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RESEARCH ARTICLE

TRIPARTITE RELATIONSHIP BETWEEN EXCHANGE RATE ON OIL PRICE VOLATILITY AND ECONOMIC GROWTH IN NIGERIA

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ABSTRACT

Because of its firm reliance on oil exports, Nigeria, a major oil-producing nation, has seen considerable economic volatility. The exchange rates and the volatility of oil prices significantly impact the country's macroeconomic stability, growth, and development. Nigeria's economy mainly depends on oil exports, which provide 70% of government revenue and more than 90% of foreign exchange revenues. On the other hand, because of shifts in monetary policy, capital flows, and oil prices, the Nigerian Naira (NGN) has seen considerable volatility against major currencies, especially the US Dollar (USD). As a result, the GDP grew at erratic rates, impacted by changes in the price of oil, ranging from -1.6% in 2016 to 3.1% in 2022 (CBN, 2023). The main subject of this study is the relationship between Nigeria's GDP growth, exchange rates, and oil price volatility. In particular, the contribution of currency rate and oil price volatility to the engineering and maintenance of Nigeria's economic growth was investigated. The study also looks at how the exchange rate affects Nigeria's economic development and how the volatility of the oil price affects that growth. The period of 40 years (1984–2023) was chosen for empirical investigation. The information was gathered from the Nigeria Bureau of Statistics (NBS; 2023), journals, the Central Bank of Nigeria Statistical Bulletin (CBN; 2023), and World Bank statistics. These data sources are thought to be highly trustworthy and dependable.

KEYWORDS

Exchange rate, oil price volatility, economic growth, ARDL, Nigeria

1. INTRODUCTION


The exchange rate is a crucial macroeconomic factor influencing a nation's economy. It represents the rate at which one currency can be exchanged for another, directly impacting international competitiveness. Exchange rate fluctuations significantly affect economic growth in open economies, especially when the demand for foreign currency exceeds supply (Adewuyi and Akpokodje, 2013; Alagidede and Ibrahim, 2017; Schnabl, 2009). In Nigeria, where more than 78% of foreign revenue is derived from crude oil exports, fluctuations in oil prices profoundly influence the economy. However, the country relies on technology imports, raw materials, and essential goods to sustain growth. This reliance and inadequate foreign revenues have led to frequent currency volatility. Nigeria has experienced persistent exchange rate volatility, macroeconomic instability, and sluggish economic development. Emerging markets like Nigeria prioritize exchange rate stability to minimize costs and risks in foreign transactions (Jacob and Umoh, 2017). Scholars have examined the relationship between crude oil prices and exchange rates, considering the impact of oil price fluctuations on the domestic currencies of exporting nations.

Before 1986, Nigeria operated a fixed exchange rate policy, pegging the Naira to the British pound and the US dollar. Between 1970 and 1985, the Naira's exchange rate remained below one Naira per dollar despite fluctuations in crude oil prices. In 1970, the official exchange rate was 0.714 kobo to the dollar, with an average crude oil price of \$1.21 per barrel. Oil prices rose gradually between 1971 and 1973, reaching \$2.7 per barrel in 1973, while the Naira's value remained relatively stable at around 0.658 kobo. By 1974, oil prices surged to \$11 per barrel, and the

Naira appreciated 0.630 kobo (Jacob, 2018a). In subsequent years, oil prices fluctuated; for instance, in 1975, oil prices dropped to \$10 per barrel, while the Naira appreciated 0.616 kobo. Oil prices increased to \$35.52 per barrel in 1980, then declined to \$27.01 per barrel by 1985. During this period, the Naira depreciated from 0.618 kobo in 1981 to 0.894 kobo in 1984. By 1985, the Nigerian Naira was valued at ₦0.60/USD due to a strong US dollar and declining oil prices (World Bank statistics, OPEC, 1985).

The Structural Adjustment Program (SAP) introduced in 1986 transitioned Nigeria to a floating exchange rate regime. This policy aimed to achieve a realistic exchange rate, curb excessive import expenditure, and stimulate GDP growth. Despite this shift, Nigeria's economy continued to experience volatility due to global oil market fluctuations and internal economic challenges (Jacob and Umoh, 2018). In 1990, oil prices rose to \$23.96 per barrel due to the Gulf War, leading to an exchange rate depreciation of ₦2.50/USD. The Asian financial crisis 1998 resulted in a 40% drop in oil prices, further depreciating the Naira to ₦120/USD. Oil prices increased in the early 2000s, reaching \$28.50 per barrel, with the Naira valued at ₦110/USD. However, geopolitical events and market disruptions in 2005 pushed oil prices to over \$50.64 per barrel, causing further depreciation of the Naira.

The 2008 global financial crisis caused a significant drop in oil prices to \$79.48 per barrel, with the exchange rate devaluing to ₦150/USD. The shale oil revolution of 2015 led to a 70% drop in oil prices to \$48.66 per barrel, depreciating the Naira to ₦200/USD. The COVID-19 pandemic 2020 resulted in a 40% decline in oil prices to \$41.84 per barrel, further depreciating the Naira to ₦380/USD. In 2023, geopolitical tensions and

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supply chain disruptions caused oil prices to rise to \$83.45 per barrel, with the exchange rate depreciating to ₦420/USD (World Bank data, OPEC, CBN, 2023). The interplay between exchange rates and oil prices illustrates their strong correlation, with fluctuations in one often influencing the other. Nigeria's dependence on oil revenue makes the economy vulnerable to global oil price volatility (Jacob, 2018b). Despite policy measures like the SAP, exchange rate volatility persists due to external shocks and internal economic weaknesses.

Nigeria's macroeconomic indicators have shown concerning trends. The GDP growth rate declined from 25% in 1970, when the Naira was valued at N0.7/USD, to 5% in 2000, with the Naira at N101.7/USD, and further to 2% in 2018, when the Naira depreciated to N363.5/USD. Unemployment rates have also risen, reaching 27.1% in 2020, with over 21.7 million Nigerians unemployed (Ayoola, 2013; Yusuf, 2015). Despite significant oil revenues, Nigeria's economy remains stagnant, with a growing portion of the population living in poverty (Okonjo-Iweala and Osafo-Kwaako, 2007).

Nigeria's reliance on oil exposes the economy to volatility, as oil price fluctuations impact macroeconomic stability. Countries dependent on oil export revenues are particularly vulnerable to negative volatility, affecting economic growth. One of Africa's largest oil producers, Nigeria faces challenges in managing the interplay between exchange rates and oil price volatility. The irony of importing refined petroleum while exporting crude oil adds complexity to the situation (Jacob and Umoh, 2019).

While studies have explored the relationship between oil prices and economic growth, fewer studies have specifically examined the impact of exchange rate volatility and oil price fluctuations on Nigeria's economic growth (Udo et al., 2023). This study aims to fill this gap by investigating the connections between exchange rates, oil price volatility, and economic growth indicators to inform policymakers and foster financial stability and growth.

