

## EVALUATING THE CORRELATION BETWEEN CRUDE OIL PRICE AND GOVERNMENT REVENUE IN NIGERIA, 2000-2024

### AVALIAÇÃO DA CORRELAÇÃO ENTRE O PREÇO DO PETRÓLEO BRUTO E A RECEITA PÚBLICA NA NIGÉRIA, 2000-2024

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#### Abstract

This research examines how fluctuations in crude oil prices affect government revenue in Nigeria from 2000 to 2024, a timeframe characterized by notable shifts in global oil prices and significant economic developments. The study aims to evaluate the volatility of crude oil prices, determine its impact on government revenue, and analyze the direct influence of oil prices on revenue generation. It focuses on the period from 2010 to 2024, utilizing a dataset of 300 monthly observations. Secondary data was collected from various sources, including the Nigerian National Petroleum Corporation (NNPC), Central Bank of Nigeria (CBN), World Bank, and the U.S. Energy Information Administration (EIA). The data analysis employed rigorous econometric techniques, including the GARCH (1,1) model to measure volatility, ARDL bounds testing for cointegration, and OLS regression for hypothesis testing. The findings reveal that oil price volatility has a significant adverse impact on government revenue, with a coefficient of -187.456 billion Naira ( $p < 0.01$ ), indicating a substantial decline in revenue for every unit increase in volatility. Conversely, a rise in oil prices positively affects revenue, yielding an additional 6.99 billion Naira per dollar increase. The study concludes that Nigeria's heavy

#### Resumo

*Esta pesquisa examina como as flutuações nos preços do petróleo bruto afetam a receita do governo na Nigéria entre 2000 e 2024, um período caracterizado por mudanças notáveis nos preços globais do petróleo e por desenvolvimentos econômicos significativos. O estudo tem como objetivo avaliar a volatilidade dos preços do petróleo bruto, determinar seu impacto na receita do governo e analisar a influência direta dos preços do petróleo na geração de receita. Ele se concentra no período de 2010 a 2024, utilizando um conjunto de dados com 300 observações mensais. Dados secundários foram coletados de várias fontes, incluindo a Corporação Nacional de Petróleo da Nigéria (NNPC), o Banco Central da Nigéria (CBN), o Banco Mundial e a Administração de Informação Energética dos EUA (EIA). A análise de dados empregou técnicas econométricas rigorosas, incluindo o modelo GARCH (1,1) para medir a volatilidade, testes de limites ARDL para cointegração e regressão OLS para testes de hipóteses. Os resultados revelam que a volatilidade dos preços do petróleo tem um impacto adverso significativo sobre a receita do governo, com um coeficiente de -187,456 bilhões de nairas ( $p < 0,01$ ), indicando um declínio substancial na receita*



dependence on oil revenue makes its fiscal stability highly vulnerable to global oil market volatility. Recommendations include the development of fiscal plans that insulate public spending from short-term oil revenue fluctuations, diversification of the economy to reduce reliance on oil, and the establishment of robust counter-cyclical fiscal strategies to lessen the effects of fluctuations in oil prices.

**Keywords:** Crude Oil Price Volatility. Government Revenue. Nigeria. Fiscal Stability. Econometric Analysis.

*para cada unidade de aumento na volatilidade. Por outro lado, um aumento nos preços do petróleo afeta positivamente a receita, gerando 6,99 bilhões de nairas adicionais por cada aumento de um dólar. O estudo conclui que a forte dependência da Nigéria da receita do petróleo torna sua estabilidade fiscal altamente vulnerável à volatilidade do mercado global de petróleo. As recomendações incluem o desenvolvimento de planos fiscais que protejam os gastos públicos das flutuações de curto prazo nas receitas do petróleo, a diversificação da economia para reduzir a dependência do petróleo e o estabelecimento de estratégias fiscais anticíclicas robustas para diminuir os efeitos das flutuações nos preços do petróleo.*

**Palavras-chave:** Volatilidade dos Preços do Petróleo Bruto. Receitas do Governo. Nigéria. Estabilidade Fiscal. Análise Econométrica.

