EFFECT OF FOREIGN EXCHANGE RATE MOVEMENTS ON OIL & GAS SECTOR OUTPUT IN NIGERIA

DR. JOEL SYLVESTER AHMODU
Ekiti state University, Ado Ekiti.
email: ahmoduj1976@gmail.com

ABSTRACT

This study examined the effect of foreign exchange rate movements on oil and gas sector output in Nigeria. The data for the variables were collected from the various issues of CBN statistical bulletin from 2010M01-2024M12. The variables for the study are real exchange rate movements, oil and gas sector output, interest rate, balance of payment and inflation rate. The ARDL Co-integration procedure coupled with ARCH and GARCH were used in estimating the data. The result showed that foreign exchange rate movements and balance of payment exhibited a positive but insignificant (Prob. > 0.05) effect on oil and gas output, interest rate and external reserve showed a significant (Prob. < 0.05) positive effect, while inflation rate revealed a significant negative effect on oil and gas output, in Nigeria. The response of the oil and gas sector output to a foreign exchange rate movement showed that the oil and gas sector does not exhibit strong short-term sensitivity to foreign exchange rate movement. Base on this, it is recommended that the Nigerian government should adopt policies aimed at stabilizing the foreign exchange rate to reduce the fluctuations that harms the oil and gas sector of the economy. This could be tackled by creating a more diversified foreign exchange market to reduce dependency on oil revenues.

Keywords: *Foreign Exchange Rate Movement, Oil and Gas Sector, ARDL Co-integration*

1.0 INTRODUCTION

The oil and gas sector remain the backbone of Nigeria's economy, serving as the primary source of government revenue, foreign exchange earnings, and industrial energy supply. The sector's output, measured through crude oil production, natural gas extraction, and refining activities, has a direct bearing on national income, employment, and fiscal stability (Ozigbo et al., 2025). Despite its centrality, oil and gas production in Nigeria has fluctuated over time, often falling short of OPEC quotas and government targets due to infrastructural constraints, policy inconsistencies, insecurity, and financial pressures (Dada et al., 2022; Olayungbo, 2019). Among these variables, exchange rate instability has emerged as a key macroeconomic factor influencing both production performance and investment outcomes in the industry.

Bahmani-Oskooee and Gelan (2018) see exchange rate as a vital and fundamental indicator for measuring the performance of an economy. In the submission made by Emmanuel (2019), one of the most macroeconomic variables that determines countries total reserves and also constitutes weapons employed by monetary authorities for economic stabilization is exchange rate. When currency of a country interplays with another currency and traded at the international market (the

US dollar) such situation is referred to as exchange rate (Onyebuchi & Chiawolam, 2019). Exchange rate is the rate at which currency changes with other currencies. This rate determines the strength of one country in relation to the other. Since no nation is self-sufficient as a result of differences in the natural endowments, calls for their involvement in international trade which will involve the interplay of currencies among nations become necessary. Therefore, exchange rate stability becomes vital to ensure favourable term of trade.

Foreign exchange rate movements play a critical role in shaping oil and gas sector performance. Since crude oil and gas are globally priced in U.S. dollars, any change in the naira-to-dollar exchange rate directly affects the domestic valuation of export earnings and budgetary revenues. Exchange rate depreciation increases naira-denominated earnings from oil exports but simultaneously raises the cost of imported machinery, equipment, and technical services needed for exploration and production (Anthony et al., 2025). Conversely, exchange rate appreciation can lower input costs but reduce the domestic revenue value of oil exports. Moreover, persistent foreign exchange rate movement introduces uncertainty, discourages long-term investment, and constrains the ability of firms to plan operations efficiently (Anthony et al., 2025; Etale & Ochuba, 2019).

As a developing economy, Nigeria's oil and gas sector of the economy remain heavily influenced by fluctuations in exchange rates, as well as other macroeconomic variables such as interest rates, inflation, and the balance of payments. These variables directly impact production costs, competitiveness, and investment decisions within the sectors, consequently affecting overall economic growth and development (Olawale, 2024; Ozigbo et al., 2025). Interest rates and inflation further compound the situation. High interest rates tend to reduce private sector investment by increasing the cost of borrowing, thus hampering growth in key sectors. Similarly, inflation erodes purchasing power, leading to reduced consumer demand and higher input costs, negatively impacting oil and gas sector of the economy. A favorable balance of payments, on the other hand, can strengthen the naira and help stabilize exchange rates, providing a more predictable environment for businesses (Omolola et al., 2023; Ekpo, 2023).

Nigeria’s oil and gas sector remains highly vulnerable to foreign-exchange rate movement and foreign exchange rate market distortions. This is because crude and gas revenues are largely dollar-denominated while many sectoral costs and domestic obligations are in naira, persistent exchange-rate instability translates into uncertain real revenues, distorted budgeting, impaired investment planning, and episodic operational disruptions. This structural exposure undermines the sector’s capacity to expand production and to deliver predictable fiscal contributions to the national budget (Ozigbo et al., 2025; Takpa et al., 2024). Despite Nigeria’s vast petroleum endowment, oil and gas output has remained unstable, with periodic declines undermining government revenue and export performance (Olayungbo, 2019). One persistent macroeconomic factor driving this instability is exchange rate fluctuation, which affects sectoral costs, investment flows, and fiscal projections. The volatility of the naira, coupled with multiple exchange-rate regimes, has created uncertainty for operators and weakened the sector’s capacity to achieve consistent output growth (Abubakar, 2019; Volkov & Yuhn, 2016; Osigwe, 2015).