2. CONCEPTUAL, LITERATURE AND THEORETICAL FRAMEWORK

2.1 Conceptual literature

Oil price volatility (OPV) is the standard deviation of oil prices in a given period, while an oil price shock manifests extreme volatility (Ebele, 2015). For this study, which focuses on oil price volatility as opposed to shocks, it is reasonable to understand the distinction between both measures in terms of price deviation size. Acute deviations in oil prices, such as those seen in early 2008, are termed shocks, while relatively minor price deviations are referred to as price volatility (Ebrahim et al., 2014). According to a study oil price volatility refers to instability, changes, or a rise or fall in the supply or demand side of oil prices in the international oil market (Donwa et al., 2015). The rise or flux in oil prices can be termed positive (i.e. a rise) or negative (i.e. a fall).

An economy's growth is measured by the change in the volume of its output or the real incomes of its residents (World Bank, 2006). Economic growth is the continuous expansion of an economy's productive potential; it means that the capacity utilization to produce goods and services and to meet the wants of the populace is increased. Apart from the productive expansion in the goods market, it also refers to a situation whereby improvements in the quality and quantity of resources (including technological improvements) contribute to the overall growth in the actual domestic output of an economy (Jacob et al., 2019a). The measurement of economic growth could be in either real or nominal terms; real growth implies that inflationary and exchange rate adjustments have been considered. Nevertheless, macroeconomic output is generally measured by Gross Domestic Product (GDP) or other national accounts.

2.2 Theories of oil price

The discovery of substantial oil and gas deposits in the 1960s led to a downturn in the growth of non-oil sectors of the Dutch economy, marking the onset of Dutch disease. The term describes a paradox where a country's non-oil sector revenue declines due to a large influx of foreign exchange from resource exploration (such as crude oil). The Dutch Disease concept was first tested by in Australia, an open economy with two sectors—tradable and non-tradable (Corden and Neary, 1982). Their analysis revealed two significant effects: resource movement and spending. The resource movement effect indicated that growth in the tradable goods sector attracted resources from the non-tradable sector, reducing its output. Conversely, the spending effect demonstrated that government expenditures and investments were redirected to the tradable booming industry, leading to currency appreciation (Neary and Van Wijnbergen, 1986).

The symmetric relationship theory of oil prices and economic growth posits that positive and negative oil price shocks have similar effects on economic growth. Pioneers of this theory, a group researcher argued that oil price fluctuations directly impact economic development (Hamilton, 2003; Gisser and Goodwin, 1986; Hooker, 1996). Their research, based on oil market events from 1948 to 1972, concluded that oil price changes significantly influence national output, affecting both oil-producing and importing countries. Mork, a key proponent, examined the asymmetric impact of oil price fluctuations on U.S. GDP (Mork, 1989). The asymmetry relationship theory asserts that positive and negative oil price shocks affect economic growth differently. Proponents argue that declining oil prices have minimal effects on real GDP while rising prices significantly hinder economic activity. Studies have shown that increasing oil prices negatively impact economic activity, whereas falling prices have little influence on the real GDP of the U.S. and other OECD 14 countries.

2.3 Theories of economic growth

Adam Smith developed the Classical Growth Theory during the 18th and 19th centuries. It posits that economic growth will decelerate as a nation's population grows and resources become scarce. Classical economists believed that a temporary increase in real GDP per capita would lead to a population explosion, ultimately depleting resources and stagnating economic growth. However, the Classical Growth Model has limitations, including a lack of technological consideration and inaccuracies in wage calculations (Jacob et al., 2019b). The Neoclassical Growth Theory emerged to address these shortcomings, emphasizing the interaction of labour, capital, and technology in driving economic growth. Key contributors to this school include Alfred Marshall (1842-1924), Carl Menger (1840-1921), Friedrich von Wieser (1851-1926), Leon Walras (1834-1910), John Bates Clark (1847-1938), William Stanley Jevons (1835-1882), and Irving Fisher (1867-1947). The Solow-Swan model is a widely used version of the Neoclassical Growth Model.

This theory asserts that technological advancements play a crucial role in economic performance. It identifies investment, labour force, and technological progress as fundamental to growth. The theory distinguishes short-term and long-term equilibrium, emphasizing that long-term growth depends on capital accumulation and labour utilization. It also highlights how technology enhances labour productivity, improving overall output (Umoh and Jacob, 2020). In contrast, the Endogenous Growth Theory, developed by Paul Romer in 1986, argues that economic growth is generated internally through endogenous factors rather than external technological changes. This theory challenges the Neoclassical perspective, advocating for government intervention in fostering innovation and human capital development. Endogenous growth models suggest that factors such as education, research, and innovation drive long-term growth, making technological progress an outcome of economic activity rather than an external force. Despite its insights, the Endogenous Growth Theory has been criticized for failing to explain global poverty and significant disparities in living standards among nations (Parente, 1999).

2.4 Empirical Literature

The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model and the system the generalized Method of Moments (GMM) technique was used in a study to analyze time series data from January 1980 to December 2017 (Ehikioya's, 2019). The estimations' findings prove that exchange rate volatility endures over the study and significantly hinders Nigeria's economic expansion. A group researcher assessed how the volatility of crude oil prices affected Nigeria's economy and national income between 1995 and 2017 (Adegbebi et al., 2019). Oil price volatility has a negative and negligible combined influence on gross national product, gross domestic product, and per capita income, according to research using both descriptive and inferential (regression) data. To protect the budgetary system and national income, they advised Nigeria to implement policies that would deal with adverse shocks to the price of oil (Udo and Jacob, 2021).

Sunday used co-integration and error correction modelling to examine the relationship between Nigeria's infrastructure progress and oil price volatility from 1981 to 2016 (Sunday, 2019). The findings imply that while the value of the real exchange rate tends to stimulate infrastructure investment, the volatility of the oil price and the inflation rate tend to have a detrimental effect on the expansion of infrastructure. Accordingly, the study aims to close this gap by examining how crude oil prices and exchange rates affect Nigeria's economic growth (Jacob et al., 2021). The macroeconomic effects of an exogenous oil price shock in Nigeria were examined by some researchers using generalized autoregressive conditional heteroscedasticity (GARCH), component generalized autoregressive conditional heteroscedasticity (CGARCH), and exponential

generalized autoregressive conditional heteroscedasticity (EGARCH) (Angela et al., 2018). They found that oil price volatility significantly improves the exchange rate, foreign external reserves, government revenue, capital importation, and Nigeria's symmetric and persistent oil price shock (Jacob and Umoh, 2021).

Some researcher investigated how oil prices affected Nigeria's economic expansion between 1980 and 2016 (Charles and Oguntade, 2018). The analysis found a long-term association between the variables and a positive and substantial correlation between changes in oil prices and economic growth after using the ordinary least squares (OLS) approach. Roland examined how Nigeria's economic growth was affected by premium motor spirit, gross domestic investment, labour employment, and lending interest rates between 1970 and 2013 (Roland, 2017). Premium motor spirit and interest rate lags negatively and substantially influence economic growth. In contrast, gross domestic investment and labour employment lags indicated a positive and significant impact on economic growth, according to the results of the error correction model. They suggest that the government should lower the cost of premium motor spirit pumps by deregulating the market and permitting private sector involvement.

