MCom

Oil Price Movements and Exchange Rate: Evidence from Selected Net Oil Exporting Countries in Africa

A Dissertation

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Dedication

I dedicate this dissertation to my parents Zandile and Dingane Mdluli.

Acknowledgements

Special appreciation to my supervisor, Prof. Abdullatif Alhassan Ph.D. for the support, guidance, and encouragement that without which this study wouldn't have been possible. Furthermore, I would like to thank my family their unrelenting support.

Abstract

This dissertation investigates the long and the short run relationships as well as the causal relationship between oil price movements and exchange rates. The study uses daily data for a 12-year period commencing in January 2007 and December 2018, focuses on four net oil exporting African countries, namely, Nigeria, Angola, Algeria and Egypt. The data was analysed using the time series techniques covering unit root, cointegration and causality analyses.

The results of the study found that in the long run, oil prices movements are observed to be negatively related to the returns on the Nigerian Naira, Egyptian Pounds and Algerian Dinar indicating that an oil price increases result in the depreciation of the exchange rates for each of the aforementioned countries. In the short run, oil prices movements are observed to be positively related to the returns on Nigerian Naira, Egyptian Pounds and Algerian Dinar indicating that oil price increase results in the appreciation of the exchange rates. The causality results show evidence of bidirectional causality for the Nigerian Naira and the Angolan Dinar, unidirectional causality for the Egyptian pound and lastly no evidence of causality was found for the Angolan Kwanza. This dissertation suggests the policymakers to stabilize the effects of oil price movements through expansionary monetary policy, to shield African economies from sudden economic depression.

List of Acronyms

ACF	Auto-Correlation Function
ADP	Augmented Dickey-Fuller
AFDB	African Development Bank
ARDL	Autoregressive Distributed Lag
DF	Dickey-Fuller
EGARCH	Exponential Generalised Auto-regression Condition Heteroscedasticity
FID	Final Investment Decision
GARCH	Generalised Auto-regression Condition Heteroscedasticity
GDP	Gross Domestic Product
IOC	International Oil Companies
J-B	Jarque-Bera
LM	Lagrange Multiplier
NOC	National Oil Companies
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
OLS	Ordinary Least Square
OP	Oil Price
PP	Philips Peron
RER	Real Exchange Rate
US	United States
VAR	Vector Auto- regression
VECM	Vector Error Correction Model

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CHAPTER ONE: INTRODUCTION

1.1 Background of the study

The topic of commodities has recently become an area of importance especially within the African continent's on-going process of attaining the Millennium Development Goals (MDG's). Natural commodities are especially important as they form part of the objectives of the New Partnership for Africa's Development (NEPAD) Ocran (2007).

According to Mackenzie (2019), there are c.34 countries on the African continent that are dependent on three or more commodities for at least 50% of their foreign exchange earnings. The African continent holds at least 7.5% of the total world's proven oil reserves at c.128.0 billion barrels (Mackenzie, 2019). A large portion of the 91.5% proven reserves in Africa are concentrated in Nigeria, Algeria, Libya and Egypt Iwayemi and Fowowe (2011). It is said that in 2050, that Africa will experience a 75% increase in the oil and gas reserves coupled with an increase in consumption Mackenzie (2019). Despite the commodity market holding high regard in its contribution to foreign exchange earnings, research surrounding the impact of commodity price movements has not been fully explored.

In the context of oil and the African continent, what will the oil-producing economies look like in 20 years to come? For some African countries, oil production can account for up to 95% of government revenue. Despite there being a transition towards renewable energy, oil demand is expected to peak in the mid-2030's Mackenzie, (2019).

Oil price movements have become an area of interest for Independent Oil Companies, Governments, Policymakers, Oilfield service companies, International Oil Companies (IOC), and National Oil Companies (NOC) Mlambo, Maredza and Sibanda (2013) Muzindutsi (2011). Empirical and theoretical literature has informed research that oil price movements has an adverse impact on some macroeconomic variables. It has been established that oil price volatility negatively affects production and increases operational costs. Furthermore, oil price volatility delays investments, as adverse movements raises levels of uncertainty for investors and policy makers, causing an expensive resource reallocation Mackenzie (2019).

For all consuming industries and importing countries, commodities such as oil are a substantial input in economic activities.

This study focuses on the period between January 2007 and December 2018, and as such does not consider the COVID 19 pandemic period and the consequential oil price decline in 2020. In the period preceding 2018, the rapid decline of oil prices, from $115 per barrel in June 2014 to just under $35 at the beginning of 2016 were one of the most adverse movements of the oil price and were a monumental macroeconomic event from a commodities perspective. The last time a similar event took place where oil prices dropped in a similar magnitude was in 1985-1986, when the Organization of the Petroleum Exporting Countries (OPEC) put a stop to production cuts, as a result, the decline was largely driven by over-supply (World Bank Group, 2018). The 2008-2009 sharp decline in oil prices was mostly due to a drop in the demand during the outset of the global financial crises. Whilst the 2014-2016 price decrease was a combination of a decline in demand and over- supply World Bank Group (2018)

Investigating the true cause of oil price declines is imperative and allows us to better understand the macroeconomic impact these movements have on economies. An adverse decline in the price of oil is one of the significant contributors to financial market volatility. As mentioned previously, there are deteriorating investment conditions for oil exporters and companies Gupta, Li and Yu (2015). As a result, countries largely dependent on remittances from citizens working in oil dependent economies face a challenge. Large currency reserves and exchange rate flexibility has helped many countries avoid an outright financial collapse due to volatile oil prices Kang, Ratti and Yoon (2015).

If episodes of low oil prices persist, oil producers would be forced to make fiscal changes to survive Barder (2011). Past episodes of low oil prices suggest that in the long term, oil exporters are required to find other avenues for revenue generation as a way of diversification Hong *et al.* (2004). Contrastingly, in the case of economies that are net oil importers, a price drop, provides such economies a boost and those that are advanced are afforded the chance to improve their fiscal positions and become resilient Ocran and Biekpe (2007)

As previously mentioned, a large portion of African countries depend on between one to three commodities, which have a significant contribution, at 50% or more, to sovereign earnings (Larson, 2003). As such, the phenomenon of commodity market volatility has caused immense stress on African economies Ocran and Biekpe (2007). It is therefore important to investigate how oil price movements impact on key macroeconomic indicators of African economies.

Exchange rate is one of the most important macroeconomic factors that determine the economic health of a country. By definition, the exchange rate is the value of the currency of one country in relation to another country's currency. Export levels are largely determined by two factors primarily, the commodity price determined by OPEC (Organization of the Petroleum Exporting Countries) and the exchange rate, in the simplest Keynesian tradition. As such for oil dependent countries like the ones analysed in this dissertation an oil price movement whether an increase or decrease affects aggregate demand, export earnings and the exchange rate, inflation and overall growth Ebrahim, Inderwildi and King (2014) Berument *et al.* (2010).

Oil prices movements' transmission on oil exporting economies, are generally transmitted via two channels, namely, the export and fiscal channel. When oil prices increase, net oil exporters at first there experience huge revenue inflows through foreign currency incursion, which subsequently leads to an appreciation of the exchange rate as a result of the appreciation imports become more affordable which form part of a large proportion of consumer goods. In summary an oil price increase in a net exporting country causes a price deflation which subsequent interest rate drop. From a fiscal channel perspective which is the secondary channel, sometimes referred to as the government budget channel which explains changes from a tax income and government spending perspective. Oil exports are generally heavily taxed, as such an increase in the oil price would cause an increase in fiscal income through taxation and in government spending. However for African countries the positive channel effects are not long lasting, because African countries are heavily dependent on export, when the exchange rate appreciates their exports become more expensive including that of oil and as a result become less competitive in the market and lose to the world leaders (Alekhina and Yoshino, 2018).

In contrast, an oil price decrease for oil exporting countries especially those that are heavily dependent on oil foreign currency revenue, a fall can potentially be detrimental to their economy. As discussed before, oil-exporting countries rely heavily on not on only just the revenue for oil exports, but also the tax revenue which comes through production of oil which is generally to fund government spending and particularly in African social spending. As such a drop in oil prices could potentially be followed by a government budget deficit and a huge effect on social grants which African population are very dependent upon. World leading oil exporting countries as the UAE and Saudi Arabia have as a contingency for episodes of depressed oil price have built a strong currency reserve which protects the government the detrimental effects an abrupt drop creates. (Deloitte, 2015).

