

Oil Price and Exchange Rate Volatility: Implication on Trade Transactions in Nigeria

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ABSTRACT

This study investigates the relationship between oil price, exchange rate volatility, and trade transactions in Nigeria for the period covering from 2008 to 2024. The study employed monthly frequency data from the Central Bank of Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS), and the World Bank databases to investigate the oil price-exchange rate volatility-trade nexus over the period of January 2008 to October 2024. We constructed and estimated a GARCH (1,1) model to derive the exchange rate volatility series. The unit root test and bounds test were employed to determine the stationarity properties of the series and the long-haul relationship among the variables, respectively. The Non-Linear autoregressive distributed lag (NLARDL) method was employed to analyse the nexus between the variables of interest. The NLARDL method's revealed that exchange rate volatility had insignificant and a negative effect on trade. The research determined that the price of oil has a beneficial impact on trade, while a higher inflation rate ultimately impedes trade performance. The study suggests that the monetary authorities should introduce a transparent exchange rate system and platform to stabilise the naira in order to impact positively to trade. This will foster confidence and increase the inflow of the greenback into the country in the form of foreign direct investment, foreign portfolio investment, and other capital investment.

Keywords: Oil Price, Exchange Rate Volatility, Trade Transactions, Nigerian Economy.

INTRODUCTION

To grasp the workings of Nigeria's economy, one must be aware of the connection between oil price, exchange rate volatility, and trade activities. Not only do oil prices affect production costs, consumer confidence, inflation, and the financial market, but they also transfer money from consumers to oil producers (Omojimate & Akpokodje, 2010). There is evidence that oil price alterations, especially in the post-Bretton Woods period (Adedipe, 2004, as referenced in Ogundipe, Ojeaga & Ogundipe, 2014), impact exchange rate movements and other macroeconomic factors in both developed and developing nations. For nations like Nigeria that rely on oil exports, the ever-changing price of oil has a disproportionate impact on the value of the currency. The Nigerian economy is quite vulnerable to shocks in oil prices because of the correlation between currency rates and oil prices.

Over 90% of Nigeria's foreign currency profits come from crude oil, which is a major contributor to the country's economy. Because of this reliance, Nigeria's budget, trade balances, and fiscal policies are susceptible to swings in global oil prices. Given that oil accounts for over 60.1% of government income as of Q4 2019 (Central Bank of Nigeria, 2019), the nation is particularly susceptible to fluctuations in global oil prices. Aigheyisi (2018) found that oil accounted for around 22.4% of Nigeria's overall commerce from 1999 to 2007. Because oil prices are so unpredictable, changes in oil prices affect the value of the Nigerian naira, which in turn affects business deals.

When oil prices rise, the relationship between the exchange rate and oil price changes becomes even more apparent. When oil prices are high, international investors may pour money into Nigeria, which might cause the naira, the country's currency, to rise in value. When oil prices go down, the country's foreign currency profits go down, which means the naira goes down (Oluwatomisin, Paul & Adeyemi, 2014). It is often

believed that when oil prices are high, the local currency would appreciate. However, Nigeria's exchange rate actions have frequently gone against this notion. The naira's inconsistent appreciation in the face of sharp rises in oil prices points to a complicated link between the two variables (James, 2019). The reason for this difference is because, although while it exports oil, Nigeria also imports refined petroleum products. As a result, the economy becomes structurally vulnerable to fluctuations in oil prices, which impact the exchange rate via driving up the cost of petroleum imports (Krugman, 1983). Exchange rate volatility's effect on GDP growth in Nigeria further complicates this connection. In congruent with England, Omotunde, Ogunleye, and Ismail (2010), a country's exposure to the risks of foreign currency volatility increases when exchange rates fluctuate, which may cause uncertainty in overseas transactions. Especially for developing nations like Nigeria, this instability threatens investment, commerce, and economic stability as a whole (Nwogwugwu, Ijomah & Uzoechina, 2016). Instability in currency rates is problematic for companies because it makes import and export costs less predictable. A depreciation of the exchange rate might enhance exports since manufacturing costs are cheaper, but it also causes import prices to rise. A change in the terms of trade results, which may influence economic development in ways that are good or bad (Krugman, 1983).

When it comes to determining oil prices and currency rate swings, the global economic climate is also a major factor. Nigeria and other oil-exporting nations have seen the consequences of the increased volatility in oil prices brought on by global supply chain disruptions caused by things like the COVID-19 epidemic and geopolitical events like Russia's invasion of Ukraine in 2022. As a result of these disturbances, oil prices have been very volatile, which impacts currency rates, inflation, and the general business environment (Ben, Ishaku, Joy et al., 2023). Nigeria must diversify its economy and lessen its dependence on oil exports to obtain foreign currency to protect itself from the economic risks caused by these oscillations.