Al-manganese examines how Iraq's economic activity levels were affected by fluctuations in the price of crude oil between 2003 and 2015 (Al-manganese, 2017). The results of the multivariate autoregressive regression (VAR) model showed that the volatility of the price of crude oil had a highly significant effect on Iraq's gross domestic product. Similarly, some researchers used the system GMM and annual data from 2000 to 2011 to examine how absolute effective exchange rate volatility affected export flows in 106 industrialized and emerging nations (Vieira and MacDonald, 2016). Their empirical analysis shows that exports and exchange rate volatility are negatively correlated.

Abraham examines the effects of crude oil price movement and exchange rate policy on the Nigerian stock market from 2012 to 2015 (Abraham, 2016). After applying the ARDL model, the results indicate that the performance of the Nigerian stock market is positively and strongly correlated with oil prices and that the exchange rate is a valuable tool for mitigating the impact of a fall in the price of crude oil on the stock market. Granger causality test results indicated that the policy measure might not be as effective as anticipated. A group researcher used the autoregressive distributed lag (ARDL) model in a related study to examine the relationship between exchange rate volatility and economic growth in Nigeria between 2003 and 2013 (Isola et al., 2016). The findings show no long-term relationship between the variables.

In a study, they investigate the connection between Nigeria's economic growth and the price of crude oil between 1981 and 2013 (Apere and Ijomah, 2013). Using the vector autoregressive (VAR) model and ordinary least squares (OLS), the VAR model's findings demonstrated that oil price variations significantly affected Nigeria's economic expansion. Although the OLS method's results indicated a positive correlation between oil prices and GDP, a decline in oil prices hurts GDP, and fluctuations in the exchange rate affect both the GDP and the cost of crude oil. They suggested that it was necessary to diversify to make the economy stronger, even in the absence of oil.

A group researcher analyzed the effect of oil prices on the macroeconomic variables from 1990-2015 in Nigeria (Chikwe et al., 2016). Using multiple regression techniques, the results showed that the unemployment rate contributes positively and significantly to crude oil prices. While the interest rate negatively and significantly impacted crude oil prices, the result further revealed that the inflation rate, exchange rate, and actual gross domestic product do not affect crude oil prices.

Some researchers used data from 1986 to 2013 and the OLS approach to examine the link between Nigeria's GDP, imports, exports, inflation, and exchange rate (Apollos et al., 2015). Their study showed a strong positive correlation between GDP and explanatory factors like exports and the exchange rate. Shuaibu examined the effects of exchange rate fluctuations and fluctuating oil prices on Nigeria's economic growth using data from 1981 to 2016 and the ARDL and the NARDL models (Shuaibu, 2020). The results of the NARDL indicate that oil prices have an asymmetric impact on Nigeria's national output, with a short-term direct relationship between volatile oil prices and real GDP and a long-term inverse relationship.

3. RESEARCH DESIGN

This study used a quasi-experimental research design called ex-post facto (after the fact). This is because ex-post facto research designs aim to establish a causal relationship between the independent and dependent

variables. The descriptive technique used descriptive tools to analyze trends in inflation, income distribution, and monetary policy factors in Nigeria, including basic tables, charts, and graphs. The analytical approach estimated the pertinent equations using various econometric techniques within the context of multiple regression modelling.

3.1 Model specification

The neoclassical growth theory, which highlights the importance of labour and capital in the growth process, serves as the theoretical basis for this investigation. It is important to remember that the Cobb-Douglas production function and the neoclassical model share a structural shape. Pagano assumes that the three factors—labour, capital, and output—raise the economic growth rate using an AK version of the endogenous growth model (Pagano, 1993). According to the extended model, the accumulation of human capital brought about by financial openness results in an additional efficiency advantage. To understand the concept, total output is assumed to be a linear function of total capital stock. The form of our baseline neoclassical model is as follows:

$$Y_t = A_t K_t^\alpha L_t^\beta \tag{1}$$

Where; Y = Output, A = Total factor productivity or efficiency parameter, K = Stock of capital, L = Labour force, t = time, α = output elasticity of capital, β = output elasticity of labour

The economy produces a single item that can be invested in or consumed, and the population remains constant (Abang et al., 2024). Additionally, suppose that the capital stock repayment rate is zero and the gross investment is:

$$I_t = K_{t+1} - K_t = K_{t+1} - I_t + K_t \tag{2}$$

It is assumed that there is no government and that this is a closed economy with just one industry. A percentage (1 - α) of saving is lost during the intermediation process and does not go straight to investments if we assume that financial intermediaries route a proportion α of saving, St, to investment. The capital/money market equilibrium condition can therefore be stated as follows:

$$\gamma S_t = I_t \tag{3}$$

Using equations (3.1) and equation (3), the growth rate (g) at time t+1 can be written as:

$$g_{t+1} = \left(\frac{Y_{t+1} - Y_t}{Y_t} \right) = \left(\frac{AK_{t+1} - AK_t}{AK_t} \right) = \frac{K_{t+1}}{K_t - 1} \tag{4}$$

$$g_{t+1} = \left(\frac{I_t + K_t}{K_t - 1} \right) = \left(\frac{I_t}{K_t} \right) = \frac{A I_t}{AK_t} \tag{5}$$

Where g_{t+1} is the growth rate of output at time t+1 and the steady state is defined as

$$K_t = K_{t+1} = K; Y_t = Y_{t+1} = Y; g_t = g_{t+1} = g \tag{6}$$

Substituting equation (4) into (6), the steady state growth rate (g) can be written as follows:

$$g = A \left(\frac{1}{\gamma} \right) = A \gamma s \tag{7}$$

Where s is $\frac{S}{Y}$. Taking the logarithms of equation (8), it can be expressed as:

$$\ln g = \ln A + \ln \gamma + \ln s \tag{8}$$

The growth rate as a linear function of its causes and the channels via which financial openness and foreign trade policies impact growth (A, γ, s) are depicted in equation (8). g_t is equal to y_tα st β (5). where g is the output A is the efficiency parameter or total factor productivity. y = Capital Stock s = Workforce α = capital's output elasticity β = labor's output elasticity in keeping with the neoclassical growth theory's tenets by expanding the framework to include additional factors pertinent to the current investigation. In particular, A is broadened to encompass a combination of variables affecting the volatility of the oil price and the exchange rate that impact Nigeria's economic growth. Consequently,

$$A = f(\text{EXR}, \text{OPV}) \tag{9}$$

Where EXR and OPV represent exchange rate and oil price volatility variables respectively. In this study, the augmented neoclassical model is used. Incorporating equation (9) into (8), transforms (8) into:

$$g_t = \text{EXR}, \text{OPV} K_t^\alpha L_t^\beta \tag{10}$$

The neoclassical model's enhanced version is represented by equation (10). However, since the study focuses on the impact of exchange rate and oil price volatility on Nigeria's economic growth rather than the country's overall output, we alter equation (9) to remove labour and capita and add the actual gross domestic product as our dependent variable, which is shown as follows:

$$RGDP = f(EXR, OPV) \tag{11}$$

The rise of endogenous growth theories and models implies that other endogenous elements, such as macroeconomic policies (inflation, interest rate, etc.), can impact economic growth and further reinforce the framework (e.g., Romer, 1986; Barro, 1991).