In this dissertation the exchange rate is a key variable that will be analysed in understanding the impact of oil price movements on the economic wellbeing of the selected African countries. Despite considerable oil reserves, past research provides a comprehensive framework on the economic theories around demand and supply shocks on oil and the transmission of such shocks on macroeconomic variables. However, such research does not delve into the detail of the impact of the abrupt and causality relationships between oil price movements and macroeconomic factors such as exchange rate.

1.2 Problem Statement

There is unanimity amongst academic practitioners that oil price movements are heavily linked to global economic activity. Studies (Ijoham and Apere, 2013; Aliyu, 2009; Englama et al., 2010; Gosh, 2011; Henriques and Sadorsky, 2011, Masih et al., 2011; Iyoka and Oriakhi, 2013; Wang and Fu, 2012 Ahmed and Huo, 2020; Coudert et al., 2008) have been done to investigate the nature, impact, and sources of the linkage between oil price movements and the economic activity and has become an area of great importance especially in the attainment of Millennium Development Goals (MDG). Several African countries are dependent on at least three key commodities which form a significant portion of foreign exchange earnings and as such contribute largely to GDP (Mackenzie, 2020).

Over the years the African continent has experienced the oil price highs and lows and these abrupt movements have negatively impacted these economies in many ways. For example, the adverse movements impact on the supply schedules of oil and related oil products, aggregate demand, and lastly aggregate output, which play a hand in inhibiting economic growth on the African continent

As a result of oil price movements and the uncertainty around the movements, African oil net exporters have over the years lost their competitiveness and consequently lost their global market share. Several studies have explored the causal relationship between oil prices and a variety of macroeconomic variables mostly in the economically developed countries, where the dependence of oil related foreign revenue is not as significant as it is in the African continent

((Chen and Chen, 2007; Wang and Fu, 2012; Lizardo and Mollick, 2010; Ahmed and Huo (2020; Coudert et al., 2008). However, the conclusion of these studies have generally been varied. Not enough research has been done for the African continent in investigating the relationship between commodity price movements and macroeconomic variables such as exchange rate, interest rate, inflation, and money supply. Broadly, this dissertation aims to investigate the impact of oil price movements from an economic perspective, looking particularly at exchange rate as a key variable that provides an indication of economic wellbeing.

1.3 Research questions

The study poses two research questions:

1.3.1 What are the long and short run relationships between oil price movements and exchange rates among 4 net oil exporting African countries?

1.3.2 What is the causal relationship between oil price movements and exchange rates among 4 net oil exporting countries in Africa?

1.4 Research objectives

1.4.1 To examine the long and short run impact of oil prices on exchange rates in 4 net oil exporting African countries.

1.4.2 To examine the causal relationship between oil prices and exchange rate among selected 4 net oil exporting countries in selected Africa.

1.5 Justification of the study

It is important to gain a deeper insight of the impact of commodity prices and the ongoing journey towards a successful and well-managed economic system since commodities are a large source of foreign exchange revenue. Despite the dependence of African economies on commodities there are very few comprehensive studies that investigate the impact of commodities on economic development.

If one dates back to the 1970s, there was a growing dependence on oil particularly from the United States. During this period, there were many anomalous disruptions globally in the oil market. Furthermore, the United States had poor macroeconomic performance during that era in history. This sparked a new interest to investigate whether oil price movements had a causality relationship on macroeconomic performance.

Given the paucity of evidence on the impact of oil price movements on African economies, this dissertation seeks to contribute to policy development that aims to mitigate the effect of negative commodity price movements and their eventual impact on the economic growth.

1.6 Organisation of the study

This dissertation is comprised of five chapters. Chapter one provides the introduction, followed by chapter two which provides the literature review. The third chapter presents the methodology, whilst chapter four provides the discussion of results and lastly chapter five presents insight gained in the form of conclusions and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Chapter two begins by presenting a macroeconomic overview on selected oil exporting African countries, namely Nigeria, Angola, Egypt and Algeria. The chapter continues by depicting the theoretical framework which includes the Terms of Trade channel, Wealth channel and the Portfolio Reallocation Channel and reviews empirical literature on the subject matter. The chapter concludes by summarising the importance of the commodity markets on the African continent and in doing so highlights the paucity in our understanding of the impact of oil prices on exchange rates, which this research seeks to address.

2.2 Overview of Macroeconomic economic environment in Africa

Abrupt oil prices movements to extreme high or low prices may have adverse and long-lasting effects on the economies of African oil net importing and net exporting countries, especially those who largely dependent on oil revenue. The African continent has 14 oil exporting countries AFDB (2020).

As much as Africa promises many opportunities in oil, as there are reserves in untapped territories waiting to be profitably exploited, very little research has been done to investigate the impact of oil price movements on the very oil dependent African economies. This dissertation exams the impact of abrupt oil price changes on the exchange rate of 4 African countries.

2.2.1 Nigeria

Nigeria is one of the oldest and largest oil producers on the African continent. Crude oil is the cornerstone of the Nigerian economy, the pronounced dependence on oil revenue, makes the economy rather vulnerable as it suffers from even the slightest oil price movements which contribute to the GDP(Mackenzie, 2020).

2.2.2 Angola

For the Angolan Oil Market, oil production has been above 1.6 million barrels per day for over a decade. However, because of the prolific oil price fall in 2014, more than 20 developments had to be put on hold. Furthermore, the industry had very high costs, whilst also experiencing tough fiscal term, which as a result made pre – Final Investment Decision (FID) projects not commercially viable (PwC, 2019).

With the abrupt oil price decline since 2014, many oil dependent economies, like the Angolan economy, were hit hard. The GDP dropped by 0, 2% and 0.7% in 2017 and 2018 respectively. However, efforts through reducing budget deficit by approximately 2.8% of GDP in 2018 from 4.8% in 2017, mobilization of non-oil fiscal revenue reforms from external debt increased 40.7% of GDP in 2014 to 80.5% in 2018, which raised concerns on sustainability, shielded the Angolan economy from a complete collapse (McKinsey, 2019)

Angola , in a response to the volatile oil price movements , took on a flexible foreign exchange regime, which as a result caused a depreciation of the Angolan Kwanza, however, inflation reduced and saw an approximate recovery of 10% from 2017 to 2018. As oil prices slowly recovered, the Angolan current account balance reached stabilization (World Bank Group, 2018).

2.2.3 Egypt

Oil and gas are one of the most important hydrocarbons for the Egyptian economy, contributing c. 13.6% to GDP. Egypt has sizable oil reserves at 3.3 billion and the Egyptian government has made efforts attracting International Oil Companies (IOC's), currently fifty IOC's have active operations in Egypt Oxford Business Group (2020).

2.2.4 Algeria

Algeria's economic growth has dwindled, driven largely by the struggling hydrocarbon sector, a private sector that has not adjusted as the new driver for growth and lastly the overwrought public-led growth model. The Algerian hydrocarbon sector, accounts for c.19.5% of the GDP (The World Bank, 2020).

Algeria has traditionally drawn from its foreign exchange reserves to offset adverse movements in global hydrocarbon prices and insufficient economic diversification, as a results Algeria's foreign exchange reserves have continued to decline.

Like the previously mentioned countries, Algeria is heavily dependent to the hydrocarbon sector as the currency inflows from the sector form part of a large contribution GDP and as such, adverse movements in commodity prices has an impact on the fiscus, namely tax income and government spending NKC African Economics (2020).

Table 1: Country Macroeconomic Data and

Variable	*Nigeria*	*Angola*	*Algeria*	*Egypt*
Population (million inhabitants)	201	32	43	100
GDP @ markets prices billions $)	448	89	171	303
GDP growth rate	2.2%	-0.6%	0.8%	5.6%
Inflation Rate	11.40%	20.5%	1.95%	20.85%
Proven crude oil reserves (billion barrels)	37	0.7	12.2	4

Source: International Monetary Fund (2019)

2.3. Theoretical Framework: Oil prices and exchange rates

Within this section, there will be a brief discussion of related theories that form a theoretical base for the research. There are three main transmission channels which explain the relationship between exchange rate and oil prices as outlined by Buetzer et al. (2016) and Beckmann et al. (2020). They comprise of the terms of trade channel; the wealth effect channel and lastly the portfolio reallocation channels.

