THE IMPACT OF OIL PRICE FLUCTUATIONS ON THE SOUTH AFRICAN EXCHANGE RATE

By

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ABSTRACT

This study investigates the nature of the relationship and the effects of changes in oil prices on South Africa's exchange rate. It fills an essential gap in comprehending how oil price shocks influence emerging market economic dynamics. South Africa is heavily dependent on imported oil, with 90% of the country’s oil and petroleum needs coming from imported sources, and the exchange rate is overly sensitive to fluctuations in oil prices. Through the use of a Bayesian Vector Auto Regressive (BVAR) model, this study examines the connections in the period from 2000-2022 between oil prices, the South African Rand (ZAR), and key macroeconomic indicators, like the Consumer Price Index (CPI), interest rates, and Gross Domestic Product (GDP).

The study finds that the initial oil price shock to exchange rates is weakly positive in the short run, reflecting a 1% increase in oil prices, leading to a 0.08% exchange rate appreciation. This response is, however, very short-lived, as after the initial shock, results reflect a negative relationship in the long run. The study also finds an asymmetrical relationship between oil prices and exchange rates. These effects become more pronounced when global uncertainty is at its peak. This study aligns with studies such as those by Korley and Giouvris (2022), which highlight how shifts in oil prices affect exchange rates through trade balance and inflation pressures. By incorporating the concept of asymmetry into the study, this research yields information on how vulnerable the Rand is to sudden increases in oil prices, providing essential data for policymakers.

The findings have implications for shaping policies in South Africa. Exchange rate stability strategies could involve diversifying energy sources and introducing risk hedging methods while striving for stability through flexible monetary and fiscal policies. This research also adds to the ongoing conversation about the susceptibility of emerging market currencies to external pressures, serving as a reference point for examining comparable economies. This research enriches the existing body of knowledge by addressing methodological gaps and providing a contemporary analysis of South Africa's exchange rate dynamics in a post-crisis global economy.

Keywords : ***Oil prices, Asymmetry, South African Rand, Exchange rates, Emerging market economies***

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LIST OF ACRONYMS & ABBREVIATIONS

GDP	Gross Domestic Product
GDPPC	Gross Domestic Product Per Capita
PPP	Purchasing Power Parity
ZAR	South African Rand
USD	United States Dollar
SARB	South African Reserve Bank
OXV	Oil Volatility Index
BRICS	Brazil, Russia, India, China, and South Africa
FDI	Foreign Direct Investment
BVAR	Bayesian Vector Autoregressive
SA	South Africa
OPEC	Organization of the Petroleum Exporting Countries
US	United States
EUR	Euro exchange rate

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1. CHAPTER ONE

INTRODUCTION

1.1. Introduction

South Africa still experiences the impact of international oil price volatility. The country depends on imported crude oil, meaning that the country's economy is sensitive to changes in the global oil market (Avielele, 2020). These fluctuations can directly influence the South African exchange rate, causing broader consequences, including inflation, trade deficits, and tension on the national budget (Okoro, 2021). Therefore, fluctuations in oil prices are also reflected in the costs of imports, thus affecting the country's stability and growth (Korley and Giouvris, 2022). Understanding this relationship is crucial, especially considering that oil accounts for 90 percent of South Africa's energy consumption and economic performance (The Department of Mineral Resources and Energy, 2023).

South Africa is among the leading oil-importing countries and the most affected by global oil prices (Okoro, 2021). For example, when South Africa experiences an increase in oil prices, this is realized through higher inflation, the low value of its currency, and slower economic growth (Hlongwane, 2022). Key issues explored in this research involve the correlation between fluctuations in oil prices and the value of the South African Rand, including the impact of fluctuations in oil prices on the exchange rates of the South African currency (Korley and Giouvris, 2022). While a negative correlation is often observed between oil prices and exchange rates in net-importing countries, it is also possible that several factors mediate this relationship (Kin and Courage, 2014).

The 2022 energy crisis, marked by significant volatility in global oil prices, offers a critical context for exploring the relationship between oil price fluctuations and exchange rate dynamics, particularly in countries like South Africa. Geopolitical tensions, supply disruptions, and the aftermath of the COVID-19 pandemic led to a surge in oil prices. Countries worldwide faced intensified inflationary pressures, worsened trade deficits, and heightened economic instability (Zhang, Yang, Hu, Jiao,

and Wang, 2023). For South Africa, the impact of these oil price hikes was particularly severe (The United Nations Development Programme, 2022).

Taken from above, the purpose of this study is to analyse the nature of the relationship between oil prices and exchange rates, specifically the South African Rand exchange rate (ZAR), and to establish the degree of asymmetry of the Rand's response to changes in oil prices. Asymmetry refers to the condition of inequality between two variables. In the context of the study, one seeks to see to what extent an increase or decrease in oil prices disproportionately influences the exchange rate. This analysis will provide valuable comprehension in understanding the nature of the relationship between oil prices and exchange rates. By examining the asymmetric effects, we can better handle the potential negative impact of oil prices on exchange rates.

1.2. Background of the research

Oil currencies are the currencies of those countries whose economies are highly intertwined with the global oil market. Usually, these are countries that are net exporters of oil and whose currency values appreciate or depreciate with changes in the price of oil. Oil currencies are very volatile, and their value depends greatly on the prevailing oil prices in the global market (Okoro, 2021). It is important to note that oil currencies not only apply to oil-exporting countries but are even influential for the countries that are net oil importers. The concept of oil currencies is therefore paramount to enhancing the knowledge about other effects of the changes in oil prices (Sanusi and Kapingura, 2022).

According to the U.S. Energy Information Administration (2022), South Africa depends more on oil than many other African oil-rich countries like Nigeria or Algeria, which have substantial domestic oil production capacities. Industries like mining and manufacturing in South Africa depend heavily on energy to operate efficiently and effectively transport goods worldwide. Recent hikes in oil prices have led to expenses for these sectors, making it harder for African exports to compete globally (Banya, 2023). This results in profit reductions and strains the country's currency value. As a result, the economy of South Africa is more vulnerable to fluctuations in the global oil markets compared to countries that are oil producers (Okoro, 2021). The natural resource also serves as an essential ingredient for industrial manufacturing and transportation of people. It is also a strong predictor of the cost and state of the

economy for goods and services (Osigwe, 2015). For example, oil imports have become a key factor in the country's energy security since the country possesses constrained reserves of natural gas and oil (Hlongwane, 2022).

The role of oil in net-importing countries is multifaceted, particularly in its economic implications (Nkomo, 2009). For instance, South Africa, which imported 94 percent of crude oil in 2022, is at a substantial risk due to its economy's reliance on oil imports (The Department of Mineral Resources and Energy, 2023). Whenever the global oil prices go up, there is an imbalance in trade. This, in turn, means that the demand for the South African Rand could be pressured downwards, which results in the weakening of the currency. Similarly, the rise in production costs because of high oil prices may slow down the rate of economic growth because of high operational costs for companies and low purchasing power among consumers (Nkomo, 2009).

The relationship between oil prices and exchange rates is unclear and can be unstable (Some, 2024). Some studies, including Hlongwane, Daw, Shogole, and Ribese (2022) and Avielele (2020), have endeavored to offer some insights on the relationship between oil prices and exchange rates with a focus on time-varying oil prices and real effective exchange rates. Nikbakht (2010) asserts that prices of oil and exchange rates bear an inverse relationship, which works through a reversible supply and demand mechanism. When prices are high on the demand side, it lowers the buying capacity of the purchasers and hence results in low demand for non-tradable goods. This, in turn, lowers the demand for these goods and may result in a lowering of the price of these goods, which at one time may cause the devaluation of the currency. The influence of the price of oil on the supply side shows that a rise in oil prices increases the cost of production, inflation, and depreciation of the currency (Nikbakht, 2010). These dynamics are relevant for South Africa in particular, as the price of oil has significant effects on the exchange rate.

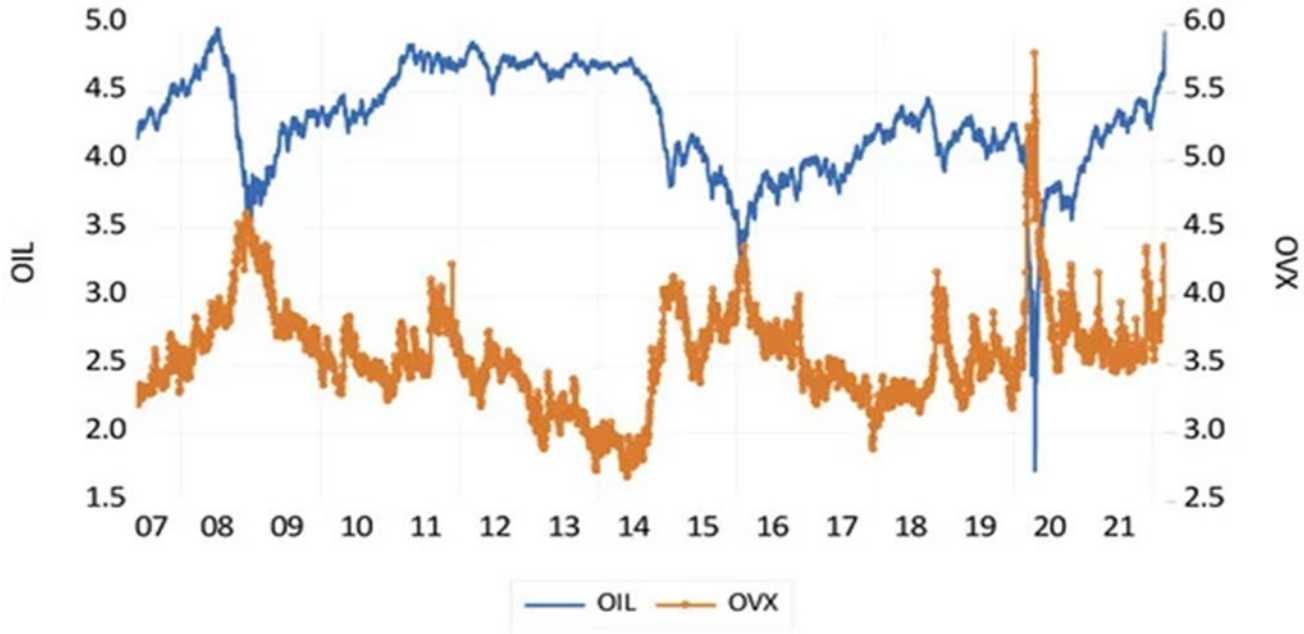
The trend among the Rand-Dollar exchange rate and oil prices in South Africa is dynamic, setting the bar high for the country's economic stability. In the last ten years, the South African Rand has depreciated, with the exchange rate increasing from approximately 7 Rand per dollar in the early 2010s to over 15 Rand per dollar in 2021 (Hlongwane, 2022). In 2020, the outbreak of the COVID-19 pandemic increased volatility, and the Rand rapidly depreciated against the Dollar, falling to lows as

investors scampered for safer currencies (Villarreal-Samaniego, 2020). Meanwhile, global oil prices crashed on the back of reduced demand, easing import costs for South Africa. As the global economy started to recover in 2021 and 2022, oil prices began to rise. The spike in oil prices, particularly during the 2022 Russia-Ukraine conflict, exerted considerable downward pressure on the Rand's value relative to the dollar, thus placing upward pressures on inflation domestically (Hlongwane, 2022).

The exchange rate continued fluctuating through 2022, reflecting ongoing global economic uncertainties. These dynamics in currency and oil prices have had far-reaching implications for the South African economy. In periods where the Rand was depreciating due to an increase in the price of oil, import costs also increased. South Africa often has a trade deficit due to importing more than it exports, which is influenced by the oil imports increasing the need for foreign currency and causing the Rand to depreciate over time (Oliphant, 2023). This cycle continues as the devaluation of the currency makes imports pricier, leading to economic instability. Increased oil prices have an impact on cost-driven inflation because the higher costs of transportation and production spread across the economy. Since South Africa heavily depends on fuel for generating electricity and managing logistics, any sudden increase in oil prices directly drives up the prices of products and services, putting pressure on household budgets and slowing down economic growth (Sanusi and Kapingura, 2022). While the depreciating Rand elevated the competitiveness of South African exports internationally, it has at the same time increased costs associated with capital equipment, which is required for production (Hlongwane, 2022; Hlongwane et al., 2022).

On the other hand, in periods where the Rand appreciated, the occurrence of lower oil prices gave some economic relief. This relief is, however, usually short-lived. This is due to economic challenges caused by the structure of the economy (Muzekenyi, Zuwarimwe, Kilonzo, and Nheta, 2019). These challenges include, among others, the economy’s struggles to create employment for its people, the prevalence of inequality, and insufficient investment and formation of capital (Udeagha and Ngepah, 2021).

Figure 1: The trend of oil price and OVX



Source: Korley and Giouvris (2022)

Figure 1 presents the movements of oil prices (OIL) and the Oil Volatility Index (OVX) in the sample period and other episodes of volatility in the oil market. A steep decline in oil was seen in the year 2008, which can be attributed to the fact that the global financial crisis had an impact on demand, and as such, the prices crashed. The next remarkable drop started from mid-2014 to early 2016 based on OPEC's oil glut due to the extraction of US shale oil, which added to the world supply of oil, thus lowering the price level. The other slip in oil prices, which was steeper, was between early 2020 and mid-2020 due to the COVID-19 pandemic. Foreign oil prices were reduced by well over threefold in this period, from 74 USD per barrel to about 20 USD per barrel. The pandemic outbreak affected global economic activities, resulting in low demand for oil and, hence, a decline in its prices. During such fluctuations in the market price, the OVX captures this uncertainty more, especially during the depressed phase. The graph clearly depicts how externalities, including but not limited to financial crises, technological trends of the global oil market, or global pandemics, affect the fluctuation of oil prices and its volatility to the producers and consumers worldwide.

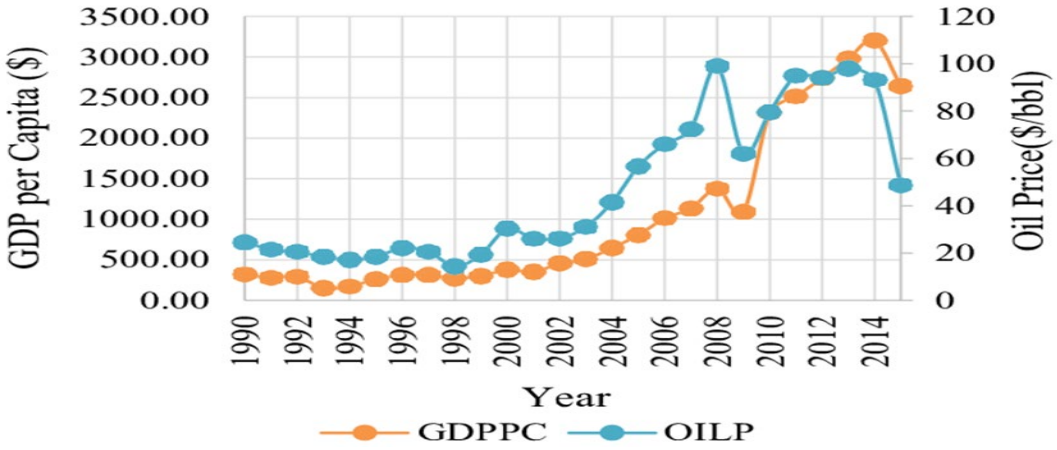
Oil price movements also have other secondary macroeconomic effects. For instance, in South Africa, higher oil prices can cause inflation hikes since the cost of production and transportation goes high; hence, the inflated cost of goods and services (Aye and

Odhiambo, 2021). This will likely lead to decreased consumer purchasing power and, eventually, a decline in economic growth. In addition, the government may encounter some difficulties in its budget process since higher prices of oil imply a reduced number of resources for fuel subsidies and other necessary expenses (Korley and Giouvris, 2022). It may, therefore, result in a contraction of fiscal policies, which in turn slows down the economy's growth.

A study by Maruping and Mongale (2017) established greater effects of global oil price variations on South Africa's Gross Domestic Product. Maruping and Mongale (2017) confirm that the South African Rand responds significantly to changes in the price of oil, and a considerable depreciation of the Rand is observed with an increase in the price of oil. This depreciation is a result of the high value of imported oil and a precautionary measure against other economic risks likely to result from such hikes. This reduction in purchasing power is particularly grievous in a country like South Africa because inflation impacts the common population, for example, the escalation of the cost of living and even disparity of general income levels.

These findings reflect the influence of global oil prices on the South African economy. The depreciation of the Rand as a result of oil price hikes enforces inflationary pressures and increases income inequality. Inflation caused by rising oil prices affects lower-income earners, who most likely spend most of their income on necessities such as food and electricity. Given these effects, policy interventions aiming to stabilize the economy are essential.

Figure 2: GDP per capita as a function of oil price



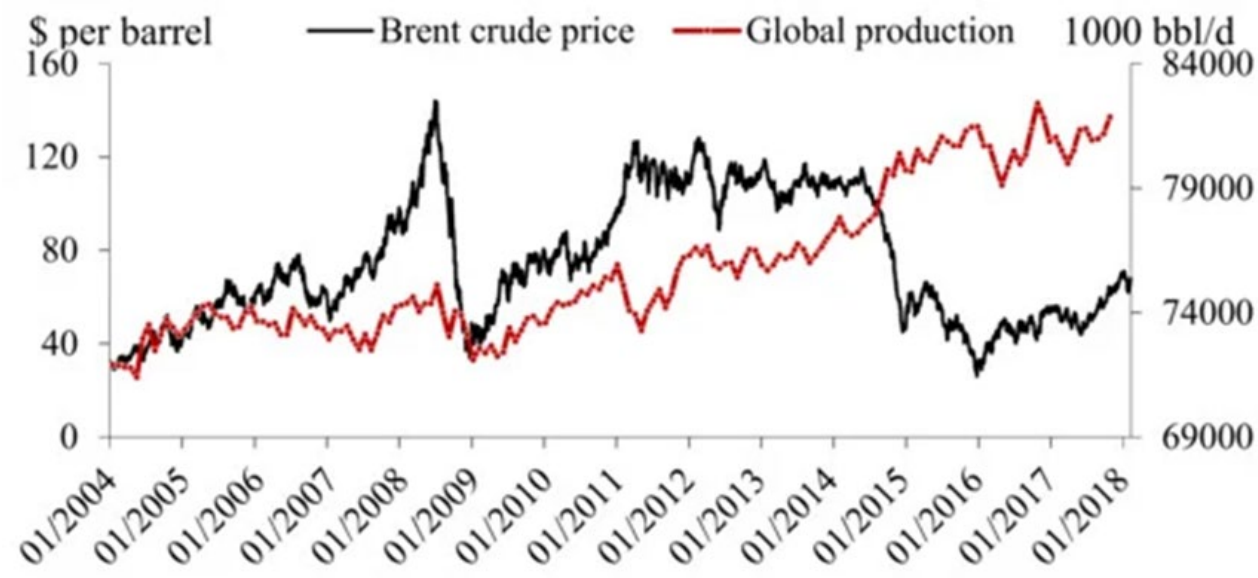
Source: Broni-Bediako , Onyije, and Unwene (2018)

Figure 2 illustrates the relationship between Gross Domestic Product per capita (GDP per capita) and oil prices (OILP) from 1990 to 2014. These facts offer valuable clues to the literature on the influence of oil price risk on South Africa's exchange rate. Global oil prices were moderate and constant in the early millennium, and the South African per capita GDP grew incrementally. However, as oil prices started to increase sharply around 2004 and reached 120 US dollars per barrel in 2008, South Africa's gross domestic product was also on the rise, but at a slower pace. This period of high growth in oil prices is related to global oil shocks that would affect the economy of South Africa and its exchange rate. Signs that can be taken as indicating that inflating the price of oil does lead to the cost of imports rising, thereby exerting pressure on the exchange rate demand for a foreign currency. Such a situation may bring about inflationary tendencies, extending the depreciation of the South African Rand. As seen in Figure 2, oil prices dropped after the 2007-2009 global financial crisis, and this could have given some relief to the South African economy, but oil price fluctuation between 2010 and 2014 is manifest in the GDP growth rates. The progressive growth in GDP per capita after 2010 depicts a gradual economic recovery, while the changes in the economic indicators prove that the exchange rate of South Africa is highly provisioned for the oil prices on the international markets .In as much as the relationship between GDPPC and oil prices is highlighted, it is important to notes that Oil prices do not affect GDPPC in the long run due to money neutrality, However oil price volatility can

influence economic performance through inflation, exchange rates, and trade balance effects in the short run and medium term.

Short-run instabilities in oil prices have been known to have an influence on performance risks in the past in many ways, especially on most of the macroeconomic indicators and overall economic growth (Lin and Su, 2020). Another condition is the relation between oil prices and exchange rates, which defines the openness of the region's economy to external shocks. According to Beckmann, Czudaj, and Arora (2020), oil-importing nations are mostly exposed to volatile oil prices, which negatively affect their economy significantly. Therefore, the repercussions of these disruptions vary, from the price that consumers must pay to the condition of the government's finances. These effects are also to an extent influenced by the production of oil in oil-exporting countries, since that can also influence the price of oil.

Figure 3: Fluctuations of the Crude Oil Price



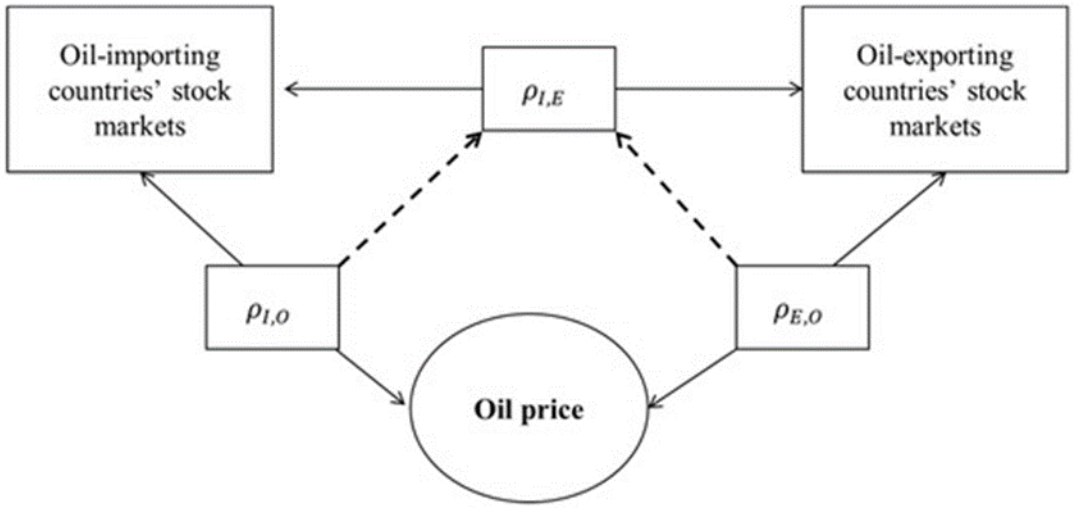
Source: Vandyck, Kitous, Saveyn , Keramidas , Los Santos, and Wojtowicz (2018)

Figure 3 shows the fluctuations of Brent crude oil prices and world production from 2004-2018. It is, however, important to note that in the period of July 2014 to January 2016, Brent crude prices lowered significantly, from a range of 100-120 USD per barrel to as low as 26 USD per barrel (Vandyck et al., 2018). This steep decrease was the lowest observed price level in the industry for a period of approximately 15 years, which gives credence to the industry's boom and bust characteristics. For instance, the high volatility of such prices may have significant implications for countries whose

economies largely depend on fossil fuel extraction because continuously low prices present profound problems for the growth of the economy and the creation of jobs in these sectors.

Ahmed and Huo (2020) discussed the connection between energy prices, currency, and stocks in the emerging economies of Africa. The study found that an increase in the price of oil leads to the devaluation of currencies in the region and poor stock market performance. This dynamic is a good illustration of the general conditions of oil-importing countries of the region and the conditions peculiar to them in that the economy responds to price fluctuations in oil through a range of interconnected factors. It is also important to note that oil prices can also affect stock prices in oil-exporting countries.

Figure 4: Relationship between correlations



Source: Youssef and Mokni *(2019)*

Figure 4 shows the interaction between oil prices and stock returns in oil-importing countries and oil-exporting nations. As shown, fluctuations in such co-movements between oil prices and stock markets are responsible for the evolving nature of connections between these markets. It is important to understand such relations because the information flow that they represent is exceptionally valuable for investors and policymakers. Episodes such as risk spillover, stemming from volatility in oil prices, have a domino effect on the overall economy and consequently influence diversification strategies during moments of stress in the economies. This research adds to the increasing list of literature works that seek to explore the association

between oil and stock markets, most of which have been done regarding oil-importing nations. It is essential to understand the behavior of markets by identifying whether oil price shocks play a structural or transitional role.

Historical background information highlights the association between oil prices and the performance of major economic industries in South Africa, especially the banking industry. According to Moyo and Tursoy (2020), the banking sector is usually affected by the shocks in one way or the other, thereby affecting the whole economy. This relationship raises the discontent of systemic risk, where external price shocks, in this case, oil price shocks, are prone to affect the financial institutions and the economy. For example, there can be a rise in inflation owing to an increase in the price of oil because almost every activity requires the use of oil; therefore, prices of goods and services will similarly rise. This will make it harder for consumers to service their debts, which heightens the credit risk for the bank. The strong connection between the oil sector and the financial sector brings about the importance of acknowledging factors that have an influence on the economy. It is important for financial institutions to prepare themselves for any risk that may come from externally. Understanding how the different industries are connected can help with mitigating any negative impacts that come from oil price fluctuations. In essence, the management of systematic risk is vital in ensuring that financial institutions withstand the impact of external shocks.

The degree of oil dependence also defines the political responses to the fluctuations in oil prices in the region (Saidu, Naseem, Law, and Yasmin, 2021). If a country relies heavily on oil imports and exports, then it is forced to employ a larger number of fiscal and monetary policies when there is a fluctuation in the price of oil. There could also be the argument that less dependent countries may contain more policy space when it comes to addressing such shocks. There are several ways through which governments have used to offset the impacts of fluctuating oil prices. For instance, monetary policies, such as the alteration of interest rates, assist in controlling inflation, while fiscal policies, such as the alteration of taxation and subsidies, assist in easing the burden of cost on consumers (Hlongwane, 2022). Furthermore, governments may use foreign exchange reserves to support the local currency and seek other energy sources besides oil imports (Hlongwane, 2022). In a country like South Africa, it has been compelled to effect policies that include changing the interest rate and government expenditure to cushion against the effects that arise from fluctuating oil

prices. These measures are often applied to solve the economic imbalance on a short-term basis (Sanusi and Kapingura, 2022). However, at the same time, these measures can lead to trend problems – for example, an increase in public debt or a decrease in investment in other vital sectors of the economy.

Due to challenges caused by the fluctuations in oil prices over time, some governments might opt for severe measures to manage public debt levels, focus on energy diversification, and maintain economic stability (Akdeniz, Catik, and Balli, 2022). In contrast, some countries have embraced other, more aggressive fiscal policies. For example, during high oil prices, some countries preferred to increase government spending with the aim of increasing growth, although this led to an increase in budget deficits and, therefore, debts (Omolade, Ngalawa, and Kutu, 2019).

The impact of policy responses on oil price volatility has been moderate in South Africa, as indicated. Sometimes, these responses have been able to formulate policies that cushion the effects of shocks in oil prices and balance the economy. South Africa has also employed fiscal policies involving holding reserves to act as a buffer in the event of currency instability and fiscal measures to counter-cyclical policies that support the economy during unstable oil prices. Nevertheless, the government's response of these strategies varies across countries based on the structure of their economies and vulnerability to changes in oil prices.

However, there have also been cases where policy responses to shocks have been suboptimal, leading to economic growth and stagnation cycles. At times, there is evidence that countries have failed to put in place sound policies because they have been constrained by low fiscal space, high debt levels, and poorly developed institutions (Sanusi and Kapingura, 2022). For instance, in oil-dependent countries with scarce foreign exchange reserves, such efforts at managing the currency through foreign exchange interventions have been unfruitful and have only led to currency depreciation and soaring inflation within a brief period (Fasanya, Oyewole, and Raheem, 2022). In general, the policy effectiveness of the examined country in reacting to fluctuations in oil prices significantly depends on the granted degree of oil intensity, the number of available foreign exchange reserves, and the general economic environment and institutional setting. There is evidence that countries with relatively higher economic and institutional development have fared better when

dealing with fluctuations in the price of oil. While other nations have had stronger policy frameworks, nations with less sturdy policies have failed to implement effective policies (Sanusi and Kapingura, 2022).

Furthermore, global factors associated with the economic geography of influential currencies and the dynamics of international trade relations are also truly relevant in capturing how oil prices impact exchange rates (Segal, 2021). For example, an increase in the value of the US dollar may result in a decline in the global price of oil, which is advantageous to countries that import oil, such as South Africa. However, if such currency movements are accompanied by tighter monetary policies in the US, the Rand could still decline even if the trends in oil prices are favorable. Furthermore, volatile crude oil prices and political tension affect the availability of oil for international markets through trade bans, which create variations in currency values as market players balance their positions with respect to expected future trends (Beckmann et al., 2020). These external shocks reinforce a view beyond the simple perspective of oil price shocks to the so-called open economy that involves a study of how countries' monetary and fiscal policies are anchored to the global economy (Segal, 2021). Hence, future work should incorporate these variables as part of their model for a better evaluation of the determinants of oil prices for the South African Rand.