Thus equation (11) becomes

$$RGDP = f(EXR, OPV, INF, INT) \tag{12}$$

This study adopts the MPR as a control variable, which is further justified in line with who adopted the MPR as a variable in their model (Olubusoye et al., 2016). Given its implications on economic activities, the increasing spate of fluctuations in the oil price remains a significant challenge to policy-makers anywhere in the world, and monetary policy is one of the tools of economic stabilization frequently employed to correct this (Olubusoye et al., 2016).

$$RGDP = f(EXR, OPV, INF, INT, MPR) \tag{13}$$

Equation 12 can be further expressed econometrically as:

$$RGDP = \alpha_0 + \alpha_1 EXR + \alpha_2 OPV + \alpha_3 INF + \alpha_4 INT + \alpha_5 MPR + \epsilon \tag{14}$$

Equation (14) would be used to address both objective 1 and objective 2 which serve as the joint effect of exchange rate and oil price volatility.

Presenting equation (18) in its log linear form:

$$\ln RGDP = \alpha_0 + \alpha_1 NEXR + \alpha_2 OPV + \alpha_3 INF + \alpha_4 INT + \alpha_5 MPR + \epsilon \tag{15}$$

Where: GDP = Real Gross Domestic Product measured in billion Naira as output, NEXR = Nominal Exchange rate measured (National currency per US dollars), OPV = Oil price Proxy for Oil Price Volatility measured in US dollar per barrel, INF = Inflation rate measured in per centage, INT = Interest rate measured in per centage, MPR = Monetary Policy Rate measured in per centage, $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4,$ and α_5 are parameters to be estimated, t = time dimension, ln = Log, ϵ = Stochastic error term

Log-linearization reduces the computational complexity of macroeconomic models and permits the equations to be calculated simultaneously. As a result, the Granger Causality Test and the Autoregressive Distributed Lags (ARDL) estimate method were chosen for this investigation (Granger, 1969; Pesaran et al., 2001). There was no arch effect to support the use of the widely used Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models to extract crude oil price volatility (OPV) because the data on crude oil prices is annual rather than quarterly or monthly. Instead, the study extracted crude oil price volatility (OPV) using the Autoregressive of Order One [AR (1)] model.

The methodology used by most of researchers is comparable to the AR(1) approach (Obaka et al., 2021; Loayza, and Ranciere, 2006). Shahbaz employed the absolute value of residuals obtained by regressing the dependent variable on its lagged value with the stochastic temporal trend to create volatility (Shahbaz, 2013). $Y_t = \gamma_0 + \gamma_1 Y_{t-1} + \epsilon_t$ is the formula for the short- and long-run models and the generalized ARDL model. The ARDL sometimes called the bound test, is the cointegration test employed in this study to ascertain whether the variables in the model in question have a long-term relationship. At a specific level of importance, two critical values are calculated: the upper critical bound and the lower critical bound.

4. RESULTS AND DISCUSSION

3.1 Exchange Rate and Oil Price Trends

The trend analysis of exchange rate and oil price volatility on economic growth, as depicted in Figure 1, provides insights into the dynamic relationship between these key economic indicators. Exchange rate fluctuations impact trade balances, inflation, and investment flows, while oil price volatility influences production costs, government revenues, and overall economic stability. Over time, periods of exchange rate depreciation or appreciation have shown varying effects on economic growth, depending on the stability of global oil prices (Jacob et al., 2022). Similarly, oil price shocks have historically triggered economic slowdowns or accelerations, reflecting the economy's dependence on oil revenue. The trend analysis highlights correlation patterns, with economic growth responding to shifts in exchange rate and oil price fluctuations. Understanding these trends is crucial for policymakers in designing strategies to mitigate adverse impacts and promote sustainable economic growth. The figure provides a visual representation of these interactions, helping to identify critical periods of volatility and stability.

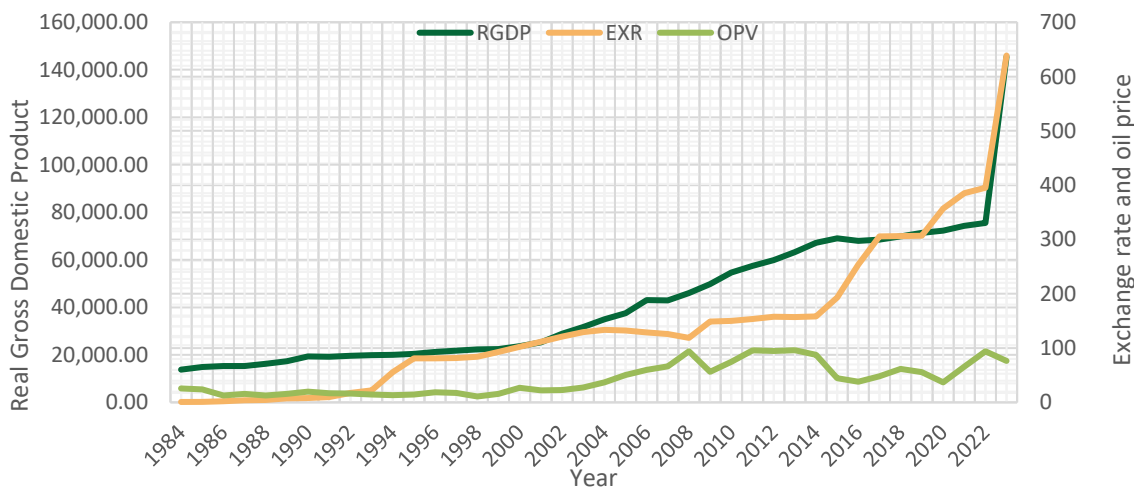


Figure 1: Trend analysis of exchange rate, and oil price volatility on economic growth Source: Author's computation (2024)

4.2 Descriptive Statistics for Key Economic Indicators

The descriptive statistics presented in Table 1 provide an overview of key economic indicators, including Real Gross Domestic Product (RGDP), Exchange Rate (EXR), Oil Price (OPV), Inflation (INF), Interest Rate (INT), and Monetary Policy Rate (MPR), across 40 observations. RGDP has a mean value of 41,988.12, with a relatively high standard deviation of 27,367.51, suggesting significant variation in the GDP values. The skewness of 1.42 indicates a positively skewed distribution, meaning there are occasional extreme values on the higher side (Jacob and Umoh, 2022b). The high kurtosis (5.96) points to a leptokurtic distribution,

suggesting that the data has more frequent extreme deviations from the mean than a normal distribution.