2.3.1 Terms of trade

The terms of trade channel was presented by Chapman and Taussig (1912). The terms of trade channel determine the nexus of oil price and exchange on a country's usage of non – traded and traded goods. With all things remaining equal, keeping non-traded items constant amongst two economies a rise in oil prices decreases the prices of traded goods in an oil exporting country as compared to an oil importing country. As a result, there is a appreciation in the currency of the oil exporting country Amano and van Norden (1995).

2.3.2 The wealth effect

A rise in oil prices causes a transfer of wealth from countries who are importers of oil as opposed to those who export oil, this essentially leads to a change in the exchange rate especially in the exchange rate of the importing countries, this transposition takes place through the portfolio reallocation and account imbalances. Net-exporting countries are expected to benefit from these changes since increased prices would cause a "spill over effect" (Bjørnland, 2009). If the oil producers (the Government) reinvest the positive income and wealth effects to purchase goods and services, this would generate higher levels of investments and activity in the domestic economy. However, negative trade effects occurring from lowered global demand could net out the first effect and have a negative effect on the domestic economy Hamilton (1983), Loungani (1986); Bjørnland, (2009).

2.3.3 The portfolio reallocation channels

The portfolio reallocation channel introduced by Krugman, no date; Golub, (1983), largely focuses on nominal exchange rate movements. The framework that guides the portfolio channel is based on the wealth channel where oil exporting countries experience a wealth transfer when the oil price increases. The portfolio channel reflects the medium to long term impacts.

The three fundamental channels, namely: Terms of trade, Wealth Effect and the Portfolio Reallocation, propose that that a drop in the price of oil prices should be followed by a depreciation of oil exporters.

2.3.4 Empirical literature: Oil price movements and Exchange Rate

In the past century, many researchers have assessed the relationship between oil price shocks and the macroeconomic variables. Different models, tests and other interesting methods have been applied and each have produced different results, mostly wildly different, and others surprisingly similar.

Buetzer, Habib and Stracca, (2012) conducted a global study that looked at 44 emerging and advanced countries, to understand whether oil price shocks influenced the global foreign exchange configuration. This study employed the Vector Autoregressive (VAR) technique and the results point out that there is no proof that after the oil price increases the exchange rate of an oil exporting country appreciates in reaction. Instead, the oil exporting countries saw an increase in the exchange rate that is largely due to the demand for oil.

A study conducted in Russia by (Ito, 2012) examined the influence of crude oil price volatility on selected macroeconomic variables. The study used VAR modelling to analyze time series data from Q1:1994-Q3:2009. The results from this study found that a 1% decrease in oil prices causes 17% increase in exchange rate in the long term. Further, the study found that an increase in oil prices causes a decrease in the exchange rate, inflation, and growth in GDP.

Similarly, Rautava, (2002) investigated the relationship between exchange rate and oil prices in Russia. The study also uses VAR co-integration on data for the period 1995-2001. The results revealed that the Russian economy was influence by the increase in real exchange rate and oil prices in both the long and the short run.

Thankgod and Maxwell, (2013) investigated the impact that oil prices had on macroeconomic variables in Nigeria. The study used Lag Augmented VAR and EGARCH modelling and the impulse function. The study utilized annual data from 1970-2009 for oil price, government expenditure and price inflation and interest rates. The results depicted that there is evidence of unidirectional casualty between crude oil to interest rate to real exchange rate. Conversely, no relationship was found between GDP and oil prices.

Ftiti *et al.*, (2016) examined the impact of oil price volatility, crude oil, external reserves on exchange rate in Nigeria and demand for foreign exchange. The study employed Vector Error Correction model (VECM) and employed the Co-integration test on data that spanned from Month 1 of 1999 to Month 12 of 2009. The results revealed that 1% permanent increase in the price of crude oil increases real exchange rate by 0.02% in the short term and 0,54% in the long run.

Rano, (2009) examined the impact of oil price shocks on the Nigerian real economic growth, using the Johansen Vector Autoregressive (VAR) based co-integration technique to assess real economic growth sensitivity, when there are oil price shocks and real exchange rate volatility. Before the VAR technique was applied, a vector error correction (VEC) technique was applied on the data set. The study found bidirectional causality from the real exchange rate towards to and from real Gross Domestic Production (GDP). Lastly, the findings further state that shocks in the oil prices and an increase in the level of exchange rate, deploy a positive impact on the Nigerian real economic growth.

Similarly, in the case of Oriakhi and Osaze, (2013) an analysis of the consequences of oil volatility on economic growth of Nigeria was conducted. The study employed a vector regressive methodology. Furthermore, the proxy for economic growth was real exchange, real imports and government expenditure. The results, which differed from (Aliyu, 2009) show that volatile oil price has a notable negative impact on government expenditure, which stresses the authoritative role the Nigerian government plays in the Nigerian oil market.

In the case of Thailand, Rafiq, Salim and Bloch, (2009) interrogated the effect of oil price volatility on macroeconomic indicators, including investment and unemployment. The study employed a VAR modelling system and the Granger causality test was the preliminary measure to test for impulse responses and the decomposition of variance. The results show that there is unidirectional causality relationship between oil price volatility, trade balance, investment and employment rate. Furthermore, in the short run the oil price volatility has the biggest impact on the investment and unemployment rate.

Henriques and Sadorsky, (2011) examined oil price volatility and its effect on stock returns. The study employed a vector autoregression method on monthly data from 1947-1996 on US industrial production of oil prices and interest rates. The results inform us that volatility in oil prices have asymmetric effects on the US economy.

Using daily prices of crude oil futures traded on the New York Mercantile Exchange, 1984-2004, Guo and Kliesen, (2005) conducted research on how oil price changes affect aggregate economic activity, however the study distinguishes the two different ways in which oil prices change economic activity. Firstly, it takes place through dollar price changes in the crude oil and secondly through an increase in the uncertainty of future crude oil prices. The result of this paper, like the results of some of the aforementioned research papers, suggests that oil truly matters. The study also found that oil price volatility has significant and adverse effects for the following macroeconomic variables: investments consumption, employment and the employment rate.

In Iran research conducted by Farzanegan and Markwardt, (2009) investigated the relationship between oil prices shocks and macroeconomic variables. The study employs VAR. The data comprises of quarterly observations for the period 1975-2006, using real oil prices extracted from the International Financial Statistics online database. The results found both negative and positive oil price shocks have an incremental effect on inflation. The results also further state that a strong positive relationship occurs between changes in oil prices and growth in industrial output. Contrary to the above-mentioned Nigerian papers, this paper found that oil fluctuations have only a marginal impact on real government expenditure.

A study conducted in India by Ghosh and Kanjilal, (2016) looked at the relationship between crude oil prices and exchange rate using daily data for the period between July 2007 and November 2008, using GARCH and EGARCH modelling. The results of the study established that an increase in the oil price decreases the Indian Rupee.

A study conducted by Chaudhuri and Daniel, (1998) investigated the relationship between the real exchange rate for 16 OECD countries and the real oil price using panel cointegration tests. The results of the study show cointegration between the exchange rates of the selected countries and the oil price. The results further show that the nonstationary attributed to US dollar real exchange rates over this period is due to the nonstationary in the real price of oil.

Similarly, Chen and Chen, (2007) sought to investigate the existence of long run relationship between oil prices and exchange rate. The study samples G7 countries and uses monthly data for the time period between 1972 to 2005 u. The results of the cointegration tests conducted found that oil prices are the main source of the exchange rate movements and further found evidence of cointegration between oil prices and exchange rate.

A study conducted in the United States by Wang and Wu, (2012) investigated the causal relationship between energy prices and exchange rates through the application of linear and nonlinear casualty tests. The study focused on the time period between January 2003 and June 2011. The results of this study show that there is no cointegration between exchange rates and natural gas prices and further found a weak a uni-directional causality relationship from exchange rates to energy prices, specifically in the period before the 2008 Financial Crisis. Post that period there is a bi-directional causal relationship between exchange rates to energy prices.

A study conducted by Ahmed and Huo, (2021) sought to investigate the interrelationships between varied returns and volatility levels and global gold, equity and markets before and throughout the COVID 19 global pandemic. The results showed bidirectional spillovers between gold and equity markets. Furthermore, there are unidirectional spillovers from the energy markets to gold and equity markets.