1.2.1. Crude oil prices and the South African Rand/US Dollar exchange rate over the years

Overview of crude oil prices

The recent hike in oil prices is nothing new. History shows that fluctuations in commodity prices have been a common occurrence since the 1970s (Masuku, 2016). The global cost of oil has consistently experienced fluctuations due to frequent shifts in the demand and supply of oil resources. In the year 2001, the price of crude oil was sitting at 26 US Dollars per barrel following the Asian financial crisis. Between 2002 and 2007, Asia played a role in boosting the demand for oil; however, due to stagnant oil production, the price of oil experienced a concerning increase. Oil prices surged to 146 US dollars per barrel at the beginning of 2008. This corresponded with the onset of the Global Crisis. By mid-2008, the price of crude oil had surged to over 140 US dollars per barrel. This increase in oil prices was driven by factors such as strong global demand (particularly from emerging economies like China and India),

geopolitical tensions, and speculative trading in the commodity markets. As the global financial crisis deepened in late 2008, oil prices experienced a sharp decline. Going towards the end of 2008, oil prices had fallen to around 30 US dollars per barrel from their mid-2008 peak. This drop in oil prices reflected the global recession's dampening effect on demand, as industrial activity slowed down, transportation needs dropped, and energy consumption fell worldwide. While this was a relief to consumers and businesses, it also created additional challenges, particularly in oil-exporting countries that relied heavily on high oil prices to sustain their economies.

Between 2009 and 2011, oil prices rose due to the economic recovery reaching a higher level. The highest amount recorded was 116 US dollars in the year 2011, with occurrences of the civil unrest taking place between 2011 and 2014. The turmoil in Libya led to a disruption in oil production, causing the price of oil to drop to 86 US dollars per barrel in September 2011. However, the oil market picked up steam again until June 2014, when a significant downturn occurred. Declining demand growth was witnessed in the downturn period. The situation led to a drop in the price of oil to a record low. The price of oil dropped to 48 US dollars per barrel by January 2015. The prices continued to drop; as a result, in October, they were at 43 US dollars per barrel. Ro (2014) anticipated that prices would continue to decrease as the market continued to seek a balance.

In 2019, as the COVID-19 pandemic spread globally, governments imposed strict lockdowns and travel restrictions to curb the virus's spread. These measures drastically reduced demand for oil, particularly in transportation and industrial sectors. In early 2020, oil-producing countries, particularly those within OPEC+, struggled to agree on production cuts. As a result, oil production continued at high levels, exacerbating the supply-demand imbalance. The combination of collapsing demand and high supply led to a historic event in April 2020, where the West Texas Intermediate (WTI) crude oil futures fell into negative territory for the first time in history. In April 2020, WTI crude prices briefly dropped to around -37 US dollars per barrel, meaning producers were effectively paying buyers to take the oil. This was primarily due to a lack of storage capacity as oil continued to be produced but not consumed, thereby creating an oversupply.

As the global economy started to recover from the pandemic's initial shock, fuel demand gradually picked up. However, the recovery was uneven, with some countries experiencing stronger economic rebounds than others. The announcement and subsequent rollout of COVID-19 vaccines toward the end of 2020 and into 2021 provided hope for a global recovery, which helped drive oil prices higher. By early 2021, prices were hovering around 60 US dollars per barrel, as the market began to price in expectations of an economic recovery and a return to higher energy demand.

To gain an understanding of how the African economy operates, consider the following price indicators. The figure below reflects how the price of oil varied before and after different financial crises.

Figure 5:Crude oil prices since 2000

Source: Federal Reserve Bank of St Louis

History of ZAR/USD exchange rate

The 10th of March 1995 marked the end of the dual exchange rate system regime. The local currency experienced a decline due to this situation, and by June 1996, it faced devaluation, where the rand traded at R4.50 against the US dollar. In 1999, the election of the first Black Reserve Bank Governor raised doubts regarding the prospective stability of the South African economy (Masuku, 2016). As a result, the value of the Rand declined, trading at R6 against the US dollar (Mandalos, 2014).

The occurrence of attacks on the World Trade Centre in the United States in September 2001 further impacted the value of the Rand. The currency's value plummeted drastically to R13.84 against the US dollar by December 2001. The abrupt decrease in the value of the Rand prompted an inquiry that was conducted by the

country's authorities, in which the country witnessed an improvement during the period from February 2003 to August 2007, where the Rand traded between R5.64 and R8.06 against the US Dollar.

The Global economic crisis in 2008 which resulted in a recession, however, rendered ineffective all efforts previously done in maintaining the Rands value. By October of 2008 amid the crisis, the Rand had depreciated and traded at R11.85 against the dollar. From May 2009 to December 2012, the Rand showed fluctuations and maintained a trading range between R6.64 and R8.66 against the US dollar, showing stability during that period. Since March 2013, the South African Rand has shown a decline against the US Dollar, and in September 2015, it hit a high of R13.64 per US dollar.

In the year 2019, the world was hit by the COVID-19 pandemic. The beginning of the pandemic caused a rush to invest in safer assets, leading to a notable decline in the value of emerging market currencies, including the Rand. In April 2020, the Rand dropped to an all-time low of about R19 per US dollar due to a decrease in risk tolerance and increased economic uncertainty. The strict lockdown regulations in South Africa, which aimed at controlling the spread of COVID-19, had an effect on important sectors of the economy, such as mining and tourism, which also contributed to the depreciation of the Rand currency.

Figure 6:History of South African Rand/US Dollar exchange rate

Source: Federal Reserve Bank of St Louis

Figure 6 depicts significant fluctuations from the year 2000 and indicates that events like the financial crisis of 2008, changes in commodity prices (including oil) and potential political and economic uncertainties greatly impact the value of the Rand

currency. Further, the consistent rise observed from 2015 to 2022 suggests a depreciation of the Rand against the US Dollar, possibly influenced by a mix of commodity prices and global market sentiment.

1.3. Problem Statement

Recently, the South African economy has been affected by the sudden increase in crude oil prices. This has raised concerns about how these price changes will influence the economy in the long run. However, while a vast literature has been devoted to the analysis of the effects of oil price changes on the exchange rate, there is limited knowledge regarding non-linearity on a country-specific basis, especially following the 2022 energy crisis, which affected the supply of oil globally. Conceptually, the aggregate supply curve would experience a leftward shift due to elevated production expenses resulting from an adverse supply shock, such as a sudden surge in oil prices (Gershon, Ezenwa, and Osabohien, 2019).

It is often concluded that an increase in oil costs may lead to a rise in general prices, which raises production costs in other sectors of the economy (Aye and Odhiambo, 2021). Businesses may choose to increase prices or decrease output to offset the elevated costs of manufacturing resulting from the surge in oil prices. Cost-pull inflation occurs when there is a general increase in production costs, leading to higher prices. A decline in real GDP might occur due to the negative consequences of the oil price shock and declining aggregate supply (Korley and Giouvris, 2022). Consumers purchasing power may be constrained due to rising oil costs and diminished real income resulting from decreased output, resulting in decreased levels of spending and investment. Several factors that may determine the potential consequences of an adverse oil shock include the nature and duration of shocks, where the actual effects on the economy may differ (Aye and Odhiambo, 2021).

Evidence suggests that a sharp decline in crude prices may adversely affect the economy and the financial markets (Aye and Odhiambo, 2021). These may lead to reduced efficiency and a decrease in the competitiveness factor. Thus, assessing how the latest oil price changes have affected the South African exchange rate is relevant. To avoid the impact of fluctuations in oil prices on exchange rates, it is strategic to have some comprehension of the various variables or factors that affect the exchange rate (Korley and Giouvris, 2022).

This research aims to fill an important gap by delving into the differing effects of increasing and decreasing oil prices on the South African Rand (ZAR). It is crucial to grasp these variations to unravel the patterns of exchange rate changes and determine if hikes in oil prices harm the Rand more than the advantages gained from price drops.

1.4. Aims, objectives and research questions of the study

The aim of this study is to investigate the relationship between changes in oil prices and variations in the exchange rate of the South African Rand.

1.4.1. Objectives of the research

Objective 1: To explore the fundamental relationship between fluctuations in oil prices and movements in the exchange rate of the South African Rand, including its general characteristics.

Objective 2: To investigate the extent of asymmetry in the relationship, analysing how increases and decreases in oil prices differently affect the South African Rand.

1.4.2. Research questions

This study aims to explore the relationship between fluctuations in oil prices and the South African Rand exchange rate, specifically through answering the research questions:

1. What is the nature of the relationship between oil prices and exchange rates?

2. To what extent do variations in oil prices asymmetrically affect the exchange rates in South Africa?

1.5. Significance of the research

This study seeks to endeavour and enrich academic knowledge, especially with reference to South Africa. Like many other countries on the African continent, the Department of Mineral Resources and Energy of South Africa has equally experienced volatility because of currency rate fluctuations and the rising cost of crude oil internationally (Hlongwane, 2022). This is especially the case with the fuel levy, which has been put on the importation and the local production of fuel from coal, natural gas, and crude oil, all of which present the interrelated and interdependent nature of these

factors within the South African economy (Department of Mineral Resources and Energy, 2023).

The majority of research assumes symmetry in the effects of oil price changes on exchange rates, treating increases and decreases as having equal but opposite impacts. However, theoretical considerations such as transaction costs, market frictions, and behavioural responses suggest that this assumption may not hold. By modelling asymmetry explicitly, this research reveals whether oil price increases exert a stronger influence on the South African Rand compared to price decreases, providing a more nuanced understanding of exchange rate volatility.

Traditional econometric approaches like ARDL or standard VAR models often dominate analyses of this relationship. However, these methods may fall short in addressing the complexity of data limitations in emerging economies like South Africa. This study applies a Bayesian Vector Auto-Regression (BVAR) model, leveraging Bayesian priors to overcome data constraints and enhance the reliability of the analysis. This approach is particularly suited to the volatile and interdependent nature of South Africa's macroeconomic variables.

While global studies have explored the oil price-exchange rate nexus, South Africa-specific analyses remain limited, particularly in the aftermath of the 2022 energy crisis. The unique challenges faced by South Africa, such as its dependence on oil imports, structural economic vulnerabilities, and fiscal constraints, are often underrepresented in the literature. The research also builds on studies by addressing the gaps in existing literature regarding the correlation between variations in oil prices and exchange rates in South Africa. This issue is particularly significant in South Africa due to the lack of research on how oil price asymmetries impact its exchange rate beyond oil crises, given that most studies tend to concentrate on impacts on exchange rates overall.

This research is particularly relevant now because it includes information on the challenges that have emerged due to the global energy crisis in 2022. This study offers new empirical insights into how external shocks impact South Africa's economic stability. In this regard, the outcomes of this study are useful for policymakers to address the regular shifts of oil prices in the international market. In addressing this issue, this research contributes to the understanding of the existing link between oil prices and currency rates. It may be used to design better and more flexible economic

policies. Government authorities and institutions such as the South African Reserve Bank can apply this insight to modify some current policies or implement new measures that would help prevent the negative impacts of the fluctuation of oil prices on the economy. Given the SARB's key role in managing exchange rate stability, monetary policy, and inflation targeting, it can adjust interest rates, intervene in foreign exchange markets, or implement macroprudential policies to counteract the inflationary pressures and currency depreciation resulting from rising oil prices. This is especially so for countries whose economic activities are primarily dominated by oil prices, as a single increase in price can trigger a host of economic shocks that are equally adverse to growth and development.

1.6. Limitations to the research

The study has certain limitations that need to be considered when interpreting the results. The complexity and forever-changing global oil market present significant challenges in isolating the specific impact of oil price changes on the economy of South Africa. Fluctuations in oil prices are influenced by numerous factors such as political unrest, advances in technology, and demand changes (Aye and Odhiambo, 2021). These external factors make this environment very volatile, hence the fluctuations in the correlation between oil prices and other macroeconomic variables like the exchange rates. The study tries to capture such relationships, but given that the world is rapidly evolving, it becomes difficult to point directly to the cause of such relationships. Due to the complex phenomenon involving both oil prices and exchange rates being affected by other conditions within the global economy, the conclusion that an increase in one leads to a decrease in the other is only valid within certain conditions and for any new world conditions and circumstances (Korley and Giouvris, 2022).

There are also certain limitations arising from the historical data the study uses in its analysis. Co-integrating and trend analysis rely on historical data and, as such, may not give a comprehensive picture of current or future relationships in the global oil market (Aye and Odhiambo, 2021). For instance, the fast advancement in the enhancement of other energy sources, new patterns of trading in the global market, or shifts in customers' behavior might change the correlation between oil prices and currency fluctuations more than estimated from past data (Gershon et al., 2019). Furthermore, historical data may also contain several biases, for example,

survivorship bias or data revisions, which can affect the results of the analysis. As a result, some of the study's key findings, which describe the nature of historical correlations between oil prices and exchange rates in the context of South Africa, might not be as applicable to particular future trends in South Africa because of the country's exposure to the valuable characteristics of the global economy.

Another significant limitation that may be associated with the research is that the study utilizes South Africa as the leading case under consideration. Employing data from South Africa can also be justified since it is one of the largest economies in the region, and its economic structure, policies, and external vulnerabilities are rather different from those of many other net oil-importing countries (Korley and Giouvris, 2022). There is, however, reason to believe that South Africa is far more diversified and has a far more developed financial structure than most other similar countries and, therefore, may have a quite different response to fluctuations in the world prices of oil. For instance, the ways by which oil prices affect the exchange rate and economic stability in South Africa may be different from the ways they affect another less diversification-oriented country, a country with lower dependence on the import of oil, or a country with a different monetary policy (Gershon et al., 2019). Thus, the conclusions drawn in the study could be incredibly useful to consider in the South African case. It is less applicable to countries that have different economic settings and levels of oil sensitivity. This limitation necessitates future research that considers countries beyond South Africa for the topic to be captured in its entirety in different regions (Aye and Odhiambo, 2021).

The study is also limited to the use of secondary data only, and there could be selection bias or reporting bias at some point, which affects the study results. (Aye and Odhiambo, 2021). The issues raised with the possibility of data gaps and inaccuracy also call for some level of caution when interpreting the findings and recommending policy action the study highlights (Korley and Giouvris, 2022).

1.7. Research Structure

This research is completed in five chapters, as illustrated in the title for each chapter, and a summary of the content.

Table 1:Research Structure

Chapter 1: Introduction	Offers an introductory overview and contextual background to this study. This chapter includes the problem statement, study objectives, significance as well as limitations of the study.
Chapter 2: Literature Review	Provides a comprehensive evaluation of theoretical and empirical literature related to the association between oil prices and exchange rates. It also offers insights on how other macroeconomic variables influence the exchange rate.
Chapter 3: Research Methodology	A comprehensive analysis is provided regarding the methodology employed in this study.
Chapter 4: Analysis and Discussions	This chapter will involve making use of statistical tools to analyse and interpret results from the data collected to find out more about trends, relationships, and patterns.
Chapter 5: Conclusions and Recommendations	This concluding chapter will reiterate the main findings of the research and evaluate the extent to which the research questions were answered. This will articulate policy implications and propose ways that would help to reduce the effect of the changes of oil prices, expounding on its findings as a contribution to extant literature. The chapter will also identify the limitations of the study and give recommendations for future research. Lastly, the conclusion will summarize the general importance of the research.

2. CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This literature review provides a comprehensive overview of the theoretical and empirical literature concerning the impact of oil price fluctuations on exchange rates globally, with a particular focus on the South African economy. It explores how these fluctuations affect the value of the South African Rand and whether the effects are asymmetrical, based on existing economic theories and empirical evidence. The review is divided into two sections: The first explores key theoretical frameworks that will provide a foundation for understanding how oil prices influence exchange rates, and the second section explores empirical evidence that assesses these theories in practice in the context of South Africa to understand how oil price changes specifically affect South Africa.

Theoretical literature lays the groundwork for grasping the effects of fluctuations in oil prices on currency exchange rates; meanwhile, empirical studies delve deeper into the implications of these theories in different scenarios. South Africa faces challenges in managing the fluctuations in its currency owing to its characteristics. It is important to understand how changes in oil prices impact the value of the South African Rand (Sibanda, Hove, and Murwirapachena, 2015).

2.2. Theoretical Frameworks

Theoretical models that explain how oil prices affect exchange rates include four theories: the terms of trade effect theory, currency substitution theory, the purchasing power parity theory (PPP), and wealth effect theory (De Villiers ,2019). These frameworks offer reasoning for the impact of oil prices on the economy (Sibanda et al., 2015).The Terms of Trade hypothesis highlights the influence of oil price changes on trade balances, while the Wealth Effect theory examines impacts on consumption and investment (Udeagha and Ngepah, 2021). The PPP theory establishes a connection between exchange rates and global commodity prices. On the other hand, the Currency Substitution Theory explains how a more stable foreign currency is encouraged through considerable changes in oil price buying (De Villiers, 2019).

Although these theories provide robust explanations for market behaviors and trends, some theories have proven to have specific weaknesses, as some are based on an ideal market model that does not include all the realistic factors (Hlongwane, 2022). Hence, this theoretical framework scrutinizes these concepts to understand better how oil prices relate to exchange rates and other economic effects on oil-susceptible nations.

2.2.1. Terms of Trade Theory

The principle of the terms of trade is the effect of the export and import prices for trading partners or oil-importing countries. A definition of terms of trade refers to the relative price of exports to imports or simply the ratio of export price to import price (Udeagha and Ngepah, 2021). Those countries that import most of their requirements of oil can easily see their import bill shoot up when the price of oil goes up. It causes deterioration of the terms of trade as the country has to spend more local currency to purchase the same quantity of oil (Obi, Anarfo, and Obi, 2019). This may lead to a trade deficit as the value of imports exceeds exports (Dada and Akinlo, 2022). This, therefore, calls for the use of foreign currency in purchasing more expensive imported oil, thereby eroding the value of the domestic currency. On the contrary, the decline in oil prices can enhance the terms of trade for these economies (Hlongwane, 2022).

When the price of oil declines, this means that the cost of imports is low; thus, a boost in the trade balance could lessen the demand for foreign currency and consequently appreciate the currency (Udeagha and Ngepah, 2021). In addition, a strong domestic currency makes imports cheaper, which leads to an increase in purchasing power for consumers, which could potentially influence economic growth. The terms of trade effects are clearly marked in an economy such as South Africa, for it is overly sensitive to changes in the prices of oil in relation to other commodities, as reflected in the trade balance and value of the currency. Empirical studies in South Africa, such as Hlongwane (2022), have investigated this relationship in detail.

As compelling as the terms of trade effect provides a mechanism for how oil prices may influence currency values, it is essential to appreciate that this does not have to be linear or of any predetermined nature (Alwerfalli, 2022). One of the most significant limitations of this concept is that it presumes that oil prices exert an immediate influence on the trade balance and the value of the country's currency. For instance,

some countries may have hedging policies or long-term contracts for crude oil with an assurance that they are immune to the volatility of oil prices in the short run, and therefore, their terms of trade may not be significantly affected (Juvonen and Schulstad, 2023). For example, a country such as Norway has long-term contracts for natural gas, which protects it from the immediate impact of oil fluctuations. This means that its currency is not directly impacted by changes in oil prices in the short run (Kedzierski, 2023). In addition, countries such as Venezuela may still experience hyperinflation despite the country being reliant on oil exports (Monaldi and Reyes, 2020). This demonstrates clearly how the relationship between oil prices and exchange rates is not straightforward.

Besides the effect of changes in oil prices in global markets, the value of a country's currency may be countered by other factors, including policies put in place by the country's reserve bank or changes in the demand for the country's other primary exportable goods (Beckmann et al., 2020). Sometimes, even where there is a theoretical depreciation or appreciation of a currency based on changes in oil prices, this may not occur or may do so with a delay (Hlongwane, 2022). However, more often, the terms of trade affect the trade balance and the trade balance in commodities. It may fail to consider other factors that may impact the flow of such funds, such as capital movements or investors' attitudes to the exchange rates (Alwerfalli, 2022). Therefore, the terms of trade effect, even when used to compare oil prices with currency values, should be done while bearing in mind those other factors that may be at work to tone down the shock effect. Changes in the terms of trade have an impact on a country's wealth due to fluctuations in oil prices. This is a connection that clarifies the decline in the economic situation and triggers the wealth effect phenomenon. When trade terms deteriorate, usually caused by changes in oil prices, the nation experiences a reduction in both income and wealth levels, which results in lowered confidence among consumers and investors and subsequently weakens the currency (Udeagha and Ngepah, 2021).

2.2.2. Wealth Effect Theory

The Wealth Effect Theory refers to changes in perceived wealth that affect the economic activity of individuals, especially regarding consumption. This theory is quite vital in explaining the relations between oil-exporting countries and oil-importing

countries (Chen, Chang, Fu, and Xie, 2024). When this theory is used in the understanding of oil currencies, particularly in South Africa, it gives useful knowledge on the influence of oil price changes on the country and its respective exchange rates. Countries exporting oil tend to gain from oil prices as it boosts their currency's value. When oil prices go up in these nations, they see a rise in revenue, which strengthens and raises the demand for their currency. This interplay establishes a connection where escalating oil prices align with stronger currencies in exporting nations and weaker currencies in importing nations. (Huang, Bossman, Gubareva, and Teplova, 2024). It assists in an approach to establishing the effect of changes in national wealth, particularly in modifications of oil prices and the implication of the currency's strength and overall performance of the economy.

Concerning South Africa, an increase in the price of oil in the global market means that the country imports less oil; hence, national wealth is reduced. The amount of capital that is used in other economic activities is reduced; hence, the depreciation of the national currency (Sanusi and Kapingura, 2022). Suggestively, the Wealth Effect Theory is especially relevant to the country of South Africa, as the country’s oil and exchange rate relationship reflects characteristics in line with the theory. Hlongwane (2022) asserts that South Africa is a perfect illustration of the Wealth Effect Theory at work. For instance, South Africa has seen a high devaluation of its currency, especially during high crude oil prices around the world. The availability of higher-priced imported oil has affected the inflation rates directly, thereby slowing down the rate of economic growth, particularly among oil-importing nations in the region.

Additionally, the depreciation of the currency also affects investor confidence. Competitive currency devaluation sends negative signals to other economies, and their investors perceive it as an indication that the economy is unstable, hence promoting the outsourcing of their capital (Ncanywa and Ralarala, 2019). This can result in a vicious cycle where the depreciation of the currency is followed by more economic turbulence, causing further depreciation of the currency. It is, therefore, important for oil-importing countries in Africa to gain insights into how this Wealth Effect Theory will respond to produce the right policies to mitigate the effects of changes in oil prices (Saidu et al.,2021). The Wealth Effect theory provides evidence that it influences purchasing power and leads to inflationary pressures that can disrupt the equilibrium explained by PPP theory. If South Africa experiences higher inflation

compared to its trading partners due to rising oil prices affecting import expenses, there is a necessity for the Rand's depreciation to restore equilibrium in purchasing power between currencies (De Villiers, 2019).

2.2.3. Purchasing Power Parity

The connection between oil prices and exchange rates is well known, and the PPP theory offers a framework for understanding this connection (Siddiqui, Ahmed, Naushad, and Khan, 2023). Variations in the price of oil can be used to balance a country's terms of trade and to manipulate its exchange rate. For example, if the price of oil increases in a net-oil-importing country, this will cause the cost of imports to go up, which will lead to a high demand for the foreign currency (Gershon et al., 2019). Considering the increased demand for foreign cash, this circumstance may cause the value of local currency to decline. In contrast, for nations that export oil, rising oil prices result in an increase in the value of their national currency due to the increased revenues from exporting oil; thus, there is a greater demand for that nation's national currency on the global market (Siddiqui et al., 2023). According to the PPP theory, these fluctuations in exchange rates eventually result in adjustments to the relative costs of commodities, restoring the exchange rate to its PPP. However, this gradual adjustment is subject to government policies, market expectation rates, and several country inflation rates.

Although PPP can offer a useful practical and theoretical approach to analysing the relationship between exchange rates and oil prices, it has drawbacks. PPP has been criticized because the model is based on a perfect market with no transport costs and trade barriers (Zhang, Bian, and Zhan, 2022). Such factors regularly affect the exchange rate, so PPP is not predominantly achieved due to these factors (Vo and Vo, 2023).PPP also supposes that products are perfectly mobile and that consumers can easily switch from domestic to imported goods. However, in the case of oil, due to geopolitical risks, availability of resource interruptions, and differences in production efficiency, the price volatility between the countries is more than the fluctuations in the exchange rate (De Villiers, 2019). Also, in an empirical analysis, Alwerfalli (2022) noted that despite the validity of PPP in the long run, PPP can often not predict short-term exchange rate movements.

Some factors affecting exchange rates include the price level, but many others include interest rates, capital flows, and investor sentiments. Therefore, relying so much on PPP to explain the exchange rate movement, particularly on the oil price, will likely result in oversimplification (Alwerfalli, 2022).

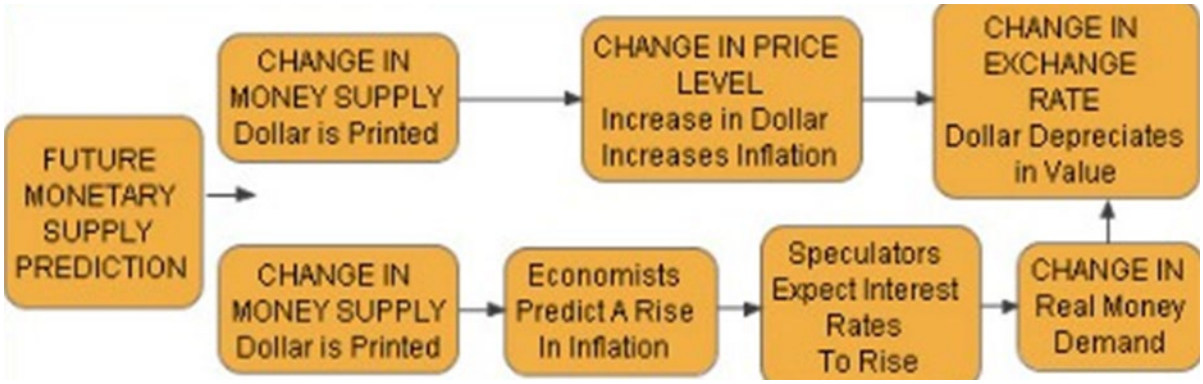
2.2.4. Currency Substitution Theory

The theory of currency substitution examines the tendency of individuals and firms in countries with unstable currencies to replace foreign currency with more stable foreign currency for transactions and savings purposes (Akinlo, 2022). This theory particularly holds relevance for countries perpetually going through heavy economic instability and currency volatility. Substantial oil price swings tend to further heighten currency instability in oil-importing countries. If oil becomes much needed, the heightened cost of imports may trigger trade deficits, ultimately putting a dent in the stability of the local currency (Korley and Giouvris, 2022). Due to currency devaluation, individuals and businesses may use more stable foreign currencies, such as the US dollar or the euro, in their transactions and savings. Such behaviour is generally referred to as currency substitution. Significant currency substitution further weakens the demand for domestic money, leading to its further depreciation. The increase in the usage of foreign currencies also has implications for monetary policy efficiency since the central bank will have lower control over the money supply and inflation (Akinlo, 2022). Thus, significant changes in oil prices can potentially trigger higher levels of currency substitution and alter exchange rate dynamics.

Despite the importance of the currency substitution theory as a conceptual tool for explaining the behaviour of people and companies in countries with a tendency towards an unstable monetary value, it is possible to identify some of its weaknesses worthy of criticism (Dada and Akinlo, 2022). One of the most obvious objections is that this model presupposes ‘rational’ behaviour of individuals and companies, who should switch to a more stable foreign currency as soon as their home currency devalues (Dada and Akinlo, 2022). However, this assumption fails to consider several factors and hindrances, such as legal frameworks that may not allow people to transact with foreign currency, transaction costs, and the circulation of foreign currency in the domestic market (Mohammed and Abid, 2020).

Furthermore, the theory often overlooks other important domestic factors, including government factors and the financing methods for making the effect of currency substitution either larger or smaller. Although the theory is clear that currency substitution leads to instabilities in the domestic economy, the theory falls short of analysing the macroeconomic consequences, such as capital flight, loss of monetary control, and long-term reliance on foreign currencies (Korley and Giouvris, 2022). These can worsen economic fluctuations and result in a cycle of instability that the theory does not capture well. Thus, although the currency substitution theory enables us to look at some of the characteristics of selected currency movements in the economy, more light should be shed on the applicability of the concept and the circumstances that induce currency substitution.

Figure 7: Currency Substitution Flowchart



Source: Forex Karma (2024)

Figure 7 depicts the Currency Substitution Theory and how changes to the monetary base will affect different variables in the economy. Like the above-discussed mechanism, the increase in dollar supply also harms the economy and is predicted to cause higher levels of inflation due to the high money supply. The mobility of real money arises due to the self-fulfilling expectations of the speculators that move away, hoping to gain from higher interest rates. This diagram demonstrates how monetary supply forecasts, inflation, exchange rates, and total money are daily preoccupations for anyone in the realm of currency substitution.

Although currency substitution plays a role in understanding the behaviour of macroeconomic variables. However, in periods where there is high inflation and an exchange rate crisis, South Africa's central bank has effectively upheld inflation

targeting and exchange rate stability in the past years, thus limiting the likelihood of widespread currency substitution (International Monetary Fund, 2020).

2.2.5. Theories guiding the study.

Although the four theories help the study to understand the notion that oil prices can influence the macroeconomic situation and the currency of countries that engage in oil imports. However, the study to a great extent relies on the terms of trade effect and the wealth effect theory, as both of them are closely linked with the analysis of fluctuation in oil prices having an impact on the economy of South Africa. These theories form a basis for exploring the impact of fluctuations in oil prices on South Africa's economy with a focus on trade balance and overall prosperity aspects specifically highlighted in the study. The aim is to offer an analysis of how shifts in oil prices could influence the country's currency and macroeconomic stability by delving into these theories. By considering these theories, understanding potential risks and opportunities stemming from oil price changes, for South Africa's economy can be enhanced. The effect of global oil prices put South Africa as a net importer of oil, and the explanation by the terms of trade has clearly expressed how the soaring oil price is considered a blow to the trade balance and currency value of the country. In South Africa, when global oil prices surged in the early 2000s or during the 2008 financial crisis, the trade deficit worsened as oil imports became more expensive. This was followed by a sharp depreciation of the Rand, illustrating the practical implications of the term of trade theory (Habanabakize, 2020).

The wealth effect theory also applies because when the prices of oil experience a significant increase, it may lead to an increase in costs for both businesses and customers, which in turn leads to a decrease in the overall economy and investor confidence. When oil prices surged in the late 2000s, South Africa faced high inflation and slower economic growth, contributing to the depreciation of the Rand (Nkomo, 2006). This can be linked to the wealth effect theory, where the country’s reduced national wealth led to lower growth and weaker currency demand. These two theories are the best foundation for the analysis to be done on how the change in the price of oil drives the change in the South African exchange rate and stability of the country's economy.