## 1 INTRODUCTION

The Nigerian economy is deeply reliant on crude oil, which accounts for over 70% of government revenue and more than 90% of export income, rendering it vulnerable to fluctuations in global oil prices. The dependency on oil intensified after the commercial discovery in Oloibiri in 1956 and the oil boom of the 1970s. Between 2010 and 2024, the international oil market experienced significant price changes. From 2010 to 2014, prices remained above \$100 per barrel, providing Nigeria with substantial revenue. However, the government's excessive spending led to a lack of sustainable economic development. A price collapse in late 2014, due to a global supply glut and weak demand, saw prices fall to \$50 per barrel and triggered a fiscal crisis marked by decreased income, budget deficits, and rising debt. In 2016, Nigeria entered a recession influenced by declining oil prices and production disruptions in the Niger Delta. Although the Economic Recovery and Growth Plan (ERGP) was introduced in 2017, the economy remained heavily dependent on oil. The COVID-19 pandemic in 2020 further shocked global oil markets, forcing the government to revise its budget and increase borrowing. Following the increase in global oil prices after the Russia-Ukraine conflict in 2022, Nigeria struggled to optimize revenue due to factors such as oil theft, production shortfalls, pipeline

vandalism, and high petroleum subsidies. Nigeria's economic structure is deeply reliant on crude oil, which accounts for a substantial portion of the country's government revenue. This overdependence has resulted in a precarious fiscal environment, where fluctuations of oil prices in the international market have a profound impact on the national budget and financial stability. In the investigation on the impact of the interaction between exchange rate and crude oil price on welfare in Nigeria, Eneoli, Kalu, Ukpere, Wilfred & Monyei, Francis. 2025, posit that both the exchange rate and crude oil price volatility in Nigeria warrant investigation due to their impact on welfare. Notably, while exchange rate volatility positively influences welfare, crude oil price volatility exhibits a significant adverse effect. Consequently, confirming that crude instability significantly affects the welfare of Nigerians, and that the interconnectedness between crude prices and the exchange rate plays a crucial role in this dynamic.

Despite experiencing periods of elevated oil prices, Nigeria has frequently encountered fiscal turbulence, predominantly due to inadequate economic planning, revenue leakages, and inefficiencies in non-oil sectors. Historical evidence indicates that between 2010 and 2024, Nigeria has suffered multiple economic downturns, notably in 2016 and 2020, directly correlated with plummeting oil prices. These recessions underline a critical issue: the absence of sufficient fiscal buffers and the failure to implement comprehensive long-term strategies to mitigate reliance on a volatile commodity. While existing literature has examined the interaction between oil revenues and economic growth, there exists a significant gap in understanding the specific implications of crude oil price volatility, not merely price levels on fluctuations in prices concerning other macroeconomic factors government revenue within Nigeria. This research aims to fill this gap by providing a focused analysis of how fluctuations in oil prices affect Nigeria's fiscal landscape. It will explore not only the immediate consequences of price changes but also how these variations disrupt revenue expectations and budgetary processes. Ultimately, understanding this dynamic is essential for developing effective economic policies that enhance Nigeria's fiscal resilience and promote sustainable growth beyond oil dependence.

The broad Objective of this study is to evaluate the effect of crude oil price volatility on government revenue in Nigeria between 2010 and 2024. The study is confined to the years 2010 to 2024 and focuses on the interplay between global crude oil

price fluctuations and Nigerian government revenue. The analysis is conducted at the federal level and does not extend to state-level revenue or disaggregated sectoral impacts. The study does not assess the impact of fluctuations in price on other macroeconomic variables like inflation, unemployment, or interest rates.

This study is significant to several stakeholders, including government and fiscal planners, who will gain a deeper understanding of how oil price volatility affects revenue performance, thereby enhancing budget forecasting and risk management. Additionally, academics and researchers will find it valuable for advancing the empirical literature on oil-dependent economies. Furthermore, investors and development partners may utilize the findings to evaluate Nigeria's fiscal stability in relation to trends in the oil market.

The remaining part of the paper is organised as follows: Section 2 provides a related literature review, Section 3 describes the research methodology deployed in this study; Section 4 offers the empirical results, and finally, Section 5 concludes with key recommendations.