Although, quite number of studies exist on exchange rate movements and oil and gas sector output across the countries, and the findings from the empirical reviews have given rise to mixed and conflicting conclusions. It is evident that various standard of econometric methods has been used in most studies. Among the few studies in the literature are; Olayungbo (2019), Volkov and Yuhn (2016), Abubakar (2019), Hussaini et al. (2018) among others. They all found mixed relationship between exchange rate movements on the oil and gas sector growth using different techniques of analysis.

In addition, most literature in this direction focuses on aggregate activities within an economy using gross domestic product (Olawale, 2024; Ekpo, 2023; Adeyemi & Akinbayo, 2019). With this, the extent of variation of exchange rate on components of the economy such as oil and gas are prevented. Since the effects of exchange rate movements on different sectors of the economy are not homogeneous, it becomes essential to study its effect on oil and gas sector in Nigeria. From the aforementioned problems, this study therefore examined the effect of foreign exchange rate movements on oil and gas sector output in Nigeria.

2.0 LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Exchange Rate Movements

In describing movements in exchange rate, the Central Bank of Nigeria (2016) explained that the existence of large swings of exchange rate for reasonable number of times can be known as exchange rate movements. It changes more often ranging from minute, hours, days, or beyond under a floating exchange rate. Thus, movements in exchange rate are the frequency or the rate at which prices of foreign exchange rate change over a given period. The extent or degree to which it changes determines exchange rate movements (ups or down). Unexpected movements in exchange rate which is often described as volatility in exchange rate leads to panic in the market where foreign exchange rate take place because the parties involved in the exchange transaction are unclear of what the situation might be in the market (Onuorah & Osuji, 2014).

The movements in exchange rate in a country depends on the stand of the monetary policy geared toward macroeconomic improvement. Onyebuchi and Chiawolam (2019) observed that exchange rate serves as a policy tool employed to direct the economy. Therefore, irrespective of the prevailing exchange rate (fixed or flexible) practiced in a country, the fundamental macroeconomic variables such as export, price level, import, interest rate, agricultural output and output from other sectors are affected by it. Exchange rate also occupies price policy position as it has a direct link with the current account balance of the economy. This places exchange rate as the determinant of resource allocation between tradable and non-tradable sectors and also act as instrument when balance of payment is to be designed. Therefore, movements in exchange rate and its attendant effect on real sectors pose a controversial issue and as such subjected to more empirical investigation in the literature.

2.1.2 Oil and Gas Sector

Oil and gas sector represent the sector of the economy where crude oil is produced and constitutes the leading sector in the economy ever since its discovery. The sector constituted the dominants export for the nation Nigeria and the major earnings for the nation. Olayungbo (2019) noted that it represents about 83.5% of the total volume of export and has therefore represents the propeller of economic growth and development in the country. Fluctuations in its price mostly impact significantly not only on the structure but the general wellbeing of the citizens. As remarked in the work of Dada et al. (2022) that any sneeze in the price of oil affects the whole economy.

The economy of Nigeria largely rests on oil revenue and this has fuel frequent movements in exchange rate of naira vis-a-vis other currency at the international oil market (Abubakar, 2019). As oil constitutes the dominants earnings for the nation, its role in the determination of exchange rate for domestic currency (naira) cannot be relegated to the backseat. As rightly observed in the works of Abubakar (2019), Dada et al. (2022), among others that the effect of shocks in oil price due to ups and down movements in exchange rate depends on the nature of the country's export. Nigeria as she occupied the position of being an exporter of crude oil and importer of refined petroleum products, to make a definitive statement on the effect on the real sectors of the economy is more worrisome.

Regarding the channel through which oil price affects exchange rate, literature documented two opposing views (Abubakar, 2019; Volkov & Yuhn, 2016; Osigwe, 2015). On one hand is the school of thought that believed that this channel is symmetric and therefore employed econometric model that showed that this relationship is linear. On the other hand, is another group of scholars that believed that the channel on which this relationship can be explained is asymmetric as this group employed a non-linear model to explain this relationship. However, Babatunde (2015), Dada et al. (2022) among others explained that the channel through which oil price affects exchange rate can both be symmetric and asymmetric in nature.

2.2 Theoretical Review

2.2.1 Mundell-Fleming IS/LM Theory

The Mundell-Fleming of IS/LM theory developed by Mundell (1961) in conjunction with Mundell-Fleming (1968) served as an extension provided to the traditional ISLM model. The theory described an economy that is open with reference to short-run relationship among nominal exchange rate existing in a country, interest rate coupled with output with an explanation that one major determinant of output is demand existing in the country. According to Emmanuel (2019), three markets constitute the demand side of an economy and they are the money, the goods and the foreign exchange market. The concern of an economy from various angles is how equilibrium can be attained for all these markets. The theory provided a detail understanding on how exchange rate can be determined. Another equilibrium considered in addition to the three-equilibrium pointed out is the balance of international payments.