Oil prices, currency rates, and Nigerian trade transactions have all been quite volatile throughout the years, in congruent with statistics from the Central Bank of Nigeria. For example, from 2000–2011, oil prices increased from \$28.23 per barrel to over \$104 per barrel, which contributed to a substantial rise in trade transactions from \$28.82 billion to \$148.22 billion by 2014. But commerce fell substantially to \$103.52 billion in 2015 as oil prices plummeted to \$50.75 per barrel. In 2022, oil prices recovered to \$97.10 per barrel, but the Naira continued to lose value against the dollar, falling from 101.7 to 645.19 by 2023. This had an effect on trade, which stabilised at \$106.77 billion the following year.

For countries that rely on oil imports, studying the correlation between oil prices and currency volatility has been an important area of study. Following the global crisis of 2008, which caused a precipitous drop in oil prices and the currency rate, a lot of this study has focused on the effects of causation on the Nigerian economy. Despite the fact that studies by Monday and Abdulkadir (2020) and Igbinoia and Ogiemudia (2021) have shown a robust relationship between fluctuations in oil prices and currency rates, no one has looked into the effects of these variations on trade agreements. In a similar vein, Kazeem and Patterson (2023) and Ben et al. (2023) focus on economic growth and oil price shocks, but they fail to include the direct effect on trade flows. Yakub et al. (2023) and Chikamalu and Ebele (2023) look at how oil price volatility affects trade flows and the balance of payments, but they do not take into account how oil price and exchange rate volatility affect trade transactions together. A study of the effects of fluctuating oil prices and currency rates on Nigerian trade transactions is therefore the focus of this article. The rest of the study is structure into literature review, data and methodology, results and discussion, conclusion and recommendations.

REVIEW OF LITERATURE

Theoretical Literature

Dutch Disease and the Overreaction of Resource Discoveries

In the 1970s, economists first appraised the term "Dutch Disease" to describe the widespread financial impact of oil discoveries on many nations. It exemplifies how a country's currency may rise in value when it receives a substantial infusion of foreign cash as a consequence of a resource boom, such as oil exports. The rise in relative pricing has a negative impact on non-oil exports and local industries, among others, which means they will be less competitive worldwide (Corden & Neary, 1982).

Countries that rely substantially on oil exports get a flood of foreign money whenever oil prices increase. This boosts income in the short term, but it causes the currency rate to appreciate, which hurts non-oil export sectors like manufacturing and agriculture since their products are not as competitive in foreign markets. This has a pronounced short-haul impact because governments often use changes to monetary policy to deal with fluctuations in currency rates. On the other hand, the effect could become more stable if the long-haul equilibrium moves to a different spot.

Hotelling's Theory of Exhaustible Resources (1931)

Due to their limited nature, Hotelling's theory initially predicted that the price of consumable resources, such as oil, should rise over time at a pace equal to the interest rate. Particularly for nations with heavy oil export reliance, the idea has consequences for currency rates. An increase in the price of oil might cause these nations' currencies to temporarily gain value due to the increased influx of foreign cash. If the oil price starts to fall, these nations could have problems in the long run, in congruent with the idea, since their currencies might lose value and cause economic instability. As a result of this cyclical dynamic, nations' trade balances change in response to changes in oil prices (Hotelling, 1931).

Dornbusch (1976) Exchange Rate Overshooting

Dornbusch's (1976) theory of overshooting examines the mechanics of shock-induced changes in exchange rates. He claims that the "overshoot" of exchange rates is possible because of the price and wage rigidities. As an example, the exchange rate could overshoot in the near term if the market reacts strongly to an oil price shock. As a result of increasing foreign currency inflows, nations whose economies are highly reliant on oil exports may see an initial appreciation of their currencies as a result of changes in oil prices. Nevertheless, in congruent with the overshooting hypothesis, this influence is often transitory and might cause fluctuations in the currency rate, which affects exchange transactions. While trade imbalances may become worse in the near term, the exchange rate may rebound to a more stable level in the long haul as the market adapts.

The J-Curve and Marshall-Lerner Condition

The J-Curve hypothesis shows how a depreciating currency affects trade balances both immediately and in the future. When the local currency falls in value, the trade deficit widens in the near run. This is usually the result of unexpected events, such as drops in oil prices. This is due to the fact that export demand is more sensitive to fluctuations in price, while import prices increase instantly. In the long run, nevertheless, the trade balance improves because import and export demand is becoming more price sensitive.

A depreciation of the currency will lead to a better trade balance if the sum of the price elasticities of demand for exports and imports is more than one, in congruent with the Marshall-Lerner condition, an crucial part of the J-Curve hypothesis. A rise in the price of imported goods decreases demand for foreign commodities, but a depreciation of the currency of the oil-exporting country makes oil cheaper for international buyers, which can boost oil exports. When this continues, the trade balance improves (Brown & Hogendorn, 2000; Abbas-Ali et al., 2014).