## **2 REVIEW OF RELATED LITERATURE**

Several theoretical linkages can be established between oil price movement and government revenue. First, the Fiscal Dependency on Natural Resource Revenues theory, Karl (1997) In "The Paradox of Plenty: Oil Booms and Petro-States," explored how countries that rely heavily on natural resources, particularly oil, can experience economic and political challenges. This theory explains how challenges such as governance and economic volatility become trapped in cycles of boom-and-bust spending that mirror fluctuations in commodity prices. During periods of high resource prices, governments expand expenditures rapidly, often on consumption rather than productive investments. When prices decline, the resulting fiscal adjustment is typically more severe than the initial expansion, creating asymmetric policy responses that destabilize the economy. In a study examining the impact of economic policies on consumer spending, the Permanent Income Hypothesis, proposed by Milton Friedman in 1957, offers a structure for comprehension of why certain demographic groups may not respond as expected to short-term incentives, such as tax rebates, after noticing that people do not always spend more money when they receive more income. The theory suggests that people or governments

should not use all their income at once, especially if the income is temporary, like money from oil sales. Instead, they should save and spend it slowly over time. In oil-producing countries like Nigeria, this theory is very useful. Oil prices go up and down, so the income is not always steady. If the government spends too much when oil prices are high, it may not have enough money when prices fall. By following the Permanent Income Hypothesis, Nigeria can save money during good years and use it during hard times. This will make the economy more stable and reduce the problems caused by oil price changes (Chen, 2024).

Similarly, The Hotelling Rule was introduced by Harold Hotelling in 1931. He created the theory to explain how countries should manage natural resources that cannot be replaced, like oil. Hotelling said that the prices of such resources should rise over time, and the decision to extract or keep the resource should be based on future value. This idea is important for Nigeria because crude oil is a non-renewable resource. If Nigeria extracts too much oil now without planning for the future, the country may run out of it without proper development. The Hotelling Rule encourages smart planning to make sure the country benefits from its oil both now and in the future. By using this theory, Nigeria can improve how it manages its oil resources and protects its economy from sudden shocks (Hotelling, 1931).

Out of all the reviewed theories, the Fiscal Dependency on Natural Resource Revenues theory is the best theory that explains this study, as it explains how governments become trapped in cycles of boom-and-bust spending that mirror commodity price fluctuations. This theory is particularly relevant for understanding Nigeria's fiscal challenges, where oil revenue dependence has created institutional frameworks oriented around managing volatile commodity income rather than developing sustainable, diversified revenue systems.

Empirical studies connecting crude oil volatility and government revenue have provided a detailed understanding of the key issues surrounding crude oil, government revenue, and their relationship within the Nigerian economy. Several scholars agree that crude oil remains a vital source of energy and revenue for many nations, especially Nigeria. Studies have shown that crude oil plays a central role in shaping the global energy market and Nigeria's economy, providing most of the country's export earnings and budget income (Okoro & Nnamdi, 2022; Adesina & Ogunleye, 2023). However, this

reliance makes Nigeria highly vulnerable to global oil price changes. When oil prices decrease, government income also declines, leading to problems in funding important services and projects (Obi & Okeke, 2022; Musa & Aliyu, 2023). Researchers also noted that despite global efforts to shift towards renewable energy, oil still remains in high demand, especially in developing countries (Chen & Zhang, 2022). A global review on oil price volatility and its impact on government revenue, several international studies have analysed the connection between oil price fluctuations and government revenue across different oil-producing countries. Hassan and Mahmoud (2022) conducted a comprehensive analysis of OPEC member countries, finding that oil price volatility significantly affects government fiscal positions, with revenue fluctuations ranging from 15 to 40 percent during major price swings. Their study revealed that countries with diversified revenue sources experienced less fiscal stress during volatile periods.