This theory served as the theory underpinning for this research work as it provides a detail explanation on the relationship between foreign exchange rate movements and the real sector output within a given economy and the causes of short-run movements in aggregate income of an open economy. As brought into lime light by Mundell and Fleming who had strong advocate for stabilization of currencies, explained that the main focus of the theory has been a step-by step analysis of the activities of the international capital mobility in the determination of effectiveness of macroeconomic policies under alternative exchange rate regimes (Emmanuel, 2019). This theory is an extension of the Keynesian theory that introduced the IS-LM. This theory is relevant and significant to this study as it pointed out the three factors: money, the goods and the foreign exchange rate market as the brain behind attaining increase in output of goods and services in a country.

2.3 Empirical Review

Anthony et al. (2025) looked at how the exchange rate affected Nigeria's manufacturing sector's production growth and employment. The study determines both short and long-term associations between the variables using the ARDL model. It was shown that a long-term correlation between the rise of industrial production and the real exchange rate. However, manufacturing production and employment are adversely affected by both inflation and real exchange rate depreciation. On the other hand, over time, production growth is greatly and favourably impacted by the labour force, trade balance, gross fixed capital formation (GFCF), and foreign direct investment (FDI).

Olawale (2024) evaluated how exchange rate volatility affected Nigeria's economic growth, concentrating on the low growth rates associated with the nation's economic structure and inconsistent exchange rate policy. Quantitative data from the CBN from 1960 to 2022 were used in the study. The study finds nonlinear correlations between GDP and important factors, such as imports, exports, inflation, interest rates, and currency rates, by using the Multivariate Adaptive Regression Spline (MARS) approach. According to the results, exchange rate swings have a direct and large impact on GDP, making them the most important factor influencing economic growth. The study also shows that imports, exports, and interest rates all have a reciprocal impact on GDP.

The impact of the real exchange rate on the manufacturing sector in Nigeria between 1999 and 2021 was examined by Takpa et al. (2024). The study employed Vector Autoregressive Estimates to analyse the data and determine how the explanatory variables (exchange rate, FDI, trade openness, and FPI) affected the dependent variable (manufacturing sector). The results of the regression showed that the real exchange rate had no significant effect on the manufacturing sector and that it had a negative effect.

Nwakarame and Awogbemi (2024) used trade balance and foreign direct investment data from 1990–2023 to investigate how foreign exchange volatility affects economic growth. STATA was used in their analysis with the aid of ARDL. The outcome demonstrated a favourable correlation between the GDP growth rate and the exchange rate. However, there is a weak but negative correlation between the GDP growth rate and exchange rate volatility, foreign reserve, and FDI as a percentage of GDP. The GDP growth rate falls by 19%, 426, and 469 percent for every

percentage increase in exchange rate volatility, FDI as a percentage of GDP, and foreign reserves. In particular, it was discovered that both in the short and long terms, foreign exchange volatility (EVAT) had no discernible effect on Nigeria's economic growth, but inflation.

3.0 RESEARCH METHOD

The study used monthly time series data from 2010M01-2024M12. The justification for the period under review is premised upon the fact that to analyze movements in foreign exchange rate necessitate the use of low frequency data and because the low frequency data available for real sectors output begins from 2010. However, the quarterly data for real sector output was also converted to monthly to allow a lower frequency range. In total, 180 observations representing a better period for time series analysis were involved in the study. The variables for the study are real exchange rate movements, oil and gas sector output, interest rate, balance of payment and inflation rate. To obtain real exchange rate movements, the study used first differentiation of the exchange rate. The order of unit root necessitated the use ARDL Co-integration procedure. The use of this method is informed on the ground that the unit root test result for all the variables is of order zero and one of integration. To model, foreign exchange rate movements, ARCH and GARCH were used.

3.1 Model Specification

The study adapted the model of Ufoeze et al., (2018) which investigated the effect of foreign exchange rate fluctuations on Nigerian economy. The model of Ufoeze et al., (2018) is stated as follow:

GDP = *f* (EXR, INFR, MS, OLR,)…..……1

Where:

GDP is Gross Domestic Product, EXR is Exchange rate, INFR is Inflation rate, MS is Money supply,

OLR is Oil revenue and *f* is the functional notation. From the model formulated by Ufoeze et. al (2018), the model for this study is therefore stated as:

$$\text{OGDP} = f\ (\text{ExrMvt}, \text{InfR}, \text{IntR}, \text{BOP}, \text{ExtRsv}) \text{ Model } \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 2$$

Equation 2 is depicted as follows:

$$\text{OGDP} = \beta_0 + \beta_1\text{ExrMvt} + \beta_2\text{InfR} + \beta_3\text{IntR} + \beta_4\text{BOP} + \beta_5\text{ExtRsv} \ldots\ldots\ldots\ldots\ldots 3$$

Where: OGDP is Oil & Gas Contribution to GDP, ExrMvt denotes Exchange Rate Movements, InfR is the Inflation Rate, IntR is Interest Rate, BOP is Balance of Payment, ExtRsv is External Reserves, Ƒ is Functional notation, Δ is Change, $t\text{-}_1$ is each Lagged variable