Empirical Literature

In 2023, Joel and Olabode investigated how alterations in oil prices and exchange rates impacted the returns on Nigerian stock markets. We appraised the ARDL model to predict monthly data on crude oil cost, naira/dollar conversion rate, and the total share index of the Nigerian Stock Exchange (NSE) from January 2000 to September 2020, supplied from the US Energy Information Administration. The upshots show that (i) the variables under inquiry were consistently associated in congruent with the ARDL boundary analysis. (ii) Short-haul stock returns would likely increase by 15.5% and long-haul returns by 23.7% in response to a 1% increase in oil prices. (iii) Stock market returns in the near haul would be reduced by 0.16% due to a 1% depreciation of the naira/dollar exchange rate, but returns in the long term would be unaffected by the exchange rate.

The authors Ben, Ishaku, Joy, et al. (2023) looked appraised how symmetric diversification, oil price variations, and investments in trade and non-trade industries relate to one another. They analysed the short- and long-period impacts on macroeconomic indicators, economic growth, and the business environment applying Structural Vector Autoregressive (SVAR) and ARDL models, with realised volatility serving as a measure of oil price swings. Their research demonstrated a strong relationship between oil prices and broader economic variables, and they found that sudden spikes in oil costs may slow development in the near term. They went on to say that from 2012 to 2022, diversification measures in both trade and non-trade sectors might help lessen the impact of oil price variations and interruptions to the demand-supply chain.

The impact of fluctuating oil prices on Nigeria's current and capital accounts was the subject of research by Chikamalu and Ebele (2023). To estimate the model for the balance of payments problem, the researchers appraised the VAR approach. Increased volatility in oil prices had a negative effect on Nigeria's current account and a substantial influence on the capital account balance, in congruent with their upshots. To get a better understanding of the imbalance brought about by fluctuations in oil prices, the research also stressed the need of looking at the balance of payments components independently.

From 1997 to 2016, Yakub, Sani, et al. (2023) studied the effects of fluctuating currency rates on Nigerian trade flows. For this purpose, they investigated the interrelationships of important economic factors such as trade flows, exchange rate volatility, and ARDL bounds testing. Their research showed that fluctuations in the value of the naira had a detrimental influence on Nigeria's trade flows in the near term, but no discernible effect in the long run. The research highlighted the possible advantages of a more stable foreign exchange market in reducing the negative effects of currency rate volatility on trade flows in the near term.

Focussing on the impact of changes in oil prices, Kazeem and Patterson (2023) investigated the mechanics of exchange rate volatility in times of economic crisis. They focused on the Great Recession and the COVID-19 pandemic, noting that the effect of oil price volatility on exchange rate volatility differed across economic and non-economic samples. They appraised the GARCH model and its expansions to show that the COVID-19 problem had an economic basis, and that oil price swings made the situation even more unpredictable.

From January 2004 through December 2022, Drebee and Aduwal-Razak (2022) studied the actual exchange rates of a number of Sub-Saharan African nations to determine the impact of changes in oil prices. In their research, they found that oil prices and currency rates in Nigeria, Angola, the Republic of the Congo, Equatorial Guinea, and Gabon moved in tandem, although only weakly and over the long term. The analysis found that oil prices substantially influenced real exchange rates in the long term, but the strength of this association differed across nations. Furthermore, the analysis highlighted that oil price predictions for the nations in question about changes in their actual exchange rates were somewhat restricted.

From 1983 until 2019, Lawson and Omorose (2021) appraised the impact of oil prices on the volatility of Nigeria's currency rate. They conducted tests for co-integration, unit roots, dynamic framework analysis, and Granger causality in addition to applying a Vector Error Correction Model (VECM). In congruent with their research, oil prices did influence exchange rate volatility in the long term, but only little. In addition, they found a detrimental but insubstantial affect in the near term. The research found that interest rates, inflation, and foreign reserves were some of the variables that affected the volatility of the Nigerian currency, but to varying degrees.

Igbinoia and Ogiemudia (2021) mainly studied how the naira's value changed in response to shifts in oil prices. Their study evaluated the ever-changing correlation between fluctuations in oil prices and shifts in exchange rates applying the Vector Error Correction Model (VECM). Their research proved that oil prices have a substantial long-haul impact on the currency rate, which means that changes in oil prices are a major factor in the volatility of the Nigerian currency.

Monday and Abdulkadir (2020) also looked at how oil price volatility affected the volatility of the Nigerian currency. Applying the VAR model, the researchers determined that oil prices had a substantial impact on the returns of exchange rates, and that there was a proportionate relationship between the returns of exchange rates and the volatility of future oil prices.

From 1986 to 2021, Victor, Isa, and Jerome (2022) studied the effect of currency fluctuations on Nigerian trade flows. Their research investigated the Marshall-Lerner condition and the J-Curve hypothesis applying the NARDL model. The upshots indicated that a decline in the value of the currency might have a beneficial effect on trade flows by increasing both exports and domestic output. As per the research, the J-Curve effect is real; it has a negative influence on trade balance in the short haul but a positive adjustment in the long run, especially when considering the dynamics of Nigeria's foreign trade.