The Exchange Rate (EXR) exhibits a mean of 143.10 with a more significant standard deviation of 136.10, indicating substantial fluctuations over the period under review. The distribution is positively skewed (1.54), and the kurtosis of 5.80 suggests a heavy tail, meaning that the exchange rates tend to have outlier values more frequently than a normal distribution. The Jarque-Bera test (p-value < 0.05) confirms the non-normality of this variable (Jacob and Umoh, 2022a). The mean for Oil Price (OPV) is 42.35, with a relatively high standard deviation of 28.92. The positive skewness (0.66) shows a slight tendency toward higher

values, and the kurtosis of 2.03 indicates a distribution close to normal, albeit with some peak characteristics. Notably, the Jarque-Bera test suggests that OPV is nearly generally distributed with a p-value of 0.11.

Inflation (INF) has a mean of 18.61 and a substantial standard deviation of 16.19, with a skewness of 1.90, suggesting a rightward skew in the data. The kurtosis value 5.67 further indicates that inflation values are more extreme than in a normal distribution. The significant Jarque-Bera statistic (p-value < 0.05) suggests the abnormal distribution. For Interest Rate (INT), the mean is 11.63, with a standard deviation 3.67. The skewness of 1.00 indicates mild rightward skewness, while the kurtosis of 4.16

suggests a distribution with a slightly higher frequency of extreme values. The p-value from the Jarque-Bera test (0.011) indicates non-normality in the distribution.

The Monetary Policy Rate (MPR) shows the highest skewness (2.03), indicating strong rightward skewness. With a mean of 15.23 and a standard deviation of 5.66, the data exhibits substantial variation and heavy tails, as noted in the kurtosis value of 9.92. The significant Jarque-Bera test result (p-value < 0.05) suggests non-normality, further confirming the presence of extreme values in the data.

Table 1: Descriptive statistics						
	RGDP	EXR	OPV	INF	INT	MPR
Mean	41988.12	143.1032	42.35425	18.60513	11.62522	15.23250
Median	33365.00	123.4017	32.16500	12.35000	10.41042	14.00000
Maximum	145515.4	638.7000	95.99000	72.81000	23.24167	39.60000
Minimum	13779.26	0.764900	10.87000	4.670000	5.692500	6.000000
Std. Dev.	27367.51	136.1021	28.91768	16.18858	3.673552	5.663769
Skewness	1.423587	1.538167	0.657108	1.896009	1.003784	2.029979
Kurtosis	5.956581	5.801602	2.032456	5.668234	4.159977	9.915297
Jarque-Bera	28.07963	28.85468	4.438842	35.83146	8.959792	107.1743
Probability	0.000001	0.000001	0.108672	0.000000	0.011335	0.000000
Sum	1679525.	5724.129	1694.170	744.2050	465.0089	609.3000
Sum Sq. Dev.	29232.10	722428.0	32613.05	10220.73	526.3044	1251.053
Observations	40	40	40	40	40	40

Source: Author’s computation (2024)

4.3 Stationarity (Unit root) test

A graph of the variables was created to observe their trends before conducting the stationarity test. The trends of the variables are shown in Figure 2 below. The stationarity (unit root) test results are presented in Table 2—the unit root test aimed to assess the stationarity of the variables. The test was based on the Phillips-Perron and Augmented Dickey-Fuller (ADF) methods. The results in Table 2 indicate that all variables, including the monetary policy rate (MPR) and exchange rate (EXR), were stationary

at the level. This was confirmed because the ADF and PP test statistics exceeded their corresponding critical values at the five per cent significance level. However, the other variables, such as actual gross domestic product (RGDP) and oil price volatility (proxied by oil price), were not stationary, as their ADF and PP test statistics were lower than the critical values at the five per cent level. After performing the first differencing operation on these variables, they became stationary. Therefore, these variables were found to be integrated of mixed orders, I(0) and I(1).

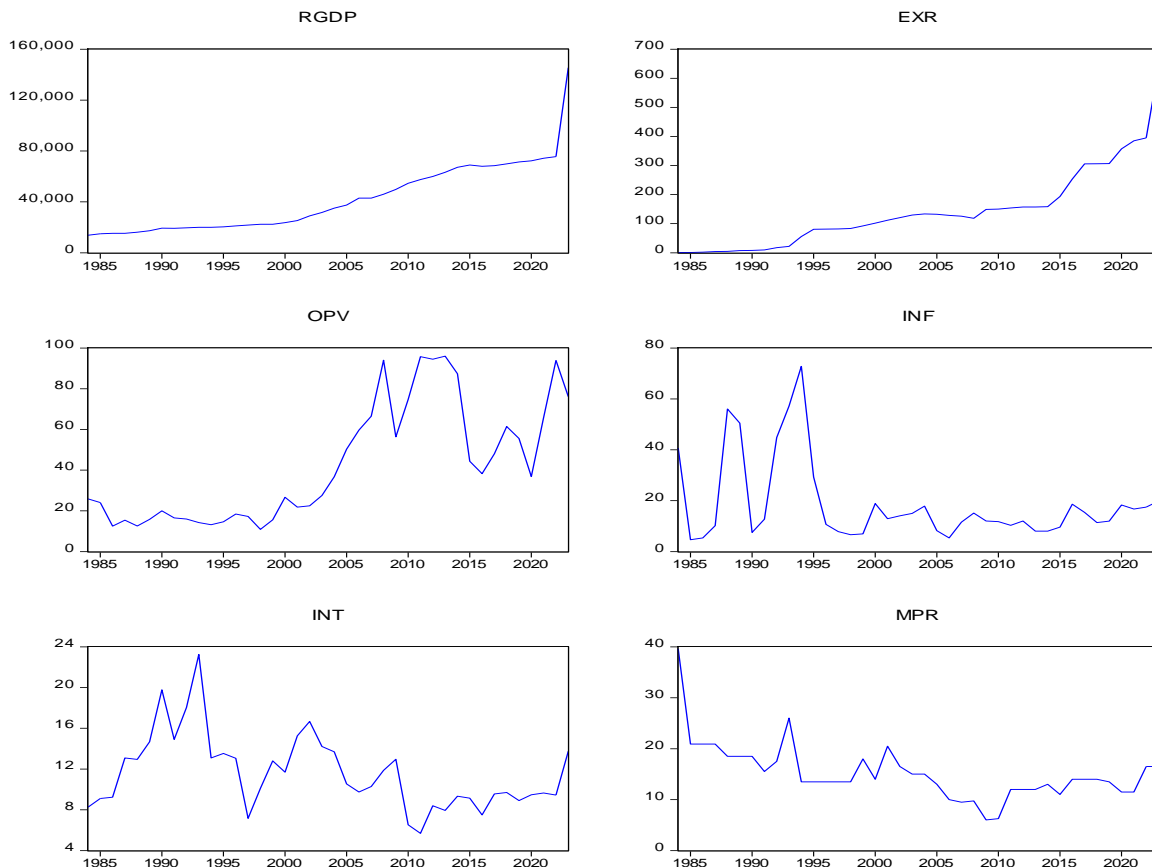


Figure 2: Trend of the variables used in the model Source: Author’s computation (2024)

To verify the results of the ADF and Phillips-Perron tests, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test was conducted, as shown in Table 2(b). The results indicate that the inflation rate (INF) was stationary at level I(1), consistent with the ADF result but differed from the Phillips-Perron outcome. Additionally, the interest rate (INT) showed discrepancies between the ADF and Phillips-Perron tests but was aligned with the Phillips-Perron test result. Given these inconsistencies, we refer to and rely on the KPSS confirmatory test results for a more accurate assessment.