4.0 RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Table 1 Descriptive Statistics of Variables

Variable	Mean	Std. Dev.	Max	Min	Skew	Kurt
OGDP	3799766	213729.7	4230768	3289150	-0.171	2.680
ExrMvt	0.047756	0.057109	0.465622	0.009593	3.763	21.52
InfR	291.3353	182.5732	867.7917	104.9	1.315	4.042
IntR	15.55635	2.051372	19.05416	11.13	-0.848	2.502
BOP	0.033206	0.10253	0.515212	-0.235	0.789	5.963
ExtRsv	36364.07	5536.148	47903.09	23689.87	0.101	2.513

Source: Researcher's Computation (2025)

The oil and gas sector has a mean output of 3,799,766, which provides a central tendency of output over the observed period. The standard deviation of 213,729.7 is relatively low, suggesting that the oil and gas output is fairly stable. The skewness of -0.171 indicates a slight leftward skew, meaning there may be a few lower values pulling the distribution towards the left. The kurtosis of 2.680 is relatively close to 3, suggesting that the distribution of oil and gas output is close to normal but has a slightly platykurtic distribution (flatter than normal). More so, the mean value of 0.047756 suggests that exchange rate movement is low on average. The standard deviation of 0.057109 shows that exchange rate movements are relatively volatile. The skewness of 3.763 is extremely high, indicating a significant positive skew, where there are some extreme high exchange rate movements, possibly caused by sharp increases in the exchange rate at certain points. The kurtosis of 21.52 is very high, indicating a highly leptokurtic distribution. This suggests that there are many extreme fluctuations or outliers in exchange rate movements, which could have significant economic implications.

4.2 Unit Root Test Analysis

Table 2 Unit Root Test Results

Variable	Augmented Dickey-Fuller (ADF)		Phillips-Perron (PP)		Remark
	@level	@diff	@level	@diff	
ln(OGDP)	-2.555	-4.377***	-3.292*	-7.104***	I(1)
ln(ExrMvt)	-2.658	-11.59***	-2.424	-14.99***	*I*(1)
ln(InfR)	3.984	-5.176***	4.593	-9.194***	*I*(1)
ln(IntR)	0.144	-16.06***	-0.356	-15.79***	*I*(1)
BOP	-6.047***	-	-5.668***	-	*I*(0)
ln(ExtRsv)	-2.658	-11.59***	-2.424	-14.99***	*I*(1)

*** p < 1%, ** p < 5%, * p < 10%

Source: Researcher's Computation (2025)

Presented in Table 2 is the ADF and PP unit root. It was shown that OGDP, ExrMvt, InfR, IntR and BOP were not stationary after observing these variables at level using ADF but became stationary when converting them into first difference. This implied that within the shortest time, the presence of unit root in these variables were removed. Similarly, the outcome of unit root using PP indicated that OGDP,

ExrMvt, InfR, and ExtRsv were only stationary after first difference. Comparing the result of these two test, it was revealed from the remark that the two test show similar remarks for other variables as OGDP, ExrMvt, InfR, IntR and ExtRsv were integrated at order one i.e I(1) and BOP integrated at order zero i.e (I(0).

4.3 Effect of Foreign Exchange Rate Movement on Oil and Gas Sector Output in Nigeria

Table 3 Regression estimate for Foreign Exchange rate Movement AR model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	1.249	0.034	36.96	0.000**
AR(2)	-0.251	0.033	-7.552	0.000***
Constant	6.077	1.008	6.031	0.000***

*** p < 1%, ** p < 5%, * p < 10%

Source: Researcher's Computation (2025)

Table 3 presents the second-order autoregressive i.e., AR(2) model, estimate for foreign exchange rate. The inclusion of the autoregressive terms is to enable the residual to be white noise, i.e., remove traces of autocorrelation from the series. Specifically, the autoregressive terms in the model estimates suggested that the foreign exchange rate movement is highly persistent and influenced by its past values. The coefficient of AR(1) with a value of 1.249 is positive and statistically significant at the 1% level, indicating that a 1-unit increase in the previous period's foreign exchange rate movement leads to a 1.249 unit increase in the current rate. Also, the AR(2) coefficient with a value of -0.251 is negative and also significant at 1%, implying a mean-reverting effect that counteracts the AR(1) momentum after two periods. The constant term (6.077) is significant, suggesting a baseline drift in the foreign exchange rate movement.

Table 4 Heteroskedasticity Test: ARCH

F-statistic	3.239	Prob. F(2,175)	0.0416**
Obs*R-squared	6.353	Prob. Chi-Square(2)	0.0417**

*** p < 1%, ** p < 5%, * p < 10%

Source: Researcher's Computation (2025)

Table 5 Estimates for the GARCH (1, 1) Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	1.108	0.092	12.04	0.000***
AR(2)	-0.180	0.092	-1.957	0.050*
Constant	5.576	0.003	1732.	0.000***
ARCH	0.701	0.108	6.461	0.000***
GARCH	0.299	0.108	2.758	0.006***

*** p < 1%, ** p < 5%, * p < 10%

Source: Researcher's Computation (2025)

The ARCH test result in Table 4 examined, whether volatility clustering exists in the residuals of the estimated AR(2) model. It can be observed that both the F-statistic with a value of 3.239 and a probability value of 0.0416 and the LM test with a value of 6.35 and a probability value of 0.0417 are significant at the 5% level, rejecting the null hypothesis of no ARCH effects. This indicates that foreign exchange rate movement exhibits time-varying patterns, justifying the use of a GARCH model to capture conditional heteroskedasticity. Table 5 presents the GARCH(1,1) model results and the presence of volatility persistence in exchange rate movements, and it can be confirmed. The AR(1) (1.108) and AR(2) (-0.180) coefficients remain significant, though slightly diminished compared to the pure AR(2) model in Table 4.