The theoretical models reviewed offer insights into how oil price fluctuations could affect exchange rates in economies like South Africa. In the following empirical section, studies that test these theories are examined and explore whether the impact of oil prices on the South African exchange rate follows the patterns predicted by the theoretical models.

2.3. Empirical Literature

Empirical studies have extensively examined the relationship between oil prices and exchange rates, with findings that both validate and refine the theoretical models discussed earlier. In the South African context, these studies reveal the unique vulnerabilities and responses of the Rand to oil price fluctuations.

2.3.1. Oil-importing countries vs oil-exporting countries

The general assumption on the relationship between the two variables is that oil-importing countries generally see currency depreciation with rising oil prices and currency appreciation with falling oil prices, mainly due to trade balance effects and inflationary pressures, while oil-exporting countries typically experience currency appreciation when oil prices rise and currency depreciation when oil prices fall, as their trade surpluses (due to oil exports) and overall economic health are directly linked to oil prices (Zorgati, 2023).While there are studies that have found no relationship between the two variables (Mollick and Sakaki ,2018; Reboredo and Rivera-Castro ,2013; Tancho and Jermsittiparsert ,2020). There are studies that show evidence that the relationship between the variables depends on whether a country is a net exporter of oil or a net importer of oil.

2.3.1.1. Evidence from net-oil importing countries

Hamilton (2009) set the stage, investigating the impact of the 2007/2008 global oil shock crisis by looking at the impact on exchange rates from increases in the price of oil in oil-importing countries. The author argued that the 2007/2008 oil price shock was driven by a combination of factors in the supply and demand of oil. The author also suggested that the depreciation of the US dollar, which resulted in expensive oil, is what contributed to the oil price spike. The study also found that higher oil prices lead to inflation, which can have a negative impact on the growth of the economy, while lower oil prices are often associated with a stimulated demand and hence, a positive reaction to the growth of the economy.

As oil price increases are said to have a negative impact on the economy, Cashin, Mohaddes and Raissi (2012) confirmed that higher oil prices lead to depreciation in the exchange rate. The authors argued that increases in oil prices result in heightened import costs, which cause inflationary pressures that would influence the balance of trade negatively and eventually weaken the currency. This trend is particularly relevant in South Africa, as Moroke, Mukuddem-Petersen, and Petersen (2013) employed the Vector Error Correction model (VECM) and found that the impact of oil prices on exchange rates was more pronounced in the short run than in the long run. The findings highlighted that increases in oil prices weaken the Rand, whereas decreases in oil prices strengthen the Rand.

Niyimbanira (2013) investigated the relationship between oil prices and inflation and how it affects economic growth in South Africa. Results of the study showed that oil price variations impact exchange rates in the long run, of which the impact on exchange rates is noted to be higher than the impact of oil prices on other economic indicators such as inflation and output. The debate about this relationship is, though, far from being settled, as Turhan, Hacihasanoglu, and Soytas (2013) came up with an opposing view suggesting that the relationship between oil prices and exchange rates in oil-importing countries is positive. The authors contend that the increase in oil prices leads to increased foreign reserves, which elevates the country's economy. This then leads to an increase in the demand for the domestic currency, which then strengthens the value of the currency.

Over time, South Africa faced challenges with currency fluctuations driven by oil price variations. Segal (2021) and Korley and Giouvris (2022) warn of a possibility that investors could become less optimistic about investing in the country's markets as they may worry about uncertainty or reduced profits resulting from higher oil prices impacting their investments; this could result in funds leaving the country, leading to a decrease in the value of the Rand. During times of oil price fluctuations, investments can become quite unstable. When investors anticipate a decline in the economy because of soaring oil prices, this results in a reduced demand for the Rand, which further depreciates its value.

Hlongwane (2022) supported the idea by connecting exchange rates to the trade balance, arguing that a larger trade deficit results in a weaker South African currency.

Bruna and Van Tran (2023) adopted a Bayesian Vector Autoregressive (BVAR) model with sign restriction to discover the effect of oil price shock on the EUR/USD exchange rate. The authors found that the manner in which exchange rate movements are endogenously associated with oil prices depends on the nature of the price change, arguing that variations in the price of oil might not influence the exchange rate as such; however, large changes lead to significant changes in the exchange rate. Although the study provides valuable information on the relationship, the findings are referred to from a certain setting and may not be applicable in a country like South Africa. The links uncovered could also present challenges for policymakers looking for recommendations to alleviate the impact of oil shifts.

Huang et al., (2024) and Chen et al., (2024) provided empirical evidence of the long-term relationship between oil prices and the exchange rates in oil-importing countries like South Africa. Utilizing the TVP-VAR connectedness model, Huang et al., (2024) demonstrated that exchange rates are affected by oil prices primarily due to trade balances and the outflow of capital. While Chen et al., (2024) found that oil price changes affect the perceptions of wealth and spending habits in countries that rely on oil imports. By looking at the effect on wealth, higher oil prices can diminish a country's wealth by raising the costs of imports, leading to a decrease in consumer expenditure and shifting spending behaviours. When people feel less wealthy, they often spend less money, which leads to a decrease in the value of the Rand as more people seek other foreign currencies. Additionally, the focus of the research on consumer habits resonates with the landscape of South Africa, where the spending behaviour of individuals greatly influences economic growth. Both studies by Huang et al., (2024) and Chen et al., (2024) underscore the significance of handling inflation expectations since rising oil prices might worsen inflation levels, decrease income, and adversely affect the Rand's value. The conclusions from the studies align with both the terms of trade and wealth theory, as findings assert the definitions of the theories. The results of the research hold importance for South Africa as the country is affected by escalating oil prices, resulting in expenses for energy resources and imported goods within the country's economy.

Studies done on net oil-importing countries offer a view on the nature of the relationship between oil prices and exchange rates. Most countries face challenges associated with increased costs and currency devaluation from rising oil prices. In

contrast to oil-exporting countries, which experience revenue boosts and currency appreciations when oil prices increase (Huang et al., 2024). This contrast underscores the significance of examining both sides of effects stemming from oil price fluctuations on a global scale.

2.3.1.2. Evidence from Net Oil Exporting Countries

In one study, Iwayemi and Fowowe (2011) looked at Nigeria's experience with changing oil prices and its effects on the Naira's exchange rate over a period spanning from 1970 to 2006. The authors found that there was no meaningful long-term correlation between the price of crude oil and Nigeria's foreign exchange revenues or reserves, suggesting that there may be other factors that played a role that is more significant in influencing Nigeria's exchange rate. These factors may include government policies, global economic conditions, and the country's market conditions. Similarly, Ojebiyi and Wilson (2011) found that there is a weak negative relationship between oil prices and the exchange rate in Nigeria. The author supports the argument that there are other macroeconomic variables that significantly affect the value of the Naira beyond oil prices.

Baumeister and Kilian (2016) examined how changes in the price of oil affect a sample of countries that export oil. They found that oil price increases led to appreciations in exchange rates, primarily driven by portfolio balance effects and income redistribution channels. This pattern of effects continued and was also supported by Hasanov, Bulut, Suleymanov, and Aliyev (2017), where the authors found that fluctuations of oil prices play a role in shaping the value of currencies in countries such as Azerbaijan, Kazakhstan, and Russia. The authors assert that when oil prices rise, it often leads to increased spending within the countries, causing the effective exchange rate to appreciate. These findings by the authors are consistent with the wealth effect theory, which has previously been discussed. With the currency appreciating, it will boost investors' confidence in the currency while counteracting inflationary pressures.

Vandyck et al. (2018) discovered how various oil-exporting regions are vulnerable due to changes in the global prices of crude oil. The study starts with an overview of the forces driving the global oil market and then gives a narrative description of regional economic vulnerability to oil production and prices. The analysis also evaluated additional indicators of macroeconomic consequences of the reduction of crude oil

prices by 60 percent, based on the causes that led to the decline of crude oil prices during 2014 and 2016. The findings indicated that the drop in oil prices resulted from several factors in a cocktail manner, in support of theories relating to the collapse of the commodity super cycle. Nonetheless, the study also recognizes that such an understanding of the extent to which price impacts or such deeper influences requires a complex analysis, specifically of regional sensitivities and market forces.

Mohammed, Afangideh, and Ogundele (2019) employed the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) and Exponential GARCH (EGARCH) to understand the relationship between oil prices and exchange rates. The study found that fluctuations in oil prices have an effect on the currency values of oil-exporting nations like Nigeria. When oil prices go up, Nigeria sees the value of its currency decline. When prices drop, it gains strength instead. This study particularly offers insight and clearly indicates the complexities of the nature of this relationship due to the study reflecting a different result from what is known to be the general assumption relating to oil-exporting nations. This view was also supported by Akinlo (2019) who discovered that changes in oil prices had a significant impact on the exchange rate, stating that a 1% increase in the price of oil causes a 0.16 % drop in the value of the Nigerian Naira.

Nwosa (2020) investigates the impact of COVID-19 on oil prices, exchange rates, and stock markets in Nigeria. The research found that the COVID-19 pandemic negatively affected the oil price in Nigeria, along with its influence on the exchange rate and equity market performance in the country. The author noted that changes in oil prices affected both exchange rates and the performance of the stock market, with shifts in the exchange rate playing a role in influencing stock market performance. In essence, it was concluded that the consequences of the COVID-19 pandemic would have implications for multinational corporations and foreign direct investment (FDI) inflow in Nigeria. The study offers great insights as it touched on the COVID-19 pandemic and its effects, given that the pandemic was one never witnessed before. By analysing various macroeconomic variables (oil prices, exchange rates, and stock prices), the study also provides an even further perspective on the connection between the variables. The study does, however, have certain limitations. The data used for the study is only from the period 1 December 2019 to 3 May 2020. This may not fully reflect the true trends of the relationship between the variables. A longer time frame

might be able to offer a greater insight into how oil prices continue to influence exchange rates. Secondly, the study also places an emphasis on the COVID-19 pandemic being the driver of changes in oil prices and exchange rates; this might overlook other factors that influence this relationship, such as the demand and supply of oil.

Not all oil-exporting countries react the same way to changes in oil prices. For instance, Sanusi (2020) investigated this relationship in twenty-five oil-exporting countries, employing the non-linear vector autoregressive (NARDL) model. The study found that when oil prices rise, there is a somewhat smaller or close to no impact on the stability of the exchange rate. However, only decreases in oil prices have a significant impact on exchange rates, revealing an asymmetric connection between oil prices and exchange rates. This view is supported by Onodje, Oke, Aina, and Ahmed (2021) and Ajala, Sakanko, and Adeniji (2021), also adopting the (NARDL) to investigate the impact of oil prices on the Nigerian exchange rate. The study recognized that the impacts of oil price changes are not uniform. The study offers great insights on the relationship, particularly on asymmetries; however, there are limitations. While the NARDL is a useful model to capture asymmetries between variables, the model highly relies on the model specification, lag selections, and the selection of variables. Misspecification can lead to biased results (Naeem, Sa'ad, Sanusi, and Usman, 2023).

Further studies, such as those by Seraj, Mar'I, Abdulkareem, and Turuc (2021) explored the relationship in five major oil-producing countries. The study reveals that there is a relationship between the prices of oil and exchange rates, showing that fluctuations in the oil market have a significant impact on exchange rate fluctuations; however, the impact differs depending on production capacities and economic conditions. Joseph, Dieudonne, and Armando (2024) also in support of this notion, added by stating that the effect on exchange rates from demand shocks is more pronounced than the one from supply shocks. On the other hand, however, Gulaliyev, Musayeva, Musayeva, Jabbarova, and Hatamov (2023) found that it is only in the long run where exchange rates in oil exporting countries are influenced by oil prices.

The reviewed studies collectively affirm the significant impact of oil price fluctuations on exchange rates, with asymmetries playing a central role. Even with research done

from oil-importing and exporting countries, some results are not consistent with the general assumption of oil shocks on the exchange rate, meaning that the results cannot be generalized and therefore bring about the need for country-specific analysis at specific time periods, given different economic factors. South Africa exhibits unique patterns that require focused analysis. Having explored the relationship between oil prices and exchange rates in oil-exporting countries, it is important to consider how other economic factors affect the exchange rate. While the general assumptions regarding oil-importing and oil-exporting nations are prevalent, it is crucial to note that exchange rates are influenced by a range of factors that can either support or counteract the relationship.

2.3.2. The influence of other macroeconomic variables

Given that the complex nature of the relationship has been confirmed, when exploring how other macroeconomic factors impact exchange rates, it is important to understand that the connection between currency values and oil prices is shaped by various factors. Although changes in oil prices have an impact on exchange rates, several macroeconomic variables also play a role in this relationship. Variables such as interest rates, inflation, and stock prices.

All these factors can either strengthen or weaken the relationship between the two variables. For example, while a lower interest rate can strengthen the value of the country's currency through foreign investment inflows, inflation can lead to reduced purchasing power, which leads to a depreciation of the currency. In addition, the fluctuation of prices in the stock market can affect exchange rates as investors move their investment portfolios between assets. According to Kilian and Zhou (2022), interest rates and inflation rates are fundamental variables that can interfere with the correlation between oil prices and exchange rates. For example, the prolonged increase in the price of oil during the 2000s can be linked to the decline in the value of the US dollar and the low real interest rates in the U.S. coupled with a rise in global economic activity. The authors noted that it would be challenging to measure the impacts of each variable individually due to the close relationship between interest rates and exchange rates, specifically. Further, the fluctuations in the demand and supply of oil in the oil market can affect the value of the US dollar as well as the real interest rates.

Beckmann et al. (2020) discovered that high interest rates weaken the currency by affecting foreign capital, while lower interest rates strengthen the currency. This relationship highlights the need to understand the issues that result from monetary policy as opposed to those from oil price changes. In order for policymakers to make informed decisions and implement appropriate policies, it is important to understand the relationship between interest rates, exchange rates, and oil prices and highlight the role that each variable plays in impacting the economy. Breitenbach, Zerihun, and Kasongo (2020) investigated the correlation between exchange rates and real interest rate variances within nations, focusing on inflation targeting practices. By analysing data collected quarterly from 1993 to 2018 across countries, they discovered indications of cointegration, which implies that though there exists a prolonged association, the results may not show divergence from countries that do not implement inflation targeting measures. This finding reinforces the idea that monetary policies play a role in shaping the dynamics of this correlation.

Whereas inflation means a constant decline in purchasing power and causes a depreciating currency (Beckmann et al., 2020). In determining the overall inflation rate in South Africa, there is a relative interplay between oil prices, exchange rates, and inflation rates. Especially given the fact that inflation in the country is often reflected through factors such as food and energy prices. Studies have shown a link between inflation and real exchange rates over time. There is evidence that suggests that a 1 percent increase in the exchange rate results in a 2 percent rise in the inflation rate in the long run (Emikonel and Orhan, 2023). Studies by Semosa and Aphane (2017) and Miyajima (2019) further confirm that when the Rand decreases in value, it often leads to a rise in inflation rates.

The connection between inflation and exchange rates can be quite intricate in nature. For example, in a study by Leshoro (2014) the author discovered that although the initial impact of depreciation could lead to inflation, this relationship can evolve over time, showing a nonlinear pattern where inflation might eventually decrease after extended periods of currency devaluation. The International Monetary Fund (2019) discovered that although headline inflation usually shows more pass-through from exchange rate movements than core inflation does, this difference is not as evident in South Africa. The research indicated that core inflation is affected by fluctuations in

the exchange rate, but to a degree, it supports the idea of a floating exchange rate system as a buffer against shocks.

Schaling and Kabundi (2014), however, pointed out that although a devalued Rand could potentially enhance export competitiveness over time and lead to increased exports in the longer term, the research indicated the immediate advantages may not be realized due to short-term price fluctuations resulting from inflation. In a study carried out by Kabundi and Mbelu (2018), on Exchange Rate Pass-Through (ERPT) in South Africa, it was discovered that the impact on headline inflation was around 0.2-2.5 percent in the period 1994 - 2014. The research utilized a two-stage model to differentiate between the impact on import prices and subsequent effects on consumer prices. The findings reflected that exchange rate fluctuations directly impact import prices swiftly and completely in the first stage, while importers only partly transfer these expenses to consumers in the second stage.

Fraiz and Fatima (2016) studied how the growth in GDP is linked to inflation, interest rates, and exchange rates. The authors collected time series data and employed OLS regression and Granger causality tests. The findings revealed that inflation, interest rate, and GDP growth significantly impact exchange rates in both developing countries and developed countries. Cabral, Carneiro, and Mollick (2018) found that exchange rates play an important role as a determinant of response from central banks in countries that follow non-inflation targeting strategies. The findings suggest that inflation has a significant impact on the exchange rate, more so since the 2008/2009 global financial crisis. In times of global crisis situations, central banks might have to consider the impact of exchange rates when deciding on policies. The study underscores the complex interplay among central bank responses, inflation, and exchange rates across different economic landscapes.

Olamide, Ogujiuba, and Maredza (2022) employed estimation techniques such as Generalized Methods of Moments (GMM) Pooled Mean Group (PMG) and Dynamic Fixed Effects (DEE) techniques for the analysis linking currency values to economic expansion in the Southern African Development Community. The results showed the effects of inflation and fluctuations in exchange rates to be negative towards economic growth. A greater degree of volatility in the currency exchange rate is associated with increased fluctuations and a negative impact of inflation and economic growth. Tey,

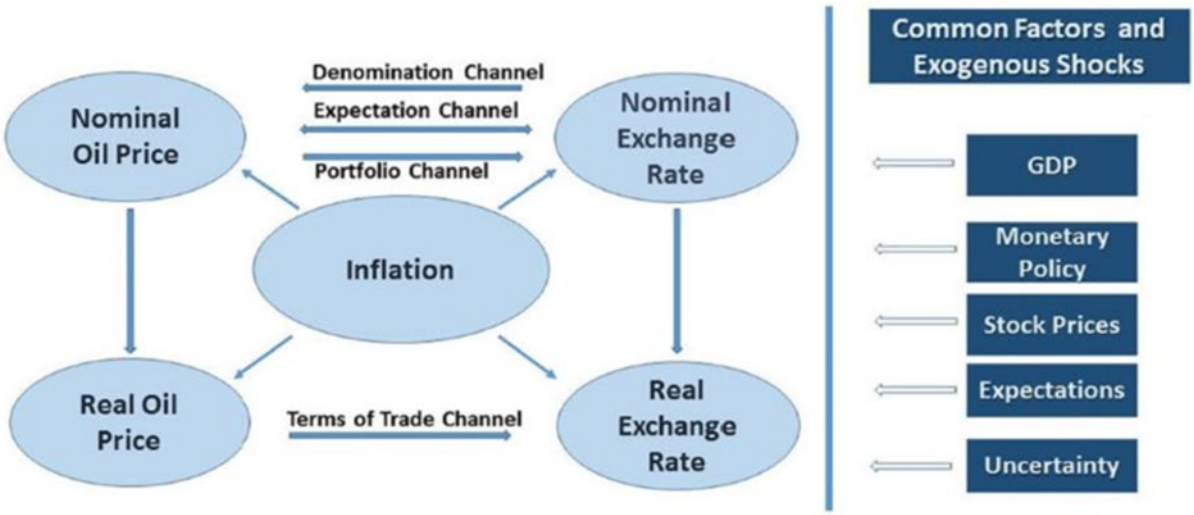
Lee, and Habibullah (2013) examined the relationship between monetary policy and the exchange rate market pressure. Based on research findings, the study concludes that the management of money supply has a noticeable impact on how inflation and exchange rates interact with each other in the economic landscape. When central banks implement policies to increase the money supply, it tends to result in higher inflation rates and may also contribute to the devaluation of a country's currency.

Several studies have also established a long-term relationship between stock prices and exchange rates in South Africa. For instance, Javangwe and Takawira (2022) analysed quarterly data from 1980 to 2020 using an Autoregressive Distributed Lag (ARDL) model. Their findings revealed a significant long-term link between stock market performance and exchange rate movements, indicating that changes in the exchange rate have a notable impact on stock prices. Specifically, they found a negative correlation between stock market activity and changes in exchange rates, suggesting that currency depreciation can lead to increased foreign investment in domestic businesses, thus boosting stock prices.

Ocran (2010) also found a lasting connection between the Rand/USD exchange rate and stock prices in South Africa. The research showed how fluctuations in the U.S. stock markets could impact the value of the Rand, underscoring how interconnected global markets are. In another study by Naidoo, Moores-Pitt, and Akande (2024), it was discovered that a rise in exchange rate volatility leads to volatility in the stock market but lower volatility in the real estate market. This indicates that investors tend to have reactions to fluctuations in exchange rates within the stock market compared to their responses within the real estate market.

The inflation rate, interest rates, stock prices, and oil prices, therefore, form complex and cyclic relationships when analysing the exchange rate fluctuations of the Rand. Additionally, the conditions of the global economy, such as changes in the importance of certain countries, currencies, and fluctuations in international trade relations, can contribute to understanding the effect of oil prices on exchange rates (Segal, 2021). The above studies on external influence from macroeconomic variables explain the need to take a wider perspective than simply adopting oil price shocks to understand why certain monetary and fiscal policies of different countries affect and are affected by the set of economic forces in the global economy (Segal, 2021).

Figure 8: Interconnections Between Oil Prices, Inflation, Exchange Rates, and Economic Factors



Source: Altunöz (2023)

Figure 8 shows how nominal and actual oil prices, inflation, exchange rates, and other macroeconomic variables are linked to one another. Nominal price affects inflation and nominal oil prices, though, while actual price affects the real exchange rate through the balance of trade or the terms of trade. Inflation, which lies at the heart of this framework, is caused by oil prices and exchange rates influenced by the denomination, expectation, and portfolio effects channels. Other variables that are related to aid include GDP, monetary policy, stock prices, expectations, and uncertainty. These show how the changes in the prices of oil affect the system.

Having explored how different economic factors affect currency exchange rates and understanding variables such as interest rates and inflation in grasping the dynamics of exchange rates, due to the distinct features of the South African economy, it becomes critical to explore South Africa's specific situation, focusing on how changes in oil prices asymmetrically influence the value of the South African Rand during both times when there is a prevalence of increasing and decreasing oil prices.

2.3.3. Asymmetry of Oil Price Effects on Exchange Rate in the South African Context

The relationship between oil prices and exchange rates has been researched extensively; however, a gap still arises regarding the asymmetrical effects of oil fluctuations. Studying these impacts is crucial for grasping the nuanced interactions

between oil prices and exchange rates in the context of South Africa. While conventional research typically assumes a connection between the two variables, this study takes an advanced stance to determine if the negative repercussions of oil price hikes surpass the positive outcomes of price drops. By filling this gap in knowledge, the research strives to enhance comprehension of how exchange rates behave in countries that rely on oil.

Kilian (2009) employed a structural vector autoregressive model (SVAR) to differentiate between the repercussions of demand disruptions and supply fluctuations. This approach enables a comprehension of how each type of shock impacts oil prices and the overall economy. The author found that oil price shocks may vary in terms of the impact depending on the nature of the shock. Demand shocks typically result in a gradual increase in oil prices as a reaction to the expanding global economic activity, whereas supply shocks cause sudden and substantial price hikes due to interruptions in oil production processes. Recognizing the root cause of a sudden increase in oil prices is vital for deciding the course of action from a policy standpoint.

In a study conducted by Saidu et al., (2021), a linear distributed lag (ARDL) method alongside NARDL is utilized to explore asymmetries in oil prices and currency exchange rates within six African nations that are net importers of oil, with South Africa being one of them. The study found that decreases in the prices of oil lead to the appreciation of the Rand. The study further notes that oil price decreases have a larger impact on exchange rates than increases. The extent of the variation depends on the size and extent of the shock across the different countries. The study placed importance on the vulnerabilities of these economies to oil fluctuations and suggested the adoption of strategies to mitigate these effects.

Gao, Wen, Zakaria, and Mahmood (2022) studied the impact of oil price fluctuations on the exchange rate in emerging economies, which is consistent with the economy of South Africa. Using the wavelet technique, the study confirmed that oil price increases tend to depreciate the currency of oil-importing emerging markets. This is because higher oil prices increase import costs, which then puts pressure on the domestic currency due to an increasing trade deficit and reduced investor confidence. On the other hand, oil price decreases do not lead to an appreciation of the exchange

rate in these economies. In contrast to Saidu et al. (2021), this study argued that the effects of the reduction in oil prices are often weaker and further added that a drop in the oil price does not immediately result in a stronger currency, which reflects asymmetries in the relationship. Hlongwane et al., (2022) provided evidence to support this and estimated the elasticity of the South African Rand, showing that the elasticity of 0.5 percent depreciation is the reaction to a 10 percent rise in oil. The study directly supports the idea of the terms of trade theory and the wealth effect theory. The authors noted that positive oil price shocks lead to inflationary pressures and weakened investor confidence, while negative shocks might only slowly improve the trade balance.

Fowowe (2014) studied the relationship using the GARCH autoregressive conditional jump intensity model. The study indicated that changes in oil prices do not uniformly impact the exchange rate, instead pointing towards a relationship influenced by economic factors and market conditions. While the terms of trade and wealth effect theory may provide an understanding of the connection between oil prices and exchange rates, this study emphasizes the nature of this relationship as it indicates that additional factors also play a significant role in determining this correlation.

Kumar (2019) found that oil prices have an asymmetric effect on exchange rates and stock prices. When oil prices go up in oil-importing countries, it usually causes exchange rates and stock prices to drop significantly; however, when oil prices fall, the positive impact is not as strong as when they rise. This view is also supported by Sibanda and Mlambo (2014) and Zhou, Wu, Zhu, Mo, and Zheng (2024), who found that increasing oil prices lead to a devaluation of the South African currency. Where Sibanda and Mlambo (2014) employed the GARCH model, specifically finding that a one percent increase in the price of oil leads to a 0.12 percent depreciation of the currency. The studies highlight the need to differentiate between the consequences of oil price hikes and drops and understand how they affect countries that import oil versus those that export oil.

While studies have explored asymmetrical effects in South Africa, they overlook how these effects may vary under different global conditions. Furthermore, there are few studies that examine these effects in South Africa specifically following the 2022 oil crisis. This gap in literature is what the study seeks to address. In as much as studies

have noted that the changes in oil prices affect immediate economic indicators, however, in studying the connecting link among the variables, it is key to understand vulnerabilities of the currency to external shocks.

2.3.4. South Africa's Currency and Its Vulnerabilities to External Shocks

This section discusses studies highlighting South Africa's susceptibility to changes in oil prices and the implications thereof.

2.3.4.1. External Vulnerabilities, Current Account Deficits, and Foreign Direct Investments

South Africa is dealing with difficulties related to its trade deficit, which make it vulnerable to factors such as fluctuations in oil prices. The country relies heavily on investments to offset its deficits. These investments are impacted by the state of the economy (Hlongwane, 2022). Several researchers have investigated the connection between trade deficits and the susceptibility of a country's currency. For instance, Sibanda et al., (2015) pointed out that South Africa's reliance on oil prices and current account deficits contributes to the instability of exchange rates in the country, adding that decrease in oil prices might lead to reduced energy costs that could reduce inflation rates and enhance consumers purchasing power, ultimately boosting the Rand's value even more.

Nkomo (2009) noted that when oil prices go up, it costs more to bring in oil from abroad, which raises the trade deficit because the money spent on importing oil goes up without any increase in export revenues. The study also found that a spike in oil prices can notably worsen the trade balance by 1.4 percent of the country's GDP. In South Africa's crude oil sector, recent data shows that the country imported around R 199 billion in petroleum, with exports totaling around R 199 thousand. This difference resulted in a negative trade balance of about R198 billion, highlighting the country's vulnerability to fluctuations in global oil prices (The Observatory of Economic Complexity, 2024).

Changes in oil prices have an impact on how South Africa's currency moves, but other factors like foreign direct investment (FDI) and economic conditions in and around the world also play a big part in shaping the South African exchange rate. Tala and Hlongwane (2023) have shown that when oil prices rise, it often causes inflation to go up, making it more expensive for foreign investors to operate in the market. The study

found that a 100 percent increase in oil prices leads to a 4.7 percent decrease in FDI inflows. This implies that increasing oil prices can make the environment for investments unfavorable.

Muhammad (2021) added that elevated oil prices have the potential to slow down expansion as they increase operating expenses for businesses and dampen overall economic activity in a country. The study also supports the notion that fluctuations in oil prices can result in decreased investment inflows due to worsening economic circumstances in a country that imports oil. In contrast, the study further highlights the positive relationship between oil prices and FDI in oil-rich countries. The author asserts that an increase in the price of oil in these countries will lead to an increase in FDI, which is expected to appreciate the currency and grow the economy.

According to Aidoo (2017), fluctuations in exchange rates have been recognized as an element influencing direct investment in South Africa. The study reveals that variations in exchange rates may discourage investors due to heightened uncertainty and the potential risks linked to currency instability. The findings indicate that ensuring stability in exchange rates could boost South Africa’s appeal to investors. In as much as exchange rates play a vital role in people's investment decisions, there are other factors that also influence FDI beyond exchange rate behavior in South Africa. These factors include political stability and market potential. In addition, some investors might see fluctuations of the exchange rate as a chance for them to gain in the future rather than a barrier.

The effects of changes in oil prices can differ among industries within the economy. Oil-producing countries might see advantages with oil price increases; however, on the other hand, some sectors relying heavily on energy-intensive operations could face challenges (Muhammad, 2021).

Figure 9: Relationship between foreign direct investment and economic growth

Source: Mohamed et al.,(2021)

Figure 9 shows the interaction between FDI equity and economic growth. Technological development from FDI challenges local companies and affiliates, making it easier to transfer technology and skills that improve efficiency in local industries and hence push up economic performance. Foreign trade thus becomes a channel through which FDI affects growth, alongside establishing that the two are mutually reinforcing or causally related. Host country incentives may propel exports, while foreign direct investment may lead to importation to satisfy local requirements that cannot be produced locally, thus promoting export-led growth. Therefore, through different channels, FDI has a positive impact on enhancing economic development.