Table 2: Unit root test result using Augmented Dickey-Fuller (ADF) and Phillips-Perron tests

Variables	ADF			Phillips-Perron		
	Level	1 st Difference	Order of Integration	Level	1 st Difference	Order of Integration
RGDP	-0.472395	-4.906162	I(1)	0.138048	-3.622024	I(1)
INF	-2.451275	-5.109831	I(1)	-2.700127	-	I(0)
EXR	-2.620637	-	I(0)	-2.785160	-3.377183	I(0)
INT	-1.984384	-3.865040	I(1)	-2.918675	-	I(0)
OPV	-1.435586	-6.226077	I(1)	-1.448735	-6.332215	I(1)
MPR	-3.251518	-	I(0)	-3.186045	-	I(0)

The critical values for the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are presented in the table. For the ADF test, at the 5% significance level, the critical value at level is -2.986225, and at the 1st difference, it is -3.724070. In comparison, for the PP test, the critical value at level is -2.954021, which is the same at both the 5% and 10% significance levels. These critical values are essential for determining stationarity. If the test statistic is less than the critical value, the null hypothesis of a unit root is rejected, indicating stationarity.

Table 3: Unit root test result using Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests

Variables	KPSS		
	Level	1 st Difference	Order of Integration
INF	0.269811	-0.400211	I(1)
INT	0.823479	-	I(0)

Table 3 presents the unit root test results using the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The inflation rate (INF) shows a KPSS statistic of 0.269811 at level and -0.400211 at the first difference, indicating that it is integrated of order I(1), meaning it is non-stationary at level but stationary after differencing. The interest rate (INT), with a KPSS statistic of 0.823479 at level and no result at the first difference, is stationary at level, suggesting it is integrated of order I(0). The critical values for the KPSS test are 0.463000 at the level and -0.463000 at the first difference at the 5% significance level.

4.4 Granger Causality

The results from the Granger causality tests, as presented in Table 4, indicate significant uni-directional causal relationships between key variables. First, a clear causality exists from the exchange rate (EXR) to the actual gross domestic product (RGDP), as shown by the F-statistic of 4.24045 and a p-value of 0.0230. This means the null hypothesis—that exchange rate does not Granger cause RGDP—is rejected. Consequently, the exchange rate is found to have a significant impact on increasing RGDP,

emphasizing the importance of exchange rate fluctuations in driving economic growth (Jacob, 2022).

Further, the results reveal a uni-directional causal relationship between real GDP and oil price volatility (OPV). The F-statistic for the relationship from oil price volatility to RGDP is 4.60309, with a p-value of 0.0292, leading to the rejection of the null hypothesis that oil price volatility does not Granger cause RGDP. This finding suggests that fluctuations in oil prices significantly influence Nigeria's overall economic output, indicating that changes in oil prices are an essential driver of real GDP growth.

Table 4: Granger causality for Exchange rate and oil price volatility on Real Gross Domestic Product Equation

Lags: 2				
Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
EXR does not Granger Cause RGDP	38	4.24045	0.0230	Reject
RGDP does not Granger Cause EXR		1.02419	0.3702	Accept
OPV does not Granger Cause RGDP	38	4.60309	0.0292	Reject
RGDP does not Granger Cause OPV		1.98097	0.1540	Accept
OPV does not Granger Cause EXR	38	0.00190	0.9981	Accept
EXR does not Granger Cause OPV		3.61976	0.0379	Reject

Source: Author's computation (2024)

The Granger causality results also show a causal link from the exchange rate (EXR) to oil price volatility (OPV), with an F-statistic of 3.61976 and a p-value of 0.0379. This result leads to the rejection of the null hypothesis that the exchange rate does not Granger cause oil price volatility, highlighting that exchange rate fluctuations significantly impact the volatility of oil prices. Conversely, the relationship between oil price volatility and the exchange rate is insignificant, as evidenced by a p-value of 0.9981. The Granger causality results demonstrate that exchange rate movements influence Nigeria's real GDP and oil price volatility. Specifically, the exchange rate Granger causes RGDP to rise, while oil price volatility significantly affects real GDP. These findings underscore the interlinkages between exchange rate dynamics, oil price fluctuations, and economic growth in Nigeria, suggesting that policymakers should closely monitor these factors for effective financial planning.

4.5 Exchange rate and oil price volatility on Real Gross Domestic Product Equation

4.5.1 Correlation Matrix

The correlation values, which quantify the strength of the linear link between each pair of variables, are displayed in the correlation matrix. The range of correlation values is -1 to +1. A totally negative linear correlation between two variables is denoted by a value of -1. There is no linear association between two variables when the value is 0. A totally positive linear correlation between two variables is denoted by a value of 1. All of the variables that enter the model are perfectly positive and connected, according to the results displayed in Table 5.

Table 5: Correlation matrix for Exchange rate and oil price volatility on Real Gross Domestic Product Equation

	RGDP	EXR	OPV	INF	INT	MPR
RGDP	1.000000					
EXR	0.940965	1.000000				
OPV	0.721739	0.569653	1.000000			
INF	-0.255961	0.226066	-0.351449	1.000000		
INT	-0.367007	0.306674	0.511286	0.428314	1.000000	
MPR	-0.396059	0.341244	0.466453	0.370400	0.306588	1.000000

Source: Author's computation using E-views 10 (2024)

4.5.2 Co-integration test

Both I(0) and I(1) showed that the variables were stationary, according to the unit root test result. To determine whether there is a long-term link between the variables, the ARDL bound test was performed. The computed F-statistics, which have a value of 17.71021, are higher than the upper and lower bound critical bound values at every level of significance, as can be observed from the results in Table 6. However, this indicates that the alternative hypothesis of cointegration is accepted and the null hypothesis of no cointegration is rejected. Cointegration and a long-term link between the variables are thus present.