The ARCH term with a value of 0.701 is significant at 1% level, indicating that past shocks (unexpected changes) strongly affect current movement in foreign exchange rate. The GARCH term with a value of 0.299 is also significant, showing that previous movement in foreign exchange has a persistent but declining impact. The sum of ARCH and GARCH coefficients (0.701 + 0.299 = 1.0) suggests high movement persistence, meaning shocks have long-lasting effects on foreign exchange rate movement. It can thus be inferred that foreign exchange rate movements in Nigeria follow an AR(2) process with significant momentum and mean-reverting behaviour, and its volatility is time-varying, with strong ARCH effects, necessitating a GARCH(1,1) framework.

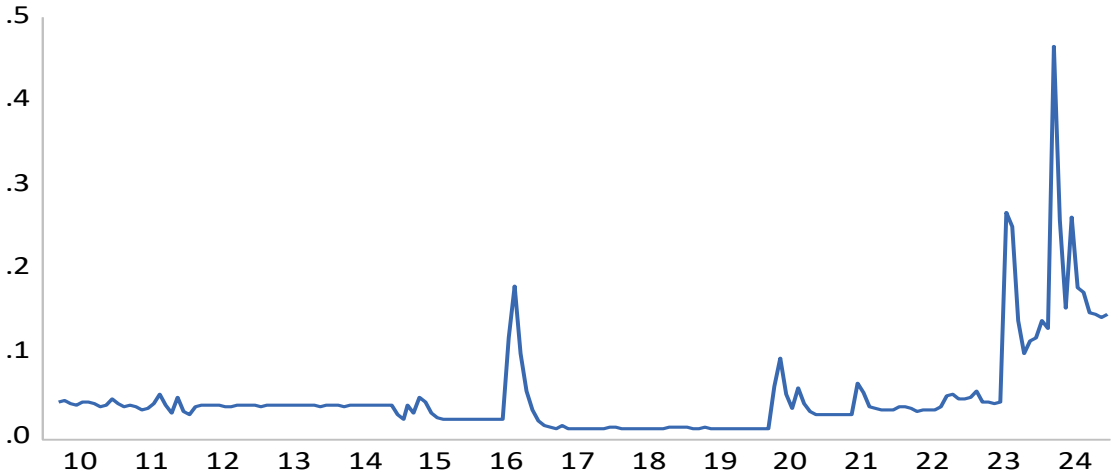

Figure 1: Foreign Exchange rate Movement

Source: Authors' computation from the GARCH (1, 1) model (2025)

Figure 1. depicts the filtered standard deviation series for the foreign exchange rate movement in Nigeria from January 2010 to December 2024. It can be noticed that between 2010 and 2014, the Nigerian foreign exchange market experienced moderate movement, with the standard deviation values oscillating between 0.03 and 0.05. Occasional spikes, such as 0.0513 in August 2011 and 0.0482 in November 2011, suggest temporary pressures, possibly from global oil price fluctuations or domestic fiscal uncertainties. However, from 2012 onwards, there was a noticeable decline in volatility, and by mid-2012 through 2014, it had stabilized around 0.037, indicating a period of relative foreign exchange rate stability, possibly supported by steady oil revenues and a managed exchange rate regime. A further decline in volatility marked the 2015 to mid-2016 period, with the standard deviation falling to 0.0267 in December 2014, and ranging between 0.021 and 0.028 throughout 2015. By the first half of 2016, foreign exchange rate movement reached a low of 0.0211, suggesting a prolonged phase of calm in the foreign exchange market. This subdued volatility could reflect tight capital controls, reduced external shocks, or policy interventions by the CBN aimed at maintaining foreign exchange rate stability.

However, this calm was disrupted in mid-2016, when sharp spikes emerged. Volatility soared from 0.1189 in July 2016 to 0.1805 in August 2016, likely reflecting the liberalisation of the foreign exchange market, collapsing oil prices, or global economic uncertainty following Brexit. Similarly, in April to May 2020, volatility jumped from 0.0614 to 0.0935, aligning with the initial economic fallout of the COVID-19 pandemic, which disrupted global trade, reduced oil demand, and strained Nigeria's foreign reserves. Another intense period of foreign exchange rate instability occurred in mid-2023 through early 2024, with the standard deviation reaching 0.2681 in July 2023, 0.2504 in August 2023, and peaking at 0.4656 in March 2024. These episodes suggest heightened macroeconomic uncertainty, potentially driven by geopolitical conflicts, global inflationary shocks, or domestic policy shifts such as fuel subsidy removals or multiple exchange rate unification attempts. Following these shock episodes, the data reveal a trend of post-crisis adjustment, where volatility subsides but often remains elevated relative to pre-shock levels.