Despite the many studies that have been conducted across the world, focusing on the long and short run and, the casual relationship between oil prices movements and key macroeconomic variables. This dissertation, however, will contribute to existing knowledge by examining the impact of oil price on exchange rate on key Africa net oil exporters. Additionally, this dissertation is important because it is the first of its kind on the chosen countries in terms of the selected period, taking into account key financial periods like the 2007/8 financial crises and the European Debt crises.

Chapter Summary

As discussed in the literature above, commodity markets play an important role in the economies of many African countries. There is still however, great scarcity in comprehensive studies that investigate the impact of commodity movements on African economies.

We hope that the results of this study assist in contributing in bridging the informational gaps in research on short run and long run impact of oil prices on exchange rate among oil exporting countries in Africa. Ultimately the research assists policy makers and investment professionals in gaining an appreciation and knowledge of the impact of oil price movements on the overall economic wellbeing of the continent.

Table 2: Summary of Literature

Author	Country	Measure	Findings
Straca, Habib and Buetzer (2012)	Emerging economies	VAR	No effect
Ito (2010)	Russia	VAR	Positive
Ruativi (2010)	Russia	VAR	Positive
Ruatova (2004)	Russia	Equilibrium Model	No effect
Ijoham and Apere (2013)	Nigeria	VAR and EGARCH	Positive
Englama et al (2010)	Nigeria	VECM	Positive
Aliyu (2009)	Nigeria	VAR	Positive
Guo and Klisem (2005),	US	VAR	No Effect
Farzan and Markwade (2008)	Nigeria	VAR	Positive
Rafiq et al. (2008)	Thailand	VAR and Granger Causality	Positive
Gosh (2011)	India	GARCH, OLS, EGARCH	Negative
Henriques and Sadorsky (2011)	United States	VAR	No effect
Masih et al (2011)	South Korea	VECM	Positive
Iyoka and Oriakhi (2013)	Nigeria	VAR	Positive
Chaudhuri and Daniel (1998)	US	Cointegration and causality techniques	Positive
Chen and Chen (2007)	G7 countries	Cointegration techniques	Positive
Wang and Fu (2012)	US	Cointegration and causality techniques	Uni-directional causality from OP (Pre Financial Crises) Bi-directional causality (Post Financial)
Lizardo and Mollick (2010)	US		Uni-directional causality from OP
Ahmed and Huo (2020)	US and China	GARCH	Bi-directional
Coudert et al. (2008)	US	VECM and VAR	Uni-directional causality from OP

Note: VAR=Vector Autoregression; VECM=Vector error correction model; EGARCH= Exponential Generalized Autoregressive Conditional Heteroskedastic; GARCH= Generalized Autoregressive Conditional Heteroskedastic; OLS=Ordinary least squares.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This dissertation employs econometric and descriptive design to investigate the impact of oil price on exchange rate. The econometric design adopts a quantitative method of analysis; employing various econometric models through the STATA Model using econometric software.

3.2 Sample Size, Data Period and Source

The sample for this dissertation comprises of daily exchanges for a 12-year period commencing in January 2007 to December 2018. The 12-year period has been carefully chosen to consider economic events which include the 2007/8 financial crises and encompasses the European debt crises. The chosen period with the mentioned macroeconomic shocks is expected to show a more robust relationship with more pronounced effects.

These exchange rates are from four of the largest African net oil exporter countries, namely, Nigeria, Angola, Egypt and Algeria. Daily crude oil price data was collected from the Standard and Poor’s Global Market Intelligence platform, the exchange rates, were also collected from Standard and Poor’s Global Market Intelligence platform

3.3 Regression equation

This dissertation examines the bivariate relationship between exchange rate and oil prices, adopting the bivariate models of Wang and Wu, (2012) and Ghosh and Kanjilal, (2016) specified below in equation 1

$$exr\_ret_t = \beta_0 + \beta_1 op\_ret_t + \varepsilon_t \text{ ……………………………….1}$$

Where exr_ret_t denotes exchange rate returns for Nigeria (NGN), Angola (AOA), Egypt (EGP) and Algeria (DZD) at time t, op_ret denotes returns on crude oil prices and $\boldsymbol{\varepsilon_t}$ denotes the error term. Equation 1 is expanded to include the specific dependent variables as equations 2 to 5;

$$ngn\_ret_t = \beta_0 + \beta_1 op\_ret_t + \varepsilon_t \text{ ……………………………….2}$$

$$aoa\_ret_t = \beta_0 + \beta_1 op\_ret_t + \varepsilon_t \text{ ……………………………….3}$$

$$egp\_ret_t = \beta_0 + \beta_1 op\_ret_t + \varepsilon_t \text{ ....} 4$$

$$dzd\_ret_t = \beta_0 + \beta_1 op\_ret_t + \varepsilon_t \text{..} 5$$

The definition of the variables are summarized in Table 2.1

Table 3: Summary of variables

Variable	Measurement	Symbol
Exchange rate of Nigerian Naira to USD	$\log\left(\frac{ngn}{ngn_{t-1}}\right)$	NGN_RET
Exchange rate of Angolan Kwanza to USD	$\log\left(\frac{aoa}{aoa_{t-1}}\right)$	AOA_RET
Exchange rate of Egyptian Pound	$\log\left(\frac{egp}{egp_{t-1}}\right)$	EGP_RET
Exchange rate of Algerian Dinar to USD	$\log\left(\frac{dzd}{dzd_{t-1}}\right)$	DZD_RET
Crude Oil Price (US$)	$\log\left(\frac{op}{op_{t-1}}\right)$	OP_RET

3.4 Estimation Technique

3.4.1 Unit root analysis: Augmented Dickey Fuller Test

According to research conducted by Brooks (2008), a stationary series is one that has a constant variable, mean and covariance for each determined lag. Disturbances and shocks that take place during the given period should gradually wear-off and the mean value should revert to its original mean value, for a stationary series. The appropriate test identified through reviewing contemporary literature is the Augmented Dickey-Duller (ADF) test Venkatesan and Ponnamma (2017). The Augmented Dickey Fuller Test (ADF) tests for the presence of unit roots for stationarity. Unit roots also referred to as a "random walk with drift". The presence of unit roots may cause spurious statistical inferences.

The Augmented Dicky Fuller (ADF) tests whether the time series has a unit root and that forms the null hypothesis. The alternative hypothesis states that the series is stationary or trend stationary.

The ADF test does however pose a flaw, a time-series can be non-stationary, however may tend to behaviour as a stationary series with an ADF test. The ADF test has lower determine power for stationarity when the coefficient on the lag term of the AR (1) regression is close to one Kisaka, Wambua and Kamuti (2014).

Determining the appropriate the lag length for the autoregressive process in a time series is a is an important step. This dissertation makes use of the Akaike's information criterion (AIC) to determine the correct lag length Akaike, (1969).

The null hypothesis under the ADF states that, the series is not stationarity or integrated of order (1). The alternate hypothesis states that the series is stationary this is 1 (0) Tsagkanos and Siriopoulos, (2015).

3.3.2 Autoregressive Distributed-lag (ARDL) Bounds Testing Procedure

Autoregressive distributed-lag models (ARDL) a cointegration testing model was first introduced by Pesaran and Shin, (1999), Dritsaki, (2017). The ARDL was wildly accepted as it is different from the traditional cointegration tests like the Engle-Granger test Engle and Granger (1987) and the Johansen test Johansen, (1988), in that the ARDL model requires variables that are integrated in the same order and are also non-stationary.

Pesaran and Shin, (1999) further extended the ARDL and introduced the bounds testing approach to cointegration, the bounds testing formulation is a tool that allows for cointegration testing where the time series variables are jointly co-integrated, integrated by order one or zero. The bound testing approach employs T and F statistical testing to assess the level of significance of the lagged variables through the univariate error correction model, when there is no clarity in whether the time series variables are stationary or displaying properties of a trend.

3.4.3 Vector Error Correction Model (VECM)

The Vector Error Correction Model (VECM), also known as the Co-integrated VAR is recommended when there is co-integration in the data or plausible economic relations Kim (1998). The VECM is applied when the variables display properties of non- stationarity at but display properties of stationarity at the first difference. The VECM was first developed by Johansen (1988) as an extension of the Vector Autoregression model. The VAR model is effective when presented with a time series that displays properties of covariance, however, is not as effect when applied to a non-stationary or integrated series. If the series are co-integrated, a VAR in first differences will not capture the long-run relationship.

