# Oil Price-Exchange Rate Interdependence: Relevance of Theory of Exchange Rate Overshooting in Nigeria

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**Abstract**
*This article investigated the interdependence between crude oil variability and foreign exchange rate changes in Nigeria. Oil price variability is decomposed into fluctuation on Brent Oil, West Texas Intermediate, OPEC Basket Reference Crude Oils and Bonny Light Crude Oil Price Variability. All the data that used in this research come from secondary sources. Annual time series data for Nigeria are used from 1993 to 2022. The research design for the study is ex post facto research analysis of annual multivariate time series data. The study examined the historical data in order to understand the current state of foreign exchange rate in Nigeria and causal connections crude oil price variability using ARDL Bound test, Johansen approach and Error-Correction Mechanism (ECM) models. In the long run, the coefficient of oil price volatility shows a positive and significant relation with the foreign exchange rate at 10 percent level of significance. This implies that a 10 percent, increase in oil price volatility induces foreign exchange rate by 0.61 percent. The positive coefficient of oil price volatility tends to reveal that Dornbusch (1976) Overshooting hypothesis of foreign exchange rate holds for Nigeria. This finding is in conformity with previous studies like (Driskill & McCafferty, 1982); Turnovsky & Bhandari, 1982; Driskill & McCafferty, 1982). Furthermore, the coefficient of BOP and OPEC show a negative and insignificant relationship with the foreign exchange rate in the long run. This implies that BOP and OPEC have no impact on foreign exchange rate. This is in contrast with economic theory particularly Dutch diseases proposition and in conformity with foreign exchange rate overshooting theory. The negative nexus can be blamed on the inability of government to manage the foreign exchange supply and demand effectively in the country. Diversifying away from oil to other non-oil activities that would generate foreign exchange should be a continuous policy pursuit of the policy makers in the country. Also, adequate measures should be put in place to de-link long run movements of the naira exchange rate from oil price changes.*

**Keywords**: *Co-integration, exchange rate volatility, exchange rate overshooting theory and oil price*

JEL Classification: C22, O24, F31, F41

## 1.0    Introduction

Although the naira exchange rate has witnessed some period of relative calm since the implementation of the structural adjustment programme (SAP) in July, 1986, its continued depreciation, however, scored an indelible mark in the level of real sector activities in the country. The naira which traded at N0.935 = $1.00 (United States) in 1985 depreciated to N2.413 = $1.00 and further to N7.901 against the US dollar in 1990. To stem the trend, the policy of guided deregulation pegged the naira at N21.886 against the dollar in 1994. Further deregulation of the foreign exchange market in 1999, however, pushed the exchange rate to N86.322 = $1.00. With huge inflow of oil revenue due to hike in the oil price, the end-period rate stood at N117.97 in December, 2007. This remained stable until towards the end of 2008 when the global financial crisis took its toll and the naira exchange rate depreciated from N116.20in November, 2008 to

N131.5 in December, 2008 or a decline in value by 12.95% and further to N142.00 or a decline by 7.98% in February 2009. The question on the lips of every Nigerian is that in the 80s, Nigeria exchanges 80k to 1 dollar and in the first quarter of 2020 it was N360 to 1 dollar and with the pandemic it skyrocketed to N470 to 1 dollar, what could have been responsible for all  these Babalola, A. (2019).

Analysis of the impact of asymmetric shocks occasioned by exchange rate and oil price variability on economic growth has been a major preoccupation of both academics and policy makers for some decades now. On the one hand, it has been recognized in the literature that depreciation of exchange rate tends to expand exports and reduce imports, while the appreciation of exchange rate would discourage exports and encourage imports. Thus, exchange rate depreciation leads to income transfer from importing countries to exporting countries through a shift in the terms of trade, and this affects the economic growth of both importing and exporting nations. On the other hand, the perception that oil price spikes have a serious negative effect on the economies is based largely on the close correlation in the timing of oil price spikes.

According to Energy Information Administration  (EIA) Bulletin (2022), In June, 2022 the global benchmark, the Brent crude oil futures was down trading at $116.66 per barrel while the United States benchmark, the West Texas Intermediate crude futures was trading at $115.80 a barrel. Organization of Petroleum Exporting countries and its allies, an oil cartel known as the OPEC+, has to increase oil production in the market to adjust its OPEC Spot price of crude oil. World crude oil price can be measured by world crude oil market, West Texas Intermediate (WTI) is commonly used as a standard, because crude oil sold in WTI is high-quality crude oil. This light-weight crude oil consists of low levels sulfur and very suitable as a fuel affects the oil price and thus set as a standard for oil trading around the world. The price of Brent consists a mixture of 15 crude oil from 15 different oil fields located in the North Sea. The quality of crude oil Brent is not as good as crude oil WTI, but still suitable if processed in-to fuel. The price of crude oil Brent is applied as a standard in Europe and Africa. Crude oil Brent is approximately one or two dollars cheaper than crude oil WTI, but four dollars higher than oil price (OPEC). Along with the new industrial countries, the needs of crude oil will escalate. The demand for crude oil will affect world crude oil price and also affect the country's economic matters if attributed to economic activities. The  OPEC Reference Basket (ORB) gained $6.67/b, 12.3% increase,  to average $61.05/b for March  2021.