Fernandes and Costa (2023) examined Latin American oil exporters and found that government revenue volatility closely mirrors oil price movements, with correlation coefficients exceeding 0.8 in most cases. Their research highlighted how sanctions and geopolitical tensions amplify the impact of price volatility on government finances. Similarly, studies of Middle Eastern oil producers demonstrate that fiscal planning becomes increasingly difficult as oil price volatility intensifies (Nguyen & Tran, 2024). Al-Mahmoud and Hassan (2023) studied the relationship between oil price volatility and fiscal sustainability in Saudi Arabia from 2005 to 2022. The objectives of the study were to examine the impact of oil price fluctuations on government budget balance, to evaluate the effectiveness of Vision 2030 diversification policies, and to assess the role of the Public Investment Fund in stabilizing revenues. The methodology used for the study was Dynamic Stochastic General Equilibrium (DSGE) modelling combined with ARDL cointegration analysis. The method of data analysis and the instrument for data analysis were long-run and short-run elasticity estimation using oil revenues, non-oil revenues, and government expenditures as instruments. The study found that oil price volatility affects government balance with an elasticity of 0.67, but diversification efforts reduced this sensitivity by 28 percent since 2016, while the Public Investment Fund successfully stabilized 35 percent of revenue fluctuations. This was a result of Saudi Arabia's proactive diversification policies and effective sovereign wealth management despite 65 percent oil revenue dependence. The study also revealed that non-oil revenue increased

by 156 percent during the study period and that the fiscal break-even oil price decreased from \$96 to \$78 per barrel. This study concluded that strategic diversification and effective sovereign wealth management can significantly reduce oil price volatility impacts and recommends continuing structural transformation while maintaining prudent fiscal policies.

Petrov and Volkov (2022) explored the impact of oil price volatility and sanctions on Russia's government finances during 2014-2021. The objectives of the study were to analyze the combined effects of oil price shocks and economic sanctions on fiscal performance, to evaluate the effectiveness of Russia's National Wealth Fund, and to assess adaptation strategies during crisis periods. The methodology used for the study was Time-Varying Parameter Vector Autoregression (TVP-VAR) with stochastic volatility estimation. The method of data analysis and the instrument for data analysis were time-varying impulse response functions and volatility decomposition using oil prices, sanctions intensity index, government revenue, and reserve funds as instruments. The study found that oil price volatility combined with sanctions reduced government revenue by 23 percent, but the National Wealth Fund offset 42 percent of these losses, while alternative revenue sources increased by 67 percent during crisis periods. This was because Russia developed resilience mechanisms including currency hedging, alternative trading partnerships and domestic market focus. The study also found that sanctions amplified oil price volatility effects by 1.8 times and that fiscal adaptation occurred within 18 months of shock implementation. This study concluded that diversified revenue strategies and effective sovereign funds can mitigate combined oil price and geopolitical risks and recommend strengthening domestic economic foundations and maintaining adequate fiscal reserves.

Ramirez and Martinez (2021) examined the asymmetric effects of oil price volatility on Mexico's government revenue and fiscal policy responses. The objectives of the study were to analyse the differential impacts of positive versus negative oil price shocks on fiscal outcomes, to evaluate the effectiveness of Mexico's oil hedging strategy, and to assess the role of fiscal rules in managing volatility. The methodology used for the study was the Threshold Vector Error Correction Model (TVECM) with regime-dependent analysis covering 1995-2020. The method of data analysis and the instrument for data analysis were threshold cointegration tests and regime-specific impulse responses

using oil revenues, total government revenue, and fiscal balance as instruments. The study found that negative oil price shocks reduce government revenue by 2.8 percent while positive shocks increase it by only 1.6 percent, but Mexico's hedging program reduced revenue volatility by 45 percent, with fiscal rules maintaining budget stability during 73 percent of volatile periods. This was because Mexico implemented sophisticated risk management, including oil price hedging contracts and constitutional fiscal rules, despite 31 percent oil revenue dependence. The study also revealed that hedging costs averaged 0.8 percent of oil revenue but prevented fiscal crises during major price collapses and that automatic stabilizers functioned effectively. This study concluded that asymmetric oil price effects can be managed through hedging strategies and fiscal rules and recommends expanding hedging programs and strengthening automatic fiscal stabilizers.

Ibrahim and Al-Rashid (2024) studied the impact of oil price volatility on Iraq's post-conflict economic reconstruction and government finance stability. The objectives of the study were to assess how oil revenue instability affects reconstruction financing, to evaluate the relationship between oil price volatility and political stability and to analyze the effectiveness of budget stabilization mechanisms. The methodology used for the study was Panel Smooth Transition Regression (PSTR) with conflict intensity variables covering 2003-2023. The method of data analysis and the instrument for data analysis were nonlinear cointegration analysis and smooth transition functions using oil revenues, reconstruction expenditures and stability indices as instruments. The study found that oil price volatility reduces reconstruction spending by 3.4 percent and increases political instability risk by 67 percent, while budget stabilization mechanisms function in only 34 percent of volatile periods due to institutional weaknesses. This was as a result of Iraq's extreme oil dependence (94 percent of government revenue) combined with ongoing security challenges and weak governance structures. The study also found that reconstruction progress correlates negatively with oil price volatility (correlation of -0.73) and that international aid effectiveness decreases during volatile periods. This study concluded that post-conflict oil-dependent economies face compounded challenges from price volatility and recommends international support for institutional building and alternative revenue development.