3.4.4 Granger Causality Test

To confirm the belief that macroeconomic variables have no predictive ability in crude oil price changes over the period investigated, the Granger causality test is applied Bressler and Seth (2011) The import of this test is to investigate whether one variable has a direct or indirect impact on a another variable. Granger causality tests seeks to ascertain whether the inclusion of the past values of a variable, say X, does or does not contribute to better prediction and explanatory power of the present values of another variable Y Hamdi (2013).

CHAPTER FOUR: PRESENTATION AND DISCUSSION OF RESULTS

4.1 Introduction

The regression analysis of the daily exchanges rates extracted over a 12-year period spanning from January 2007 to December 2018 is presented in this chapter. The exchange rates pertain to currencies for four countries Nigeria, Angola, Egypt and Algeria versus the United States Dollar. There are five sections: Presentation of result of the descriptive statistics, Stationarity tests, Co-integration tests, Vector error correlation model (VECM) and the Vector Autoregressive Model (VAR). Lastly a diagnostic test will be conducted to establish robustness of both models are also carried out.

4.2 Descriptive statistics

All five variables were observed over a period of 4383 days (2007 to 2018). The oil price, which is the nominal price in US dollar per barrel of crude oil, ranged from a high of 146.6 USD per barrel in July 2008 to a low of 28.55 USD per barrel in January 2016. It averaged 80.96 USD to the dollar during that period. The Nigerian Naira, the weakest of the four currencies during the period under review, weakened to 368.00 NGN to 1 USD in August 2017. The Angolan Kwanza was weakest at 310.46 AOA to 1 USD in early December 2018. The Egyptian Pound was the strongest currency with an all-time low of 19.48 EGP to 1 USD in December 2016 and was the most stable as indicated by the low standard deviation. Lastly, the Algerian Dinar was strongest in October 2018 at 60.33AOA to 1 USD. The returns of the five variables which are used for the econometric estimations are also presented in Table 3.

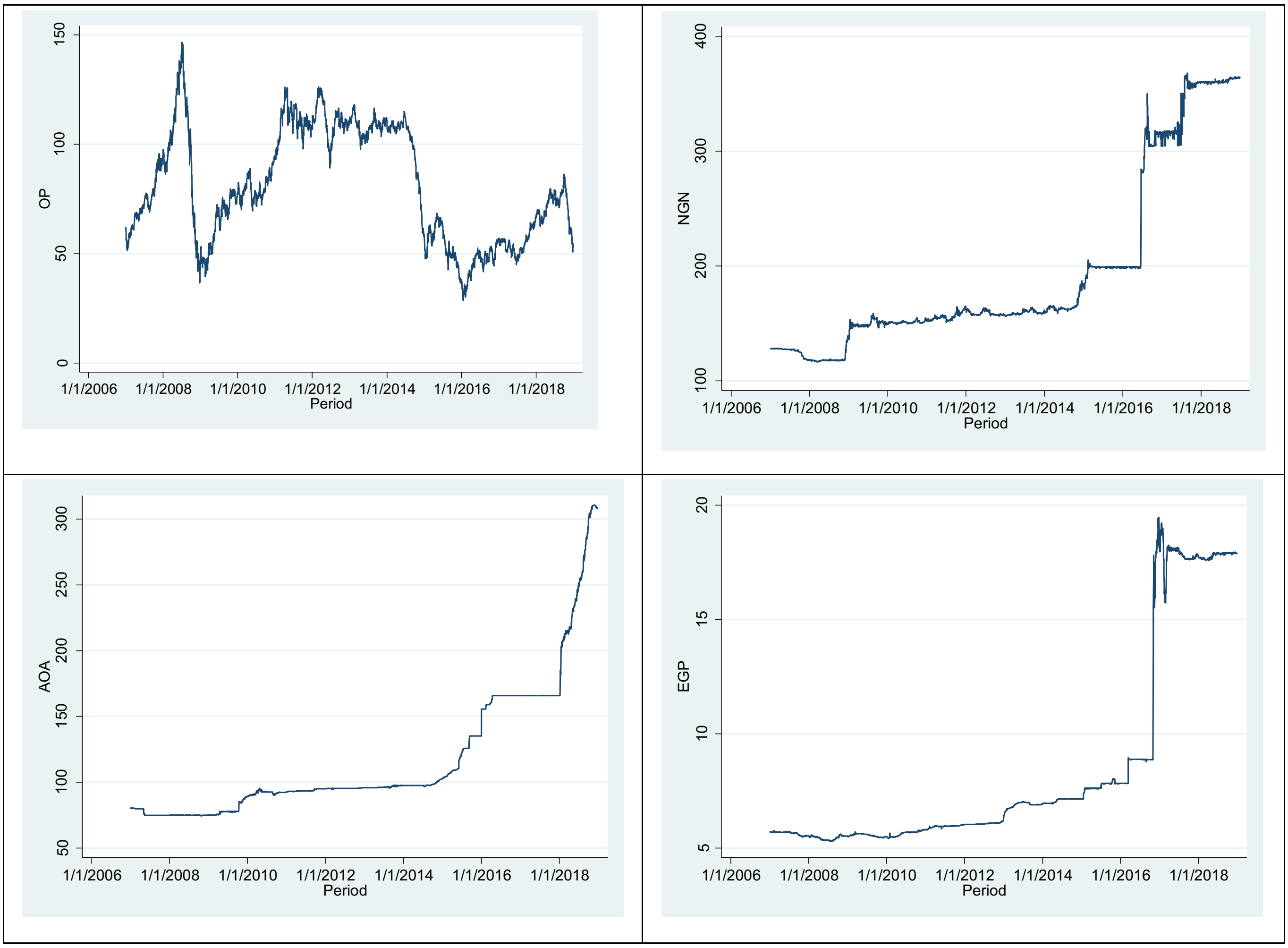
Table 4: Summary statistics

	Mean	Median	Std. Dev.	Min	Max	N
OP (US$)	80.95521	77.12000	25.78234	28.55000	146.60000	4,383
OP_RET	-0.00003	0.00000	0.01774	-0.10480	0.11856	4,382
NGN (US$)	194.75650	158.95000	78.79217	116.50000	367.99500	4,383
NGN_RET	0.00024	0.00000	0.00759	-0.10616	0.24788	4,382
AOA(US$)	117.42180	95.82000	51.73674	74.25000	310.45750	4,383
AOA_RET	0.00031	0.00000	0.00412	-0.02566	0.13976	4,382
EGP(US$)	8.47431	6.28200	4.47414	5.29210	19.48000	4,383
EGP_RET	0.00026	0.00000	0.00796	-0.05839	0.42591	4,382
DZD(US$)	86.01070	78.89800	17.86032	60.33000	119.65000	4,383
DZD_RET	0.00011	0.00000	0.00464	-0.02825	0.03430	4,382

Note: OP=Crude Oil prices; OP_RET=Crude Oil price returns; NGN=Nigerian Naira to US$ exchange rate; NGN_RET=Nigerian Naira returns; AOA= Angolan Kwanza to US$ exchange rate; AOA_RET= Angolan Kwanza returns; EGP= Egyptian Pound to US$ exchange rate; EGP_RET= Egyptian Pound returns; DZD= Algerian Dinar to US$ exchange rate; DZD_RET= Algerian Dinar returns. Source: Author's estimate from research data.

The time series plots of the nominal price in US dollar per barrel of crude oil from January 2007 to December 2018 as well as individual country currency exchange rates, namely; Nigerian Naira, Algerian Dinar, Angolan Kwanza and Egyptian Pound, versus the US Dollar are shown in Figure 1. From the plots above, different trends are observed for the variables suggest that there may not be stationary. However, formal tests are conducted to explore whether the variables are in fact stationary or not.

Figure 1: Time series plot of oil prices and exchanges rate for Nigeria, Angola, Egypt and Algeria



4.3 Unit Root Results

The results of the Augmented Dickey Fuller (ADF) tests for stationarity of the series is presented in Table 4. Also included in the results is the optimal lag length selected for the tests for the returns on crude oil price and the returns on exchange rate for Nigeria, Angola, Egypt and Algeria. The Akaike Information Criterion (AIC) was used in this study. The lag selection analyses the maximum number of lags of 3 for OP_RET, 0 for AOA_RET and 4 for NGN_RET, EGP_RET and DZD_RET. The results of the ADF and PP test based on the selected lags in Table 4 indicates that the null hypothesis of unit root or non- stationary series is rejected for all variables as the test statistics are all greater than the 5% critical value of -2.860.