Maijama'a (2021) looked at how alterations in oil prices affected the Nigerian currency rate and other economic metrics in the medium term. Although there was no obvious positive or negative trend in exchange rate movements in the near term, his research showed that the shocks from oil price were a major factor in driving exchange rate volatility.

Applying Johansen cointegration and VECM, Ehikioya et al. (2020) appraised the impact of oil price fluctuations on the volatility of the Indian rupee. Their research showed that variations in oil prices substantially affected currency exchange rates, and they suggested that countries diversify to lessen the blow of these swings.

In 2020, Monday and Abdulkadir studied how oil price volatility affected the changes in currency rates of sub-Saharan nations that rely on oil. In order to examine the connection between oil prices and currency rates, their research appraised the Modified Wald (MWALD) test, Forecast Error Variance Decomposition (FEVD), and Impulse Response Functions (IRFs) from 1995 to 2018. The upshots showed that oil prices affected interest rates and consumer price indices, and that oil prices affected the exchange rate, all in one direction. The research highlighted the importance of oil price swings in influencing Nigeria's currency rate, borrowing costs, and inflationary pressures.

Olayungbo (2019) investigated how fluctuations in oil prices affected the growth, trade balance, and exchange rate of Nigeria. The research analysed monthly data from 2008–2014 applying Ordinary Least Squares (OLS) regression and concluded that Nigeria's currency rate was substantially impacted by global oil prices. The report went on to say that fluctuations in oil prices were a big reason for the disorder in the macroeconomy, especially in the areas of interest rates and trade balance.

In 2019, Ji et al. looked at how oil price volatility relates to the US dollar index. They found that crude oil prices had a strong negative correlation with FX markets, especially those between the US and China. Applying the NARDL modelling approach, the research found that asymmetric risk spillovers occurred as a result of oil price volatility, with oil prices having a substantial impact on the changes of the exchange rates in both nations.

Another study that added to this body of knowledge was Bhattacharya, Jha, and Bhattacharya's (2019) examination of how oil price volatility affects Nigerian exchange rate swings. To model the data, they appraised a variety of econometric models, such as EGARCH, PARCH, and GARCH. The research concluded that changes in oil prices did not substantially affect the volatility of the Nigerian currency, indicating that other macroeconomic factors may have a more considerable impact on this variable.

In his 2019 study, Ahmad investigated how sudden changes in the price of crude oil affected the Nigerian naira exchange rate. Applying a two-stage heteroskedastic Markov switching model, the research zeroed focused on times when the exchange rate went up and down. In congruent with the upshots, the Naira strengthened in response to increases in oil prices and fell in value in response to decreases in oil prices. In congruent with Ahmad's research, oil price shocks are the primary factor influencing currency exchange rate fluctuations, and these impacts are present throughout both the depreciation and appreciation periods.

Ji et al. (2019) and Zhu and Chen (2019) further upon the relationship between oil price fluctuations and US and Chinese currency rate fluctuations. According to their upshots, there is a substantial asymmetric risk spillover effect, which means that changes in oil prices affect the US and Chinese currency markets differently. To measure the immediate and lingering impacts of oil price swings on currency rates, these research appraised the NARDL method.

Applying monthly data from 1986 to 2015, Nwogwugwu et al. (2016) studied how oil price shocks affected the volatility of the Nigerian currency. Researchers found no correlation between oil price fluctuations and currency exchange rates applying a frequency domain causality technique. Still, they discovered a direct relationship between oil prices and foreign reserves.

In 2015, Osuji studied how alterations in oil prices affected the volatility of the US dollar-Naira currency pair. The research appraised GARCH models to analyse data collected on a daily and monthly basis. In congruent with Osuji's research, the swings in oil prices greatly affected the volatility of the exchange rate, which in turn affected the rate in both the short and long run.

From May 1989 through April 2019, Onoja (2015) appraised the effect of changes in oil prices on the volatility of the Nigerian currency. Oil price variations substantially affected exchange rate volatility, in congruent with the study's upshots, which were as per an assessment of the connection applying the TGARCH model. It seems that oil price volatility was a major factor influencing the fluctuations in Nigeria's currency rate, since there was a substantial positive association between the two variables.

Researchers Oluwatomisin, Paul, and Adeyemi (2014) looked at how interest rates, oil prices, and foreign reserves affected the volatility of the Nigerian currency. This research appraised Johansen cointegration and VECM models applying yearly data from 1970 to 2011. The upshots demonstrated a robust relationship between changes in oil prices and the exchange rate, indicating that the two variables responded more than proportionally to one another. In order to lessen the impact of swings in oil prices, the report suggested that Nigeria should diversify its economy away from its reliance on the commodity.