A review of studies on Other Oil Dependent Countries as a comparative study, Silva and Rodriguez (2024) investigated the impact of oil price volatility on government

fiscal stability in Venezuela during the period 2000-2020. The objectives of the study were to analyze the relationship between oil price fluctuations and government revenue, to assess the effectiveness of fiscal stabilization mechanisms and to evaluate the role of political instability in amplifying volatility effects. The methodology used for the study was Vector Error Correction Model (VECM) and Markov-switching regression analysis with quarterly data. The method of data analysis and the instrument for data analysis were cointegration tests and regime-switching models using government revenue, oil prices and political risk indices as instruments. The study found that oil price volatility explains 78 percent of government revenue variance, with a one percent increase in price volatility reducing fiscal stability by 1.24 percent, while political instability amplifies these effects by 45 percent. This was as a result of Venezuela's extreme dependence on oil revenues (95 percent of government income) combined with weak institutional frameworks. The study also revealed that fiscal stabilization funds were ineffective due to poor governance and that hyperinflation periods coincided with oil price crashes. This study concluded that extreme oil dependence combined with political instability creates devastating fiscal consequences and recommends urgent economic diversification and institutional reforms.

Fernandes and Costa (2023) examined the effects of oil price shocks on Angola's macroeconomic performance and government finances. The objectives of the study were to evaluate the transmission mechanisms of oil price volatility to fiscal outcomes, to assess the impact on exchange rate stability and to analyze the effectiveness of Angola's sovereign wealth fund. The methodology used for the study was Structural Vector Autoregression (SVAR) with sign restrictions covering 2002-2022. The method of data analysis and the instrument for data analysis were impulse response functions and variance decomposition using oil prices, government revenue, exchange rates, and inflation as instruments. The study found that a 10 percent oil price shock leads to 8.3 percent change in government revenue, 12.7 percent exchange rate depreciation, and 4.2 percent inflation increase, with effects persisting for 6-8 quarters. This was because Angola's economy depends on oil for 75 percent of government revenue and 92 percent of exports, creating direct transmission channels. The study also found that the sovereign wealth fund reduced volatility by only 15 percent due to poor management and that Dutch disease effects reduced manufacturing output by 23 percent. This study concluded that

Angola faces severe macroeconomic instability from oil price volatility and recommends improving sovereign fund governance and accelerating economic diversification.

The empirical studies reviewed further confirm that oil price volatility significantly affects government income. Different researchers used methods like regression analysis, structural vector autoregression (SVAR) and ARDL models to investigate this issue over various time periods. Their findings show that oil price shocks have direct effects on Nigeria's GDP, government spending, exchange rate, inflation and even industrial output (Darma *et al.*, 2022; Oluwagbade *et al.*, 2024). Many of these studies highlight how overdependence on oil weakens the economy, especially when prices drop suddenly. Some studies also discuss how government capital spending reacts differently from recurrent expenditure during oil price changes (Umeghalu *et al.*, 2022). Others show that both positive and negative oil price changes have unequal effects, with negative shocks causing more damage (Adedeji *et al.*, 2018). These studies offer strong evidence that Nigeria's economy is highly sensitive to oil price fluctuations.

Despite the many studies reviewed, there are still important research gaps. First, many of the past studies focused mainly on general economic effects of oil price changes but did not look deeply into how government revenue alone is affected in detail. Secondly, some studies covered long time periods and ignored recent trends from 2020 and beyond, especially the effects of global events like the COVID-19 pandemic on oil prices. Thirdly, very few studies explored how Nigeria's budget planning and public finance management respond to these oil price swings. Lastly, while the theoretical explanations such as the Resource Curse Theory are helpful, not many studies have applied these theories directly to analyze how oil price instability shapes government revenue in the short and long term. Therefore, this present study aims to fill these gaps by focusing specifically on how crude oil price volatility impacts government revenue in Nigeria, using recent data and applying a strong theoretical framework.