Table 6: ARDL Bounds Test Exchange rate and oil price volatility on economic growth equation

Test Statistic	Value	K	Significance Level	I ₀ Bound	I ₁ Bound
F-statistic	17.71	5	10%	2.08	3.00
			5%	2.39	3.38
			2.5%	2.70	3.73
			1%	3.06	4.15

Lower Bound @ 5% = 2.39, Upper Bound @ 5% = 3.38

Source: Author’s computation using E-views 10 (2024)

4.5.3 Long-Term Effects of Oil Price and Exchange Rate Volatility on Real Gross Domestic Product

Table 7 presents the long-term effects of oil price and exchange rate volatility on real gross domestic product (RGDP). The results show a positive relationship between Nigeria’s RGDP and exchange rate (EXR). Specifically, a 10% increase in the exchange rate is associated with a 2.01% rise in RGDP, based on the coefficient value of 0.201426. Additionally, a positive correlation exists between RGDP and oil price volatility (OPV), meaning that a 10% increase in OPV will lead to a 3.16% rise in RGDP, which is in line with theoretical expectations.

However, a statistically significant negative correlation is observed between RGDP and inflation (INF). According to the findings, a 10% increase in inflation will result in a 4.49% decline in RGDP, consistent with theoretical predictions. Similarly, the results show a significant positive relationship between RGDP and interest rates (INT). Specifically, a 1% increase in the interest rate will lead to a 2.43% decrease in RGDP, assuming all other factors remain constant. The monetary policy rate (MPR) exhibits a positive and statistically significant relationship with RGDP. A 10% increase in MPR is associated with a 0.24% rise in RGDP, which aligns with theoretical expectations.

Table 7: Long run ARDL result of exchange rate and oil price volatility on real gross domestic product equation

Variable	Coefficient	Std. Error	t-Statistic	p-Value
EXR	0.201426	0.000412	3.456962	0.0043
OPV	0.316141	0.001342	12.02679	0.0000
INF	-0.449108	0.002913	-6.559529	0.0000
INT	0.243493	0.009901	4.392971	0.0007
MPR	0.024056	0.011156	2.156408	0.0504
C	9.045434	0.205254	44.06938	0.0000

Source: Author’s computation using E-views 10 (2024)

4.5.4 Short-Term Effects of Oil Price and Exchange Rate Volatility on Real GDP

Table 8 presents the short-term effects of oil price and exchange rate volatility on real gross domestic product (RGDP). The results reveal a positive short-term relationship between exchange rate (EXR) and RGDP across the current period, as well as the first, second, and third period lags, with statistical significance at the 5% level. Specifically, a 10% increase in the exchange rate results in a 4.12% increase in RGDP in the current period, 2.41% in the first lag, 1.32% in the second lag, and 2.21% in the third lag. For oil price volatility (OPV), the correlation with RGDP is positive in the current period but negative in the first lag. These relationships are statistically significant. A 10% increase in OPV leads to a 1.73% rise in RGDP in the current period, while the same increase in the first lag results in a 2.13% decrease in RGDP.

Regarding interest rates (INT), there is a positive but statistically insignificant association with RGDP in the current period. However, in the

first and second period lags, the relationship turns negative. A 10% increase in interest rates in the current period results in a 1.93% rise in RGDP, but after the first and second lags, RGDP declines by 2.11% and 3.02%, respectively. Inflation (INF) impacts RGDP in the current period with a negative correlation, but this changes to positive correlations in the first and second period lags. In the current period, a 10% increase in inflation leads to a 2.73% decrease in RGDP, while in the first and second lags, RGDP increases by 1.94% and 2.92%, respectively. These findings deviate from theoretical expectations.

The error correction mechanism (ECM) shows a correct size and sign, indicating that approximately 60% of the short-term disequilibrium is corrected each year. The ECM coefficient of -0.595022 is statistically significant with a t-statistic of -13.46065. The model explains around 96% of the variation in RGDP, with an R-squared value of 0.977989 and an adjusted R-squared of 0.959454. The Durbin-Watson statistic of 2.33 suggests no autocorrelation, making the results suitable for forecasting and economic simulation.

Table 8: Short run ARDL (Error Correction) exchange rate and oil price volatility on real gross domestic product equation

Variable	Coefficient	Std. Error	t-Statistic	p-Value
D(EXR)	0.412238	0.000123	18.15426	0.0000
D(EXR(-1))	0.240516	0.000455	1.132987	0.2777
D(EXR(-2))	0.131905	0.000544	3.502715	0.0039
D(EXR(-3))	0.221283	0.000345	3.723255	0.0026
D(OPV)	0.172705	0.000336	8.041962	0.0000
D(OPV(-1))	-0.213311	0.000591	-5.600065	0.0001
D(INF)	-0.273480	0.000441	-7.882273	0.0000
D(INF(-1))	0.193835	0.000454	8.449951	0.0000
D(INF(-2))	0.291871	0.000426	4.395260	0.0007
D(INT)	0.193223	0.002094	1.539649	0.1476
D(INT(-1))	-0.211326	0.002283	-4.959851	0.0003
D(INT(-2))	-0.302425	0.001951	-1.243274	0.2357
D(MPR)	-0.402914	0.001966	-1.482261	0.1621
D(MPR(-1))	-0.326498	0.001742	-3.729019	0.0025
D(MPR(-2))	-0.226966	0.001680	-4.145592	0.0012
D(MPR(-3))	-0.312193	0.001058	-2.072890	0.0586
CointEq(-1) *	-0.595022	0.029346	-13.46065	0.0000
R-squared	0.977989			
Adjusted R-squared	0.959454			
Durbin-Watson	2.331422			
Mean Dependent Variable	0.062633			
SD Dependent Variable	0.108594			

Source: Author’s computation (2024)

4.5.5 Stability test for monetary policy and real gross domestic product equation

Following the estimation of the ECM models, the stability of the parameters was assessed using the Cumulative Sum (CUMSUM) and Cumulative Sum of Squares (CUMSUM SQ) tests. The CUMSUM and CUMSUM SQ statistics remain within the critical boundaries of the ± five per cent significance threshold, as illustrated in Figures 3 and 4. These plots indicate that a long-term relationship exists between oil price volatility, exchange rate, and real gross domestic product in Nigeria. Furthermore, they suggest that the coefficients under evaluation remain

stable over the long term from 1984 to 2023, with progressive adjustments.