A study by Ogundipe and Ogundipe (2013) looked at how alterations in oil prices affected the volatility of the Nigerian currency. The researchers appraised the GARCH model and Johansen cointegration tests on time series data with heteroskedasticity. The upshots demonstrated that the volatility of the exchange rate was quite susceptible to changes in oil prices, lending credence to the notion that shocks in oil prices substantially affect the dynamics of the Nigerian exchange rate.

Gap in Literature Reviewed

Focussing on the consequences on inflation, economic growth, and exchange rates, the current research delves deeply into the connection between oil price variations and exchange rate volatility in Nigeria. Monday and Abdulkadir (2020) and Igbinovia and Ogiemudia (2021) are among the research that show a robust connection between oil prices and changes in exchange rates. However, these studies do not discuss how these influences trade transactions. Ben et al. (2023) and Kazeem and Patterson (2023) are among the studies that take oil price shocks and economic development into account, but they fail to take trade flows into account. Specifically, research by Chikamalu and Ebele (2023) and Yakub et al. (2023) has concentrated on trade flows and the balance of payments, whereas Joel and Olabode (2023) looked at how oil and exchange rates affected the stock market, but they did not look at how these two factors combined affected trade transactions. Notably, in the reviewed literature, only Ji et al. (2019) and Zhu and Chen (2019) using the Non-linear ARDL to evaluate the impact of oil price and exchange rate fluctuation without modelling the volatility of the series. Methodologically, this work contributes by correctly modelling the volatility in exchange rate using the generalised autoregressive conditional heteroscedasticity (GARCH) framework and integrating the series which may have a positive and negative shock in the asymmetries association between oil price, exchange rate volatility and trade transaction using the non-linear ARDL

DATA AND METHODOLOGY

Data

Monthly official exchange rates of naira versus the US dollar, Brent crude oil price, trade and inflation make up the datasets appraised for this analysis. Data coverage spans January 2008 to October 2024. Data availability guided the chosen range. The World Bank database, National Bureau of Statistics, and the Central Bank of Nigeria (CBN) source of the statistics The CBN Statistical Bulletin provides the official exchange rate

and trade (in USD) data for simple replication; the National Bureau of Statistics extracts inflation from this source. The World Bank database served the Brent crude oil price data.

Model for the Study

The research built a predictive model for exchange rate volatility-oil price-trade nexus in a manner that captures the characteristics of the predictor series as modelled below after the work of Joel and Olabode (2023) who described stock market return as a function of oil price and exchange rate:

$$TRD = f(EVL, OLP, INF) \quad (1)$$

Together with the tick variable of inflation, the econometric presentation of Eq. 1 with trade as dependent variable and the independent variables of exchange rate volatility and Brent crude oil price shows below:

$$lntrd_t = \delta_0 + \delta_1 evl_t + \delta_2 lnolp_t + \delta_3 inf_t + \varepsilon_t \quad (2)$$

Where trd_t denotes trade in million US dollars, evl_t is exchange rate volatility, olp_t is the price of Brent crude, inf_t denotes inflation (measured by means of year on change of consumer price index), ε_t is error term and ln is natural logarithm notation.

Measuring Exchange Rate Volatility

Generally speaking, there are three methods that have been appraised in the process of assessing the volatility of exchange rates, as described in the relevant literature. [Nishimura & Hirayama, 2013] The first method is the standard deviation technique, which involves calculating the initial difference between the natural logarithm of the exchange rate. In congruent with Asteriou, Masatci, and Pilbeam (2016), the second method involves the utilisation of the moving average of the standard deviation of the natural logarithm of the exchange rate. The third possibility is to produce exchange rate volatility series by applying the generalised autoregressive conditional heteroscedasticity (GARCH) modelling framework. Both the first and second techniques, as pointed out by Serenis and Tsouris (2013), result in estimations of bias and errors in evaluation. Although it integrates time-varying conditional variance and better captures volatility clustering in historical data, the GARCH technique has been more popular in the generation of exchange rate volatility series (Sharam & Pal, 2018). This is due to the fact that it combines both of these factors. In order to generate the exchange rate volatility series, this research makes use of the GARCH methodology.

With the following equation, we were able to estimate the volatility of the exchange rate:

$$EXR_t = \gamma_0 + \gamma_1 EXR_{t-1} + \varepsilon_t \quad (3)$$

$$g_t^2 = \theta_0 + \vartheta_1 \varepsilon_{t-1}^2 + \vartheta_2 \varepsilon_{t-2}^2 + \dots + \vartheta_q \varepsilon_{t-q}^2 + \delta_1 g_{t-1}^2 + \delta_2 g_{t-2}^2 + \dots + \delta_p g_{t-p}^2 \quad (4)$$

Where g_t^2 is the conditional variance of ε , determined by the ARCH term (ε_{t-1}^2) and the GARCH term (the lag conditional variance), EXR denotes exchange rate of the naira against the US dollars.