## 1.1     Statement of Problems

Oil price and exchange rate are among the most important global economic factors that constitute major external shocks to business cycles and economic stability. Oil as an internationally traded commodity is an important driver of foreign exchange accumulation, foreign reserves and invariably influence exchange rate movement (Darko and Kruger, 2017; Kayalar et al., 2017).

Beckmann (2020) contends that the exchange rate of a national currency relative to another currency has a direct bearing on the national economy because of bilateral trade relationship between both countries. When the exchange rate of the foreign currency rises with respect to the domestic currency, more number of units of domestic currency are required for one unit of the foreign currency. The implication is that the country has to pay more for its imports - an activity that will disturb its balance of payments situation and reduce its foreign exchange reserves. This will also affect the entire economy negatively. All imports, foreign currency loan and interest payments are affected as the country has to pay more for them. Exchange rate affects the inflation rate too (Beckmann *et al.*, 2020).

The overall intuition is that the instability of exchange rate is of a great concern to the economy as it slows down and hampers the development of the economy. While the Central Bank of Nigeria (CBN) has tremendously activated policies to stabilize this instability over time, the results are still not satisfactory. The question that this study seeks to answer is that is there a relationship between changing oil price and exchange rate fluctuations? Hence, this study seeks to look at oil price and exchange rate relationship; especially with a focus on the various exchange rate regimes in the country. While many studies have investigated the oil price – exchange rate nexus for different countries and have provided various justifications for their studies, this study will be the first to employ a theoretical framework which is that of Krugman (1983) that considers oil price and other variables affecting exchange rate. Most of the previous studies have examined solely oil price and exchange rate dynamics without considering other factors affecting exchange rate. This is being captured in the modified model by including other factors affecting exchange rate but not mentioned in Krugman (1983) model as control variables.

## 1.2 Objectives of the study

The broad objective of the study is to investigate the interdependence between crude oil variability and foreign exchange rate changes in Nigeria, while the specific objectives are to:

 i. investigate the causal effect of Brent oil price variability on foreign exchange rate (Naira/Dollar) changes in Nigeria;

 ii. examine the causal relationship between OPEC Based Reference oil price variability and foreign exchange rate (Naira/Dollar) changes in Nigeria;

 iii. evaluate the effect of West Texas Intermediate oil price variability on foreign exchange rate (Naira/Dollar) changes in Nigeria; and

 iv. assess the influence of Bonny Light Crude Oil Price variability on foreign exchange rate (Naira/Dollar) changes in Nigeria.

## 1.3 Research Hypotheses

This study is designed to test the following hypotheses:

$H_{01}$ - Brent oil price variability has no significant causal effect on foreign exchange rate (Naira/Dollar) changes in Nigeria;

$H_{0\,2}$ - OPEC Based Reference oil price variability has no significant causal relationship with foreign exchange rate (Naira/Dollar) changes in Nigeria;

$H_{0\,3}$ - West Texas Intermediate oil price variability has no significant effect on foreign exchange rate (Naira/Dollar) changes in Nigeria;

$H_{0\,4}$ - Bonny Light Crude Oil Price variability have no significant influence on foreign exchange rate (Naira/Dollar) changes in Nigeria.

## 2.0 Literature Review

## 2.1 Conceptual review

## 2.11 Exchange Rate

Exchange rate is an amount of NG₦ for each unit of the eight major currencies of international trade: USD Dollar, The Euro (EUR), the Australian Dollar (AUD), the Canadian dollar (CAD), the Mexican Peso (MXN), the Norwegian kroner (NOK), the British pound (GBP), and the Japanese Yen (JPY). An increase in nominal exchange rates may reflect a recession of the US dollar against foreign currencies.

The exchange rate of an economy plays a critical role because it has a direct impact on all macroeconomic variables, including domestic price indicators, profitability of traded goods and services, resource allocation, and investment decisions, which explains why monetary authorities and private sectors strive for stability in these variables (Ajakaiye, 2001). It is a crucial macroeconomic variable in the formulation of economic policies in general and economic reform programs in particular, in which these policies aid in the acceleration of macroeconomic goals. In Nigeria, these goals include obtaining and maintaining price stability; achieving and maintaining balance of payment equilibrium; full employment; equitable income distribution; economic growth; and development. In fact, exchange rate swings have become the backbone of all economic operations around the world, making exchange rate management a key driver of many countries' economic strategies (Todaro, 2004).