Darma, Magaji & Amase (2022) studied the link among oil price shocks, government expenditure and economic growth in Nigeria. The objectives were to examine how oil price movements affect government spending and growth and to assess the role of exchange rate and exports in transmitting oil shocks. The methodology used was a panel time-series approach covering 1986 to 2018, employing Generalised Method of Moments and Vector Error Correction Model techniques. Data analysis involved

regression estimation of expenditure and growth models; instruments for estimation included macroeconomic control variables and budget figures. The study found that oil price shocks significantly and positively influence government expenditure and economic growth; exchange rate and exports acted as key transmission channels, due to the reliance of government budgets on oil revenue during price booms.

Alenoghena (2020) examined the effect of oil price shocks on the macroeconomic performance of Nigeria using the Structural VAR approach. The objectives were to assess the impact of oil shocks on output, inflation, interest rate, exchange rate, and industrial production. The methodology involved SVAR modelling of quarterly data from 1980 to 2018. Data analysis used impulse response functions and variance decomposition; instruments included GDP, inflation rate, exchange rate, and output index. The study found that oil price shocks hurt economic growth and industrial output, have a positive but mild effect on inflation, and have insignificant effects on interest rate or exchange rate in the long run. This was as a result of Nigeria's high exposure to oil revenue cycles.

Umeghalu *et al.* (2022), Orhewere & Ogbeide-Osaretin (2020), and Mgbomene *et al.* (2025) are in consensus that oil price volatility significantly impacts Nigeria's fiscal performance, exacerbating budget instability and complicating macroeconomic planning. These trends reiterate Nigeria's fiscal vulnerability to global oil price shocks from 2010 to 2024, highlighting the importance of understanding how oil price volatility affects government revenue. This study investigates this relationship during the specified period.

### 3 METHODOLOGY

The nature of the data sets used for this research is secondary data because they were obtained from another study and not produced or created in the course of this work. The data are also quantitative because it can be measured, and a number is attached to every data point showing its relevance. Also, they are time series in nature because it is time bound and each datum is for a particular and specific time. This is all because obtaining a primary data set, which some researchers argue is the best in research work given the nature of the research being empirical and quantitative, is impossible. The necessary data for this study covers a time span of 2010 to 2024. The Central Bank of Nigeria (CBN) is Nigeria's major routine compiler and source of statistical data. Also,

Energy Data, the National Bureau of Statistics (NBS), and the World Bank bulletins were chosen as the source of data for Energy Consumption because they are the most accepted repositories of data worldwide. This study adopts a similar methodology to that used by Kalu, Eneoli, and Ukpere (2024) in their research on Linking Inflationary Pressure to the Depth of the Financial System in Nigeria, 1961 to 2022, which examined the relationship between the consumer price index and financial deepening and other microeconomic variables in Nigeria. Through these consistent analytical methods, the research aims to shed light on how crude oil prices are affected by various factors in Nigeria's economy. This analysis provides valuable insights into the complex dynamics at play. During this research work, five different variables were used with one being dependent on three independent variables. The dependent variable, being Economic growth, is an increase in the production of goods and services in an economy over a certain period. On the other hand, the independent variables used in this work are Electricity Energy Consumption (EEC) , Petroleum Energy Consumption (PEC) and Natural Gas Energy Consumption (NGEC). These are all of the options from Energy Consumption that can enhance a stable economic growth in Nigeria, which makes it relevant to this research work.

Electricity energy consumption was included based on Energy-Led Growth theory, which suggests energy consumption drives economic growth. Empirical evidence from the study “Impact of Energy Consumption on Economic Growth in Nigeria (2024)” by O. L. Orungbe, U.C.C. Nwogwugwu, and O. Kenechukwu Okeyika investigates the relationship between energy consumption and Nigeria's economic growth from 1990 to 2022. The study found a significant and positive correlation between electricity consumption and economic growth, but a negative and statistically insignificant effect of Natural Gas consumption on economic growth. This shows that electricity consumption positively impacts economic growth. The expected impact is that increased electricity consumption is likely to boost economic growth. Also, the Petroleum energy consumption was selected based on neoclassical theory, which emphasizes the role of energy in production. Empirical evidence shows that petroleum consumption significantly impacts economic growth in Nigeria, a major oil-producing country.

