.57	11	13.38	86.8
1999M1	5.9931	141.8	45.55125	8.8812	14.08	11	11.29	87.8
1999M2	6.1146	142	56.2375	8.63061	12.61	11	5.81	86.7
1999M3	6.2136	142.9	31.1271	7.88571	11.75	11	9.4	86.4
1999M4	6.1186	143.61	6.447367	7.6223	10.91	11	7.34	85.8
1999M5	6.1809	141.31	6.146267	7.02152	10.71	11	7.41	88.3
1999M6	6.088	146.54	4.406501	7.22348	9.91	11	8.24	85.3
1999M7	6.1182	140.34	1.021784	4.85116	8.65	11	8.05	87.5
1999M8	6.1302	142.63	6.105017	3.27154	8.19	11	6.33	88.4
1999M9	6.0563	142.07	19.45545	1.92926	7.15	11	8.87	88.8

1999M10	6.1029	140.17	19.54377	1.70758	6.94	11	9.8	88.8
1999M11	6.1424	141.79	46.93392	1.92102	6.5	11	10.13	90.2
1999M12	6.1503	142.3	60.54137	2.2412	6.5	11	10.45	90.1
2000M1	6.1309	140.93	9.532656	2.64831	6.25	11	9.85	91.2
2000M2	6.3209	141.71	0.459006	2.33051	6	11.25	13.07	91.1
2000M3	6.4675	136.64	0.701406	3.38983	5.75	11.25	9.11	92
2000M4	6.648	135.37	33.26406	4.54545	5.75	11.25	9.86	87.9
2000M5	7.0238	132.3	0.823556	5.07937	5.25	11.25	9.24	90.8
2000M6	6.9147	133	1.883756	5.15789	5.25	11.25	7.55	91.7
2000M7	6.8971	133.41	0.041006	5.99369	5.25	11.25	6.39	91.5
2000M8	6.957	135.44	2.504306	6.86378	5.25	11.25	8.46	91.5
2000M9	7.1805	130.54	18.59766	6.94006	5.25	11.25	8.01	91.8
2000M10	7.4902	128.94	6.877506	7.03043	5.5	11.25	7.43	92.3
2000M11	7.6889	125.35	17.74516	7.01571	5.5	11.25	5.79	92.9
2000M12	7.6439	123.61	9.165756	6.99374	5.5	11.25	7.26	94.4
2001M1	7.7786	120.65	1.508803	7.12074	5.9839	11.25	9.5	93.7
2001M2	7.8214	123.36	8.990003	7.76398	6.5	11.25	10	94
2001M3	7.898	122.08	0.000136	7.37705	6.6935	11.25	12.71	93.6
2001M4	8.0783	121.74	1.295803	6.47118	7.2167	11.25	12.31	93.2
2001M5	7.9789	123.64	16.30814	6.44512	7.7742	11.25	13.78	90.5
2001M6	8.0595	123.6	10.94507	6.30631	7.0333	11.25	14.45	92.6
2001M7	8.2094	118.78	0.016469	5.25794	7.25	11.25	18.07	93.2
2001M8	8.3115	113.38	1.583403	4.64427	7.3387	11.25	18.7	90.3