In the economies of most developed countries, a correct or appropriate exchange rate has been one of the most important factors for economic growth, whereas regular fluctuations or an inappropriate exchange rate have been a major impediment to economic growth in many African countries, including Nigeria.

Exchange rate is an important macroeconomic variable used as a parameter for determining international competitiveness (Njoroge, 2020). Fluctuations in the exchange rate can lead to currency appreciation or depreciation. For instance, the exchange rate of the naira to a dollar fluctuated from ₦22.02, ₦34.02, ₦54.54, ₦57.39, ₦58.08, ₦59.9 and ₦57.7 to $1 in 1993, 1994, 1995, 1996, 1997, and 1998 respectively to ₦130.83, ₦138.57, ₦158.88, ₦160.3, ₦163.86, ₦167.49, ₦177.31, ₦178.55, ₦200.28, ₦273.5, and ₦355.8 respectively to $1 between 2009 and 2019 (Ekomabasi & Kufre, 2020). This shows that the fluctuation in the value of the naira relative to the dollar makes Nigeria's import expensive and could invariably affect the volume of aggregate trade (Yakub *et al.*, 2019).

Fluctuations in the exchange rate since the inception of the flexible exchange rate regime have raised concerns particularly on the impact of such movement on the over all development of the economy. The movement in the exchange rate it is assumed has made planning more difficult and investment riskier (Chaudhry & Yuce, 2019). Exchange rate volatility induces uncertainty in international transaction which decreases trade and general welfare (Adeniyi & Olasunkanmi,

2019). These fluctuations in the exchange rate have increased uncertainty in investment climate resulting to a reduction in investment and a fall in income, output and employment. This has led to a fall in the standard of living of individuals in the country and a reduction in a country's trade. Exchange rate volatility affects the profitability of businesses; this is due to the fact that fluctuations in the exchange rate increases the cost of transaction and reduces the profit accruable to the business (Yakub *et al.*, 2019).

The management of exchange rate system has been on the ladder of every government today owing to its great influence on the external sector performance. A favourable exchange rate is expected to lower cost of living, especially for developing countries who rely heavily on imports for consumption like Nigeria, for instance, the exchange rate of the Nigerian Naira against the US dollar affects and sharps the production activities in Nigeria. Any fluctuation in the value of the US dollar would transfer such shock to Nigeria due to our reliance of dollar for importations.

Movements in the exchange rate have screwed up effects on other economic variables such as interest rate, inflation rate, import, export and output, and so on. These facts underscore the importance of exchange rate to the economic well-being of every country that opens its doors to international trade in goods and services. The importance of exchange rate derives from the fact that it connects the price systems of two different countries making it possible for international trade to make direct comparison of traded goods. In other words, it links domestic prices with international prices. Through its effects on the volume of imports and exports, exchange rate exerts a powerful influence on a country's balance of payments position.

## 2.12 Crude Oil Price Volatility

Crude oil prices always seem to be fluctuating over time, showing different degrees of ups and downs. The degree of the responsiveness of different countries to the volatility of oil prices typically varies according to economic conditions worldwide. However, for both oil-importing and oil-exporting nations, oil continues to play a key position, because it is a critical energy source and one of the most exchanged product. In case of oil-consuming countries, the rise in oil prices is bad news as it affects production, investment decision and economic growth. Arise in oil prices will cause an increase in the cost of producing domestic products and this will affect production and output negatively (Alekhina & Yoshino, 2018).

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At the same time, an increase in oil prices is often accompanied with effect on investment and spending decisions in a country and a rise in oil prices may also cause an economic recession Oil revenues in many nations have remained largely unstable owing to factors like volatility in global oil prices and output regulations among other international and domestic issues, thereby affecting the stability of many oil-dependent economies (Charfeddine & Barkat, 2020).

Brent Crude's price is the benchmark for African, European and Middle Eastern for Crude oil originating from North Sea oil fields in Norway. Two-thirds (2/3) of all crude oil contracts around the world reference Brent Crude making it the most widely used oil price of all. OPEC spot rate Crude Oil Price (OP) is referenced by Nigerian bonny Light and determined by Average of Thirteen (13) crude oil types of 13 member countries of the Organization of the Petroleum Exporting Countries (OPEC) reference Basket (ORB). West Texas Intermediate is the benchmark crude oil price for US Light Oil from North America US oil fields and is used by the United States as the largest importer and exporter of crude oil with largest storage inventory in the world.