2.3.4.2. The Role of External Shocks in South Africa's Currency Volatility

South Africa's exposure to influences goes beyond changes in oil prices and includes other global economic occurrences such as financial crises and the worldwide economy as well. One notable instance is how the 2008 global financial crisis had an impact on exchange rate instability in South Africa. According to Rena and Msoni (2014), the African Rand faced a decline amidst the crisis because of the effects of the crisis and a concurrent rise in oil prices. This led to the country going into a recession for the first time in 19 years. In another study, Madubeko (2010) investigated the impact of the 2008 crisis. The author discovered that the South African economy was not significantly affected by the crisis immediately but further notes that the growth in the economy in the following years was slower due to the impact of the crisis. Kabundi

and Rapapali (2019), on the other hand, delved into the structural weaknesses of the South African economy amidst external disruptions like the global financial crisis, emphasizing the role of oil price changes and worldwide financial instability in intensifying currency devaluation. The study highlights the importance of looking and attempting to find solutions for the weaknesses to safeguard economic stability in South Africa.

Studies noted in this section have provided evidence on the vulnerabilities of the South African economy. The main point to remember is that when oil prices drop, it usually helps the economy by improving trade balance and controlling inflation; however, this can be influenced by global factors, and the effect on exchange rates will be determined by how different economic factors interact with each other.

2.4. Findings Summary

This section ties together the key theories discussed in the review with the empirical evidence from South Africa and globally to answer the research questions posed at the beginning of this study. The empirical studies reviewed largely support the theoretical frameworks, confirming the significant impact of oil price fluctuations on exchange rates, with particular emphasis on asymmetry.

While the literature extensively examines the relationship between oil price fluctuations and exchange rates, methodological differences across studies contribute to significant variations in findings. A significant difference comes from employing models that each have their own strengths and weaknesses. For instance, the NARDL model is often used to capture relationships as seen in the study by Saidu et al., (2021). This model is good at recognizing both short-term and long-term trends. Its accuracy relies heavily on how well the model is set up, the lag choices made, and which variables are included. If there are errors in setting up the model, it could result in findings that weaken the conclusions reached. The GARCH model is also good at capturing volatility (Sibanda and Mlambo ,2014). However, it sometimes oversimplifies by only looking at variance changes instead of the underlying causes of the fluctuations. Sophisticated methods, like the BVAR as utilized by Bruna and Van Tran (2023) provide an approach to analysing the ever-changing connections among different factors over time periods. The BVAR model enables the integration of existing

knowledge into the analysis process. A feature, in situations where there is a scarcity of available information.

Geographical and time variations add complexity to comparing research results. Research studies such as (Killian ,2009; Fowowe ,2014; Kumar, 2019) use data that might not completely reflect the changing trends in the oil industry or consider recent events such as the COVID-19 pandemic and the 2022 energy crisis.

Global vs. South African Context:

Research conducted on nations that export oil, like the study by Hasanov et al., (2017) showed a connection between increasing oil prices and the strengthening of their currency due to trade surplus trends. Another perspective comes from countries that rely on oil imports, like South Africa, where the opposite is observed. Higher oil prices contributed to worsening trade imbalances and inflationary stresses. Global studies indicate that when oil prices increase, countries importing oil usually experience a decrease in the value of their currency. In the case of South Africa, however, the situation is complicated due to its challenges, like the existing current account deficit and reliance on external sources for capital inflows. These factors escalate the impacts of oil price effects on the country's economy (Korley and Giouvris, 2022; Hlongwane et al., 2022).

Studies by Hlongwane (2022) and Sibanda and Mlambo (2014) showed that South Africa faces challenges when oil prices rise, causing the Rand currency value to drop and inflation rates to surge. Conversely, when oil prices decrease, there is an impact felt in terms of trade balance and currency exchange rates, though these effects are typically less significant. Huang et al., (2024) suggested that there is a correlation between increasing oil prices and the devaluation of currency in countries that rely on oil imports, such as South Africa. However, Bruna and Van Tran (2023) on the other hand, believe that the level of fluctuations in exchange rates hinges on the magnitude of the shocks. These contradictions leave the specific effects of the South African currency unclear.

Other Macroeconomic Factors:

Empirical studies also highlight the role of other macroeconomic variables, such as interest rates, inflation, and investor sentiment, in influencing the relationship between

oil prices and exchange rates. Rising oil prices contribute to inflation, which results in the central bank having to adjust interest rates that consequently impact the exchange rate dynamics and further have implications on the growth of the economy (Beckmann et al., 2020; Segal, 2021).

Asymmetry in Oil Price Effects:

Empirical studies consistently show that the impact of oil price increases on the exchange rate is more immediate and pronounced compared to oil price decreases. This is especially evident in South Africa, where oil price increases are associated with significant depreciation of the Rand, while the effects of falling oil prices are weaker and more gradual (Gao et al., 2022). This aligns with the terms of trade effect and wealth effect theories, which both predict stronger impacts during price increases. This study addresses the need for understanding the nature of the relationship as well as asymmetrical impacts of oil price changes on the South African Rand, using recent data and advanced modeling techniques to capture non-linear and crisis-specific effects.

2.5. Conclusion

The literature explored how fluctuations in oil prices influence currency exchange rates in South Africa as an economy depending on oil imports. Theoretical concepts like the terms of trade effect and purchasing power parity (PPP), currency substitution, and wealth effect theory provide an understanding of how shifts in oil prices impact exchange rates through factors such as trade balances and currency demand.

Empirical evidence validates the terms of trade effect and wealth effect theoretical predictions, particularly the detrimental effects of rising oil prices on the South African Rand. Research has shown that when oil prices rise significantly, it can result in trade deficits and higher inflation rates while also shifting investor confidence, which may cause currency values to drop. In contrast, falling oil prices have a weaker and delayed impact on currency appreciation, underscoring the asymmetric nature of this relationship. These asymmetries, supported by findings from South Africa-specific studies, suggest that oil price increases have a more immediate and pronounced effect on the exchange rate compared to decreases. While the literature provides valuable insights into how oil prices affect the South African exchange rate, further research is

needed to explore the asymmetry in greater detail, especially following global crises like the 2022 energy shock.

Further, while literature sheds light on the complex relationship between the variables, literature presents a gap that can warrant future research, which is the potential impact of emerging technologies in the oil production process on the traditional relationship between oil prices and the exchange rate. The changing global energy scene, with the progress in renewable energy technologies, suggests a need to explore how these developments could impact oil dependence and consequently influence exchange rates. Potential research can involve investigating how advancements in the energy production process or methods might lessen the need for oil imports in South Africa. This shift might break the connection between oil prices and currency values.

Drawing inspiration from the achievements of the BVAR model as seen in studies like Bruna and Van Tran (2023), this research will adopt a BVAR approach to explore the changing relationship between oil prices and the dynamics of the exchange rate. The model’s capacity to integrate data holds importance considering the unpredictable nature of South Africa's oil market and exchange rate fluctuations. In the following section, we will detail the research outline and strategies for data collection and analysis methods to delve into this correlation.

3.CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

This chapter delves into the methods used to investigate how oil prices and exchange rates are related by emphasizing approaches to explore the connections between these variables. The research employs a Bayesian Vector Autoregressive (BVAR) model to conduct an analysis focusing on aspects, such as model structure priors and Bayesian estimation techniques. The section also discusses the data collection process and the macroeconomic factors considered in conjunction, with the time series analysed for the research objectives. It also explains the techniques used to understand the relationships, between the variables thoroughly using methods like Granger causality the connections between and different analyses such as response functions (IRFs) and variance decomposition.

The process of estimating the model is outlined step by step, which involves tasks like data preparation and choosing delays and parameters for estimation purposes to ensure the accuracy of the results by conducting checks, on prior distributions testing lag orders and model specifications. A detailed discussion about assumptions and limitations is presented towards the end of the chapter.

3.2. Research Design

Quantitative research is particularly useful as it allows for the measurement of how macroeconomic variables interact over time. According to Ivascu, Sarfraz, Mohsin, Naseem, and Ozturk (2021), using variables and econometric modelling can help capture the relationships between economic factors. This method is suitable since it can quantify retention and measure the causal impact of functional oil price changes on the exchange rate.

The research questions were developed considering the assumption that fluctuations in oil prices have an effect on the value of the South African Rand.

The BVAR model better suits the conditions of nonlinear dynamics, which are characteristic of emerging markets, in contrast to the VAR model example (Kuschnig and Vashold, 2021). Another strength of the BVAR is that it allows prior distributions to be incorporated into the estimation process, which realizes the stabilizing effects on the system when dealing with a small sample and highly fluctuating variables within the economic system (Cao, 2022). With the prior knowledge incorporated into the model, the Bayesian framework generates more accurate estimations and better forecasting depending on the regularity conditions of the model, where frequentist procedures may fail due to issues of overfitting or multicollinearity (Kuschnig and Vashold, 2021).

Concerning the research methodology, this paper employed the causal-comparative research design to compare the effect of oil price changes on the South African exchange rate. The approach is in line with the research questions that aim to establish how oil prices impact exchange rate movements in the short and long run. According to Cao (2022), causal-comparative designs help determine the existence and nature of the causal relationship between the variables prevalent in the economic environment; hence, they can help one determine the effect of one variable on another.

Time series data is adopted to capture the results within the short and long run and to ensure that ample data exists for the estimate. Lastly, the analysis technique is also concerned with other tests and models, such as the causality test based on the oil price direction and exchange rate (Ivascu et al., 2021). Further, impulse response functions (IRFs) are used to follow the dynamics of the exchange rate following oil price shocks and variance decomposition to determine the portion of exchange rate variability accounted for by oil price shocks (Iwanaga, Brennan, Tang, Scussel, and Almeida, 2021). Thus, using BVAR in conjunction with advanced econometric techniques puts the present work in a strong methodological position to tackle the research questions and achieve the research goals.

3.3. Econometric Model

The (BVAR) model extends the traditional Vector Autoregression (VAR) framework by incorporating Bayes' Theorem, allowing the introduction of prior and posterior distributions. Essentially, it is a VAR model that has been improved by incorporating

priors to regulate the coefficients on the components better. Bayesian statistics is centred around Bayes' Theorem. When we observe one variable X and want to draw conclusions about another random variable, ϕ based on its probability distribution $P\ (\phi)$, the theorem relies on the fundamental idea of conditional probability.

$$P(\phi/X) = \frac{P(X,\phi)}{P(\mathrm{X})} \tag{3.1}$$

Equation 3.1 may be expressed as the joint probability by conditioning and, thereby, providing:

$$P(X,\phi) = P(X/\phi)P(\phi) \tag{3.2}$$

By rearranging equation (3.2) in (3.1), we can obtain the Bayes theorem:

$$P(\phi/X) = \frac{P(X/\phi)/P(\phi)}{P(X)} \tag{3.3}$$

With n possible outcomes $(\phi_1, \dots, \phi_n)$, equation 3.3 could be expressed as:

$$P(\phi_j/\boldsymbol{X}) = \frac{P(X/\phi_j)P(\phi_j)}{\mathrm{P(X)}} = \frac{P(X/\phi_j)P(\phi_j}{\sum_{i=1} P(\phi_j)P(X/\phi_i)} \tag{3.4}$$

$P(\phi)$ is the prior distribution of possible ϕ values, and $P(\phi/X)$ is the posterior distribution of ϕ, for the given observed data X.

Unlike classical statistics, which rely on point estimators such as means and variances, Bayesian statistics focus on deriving the posterior distribution of unknown parameters by combining observed data with a prior distribution. This approach offers a more comprehensive representation of the uncertainty associated with parameter estimation, particularly after accounting for and eliminating the influence of nuisance parameters. The BVAR model structure was introduced by Litterman (1980) to overcome the issue relating to the difficulties of the model handling large samples as well as overfitting. According to Bruna and Van Tran (2023) the BVAR model can be depicted as follows:

$$Y_t = k + TY_{-i,t} + \sum_{j=1}^{p} A_j\, Y_{t-j} + BX_t + U_t \tag{3.5}$$

where:

Y_t is a vector of endogenous variables,

$Y_{-i,t}$ is a vector of endogenous variables excluding those already present on the left-hand side of each equation.

X_t is a vector of exogenous variables.

$T, A_j \; and \; B$ are the coefficient matrices corresponding to lag i,

p is the optimal lag length selected using model selection criteria,

u_t represents the error term, which follows a normal distribution.

The BVAR can be presented as:

$$REER_t = c_1 + \sum_{i=1}^{p} \phi_{11,i} \, OP_{t-i} + \sum_{i=1}^{p} \phi_{12,i} \, CPI_{t-i} + \sum_{i=1}^{p} \phi_{13,i} \, GDP_{t-i} + \sum_{i=1}^{p} \phi_{14,i} \, IR_{t-i} + \epsilon_{2t} \quad (3.6)$$

Where,

$REER_t$ is the Real Effective Exchange rate at time t.

$c_1$is the constant term.

p is the lag length.

i lag index, which is used to denote each individual lagged value in the summation up to the maximum lag length p.

$\sum_{i=1}^{p} \phi_{11,i} \, OP_{t-i}$ is the lagged oil price effect, which captures the impact of past oil prices (OP) on REER.

$\sum_{i=1}^{p} \phi_{12,i} \, CPI_{t-i}$ the lagged CPI effects reflect how past inflation (CPI) influences REER. Higher inflation can erode the value of the domestic currency in real terms.

$\sum_{i=1}^{p} \phi_{13,i} \, GDP_{t-i}$ The lagged GDP effects represent the effect of economic growth (GDP) on the exchange rate.

$\sum_{i=1}^{p} \phi_{14,i} \, IR_{t-i}$ is the lagged Interest rate effects, which indicates how past interest rates (IR) impact REER.

ϵ_{2t} is the error term , which captures random shocks and unexplained variations in REER that are not accounted for by the included variables.

To investigate the presence of asymmetries, the study will introduce a dummy variable K, which is given as follows:

$$k = \begin{cases} 1 \; if \; X \geq 0 \\ 0 \; otherwise \end{cases} \quad (3.7)$$

With k the model will be transformed to:

$$Y_t = c + \sum_{i=1}^{p} P_i Y_{t-i} + [Q + kR] X_1 + E_t, \quad (3.8)$$

where R is a matrix of parameters capturing the asymmetric effect.

The dummy variable
K is set to distinguish between oil price increases and decreases, allowing the BVAR model to assess whether exchange rate responses are disproportionately larger for positive shocks.

3.3.1. BVAR Model Estimation

The method of estimation consists of three elements:

Prior distribution: Refers to the beliefs we hold about the models' parameters before we have actually seen any data.

Mathematically, the prior distribution for a parameter θ is expressed as:

$$p(\theta) \sim N(0, \sigma^2)$$

where: $p(\theta)$ is the prior distribution of the parameter, $N(0, \sigma^2)$ represents a normal distribution centered at zero with variance σ^2. This prior belief is then updated with the observed data using Bayes' theorem:

$$p(\theta \mid Y) \propto p(Y \mid \theta) \cdot p(\theta)$$

where: $p(\theta \mid Y)$ is the posterior distribution of the parameters given the data, $p(Y \mid \theta)$ is the likelihood of the data given the parameters, $p(\theta)$ is the prior distribution of the parameters. The posterior distribution $p(\theta \mid Y)$ combines the information from the data (likelihood) with the prior.

Likelihood Function: The probability calculation is based on assumptions to guarantee an accurate depiction of the connection between the data observed and the models' parameters in the BVAR. Analysis results are influenced by these assumptions that form the basis for the mathematical expression of the probability calculation. In the BVAR model case, it is presumed that it represents white noise and adheres to a multivariate normal distribution, with a zero mean and covariance.

Posterior Distribution: In line with Bayes' theorem principle, the initial likelihood of parameter distribution is influenced by the data observed to establish the probability distribution. This new distribution combines information with observed data and a likelihood function to provide improved estimations of model parameters compared to relying on the initial distribution. In the world of analysis, one can gauge the variability

of parameters by looking at the range of possible values instead of focusing solely on a single estimate (Kuschnig and Vashold, 2021).

Mathematically, the posterior distribution of the parameters is given by Bayes' theorem:

$$p(\theta \mid Y) \propto p(Y \mid \theta) \cdot p(\theta)$$

where: $p(\theta \mid Y)$ is the posterior distribution of the parameters given the data Y, $p(Y \mid \theta)$ is the likelihood of the data given the parameters, $p(\theta)$ is the prior distribution of the parameters. By specifying the information priors, the Bayesian VAR model can reduce the impact of overfitting, particularly in the case of highly volatile data such as oil prices.

3.3.2. Selection of Priors to be used in the BVAR Model

The choice of prior selection is important in the BVAR model because it is used to determine the parameters. The two prior structures applied in this study comprise of the Minnesota prior and the diffuse prior. These priors have other characteristics that define how they influence the estimation process.

Minnesota Prior: The Minnesota prior is more straightforward to implement. It supposes that the coefficients of the lagged variables are weakly mean-reverting and constrains these coefficients. The prior is made in this way to capture the view that some variables are likely to be more permanent than what the data would indicate alone. It attaches more importance to the prior that the parameters are close to elimination, especially the higher-order lag parameters (Carriero, Clark, and Marcellino, 2023).

3.3.3. Model Estimation and Forecasting

After the prior distributions have been set, it becomes possible to estimate the model parameters. This is done using Markov Chain Monte Carlo (MCMC) methods, which provide samples from the posterior distribution. In this approach of analysis, for BVAR models involves calculating the values and ranges for each parameter using the collected samples. The future predictions under the BVAR model rely heavily upon the estimated distribution of parameters within the system. These predictions serve as a means to assess how fluctuations in oil prices impact the exchange rate in South Africa

and delve into the changes affecting the interconnectedness, among variables. Analysing the impact of oil price shocks, in exchange rate fluctuations involves utilizing variance decomposition techniques and studying response functions (IRFs) which help interpret the models' outcomes (Iwanaga et al., 2021).

3.3.4. Justification of model Selection

While this study employs the Bayesian Vector Autoregressive model, other methods were also considered:

Non-linear models (Threshold VAR or Markov-Switching Models)

Nonlinear models are good at capturing relationships. This is important for our study that looks into the imbalances in how oil prices impact variables. However, these models usually present computational complexities. In contrast, BVAR can incorporate nonlinearity through prior specification, providing a balance between model complexity and computational suitability.

Other time-series approaches

Traditional VAR and ARIMA models were considered less suitable because they rely on large datasets and do not account for prior beliefs effectively. On the other hand, BVAR provides an approach that enhances forecast accuracy and ensures stable parameters even with limited datasets.

3.4. Data descriptions and data Sources

The study used secondary monthly time series data. The primary source of data for all macroeconomic variables involved in the study was obtained from the Federal Reserve Bank of St. Louis. Alternatively, the data can also be sourced from various credible sources such as the SARB, IMFs' international financial statistics, the OECD, and others. The data is collected over the period 2000M1 to 2022M12, which provides a wide coverage to make proper analysis for the two decades with major economic events, such as the Rand crises in 2001 coupled with the dot-com bubble bust of the US, the 2008 financial crisis, the Covid-19 pandemic, and the recent 2022 oil crisis, which came with oil price fluctuations as well as variations in the exchange rate (Ratombo and Kgomo, 2024).

Table 2: Data definitions and data sources

Variable	Description/measurement
Oil Price (OILP)	The pricing of crude oil is in US dollars. In the worldwide oil market, the price of oil refers to the daily selling price for one barrel. Increases in oil prices are expected to lead to a depreciation of the South African Rand exchange rate, due to the negative relationship between oil prices and the exchange rate in South Africa (Hlongwane et al., 2022).
Real Effective Exchange rate (REER)	The country's currency average compared to a basket of currencies and is calculated as the weighted average with the weights based on trade balance relative to each country in the index.
Real Interest rate (IR)	The interest rate is the cost of borrowing money, expressed as a yearly percentage of the loan amount plus interest payments adjusted for inflation. Since oil prices have been shown to impact exchange rates in South Africa, and the exchange rate is theoretically linked to the real interest rate differential, we would expect an increase in oil prices to lead to an increase in the real interest rate in South Africa, in order to appreciate the domestic currency and offset the depreciation pressures from higher oil prices (Hlongwane,2022).
Inflation (CPI)	The Consumer Price Index (CPI) is a metric utilized to measure inflation by considering the percentage fluctuation in the expenses incurred by an average consumer while buying a predetermined assortment of products and services. These expenses may include both fixed and periodically adjustable costs, such as on a yearly basis. Increases in global oil prices are expected to have a direct and significant upward impact on the rate of inflation in South Africa, primarily through higher fuel and energy costs (Balcilar, Uwilingiye and Gupta,2018).
Gross domestic product (GPD)	The Gross Domestic Product measures the total worth of all products and services manufactured within a nation's boundaries during a specific period, usually a year. The expected correlation among oil prices and GDP suggests that elevated oil prices will detrimentally affect the country's GDP growth and economic performance (Hlongwane, 2022)

3.5. Stationarity and Unit Root Tests

In practice, many macroeconomic and financial time series variables are non-stationary, and various methods, such as unit root tests, are used to identify this characteristic. Non-stationarity can be detected by visually inspecting the time-series graph, examining the correlation, or conducting statistical unit root tests. Stationarity in the BVAR model is important because it keeps the statistical properties of the time series, like mean and variance, steady over time, which helps make reliable predictions and accurate forecasts in econometric analysis (Grynkiv and Stentoft, 2018).

To make a series stationary, it can be converted by differencing it one or more times. The number of differencing steps required to achieve stationarity is called the differencing order. A series differenced once is denoted as $I(1)$, while a stationary series without differencing is represented as $I(0)$. This study discusses three key stationarity tests namely: the Augmented Dickey-Fuller test, Phillips-Perron test and the Kwiatkowski-Phillips-Schmidt-Shin test.

Consider y_t time-series in the form $y_t = \alpha + \beta y_{t-1} + u_t$, where $u_t = \rho u_{t-1} + \varepsilon_t$, the unit root tests focus on evaluating whether $\mathrm{H}_0: \rho = 1$(null hypothesis) against the alternate hypothesis that $\mathrm{H}_1: \rho < 1$. The characteristic polynomial exhibits a unity root in the null hypothesis case hence, leading to the name unit root tests.

3.5.1. Augmented Dickey-Fuller test

One popular method for identifying unit roots is the Augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1979). The test adheres to an AR(1) process.

$$y_t = \rho y_{t-1} + \mu_t \qquad (3.9)$$

where, u_t constitutes an independent and identically distributed(IID) series of random variables. The DF test hypotheses are:

$$H_0: \rho = 1, \text{ against}$$
$$H_1: \rho < 1$$

Under the null hypothesis y_t is non-stationary. y_t is only stationary under the alternative hypothesis. Due to non-stationarity under the null hypothesis, the traditional t-statistic does not follow t distribution. For evaluating the hypothesis put forward for

testing purposes concerning y_t behavior over time it is suggested to use the provided equation for deriving test statistics values, for analysis and interpretation of results:

$$DF = \frac{\rho - 1}{s.e(\rho)} \tag{3.10}$$

The Dickey-Fuller (DF) test, as outlined in equation (3.10), assumes that the error terms are independent and identically distributed, and it does not account for a drift term in the model. The augmented Dickey-Fuller test is an extension of this test, which addresses autocorrelations within the time series. The procedure for the ADF test is similar to that of the DF test, with the key distinction being the model to which it is applied. The ADF test's model can be represented as follows:

$$\Delta y_t = \alpha + \beta t + \phi y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \tag{3.11}$$

where, α indicates a constant, β is the coefficient on a time trend, and p represents the lag order of the autoregressive process. Putting the constraints $\alpha = 0$ and $\beta = 0$, The ADF test is conducted based on the assumption

$H_0: \phi = 0$, against
$H_1: \phi < 0$

The test statistic is computed as:

$$DF_\tau = \frac{\hat{\phi}}{SE(\hat{\phi})} \tag{3.12}$$

If the DF_z test statistic is less than the critical value, then the null hypothesis of $\phi = 0$ is rejected and no unit root is present.

3.5.2. Phillips-Perron test

Introduced by Phillips and Perron in 1988, the Phillips-Perron(PP) test provides an alternative approach for addressing serial correlation in unit root testing. While it builds upon the standard Dickey-Fuller (DF) or Augmented Dickey-Fuller (ADF) tests, the PP test adjusts the t-ratio to ensure that serial correlation does not influence the asymptotic distribution of the test statistic. The primary distinction between the PP and ADF tests lies in how they handle serial correlation and heteroscedasticity in the error terms. The test model for the PP test is expressed as follows:

$$\Delta y_t = \beta' D_t + \pi y_{t-1} + \mu_t \tag{3.13}$$

where μ_t denotes $I(0)$ which could vary in volatility levels overtime. The PP tests accounts for both relationship and varying volatility levels in the error terms μ_t of the

being tested, by adjusting the Dickey-Fuller test statistics $t_{\pi=0}$ and $T\hat{\pi}$ directly. The test statistics indicated by Z_I and Z_n are given as:

$$Z_t = \left(\frac{\hat{\sigma}^2}{\hat{\lambda}^2}\right)^{1/2} \cdot t_{x=0} - \frac{1}{2}\left(\frac{\lambda^2-\hat{\sigma}^2}{\hat{\lambda}^2}\right) \cdot \left(\frac{T \cdot SE(\hat{\pi})}{\hat{\sigma}^2}\right)$$
$$Z_z = T\hat{\pi} - \frac{1}{2}\frac{T^2 \cdot SE(\hat{\pi})}{\hat{\sigma}^2}\left(\hat{\lambda}^2 - \hat{\sigma}^2\right) \quad (3.14)$$

The estimates of the variance parameters of

$$\sigma^2 = \lim_{T\to\infty} T^{-1} \sum_{t=1}^{T} E[\mu_t^2]$$
$$\lambda^2 = \lim_{T\to\infty} \sum_{I=1}^{T} E[T^{-1} S_T^2] \quad (3.15)$$

are $\hat{\sigma}^2$ and $\hat{\lambda}^2$. Where $S_T = \sum_{t=1}^{T} \mu_t$. The variance calculated from the values in the least squares $\hat{\mu}_t$ represents an estimate of the variability of σ^2, while the long-term variance estimation of μ_r using $\hat{\mu}_r$ in the Newey West approach provides a reliable estimate of λ^2. When assuming that $\pi = 0$,as per the null hypothesis case, the PP Z_I and Z_l statistics exhibit asymptotic distributions as the ADF t-statistics and normalized bias statistics. The benefit of using PP tests over ADF tests is that PP tests can handle types of heteroscedasticities, in the error term μ_t, without requiring the user to determine a lag length, for the test adjustment.

3.5.3. Kwiatkowski-Phillips-Schmidt-Shin test

The Kwiatkowski-Phillips-Schmidt-Shin test (KPSS) test developed by Kwiatkowski, Phillips, Schmidt, and Shin in 1992 has become a tool, for examining econometric time series data. The work of Kwiatkowski et al., (1992) was influenced by the Dicky fuller unit root tests of 1979.The test model for the KPSS test can be represented as:

$$KPSS_{\mathrm{N}} = \frac{1}{\mathrm{N}^2 \hat{\sigma^2}_{\mathrm{N}}} \sum_{n=1}^{\mathrm{N}} S_n^2 = \frac{R_{\mathrm{N}}}{\hat{\sigma^2}_{\mathrm{N}}} \quad (3.16)$$

Where, $\hat{\sigma^2}_{\mathrm{N}}$ is the constant estimator of σ^2 in the long run.

It was quickly understood that the KPSS test has a range of applications (Kokoszka and Young, 2016).

3.5.4. Model Diagnostics and Robustness Checks

In estimating the BVAR model, performing some diagnostic checks to verify whether the model was correctly specified and control the results reliability is relevant. The first check is conducted through a residual analysis, in which one analysed the model's residuals to check whether they were white noise or had any autoregressive

characteristics. If a random null hypothesis in the residuals is observed, then it would mean that the developed model had not incorporated temporal structure in the data. The second test is the Stability Condition, which guarantees that the estimated system is stable and that all roots of the characteristic equation are inside the unit circle. This means that if the system is stable, the estimates of the parameters may need to be revised. This is done using the fact that all values of the companion matrix should lie inside the unit circle if the system is to be stable (Cimadomo, Giannone, Lenza, Monti and Sokol, 2022). Lastly, sensitivity analysis is performed where prior means and lag orders were varied to determine the sensitivity of the model's outcome. Here, one finds the effect of prior distributions of Minnesota prior and diffuse prior on the calculated relationships between oil price and the exchange rate. Also, in the context of mixed data, the robustness of the results of the lag length selection is examined.

3.5.5. Forecasting with the BVAR Model

Point and interval forecasts are presented as part of the BVAR model, which entails stochastic parameter estimate uncertainty. The BVAR model's performance was determined by comparing its generated forecasts with actual exchange rate data. IRFs are also applied to analyse the longitudinal changes in the impact of oil price shocks on the exchange rate; specifically, they depict short-run and long-run changes in the South African Rand value concerning changes in oil prices (Iwanaga et al., 2021).

3.5.6. Measures of Accuracy for Forecasting

To evaluate forecast accuracy, commonly used metrics are applied to assess the performance of models across the entire sample period. These measurements can be used to compare datasets of their scale differences (Molapo, Olaomi, and Ama, 2019). Two metrics to consider are the Mean Percentage Error (MPE) and the Mean Absolute Percentage Error (MAPE) which are defined as:

$$MPE = \frac{1}{n}\sum_{t=1}^{n} |y_t - \hat{y}_t| \quad (3.17)$$

$$MAPE = \frac{1}{n}\sum_{t=1}^{n} \left|\frac{y_t - \hat{y}_t}{y_t}\right| \quad (3.18)$$

where, the forecasted value, at time t is represented by $\hat{y}_t$ and is the actual value in the period t is denoted as y_t ,while n signifies the size of the sample. In addition to

these metrics are accuracy measures that depend upon scale like mean error (MSE) mean absolute error (MAE) and root mean square error (RMSE). The formulas, for calculating these accuracy metrics are as follows:

$$\text{MSE} = \frac{\sum_{t=1}^{n} e_t^2}{n} \quad (3.19)$$

$$MAE = \frac{\sum_{t=1}^{n} |e_t|}{n} \quad (3.20)$$

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n} (y_t - \hat{y}_t)^2} \quad (3.21)$$

Mean Percentage Error (MPE): This measurement computes the percentage variance between the anticipated values to highlight the forecast bias direction accurately with positive or negative figures representing either overestimation or underestimation tendencies in the predictions.