2001M9	8.6756	106.74	1.273136	4.42478	6.2333	11.25	15.07	91.7
2001M10	9.2804	101.93	15.458	4.01961	6.9839	11.1	15.61	95
2001M11	9.7388	94.13	29.93914	4.30528	7.4167	12	17	95
2001M12	11.6761	81.17	33.77547	4.58537	7.6694	12	16.44	96.8
2002M1	11.6258	87.06	30.452	5.00963	8.75	12	20.41	95.8
2002M2	11.4923	86.93	22.1684	5.85975	8.75	12	20.69	95.9
2002M3	11.4863	86.76	1.711736	6.20229	9.75	12	20.02	98.7
2002M4	11.0832	89.9	0.424669	7.40741	9.75	12	20.42	97.3
2002M5	10.1615	95.89	0.186336	7.75781	9.75	12	23.12	98.3
2002M6	10.1841	86.77	0.754003	8.00377	10.75	12	19.83	97.2
2002M7	10.1032	88.91	0.595469	9.61357	10.75	12	18.85	97
2002M8	10.5878	84.78	2.662336	10.3872	10.75	12	17.67	96.9
2002M9	10.5967	85.66	11.16674	11.2053	11.75	12	18.49	99.1
2002M10	10.3058	89.85	6.511003	13.0066	11.75	12	20.65	98.9
2002M11	9.6509	97.31	0.248336	12.8518	12.1667	12	19.77	96.9
2002M12	8.9479	100.82	12.40214	12.4067	12.25	12	18.07	97
2003M1	8.6949	99.79	5.941406	11.6	12.25	12	14.88	96.6
2003M2	8.2858	107.96	14.42101	10.3	12.25	12.25	13.84	96.7
2003M3	8.0506	108.38	2.212656	10	12.25	12.25	13.34	95.2
2003M4	7.6634	119.41	14.68806	8.6	12.25	12.25	15.46	96.9
2003M5	7.6604	101.76	9.256806	8.5	12.25	12.25	13.12	94.6
2003M6	7.8588	113.11	1.696506	7.8	11	12.25	15.47	95.4
2003M7	7.5458	112.94	0.204756	4.8	11	12.25	15.51	96.2
2003M8	7.3945	116.85	0.955506	4.7	10	12.25	12.71	93.3
2003M9	7.306	116.77	3.071256	3.1	9	12.25	14.57	94.4

2003M10	6.9644	118.05	0.543906	0.5	7.5	12.25	13.1	95.1
2003M11	6.7205	125.9	0.006806	-2.7	7.5	12.25	12.98	94.5
2003M12	6.5374	117.16	1.055756	-2.8	7	12.25	12.88	93.6
2004M1	6.9398	110.21	50.65881	-3.4	7	12.25	12.69	95.7
2004M2	6.7542	117.76	55.16776	-3.4	7	12.25	15.27	96.3
2004M3	6.614	123.8	20.22751	-3.3	7	12.25	14.34	99.5
2004M4	6.5747	117.34	24.37891	-3.6	7	12.25	12.77	96.4
2004M5	6.7996	121.33	0.142506	-3.7	7	12.25	11.07	101.3
2004M6	6.4216	126.8	9.656556	-3.7	6.75	12.25	11.26	98.7
2004M7	6.135	127.93	0.005256	-2.3	6.75	12.25	10.96	99.7
2004M8	6.4667	119.08	22.39656	-2.4	6	12.25	13.97	101.1
2004M9	6.5349	122.75	25.83181	-1.7	5.75	12.25	14.4	100.9
2004M10	6.3815	126.51	131.6183	-0.6	5.75	12.1	15.54	100.8
2004M11	6.0305	129.14	22.58626	1.6	5.5	12.1	14.05	98.5
2004M12	5.7235	130.82	1.829256	1.6	5.25	12.1	13.13	99.3
2005M1	5.9587	125.99	103.1071	1.9	5.25	13	12.95	101.7
2005M2	6.0001	128.98	78.75083	1.9	5	13	12.6	103.4
2005M3	6.0328	121.49	1.833767	1.9	4.75	13	12.28	101.8
2005M4	6.1469	124.16	6.626334	2.1	4.25	13	14.99	103.3
2005M5	6.3267	115.48	33.22562	1.6	4	13	16.27	101.9
2005M6	6.7396	117.77	0.015417	1.5	3.75	13	17.08	100.7
2005M7	6.6966	118.74	9.896267	1.5	3.75	13	19.86	101.6
2005M8	6.4599	120.29	93.23512	1.5	3.5	13	19	101.7
2005M9	6.3661	123.96	73.03127	1.5	3.25	13	17.36	103.7