For instance, post-2020, the volatility floor appears to have risen to around 0.03–0.05, compared to the sub-0.03 levels seen before 2016. The persistent high volatility observed in 2023–2024 reflects ongoing structural challenges in Nigeria's economy, including inflation, foreign exchange shortages, and investor uncertainty.

4.4 Lag Length Selection

Table 6 Akaike Model Selection Criteria Table for ARDL Models

Model	Specification
DV: ln(OGDP) IV: ln(ExrMvt), ln(InfR), ln(IntR), BOP, ln(ExtRsv)	ARDL (4,0,1,3,0,0)

Source: Author's Computation, 2025

Reported in Table 6 is the best lag structure suitable for the model as suggested by Akaike model selection criteria. It uses the natural logarithm of OGDP (ln(OGDP)) as dependent variable while its independent variables remain as exchange rate movement (In(ExrMvt)), inflation rate (ln(InfR)), interest rate (ln(IntR)), Balance of payment (BOP), and external reserve (ln(EvtRsv)), the AIC has suggested an ARDL (4,0,1,3,0,0) specification. This connotes that the model includes four lags of the dependent variable (ln(OGDP)), indicating that current OGDP is influenced by its values from the previous four periods. Interest rate has lag three, indicating that current value of interest rate is induced by its three lags. On the other hand, inflation suggested only one lag while balance of payment and external reserve can only be influenced by their current values. The differences in lag structures between the three models reflect the varying dynamics of the included variables, and the specified models are used in the cointegration test that follows.

4.5 Cointegration Test Analysis

Table 7 ARDL Bound Test Results Summary

	Model	F-stat	t-stat		Critical value
1	DV: ln(OGDP)	33.73***	-	I(0)	*I(1)*
	IV: ln(ExrMvt), ln(InfR), ln(IntR), BOP, ln(ExtRsv)		14.19***		
				2.620	3.790

Source: Author's Computation, 2025

Presented in Table 7, is the bound test results for each Autoregressive Distributed Lag (ARDL) model, as selected by the Akaike Information Criterion (AIC). The outcome of this test supports a valid long-run cointegration relationship between OGDP as dependent variable, it was also evident that stable long-run between (In(OGDP)) and other variables: ln(ExrMvt), ln(InfR), ln(IntR), BOP, ln(ExtRsv) as its F-statistics of 8.198 exceeded 3.120 and 4.250 lower and upper bounds test respectively. These results imply that while short-term shocks may cause deviations, AGDP, MGDP and OGDP, these variables eventually return to equilibrium.

4.6 Regression Result

Table 8 Estimates for Foreign Exchange rate Movement on Oil and Gas Output in Nigeria

Variables	Coeff.	St. Err	T-stat.	Prob.
Long-run Estimates				
$\ln(\mathrm{ExrMvt_t})$	0.033	0.019	1.779	0.077*
$\ln(\mathrm{InfR_t})$	-0.440	0.161	-2.728	0.007***
$\ln(\mathrm{IntR_t})$	0.235	0.081	2.886	0.004***
$\mathrm{BOT_t}$	0.147	0.112	1.310	0.192
$\ln(\mathrm{ExtRsv_t})$	0.143	0.061	2.333	0.021**
Short-run Estimates				
$\Delta\ln(\mathrm{OGDP_{t-1}})$	0.645	0.067	9.672	0.000***
$\Delta\ln(\mathrm{OGDP_{t-2}})$	-0.199	0.070	-2.850	0.005***
$\Delta\ln(\mathrm{ExrMvt_t})$	-0.002	0.004	-0.595	0.552
$\Delta\ln(\mathrm{InfR_t})$	-0.063	0.026	-2.423	0.017**

$\Delta\ln(\text{IntR}_t)$	0.034	0.013	2.629	0.009***
$\Delta(\text{BOT}_t)$	0.053	0.026	2.072	0.040**
$\Delta(\text{BOT}_{t-1})$	-0.062	0.027	-2.346	0.020**
$\Delta\ln(\text{ExtRsv}_t)$	0.021	0.009	2.342	0.020**
Constant	2.177	0.384	5.674	0.000***
Trend	0.001	0.000	5.437	0.000***
Adjustment coefficient				
ECT_{t-1}	-0.144	0.025	-5.669	0.000***
Adj. R2	0.414			
LM-Test	45.95			0.402
ARCH Test	2.568			0.109

Source: Authors' computation, 2025

Note: *** p < 1%, ** p < 5%, * p < 10%

Table 8 is the outcome of regression analysis (short and long-run) conducted on the examination of foreign exchange rate movement on oil and gas output in Nigeria. In the short-run, it was revealed that the coefficient of previous one year period of oil and gas output is significant and directly induced the current value of oil and gas to the tune of 0.645 unit. The positive coefficient indicates that past oil and gas output strongly influences current oil and gas output. That is a 1% increase in past output leads to a 0.645% increase in current output. Contrarily, its previous two-year periods came out to be negative but also significant with a value of -0.199 unit. This connotes that a 1% unit rise in past two-years period of oil and output results in 0.199% reduction in current value of oil and gas output.