Table 5: Stationarity results

ADF			**Levels (I (0))**		
	Lags	**Z(t)**	**CV (5%)**	**p-value**	**Order**
OP_RET	3	-32.808	-2.86	0.0000	I(0)
NGN_RET	4	-32.118	-2.86	0.0000	I(0)
AOA_RET	0	-66.592	-2.86	0.0000	I(0)
EGP_RET	4	-24.258	-2.86	0.0000	I(0)
DZD_RET	4	-36.451	-2.86	0.0000	I(0)
Perron			**Levels (I (0))**		
		Z(t)	**CV (5%)**	**p-value**	**Order**
OP_RET	3	-70.035	-2.86	0.0000	I(0)
NGN_RET	4	-68.448	-2.86	0.0000	I(0)
AOA_RET	0	-66.592	-2.86	0.0000	I(0)
EGP_RET	4	-52.569	-2.86	0.0000	I(0)
DZD_RET	4	-88.599	-2.86	0.0000	I(0)

Note: OP_RET=Oil price returns; NGN_RET=Nigerian Naira to US$ exchange rate returns; AOA_RET= Angolan Kwanza to US$ exchange rate returns; EGP_RET= Egyptian Pound to US$ exchange rate returns; DZD_RET= Algerian Dinar to US$ exchange rate returns. Source: Author’s estimate from research data.

4.4 Testing for co – integration

The co-integration approach refers to the integration of the long run and short run relationship within a unified framework (Rao, 2007). Co-integration describes the existence of a stationary relationship between the gross domestic product and its determinants (Armstrong, 2001). The number of lags to be used in the test must be determined first. The number of lags for included in the cointegration results in Table 5 while the full results for all 4 equations/models are presented as Appendix 1. Form Table 6, the result for NGN_RET and OP_RET (Model 2), EGP_RET and OP_RET (Model 4) and DZD_RET and OP_RET (Model 5) suggests that the model will be accounted for by 4 lags (LR, FPE and AIC). The AOA_RET and OP_RET model (2) indicate 1 lag (LR, FPE and AIC). The cointegration analysis were estimated by considering these number of lags.

Table 6: Lag selection results

Equation	Lag	LL	LR	FPE	AIC	HQIC	SBIC
2	4	26634.5	18.189*	1.8e-08*	-12.1592*	-12.1499	-12.1329
3	1	29280	15.687*	5.3e-09*	-13.3732*	-13.3702	-13.3645
4	4	26599.9	135.52*	1.8e-08*	-12.1434*	-12.1341*	-12.1172*
5	4	28985.7	17.787*	6.1e-09*	-13.2333*	-13.224*	-13.207

Note: The “*” on the test statistics suggest the number of lags. Source: Author’s estimate from research data.

4.5 Co-integration results

Following the lag selection described in the previous section, the results of the bounds test for Co-integration to examine the existence of long-run relationship for all fours models are presented in Table 6. The null hypothesis of no co-integration between crude oil price returns and the exchange rates (NGN, AOA, EGP and DZD) is rejected when the estimated F statistic is greater than the upper bound (I(1)) critical value at 5% in favour of the alternative hypothesis long run co-integration relationship. From Table 6, we fail to reject the null hypotheses of no co-integration since the estimate F-statistics of all the four models are great than the upper bound critical value of 5.76 at 5% significance. This indicates that a long run equilibrium relationship exists between the returns of crude oil prices and the exchange rate returns for Nigeria, Angola, Egypt and Algeria. This finding is consistent with Chaudhuri and Daniel, (1998); Chen and Chen, (2007) who found a cointegration relationship between exchange rate and oil prices. An error-correction model is the appropriate econometric specification and so the VECM is estimated for the oil prices and AOA equation (2)

Table 7: ARDL bounds Co-integration results

		F		F		
Equation 2	NGN_RET & OP_RET	588.234		Significance	I(0)	I(1)
Equation 3	AOA_RET & OP_RET	2215.394		10%	4.051	4.803
Equation 4	EGP_RET & OP_RET	351.675		5%	4.933	5.76
Equation 5	DZD_RET & OP_RET	848.681		1%	6.879	7.857

Note: OP_RET=Oil price returns; NGN_RET=Nigerian Naira to US$ exchange rate returns; AOA_RET= Angolan Kwanza to US$ exchange rate returns; EGP_RET= Egyptian Pound to US$ exchange rate returns; DZD_RET= Algerian Dinar to US$ exchange rate returns. Source: Author's estimate from research data.

4.6 The Vector Error Correction Model (VECM)

Based on the results of the bounds test for co-integration which supports the existence of long equilibrium bivariate relationships between oil price returns (OP_RET) and exchange rate returns for Nigeria (NGN_RET), Angola (AOA_RET), Egypt (EGP_RET) and Algeria (DZD_RET), the vector error correction model (VECM) estimated for the fours equations are presented in Table 6.

4.6.1 Long run regression results

The estimates obtained from fitting a Vector Error Correction Model for model 2, 3, 4 and 5 covering the long and short run regression coefficients are shown Table 7. From Table 7, the long run coefficient for oil prices returns (OP_RET) is observed to be negative related to the returns on Nigerian Naira (NGN_RET), Egyptian Pounds (EGP_RET) and Algerian Dinar (DZD_RET) indicating that oil price increase results in the depreciation of the exchange rates for Nigeria, Egypt and Algeria. This implies that a 1% increase in oil price is associated with approximately 6% and 3% depreciation in the Egypt and Algeria exchange rates at 1% significance. Furthermore, the depreciation of the Nigerian Naira, Egyptian dollar and Algerian Dinar against the 1% increase on the oil price is in line with the terms of trade channel theory that was discussed in Chapter 2, the Terms of Trade channel essentially states that, keeping non-traded items constant amongst two economies, a rise in oil prices increases the prices of traded goods in an oil importing country as compared to an oil exporting country. As a result, there is a depreciation in the currency of the oil importing country Martin and Anthony (2000). This is consistent with the findings of Ghosh and Kanjilal, (2016) who found a negative effect of oil price changes on exchanges rate in India and w for Germany and Japan.

Lastly, in the case of Angola observations show that oil price increase results in the long run appreciation of the Angolan Kwanza, however the results are statistically insignificant.

4.6.2 Short run regression results

For the short run relationships, the adjustment parameters, which are the coefficients of ECT is observed to have the required sign (negative) and significant at 1% across all the four models. The estimated adjustment parameter for model 4 (Egypt) indicates that about 67% of deviations in the short run are corrected within a day in long run equilibrium. Similarly, the estimated ECT's for Nigeria, Angola and Algeria are marginally above the threshold of 1, which suggests the existence of oscillatory convergence. In line with Narayan and Smyth, (2006), oscillatory convergence reflects the fluctuations around the equilibrium in a dampening process, which ultimately results in rapid convergence to long run equilibrium.

In Model 2, the coefficient of oil prices returns (OP_RET) at lags 1 to 2 have to significant effect on NGN_RET while the lags 3 is positive and significant effect at 5%. Similar observations are also made for the short run coefficients between EGP_RET and oil prices returns in Model 4 for the first three lags and the first lag of DZD_RET. These observations show that oil prices increase result in short run appreciation of the Nigerian Naira, Egyptian Pounds and Algerian Dinar. Finally, the third lag of NGN_RET is observed be positively related NGN_RET while the first three lags of DZD_RET are observed to have a positive and significant effect on DZD_RET. On the contrary, a significant (1%) and negative coefficient is observed for the first three lag of EGP_RET on EGP_RET at 1%. Lastly, in the case of Angola observations show that an oil prices increases results in short run appreciation of the Angolan Kwanza. However, the results are statistically insignificant.