2005M10	6.5878	117.53	16.69403	1.5	3.25	13	16.48	99.3
2005M11	6.6554	123.69	1.200851	1.1	3	13	16.98	101.5
2005M12	6.348	126.12	5.363084	1.1	2.75	13	20.45	104.8
2006M1	6.076	128.61	3.3124	0.9	2.5	13	20.23	106.1
2006M2	6.1153	128.6	29.9209	0.7	2.5	13	21.57	104.4
2006M3	6.2436	127.27	9.8596	0.4	2.25	13	27.25	103.3
2006M4	6.0811	125.18	25.5025	0.4	2.25	13	23.46	105.9
2006M5	6.3128	113.86	23.04	0.9	2	13	24.51	104.7
2006M6	6.9738	107.38	12.0409	1.5	2.25	13	23.33	106.9
2006M7	7.0688	111.35	72.4201	1.7	2.25	13	21.33	108.6
2006M8	6.9503	107.63	67.5684	2.2	2.75	13	21.74	106.4
2006M9	7.4465	99.71	6.8644	2.8	2.75	13	21.95	107.2
2006M10	7.63	100.73	49.1401	3.5	3.25	13	23.71	108.1
2006M11	7.2455	104.87	47.7481	3.5	3.25	13	25.56	109
2006M12	7.0345	107.5	9.4864	4.1	3.75	13	22.54	111.3
2007M1	7.1898	103.75	339.0202	4.2	3.75	13	22.05	111
2007M2	7.1755	103.27	223.5773	4.4	3.75	13	23.01	112.6
2007M3	7.3525	102.54	111.7778	4.6	3.75	13	20.02	111.9
2007M4	7.1026	103.34	28.22266	4.9	3.75	13	22.27	110.3
2007M5	7.0148	103.31	27.37906	4.9	3.75	13	22.67	112.8
2007M6	7.1515	104.18	1.939056	4.9	4.25	13.25	23.41	109.7
2007M7	6.973	102.53	20.13766	5.2	4.25	13.25	24.46	110.8
2007M8	7.2153	102.77	3.657656	5.1	4.75	13.25	25.8	111.5
2007M9	7.1007	103.91	19.51431	5.1	5.25	13.25	24.94	106.7
2007M10	6.7574	107.95	106.6573	5	6	13.25	23.34	113.6
2007M11	6.7049	102.37	392.7333	5.1	6	13.25	23.13	113
2007M12	6.8376	103.3	351.0939	5.1	6.75	13.25	23.59	111.7
2008M1	6.9962	94.18	32.9476	5.5	8	13.25	24.5	111.6
2008M2	7.6578	89.31	8.0656	6.1	8	13.25	20.61	112.8
2008M3	7.9921	82.33	31.5844	6.7	8.75	13.25	20.48	113.5