According to Mukhtarov *et al.* (2019), Crude oil is traded globally in, US Dollars while consumers use local currencies to buy petroleum products. When the US dollar depreciates against other currencies, countries with non-dollar appreciating currencies enjoy cheap oil, while consumers in US Dollar-pegged countries pay a higher price for the same barrel of oil (Ayoola & Olanrewaju, 2018). Changes in the US Dollar will therefore affect world oil demand. Depreciation of the US Dollar versus the appreciation of other currencies will decrease the cost of buying a dollar. This will increase the demand for crude oil, in other currencies than the US Dollar which consequently leads to increases in prices. A negative relationship between the US Dollar exchange rate and the crude oil price changes is thus expected (Namovsky, 2018).

## 2.2    Theoretical Review

The theoretical relationship between oil price and exchange rate has been well espoused in the

literature. The theoretical literature has recorded four (4) major theories. These are the Dutch disease phenomenon, the Hotelling (1931) theory of exhaustible resource, Dornbusch (1976) Overshooting hypothesis and the portfolio-balancing theory of Krugman (1983). The Dutch disease phenomenon was first coined by the Economist magazine in 1977 but later popularised by Corden and Neary (1983). The theory is primarily associated with a natural resource discovery that resulted in a large influx of foreign currency into a country, including foreign direct investment, foreign aid or a substantial increase in natural resource price. The theory predicted that a resource boom affects the rest of the economy through two channels.

Dornbusch (1976) introduced a theory of exchange rate overshooting. This theory was later extended by Driskill and McCafferty (1982). Later, Turnovsky and Bhandari (1982) refined the Driskill and McCafferty (1982) extension. The basic theory explains an over-reaction of monetary policy-inducement to exchange rate volatility and that short-term effect of this volatility would exceed its long-term effect. This occurs due to prices and wage stickiness in the short-run and that as time passes, prices and wages become 'unsticky' and this dissipate the initial over-reaction for the long-run situation at a new equilibrium position for all markets. The additions made by Driskill and McCafferty (1982) and the refinement done by Turnovsky and Bhandari (1982) were to further interrogate the origin of shock that hits the economy through the exchange rate volatility. The former found that trade balance and relative prices were correlated with the spot and forward exchange rates while the latter concluded that the balance of payment position is a determining factor.

## 2.3    Empirical Review

Igbinovia and Ogiemudia (2021) examined oil price influence on the Nigeria exchange rate volatility spanning the retro of thirty five (35) years. The Simultaneous equation modeling of Granger causality test and Vector Error Correction Model (VECM) techniques were adopted, to analyzed the data stream from 1983 – 2019. A dynamic framework analysis that includes test of unit root, descriptive statistics and co-integration preliminary test were carried out. Specifically, the empirical findings show that the coefficient of oil price and other variables (rate of interest, inflation rate and external reserve) considered has varying degree of significant relationship with volatility of exchange rate in Nigeria both in the succinct and long run during the retro under review. The study concludes that oil price has a long run positive non-significant influence on exchange rate volatility and a short run negative non-significant influence on exchange rate volatility in Nigeria during the sample retro under concern.

Ehikioya *et al.* (2020) employed the Johansen cointegration and the vector error correction model (VECM) to assess the dynamic relationship that exists between oil price fluctuations and the real exchange rate in selected Sub-Saharan Africa countries from January 2004 to December 2017. The result of the monthly data analysis provides evidence to support a cointegration between oil prices and the real exchange rate in sub-Saharan oil dependent nations. The results of the study established a long-run equilibrium connection between fluctuations in oil price and the real exchange rate. Importantly, the study demonstrates the significant power of oil prices to predict the movement of real exchange rates in Nigeria, Angola, the Republic of Congo, Equatorial Guinea and Gabon. This study has implications not only for investors and industry leaders but also for policymakers responsible for the growth and stability of the economy. The results of this study also attest to the need for urgent economic diversification to other sectors of the economy both to reduce the negative influence of oil price fluctuations and to boost economic growth.

Olayungbo (2019) studied the effect of global oil price on exchange rate, trade balance and reserve in Nigeria from 196Q4 to 2018Q1. The frequency domain causality approach was adopted. Findings indicate that causality relationship was not detected between oil price and exchange rate movement in Nigeria. Bhattacharya, Jha and Bhattacharya (2019) studied oil price influence on exchange rate volatility in India using the Causality, GARCH model. Findings reveal a weak and long run co-movement between oil price and exchange rate volatility. Monday and Abdulkadir (2020) looked at the influence of oil price volatility, foreign exchange demand, and external reserves on exchange rate volatility in Nigeria using monthly data and ARCH model over the period from May 1989 to April 2019.