Foreign exchange rate movement depicts an insignificant negative effect on oil and gas output. The connotes that foreign exchange rate movement does not have a significant short-run effect on oil and gas output, indicating that foreign exchange rate movement in the short term may not immediately impact oil and gas production levels. The coefficient of inflation rate is significant but negatively induced oil and gas output to the tune of -0.063 unit. The negative coefficient suggests that in the short run, inflation negatively impacts oil and gas output. A 1% increase in inflation results in a 0.063% decrease in oil and gas output. Similarly, the coefficients of interest rate, balance of payment in its previous year and external reserve are 0.034, 0.053 and 0.021 units respectively. The positive effect of interest rates, balance of payment in its current year and external reserve in the short run suggest that higher interest rates, balance of payment in its current year and external reserve are associated with an increase in oil and gas output. A 1% increase in interest rates, balance of payment in its current year and external reserve leads to a 0.034%, 0.053% and 0.021 respective increase in oil and gas output. Contrarily, balance of payment in its previous year has a significant but negative effect on oil and gas output to the tune of -0.062 unit. The result implied that a unit increase in previous year period of BOP results in a decrease in oil and gas output to the tune of 0.062%.

The long-run result on the analysis of foreign exchange rate movement on oil and gas output also revealed that foreign exchange rate movement has an insignificant positive effect on oil and gas output to the tune

of 0.033 unit. This result indicated that foreign exchange rate movement in the long-run has no influence on oil and gas output. The coefficient of inflation rate is significant but negatively induced oil and gas output to the tune of -0.440 unit. It connotes that a unit rise in inflation leads to a decrease in oil and gas output to the tune of 0.440%. Interest rate and external reserve on the other hand have a significant positive effect on oil and gas output to the tune of 0.235 and 0.143 units respectively. The result connotes that as interest rate and external reserve increase by a unit result in 0.235 and 0.143 respective unit increase in oil and gas output. The effect of balance of payment on oil and gas in the long-run is not significant with a coefficient of 0.147 unit.

The coefficient of the ECM is rightly signed and significant. The negative and significant coefficient indicates that any short-term deviations from the long-term equilibrium in oil and gas output are corrected at a rate of 14.4% per period. This adjustment suggests that the oil and gas sector is relatively resilient and can return to equilibrium after temporary shocks or deviations, contributing to stability in the sector. Adj. R^2 of 0.414 suggests that the model explains about 41.4% of the variation in oil and gas output. This indicates that the model is moderately effective, though additional factors may influence the oil and gas sector that are not captured by the model. The LM-Test of 45.95, and Prob. of 0.402 indicate no autocorrelation in the residuals of the model, suggesting that the error terms are not correlated over time. This means that the model is well-specified and that the residuals do not exhibit patterns that would undermine the reliability of the estimates. Finally, the ARCH Test of 2.568, and Prob. of 0.109 (p-value > 0.05) means that the variability of the error terms is stable over time. This implied that the model does not exhibit significant changes in volatility, suggesting that the estimates are stable, and the model can reliably predict oil and gas output.

4.7 The responsiveness of oil & gas sectors to foreign exchange rate movements in Nigeria

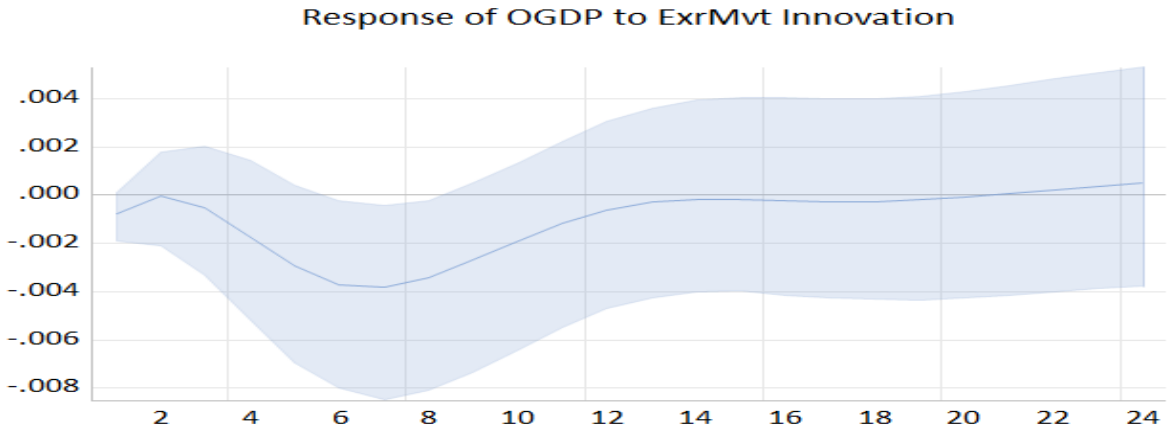

Figure 2 Responsiveness of Oil and gas Output to Foreign Exchange rate Movement

Figure 2 illustrates the impulse response of oil and gas sector output in Nigeria to a foreign exchange rate movement shock. Initially, the shock results in a modest decline of approximately

0.008% in the oil and gas sector output below the steady state. However, this immediate impact is not statistically significant, indicating that the oil and gas sector does not exhibit strong short-term sensitivity to foreign exchange rate movement. This could be due to the dominance of long-term contracts and dollar-denominated transactions in the sector, which typically cushion immediate shocks in the official exchange rate. Interestingly, a statistically significant negative response emerges between the 5th and 9th periods, during which output declines by an average of 0.003% below the steady-state level. This delayed effect reflects the sector's sensitivity to medium-term exchange rate adjustments, which may influence investment inflows, procurement cycles for oilfield equipment, and offshore service contracts. In the Nigerian context, where the oil and gas sector is heavily reliant on imported capital goods and technical expertise, fluctuations in the naira can affect the cost structure and profitability of operations over time.