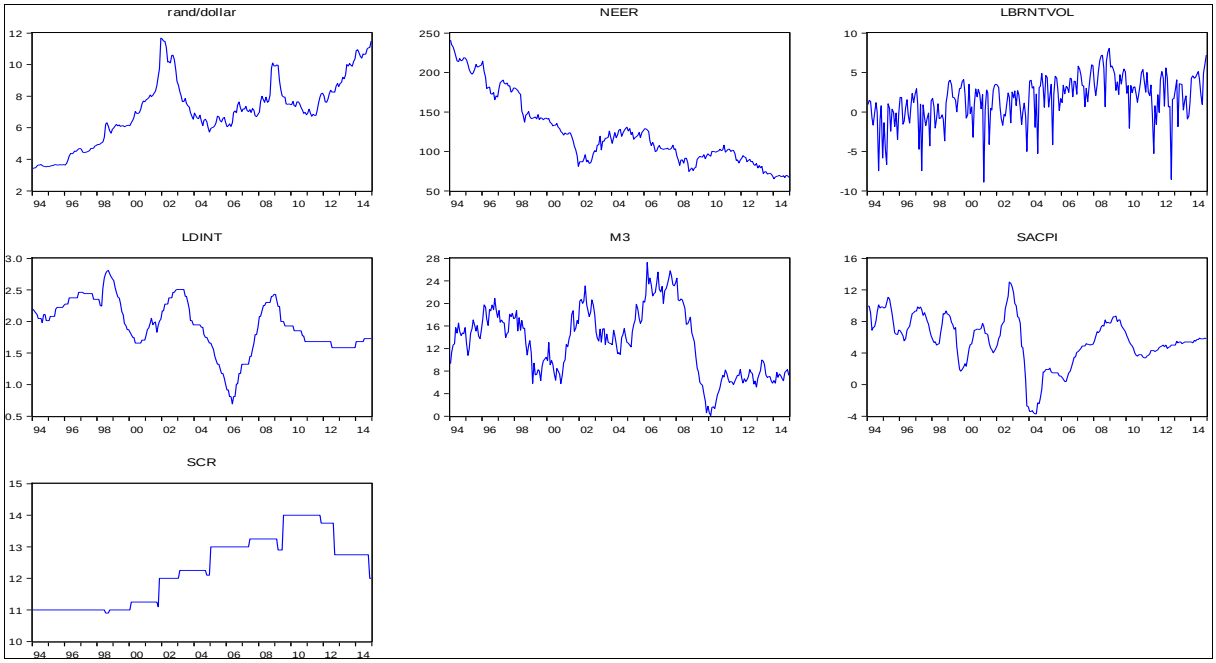
2008M4	7.7585	89.03	163.3284	6.6	9.5	13.25	20.8	117.3
2008M5	7.6076	89.34	690.6384	6.8	9.5	13.25	20.65	113.9
2008M6	7.9367	84.99	1252.452	7.3	10	13.25	19.87	115
2008M7	7.6114	91.49	1313.338	7.5	10	13.25	19.1	112.5
2008M8	7.6651	91.43	262.1161	7.4	10	13.25	16.3	113
2008M9	8.0753	85.73	1.96	8.2	10	13.25	16.41	109.6
2008M10	9.78	74.59	616.0324	7.8	11	13.25	16.89	107.7
2008M11	10.1112	76.97	1973.136	7.9	11	13.25	17.58	103.2
2008M12	9.9227	79.02	3144.966	7.8	11.375	13.25	14.84	98.5
2009M1	9.9076	75.69	289.0197	7.8	11.375	13.25	13.94	97.3
2009M2	9.9773	78.85	346.6329	8.2	10.375	13.25	13.17	96.4
2009M3	9.9536	79.69	225.6451	8.6	9.375	12.9	10.58	94.2
2009M4	8.9644	89.89	121.3378	8.6	9.375	12.9	8.49	93.5
2009M5	8.3741	91.87	15.38589	8.7	7.375	12.9	7.86	93.7
2009M6	8.0332	93.6	45.33404	8	7.375	12.9	6.02	93.3
2009M7	7.9446	93.08	9.338777	8.2	7.375	14	5.65	94.7
2009M8	7.9406	92.77	113.2986	8.2	6.875	14	5.5	94.1
2009M9	7.5025	95.92	33.94505	7.5	6.875	14	4.01	95.3
2009M10	7.4871	90.72	128.4485	7.2	6.875	14	2.68	97.4
2009M11	7.5096	94.17	230.3136	7	6.875	14	0.59	97.2
2009M12	7.4848	97.08	164.0696	6.7	6.875	14	1.79	100.5
2010M1	7.4631	95.14	10.61762	6.2	6.875	14	0.6	99.1
2010M2	7.668	93.95	28.29675	5.8	6.875	14	0.12	97.6
2010M3	7.4057	99.99	0.127225	5.4	6.375	14	1.55	100.2

2010M4	7.3444	100.1	28.05998	5.1	6.375	14	1.67	99.7
2010M5	7.6515	99.64	11.42789	4.9	6.375	14	1.35	101.3
2010M6	7.6356	99.09	22.9756	4.6	6.375	14	2.47	101.6
2010M7	7.5212	100.19	23.97095	4	6.375	14	3.77	102.3
2010M8	7.2877	100.77	8.63353	3.7	6.375	14	4.39	98.6
2010M9	7.11	102.78	3.402736	3.6	5.875	14	5.09	97.5
2010M10	6.9087	101.02	10.80191	3.8	5.875	14	6.36	100.4
2010M11	6.9749	102.05	36.46386	3.8	5.375	14	7.23	100.3
2010M12	6.8237	107.93	147.9885	3.8	5.375	14	6.92	100.3
2011M1	6.9239	99.18	214.8401	3.5	5.375	14	8.2	102.5
2011M2	7.1844	101.03	48.94697	3.4	5.375	14	7.57	103.5
2011M3	6.8976	102.81	12.17726	3.4	5.375	14	6.53	104.8
2011M4	6.7209	102.81	148.8099	3.6	5.375	14	6	102
2011M5	6.8556	99.97	12.29534	3.7	5.375	14	6.14	101.2
2011M6	6.7859	101.41	7.873727	3.9	5.375	14	6.03	103.1
2011M7	6.7871	101.24	30.34125	4.3	5.375	14	5.6	97.7
2011M8	7.0871	97.52	0.757608	4.3	5.375	14	6.22	103.6
2011M9	7.5769	88.68	0.005274	4.3	5.375	14	6.79	105.1
2011M10	7.954	89.25	2.199703	4.2	5.375	14	7.26	103.5
2011M11	8.1493	85.35	0.200364	4.3	5.375	13.75	7.23	103.2
2011M12	8.1933	89.05	8.890601	4.4	5.375	13.75	8.28	104
2012M1	8.0025	91.28	0.933069	4.7	5.375	13.75	6.7	103.8
2012M2	7.6388	94.6	59.95079	4.8	5.375	13.75	5.89	104.9
2012M3	7.6071	92.9	168.1961	4.9	5.375	13.75	6.65	103.1
2012M4	7.8329	92.32	74.50039	5	5.375	13.75	6.16	104.4