Drebee and Adual-Razak (2022) investigated the effects of oil price fluctuations on economic growth, financial development and exchange rate in Iraq. To achieve this objective, IRFs and VDCs, which are estimated from VAR, have been used. This study found that great fluctuations in economic growth, financial development, and exchange rate are due to oil price fluctuations. It is a reflection of oil resource mismanagement besides the rampant corruption in the state administrations additional to allocating most of financial resources to the war efforts when Iraq fought against terrorism.

Gylych *et al.* (2019). The study aims to find the short-run empirical analyses of the impact of oil price fluctuation on the monetary instrument (Exchange rate, Inflation, Interest rate) in Nigeria. We explored the frequently used Toda–Yamamoto model (TY) model, by adopting the TY Modified Wald (MWALD) test approach to causality, Forecast Error Variance Decomposition

(FEVD) and Impulse Response Functions (IRFs). The study covered the period 1995 to 2018 (monthly basis), and our findings from MWALD test indicated that there is a uni-directional causality of the log of oil price (lnoilpr) to log of the exchange rate (lnexchr) at 10% level of significance, also there is a contemporaneous response of log of consumer price index (lncpi) to log of exchange rate (lnexchr) and log of interest rate (lnintr), and jointly (lnoilpr, lncpi and lnintr) granger cause lncpi. Also at 5% level of significance lnintr responded due to positive change in lnoilpr and lnexchr, and jointly causes lnintr at 5% level ofsignificance. This is complimented with our findings in FEVDs, and IRFs. The empirical analyses shows that oil price is a strong determining factor of exchange rate, cost of borrowing and directly influences inflationary or deflationary tendencies in Nigeria.

Studies by Khan *et al.* (2017)using structural break point and structural dummy variable has indicated that there exists a negative relationship between crude oil price and economic growth of oil price fluctuation in Pakistan,. Eyden *et al.* (2019) indicate that Oil price volatility has a negative and statistically significant impact on economic growth of OECD countries more especially to oil importing countries in the sample. Similarly, Gbatu *et al.* (2017a) have examined the relationship as positive between oil price increase and an increase in the economic growth of Liberia. Studies by Mo (2019) found Positive effect shown in the short-run and medium term in China.

## 2.4    Gap Identification

The fluctuations in the oil price play a big role in the economy of both oil exporting and importing countries. Krugman (1983) and Golub (1983)pointed to the potential importance of oil prices as a predictor of exchange rate movements. Empirical work on the interactions between oil prices and exchange rates are, however, much less extensive than those on the effects of oil prices on economic activities.

Observing the fluctuations of oil prices in the past three decades, it can be found that when oil prices fluctuated, many unexpected events occurred in the world, such as the Iranian nuclear issue and OPEC's refusal to reduce production, which all led to excess oil supply and short-term changes in the relationship between oil supply and demand. It caused frequent jumps in oil prices. Correspondingly, the exchange rates of different countries have also changed significantly, which also shows that it is necessary to study the fluctuations of oil prices and their jumping phenomena (Abubakar, 2019; Adebayo, 2020; Ahmed *et al.*, 2016); Alzyoud *et al.*, 2018; Beckmann *et al.*, 2020); Bhattacharya *et al.*, 2019; Ehikioya *et al.*, 2020; Gbatu *et al.*, 2017; Igbinovia & Ogiemudia, 2021; Musa *et al.*, 2020; Nouira *et al.*, 2018; Salisu *et al.*, 2020; Volkov & Yuhnb, 2016; Wen *et al.*, 2018; Wu & Yu, 2017; Yang *et al.*, 2017; Yin & Ma, 2018; Yip *et al.*, 2019). Igbinovia and Ogiemudia (2021) explained how the exchange rate affects oil prices from a theoretical level and carried out an empirical analysis. Abubakar (2019) believes that there is a cointegration relationship between the US dollar exchange rate and the international oil price. Changes in international oil prices will lead to fluctuations in the US dollar exchange rate, but changes in the US dollar exchange rate will not lead to fluctuations in international oil prices. Yip *et al.* (2019) believes that there is a cointegration relationship between international oil prices and real exchange rates, and the prediction of international oil prices to exchange rate changes has a high significance in the long run. Nouira *et al.* (2018) conducted an empirical study by adding the international oil price as a variable to the exchange rate determination model and found that the international oil price can significantly explain and predict the changes in the US dollar exchange rate. Salisu *et al.* (2020) studied the relationship

between the international oil price and the US dollar exchange rate before and after the financial crisis through linear and nonlinear causal analysis and found that there was a single linear causal relationship between the international oil price and the US dollar exchange rate before the financial crisis