The study appraised the generalized autoregressive conditional heteroscedasticity (GARCH) model in modeling exchanger rate volatility.

The general form of the GARCH model is given by the specification below:

$$h_t = \varphi + \theta_1 h_{t-1} + b_1 u_{t-1}^2 \quad (5)$$

The GARCH (1,1) can also be extended to a GARCH (p,q) model where p = lagged terms of the conditional variance (h) and q = lagged terms of the squared error (u^2). That is:

$$GARCH(p,q): h_t = \varphi + \sum_{k=1}^p \theta_k h_{t-k} + \sum_{i=1}^q b_i u_{t-i}^2 \quad (6)$$

The estimation of the GARCH model followed the test for ARCH effect applying the Lagrange Multiplier (LM) test.

The null hypothesis is that:

$H_0: \alpha_1 = 0$, indicating no ARCH effect, against

$H_A: \alpha_1 \neq 0$, there is ARCH effect.

Estimation Technique

The study adopted the Non-Linear Autoregressive Distributive Lag Model (NLARDL), an extension of the traditional ARDL. The NLARDL model evaluate the connection between variables in the existence of both short and long-run dynamics. The significant gain of the NLARDL model is that it consents for the inclusion of non-linear relationships among variables in the model estimation. This is specifically useful when nearby are asymmetric impact, such as when positive and negative shocks to an economic outcome have diverse effects over time.

The long run specification of the NLARDL:

$$\ln(TRD_t) = \delta_0 + \delta_1^+ EVL_t^+ + \delta_1^- EVL_t^- + \delta_2^+ \ln(OLP_t^+) + \delta_2^- \ln(OLP_t^-) + \delta_3 INF_t + \epsilon_t$$

Where: TRD_t = Trade at time t; EVL_t^+ , EVL_t^- = Partial sums of positive and negative changes in exchange rate volatility; OLP_t^+ , OLP_t^- = Partial sums of positive and negative changes in oil price; INF_t = Inflation rate; ϵ_t = Error term; and δ_1^+ , δ_1^- , δ_3 = the asymmetric Coefficients of the variables

The short run specification:

$$\begin{aligned} \Delta \ln(TRD_t) = & \alpha_0 + \sum_{i=1}^P \alpha_1^i \Delta \ln(TRD_{t-1}) + \sum_{j=0}^q (\alpha_2^{+j} \Delta EVL_{t-j}^+ + \alpha_2^{-j} \Delta EVL_{t-j}^-) + \sum_{K=0}^R (\alpha_3^{+j} \Delta \ln(OLP_{t-K}^+) \\ & + \alpha_3^{-j} \Delta \ln(OLP_{t-K}^-)) + \sum_{L=1}^S \alpha_4^L \Delta (INF_{t-1}) + \phi ECM_{t-1} + \epsilon_t \end{aligned}$$

Where: Δ = Indicates first differences (i.e., short-run changes); ECM_{t-1} = is the lagged error correction term from the long-run model; α_i = terms represent short-run dynamic coefficients; ϕ = measures the speed of adjustment from short run back to long-run equilibrium.

Justification of the Method

The structure of Linear ARDL model (NLARDL) augments model's pragmatism and predictive power. The asymmetric impact not structure in the Linear ARDL model is evaluated using the Non-Linear ARDL (NLARDL). The volatility in exchange rate and oil price shock which affects trade through either positively or negatively is captured by this method. The asymmetric effect of the long and short run period is easily computed using this method. This permits for more informed policy decision in an economy resource reliant country like Nigeria.

RESULTS AND DISCUSSION

Table 1: Descriptive Statistics of Variables

	TRD	EXR	OLP	INF
Mean	9971.455	323.8085	78.3729	14.4426

Median	9480.360	214.4157	75.9754	12.7750
Maximum	17318.66	1641.120	133.8730	34.1900
Minimum	5027.940	117.7243	23.3400	7.7100
Std. Dev.	2798.600	297.7606	25.1054	6.0184
Skewness	0.4329	2.9980	0.1085	1.6020
Kurtosis	2.4088	12.2473	2.0229	5.4732
Jarque-Bera	9.2536	1022.334	8.4302	137.8932
Probability	0.0097	0.0000	0.0147	0.0000
Observations	202	202	202	202

Source: Computation done by author (2025)

Table 1 reveal a mean value of USD 9,971.455 million for trade, which range between USD 5,027.940 million and USD 17,318.66 million. Exchange rate averaged N323.8085/USD 1, with a maximum and minimum value of N1,641.120/USD 1 and USD 117.7243/USD 1 respectively. The average Brent crude oil price was USD 78.3729 per barrel, ranging between USD 23.34 per barrel and USD 133.8730 per barrel. During the period of investigation, inflation from rose from 7.71% to 34.19%. The skewness statistics revealed that all the variables of interest (TRD, EXR, OLP and INF) are positively skewed, indicating that there were more smaller values than larger values in the distribution of the variables. In terms of normality, the upshots shows that none of the variables are normally distributed.