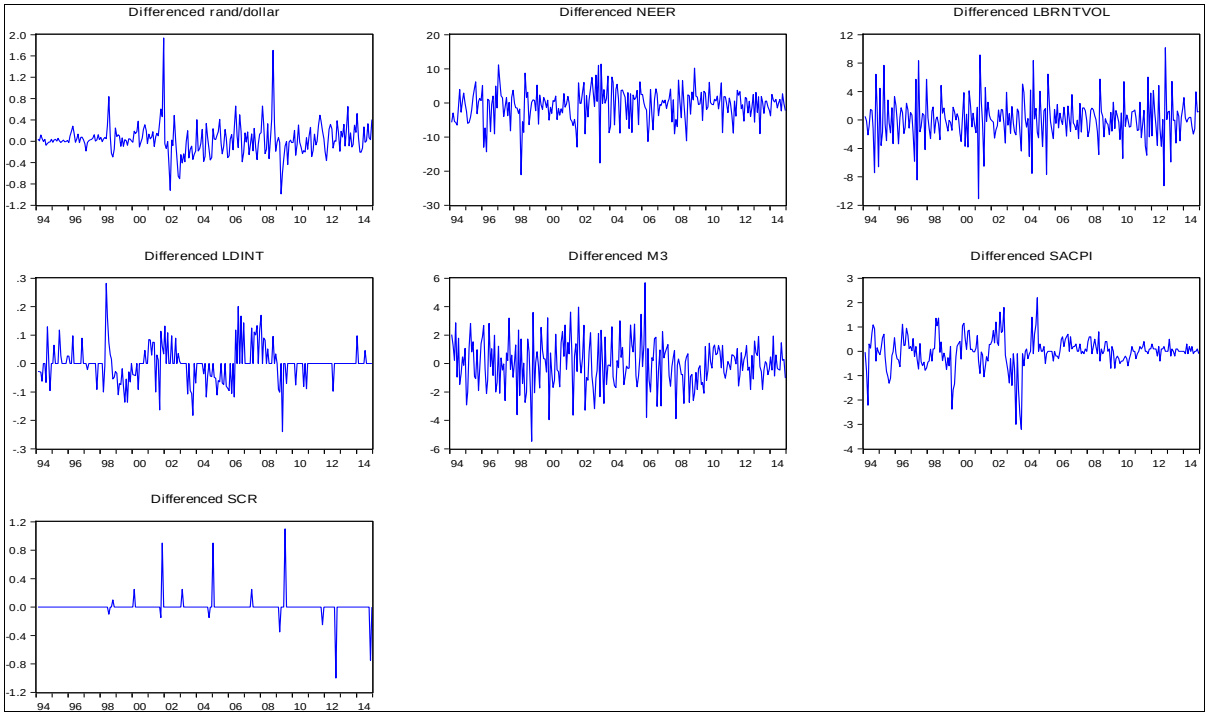
2012M5	8.1506	86.95	2.06742	4.8	5.375	13.75	6.43	105.4
2012M6	8.3818	88.55	267.9947	5	5.375	13.75	7	105.1
2012M7	8.2535	89.94	77.76916	4.6	4.875	13.75	8.27	104.5
2012M8	8.2596	86.98	1.905528	4.7	4.875	13.75	7.79	105.1
2012M9	8.2574	87.47	2.024669	4.8	4.875	12.75	7.54	104.8
2012M10	8.6424	83.49	0.000193	5	4.875	12.75	5.7	104.9
2012M11	8.7994	82.22	5.052485	5	4.875	12.75	6.26	107.2
2012M12	8.6116	84.71	5.380505	5	4.875	12.75	5.17	106.1
2013M1	8.7978	79.04	16.68563	5	4.875	12.75	6.75	106
2013M2	8.8766	82.09	57.92898	5.5	4.875	12.75	7.51	105.1
2013M3	9.1927	79.32	0.156902	5.3	4.875	12.75	8.07	105.3
2013M4	9.1007	81.09	35.62223	5.4	4.875	12.75	9.98	108.1
2013M5	9.3494	72.04	33.83672	5.4	4.875	12.75	9.75	107.3
2013M6	10.0001	73.96	32.8775	5.2	4.875	12.75	9.17	106.7
2013M7	9.9133	74.33	1.271942	5.3	4.875	12.75	7.34	109.2
2013M8	10.0708	71.24	4.497176	5.4	4.875	12.75	6.88	106.5
2013M9	9.9616	71.75	7.714716	5.4	4.875	12.75	7	101.5
2013M10	9.8979	72.29	0.402977	5.4	4.875	12.75	7.02	106.3
2013M11	10.2009	71.16	0.589364	5.4	4.875	12.75	6.23	108.3
2013M12	10.3683	68.98	3.203189	5.4	4.875	12.75	5.85	107.7
2014M1	10.8872	65.17	74.4275	5.4	5.375	12.75	6.32	108.3
2014M2	10.9506	67.67	97.39129	5.3	5.375	12.75	5.85	107.1
2014M3	10.7445	68.46	71.6125	5.6	5.375	12.75	7.78	104.9
2014M4	10.5364	68.7	79.78343	5.5	5.375	12.75	6.89	108.9
2014M5	10.4092	69.7	115.189	5.7	5.375	12.75	7.5	105.6