Furthermore, since the sector is the primary source of Nigeria's foreign exchange earnings, volatility in the exchange rate can also influence government budgetary allocations and investment planning, especially under a regime of oil price instability. The long-run insignificance of the shock, however, suggests that the sector eventually adjusts to exchange rate disturbances, possibly due to hedging strategies, fiscal buffers, or global oil price dynamics that override local currency effects.

4.8 Discussion and Implication of Findings

It was revealed that foreign exchange rate movements exhibited a significant effect on oil and gas sector output. This suggests that a depreciation of the local currency (naira) can have a positive effect on oil and gas output in the long run. This may occur because a weaker domestic currency makes Nigeria's oil and gas exports cheaper and more competitive in global markets, which could increase demand for Nigerian oil and gas. However, the positive effect is marginal, implying that the oil and gas sector is somewhat insulated from foreign exchange rate movement in the long run due to its global market pricing in US dollars. The positive relationship negates the works of Ozigbo et al. (2025), Ozigbo et al. (2025), Nwakarame and Awogbemi (2024) among others. Similarly, inflation rate has a significant negative effect on oil and gas output. This result suggests that higher inflation raises production costs in the oil and gas sector, such as for labour, equipment, raw materials and logistics thereby making production more expensive. Additionally, inflation erodes the value of the local currency, reducing the sector's profitability and discouraging long-term investments. The negative effect of inflation on oil and gas output is corroborated with the works of Omolola et al. (2023), Ekpo (2023), Adeyemi and Akinbayo (2019), among others but negates the discovery made by Gatawa and Mahmud (2017).

Interest rate has a significant positive effect on oil and gas sector output. The suggests that higher interest rates could signal economic stability, which encourages investments in the oil and gas sector. In practice, higher interest rates could reflect a stable economic environment and may encourage oil companies to invest in capital-intensive projects, such as exploration, extraction, and upgrading infrastructure. However, excessive interest rates could eventually reduce the sector's ability to access affordable financing, thereby limiting future growth. This goes with the findings

of Nwakarame and Awogbemi (2024), Onyebuchi and Chiawolam (2019), Bahmani-Oskooee and Gelan (2018) works.

The coefficient of balance of payment is positive but not significant in explaining oil and gas output. The implication is that balance of trade (BOT) does not have a statistically significant impact on oil and gas output in the long run, as indicated by the p-value greater than 0.05. This result suggests that, while a positive balance of trade (trade surplus) may imply greater foreign exchange reserves and a favorable economic environment, it does not have a direct and strong effect on the oil and gas sector's output in the long run. The oil and gas sector's performance are likely influenced more by factors such as global oil prices, domestic production capabilities and policy support through the overall trade balance. This result is supported by Ozigbo et al. (2025), Olawale (2024), Nwakarame and Awogbemi (2024) works but negates the findings of Emmanuel (2019), Onyebuchi and Chiawolam (2019) among others.

External reserve is positive and significant in explaining oil and gas output. The result implied that the growth in external reserves is often seen as an indicator of economic stability and investor confidence. A healthy reserve position allows for a stable currency, which is critical for the importation of necessary equipment and technology for the oil and gas sector. Moreover, it helps mitigate risks from external shocks, such as changes in global oil prices or geopolitical events, making it easier for oil companies to maintain operations and investments. This result is consistent with the apriori expectation and also supported by Ozigbo et al. (2025), Omolola et al. (2023), Gatawa and Mahmud (2017) works.

5.0 CONCLUSION AND RECOMMENDATIONS

The study aimed at investigating the effect of foreign exchange rate movements on the oil and gas sector output in Nigeria. To capture movement in exchange rate, monthly time series data ranging from 2010M01-2024M12 were employed in the analysis. From the analysis, it was concluded that interest rate and external reserve exhibited a significant positive effect on oil and gas output, inflation rate is significant but induces oil and gas negatively, while foreign exchange rate movement, and balance of payment exhibited an insignificant positive effect on oil and gas output in the long-run. The response of oil and gas sector output to a foreign exchange rate movement shock showed that the oil and gas sector does not exhibit strong short-term sensitivity to foreign exchange rate movement. Based on this, it was recommended that the Nigerian government should adopt policies aimed at stabilizing the foreign exchange rate to reduce the fluctuations that harms the oil and gas sector. This could be tackled by strengthening fiscal and monetary policies, improving the management of foreign exchange reserves, and creating a more diversified foreign exchange market to reduce dependency on oil revenue. These measures will go a long way in creating a more predictable foreign exchange rate environment for businesses which will ultimately boost real sectors of Nigerian economy.

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