Most of these studies have been conducted in developed Countries (Alzyoud *et al.*, 2018; Beckmann *et al.*, 2020); Bhattacharya *et al.*, 2019; Volkov & Yuhnb, 2016; Wen *et al.*, 2018; Wu & Yu, 2017; Yang *et al.*, 2017; Yin & Ma, 2018; Yip *et al.*, 2019). It is quite surprising to learn that there were few studies on the effects of the oil price fluctuations on the economy of the oil-exporting countries (Abubakar, 2019; Adebayo, 2020; Ahmed *et al.*, 2016); Alzyoud *et al.*, 2018; Beckmann *et al.*, 2020); Bhattacharya *et al.*, 2019; Ehikioya *et al.*, 2020; Gbatu *et al.*, 2017; Igbinovia & Ogiemudia, 2021; Musa *et al.*, 2020; Nouira *et al.*, 2018; Salisu *et al.*, 2020; Volkov & Yuhnb, 2016; Wen *et al.*, 2018; Wu & Yu, 2017; Yang *et al.*, 2017; Yin & Ma, 2018; Yip *et al.*, 2019).

The findings of these studies were mixed with some finding positive relationship, negative relationship while others found no relationship between oil price and ERV (Abubakar, 2019; Adebayo, 2020; Ahmed *et al.*, 2016); Alzyoud *et al.*, 2018; Beckmann *et al.*, 2020); Bhattacharya *et al.*, 2019; Ehikioya *et al.*, 2020; Gbatu *et al.*, 2017; Igbinovia & Ogiemudia, 2021; Musa *et al.*, 2020; Nouira *et al.*, 2018; Salisu *et al.*, 2020; Volkov & Yuhnb, 2016; Wen *et al.*, 2018; Wu & Yu, 2017; Yang *et al.*, 2017; Yin & Ma, 2018; Yip *et al.*, 2019).

Most studies have dealt with the impact of oil price fluctuations on GDP (Anderu, 2018; van Eyden et al., 2019; Shah et al., 2017; Mo et al., 2019; Gylych et al., 2019; Gbatu & Tutdel, 2017; Drebee & Adual-Razak, 2022). Other studies have dealt with the impact of those fluctuations on money supply, financial markets , interest rates, inflation and other financial indicators (Alekhina & Yoshino, 2018; Aloui et al., 2018; Babalola, 2019;Charfeddine & Barkat, 2020;Darko & Kruger, 2017; Kayalar et al., 2017; Monday & Abdulkadir, 2020; Saka, 2021; Raji et al., 2017).

The purpose of this study is to examine the relationship between oil and currency markets through studying current market trading activities. The data includes crude oil prices and nominal exchange rates expressed in Naira (NGN) over the period between 1993 and 2023. Exchange rate is an amount of NGN for each unit of the eight major currencies of international trade: USD Dollar, The Euro (EUR), the Australian Dollar (AUD), the Canadian dollar (CAD), the Mexican Peso (MXN), the Norwegian kroner (NOK), the British pound (GBP), and the Japanese Yen (JPY). An increase in nominal exchange rates may reflect a recession of the US dollar against foreign currencies. Data frequency is annual. As our focus is oil prices, and for comparison purposes, we use the most important criterion of the Brent index serves as a pricing benchmark for two thirds of the world's internationally traded crude oil supplies. For the purpose of the study, we express rates by their logarithm.

**Figure 2.1: Conceptual Framework**
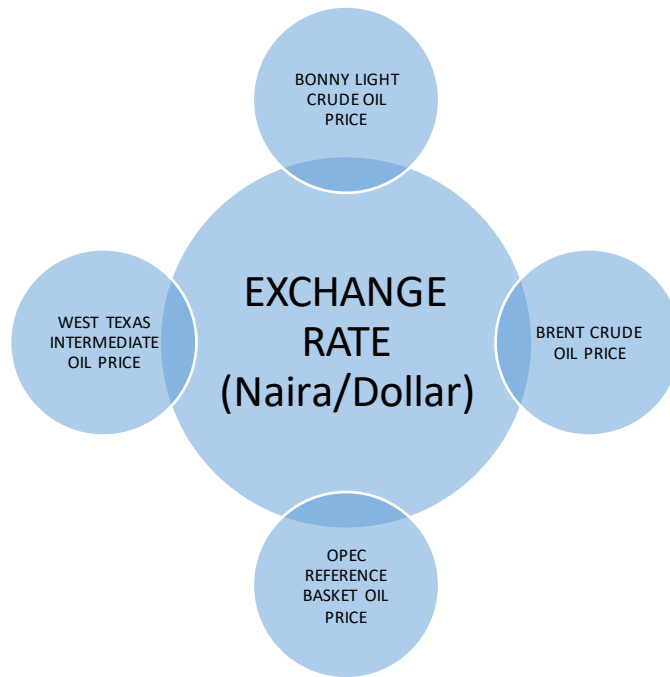
**Authors' Conceptualisation 2023**

**3.0    Research Design**

The research design for the study is *ex post facto* research analysis of annual multivariate time series data. The study examined the historical data in order to understand the current state of foreign exchange rate in Nigeria and causal connections crude oil price variability.