2014M6	10.6766	68.21	167.0504	5.7	5.375	12.75	7.16	107.3
2014M7	10.6577	68.15	64.63052	5.9	5.625	12.75	6.74	100.6
2014M8	10.6632	69.17	8.874938	5.8	5.625	12.75	6.28	105.7
2014M9	10.9908	66.82	2.582236	5.8	5.625	12.75	7.74	108.1
2014M10	11.0594	69.48	136.276	5.8	5.625	12.75	7.97	108.1
2014M11	11.0901	69.27	420.4672	5.9	5.625	12	8.26	107.2
2014M12	11.4975	67.03	1352.787	5.8	5.625	12	7.23	107.8

Appendix 2.1: Informal Stationarity test (Level series)



Appendix 2.2: Informal Stationarity test (Differenced data)



Appendix 3.1: Formal Stationarity test (Level series)

AUGMENTED DICKEY-FULLER				PHILIPS PERON		
Variable	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None
ZAR/USD	-2.074872	-2.229376	0.137570	-1.963848	-2.018451	0.226005
NEER	-2.654696*	-2.402785	-2.728801***	-2.632404*	-2.455232	-2.669874***
SACPI	-2.304080	-2.253515	-1.427934	-2.898240**	-2.989777	-1.719967*
LDINT	-2.492434	-3.009458	-0.644832	-2.079129	-2.407844	-0.705750
IIP	-2.109158	-2.615805	1.044929	-2.132460	-2.787078	0.911767
M3	-2.063096	-2.271772	-0.862642	-1.896963	-2.153853	-0.814174
LBRNTVOL	-5.912356***	-10.85989***	-4.841540***	-8.669629***	-10.85989***	-7.311055***
SCR	-0.547176	-3.169010*	1.469079	-0.267949	-3.004153	2.100804

*** Statistically significant at 1% ** statistically significant at 5% *statistically significant at 10%

AUGMENTED DICKEY-FULLER				PHILIPS PERRON		
Variable	Intercept	Trend and intercept	None	Intercept	Trend and intercept	None

ZAR/USD D/DOL	-10.36021***	-10.35650***	-10.34738***	-10.32203***	-10.31787***	-10.30905***
NEER	-15.05828***	-15.19821***	-14.83228***	-15.06120***	-15.19113***	-14.86071***
SACPI	-4.906778***	-4.936731***	-4.889308***	-9.091843***	-9.089233***	-9.102702***
LDINT	-6.841267***	-6.827016***	-6.851676***	-13.72449***	-13.70676 ***	-13.73631 ***
IIP	-21.02894***	-21.03913***	-20.96778***	-20.79783***	-20.84194***	-20.52779***
M3	-4.077228***	-4.148767***	-4.084453***	-16.62132***	-16.63866***	-16.65588***
LBRNTVOL	-9.481932***	-9.455608***	-9.502607***	-67.54597***	-65.75114***	-65.56230***
SCR	-15.48974***	-15.46309***	-15.35265***	-16.24917***	-16.26060***	-15.57285***