Table 8: Long and short run estimates

	NGN_RET (EQN 2)			AOA_RET (EQN 3)			EGP_RET (EQN 4)			DZD_RET (EQN 5)		
	Coef.	*Std. Err.*	*t*	*Coef.*	*Std. Err.*	*t*	*Coef.*	*Std. Err.*	*t*	*Coef.*	*Std. Err.*	*t*
Long run Results												
OP_RET	-0.0078	0.0139	-0.56	0.0029	0.0051	0.57	-0.0614***	0.0223	-2.75	-0.026***	0.005	-4.7
Short run Results												
NGN_RET(LD)	0.0420	0.0271	1.55									
NGN_RET(L2D)	0.0035	0.0217	0.16									
NGN_RET(L3D)	0.0337**	0.0151	2.23									
EGP_RET(LD)							-0.0935***	0.0225	-4.16			
EGP_RET(L2D)							-0.1609***	0.0187	-8.62			
EGP_RET(L3D)							-0.1735***	0.0149	-11.65			
DZD_RET(LD)										0.298***	0.032	9.34
DZD_RET(L2D)										0.188***	0.024	7.69
DZD_RET(L3D)										0.060***	0.015	3.96
OP_RET(D1)	0.0095	0.0133	0.71	0.0005	0.0035	0.15	0.0380***	0.0134	2.83	0.023***	0.008	2.96
OP_RET(LD)	0.0041	0.0116	0.35				0.0268**	0.0117	2.3	0.003	0.007	0.38
OP_RET(L2D)	0.0041	0.0094	0.43				0.0195**	0.0095	2.06	0.002	0.006	0.37
OP_RET(L3D)	0.0165**	0.0065	2.55				0.0071	0.0065	1.1	-0.002	0.004	-0.56
ECT	-1.0727***	0.0313	-34.28	-1.0061***	0.0151	-66.56	-0.6706***	0.0253	-26.48	-1.581***	0.038	-41.19
Constant	0.0003**	0.0001	2.23	0.0003***	0.0001	4.95	0.0002	0.0001	1.51	0.000***	0.000	2.73
R-squared	0.5196			0.5033			0.4113			0.6345		
Adj R-squared	0.5186			0.5029			0.4101			0.6338		
Root MSE	0.0076			0.0041			0.0076			0.0044		
Observations	4,378			4,381			4,378			4,378		

Note: OP_RET=Oil price returns; NGN_RET=Nigerian Naira to US$ exchange rate returns; AOA_RET= Angolan Kwanza to US$ exchange rate returns; EGP_RET= Egyptian Pound to US$ exchange rate returns; DZD_RET= Algerian Dinar to US$ exchange rate returns. ECT=Error correction term. *** and ** denote significance at 1% and 5% respectively. Source: Author’s estimate from research data.

4.6.3 Granger causality results

The long run causality results are estimated for the four models NGN (2), AOA (3), EGP (4) and DZD (5) are presented in Table 8. From the Table 9, the null hypothesis of non-causality between the returns Nigerian Naira (NGN_RET) and oil price returns (OP_RET) is rejected at 5% to indicate a bi-directional causality. The same observations are reported for DZD_RET and OP_RET consistent with the findings of Wang and Wu, (2012). The causality from the returns Nigerian Naira and Algerian Dinar to oil price movements is consistent with evidence by Ahmed and Huo, (2021) for ten selected African countries. On the contrary, the null hypotheses that oil price returns (OP_RET) does not Granger-cause Angolan Kwanza returns (AOA_RET) and Angolan Kwanza returns (AOA_RET) does not Granger-cause oil price returns (OP_RET) could not be rejected which suggests the lack of causality between return on oil prices and returns on Angolan Kwanza. Similar to the findings of Amano and van Norden (1998a), Coudert et al. (2008), Lizardo and Mollick, (2010) and Wang and Wu, (2012), a unidirectional causality is observed from OP_RET to EGP_RET.

Table 9: Granger causality Wald tests

Null Hypothesis	χ^2	**Prob >** χ^2	**Decision**(H_0)	**Causality**
Equation 2				
NGN_RET does not Granger-cause OP_RET	10.22	0.0369**	Reject	YES
OP_RET does not Granger-cause NGN_RET	11.65	0.0201**	Reject	YES
Equation 3				
AOA_RET does not Granger-cause OP_RET	0.29	0.5924	Accept	NO
OP_RET does not Granger-cause AOA_RET	0.04	0.8375	Accept	NO
Equation 4				
EGP_RET does not Granger-cause OP_RET	2.81	0.5908	Accept	NO
OP_RET does not Granger-cause EGP_RET	8.56	0.0732*	Reject	YES
Equation 5				
DZD_RET does not Granger-cause OP_RET	9.24	0.0553*	Reject	YES
OP_RET does not Granger-cause DZD_RET	28.64	0.0000***	Reject	YES

Note: OP_RET=Oil price returns; NGN_RET=Nigerian Naira to US$ exchange rate returns; AOA_RET= Angolan Kwanza to US$ exchange rate returns; EGP_RET= Egyptian Pound to US$ exchange rate returns; DZD_RET= Algerian Dinar to US$ exchange rate returns. ***,** and * denotes significance at 1%, 5% and 10 respectively. Source: Author's estimate from research data.

4.7 Model Specification Diagnostic Tests

The adequacy of the VECM models must be checked through a two main model specification tests. This includes tests for parameter stability and normality using Jarque-Bera, skewness and kurtosis tests.

4.7.1 Stability results

For stability, the moduli of the remaining *r* eigenvalues should be strictly less than unity. The results are plotted in Table 9. It is clear that the moduli of three of the four eigenvalues appear inside the unit circle. Since one of the eigenvalues lies on the unit circle, this stability check suggest that our model is incorrectly specified.

Table 10: Stability results

NGN_RET (EQN 2)		**AOA_RET (EQN 3)**		**EGP_RET (EQN 4)**		**DZD_RET (EQN 5)**	
Eigenvalue	Modulus	Eigenvalue	Modulus	Eigenvalue	Modulus	Eigenvalue	Modulus
1	1	1	1	1	1	1	1
-0.0949 + 0.6443i	0.6512	-0.0579	0.0579	0.040 +0.7392i	0.7403	-0.1117 +0.6238i	0.6337
-0.0949 -0.6443i	0.6512			0.0401 -0.7392i	0.7403	-0.1117 -0.6238i	0.6337
-0.6202	0.6202			-0.6560	0.6560	-0.5952	0.5952
-0.3475 +0.4064i	0.5348			-0.2371 +0.2759i	0.3638	0.2470 +0.4809i	0.5406
-0.3475 - 0.4064i	0.5348			-0.2371 -0.2759i	0.3638	0.2470 - 0.4809i	0.5406
0.3308 +0.3109i	0.4539			0.2068 +0.107i	0.2300	-0.3855 +0.2294i	0.4487
0.3308 -0.3108i	0.4539			0.2068 -0.1007i	0.2300	-0.3855 - 0.2295i	0.4487

Source: Author's estimate from research data.

4.7.2 Normality results

The results are normality test for the VECM estimation is presented in Table 10. The Jarque-Bera test checks for the goodness of fit of whether the single equations have a normal distribution. A p-value less than 0.05 indicates that the null hypothesis of normal distribution is rejected. The skewness and kurtosis of a normally distributed variable is zero and three respectively. This means that the test of the null hypothesis that the disturbance terms have kurtosis consistent with normality is rejected. The normality results (Jarque-Bera, skewness and kurtosis) for the four models were carried out and the results are shown in Table 13. The p-values are all less than 0.05 indicating the rejection of the null hypothesis of normality in the bi-variate VAR models.

Table 11: Normality results

	χ^2	**Prob > χ^2**		χ^2	**Prob > χ^2**
Equation 2: **NGN_RET & OP_RET**			Equation 4: **EGP_RET & OP_RET**		
Jarque Bera			Jarque Bera		
D_NG_RET	1.80E+07	0.000	D_EGP_RET	2.30E+08	0.000
D_OP_RET	3447.945	0.000	D_OP_RET	6286.348	0.000
Skewness			Skewness		
D_NG_RET	7.40E+04	0.000	D_EGP_RET	2.40E+05	0.000
D_OP_RET	20.753	0.0001	D_OP_RET	1.084	0.29782
Kurtosis			Kurtosis		
D_NG_RET	1.80E+07	0.000	D_EGP_RET	2.30E+08	0.000
D_OP_RET	3427.192	0.000	D_OP_RET	6285.264	0.000
Equation 3: **AOA_RET & OP_RET**			Equation 5: **DZD_RET & OP_RET**		
Jarque Bera			Jarque Bera		
D_AOA_RET	2.60E+07	0.000	D_DZD_RET	4899.626	0.000
D_OP_RET	6198.353	0.000	D_OP_RET	3941.965	0.000
Skewness			Skewness		
D_AOA_RET	1.50E+05	0.000	D_DZD_RET	30.056	0.000
D_OP_RET	102.164	0.000	D_OP_RET	28.658	0.000
Kurtosis			Kurtosis		
D_AOA_RET	2.60E+07	0.000	D_DZD_RET	4869.569	0.000
D_OP_RET	6096.189	0.000	D_OP_RET	3913.307	0.000

Note: OP_RET= Crude Oil price returns; NGN_RET=Nigerian Naira to US$ exchange rate returns; AOA_RET= Angolan Kwanza to US$ exchange rate returns; EGP_RET= Egyptian Pound to US$ exchange rate returns; DZD_RET= Algerian Dinar to US$ exchange rate returns.