**3.1    Sources and Methods of Data Collection**

All the data that used in this research come from secondary sources. Annual time series data for Nigeria are used from 1993 to 2022. The period is regarded as a time of natural resources (oil) crisis, debt crises, public infrastructure failure, industrial collapse, price instability, infectious diseases (COVID-19, Ebola), illicit economic activities and terrorist attacks. The years of coverage of 30years is crucial because it is characterized by economic recessions, transitional government to democratic governance, depletion of oil prices, oil price fluctuation as a result of significant risk factors and macroeconomic instabilities and uncertainties to Nigerian budgetary system and world at large. The time series data were sourced from statistical bulletins Central Bank of Nigeria, Budget Office of the Federation, OPEC, NNPC Limited, Federal Ministry of Finance and Energy International Agency (EIA).

**3.2        Model Specification**

This study examined the evaluation of the effect of oil price volatility on foreign exchange rate (Naira/Dollar) changes in Nigeria;

Oil price variability is decomposed into fluctuation on Brent Oil, West Texas Intermediate, OPEC Basket Reference Crude Oils and Bonny Light Crude Oil Price Variability.

FERC=$f$(BOP,WTI,OPEC,BONN)……………………………………………………………(1)
FERC=$f$(BO,WTI,OPEC,BONN)………………………………………………………(2)

The proposed model is adapted from work of (Volkov & Yuhnb, 2016; Wen *et al.*, 2018).

$$FERC=\beta_0+\beta_1 BO+\beta_2 WTI+\beta_3 OPEC+\beta_4 BONN + \varepsilon$$ ……………………….(3)

Where; FERC represents Foreign Exchange Rate (Naira/Dollar) Changes (Dependent variable); BOP represents Brent Oil Price Volatility (Independent variable); OPEC represents OPEC Oil Price Volatility (Independent variable); WTI represents West Texas Intermediate Oil Price Volatility (Independent variable); BONN represents Bonny Light Crude Oil Price Variability (Independent variable); $\beta_0$, $\beta_1$, $\beta_2$, $\beta_3$, and $\beta_4$ are regression coefficients to be estimated and $\varepsilon$ is rrror term.

### 3.3    *A-priori* Expectation

$\frac{dBOP}{dFERC} < 0$:connote that Brent oil price variability  is expected to exert negative or positive  effect on foreign  exchange  rate (Naira/Dollar) changes in Nigeria.

$\frac{dOPEC}{dFERC} < 0$: connote that OPEC Based Reference oil price variability is expected to exert negative or positive  effect on foreign  exchange  rate (Naira/Dollar) changes in Nigeria.

$\frac{dWTI}{dFERC} < 0$: connote  that West Texas Intermediate oil price variability is expected to exert negative or positive  effect on foreign exchange rate (Naira/Dollar) changes in Nigeria.

$\frac{dBONN}{dFERC} < 0$: connote that Bonny Light Crude Oil Price variability is negative to exert positive effect on foreign  exchange  rate (Naira/Dollar)  changes in Nigeria.

### 4.0    Estimating Techniques

### 4.1    Descriptive Statistics and Normality Tests Multivariate Time Series Data

The following descriptive statistics, mean, median, percentage, variance, standard deviation, standard error and coefficient of variation, are used to summarize the data. Normality of the data will be tested by skewness, kurtosis, Shapiro-Wilk test, Kolmogorov-Smirnov test and Jarque-Bera (JB) test.

### 4.1.1    Inferential Statistics for Multivariate Time Series Data

### 4.1.2    Diagnostic Tests

The following diagnostic test were used to resolve the following econometric time series problems: Non-stationarity (Unit root)-Dickey Fuller(DF), Augmented-Dickey-Fuller(ADF), Phillips-Perron(PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests; Heteroscedasticity-Breusch-Pagan test, white test and Ramsey-Reset test; Autocorrelation-Durbin-Watson test; Multicollinearity.

### 4.1.3    Estimating Techniques
The following regression, cointegration and causality tests were conducted on the time series data: Regression: ARDL Bound test, Johansen approach and Error-Correction Mechanism(ECM)

models. Time series regression (estimating standard error of regression(S), R-squared, adjusted R-squared and predicted R-squared) using heteroscedasticity models for prediction applying Generalised Auto-Regressive Conditional Heteroscedasticity (GARCH) model and AutoRegressive Integrated Moving average (ARIMA).