Appendix 3.2: Formal Stationarity test (Differenced data)

*** Statistically significant at 1% ** statistically significant at 5% *statistically significant at 10%

Appendix 4: GARCH (1.1) RESULTS

ZAR/USD equation

GARCH = C(10) + C(11)*RESID(-1)^2 + C(12)*GARCH(-1) + C(13) *LBRENTVOL

Variable	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	-0.083514	0.480533	-0.173794	0.8620
C	0.174790	0.293137	0.596275	0.5510
Oil price volatility	0.100164	0.004680	3.034994	0.0021
Interest rate Differential	-0.047888	0.045182	-1.059891	0.2892
Index of Industrial Prod	0.010938	0.003470	3.152570	0.0016
Money Supply	-0.005900	0.003413	-1.728765	0.0839
S.A. inflation rate	-0.000186	0.004873	-0.038076	0.9696
Sovereign credit ratings	-0.076252	0.028015	-2.721842	0.0065
ZAR/USD (-1)	0.983021	0.012961	75.84384	0.0000
	Variance Equation			
C	0.005438	0.002038	2.668788	0.0076
RESID(-1)^2	0.248207	0.056467	4.395638	0.0000
GARCH(-1)	0.657805	0.067434	9.754797	0.0000
LBRENTVOL	0.081323	0.000571	2.317019	0.0205

NEER Equation

Dependent Variable: NEER
GARCH = C(10) + C(11)*RESID(-1)^2 + C(12)*GARCH(-1) + C(13)
*LBRENTVOL

Variable	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	0.191839	0.069846	2.746587	0.0060
C	3.498656	7.826996	0.446998	0.6549
LBRENTVOL	-0.229124	0.103193	-2.220343	0.0264
LDINT	-2.126078	0.946737	-2.245691	0.0247
M3	-0.048382	0.054977	-0.880037	0.3788
SACPI	0.369294	0.147705	2.500216	0.0124
IIP	-0.074797	0.063415	-1.179480	0.2382
SCR	0.413326	0.442707	4.933634	0.0505
NEER(-1)	0.972801	0.011016	88.30767	0.0000
	Variance Equation			
C	0.861585	0.599047	1.438259	0.1504
RESID(-1)^2	0.069718	0.030647	2.274872	0.0229
GARCH(-1)	0.903338	0.038308	23.58111	0.0000
LBRENTVOL	-0.180523	0.093285	-1.935184	0.0530

R-squared	0.988633	Mean dependent var	123.7663
Adjusted R-squared	0.988257	S.D. dependent var	42.52246
S.E. of regression	4.607933	Akaike info criterion	5.846836
Sum squared resid	5138.398	Schwarz criterion	6.029429
Log likelihood	-720.7779	Hannan-Quinn criter.	5.920316
Durbin-Watson stat	2.118553		

Appendix 5: Autocorrelation

Squared residuals

Date: 07/07/16 Time: 14:23
Sample: 1994M01 2014M12
Included observations: 251

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob...
		1	0.077	0.077	1.5235	0.217
		2	-0.06...	-0.07...	2.6049	0.272
		3	0.037	0.048	2.9544	0.399
		4	-0.10...	-0.12...	5.9504	0.203
		5	-0.09...	-0.07...	8.3284	0.139
		6	0.165	0.166	15.358	0.018
		7	-0.04...	-0.07...	15.815	0.027
		8	0.005	0.037	15.823	0.045
		9	0.038	-0.00...	16.204	0.063
		1...	-0.08...	-0.05...	17.994	0.055
		1...	0.010	0.048	18.018	0.081
		1...	0.060	0.008	18.975	0.089
		1...	-0.09...	-0.07...	21.396	0.065
		1...	-0.08...	-0.08...	23.146	0.058
		1...	-0.03...	-0.04...	23.392	0.076
		1...	-0.01...	0.026	23.467	0.102
		1...	0.181	0.170	32.384	0.013
		1...	0.010	-0.06...	32.411	0.020
		1...	-0.10...	-0.07...	35.282	0.013
		2...	0.062	0.077	36.346	0.014
		2...	-0.05...	-0.04...	37.103	0.016
		2...	-0.10...	-0.04...	39.888	0.011
		2...	0.017	-0.07...	39.973	0.015
		2...	-0.03...	-0.03...	40.336	0.020
		2...	-0.05...	-0.01...	41.306	0.021
		2...	0.068	0.027	42.594	0.021
		2...	-0.01...	-0.00...	42.666	0.028
		2...	0.052	0.055	43.432	0.032
		2...	0.157	0.111	50.456	0.008
		3...	-0.04...	-0.01...	50.967	0.010
		3...	-0.08...	-0.02...	52.932	0.008
		3...	-0.03...	-0.07...	53.253	0.011
		3...	-0.08...	-0.05...	55.480	0.008
		3...	-0.03...	-0.05...	55.858	0.010
		3...	0.051	-0.00...	56.616	0.012
		3...	0.034	0.058	56.954	0.015