Mean Absolute Percentage Error (MAPE): In contrast to MPE, MAPE calculates the size of forecasting errors without considering their direction. This metric gives a picture of the accuracy of predictions by concentrating on the magnitude of the errors only.

3.6. Empirical Strategy

The strategy includes identifying elements by figuring out the model employed for analysis and examining connections while also looking at how the system responds to stimuli and breaking down changes to ensure the credibility of results is upheld consistently during the procedure (Ivascu et al., 2021). The methodology used in this study follows a process to reveal patterns and enduring effects of oil price shifts on currency exchange rates to illuminate the interconnected nature of these variables. In the study, regression analysis and time series modelling are employed to investigate the relationship between oil prices and exchange rates by dividing the data into segments to comprehend how fluctuations in oil prices affect exchange rates across time periods.

3.6.1. Causality Testing

Before we start analysing things, it is important to look into how oil prices and the African exchange rate are connected to really understand what causes the effect. We use the Granger causality method to see if the past data of one thing can give us a clue, about another thing. Through these tests using Granger causality, we confirm the connection between them. Figure out which one influences the other. In economics

studies this testing often involves looking at time frames that come before or after each other, within sets of data (Ivascu et al. 2021).

Before you can correctly analyse the results of Granger causality tests it is important to establish the lag order, for the variables used in the BVAR model. This is crucial to prevent situations where the model's either not fit enough or too fit. Remember that choosing the right lag length is affected by factors such, as Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC). The findings, from these evaluations are used in Granger causality analysis to see if past oil price levels can impact fluctuations, in the exchange rate and vice versa.

Cointegration analysis

Additionally performed are a Johansen cointegration analysis and a pairwise causality examination to delve deeper into the connection, between oil prices and key macroeconomic indicators like inflation rates, interest rates and GDP growth in order to gain insights into the macroeconomic factors at play. This detailed investigation expands our comprehension of how the exchange rate's impacted by changes in oil prices by exploring the cause-and-effect links, between oil prices and other macroeconomic variables as highlighted by Cimadomo et al., (2022). In studies, like Carriero et al., (2023), there has been a focus on the importance of investigating causality in both directions to understand the relationship, between commodity prices and currency values.

3.6.2. Econometric Analysis of the Impulse Response Function (IRF)

To identify the causal direction between the price of oil and the S.A. exchange rate, the subsequent exercise in the empirical framework analyses the impulse response functions. The use of the IRF analysis also enables the determination of the fluctuations in the exchange rate in reaction to oil price shocks over time.

$$\mathrm{IRF}(X_t, \epsilon_Y) = \sum_{i=0}^{h} \mathbf{A}_i \cdot \epsilon_{Y,t-i} \qquad (3.22)$$

where:

$\mathrm{IRF}(X_t, \epsilon_Y)$ is the impulse response of X_t (the exchange rate) to a shock in Y (oil prices),

h is the time horizon over which the response is measured,

$\mathbf{A}_i$ is the coefficient matrix at lag i, $\epsilon_{Y,t-i}$ is the shock to oil prices at lag i.

This equation is used to analyse how a one-time shock to oil prices propagates over time, affecting the exchange rate in both the short run and the long run.

In the BVAR context, an impulse response function shows the response of the endogenous variable (that is, the exchange rate in this model) to a one-time shock in one of the endogenous variables (oil prices). In contrast, other variables remain fixed (Iwanaga et al., 2021). The analysis of the above-stated model through implementing the IRF approach yields profound information regarding both the short-term and long-term impacts of oil price changes on the exchange rate. For instance, if there is an upward price movement in oil, it is believed that the South African Rand will be devalued, and inflation will occur due to high import rates. The extent of depreciation and the time taken for the exchange rate to correct itself can be noted from the IRF. Furthermore, the importance of the results will be examined using critical intervals from the posteriors in the Bayesian framework following Carriero et al.,(2023).

Since the cost of oil is directly linked to the exchange rate in the South African Rand, any changes to the oil price may have a knock-on effect on macroeconomic variables; therefore, the IRF analysis in this study will also consider feedback from the oil price, interest rates, inflation, and GDP. As identified by Kuschnig and Vashold (2021), the IRF analysis is performed for short-term (T1 = 1-4) and medium-term (T2 = 5-10 and long-term T3 = 10+) time horizons. The approach militates against capturing how oil price shocks are transmitted through the South African economy in different periods.

3.6.3 Variance Decomposition

For a deeper analysis of the role of oil price changes in variations in the exchange rate, we apply variance decomposition. Variance decomposition is used to establish the extent to which the oil price shocks have attributed to the forecast error variance of the exchange rate. This method breaks a forecast error variance into the shocks given as oil price, interest rate, inflation, and GDP (Kuschnig and Vashold, 2021). Variance decomposition is an important method for determining oil price shocks' contribution to exchange rate changes. By decomposing the exchange rate risk attributed to oil price shocks.

3.7. Limitations and Assumptions

The BVAR pegged a strong framework for modelling the shock of oil price changes on the South African exchange rate; however, the model has limitations and induces some assumptions. Such limitations are transcendent to the type of model

specification, the data inputs, and the assumptions usually associated with the econometric techniques. It is also important to understand these limitations to properly analyse what is discovered in the current study and plan subsequent research on the subject. Here, the following limitations and assumptions arising from the methodological context are discussed.

3.7.1. Assumptions of the BVAR Model

The first and most important assumption when choosing the BVAR model is that there should be an association between the variables being analysed. Although this specification eases the estimation process and offers straightforward interpretation, it can overlook the refined relationship between oil price movements and exchange rate fluctuation, particularly in the presence of structural change, nonlinearity, or oil shock. For example, the effects of an oil shock on the exchange rate may differ depending on the affordability state or test of some predetermined thresholds like geopolitical tensions, which may form nonlinearities (Carriero et al., 2023). However, nonlinearities in the economic systems are documented, and future research could try exploring non-linear models or regime-switching approaches to capture the dynamic nature when economic structures undergo periods of stress or crises (Iwanaga, 2021).

The last assumption made in the context of the BVAR model is that the error terms are typically homoscedastic distributed. Although this assumption is reasonable if valid in many neoclassical models, it does not entirely apply to the macroeconomic data where heteroscedasticity and autocorrelation often prevail (Kuschnig and Vashold, 2021). To overcome this problem, residual diagnostics within the model are used, as well as other tests for autocorrelation and heteroscedasticity, including but not limited to the Breusch Godfrey serial correlation test and White's heteroscedasticity test. If these assumptions are not met, the findings may be distorted, and model modifications or other estimation methods, including generalized least squares (GLS) or heteroscedasticity-consistent standard errors, might be required.

3.7.2. Model Limitations

Among the significant limitations of the BVAR model is the assumption of endogeneity in the variables under consideration in this work. Although the BVAR model aims to depict the dynamic classifiers of multiple time series variables endogenously, the model does not adjust for endogeneity due to omitted variables or reverse causality. For example, even though the model assumes that oil prices are a determinant of the

exchange rate, it is equally possible that changes in the exchange rate impact oil prices through changes in the oil demand or adjustments of the cost of production of oils in exporting nations . To address the issue of endogeneity, Granger causality tests are used, although these are insufficient to control for reverse causality (Cimadomo et al., 2022).

Although BVAR models offer adaptability and handle uncertainty effectively compared to conventional VAR models, comprehending the outcomes can pose difficulties because of the Bayesian structure and the probabilistic essence of the estimations. Canova (2007) highlights that interpreting results from the IRF and variance decomposition requests a great level of careful consideration, especially with the roles that priors play in estimation. To address this limitation, priors are clearly explained, and graphical representation will be depicted to reflect the IRFs clearly for better understanding.

3.8. Conclusion

This methodology chapter has clearly detailed how the BVAR will be adopted to address the research questions concerning the nature of the relationship between oil prices and the exchange rate, with an emphasis on the asymmetric effects. The choice of the BVAR model is justified by the model's ability to handle high-dimensional macroeconomic data while incorporating prior information. This approach is relevant given that South Africa's economy is susceptible to external oil price fluctuations.

The chapter carefully outlines the model used from setting priors and estimating the model to running diagnostic tests. The importance of using response functions and variance decomposition is highlighted to track how oil price shocks affect the exchange rate over time. Incorporating the dummy variable allows for examining any differing effects of positive and negative oil price changes on the South African Rand.

Granger causality tests improve the reliability of the methodology by validating the direction of connections, between variables and conducting examinations like sensitivity analysis and identifying lag durations to verify results accurately and tackle concerns like biases, in the model specification.

4.CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Introduction

This chapter outlines findings of studying and analysing data from the models used to investigate the relationship between fluctuations in oil prices and the exchange rate with a particular focus on assessing possible asymmetries within this connection. The primary objective of the study is to explore whether changes in oil prices affect the value of the South African Rand (ZAR) unevenly and how these fluctuations influence the exchange rate over short and long time periods. The research utilizes a Bayesian Vector Autoregression (BVAR) model to understand the relationships between oil prices and variables like exchange rates, as well as important macroeconomic indicators such as inflation rates, interest rates, and GDP growth patterns. This method of modelling enables an examination of the links between these factors by incorporating expertise to tackle problems, like overfitting and multicollinearity that may occur when analysing volatile datasets containing oil prices and exchange rates.

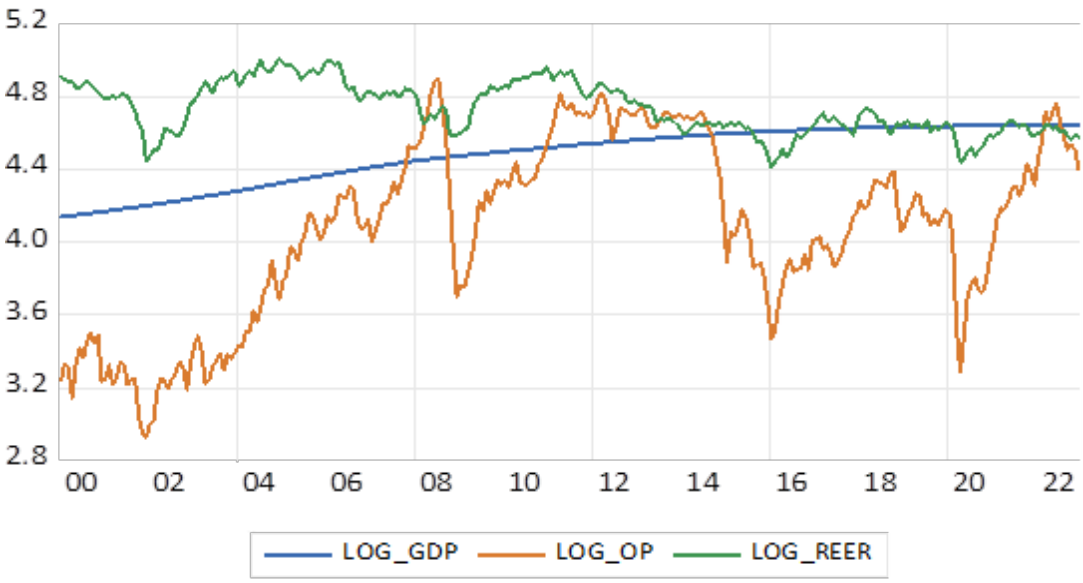
4.2. Data Analysis

4.2.1. Descriptive Statistics and Preliminary Insights

In this section, we discuss the data and initial findings regarding the variables studied, such as oil prices, real effective exchange rates, GDP, interest rates, and CPI. These early observations provide context for the connections examined through analysis and give a better grasp of the data and its traits.

Figure 4.1: Overview of data set

Log units



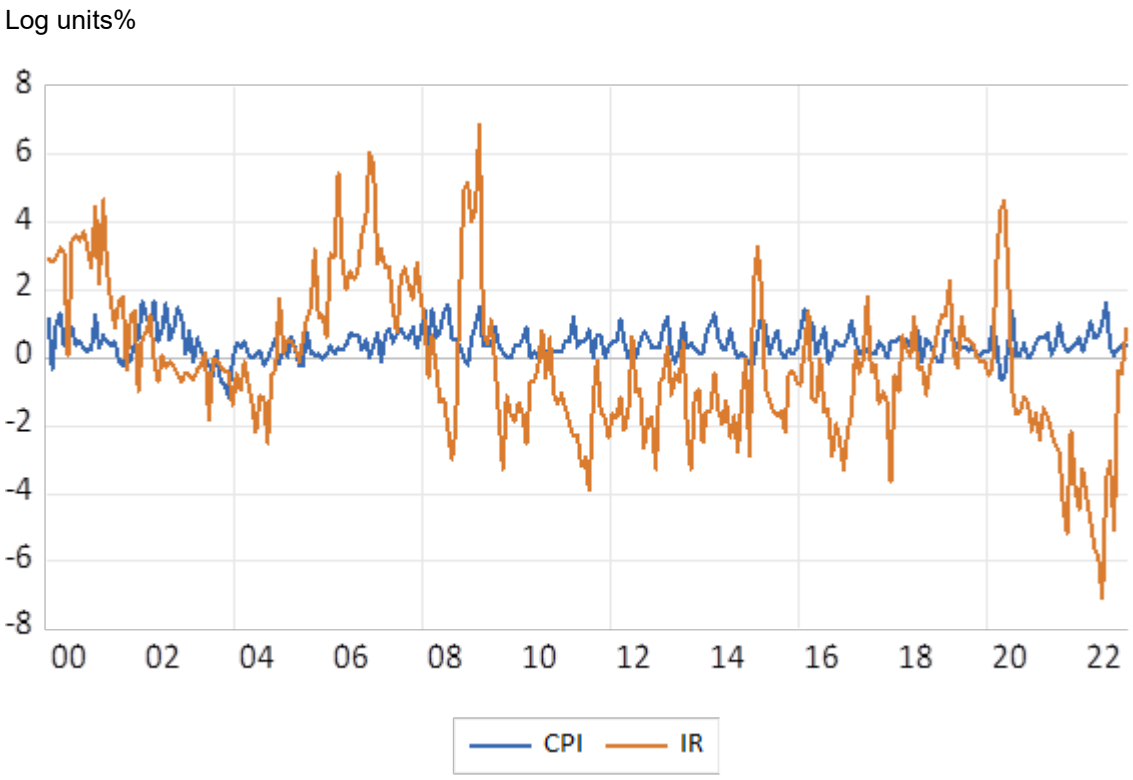
Source: Authors own estimates

Figure 4.1 shows the time series plot for the variables GDP, oil prices (OP), and real effective exchange rate (REER) respectively. The plot reveals the statistical behaviour of the selected time series variables, which will have further implications for stationarity and the estimation of BVAR estimation. The time series of GDP shows a persistent upward trend, reflecting long-term economic growth in the given period from 2000 to 2022. In addition, consistent growth also shows the presence of autocorrelation and a deterministic trend, which indicates non-stationarity in its levels. In contrast, the oil price time series plot shows high volatility and cyclical behaviour with sharp spikes and declines around the period 2008, with the global financial crisis, the 2014–2016 oil market oversupply, and the 2020 COVID-19 pandemic.

These inter-temporal fluctuations in the oil prices, along with the lack of mean-reverting behaviour show non-stationarity and the influence of stochastic trends driven by external shocks in the given period. However, the time series plot of the Real Effective Exchange Rate (LOG_REER) shows fewer fluctuations with periodic oscillations that may indicate stationarity or mean-reverting behaviour. While the graphical analyses are just an initial step to the analyses of stationarity, they do not provide certainty about the behaviour of these variables hence, a need arises to use statistical methods to test for stationarity in the series.

To empirically validate the relationship among the variables, econometric techniques such as correlation analysis, Granger causality tests, and cointegration analysis would be necessary. These methods could uncover whether oil price shocks have a direct, long-term impact on the real effective exchange rate or if the relationship is mediated by other economic variables. The second time series plot of the non-logarithmic series is given below:

Figure 4.2:Non-logarithmic time series



Source: Authors own estimates

Figure 4.2 represents the time series for CPI and IR in their first differenced form. Non-logarithmic in this instance refers to the fact that the data has been transformed using natural logs before differencing. The Figure shows differenced series, which assist in address non-stationarity concerns. There is an upward trend in the CPI time series, whereas IR shows no distinct visible trend. In addition, both series also show significant volatility, reacting dynamically to economic events and monetary policy adjustments. The lack of a consistent direction over time suggests that IR is primarily influenced by short-term economic shocks and policy responses rather than a long-term trend.

Table A1 and A2 (attached in appendix) show the summary statistics of the selected variables before and after log transformation. OP, REER, and GDP exhibit large means and standard deviations. This shows high variability at the level. In contrast, other variables such as CPI and IR have a smaller average and lower standard deviation. The standard deviation for OP is 29.4126, which is higher in comparison to other macroeconomic variables. As oil prices are volatile in nature, it is expected that the standard deviation will be higher. In addition, the standard deviations for the variables REER and GDP are 16.36285 and 13.35021 respectively. The variables CPI and IR are having lower standard deviation. After doing log-transformation, the standard deviation has reduced significantly for the variables, which can be seen in Table A2. The range of skewness values for the variables OP, REER, and GDP is close to 0, which approximates the normal probability distribution. However, the kurtosis value for all the variables is close to 3, except REER and GDP. The Jarque-Bera test statistics confirms the data are not normally distributed, but the log transformation has clearly enhanced the distributions' characteristics. Hence, the potential non-linear relationship is present among the variables.

Table 4.1: Correlation Matrix of the Selected Variables

Variables	OP	REER	GDP	IR	CPI
OP	1.00	0.04	0.53	-0.44	0.15
REER	0.04	1.00	-0.54	0.18	-0.20
GDP	0.53	-0.54	1.00	-0.44	-0.01
IR	-0.44	0.18	-0.44	1.00	-0.01
CPI	0.15	-0.20	-0.01	-0.01	1.00

Source : Authors own estimates

Table 4.1 presents the correlation matrix of the selected variables OP, REER, GDP, IR, and CPI, respectively. REER and OP show a weak positive relationship. However, the weak positive relationship also indicates that volatility in oil price is not having any linear effect on the real effective exchange rate. The dynamics between the two variables may occur through other indirect channels such as trade balances, inflation, and other related variables. The variables GDP and OP have a positive linear

relationship (0.53) as per the theoretical expectation. Higher GDP leads to more demand for crude oil. However, OP and IR are having a negative linear relationship. The correlation matrix also suggests exploring the dynamics of the selected variables through more advanced variables to find out the inter-temporal dynamics.

This preliminary analysis not only help us to understand the time series properties of the selected variables but also provides a foundation for conducting more detailed econometric analysis to explore the complex relationships between oil prices, exchange rates, interest rates, and other key macroeconomic variables within the South African context.

4.3. Unit root tests and Cointe

gration result

Unit root test results

Table 4.2: Unit Root Test(Levels and First Difference) for the selected variables

Variables	ADF Unit Root Test		Phillips-Perron Test		KPSS Unit Root Test	
	Constant	T&I	Constant	T&I	Constant	T&I
OP	-2.358720 (0.1546)	-2.527722 (0.3145)	-2.196927 (0.2080)	-2.194153 (0.4905)	0.745615 (0.0000)	0.329268 (0.0000)
REER	-2.350626 (0.1570)	-2.955895 (0.1468)	-2.165346 (0.2196)	-2.713991 (0.2318)	0.955414 (0.0000)	0.125412 (0.0000)
GDP	-3.931741 (0.0021)	0.345046 (0.9988)	-5.783664 (0.0000)	2.494759 (1.0000)	1.858605 (0.0000)	0.478518 (0.0000)
CPI	-11.42746 (0.0000)	-11.40546 (0.0000)	-11.83242 (0.0000)	-11.81285 (0.0000)	0.057114 (0.0000)	0.055170 (0.0000)
IR	-5.429931 (0.0000)	-6.026918 (0.0000)	-5.254017 (0.0000)	-6.000305 (0.0000)	0.759811 (0.0000)	0.076150 (0.0000)

Source: Authors own estimates

Table 4.3: Unit Root Test (First Difference) for the elected variables

Variables	ADF Unit Root Test		Phillips-Perron Test		KPSS Unit Root Test	
	Constant	T&I	Constant	T&I	Constant	T&I
OP	-12.27258	-12.25801	-11.98825	-11.97018	0.073432	0.041668
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
REER	-13.38590	-13.36092	-13.31607	-13.29038	0.038167	0.038825
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP	-2.547315	-5.168485	0.489308	-3.664237	1.614619	0.278876
	(0.1056)	(0.0001)	(0.0264)	(0.9861)	(0.0000)	(0.0000)
CPI	-15.07276	-15.04557	-70.93722	-69.95945	0.362952	0.313836
	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0000)	(0.0000)
IR	-9.426058	-9.408170	-24.16436	-24.12054	0.042693	0.024949
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Source : Authors own estimates

The above results of the unit root test in Tables 4.2 and 4.3 provide insights into the stationarity properties of the selected variables, both in levels and after first differencing. In Table 4.2, which presents the results for variables in levels, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests show that most variables are non-stationary at conventional significance levels when tested with constant or trend and intercept. For instance, OP and REER have p-values above 0.05, failing to reject the null hypothesis of a unit root. Similarly, GDP shows evidence of non-stationarity in the trend and intercept model, while CPI and IR are stationary across all tests in levels, as indicated by significant p-values and low KPSS statistics.

In Table 4.3, after first differencing, all variables exhibit stationarity across the ADF, PP, and KPSS tests. For example, the first-differenced OP and REER display significant p-values in the ADF and PP tests, rejecting the null hypothesis of a unit root. Additionally, the KPSS test results confirm stationarity, with values well below critical thresholds. GDP, which was non-stationary in levels, becomes stationary after first differencing under the trend and intercept model. Similarly, CPI and IR, which were already stationary in levels, remain stationary after first differencing.

However, the unit root test results indicate that OP, REER, and GDP are non-stationary in levels but become stationary after first differencing, making them suitable for inclusion in econometric models in their differenced forms. On the other hand, CPI and IR are stationary in levels and can be used directly. These findings confirm the need to appropriately transform the variables to ensure stationarity and avoid spurious results in time series modelling.

Cointegration Test Results

Table 4.4: Cointegration Test Results

Hypothesized No. of CE(s)	Trace Statistic	Critical Value (5%)	p-value	Max-Eigen Statistic	Critical Value (5%)	p-value
None	251.768	76.973	0	116.896	34.806	0
At most 1	134.872	54.079	0	79.468	28.588	0
At most 2	55.404	35.193	0.0001	26.224	22.3	0.0134
At most 3	29.18	20.262	0.0023	18.794	15.892	0.017
At most 4	10.385	9.165	0.0292	10.385	9.165	0.0292

Source : Authors own estimates

Table 4.4 presents the Johansen Cointegration Test results. The trace test assesses whether there is no cointegration compared to the possibility of having, at one cointegrating vector. All the statistical trace values exceed their thresholds at the 5 percent level. In the analysis results, we therefore reject the hypothesis for each step as it reveals multiple cointegrated relationships. When conducting the max test, it evaluates the presence of r cointegrating vectors compared to the possibility of r + 1 vectors being present. “At most 4” is rejected at the 5% significant level meaning that the trace and maximum eigenvalue tests indicate the presence of five cointegrating equations at the 5% significance level, highlighting long-term relationships among the variables.

As the present study focuses on exploring the fundamental relationship between oil prices and exchange rates (REER). The normalized cointegration equation can be specified as below:

Table 4.5: Normalized Cointegrating Equation for oil prices and REER

Variable	Cointegrating Equation 1 (Normalized on LOG_OP)	Cointegrating Equation 2 (Normalized on LOG_REER)
LOG_OP	1	0
LOG_REER	-2.3578 *(0.87993)*	1.0000 *(N/A)*
LOG_GDP	7.6461 *(1.14324)*	-8.0489 *(0.88561)*
CPI	0.4261 *(0.29456)*	-1.4516 *(0.21347)*
IR	0.3525 *(0.04671)*	-0.2074 *(0.03649)*
Constant	-28.3814 *(6.18671)*	42.2225 *(4.15369)*

Source : Authors own estimates.

Table 4.5 presents the normalized cointegrating equations between the variables oil prices, real effective exchange rate, gross domestic product, consumer price index, and interest rates.

The results indicate that an appreciation in the REER is associated with a decline in oil prices, while GDP growth is positively related to oil prices in the long run. When normalizing on LOG_REER, GDP, CPI, and interest rates all exhibit negative long-run relationships with REER, suggesting that higher economic activity and inflationary pressures contribute to currency depreciation. These findings support the hypothesis that oil price fluctuations have long-run effects on exchange rate dynamics.

The above cointegration results give insights about the long-term relationship among the variables. These results are consistent with theoretical expectations. The variables such as exchange rates, inflation, and GDP are significantly affected by oil prices.

Table 4.6: Error Correction Coefficients from the Cointegrating Equations

Variable	CointEq1 (α)	Std. Error	t-statistic	CointEq2 (α)	Std. Error	t-statistic
LOG_OP	-0.026	0.017	-1.53	0.101	0.062	1.62
LOG_REER	0.0003	0.006	0.05	0.0003	0.023	0.02
LOG_GDP	-4.34E-05	1.10E-05	-4.12	0.0001	3.80E-05	2.78
CPI	0.488	0.069	7.05	-1.859	0.251	-7.42
IR	-0.711	0.23	-3.09	2.435	0.832	2.93

Source : Authors own estimates.

Table 4.6 shows the error correction coefficients from the two cointegrating equations. The error correction coefficients measure the speed at which the variables adjust to the long-run equilibrium. The error correction term for oil prices and the real effective exchange rate is not statistically significant. Oil prices are weakly influenced by long-run disequilibrium, suggesting that other macroeconomic forces primarily drive their movements. The exchange rate (LOG_REER) does not adjust to long-run disequilibrium, suggesting that exchange rate fluctuations are primarily driven by external shocks rather than internal correction mechanisms.

However, the error correction terms for GDP, CPI, and IR are statistically significant, and they help to restore the long-run equilibrium. However, GDP adjusts but at a very slow rate, suggesting that economic growth trends respond weakly to long-run disequilibrium in oil prices and exchange rates.

4.3.1. Lag Length Selection Criteria

Results from the previous section suggest going for BVAR models, which will help depict how an increase or decrease in the oil prices affects the changes in the real effective exchange rate. Before we proceed with BVAR estimation, it is pertinent to assess the lag length selection criteria for choosing the appropriate BVAR model.

Table 4.7: Lag Selection Measures of Selected Variables

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1560.186	NA	6.00e-12	-11.64933	-11.58215	-11.62235
1	2707.170	2242.419	1.34e-15	-20.05371	-19.65065	-19.89180
2	3497.902	1516.310	4.34e-18	-25.78953	-25.05058	-25.49270
3	3537.257	73.99340	3.90e-18	-25.89706	-24.82222	-25.46530
4	3644.094	196.8675	2.11e-18	-26.51006	-25.09935	-25.94339
5	3735.467	164.9509	1.29e-18	-27.00724	-25.26064*	-26.30564*
6	3775.050	69.97501	1.16e-18	-27.11648	-25.03400	-26.27996
7	3803.348	48.96461	1.13e-18	-27.14118	-24.72281	-26.16974
8	3829.144	43.66938*	1.13e-18*	-27.14714*	-24.39289	-26.04078

Source : Authors own estimates

Table 4.7 shows the lag selection measures of selected variables. The Log Likelihood (Log L), Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ) are used to assess the optimal lag selection. SC and HQ lag length selection criteria all suggest 5 lags as the optimal lag length as it has the lowest values at lag 5. This helps to ensure the accuracy of findings and address issues such as biases and overfitting in the model specification.

Granger causality Test

Table 4.8: Granger Causality Test of the Variables

Null Hypothesis	Obs	F-Statistic	Prob.
REER does not Granger Cause OP	272	0.49607	0.7386
OP does not Granger Cause REER	272	2.67698	0.0323

Source: Authors own estimates

The Granger causality test is conducted before VAR estimation to determine the directional causality between variables thus, helping identify whether one variable provides predictive information about another. The Granger causality test is conducted at lag length of 5. The null hypothesis that "REER does not Granger cause OP" could not be rejected, as the F-statistic is 0.49607 with a p-value of 0.7386. This indicates that changes in REER do not have a statistically significant predictive effect on OP.

On the other hand, the null hypothesis that "OP does not Granger cause REER" was rejected, with an F-statistic of 2.67698 and a p-value of 0.0323, which is below the 5% significance level. This result suggests that fluctuations in oil prices Granger cause movements in the real effective exchange rate, meaning that past values of oil prices have predictive power for REER. The results indicate a unidirectional causality from oil prices to the real effective exchange rate, but not vice versa.