## 4.2    Data Analysis and Discussion of Findings

Table 4.1        F-Stat. and Prob. of Auto-correlation, Heteroscedasticity and Ramsey Reset Tests

| Tests | F-Statistics | Probabili |
|---|---|---|
| Serial Correlation | 0.213 | 0.809 |
| Heteroscedasticit | 1.121 | 0.375 |
| Ramsey Reset | 1.085 | 0.285 |

Source: Author's Computation, 2023

Considering diagnostic tests, it is revealed from the Bruesch-Godfrey serial correlation test that the F-statistics is 0.2132 with a p-value of 0.8093 (Table 4.1), which suggest that the error terms in the model are free from serial correlation problem. In the case of the heteroscedasticity problem, it is revealed in the Bruesch-Pagan-Godfrey test that F-statistics is 1.121 with a p-value of 0.3751 (see Table 4.1), which implies that the F-statistics is not statistically significant and as such, the model is free from heteroscedasticity problem.

Long Run Relationship of the Impact of oil price variability on foreign exchange rate changes

The result of the bound test clearly shows that a long run co-integration relationship exist between the variables included in the model using ARDL. The result obtained is presented in table 4.2.

Table 4.2: Estimated Long Run Coefficient Using ARDL Approach

Estimated Long-Run Coefficients Using ARDL Approach

Dependent Variable: Foreign Exchange Rate (Naira/Dollar) Changes

| Regressor | Coefficient | Standard Error |
|---|---|---|
| Constant | -0.3630** | 3.1142 |
| LOGFERC | 0.6145* | 0.2284 |
| LOG BOP | -0.0990* | 0.8636 |
| LOG OPEC | -0.1203** | 0.1666 |
| LOG WTI | 0.7618** | 0.1443 |
| LOG BONN | -0.0047*** | 0.0023 |

Source: Computed by author using E-view 10.0.

In the long run, the coefficient of oil price volatility shows a positive and significant relation with the foreign exchange rate at 10 percent level of significance. This implies that a 10 percent, increase in oil price volatility induces foreign exchange rate by 0.61 percent. The positive coefficient of oil price volatility tends to reveal that Dornbusch (1976) Overshooting hypothesis of foreign exchange rate foreign theory holds for

Nigeria. This finding is in conformity with previous studies like (Driskill & McCafferty, 1982; Turnovsky & Bhandari, 1982; Driskill & McCafferty, 1982).

Furthermore, the coefficient of BOP and OPEC show a negative and insignificant relationship with the foreign exchange rate in the long run. This implies that BOP and OPEC have no impact on foreign exchange rate. This is in contrast with economic theory particularly dutch diseases proposition and in conformity with foreign exchange rate overshooting theory Abubakar, 2019; Adebayo, 2020; Ahmed *et al.*, 2016); Alzyoud *et al.*, 2018; Beckmann *et al.*, 2020); Bhattacharya *et al.*, 2019; Ehikioya *et al.*, 2020; Gbatu *et al.*, 2017; Igbinovia & Ogiemudia, 2021; Musa *et al.*, 2020; Nouira *et al.*, 2018; Salisu *et al.*, 2020; Volkov & Yuhnb, 2016; Wen *et al.*, 2018; Wu & Yu, 2017; Yang *et al.*, 2017; Yin & Ma, 2018; Yip *et al.*, 2019). The negative nexus can be blamed on the inability of government to manage the foreign exchange supply and demand effectively in the country.

## 5.0    Conclusion and recommendation

Diversifying away from oil to other non-oil activities that would generate foreign exchange should be a continuous policy pursuit of the policy makers in the country. Also, adequate measures should be put in place to de-link long run movements of the naira exchange rate from oil price changes. This is because oil prices are highly volatile and very unsettled. If current changes in the prices of oil categorically affects long run exchange rate, then long run stability of the external sector is not guaranteed. Finally, permanent adjustment in exchange rate of the naira should be the main issue of concern when oil prices are fluctuating. Government should intensify effort to ensure that resources are properly managed and invested in productive sectors as well as diversification of the economy so as to raise the level of productive activities and most importantly raise economic growth. The monetary authority should ensure that the value of the naira is protected; this will lead to appreciation of the naira and further increase economic growth. Based on the findings of this study, the following are suggested:  Nigerians should be aware that the upsurge in the naira/dollar rate is not largely due to the oil price downturns/upturns.  The economy should step-up other internationally demanded products like crude oil, and produce in large quantities to cushion the effect of low export. There is a need for a reduction in imports during this period as it will seriously affect the naira.

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