*Probabilities may not be valid for this equation specification.

Appendix 6: ARCH LM Test for Heteroscedasticity

ARCH (1)

Heteroscedasticity Test: ARCH

F-statistic	1.497530	Prob. F(1,248)	0.2222
Obs*R-squared	1.500545	Prob. Chi-Square(1)	0.2206

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 07/07/16 Time: 14:32
Sample (adjusted): 1994M03 2014M12
Included observations: 250 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.942476	0.133082	7.081929	0.0000
WGT_RESID^2(-1)	0.077474	0.063309	1.223736	0.2222

R-squared	0.006002	Mean dependent var	1.021625
Adjusted R-squared	0.001994	S.D. dependent var	1.840820
S.E. of regression	1.838983	Akaike info criterion	4.064271
Sum squared resid	838.7013	Schwarz criterion	4.092442
Log likelihood	-506.0338	Hannan-Quinn criter.	4.075609
F-statistic	1.497530	Durbin-Watson stat	1.988908
Prob(F-statistic)	0.222213		

ARCH (1-3)

Heteroscedasticity Test: ARCH

F-statistic	1.093101	Prob. F(3,244)	0.3527
Obs*R-squared	3.288859	Prob. Chi-Square(3)	0.3492

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 07/07/16 Time: 14:33
Sample (adjusted): 1994M05 2014M12
Included observations: 248 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.970782	0.160755	6.038876	0.0000
WGT_RESID^2(-1)	0.084858	0.063916	1.327658	0.1855
WGT_RESID^2(-2)	-0.076151	0.063980	-1.190238	0.2351
WGT_RESID^2(-3)	0.048408	0.063925	0.757255	0.4496

R-squared	0.013262	Mean dependent var	1.029252
Adjusted R-squared	0.001129	S.D. dependent var	1.846277
S.E. of regression	1.845234	Akaike info criterion	4.079087
Sum squared resid	830.7928	Schwarz criterion	4.135755
Log likelihood	-501.8068	Hannan-Quinn criter.	4.101899
F-statistic	1.093101	Durbin-Watson stat	1.989125
Prob(F-statistic)	0.352668		

ARCH (1-5)

GED parameter fixed at 1.5
GARCH = C(10) + C(11)*RESID(-1)^2 + C(12)*GARCH(-1) + C(13)
*LBRENTVOL

Variable	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	-0.083514	0.480533	-0.173794	0.8620
C	0.174790	0.293137	0.596275	0.5510
LBRENTVOL	-0.000164	0.004680	-0.034994	0.9721
LDINT	-0.047888	0.045182	-1.059891	0.2892
IIP	0.010938	0.003470	3.152570	0.0016
M3	-0.005900	0.003413	-1.728765	0.0839
SACPI	-0.000186	0.004873	-0.038076	0.9696
SCR	-0.076252	0.028015	-2.721842	0.0065
ZAR/USD (-1)	0.983021	0.012961	75.84384	0.0000
Variance Equation				
C	0.005438	0.002038	2.668788	0.0076
RESID(-1)^2	0.248207	0.056467	4.395638	0.0000
GARCH(-1)	0.657805	0.067434	9.754797	0.0000
LBRENTVOL	0.001323	0.000571	2.317019	0.0205

R-squared	0.980743	Mean dependent var	7.060122
Adjusted R-squared	0.980106	S.D. dependent var	2.046779
S.E. of regression	0.288689	Akaike info criterion	-0.091948
Sum squared resid	20.16855	Schwarz criterion	0.090645
Log likelihood	24.53949	Hannan-Quinn criter.	-0.018468
Durbin-Watson stat	1.360043		