GARCH Estimation

On the basis of the test that was performed on the residuals, the volatility of the series may be determined. Contrary to the alternative hypothesis, which states that the ARCH effect is present, the null hypothesis of the test states that there is no ARCH effect.

Table 2: Result of ARCH Test

F-statistic	42.1861	Prob. F(1, 198)	0.0000
Obs* R^2	33.7260	Prob. $\chi^2(1)$	0.0000

Source: Authors' computation (2025)

In congruent with Table 2, the probability value of the Lagrange Multiplier (LM) statistics, which is 33.7260, is less than 0.05, which indicates that the data are substantial at the 5% level. The hypothesis that there is no ARCH effect is thus rejected, and the alternative hypothesis is accepted as a result. This study suggests that the pattern of volatility may be modelled by applying the generalised autoregressive conditional heteroscedasticity (GARCH) model. This discovery also suggests that the GARCH model can be appraised to extract exchange rate volatility.

Unit Root Test

The study carried out unit root test on the selected variables to determine the stationarity properties of the series. Series with unit root produce hypothesis testing statistics such as t-statistics and R^2 that are inflated and give falsehood on estimated relationship between foreign portfolio investment and other selected variables

(Gujarati & Porter, 2021; Austerious & Hall, 2016). The study test for unit root presence in the selected series was as per the KPSS method.

Table 3: Unit Roots Result

Variable	KPSS			I(d)
	Level	1 st Diff	5% Critical Value	
$lntrd_t$	0.4829	0.0643**	0.4630	I(1)
evl_t	0.5220	0.0829***	0.4630	I(1)
$lnolp_t$	0.3190**	-	0.4630	I(0)
inf_t	0.9358	0.3063**	0.4630	I(1)

Note: *, **, and *** denote significance at 10%, 5% and 1%, respectively

Source: Computation done by author (2025)

As reported in Table 3, the KPSS show that Brent crude oil price (OLP) series is stationary in their level form. The outcome of the KPSS indicated that the level values of trade (TRD), exchange rate volatility (EVL) and inflation (INF) contain unit root, and are stable under the first difference condition. Conclusively, the test upshots revealed that the highest order of integration of the interest variables is I(1) and the series are of mixed order of integration.

Cointegration

Table 4: Bound Test Result

Estimated Model		F-statistics
$F_{TRD}(trd/evl,lnolp,inf)$		6.803774***
K = 3		
Critical Value	I(0)	I(1)
1%	3.65	4.66
5%	2.79	3.67
2.5%	23.15	4.08
10%	2.37	3.2

Note: Null hypothesis: No level relationship; K = number of regressors; *, ** and *** denote significance at 10%, 5% and 1% level, respectively.

Source: Computation done by author (2025)

The cointegration test is as per the bounds test introduced by Pesaran, et al., (2001). The method is appraised to test the null hypothesis of no cointegration in level series. The combination of nonstationary and stationary series in a model disturbs the short- and long period and makes the parameter estimates to be inconsistent and inefficient. The bounds test is more suitable for this study because it is not restrictive like Engle and Granger (1987) two-step residuals cointegration method and it does not require the data series to have the same

integration process. The bounds test is as per the F-statistics and gives accurate upshots for series that are of mixed orders. The upshots of the bounds test presented in Table 4 reveals that the F-statistics of 6.803774 is statistically substantial at 5% level, evidencing that there is cointegration relationship among the variables.

Table 5: NARDL Long and Short Run Results

Dependent Variable: $\ln TRD_t$				
Panel I: Long Run Results				
Variable	Coefficient	Std. Error	t – Stats	Prob.
evl^+	-1.0696*	0.6076	-1.7601	0.0800
evl^-	-1.0249*	0.5659	-1.8110	0.0717
$\ln olp^+$	0.6954***	0.0539	12.8988	0.0000
$\ln olp^-$	0.6805***	0.0522	13.0246	0.0000
INF_t	-0.0185***	0.0053	-3.4731	0.0006
C	9.5640	0.0597	160.0777	0.0000
Panel II: Short Run Results				
Variable	Coefficient	Std. Error	t – Stats	Prob.
$D(\ln TRD_{t-1})$	-0.2083***	0.0579	-3.5951	0.0004
$D(evl_t^+)$	-0.0899	0.1836	-0.4894	0.6251
$D(\ln olp_t^-)$	0.6543***	0.1103	5.9317	0.0000
ECM_{t-1}	-0.5229***	0.0617	-8.4692	0.0000
$R^2 = 0.4573$		Adjusted $R^2 = 0.4489$		

Note: *, ** and *** denote significance at 10%, 5% and 1% level.