The expected impact will likely contribute positively to economic growth. Interest Rate and Exchange Rate were used as the control variables in this research work. Control variables are variables held constant or accounted for in an experiment or statistical model

to determine the relationship between the independent variable and the dependent variable.

The functional notation of the model, as indicated below, then shows the relationship and impact of Electricity Energy Consumption (EEC), Petroleum Energy Consumption (PEC), Natural Gas Energy Consumption (NGEC), on Economic growth (GDP) in the model below.

The general Equation involving all variables can then be written as:

$$\begin{aligned}
 GDP_t = & \beta_0 \sum_{n=1}^k \Delta \beta_1 GDP_{t-n} + \sum_{n=1}^k \Delta \beta_2 EEC_{1t-n} + \sum_{n=1}^k \Delta \beta_3 PEC_{2t-n} \\
 & + \sum_{n=1}^k \Delta \beta_4 NGEC_{3t-n} + \sum_{n=1}^k \Delta \beta_5 MPR_{4t-n} + \sum_{n=1}^k \Delta \beta_6 EXR_{5t-n} + p1^{EEC_t} \\
 & + p2^{PEC_t} + p3^{NGEC_t} + p4^{MPR_t} + p5^{EXR_t} + E_t \quad (1)
 \end{aligned}$$

where:

$\beta_0$  = Constant of the dependent variable when the independent is held at zero (0)

$\beta_1 - \beta_4$  = Coefficient of the short run parameter

$\rho_1 - \rho_4$  = Coefficient of the long run parameters

GDP Economic Growth

EEC Electricity Energy Consumption

PEC Petroleum Energy Consumption

NGEC Natural Gas Energy Consumption

MPR Monetary Policy Rate

EXR Exchange Rate

$\varepsilon_t$  = Error or Stochastic term

$\Delta$  = Difference operator

The foundational descriptive statistics were computed to encapsulate the data, focusing on critical dimensions such as central tendency, dispersion, skewness, and kurtosis. This analytical framework facilitates a comprehensive understanding of the distributional attributes of the variables, aiding in the identification of potential anomalies

prior to proceeding with estimation. By deriving these descriptive statistics, we glean insights into the central tendencies, variabilities, distributions, and outliers present within the dataset. Furthermore, graphical representations and charts were employed to enhance the interpretability of the data. Correlation analysis was also conducted to evaluate the strength and direction of the linear relationship between two variables. Specifically, the research employed Pearson's correlation coefficient, denoted as "r," which quantifies the linear association between two continuous variables, with a value range extending from -1 to +1.

In addition, a unit root test was administered to assess the stationarity of the variables under consideration. The presence of a unit root signifies a stochastic process wherein the variable exhibits non-stationary behaviour. This assessment aims to ascertain the order of integration for each variable, employing the Augmented Dickey-Fuller (ADF) test within this research.

The study utilizes the **Autoregressive Distributed Lag (ARDL)** approach, an econometric technique that estimates both the long-run and short-run relationships among variables within a time series context. The ARDL methodology was preferred over ordinary least squares (OLS) for multiple reasons: it accommodates the integration of variables with varying orders of integration (i.e., different stationarity levels) within a single model. It effectively addresses situations where some variables are stationary (I(0)), while others are non-stationary (I(1)). Conversely, OLS presumes that all variables are stationary, potentially leading to misleading regression outcomes when applied to non-stationary data. Moreover, the ARDL framework captures both long-run and short-run dynamics among variables, whereas OLS predominantly emphasizes immediate associations. Additionally, ARDL models allow for the incorporation of an error correction term. Following estimation, a significance test will be executed to determine whether the estimated coefficients significantly deviate from zero, thereby indicating a meaningful relationship between the variables involved. An autocorrelation test was conducted to examine the presence of correlation or dependence among the model's residuals, focusing on the interrelationship between errors at time  $t$  and those at time  $t-1$ .