4.7.3 Serial and heteroskedasticity results

The results of the Lagrange-multiplier test for serial correlation and heteroskedasticity tests for the four models presented in Table 11 indicates a rejection of null hypothesis of no autocorrelation and homoskedasticity in all equations except for equation 2.

Table 11: Serial and heteroskedasticity results

		Breusch-Godfrey LM		LM heteroskedasticity (ARCH)	
		χ^2	**Prob** > χ^2	χ^2	**Prob** > χ^2
Equation 2	**NGN_RET**	4.803	0.028	93.336	0.000
Equation 3	**AOA_RET**	0.164	0.685	0.013	0.908
Equation 4	**EGP_RET**	219.186	0.000	49.474	0.000
Equation 5	**DZD_RET**	271.971	0.000	124.899	0.000

Note: NGN_RET=Nigerian Naira to US$ exchange rate returns; AOA_RET= Angolan Kwanza to US$ exchange rate returns; EGP_RET= Egyptian Pound to US$ exchange rate returns; DZD_RET= Algerian Dinar to US$ exchange rate returns.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Introduction

This final chapter provides a conclusion and summary of the study. Furthermore, there is a discussion on recommendations for policy and future research to assist the gap in information and the formulation of policies.

5.2 Summary and Findings

The paper employs empirical analysis to investigate the impact of oil price movements on exchange rate on selected net oil exporting countries in Africa, using a sample of observations from 2008Q1 to 2019Q4. Firstly, the analysis involved the time series testing to understand the characteristics of the data and this was done, using the Augmented Dickey Fuller test and subsequently the Granger Causality. We then applied the Autoregressive Distributed-lag (ARDL) integration test and conduced an estimation of whether there is long run-integration in the vectors, followed by the short run vector error model.

Firstly, stationary tests revealed the stationarity of the data series at all levels, while the ARDL co-integration tests show the existence of long run equilibrium in all the estimated models, furthermore, Granger causality tests were done. The results of the study found that in the long run, oil prices movements are observed to be negatively related to the returns on the Nigerian Naira, Egyptian Pounds) and Algerian Dinar indicating that oil price increase results in the depreciation of the exchange rates for each of the aforementioned. In the short run, oil prices movements observed to positively related to the returns on Nigerian Naira, Egyptian Pounds and Algerian Dinar indicating that oil price increase results in the appreciation of the exchange rates. The causality results show evidence of bidirectional causality for the Nigerian Naira and the Angolan Dinar, unidirectional causality for the Egyptian pound, no evidence of causality was found for the Angolan Kwanza.

5.3 Policy Recommendations

As discussed in the introduction of this dissertation, the exchange is a key macroeconomic variable that is an important indicator of the economic wellbeing of the country. The monetary policy is one of the most important policies that have a direct effect on the exchange rate. Policymakers are faced with a dilemma which requires a trade-off between fiscal and monetary policy response when the economy experiences an unexpected oil price movement. The chosen policy could either be one that is expansive through the increase of interest rates, the supply of money and essentially the expansion of the economy or one that takes contractionary measures through the increase of tax rates or restricting government spending. An expansionary or contractionary policy may in the long or short term determine the magnitude of the impact of oil price movements on key macroeconomic variables like the exchange which has an effect on the larger economy Edwards and Ostry (1992).

The cointegration tests conducted in this study, showed evidence of a long run equilibrium relationship existing between the returns of crude oil prices and the exchange rate returns for Nigeria, Angola, Egypt and Algeria. Whereas in the short run observations show that oil prices increases result in short run appreciation of the Nigerian Naira, Egyptian Pounds and Algerian Dinar

Initially, an increase in oil price is positive as there is an increase in income in the oil exporting countries, like those mentioned in this study. However, alongside the rise in income, is an rise in aggregate consumption and also in foreign investment which in turn will reduce the unemployment rate as a result of an abrupt spike in the production and consumption of basic goods and services. However the jolt in the economy with increased activity, productivity and demand is transferred to consumers through an increase in consumer based pricing which as a consequence causes a decline in the aggregate demand, as such the aforementioned sudden changes, may in the short term lead a country an economic depression

A sound monetary policy may shield an oil exporting country from a sudden economic depression because of adverse oil price movements, through putting in place stimulants that manage inflation. Generally, economies that are mature, actively manage inflation through interest rates, however not all have this luxury. Emerging and developing countries, use a monetary policy to manage exchange rate fluctuations and through adopting varied exchange rate policies depending on the economic environment Bacon and Adib (2005); Granville and Mallick, (2006).

5.5 Avenues for future research

This dissertation has identified a few gaps in the current literature covering the impact of oil price movements and exchange rate, which we outline below. This study only investigated the relationship between oil price movements and the exchange rate. Specifically, in the context of

Nigeria, Algeria, Angola, and Egypt, within a specific time frame as such there are constraints. Therefore, studies in the future may investigate the below:

a) Increase the reach of the study to parts of Southern and East African oil net exporting countries, to understand the impact of adverse commodity price movements in other parts of the African continent
b) Explore the relationship of adverse price movements in other key commodities and their impact on key economic indicators. This investigation would particularly be interesting as a large portion of African countries are dependent on between one to three commodities.
c) There is also scope to extend this research, to include the commodity price volatility that took place in 2020 to understand the impact of COVID 19 on the commodity market.

5.6 References

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Appendix

Appendix 1: Lag Selection results for cointegration

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
Equation 2: NGN_RET & OP_RET								
0	26602.9				1.80E-08	-12.1521	-12.1511	-12.1492*
1	26615	24.15	4	0.000	1.80E-08	-12.1558	-12.1527*	-12.147
2	26618.7	7.3917	4	0.117	1.80E-08	-12.1556	-12.1505	-12.1411
3	26625.4	13.318	4	0.01	1.80E-08	-12.1569	-12.1497	-12.1364
4	26634.5	18.189*	4	0.001	1.8e-08*	-12.1592*	-12.1499	-12.1329
Equation 3: AOA_RET & OP_RET								
0	29272.2				5.30E-09	-13.3715	-13.3705*	-13.3686*
1	29280	15.687*	4	0.003	5.3e-09*	-13.3732*	-13.3702	-13.3645
2	29282.9	5.7368	4	0.22	5.30E-09	-13.3727	-13.3676	-13.3581
3	29285.6	5.4277	4	0.246	5.30E-09	-13.3721	-13.3649	-13.3517
4	29286.6	1.9711	4	0.741	5.30E-09	-13.3708	-13.3615	-13.3445
Equation 4: EGP_RET & OP_RET								
0	26390.6				2.00E-08	-12.0551	-12.054	-12.0522
1	26512.9	244.74	4	0.000	1.90E-08	-12.1091	-12.1061	-12.1004
2	26525.8	25.786	4	0.000	1.90E-08	-12.1132	-12.1081	-12.0986
3	26532.2	12.694	4	0.013	1.90E-08	-12.1143	-12.1071	-12.0939
4	26599.9	135.52*	4	0.000	1.8e-08*	-12.1434*	-12.1341*	-12.1172*
Equation 5: DZD_RET & OP_RET								
0	28774.1				6.70E-09	-13.144	-13.1429	-13.141
1	28930.4	312.51	4	0.000	6.30E-09	-13.2135	-13.2104	-13.2048
2	28943.7	26.586	4	0.000	6.20E-09	-13.2178	-13.2126	-13.2032
3	28976.8	66.185	4	0.000	6.20E-09	-13.2311	-13.2239	-13.2106*
4	28985.7	17.787*	4	0.001	6.1e-09*	-13.2333*	-13.224*	-13.207

Note: OP_RET=Oil price returns; NGN_RET=Nigerian Naira to US$ exchange rate returns; AOA_RET= Angolan Kwanza to US$ exchange rate returns; EGP_RET= Egyptian Pound to US$ exchange rate returns; DZD_RET= Algerian Dinar to US$ exchange rate returns. Source: Author's estimate from research data.