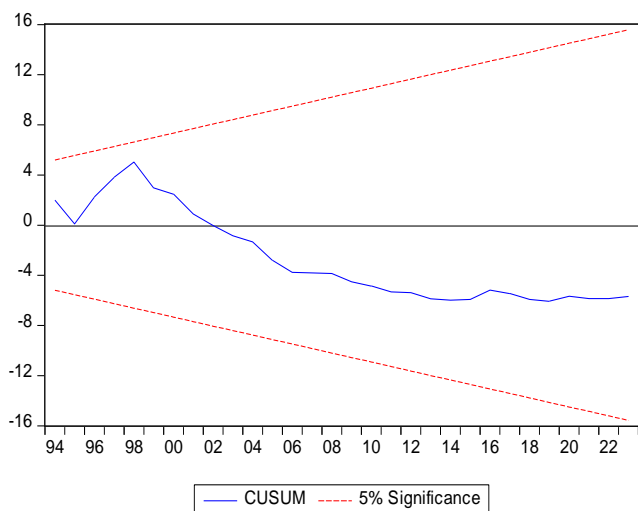


Figure 3: Cumulative Sum (CUSUM) Test for Stability of Parameters in the Real GDP Equation (Source: Author’s computation using E-views 10 (2024))

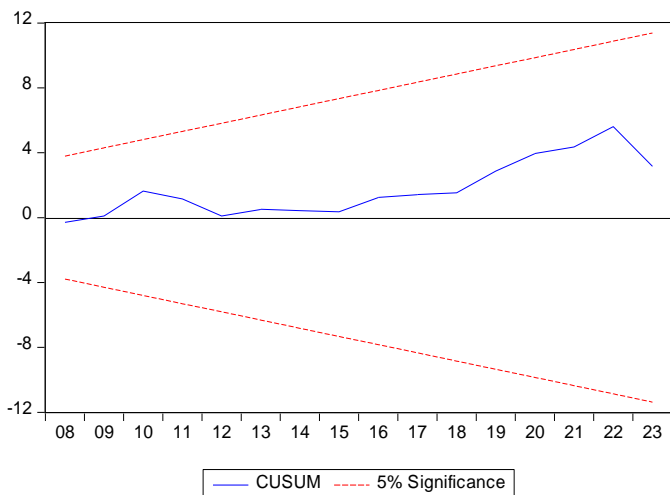


Figure 4: Cumulative Sum of Squares (CUSUM SQ) Test for Stability of Parameters in the Real GDP Equation (Source: Author’s computation using E-views 10 (2024))

5. DISCUSSION OF RESULTS

The study looked at how actual gross domestic product was affected by oil price changes and currency rate changes. The study’s conclusions showed that, over the long term, every variable—aside from inflation—was favourable and significantly impacted Nigeria’s gross domestic product. In particular, there was a positive correlation between the actual gross domestic product and the exchange rate. The results of who discovered a strong positive correlation between the exchange rate and actual gross domestic product, are consistent with this finding (Danmola, 2013; Apollos et al., 2015; Abraham, 2016). Furthermore, due to low levels of risk, credit to the private sector, more excellent interest rates on deposits, and the financial markets’ need for more collateral, increased exchange rate volatility may result in increased investment. Additionally, the positive association aligns with the study’s theoretical framework and presumptions (Udo et al., 2022).

As the primary lending rate in the Nigerian economy, the monetary policy rate was found to have a positive and significant relationship with actual gross domestic product, and the study’s findings also showed that, by economic theory and a priori expectations, oil price volatility has a positive and significant effect on real gross domestic product in the Nigerian economy. This finding supports the findings of (Baba, 2020; Aimer and Mofteh, 2016). According to the findings, raising the monetary policy rate tends to decrease the economy’s demand and money circulation, which lowers investments and the demand for goods and services and, eventually, lowers inflation. Conversely, a higher liquidity ratio makes loanable funds more affordable, raising money demand and ultimately

leading to inflation. This finding is in line with the findings of who found a significant relationship between monetary policy rate and actual gross domestic product (Popkran, 2018). The positive relationship also aligns with this study’s theoretical framework and a priori expectations. These monetary policy rates directly impact the desirability of funds used for investment; thus, they affect the actual gross domestic product in one way or another (Jacob, 2023).

The study’s conclusions also showed that the monetary policy rate has a cumulative, significant impact on the actual gross domestic product of the Nigerian economy, which is consistent with economic theory and presumptions (Popkran’s, 2018; Onyeiwu, 2012). Actual gross domestic product was positively and significantly correlated with the monetary policy rate. Since the monetary policy rate is the primary lending rate in the Nigerian economy, it would inevitably have a considerable and beneficial impact on other lending rates in the country. A negative but negligible correlation existed between Nigeria’s gross domestic product and the cash reserve and liquidity ratios. With more liquidity available to the bank, the interest rate drops as loans become cheaper to disburse due to the availability of funds that investors can use for production, increasing gross domestic product.

As anticipated, it was discovered that the monetary policy rate significantly and favorably impacted Nigeria’s economic growth. The liquidity ratio was the lone exception to this rule. These results are consistent with economic theory—more significantly, monetary policy. As a result, the government employs instruments like the cash reserve ratio, liquidity ratio, and monetary policy rate to manage inflation (Jacob and Umoh, 2023). According to the findings, raising the monetary policy rate tends to decrease the economy’s demand and money circulation, which lowers investments and the demand for goods and services and, eventually, lowers inflation. However, a higher liquidity ratio makes loanable funds more affordable, raising demand for money and eventually causing inflation to rise.

6. CONCLUSION

This study examined the relationship between exchange rate and oil price volatility and economic growth using the augmented Dickey-fuller (ADF) test, the Phillip-Peron test, the Autoregressive Distributed Lag (ARDL) bounds approach, the Granger Causality test, and the Error Correction Model (ECM) regression analysis technique. The primary goal of this study was to evaluate the impact of exchange rate and oil price volatility on economic growth in Nigeria, specifically analyzing the effect of exchange rate on economic growth (RGDP) and determining the impact of oil price volatility on economic growth in Nigeria. A forty-year time series data set was used from 1984 to 2023. The Granger causality test indicates that monetary policy and macroeconomic performance are causally related, and the error correction model is correctly signed for the equation and statistically significant.

Tests of the effects of exchange rate and oil price volatility variables revealed that they significantly impact Nigeria’s economic growth. As a result, the null hypotheses, first put forth in chapter one, that exchange rate and oil price volatility have no effect on Nigeria’s economic growth, were rejected, and their alternative—that they do—was accepted. The analysis’s conclusion, which focused on the relationship between actual gross domestic product and exchange rate and oil price volatility, suggests that these factors positively impact economic growth. The government’s efforts and policies aimed at maintaining a stable exchange rate and raising the gross domestic product could explain the positive link.

On the other hand, a negative link can lower the inflation rate and the favourable monetary policy rate. The long-term findings demonstrated that the volatility of the oil price and exchange rate and other variables like interest rates, inflation rates, and economic policy rates substantially impact gross domestic product. The outcome demonstrated that rising oil price volatility positively impacts actual gross domestic product. The findings also showed that while inflation has an inverse relationship with actual gross domestic product, exchange rates can positively affect it. The outcome also suggests that interest and monetary policy rates have a long-term, favourable, and noteworthy effect on gross domestic output. The study concluded that exchange rate and oil price volatility play significant roles in Nigeria’s economic growth.

The study recommends economic diversification to boost Nigeria’s economic growth by investing crude oil revenue into productive sectors and expanding infrastructure to stabilize the exchange rate. Additionally, the government should ensure transparency in oil revenue management to support economic development. Monetary authorities must implement

appropriate policies to curb inflation and create a favourable environment for sustainable growth.

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