Source: Author's computation (2025)

From the non-linear ARDL result presented in Table 5, both increase and decrease in exchange rate volatility had insignificant effect on trade in the long run. An increase in exchange rate volatility by one percent is expected to lead to a fall in trade by 1.0696%. Similarly, it can be seen from Table 5 that, a decrease in exchange rate volatility leads to an increase in trade. In specific terms, 1% decrease in exchange rate volatility stimulate trade by 1.0249%. Table 4 reveals that the estimated coefficient of positive and negative changes in crude oil price have significant impact on trade in the long run. Table 5 shows that 1% increase in Brent crude oil price leads to 0.6954% increase in trade. This result mirrors the economic structure of Nigeria, as crude oil constitutes one of the largest exports of Nigeria. As seen in Table 5, a fall in Brent crude oil price by 1% results in 0.6805% decline in trade. These findings shows that the effect of positive and negative changes in exchange rate volatility and Brent crude oil price has different effect on trade, alluding to the existence of asymmetric effect of exchange rate volatility and Brent crude oil price on trade in the long run. Regarding the effect of inflation variable has a negative sign, implying that there is a negative relationship between inflation and trade, which is consistent with economic theory. The elasticity of -0.0185 indicates that, 1% increase in

domestic inflation leads to 0.0185% reduction in the volume of trade. As can be seen from the lower portion of Table 5, positive exchange rate volatility has insignificant negative contemporaneous effect on trade, with trade decreasing by 0.0899% when there is 1% increase in the volatility of exchange rate. Moreso, the study observed that negative Brent crude oil price has detrimental impact on trade, as 1% decrease in crude oil price leads to 0.6543% decline in trade. The negative relationship between crude oil price and trade mirrors the Nigerian economy, and the decrease in trade might be fueled by low export of crude oil, due to falling oil price. As it can be seen from Table 5, the error correction coefficient is -0.5229, which is significant, negative and less than unity. The coefficient indicates that, short run disequilibrium from long run trade level is corrected at a speed of 52.29%.

The NARDL results of Table 6 was subjected to certain diagnostic test to ensure they are valid for prediction purposes. The use of an estimated econometric model for prediction requires that certain classical linear regression model (CLRM) conditions are satisfied, one of such being the stability of the parameter estimates. Concerning stability of the estimated parameters, Figure 1 shows that the parameter estimates are stable as the CUSUM plot lay within the 5% bound level.

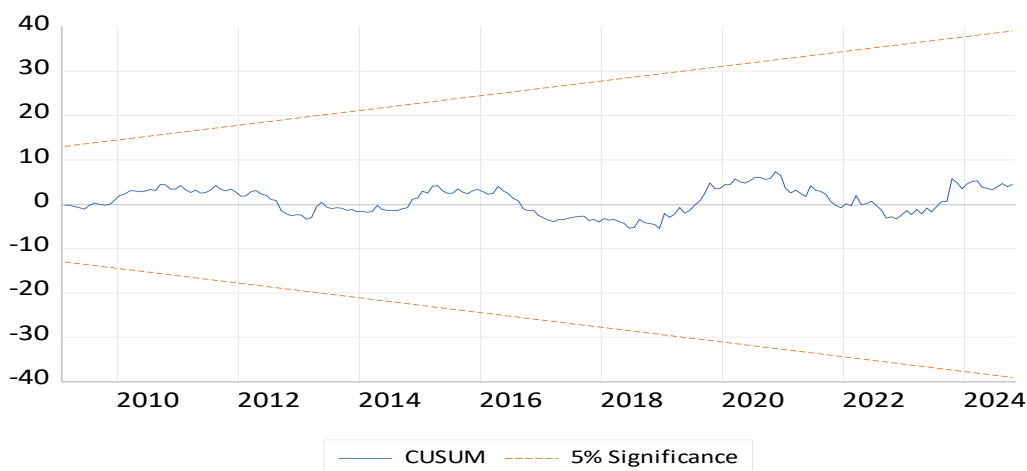


Figure 1: CUSUM Plot

CONCLUSION AND RECOMMENDATIONS

From January 2008 to October 2024, this study appraised the relationship between crude oil price, exchange rate volatility, and trade in Nigeria. In order to elucidate fluctuations in trade, Brent crude oil, and inflation, the study implemented a GARCH (1,1) model to produce the exchange rate volatility series. The NLARDL method was employed to estimate the model that was constructed. The study discovered a long-period correlation between exchange rate volatility, crude prices, and trade as per the upshots of the bounds test. The results indicate that the negative impact of exchange rate volatility on trade was negligible and that the price of Brent crude oil has a positive impact on trade. The study discovered a substantial negative correlation between inflation and trade, suggesting that an inflationary environment undermines trade. The study suggests that the monetary authorities should introduce a transparent exchange rate system and platform to stabilise the naira in order to increase the volume of trade. This will foster confidence and increase the inflow of the greenback into the country in the form of foreign direct investment, foreign portfolio investment, and other capital investment. Also, the monetary authorities must work in conjunction with the fiscal authority to address the security challenges in the country and address the rising inflation by deploying monetary policy tools.

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