4.4. BVAR Model Results and Interpretation

4.4.1. BVAR Results on the asymmetric effects between Oil Prices and the South African Exchange rate

Table 4.1: Asymmetry results

	OP_POS	OP_NEG	DLOG_REER
OP_POS(-1)	0.396185	0.235797	0.000869
	(0.09282)	(0.08677)	(0.00210)
OP_POS(-2)	0.050735	0.075562	0.000950
	(0.08023)	(0.07202)	(0.00179)
OP_POS(-3)	-0.012960	0.071753	-0.000419
	(0.07136)	(0.06189)	(0.00156)
OP_POS(-4)	0.066691	0.021696	-0.000462
	(0.06536)	(0.05519)	(0.00141)
OP_POS(-5)	0.102368	-0.003320	-7.13E-06
	(0.06093)	(0.05030)	(0.00130)
OP_NEG(-1)	0.298237	0.317344	-0.001444
	(0.09015)	(0.09371)	(0.00217)
OP_NEG(-2)	0.103979	0.006794	-0.001243
	(0.07372)	(0.08111)	(0.00182)
OP_NEG(-3)	0.089893	-0.045019	0.000234
	(0.06308)	(0.07200)	(0.00159)
OP_NEG(-4)	0.033817	0.040676	0.000325
	(0.05616)	(0.06597)	(0.00143)
OP_NEG(-5)	0.005498	0.080464	-0.000106
	(0.05113)	(0.06146)	(0.00132)
DLOG_REER(-1)	0.971789	-1.131438	0.234674
	(2.09357)	(2.08480)	(0.06042)
DLOG_REER(-2)	1.767107	-1.915483	-0.094440
	(1.93809)	(1.92998)	(0.05856)
DLOG_REER(-3)	-0.337981	0.180688	0.048415
	(1.80122)	(1.79404)	(0.05633)
DLOG_REER(-4)	-0.995050	0.898745	0.015099
	(1.67974)	(1.67230)	(0.05386)
DLOG_REER(-5)	-0.746380	0.691644	-0.053296
	(1.57432)	(1.56698)	(0.05126)
R-squared	0.050009	0.053116	0.081551
Adj. R-squared	-0.002148	0.001131	0.031126
F-statistic	2.958823	3.021750	4.617276

Source : Authors own estimates

The BVAR output reflects the relationship between the positive oil price changes (OP_POS), negative oil price changes (OP_NEG) and the real effective exchange rate

(DLOGREER). The coefficient for positive oil price changes at the first lag is statistically significant. Furthermore, the higher lag of positive oil price changes shows a deteriorating effect and is not statistically significant, which shows the distant lag of positive oil price changes has a negative but minimal effect on the REER. Similarly, the negative oil price changes are statistically significant at the first lag. Both positive oil price changes and negative oil price changes dynamically affect the real effective exchange rate in a unidirectional way. Hence, the asymmetric effect of oil price changes is more prominent in the BVAR model. In addition, if we compare the impact of higher order lag for positive oil price changes and negative oil price changes, we can conclude that the negative oil price change impact is less prominent in comparison to the positive oil price changes.

The coefficients for various lags of the real effective exchange rate show that they are not statistically significant apart from the first lag. This shows there are potential other factors, such as trade balance and other structural factors, which might play an important role in developing the Bayesian vector autoregression model apart from the dummy variables, positive oil price changes, and negative oil price changes. The low R-squared values across the equations indicate that the model explains only a small proportion of the variability in the dependent variables, particularly for (OP_POS) and (OP_NEG).

Overall, the results suggest that while oil price changes reflect persistence and some interaction between positive and negative components, their direct impact on the REER is limited and minimal. This finding implies that exchange rate movements are likely influenced by a broader set of factors beyond oil price shocks alone. Further analysis, such as impulse response functions or forecast error variance decomposition, could provide additional insights into the dynamic responses and relative contributions of shocks within the system. Additionally, incorporating other relevant macroeconomic variables, such as interest rate differentials or trade balances, may improve the explanatory power of the model. Although the exclusive BVAR model is capable capturing the asymmetric effect, the model can be further improved with the inclusion of other macroeconomic variables. Hence, in the next section, we discuss the BVAR model with other macroeconomic variables. The inclusion of other macroeconomic variables provides a much realistic view as studies such as (Leshoro, 2014, Fraiz and Fatima, 2016, Kilian and Zhou ,2022) have

previously noted the importance of other macroeconomic variables and their role in shaping exchange rates.

4.4.2. BVAR Model of Oil prices, REER, and Other Macroeconomic Variables

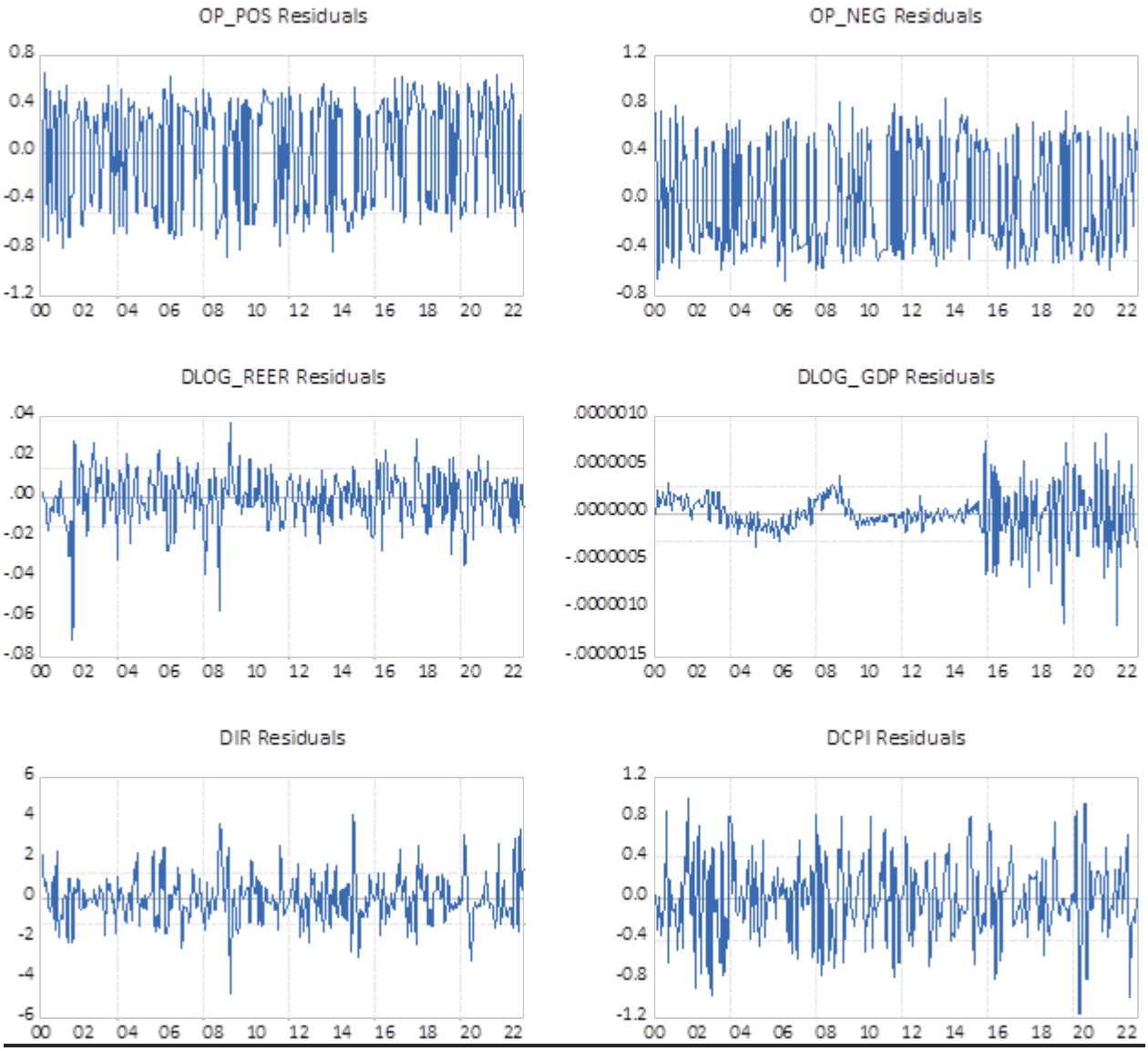
The results (Table A7, attached in appendix) summarized the BVAR model of oil price, REER, GDP, interest rates, and CPI. The results indicate persistence in oil price dynamics, as lagged values of (OP_POS) and (OP_NEG) significantly affect their current values. Positive oil price changes (OP_POS) exhibit strong autocorrelation, while negative oil price changes (OP_NEG) not only influence themselves but also negatively affect the real effective exchange rate, meaning that an appreciation of the exchange rate is associated with positive oil price shocks in the short run. The exchange rate (DLOG_REER) remained unchanged, as its lagged values significantly contribute to its own dynamics, while its interaction with OP_NEG highlights a crucial link between exchange rate fluctuations and oil price declines.

Macroeconomic variables such as GDP growth, interest rates, and inflation display notable interactions with oil price dynamics. The interest rate (DIR) is influenced by OP_NEG, indicating that monetary policy may respond to negative oil price shocks. Inflation (DCPI) reflects some lagged responses to both positive and negative oil price changes, reflecting the inflationary pressures associated with oil price volatility. However, GDP growth (DLOG_GDP) appears relatively insulated in the short term, given its longer adjustment horizon.

The R-squared values across the equations suggest that the model captures a modest proportion of the variations in the dependent variables, which is expected in macroeconomic time series analysis due to inherent noise and external factors. The high F-statistic for the GDP equation indicates its strong autoregressive structure, emphasizing its dependence on past values.

4.4.3. VAR Residuals

Figure 4.3:VAR Residuals



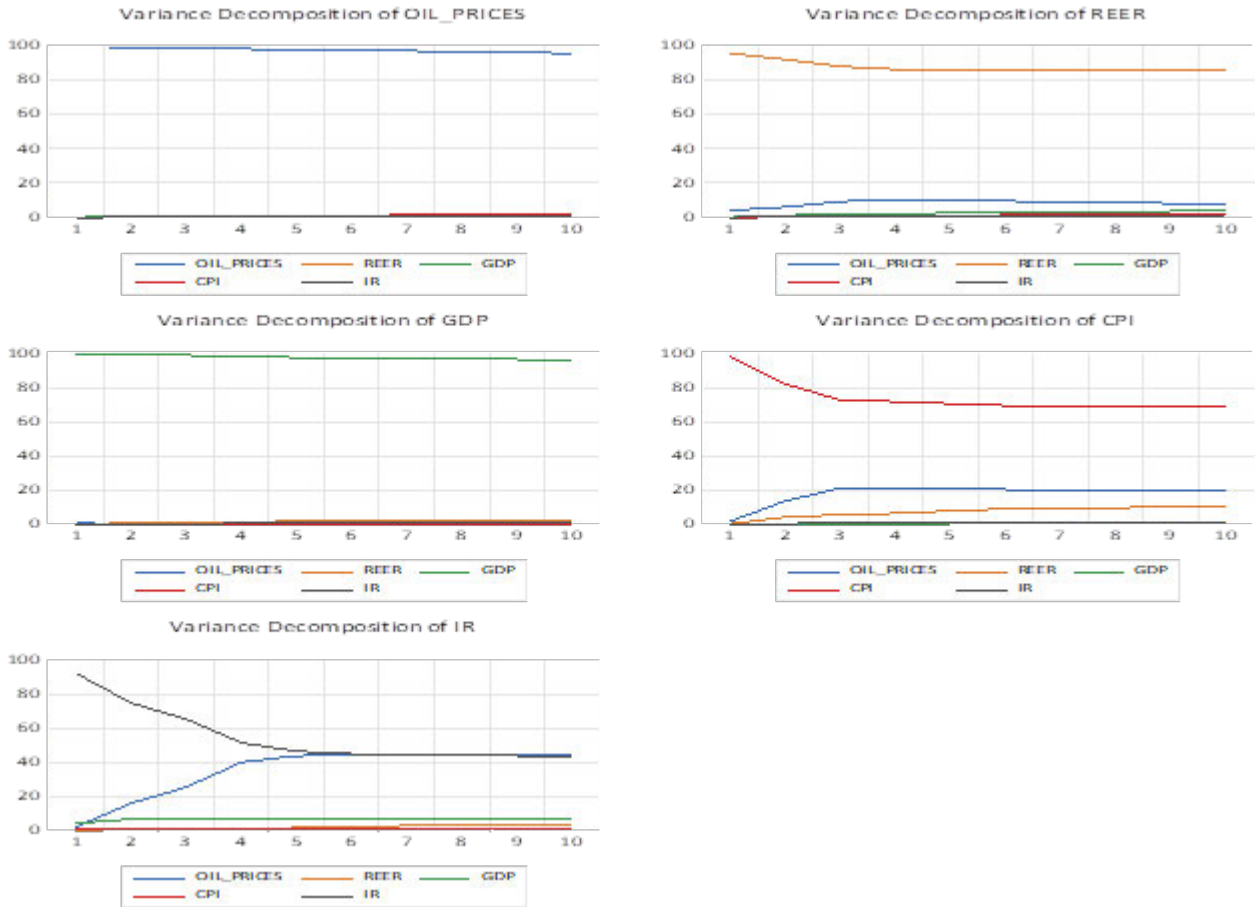
Source: Authors own estimates

The residual plots of the VAR model offer information on how the model fits and the unexpected changes, in each variable it represents. In the case of oil prices (OP) the residuals hover near zero without any downward pattern; however occasional significant spikes occur towards the end of the analysis period indicating temporary disturbances or unusual events, in oil prices that are not accounted for by the model. The distinction between positive and negative oil price shocks (OP_POS and OP_NEG residuals) indicates that the model considers the possibility of effects from changes in oil prices. Likewise, the residuals for the Real Effective Exchange Rate (REER) do not exhibit trends and tend to revert to an average around zero; however

occasional spikes suggest that certain shocks, to the REER may not be completely explained by the models' variables. The leftover values, for GDP are quite minor and exhibit changes around zero points which suggests that the model accounts for most of the GDP variations effectively; however, some random fluctuations remain possibly caused by external influences or measurement inaccuracies. When it comes to the interest rate (IR) the residuals display fluctuations in volatility during specific timeframes but ultimately return to zero levels; occasional significant spikes indicate that factors beyond those captured by the model play a role, in influencing interest rates. The residuals for the Consumer Price Index (CPI) exhibit higher volatility compared to the other variables, pointing to the possibility of additional external shocks or omitted variables affecting inflation dynamics.

4.4.4. Variance decomposition

Figure 4.4: Variance decomposition

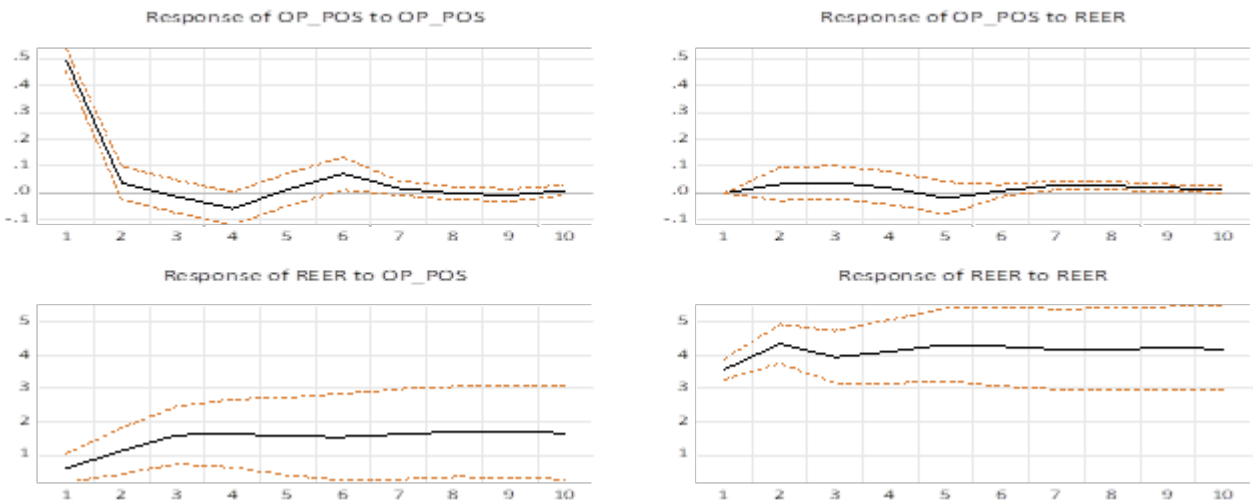


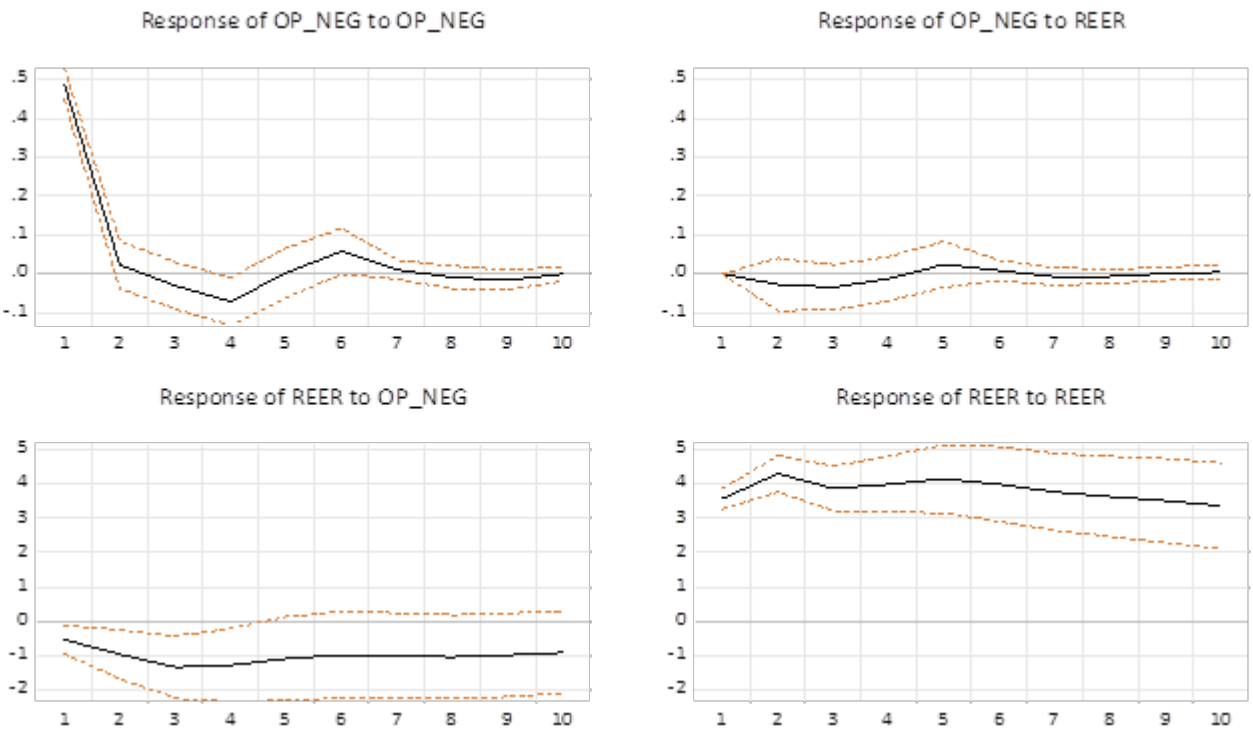
Source: Authors own work estimates

The variance decomposition results using Cholesky ordering reveal the dynamic contributions of each variable to the forecast error variance over time. Oil prices exhibit strong exogeneity, with their variance predominantly explained by their own shocks (over 96% by period 10). The Real Effective Exchange Rate (REER) is mostly driven by its own shocks but increasingly influenced by oil prices (7.8% by period 10). GDP's variance is largely self-driven (96.4% by period 10), with minimal influence from other variables. CPI's variance shifts significantly to external factors, with oil prices contributing over 19.9% by period 10, reflecting the sensitivity of inflation to energy costs. Finally, the interest rate (IR) variance is increasingly dominated by oil prices, which explain over 43.8% by period 10, highlighting the critical role of oil price dynamics in shaping monetary policy responses. Overall, oil prices emerge as a key driver of fluctuations across several macroeconomic variables, especially CPI and IR, while GDP remains relatively insulated.

4.4.5. Impulse Response of BVAR Model with Macroeconomic variables

Figure 4.5: Impulse Response of BVAR





Source: Authors own estimates

The impulse response functions (IRFs) reveal the dynamic relationship between oil prices and the real effective exchange rate (REER) of the South African Rand. A one-standard-deviation positive shock to oil prices initially leads to an appreciation of the Rand, suggesting that increases in oil prices positively impact the exchange rate in the short term. However, this effect diminishes over time, stabilizing after approximately 5–7 periods. This temporary response indicates that while oil price changes influence the exchange rate in the short term, there is a limit to this effect in the long run, suggesting that the period of the Rand appreciation is only short-lived. There is also a minimal response from oil prices regarding REER, suggesting that global oil prices are mostly independent of exchange rate changes.

The IRFs also indicate that inflation (CPI) has a longer-lasting effect on the exchange rate than oil price shocks do on the exchange rate. The gradual depreciation of the Rand following an inflation shock supports the idea that increased inflation diminishes the currency's value by weakening purchasing power and investor trust. On the other hand, changes in interest rates can have varying short-term impacts on the Real Effective Exchange Rate (REER). Over time, a trend of depreciation becomes evident, which could indicate the adverse effects of elevated interest rates on both economic

growth and investor confidence. These findings underscore the significance of controlling inflation and implementing policies to uphold stability in exchange rates.

The data from the IRFs indicates that there is evidence supporting the idea of an imbalance in how oil prices affect exchange rates over time. When oil prices go up significantly and rapidly in a period of time, the Real Effective Exchange Rate (REER) reacts positively. However, that response fades quickly. This implies that the impact of rising oil prices is more immediate and shorter-lived compared to when prices drop. In actuality, the decrease in oil prices may not have a significant effect and may not happen immediately. This uneven pattern highlights the significance of exploring the relationship of inflation and the exchange rate, as inflation is the commodity that reflects having a more significant impact on the exchange rate.

4.5. Forecasting with the BVAR Model

According to the BVAR model's guidelines and principles, we plan to predict the variables by offering both predictions and ranged forecasts to consider the uncertainties in estimated parameters.

The forecast evaluation results reveal that the Bayesian VAR model demonstrates excellent predictive performance for GDP and REER, as reflected by the very low RMSE (0.358 for GDP, 11.325 for REER), MAE, and Theil coefficients (0.00198 for GDP, 0.04888 for REER). Oil Prices (OP) forecasts also perform well, with a relatively low RMSE (20.92), MAPE (23.73), and a Theil coefficient of 0.1494, suggesting robust prediction accuracy. The CPI forecasts exhibit moderate accuracy, with a slightly higher Theil coefficient (0.4024) and significant percentage errors (MAPE: 74.86). However, the Interest Rate (IR) forecasts are less reliable, with the highest MAPE (416.39) and a moderate Theil coefficient (0.6028), indicating challenges in capturing its variability. Overall, the model shows strong predictive capabilities for stable variables like GDP, REER, and OP but struggles with more volatile variables like IR and CPI.

Table 4.2: Forecast Evaluation

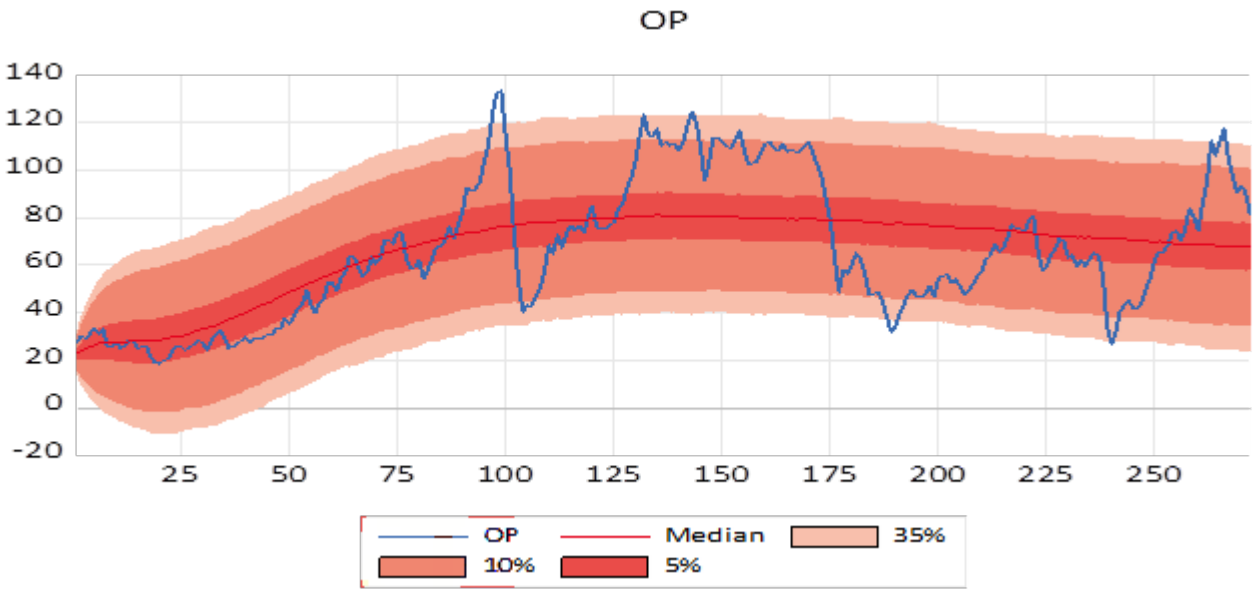
Variable	Inc. obs.	RMSE	MAE	MAPE	Theil
OIL_PRICES	276	20.92037	16.37095	23.73061	0.149444
REER	276	11.32456	8.756577	7.52164	0.048882
GDP	276	0.357926	0.307103	0.350356	0.001982
IR	276	1.946022	1.526708	416.3917	0.602825
CPI	276	0.431172	0.326004	74.85914	0.402387

Source: Authors own estimates

Oil Prices Forecast

Figure 4.6 displays a projection of oil prices using Bayesian Vector Autoregression (BVAR) where the blue line depicts past prices and the red line illustrates the expected median price trendline going forward. Uncertainty ranges are highlighted in areas, on the graph. Darker shades (representing 5%) signify certain price intervals while lighter shades (10% and 35%) encompass wider potential outcomes. According to the forecast depicted in the graph, it predicts a rise followed by a decrease in oil prices over time and an increase, in uncertainty as indicated by the expanding bands. This statistical approach emphasizes the price paths, for policymakers and analysts to consider when planning for uncertainties and risks ahead.

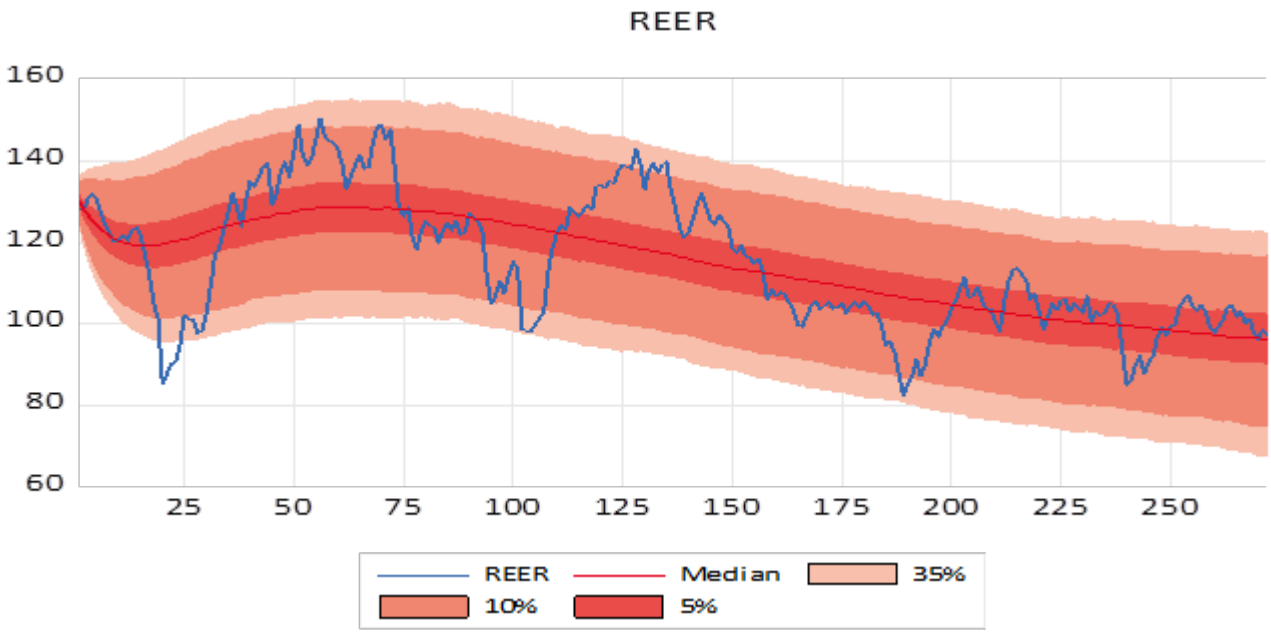
Figure 4. 6:Oil Prices Forecast



Real Effective Exchange Rate Forecast

In Figure 4.7 there is an outlook, for the Real Effective Exchange Rate that showcases a pattern of short-term growth followed by a decline and the future direction indicated by the midpoint. With areas representing uncertainty and risk levels. Impacting competitiveness and economic situations due to factors, like inflation rates and trade imbalances.

Figure 4.7:Real Effective Exchange Rate Forecast

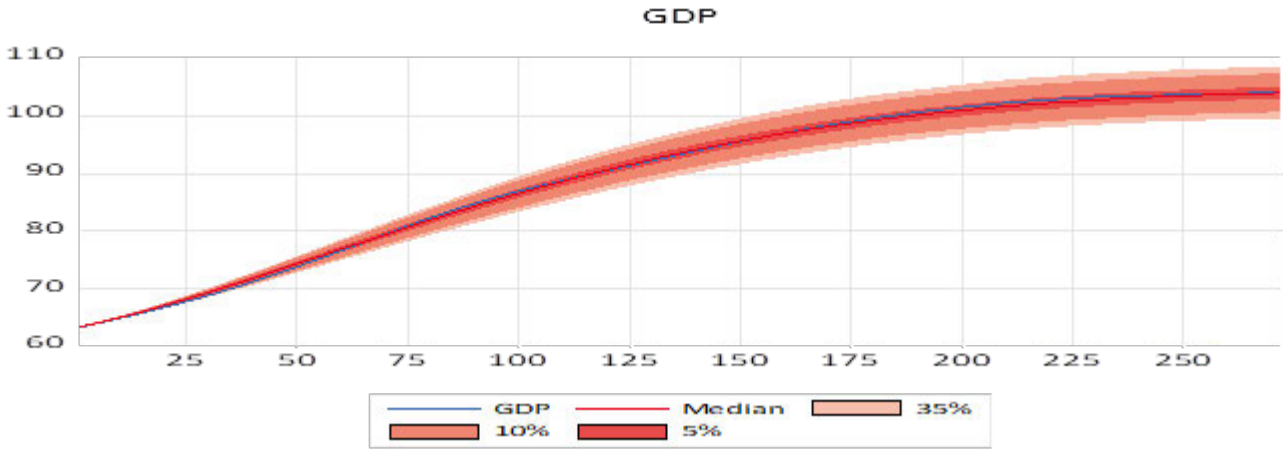


Gross Domestic Product Forecast

The Bayesian prediction, for the domestic product shows a consistent rise in GDP over time on the graph displayed here. Indicating an overall upward trajectory in economic performance with the middle line pointing to where growth is predicted to stabilize in the future. The shaded regions, on the graph signify uncertainty surrounding this forecast; wider areas denote levels of variability and associated risks. The gentle slope of the GDP line reflects a pace of expansion while fluctuations may reflect impacts stemming from policy changes, market dynamics or unexpected external influences. In terms and visual representations show a view of the Gross Domestic Product (GDP)

giving helpful perspectives on possible upcoming economic situations and related uncertainties.

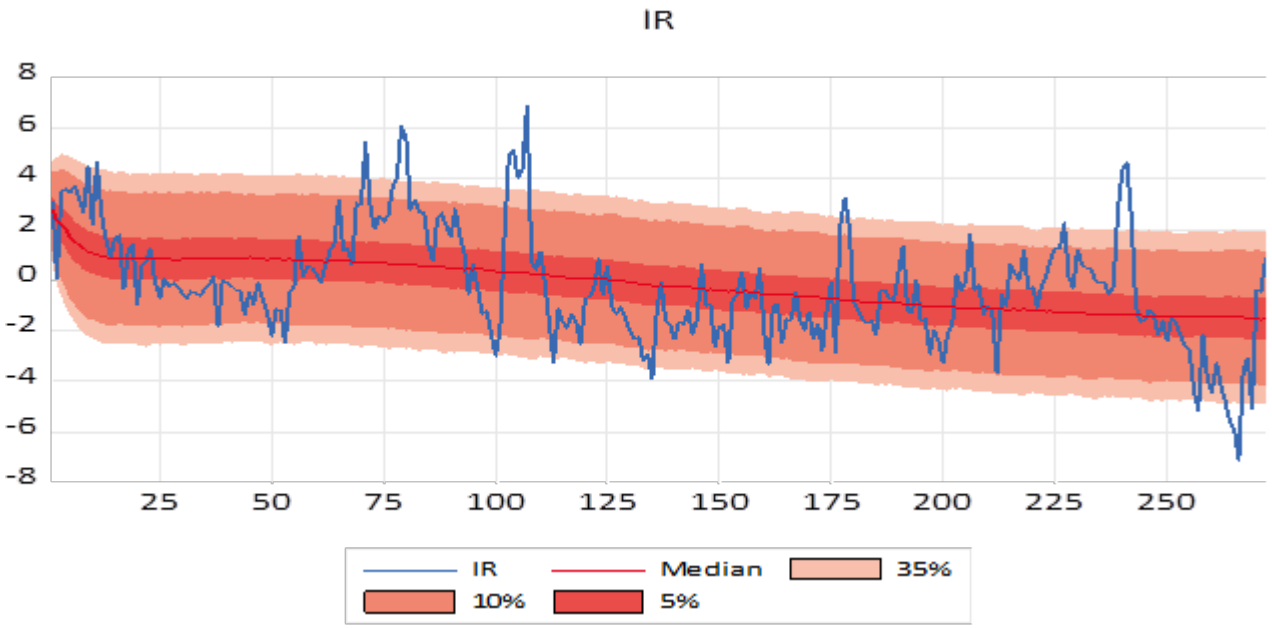
Figure 4.8:Gross Domestic Product Forecast



Interest Rate Forecast

The interest rate forecast shows that the interest slowly shows a downward trend.

Figure 4.9:Interest Rate Forecast

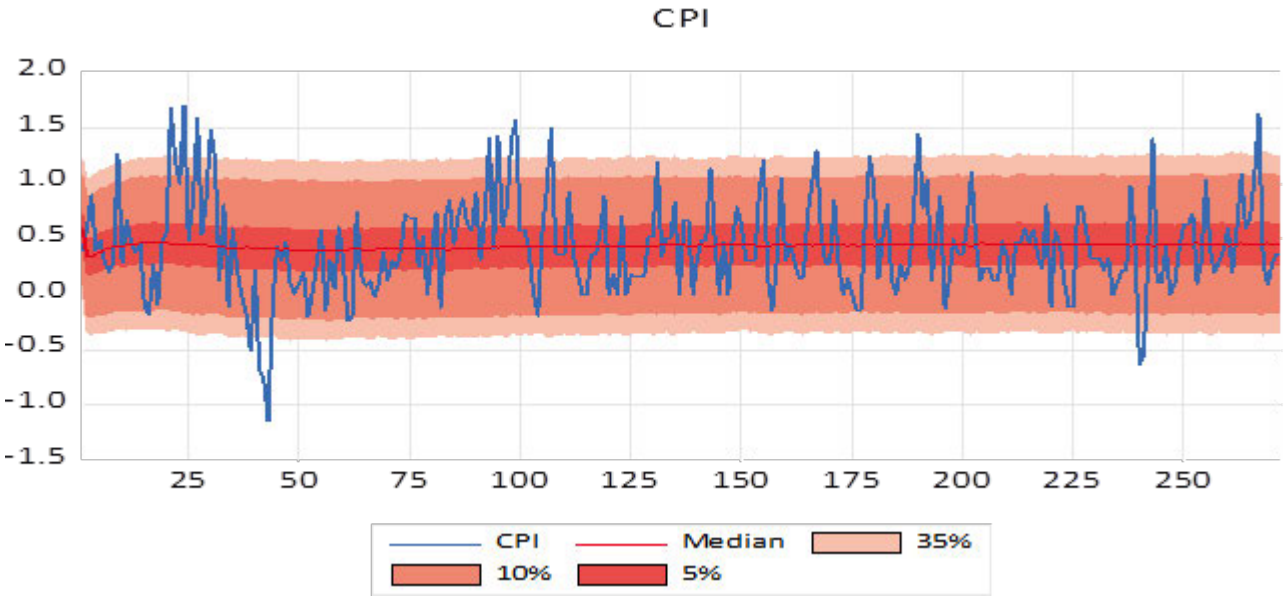


Inflation (CPI) Forecast

The CPI graph reveals significant fluctuations around a central median line, with frequent spikes and dips reflecting volatility, while the median suggests a relatively

stable expected inflation rate over time, indicating that despite short-term variability influenced by economic factors, inflation is anticipated to remain moderate and stable in the medium term.

Figure 4.10: Inflation (CPI) Forecast



4.6. Comparison with another econometric model: The NARDL

To ensure the appropriateness of the NARDL methodology, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were conducted. The tests assessed the stationarity properties of the following variables: real effective exchange rate (REER), oil prices (POIL), consumer price index (CPI), real interest rate (IR), and gross domestic product (GDP).

CPI and RIR are stationary at level, indicating integration of order zero [I(0)].REER, POIL, and GDP become stationary after first differencing, indicating they are I(1).

To assess asymmetries, oil price changes were decomposed into positive (POS) and negative (NEG) partial sums: This decomposition allows for the estimation of asymmetric effects within the NARDL model.

Results of the NARDL (attached in appendix).

Long run effects

A 1% increase in oil prices has a significant negative long-run effect on the exchange rate (REER), implying real appreciation.

A 1% decrease in oil prices has a positive but weaker and marginally significant effect.

Short run effects:

In the short run, positive oil price shocks significantly reduce the value of the exchange rate both contemporaneously and with a one-period lag. Negative oil price changes are not statistically significant in the short term, suggesting an asymmetric response.

Macroeconomic controls (CPI, interest rate, GDP) significantly affect the exchange rate, confirming robustness.

The Wald tests confirm asymmetric effects of oil prices on the exchange rate in both the short and long run.

4.7. Discussion

4.7.1 Restating the Research Questions

- What is the nature of the relationship between oil prices and exchange rates?
- To what extent do variations in oil prices asymmetrically affect the exchange rates in South Africa?

4.7.2 Linear vs. Asymmetric Relationship between Oil Prices and Exchange Rates

Traditional economic theory posits that oil prices and exchange rates are inversely related in countries that rely heavily on imported oil (Altunoz, 2023). The rationale is straightforward: when oil prices rise, the cost of imports increases, leading to inflationary pressures that weaken the local currency. Conversely, when oil prices decline, the cost of imports decreases, exerting upward pressure on the domestic currency.

The results from the Bayesian Vector Autoregression (BVAR) model suggest that the relationship between oil prices and the exchange rate is more complex than a simple, linear inverse correlation. Although oil prices and the exchange rate do generally move in opposite directions, the exchange rate’s response to oil price fluctuations is not uniform. There are clear signs of asymmetry in the way the exchange rate reacts to oil price increases versus decreases, which highlights the non-linear nature of the relationship.

In the case of South Africa, these basic expectations largely hold true; however, only up to a certain extent. The BVAR model presents that a 1% increase in oil price results in a 0.08% appreciation of the ZAR/USD exchange rate, meaning that an immediate reaction to a positive oil price shock(increase in oil price) OP_POS(-1) causes a slight appreciation of the exchange rate in the short term. Even though the effect is small. According to Masuku (2016), this reaction in the exchange rate is expected given that when oil prices increase, we expect the US to pay more dollars for the import of oil, which will weaken the dollar currency. If the dollar weakens, then the South African Rand appreciates against the US dollar. Conversely, during oil price declines, the Rand depreciates, also reflecting a weak relationship. This reaction of the exchange is, however, evident in the initial shock stage.

Findings reflect that at lags 4 and 5, the coefficients for OP_POS and OP_NEG on DLOG_REER become negative but are closer to zero, meaning that there is a weak relationship over time. This depicts that other variable, such as GDP (DLOG_GDP) and inflation (DCPI), have a more pronounced and persistent effect on exchange rates than oil prices. Meaning that, during periods of high inflation, the exchange rate tends to depreciate more significantly. Reflected in the BVAR results as a 1% increase in inflation leads to a 0.10% depreciation of the REER. This depreciation is likely due to several factors. First, higher oil prices lead to cost-push inflation, where the cost of production and transportation rises, affecting a wide range of sectors, from goods manufacturing to retail. These inflationary pressures may result in a deterioration of the currency, as the market anticipates higher costs and reduced consumer spending, eroding the value of the Rand.

On the other hand, when inflation rates decrease, the exchange rate appreciates, even though the effect is less pronounced and more short-lived. This muted response could be attributed to the fact that lower oil prices, while they assist in reducing import costs, do not necessarily lead to a significant improvement in other macroeconomic indicators that affect the exchange rate. In other words, while falling oil prices may ease inflationary pressures, they do not immediately translate into a stronger economy or improved investor sentiment, which are necessary for a substantial and persistent appreciation of the Rand. The unequal dynamic in this situation implies that individuals involved in the market tend to see rises in oil prices as causing disruption to the economy compared to when oil prices fall down. When oil prices go up, it usually brings

about uncertainty as people worry about inflation rates increasing and how it may impact interest rates and the trading balance. On the other hand, when oil prices drop, it may provide some relief by lowering import costs. However, this does not always indicate a significant boost in the overall economic forecast, resulting in a less robust reaction regarding currency values.

4.7.3 Impulse Response Functions (IRFs) and Asymmetric Reactions

The Impulse Response Functions (IRFs) generated from the Bayesian Vector Autoregression (BVAR) provide insights into how oil prices impact the exchange rate of the South African Rand over time. These functions help us understand the extent and duration of the exchange rate's response to changes in oil prices and reveal that this relationship is not symmetrical. The analysis shows that when oil prices increase compared to when they decrease, the effects on the exchange rate are more pronounced. The indication here is that when oil prices rise, it impacts the South African Rand noticeably with an appreciation of the currency, in contrast to when oil prices fall, resulting in minor and short-lived currency appreciations.

A positive shock of oil prices leads to the real effective exchange rate increasing initially. This reflects that following a positive oil price shock, the South African Rand appreciates in value relative to the USD. Period 1-2: In the period, the IRFs reflect a significant reaction after a shock, which was followed by a weaker response in period 2. This indicates short-term gains in the South African Rand following increased oil prices, which is most likely driven by the expectation of an improved balance of trade.

In periods 3-5, this positive effect weakens and fluctuates. Now reflecting a decreasing impact as time goes. This could imply that following the initial response, market forces, such as inflation and trade balance, adjust accordingly and eventually bring back the exchange rate toward equilibrium. This is as per theoretical expectation, as we know that there is a negative relationship between increasing oil prices and the balance of trade; hence, an increase in the terms of trade results in a decrease in the real effective exchange rate.

Negative oil price shocks (Decreases in Oil Prices)

In contrast, a negative oil price shock leads to a depreciation of the exchange rate.

Period 1: The initial response to oil price shocks shows a decrease in exchange rates. However, the decrease remains negative for some time up until period 3 and beyond, where the negative effect fades away. However, the exchange rate still remains relatively unchanged, which reflects that negative oil price shocks have lesser effects on the exchange rate than positive shocks in the long run.

Asymmetric Reactions

The way the IRFs are not symmetrical implies that the impact and duration of how the exchange rate reacts to changes in oil prices vary greatly based on whether oil prices are going up or down. The REER's response to negative oil price shocks appears to be of a more retained manner than more positive shocks, though it remains persistent. This asymmetry indicates that the REER reacts differently to increases and decreases in oil price.

This difference highlights the significance of taking into account both the direction and magnitude of fluctuations in oil prices when predicting changes in exchange rates and shaping policy actions. It is crucial for policymakers and companies to understand that increasing oil prices could have enduring effects on currency value compared to decreasing oil prices, which might not result in significant or lasting consequences.

4.7.4 Short-Term vs. Long-Term Effects

Short-Term Effects

Oil prices and exchange rates tend to fluctuate frequently and show short-term changes according to the models' residuals data analysis that indicate how oil price shocks affect currencies immediately, causing rapid responses in the exchange rate due to market reactions to unforeseen circumstances like geopolitical tensions or changes in global oil demand or supply disruptions, which result in noticeable temporary fluctuations in the exchange rate, especially when oil prices increase. When oil prices go up, the Rand appreciates in value quickly; however, overtime it loses value due to inflation and expensive imports. This is a clear sign that South Africa's economy's quite sensitive to oil price changes since its crucial for energy and other industries within the country; however, if oil prices drop instead a slighter decrease in the Rand's value is usually seen. Even though cheaper imports and less inflation are a benefit, the currency's appreciation reaction does not last long, though. It seems like

the market does not view the increase in oil prices as a sign of long-term progress yet – especially given the current economic landscape. Short-term fluctuations are heightened amid the 2022 energy crisis due to influences worsening exchange rate uncertainties.

Long-Term Effects

The immediate outcomes display variations and rapid shifts, in behaviour; however the enduring impacts of oil price fluctuations impacting currency valuation are shaped by factors within the system itself. The disparities in oil prices and exchange rates across time unveil variations that transcend market reactions. Over time the African economy adjusts to the effects of changes, in oil prices. For example, while a rise, in oil prices may lead to an uptick in currency value, government interventions such as adjusting interest rates or implementing measures to regulate inflation fluctuations can mitigate the long-term effects on the currency. Similarly, during a period of oil prices there may be improvements, over time but the initial currency strengthening usually diminishes as the economy adapts to the changes. The analysis of variance suggests that while oil prices impact short term changes, in exchange rates to some extent their effect weakens over time because of factors such, as GDP growth and interest rates and particularly inflation rates.

4.7.5 Macroeconomic Linkages: Oil Prices, Inflation, Interest Rates, and GDP

The connection between oil prices and the exchange rate of the South African Rand is not just affected by market reactions to oil price shifts but also by the broader economic landscape in which these changes take place. It is essential to comprehend how fluctuations in oil prices intersect with economic factors like inflation rates, interest rates, and GDP to fully evaluate the consequences of oil price adjustments on the South African economy.

Oil Prices and Inflation (CPI)

Increased oil prices often result in production expenses for sectors that heavily rely on energy, like manufacturing and transportation industries, along with businesses. These additional costs eventually get shifted to customers through increased prices of products and services, which further contributes to inflation caused by rising costs.

In the short run, the response patterns demonstrate that when oil prices go up significantly, inflation also rises because higher oil costs quickly affect transportation and energy expenses, causing a price increase that affects consumers ability to buy and raises living expenses too. The inflating pressures from increasing oil prices usually devalue the currency as inflation diminishes its worth. According to the principles of economics, if inflation is high, it decreases the purchasing power of a currency, which might make it less appealing to investors and traders from countries.

In the long term, the magnitude of the response of oil prices is very moderate, which means that oil prices do pass through inflation rates; however, they are not the main determinant of inflation. Over time and in the scheme of things, inflation usually sticks around and strengthens itself spontaneously. If inflation goes up because of oil price surges, the South African Reserve Bank might decide to adjust its policies. This strategy of action might not completely counteract the pressure on inflation, particularly if oil prices stay high for extended periods. The analysis of the distribution of influences shows that oil prices play a role in the ups and downs of inflation in the term, with oil shocks being a major factor in its enduring nature.

Oil Prices and Interest Rates (Monetary Policy Response)

The South African Reserve Bank (SARB) plays a role in handling the effects of changes in oil prices using monetary policy strategies that involve adjusting interest rates when inflation increases due to rising oil prices. This can influence the exchange rate and overall economic situation significantly.

In the short term, the real interest rate goes up due to pressures resulting from higher oil prices. The magnitude of the effects is, however, very moderate, as it depends on the state of the economy at the time the shocks take place. The SARB introduces measures to assist in such situations. This policy tightening is intended to curb inflation expectations and steady the currency. Increased interest rates hinder investments and reduce the overall functionality of commercial banks since taking out loans becomes pricier. This then depreciates the currency exchange. In the impulse response functions (IRFs) it is clear that there is a rise in interest rates after oil prices and not much of a stronger decrease in interest rates when there is a decrease in oil prices. This asymmetrical response reflects that the SARB's response to oil price increases is stronger than its response when oil prices decrease. This non-linearity reflects the

primary focus of the SARB clearly to controlling inflation rather than simulating demand as a response to falling oil prices.

There are long-term effects witnessed from the relationship between oil prices and interest rates. In the course of time, the relationship between rising oil prices and interest rates grows intricate. Heightened interest rates negatively affect economic expansion by increasing borrowing expenses for both businesses and individuals. The lasting impacts of interest rate hikes triggered by oil price changes may entail a decline in consumer expenditures diminished business ventures and, a possible deceleration in economic progress, which collectively could lead to currency devaluation overtime filtering to a decline in the growth of the economy.

Oil Prices and GDP (Economic Growth)

The price of oil plays a role in driving growth in countries that heavily depend on oil imports like South Africa. The initial impact of an increase in oil prices leads to an increase in GDP; however, this is very short-lived, as in the lag following the initial impact, the response deteriorates to a negative impact from a positive oil price shock. This is because overtime higher oil costs will include production costs to increase. The magnitude of the initial impact can be very significant, reflecting how the country is sensitive to oil price changes. On the other side, lower oil prices can temporarily spur economic activity by cutting down input costs. Rising oil prices result in increased expenses for transportation and production operations. This ultimately impacts the line of businesses while also limiting consumer spending abilities, which eventually affects economic growth.

In the short run, oil prices have a positive but weaker relationship to GDP following increased oil prices. Over the long term, however, the effects of oil prices on GDP can be mitigated as the economy adjusts. The long-term persistence of oil price effects is moderated by other variables such as domestic investment, consumer confidence, and government fiscal policies. The variance decomposition results suggest that oil prices explain a smaller portion of GDP fluctuations in the long run compared to other factors, such as interest rates and overall economic conditions.

Interconnectedness of Macroeconomic Variables

The results from the BVAR model emphasize the interdependence of oil prices, inflation, interest rates, and GDP in shaping the exchange rate dynamics. Oil prices do not operate in isolation but interact with other macroeconomic variables to determine exchange rates as well as the overall economic environment.

In 2008, oil prices peaked at $140 per barrel during the global financial crisis, representing a 100% increase compared to the prior year.

During that period, in South Africa, the economy experienced fluctuation in its currency value against the US dollar, with the Rand depreciating from around R7 per USD in 2008 to approximately R10 per USD by the end of the year. This was a drop of more than 40%. This decrease was mainly driven by a mix of surging oil prices and international investors shifting towards assets such as the US dollar.

Oil price fluctuations can have effects on the economy due to the relationships between oil prices and key economic factors like inflation rates and interest rates, which can impact GDP growth in various ways. For instance, when oil prices rise, inflation tends to increase. This often leads to interest rate increases, which ultimately result in a slowdown in GDP growth. These connections emphasize the ways in which changes in oil prices can influence the exchange rate and overall economic conditions since we have established that the oil price alone does not have a significant impact on shaping the exchange rate.

When dealing with oil price shocks, it is critical for policymakers to look beyond oil prices and consider the macroeconomic situation and other factors that can come into play. The way the exchange rate reacts unevenly to changes in oil prices indicates that policymakers should concentrate on controlling inflation and maintaining stability since inflation reflects having more of a pronounced impact on the exchange rate. They must also be aware of the lasting impacts of this relationship on growth and investment.

The results of this research on how oil prices affect the exchange rate of the South African Rand have implications for policy development and risk mitigation approaches for both policymakers and businesses. Due to the uneven reactions of the exchange rate to changes in oil prices, it is essential for stakeholders to create resilient strategies to lessen the economic effects of oil price instability, economic growth, and investment.

4.7.6 Policy Implications and Risk Management

the research shows that when oil prices rise up in the market it impacts currency rates significantly compared to when they decrease. This implies that the South African Reserve Bank must be prepared for adjusting interest rates in order to regulate inflation during oil price fluctuations. Higher oil prices typically lead to inflation levels that can potentially devalue the Rand and prompt capital outflows, from the country. With alterations, in interest rates the SARB can effectively handle inflation control measures concerning escalating prices. Bolster the currency's strength. Policymakers should thoughtfully weigh the disadvantages of increasing interest rates as it may impede growth and limit investment prospects.

Mitigating the impact of fluctuations in oil prices and currency exchange rates.

In light of the impacts of changes in oil prices on different industries. There are businesses that are vulnerable to oil price fluctuations (such as those in manufacturing transport and energy intensive sectors) it is advisable to adopt risk management techniques. This may entail utilizing commodity futures and currency hedges to shield against unfavourable price shifts. Hedging can offer economic security by lessening the uncertainty surrounding costs of supplies and fluctuations in exchange rates, enabling companies to plan and manage their finances more efficiently.

• **Methods for transferring costs to customers**

Businesses should also consider their capacity to offset expenses due to escalating oil prices by adjusting prices or embracing energy-efficient technologies to enhance productivity and cut down on costs associated with energy consumption. Moreover, companies operating in sectors on oil should investigate ways to diversify their supply chains or find more affordable alternatives to alleviate the impact of rising oil prices on their expenses.

• Exploring a variety of options and mapping out long-term strategies

Given the varying reactions of exchange rates to changes in oil prices and the importance of long-term planning for businesses facing this imbalance of responses, it is advisable for companies to adopt an outlook on their operations. This could entail expanding market presence and sources of inputs to minimize exposure to fluctuations in oil prices and currency values. Through building a business framework,

organizations can effectively manoeuvre through the changing economic landscape influenced by shifts in oil prices and exchange rates.

4.8. The impact of the 2022 oil crisis

In the midst of the 2022 energy crisis, oil prices saw an increase, from around 70 dollars per barrel in 2021 to surpassing 120 dollars per barrel by mid-year 2022. Marking a nearly 70 percent surge. This significant spike in oil prices further strained import expenses for South Africa, which relies on oil imports, resulting in challenges.

During that period, the South African Rand lost value from about R14.50 per USD to ZAR 16.80 per USD, showing a drop of around 16 percent in the currency exchange rate. The link between increasing oil prices and the decline in the Rand emphasizes how sensitive South Africa's currency is to energy fluctuations.

The surge in oil prices resulted in fuel and energy expenses locally, which led to a peak in inflation at 7 percent by the middle of 2022.This increase in inflation weakened the purchasing ability of the South African currency and intensified fluctuations in exchange rates.

The crisis made investors more cautious, which caused foreign capital to flow out of the market, which pushed the Rand down further and increased exchange rate volatility due to uncertainty surrounding the crisis.

Response of Policies and their Constraints

The South African Reserve Bank (SARB) increased interest rates to address inflation and maintain currency stability but faced challenges due to the impact of factors on its effectiveness. Raising interest rates might help tackle inflation but could also hinder and discourage borrowing and spending, which could reduce the growth in the economy. In addition, the impact of policy could be restricted by factors like worldwide economic circumstances and global market conditions.

Possible Long-Term Effects

The recent crisis in South Africa brought attention to the country's dependence on oil imports and emphasized the importance of broadening energy sources to lessen potential risks in the future. The unequal impact of oil price changes, with increases causing effects compared to decreases, highlighted the difficulties in handling external

pressures. These difficulties could have lasting impacts on the economy, such as reduced investment and growth potential for the country, which could also result in inflation rates increasing and mounting debt burdens if borrowing and expenditure remain uncontrolled. South Africa needs to focus on expanding its energy resources and reinforcing its economic strategies to be more resilient against external influences moving forward.

4.9. Discussion of Findings

The study showed that when oil prices go up, the currency tends to appreciate; however, this has shown to be short-lived as the currency begins to depreciate in the long run following the oil price increase. This clearly depicts the nature of the relationship between oil prices and the exchange rate in South Africa.

In line with the studies by Huang et al., (2024) and Chen et al., (2024) this research affirms that the increase in oil prices impacts the devaluation of currencies in South Africa. The study also supports the notion by Bruna and Van Tran (2023) that the effect of exchange rate variations from oil prices depends on the nature of the shock; as seen at different lags, the response in exchange rates differs. In addition, the initial shock reflects a positive relationship and then the relationship changes to negative in the long run.

The asymmetry observed in the exchange rate response further supports their conclusions regarding the disproportionate impact of oil price increases and also demonstrates that oil price shocks influence perceived wealth and consumption patterns, which indirectly affect exchange rates. The emphasis on inflationary pressures aligns with their analysis of oil prices' role in increasing consumer price levels.

These findings align with the terms of trade and wealth effect theories, which predict that increased oil prices in net oil-importing countries negatively impact currency value.

When comparing the results with the analysis done using the NARDL, the relationship seems to be consistent in the long run. Positive oil price changes negatively affect the exchange rate and overall, oil price increases affect the exchange rate much more than oil price decreases. Asymmetries are evident in both the short run and the long run.

4.10. Conclusion

In this chapter we explored how changes in oil prices impact the exchange rate of South Africa while delving into the research questions. The research verified an adverse correlation between oil prices and the South African currency exchange rate in South Africa; it emphasized the impacts in both the short run and the long run.

In as much as this study offers insights, it is worth noting that in analysing the data and interpreting, there were some challenges faced during the process of drawing conclusions:

Accessing high-frequency, reliable data for key variables (e.g., oil prices, exchange rates, and inflation) posed a challenge. Data gaps and inconsistencies, particularly for emerging markets like South Africa, required preprocessing and imputation techniques, which could introduce biases. Different interpretations might arise when another study utilizes varying datasets, with levels of accuracy or time frames, for their analysis. The research aimed at measuring differences in how the exchange rate reacts to shifts in oil prices. It is crucial to distinguish between negative impacts when assessing these effects even small changes, in how these impacts are described can impact the outcomes. When examining changes, in oil prices through methods (like comparing changes to percentage changes) the assessments may reveal asymmetry because of the subjective judgments made in applying the techniques used for analysis. The unique economic and structural conditions of South Africa. Such as reliance on imported oil and facing difficulties, like pressures and budget constraints significantly impact how the currency exchange rate responds to these factors. Taking into account these specific factors can pose a challenge when trying to understand the situation. If researchers overlook South Africa's dependencies while studying a country's circumstances they might arrive at varying conclusions. Significant global events such, as the crisis of 2008 and the recent energy crisis in 2022 can influence the findings observed in this context by introducing irregularities and variations that might skew interpretations if not handled carefully. On the hand if a different researcher studies a timeframe or disregards disruptions, they may come across divergent outcomes concerning the reliability and intensity of relationships. Interpreting results frequently entails making assessments in terms of determining causes or assessing the implications, on policies. For instance when comparing short term changes, to long term trends it is important to think it through. On the hand a

different perspective could focus on aspects of the results and delve into various factors. This might lead to narratives or recommendations for policy decisions.

5. CHAPTER FIVE :

CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This chapter concludes this study by summarizing the key findings from the analysis of the relationship between oil price fluctuations and the South African Rand. The study employed a Bayesian Vector Autoregression (BVAR) model to explore how changes in global oil prices impact the value of the South African currency, focusing on both short-term and long-term dynamics, as well as the potential asymmetric effects that arise from these fluctuations. This research sought to answer whether oil price movements asymmetrically affect the exchange rate and to what extent these fluctuations influence the value of the Rand.

5.2 Summary of Key Findings

5.2.1. Asymmetric Relationship between Oil Prices and the Exchange Rate

One key discovery of the research is that there is a connection, between oil prices and the value of the South African exchange rate. The findings indicate that the exchange rate reacts significantly to rises in oil prices more than to declines in oil prices. This implies that when there is a surge in oil prices, it leads to a notable weakening of the South African Rand as opposed to the strengthening seen when oil prices decrease in the long run. The impact and lasting influence of changes in oil prices are more pronounced when it comes to the response of exchange rates, indicating that increases in oil prices result in heightened pressures and increased production costs, which may lead to potential economic instability. Conversely. Decreases in oil prices may cause some strengthening of the Rand currency but do not prompt a market reaction as seen with price increases due to the perception that falling oil prices do not necessarily signal long-term economic progress, especially when other economic issues persist.

The unequal reaction underscores the relationship between oil prices and exchange rates in a way that is not always straightforward or predictable in their correlation with each other. It is crucial for policymakers and businesses to understand that when oil prices go up, it poses more difficulties for the economy than when they go down, calling for a stronger and more forward-thinking approach to deal with rising oil prices.

Macroeconomic Linkages : Oil Prices, Inflation, Interest Rates, and GDP

The results also highlight the linkages among oil prices, inflation rates, and GDP by emphasizing their interdependence. According to the BVAR model outcomes, it is indicated that changes in oil prices impact not only the exchange rate but also have an impact on other significant macroeconomic factors that influence the currency's reaction in a more complex manner.

A vital conclusion is to acknowledge that oil prices are not the main driver of exchange rates, as various factors come into play in determining the value of the currency. Such factors include the inflation rate. When oil prices go up in South Africa, it causes inflation to rise too, as the higher energy expenses impact how much things cost on the market. This kind of inflation is known for weakening the Rand's purchasing ability. In addition to that inflation going up, it prompts reactions from the South African Reserve Bank (SARB), like raising interest rates to manage inflation, although this may also slow down growth.

The short-term impact of oil price increases on GDP is negative, as higher energy costs reduce production capacity and consumer spending. However, the long-term effect of oil prices on GDP is more complicated. Although oil prices are a significant determinant of short-term economic growth, other factors such as domestic economic policies and global market conditions play a larger role in the long-term growth trajectory.

5.2.2. Policy Implications

Policy and Business Implications

The study offers suggestions for policymakers and businesses to deal with fluctuations in oil prices and their impact on the African economy.

For industries that heavily rely on energy, such as manufacturing and transportation, it is crucial to grasp how shifts in oil prices affect exchange rates to ensure viability in the long run. The following strategies can help businesses manage risk and maintain profitability in the face of oil price volatility:

Cost-Passing Mechanisms: In industries where input costs are heavily influenced by oil prices, businesses should explore cost-passing mechanisms that allow them to transfer some of the higher costs to consumers. This could involve adjusting pricing

strategies or increasing efficiency to offset the impact of rising fuel prices without losing market competitiveness.

Diversification of Supply Chains and Markets: To mitigate the effects of oil price volatility, businesses should diversify their supply chains to reduce dependence on regions or suppliers that are heavily affected by oil price fluctuations. Additionally, businesses should look for new market opportunities or expand into regions with lower energy costs to offset higher costs from domestic oil price increases.

Operational Efficiency and Technology Investments: Companies should invest in energy-efficient technologies and process optimization to reduce reliance on energy and minimize the impact of rising fuel prices. Adopting alternative energy sources or exploring greener technologies can not only help mitigate the effect of high oil prices but also enhance the company's long-term competitiveness and sustainability.

In conclusion, for businesses, the study highlights the importance of adopting robust risk management strategies to mitigate the impact of both oil price fluctuations and exchange rate volatility.

The unequal impacts of changes in oil prices on currency exchange rates have implications for policy in South Africa's economy. The South African Reserve Bank (SARB) should be ready to adjust its policies when oil prices rise, and inflationary pressures start affecting the stability of the exchange rate (Ahmed and Huo ,2020). According to the study's results, it indicates that increasing interest rates might be necessary to control inflation and uphold the Rand's value; however, it is essential to implement these measures to prevent hindering growth.

Inflation Control Strategy: As rising oil prices often result in cost-driven inflation trends rising the ranks of priorities, for the SARB, it is vital to monitor inflation levels and be prepared for interest rate adjustments aimed at maintaining price stability levels. With the surge in oil prices paving the way towards a robust and enduring exchange rate devaluation approach, caution is advised when contemplating interest rate hikes, by the SARB ensuring that actions taken against inflation do not inadvertently reduce economic growth opportunities.

Monetary Policy Coordination: The Reserve Bank should think about collaborating with the government in executing financial strategies that promote stability in exchange

rates and lessen the effects of increasing oil prices. This collaboration could assist in aligning interest rate policies with macroeconomic stability initiatives. The South African government has a role in dealing with the economic difficulties caused by the fluctuating prices of oil.

Diversification of Energy Sources: An essential long-term goal is to decrease South Africa's reliance on imported oil by focusing on investing in energy options like power and wind turbines while also exploring hydropower resources to mitigate the effects of increasing global oil prices. Expanding the range of energy sources does not decrease the country's dependency on oil but it also works towards stabilizing energy expenses and supporting a more sustainable economic development path.

The government should make sure the financial system can handle events, like oil price increases, by being adaptable and having a reserve fund to help people and businesses when oil prices are high.

5.3. Recommendations for Future Research

This study provides important insights into the relationship between oil prices and exchange rates, but several areas remain underexplored that warrant further investigation:

Impact of Geopolitical Events: Future research could examine the role of geopolitical risk in amplifying or mitigating the effects of oil price fluctuations on exchange rates. For example, how do political events in major oil-producing countries exacerbate or reduce the impact of oil price shocks on the South African economy?

Oil Price Pass-Through to Inflation: Further research could also explore the pass-through effects of oil price changes to inflation in greater detail. Understanding how oil price fluctuations affect consumer prices at different levels of the economy can help guide both monetary and fiscal policy decisions. Studying how oil price fluctuations affect inflation by analysing when and how much impact they have and examining any irregularities in how the effects are passed on can offer insights for policymakers to consider other factors like currency movements and disruptions in supply chains that also influence how changes in oil prices affect inflation levels. Understanding these mechanisms can help policymakers predict and address potential inflationary challenges within the economy.

5.4. Limitations of the Study

The research offers insights into how changes in oil prices affect the exchange rate of the South African Rand; however, it is crucial to acknowledge constraints when interpreting the results. These limitations arise from data limitations and methodological concerns pointing towards avenues for study and improvement in the future.

1. Data Limitations

The primary limitation of this study is related to the data used for the analysis. The study relied on monthly data spanning from 2000 to 2022, sourced from a credible institution, The Federal Reserve Bank of St. Louis. While this period captures a range of significant global events, including the 2008 financial crisis and the COVID-19 pandemic, it is important to note that the relatively limited sample size may affect the robustness of the results, especially in capturing the long-term dynamics between oil prices and the exchange rate. Shorter time spans may also lead to sampling bias, where certain economic events or outliers disproportionately influence the results.

2. Model Limitations

The Bayesian Vector Autoregression (BVAR) model is quite useful in understanding how various macroeconomic factors interact over time. However, it has some limitations to consider. It assumes connections between variables, which might not always capture the complex dynamics at play when it comes to how oil prices and exchange rates influence each other. For example, the effects of oil price shocks can vary based on factors like the situation or specific national economic conditions.

In addition to factors included, such as interest rates and GDP in the BVAR model analysis of exchange rates, it fails to consider all possible factors affecting exchange rate movements, like geopolitical events, financial market speculations, and changes in commodity prices, which could also have a substantial impact but are not accounted for in the model.

The study recommends the use of other econometric models, such as the SVAR or other nonlinear models such as the NARDL, which have a possibility of giving better results. The SVAR model allows for the imposing of theory-based restrictions to determine structural breaks such as oil price changes, and the model also allows for

the decomposition of exchange rate effects driven by oil prices only, as opposed to the inclusion of other variables. This method may assist in identifying the influence of oil prices on the exchange rates and offer a further contribution to their connection. By using sophisticated econometric methods such as the NARDL model to account for the uneven effects of oil price fluctuations on exchange rates that linear models might fail to account for.

5.5 Final Remarks

In summary, the study revealed an analysis of the influence of fluctuations, in oil prices on the value of the South African Rand specifically examining the repercussions of these price changes. The research employed a Bayesian Vector Autoregression (BVAR) model and indicated that currency exchange rates are notably responsive and consistently affected by increases in oil prices as opposed to decreases. The research underscores the importance of taking into account both the magnitude and duration of oil price fluctuations when evaluating their impacts on emerging economies such, as South Africa. It also suggests that while oil prices can affect currency fluctuations in the run at glance reduces over time as additional economic factors such, as interest rates and GDP growth take on more significance which highlights the necessity of coordinating financial plans to address the effects of increasing oil prices and address the fundamental vulnerabilities, in South Africa's economy going forward.

Government officials can refer to the research, for assistance in managing changes in oil prices through inflation targeted strategies. Adjusting interest rates accordingly. Alongside this advice for policymakers are lessons for businesses on handling risks and adopting strategies to mitigate the effects of fluctuations, in oil prices.

The study contributes insights into the effects of factors, like changes in oil prices on economic conditions and sets a foundation for future research exploring the political and financial factors that shape currency exchange rate movements as well. The findings from this study are not only significant for South Africa but also offer lessons that can benefit other developing economies facing similar challenges.

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Appendix A

Table A1: Descriptive Statistics of the Selected Variables

Statistics	OP	REER	GDP	CPI	IR
Mean	65.70283	115.237	89.34409	0.433841	-0.1662
Median	62.795	111.87	93.01	0.375	-0.405
Maximum	133.59	150.37	104.11	1.7	6.9
Minimum	18.68	82.5	62.83	-1.14	-7.1
Std. Dev.	29.4126	16.36285	13.35021	0.442756	2.224427
Skewness	0.336267	0.224845	-0.57994	0.349169	0.328722
Kurtosis	2.067449	1.966839	1.945722	3.846989	3.476112
Jarque-Bera	15.20246	14.6009	28.25344	13.85828	7.577521
Probability	0.0005	0.000675	0.000001	0.000979	0.022624
Sum	18133.98	31805.42	24658.97	119.74	-45.87
Sum Sq. Dev.	237902.8	73629.31	49012.75	53.90913	1360.72
Observations	276	276	276	276	276

Table A2: Descriptive Statistics of the Selected Variables (After Log Transformation)

Statistics	log (OP)	log (REER)	log (GDP)	CPI	IR
Mean	4.073482	4.736965	4.480443	0.433841	-0.166196
Median	4.139875	4.717336	4.532707	0.375000	-0.405000
Maximum	4.894775	5.013099	4.645448	1.700000	6.900000
Minimum	2.927453	4.412798	4.140433	-1.140000	-7.100000
Std. Dev.	0.492014	0.141909	0.158738	0.442756	2.224427
Skewness	-0.373228	0.022738	-0.728826	0.349169	0.328722
Kurtosis	2.152197	1.990725	2.173010	3.846989	3.476112
Jarque-Bera	14.67364	11.73810	32.29962	13.85828	7.577521
Probability	0.000651	0.002826	0.000000	0.000979	0.022624
Sum	1124.281	1307.402	1236.602	119.7400	-45.87000
Sum Sq. Dev.	66.57152	5.538027	6.929370	53.90913	1360.720
Observations	276	276	276	276	276

Table A3 : Cointegration Test Results

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
0	2537.913	2537.913	2541.050	2541.050	2555.722
1	2601.108	2606.006	2606.131	2607.029	2616.844
2	2617.588	2635.720	2635.821	2640.539	2649.613
3	2630.136	2648.524	2648.541	2654.334	2658.912
4	2637.845	2656.927	2656.943	2662.892	2667.465
5	2637.931	2662.968	2662.968	2668.921	2668.921
0	-17.99198	-17.99198	-17.97823	-17.97823	-18.04961
1	-18.38456	-18.41333	-18.38473	-18.38398	-18.42690
2	-18.43238	-18.55144	-18.53005	-18.55011	-18.59493*
3	-18.45118	-18.56475	-18.55012	-18.57073	-18.58976
4	-18.43428	-18.54559	-18.53833	-18.55271	-18.57908
5	-18.36112	-18.50899	-18.50899	-18.51602	-18.51602

0	-16.66278	-16.66278	-16.58257	-16.58257	-16.58750
1	-16.92245	16.93792*	-16.85616	-16.84211	-16.83186
2	-16.83735	-16.92982	-16.86855	-16.86203	-16.86697
3	-16.72323	-16.79692	-16.75570	-16.73644	-16.72888
4	-16.57341	-16.63155	-16.61100	-16.57221	-16.58528
5	-16.36732	-16.44874	-16.44874	-16.38931	-16.38931

Table A4: Granger Causality Test of the Variables

Null Hypothesis	**Obs**	**F-Statistic**	**Prob.**
REER does not Granger Cause OP	272	0.49607	0.7386
OP does not Granger Cause REER	272	2.67698	0.0323

Table A5: Lag Length Selection Criteria for BVAR

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1560.186	NA	6.00e-12	-11.64933	-11.58215	-11.62235
1	2707.170	2242.419	1.34e-15	-20.05371	-19.65065	-19.89180
2	3497.902	1516.310	4.34e-18	-25.78953	-25.05058	-25.49270
3	3537.257	73.99340	3.90e-18	-25.89706	-24.82222	-25.46530
4	3644.094	196.8675	2.11e-18	-26.51006	-25.09935	-25.94339
5	3735.467	164.9509	1.29e-18	-27.00724	-25.26064*	-26.30564*

6	3775.050	69.97501	1.16e-18	-27.11648	-25.03400	-26.27996
7	3803.348	48.96461	1.13e-18	-27.14118	-24.72281	-26.16974
8	3829.144	43.66938*	1.13e-18*	-27.14714*	-24.39289	-26.04078

Table A6: Roots of Characteristic Polynomial

Endogenous variables: OP_POS OP_NEG

DLOG_REER

Exogenous variables:

Lag specification: 1 5

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Root	Modulus
0.986562	0.986562
0.219806 - 0.647753i	0.684031
0.219806 + 0.647753i	0.684031
0.234650 - 0.553877i	0.601532
0.234650 + 0.553877i	0.601532
-0.111489 - 0.577065i	0.587736
-0.111489 + 0.577065i	0.587736
0.573341	0.573341
0.486048 - 0.303504i	0.573024

0.486048 + 0.303504i	0.573024
-0.481797 - 0.299546i	0.567324
-0.481797 + 0.299546i	0.567324
-0.413164 - 0.295853i	0.508166
-0.413164 + 0.295853i	0.508166
-0.479809	0.479809

No root lies outside the unit circle.

VAR satisfies the stability condition.

Table A7: BVAR MODEL Result of OP, REER, and Other Macroeconomic Variable

	OP_POS	OP_NEG	DLOG_REER	DLOG_GDP	DIR	DCPI
OP_POS(-1)	0.357505	0.240804	0.000878	1.87E-08	-0.191938	0.057873
	(0.09708)	(0.09074)	(0.00223)	(4.1E-08)	(0.20728)	(0.06609)
OP_POS(-2)	0.024223	0.080759	0.000938	2.18E-09	0.000423	0.025410
	(0.08255)	(0.07352)	(0.00184)	(3.4E-08)	(0.17132)	(0.05460)
OP_POS(-3)	-0.028167	0.073648	-0.000377	-1.55E-08	-0.142482	-0.056418
	(0.07317)	(0.06283)	(0.00160)	(2.9E-08)	(0.14890)	(0.04746)
OP_POS(-4)	0.051743	0.024569	-0.000391	3.64E-09	-0.027859	0.000873
	(0.06729)	(0.05597)	(0.00144)	(2.6E-08)	(0.13455)	(0.04286)
OP_POS(-5)	0.092831	-0.002086	-8.18E-05	1.15E-08	0.111626	-0.006570
	(0.06251)	(0.05089)	(0.00132)	(2.4E-08)	(0.12336)	(0.03932)

OP_NEG(-1)	0.272231	0.314249	-0.001685	-2.13E-08	0.268425	-0.064509
	(0.09330)	(0.09769)	(0.00227)	(4.1E-08)	(0.21164)	(0.06746)
OP_NEG(-2)	0.094130	-0.000996	-0.001347	-3.40E-09	0.036897	-0.028695
	(0.07494)	(0.08324)	(0.00187)	(3.4E-08)	(0.17410)	(0.05547)
OP_NEG(-3)	0.082242	-0.046575	0.000114	1.49E-08	0.168729	0.054931
	(0.06382)	(0.07357)	(0.00162)	(2.9E-08)	(0.15072)	(0.04803)
OP_NEG(-4)	0.029636	0.036146	0.000195	-4.28E-09	0.046788	-0.002402
	(0.05682)	(0.06777)	(0.00146)	(2.7E-08)	(0.13623)	(0.04339)
OP_NEG(-5)	0.001088	0.079306	-7.72E-05	-1.21E-08	-0.097765	0.005417
	(0.05165)	(0.06298)	(0.00134)	(2.4E-08)	(0.12486)	(0.03979)
DLOG_REER(-1)	0.911913	-1.042272	0.237218	8.98E-07	-1.540431	-4.218853
	(2.17171)	(2.16247)	(0.06300)	(1.1E-06)	(5.49969)	(1.75607)
DLOG_REER(-2)	1.567264	-1.698320	-0.106463	-1.09E-06	-4.924393	-0.286667
	(2.00996)	(2.00153)	(0.06128)	(1.0E-06)	(5.09020)	(1.62518)
DLOG_REER(-3)	-0.133590	0.031525	0.048942	3.59E-07	2.002086	-1.073588
	(1.85572)	(1.84779)	(0.05862)	(9.2E-07)	(4.69957)	(1.50026)
DLOG_REER(-4)	-0.796527	0.729253	-0.000229	-7.35E-08	3.358132	-1.990027
	(1.72548)	(1.71770)	(0.05590)	(8.6E-07)	(4.37060)	(1.39578)
DLOG_REER(-5)	-0.504405	0.457107	-0.049397	-8.94E-07	-1.977163	0.141187
	(1.61749)	(1.61000)	(0.05328)	(8.0E-07)	(4.09906)	(1.30978)
DLOG_GDP(-1)	29214.10	-15657.06	2048.302	1.806866	-62044.85	-5617.453
	(57201.6)	(56961.8)	(1556.39)	(0.03492)	(144913.)	(46203.2)
DLOG_GDP(-2)	-60746.98	52991.09	-3424.951	-0.060402	23326.74	-13570.60

	(119378.)	(118819.)	(3249.62)	(0.07583)	(302421.)	(96451.7)
DLOG_GDP(-3)	44804.91	-58666.59	1609.461	-0.845835	70121.86	58919.73
	(98718.0)	(98259.4)	(2688.98)	(0.06265)	(250074.)	(79744.1)
DLOG_GDP(-4)	-26525.39	21541.88	-1025.292	-0.360995	38311.92	-54704.53
	(98250.4)	(97783.6)	(2674.88)	(0.06592)	(248913.)	(79387.7)
DLOG_GDP(-5)	13349.72	-210.5384	793.3755	0.460325	-69765.65	14968.03
	(48623.7)	(48409.9)	(1322.77)	(0.03134)	(123146.)	(39276.8)
DIR(-1)	-0.029575	0.031334	0.000519	1.19E-08	-0.221661	-0.000374
	(0.02353)	(0.02344)	(0.00064)	(1.2E-08)	(0.06386)	(0.01903)
DIR(-2)	-0.012173	0.013990	1.38E-05	5.05E-09	-0.124678	-0.012360
	(0.02182)	(0.02174)	(0.00059)	(1.1E-08)	(0.06248)	(0.01762)
DIR(-3)	0.017549	-0.016898	0.000126	-1.19E-09	-0.043356	0.000354
	(0.02019)	(0.02010)	(0.00055)	(1.0E-08)	(0.06008)	(0.01630)
DIR(-4)	0.001751	-0.001376	-6.16E-05	-5.75E-09	-0.018341	0.017797
	(0.01870)	(0.01861)	(0.00051)	(9.3E-09)	(0.05681)	(0.01508)
DIR(-5)	-0.009358	0.009405	-0.000113	9.57E-10	0.019405	0.004964
	(0.01740)	(0.01731)	(0.00047)	(8.6E-09)	(0.05350)	(0.01405)
DCPI(-1)	0.009938	-0.011033	-0.000106	-2.26E-08	-0.158485	-0.391968
	(0.07017)	(0.06984)	(0.00191)	(3.5E-08)	(0.17761)	(0.06126)
DCPI(-2)	0.042095	-0.043027	0.000233	-1.76E-08	-0.218675	-0.309583
	(0.06673)	(0.06642)	(0.00182)	(3.3E-08)	(0.16870)	(0.06205)
DCPI(-3)	0.022170	-0.023625	-0.000359	3.15E-09	-0.072093	-0.150787
	(0.06184)	(0.06156)	(0.00169)	(3.1E-08)	(0.15667)	(0.06016)
DCPI(-4)	-0.003588	0.002388	0.001829	2.24E-08	0.133170	-0.077668

	(0.05638)	(0.05612)	(0.00154)	(2.8E-08)	(0.14293)	(0.05543)
DCPI(-5)	0.006443	-0.006448	-0.000242	-2.82E-08	-0.042487	-0.034368
	(0.05189)	(0.05165)	(0.00141)	(2.6E-08)	(0.13160)	(0.05063)
R-squared	0.177368	0.180995	0.114230	0.230000	0.186390	0.325782
Adj. R-squared	0.134117	0.140051	0.170199	0.16321	0.128079	0.244314
Sum sq. resids	60.30939	60.07229	0.051059	1.88E-11	409.7789	43.02919
S.E. equation	0.501287	0.500301	0.014586	2.80E-07	1.306680	0.423424
F-statistic	0.693977	0.729380	1.067265	31703004	1.895924	3.998890
Mean dependent	0.588889	0.411111	-0.000440	0.000792	0.002837	-0.000855
S.D. dependent	0.492949	0.492949	0.014639	0.000518	1.368329	0.487085
Data marginal log-likelihood	-7625.799					

Roots of Characteristic Polynomial

Endogenous variables: OP_POS OP_NEG

DLOG_REER DLOG_GDP DIR DCPI

Exogenous variables:

Lag specification: 1 5

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Root	Modulus
0.992606	0.992606

0.969303 + 0.032840i	0.969859
0.969303 - 0.032840i	0.969859
0.940652	0.940652
-0.563927 - 0.413290i	0.699158
-0.563927 + 0.413290i	0.699158
0.077765 + 0.621839i	0.626682
0.077765 - 0.621839i	0.626682
0.306745 + 0.529909i	0.612288
0.306745 - 0.529909i	0.612288
-0.442711 - 0.411483i	0.604409
-0.442711 + 0.411483i	0.604409
-0.184546 - 0.569476i	0.598632
-0.184546 + 0.569476i	0.598632
0.235372 - 0.549042i	0.597367
0.235372 + 0.549042i	0.597367
0.493092 - 0.323016i	0.589474
0.493092 + 0.323016i	0.589474
-0.519685 + 0.255845i	0.579248
-0.519685 - 0.255845i	0.579248
0.173877 + 0.549734i	0.576577
0.173877 - 0.549734i	0.576577
0.547579	0.547579
-0.408892 + 0.295338i	0.504397
-0.408892 - 0.295338i	0.504397

-0.475093 + 0.062020i	0.479124
-0.475093 - 0.062020i	0.479124
-0.034931 + 0.391830i	0.393384
-0.034931 - 0.391830i	0.393384
0.368633	0.368633

No root lies outside the unit circle.

VAR satisfies the stability condition.

Table A8: Asymmetry results

	OP_POS	OP_NEG	DLOG_REER
OP_POS(-1)	0.396185	0.235797	0.000869
	(0.09282)	(0.08677)	(0.00210)
OP_POS(-2)	0.050735	0.075562	0.000950
	(0.08023)	(0.07202)	(0.00179)
OP_POS(-3)	-0.012960	0.071753	-0.000419
	(0.07136)	(0.06189)	(0.00156)
OP_POS(-4)	0.066691	0.021696	-0.000462
	(0.06536)	(0.05519)	(0.00141)
OP_POS(-5)	0.102368	-0.003320	-7.13E-06
	(0.06093)	(0.05030)	(0.00130)
OP_NEG(-1)	0.298237	0.317344	-0.001444
	(0.09015)	(0.09371)	(0.00217)

OP_NEG(-2)	0.103979	0.006794	-0.001243
	(0.07372)	(0.08111)	(0.00182)
OP_NEG(-3)	0.089893	-0.045019	0.000234
	(0.06308)	(0.07200)	(0.00159)
OP_NEG(-4)	0.033817	0.040676	0.000325
	(0.05616)	(0.06597)	(0.00143)
OP_NEG(-5)	0.005498	0.080464	-0.000106
	(0.05113)	(0.06146)	(0.00132)
DLOG_REER(-1)	0.971789	-1.131438	0.234674
	(2.09357)	(2.08480)	(0.06042)
DLOG_REER(-2)	1.767107	-1.915483	-0.094440
	(1.93809)	(1.92998)	(0.05856)
DLOG_REER(-3)	-0.337981	0.180688	0.048415
	(1.80122)	(1.79404)	(0.05633)
DLOG_REER(-4)	-0.995050	0.898745	0.015099
	(1.67974)	(1.67230)	(0.05386)
DLOG_REER(-5)	-0.746380	0.691644	-0.053296
	(1.57432)	(1.56698)	(0.05126)
R-squared	0.050009	0.053116	0.081551
Adj. R-squared	-0.002148	0.001131	0.031126
Sum sq. residual	62.09776	61.89462	0.052942
S.E. equation	0.493478	0.492670	0.014409
F-statistic	2.958823	3.021750	4.617276
Mean dependent	0.588889	0.411111	-0.000440
S.D. dependent	0.492949	0.492949	0.014639

Data marginal log-likelihood	-2283.552

Unit root test: ADF and PP test

Table A9

Test	REER	POIL	CPI	RIR	GDP
ADF (Level)	-1.92	-2.15	-3.45**	-3.88***	-2.01
ADF (Diff)	-4.87***	-6.12***	-	-	-5.24***
PP (Level)	-1.85	-2.21	-3.62**	-4.11***	-2.12

Variables OP,REER and GDP are stationary after differencing while IR and CPI are stationary at levels.

The NARDL model requires decomposing oil price changes into positive and negative partial sums:

1. **First difference of oil prices**:

   $\Delta OILt = OILt - OILt-1$

2. **Partial sum decompositions**:
   $POSt = i=1\sum t \max(\Delta OILi, 0), NEGt = i=1\sum t \min(\Delta OILi, 0)$

Long-Run Coefficients

Table A10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POS(-1)	-0.192***	0.045	-4.267	0.000
NEG(-1)	0.087*	0.051	1.706	0.089
ECM Term (ρ)	-0.312***	0.071	-4.394	0.000

Table A11

Short-Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ΔPOS	-0.095**	0.041	-2.317	0.021
ΔNEG	0.042	0.039	1.077	0.282
ΔPOS(-1)	-0.073*	0.038	-1.921	0.056
ΔNEG(-1)	0.048	0.044	1.091	0.276
ΔCPI	0.138**	0.063	2.190	0.029
ΔIR	0.231***	0.067	3.448	0.001
ΔGDP	0.193**	0.081	2.383	0.018

Table A12

Wald Tests for Asymmetry

Test	F-Statistic	Prob.
Short-Run	5.427**	0.021
Long-Run	9.836***	0.002

Conclusion:

- Asymmetry exists in both short-run and long-run effects.
- The impact of oil price increases ≠ decreases.

4. Bounds Testing for Cointegration

Test Statistic	Value	Critical Values (5%)
F-statistic	7.153	I(0) = 3.12, I(1) = 4.25
t-statistic	-4.394	I(0) = -2.86, I(1) = -3.78

Conclusion: Since 7.153 > 4.25, we confirm cointegration.

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

06-11-2024
Miss Noko Kgaogelo Moabelo (223047354)
School Of Acc Economics&Fin
Westville

Dear Miss Noko Kgaogelo Moabelo,

Original application number: 00028526
Project title: The impact of oil price fluctuations on the South African exchange rate

Exemption from Ethics Review

In response to your application received on 24 October 2024, your school has indicated that the protocol has been granted **EXEMPTION FROM ETHICS REVIEW.**

Any alteration/s to the exempted research protocol, e.g., Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through an amendment/modification prior to its implementation. The original exemption number must be cited.

For any changes that could result in potential risk, an ethics application including the proposed amendments must be submitted to the relevant UKZN Research Ethics Committee. The original exemption number must be cited.

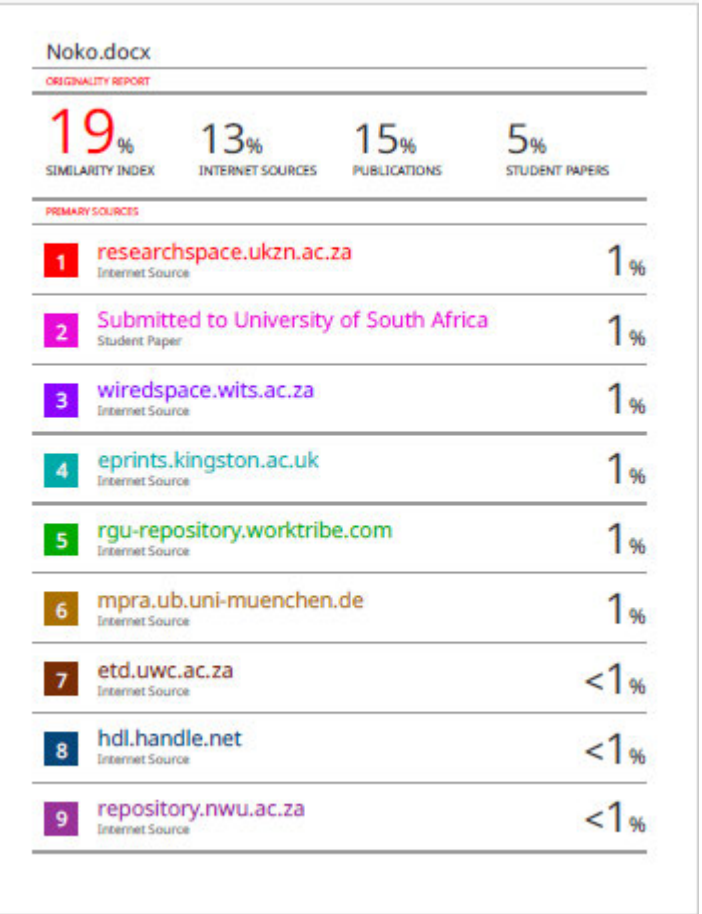
In case you have further queries, please quote the above reference number.

PLEASE NOTE:
Research data should be securely stored in the discipline/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours sincerely,

[redacted]----------
Prof Claire Lauren Vermaak
Academic Leader Research
School Of Acc Economics&Fin



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Appendix A

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b) I made use of generative AI in this report/dissertation/thesis in the following areas:

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Signed:

[Noko Moabelo ,223047354]