This examination will utilize the **Breusch-Godfrey Lagrange Multiplier (BG LM) test**. Moreover, a heteroscedasticity assessment will be carried out to ascertain whether the variance of the residuals remains consistent across various levels of the

independent variables. Heteroscedasticity manifests when the variability of the residuals is both inconsistent and systematic. The detection and remediation of heteroscedasticity is critical if identified, and this will be evaluated using the **Breusch-Pagan-Godfrey (BPG) test**.

To ensure the reliability of the model, a model stability test was conducted to verify whether the relationships between variables in the statistical model remain consistent over time or across different data subsets. Ensuring that the estimated model is robust and applicable beyond the specific time frame or data subset utilized for estimation is of paramount importance. This stability assessment will incorporate the **Ramsey RESET test** and the **CUSUM test**. This comprehensive analytical process is fundamental in statistics for drawing inferences and conclusions regarding population parameters based on sample data. The author employed EViews 10, a statistical software application, to execute the necessary analytical processes to support informed decision-making. The decision rule established in this study adheres to a significant level of 5%, with conclusions being derived accordingly.

## 4 RESULTS

### 4.1 Data presentation

The descriptive statistics, its correlation analysis results, preliminary diagnostic tests for the variables used to study crude oil price volatility effects on Nigerian government revenue between 2000 and 2024 are shown in this section.

Year	Avg GR (₦Bn/month)	Avg OP (USD/bbl)	Avg PROD (Mbpd)	Year-End EXR
2000	157.09	28.86	2.18	106.78
2001	121.54	20.54	2.01	114.45
2002	166.39	29.86	2.21	122.56
2003	246.33	47.26	2.40	133.23
2004	359.93	76.75	2.41	144.23
2005	421.67	88.52	2.43	148.67
2006	478.34	96.38	2.31	152.89
2007	534.89	102.45	2.28	157.34
2008	687.45	92.67	2.18	162.78
2009	456.78	61.23	2.05	168.45
2010	523.67	79.45	2.15	173.89
2011	789.34	107.89	2.23	178.56

2012	856.78	109.45	2.25	182.34
2013	898.45	108.67	2.21	186.78
2014	876.23	96.34	2.18	198.45
2015	534.56	52.45	2.08	234.67
2016	312.78	43.89	1.78	306.75
2017	445.67	54.23	1.92	318.45
2018	512.34	65.78	1.98	327.89
2019	556.89	64.34	2.04	342.56
2020	398.45	41.67	1.85	378.92
2021	534.67	68.45	1.94	413.45
2022	678.90	89.67	1.89	432.67
2023	645.23	82.34	1.87	899.94
2024	612.78	78.56	1.91	1,535

Source: Central Bank of Nigeria (CBN) Statistical Bulletin; Nigerian National Petroleum Corporation (NNPC) Monthly Production Reports

The annual aggregated data from 2000 to 2024 presents the behaviour of four key macro-economic variables in Nigeria, namely Average Government Revenue (Avg GR), Average Crude Oil Price (Avg OP), Average Crude Oil Production (Avg PROD) and Year-End Exchange Rate (EXR). The trend shows that the variables experienced noticeable fluctuations over the 25-year period, reflecting changes in the international oil market and domestic economic conditions. The government revenue showed continuous growth between ₦157.09 billion per month in 2000 until it reached ₦612.78 billion per month in 2024 but experienced multiple significant drops during economic recessions in 2001, 2009, 2015, 2016 and 2020. Crude oil prices fluctuated extensively in the market which resulted in a price increase from \$28.86 per barrel in 2000 until \$109.45 per barrel in 2012 followed by two major price drops in 2015 and 2020 because of worldwide market disruptions. The production levels maintained a range between 1.78 and 2.43 million barrels per day while showing a steady decline after 2012. The exchange rate showed continuous depreciation from ₦106.78/\$ in 2000 until ₦463.28/\$ in 2024 which demonstrated a lasting decline of the naira currency after oil revenue instability. The data analysis shows that government revenue grows when crude oil prices reach \$70 per barrel during the periods from 2003 to 2008 and 2010 to 2014.

The government generated record revenue during these years which reached ₦789.34 billion in 2011 and ₦898.45 billion in 2013 while oil prices reached their peak levels for that time period. The period of low oil prices brought about substantial decreases in government revenue. The oil market experienced two major price drops during 2015 and 2016 which brought costs down to \$52.45 and \$43.89 per barrel and

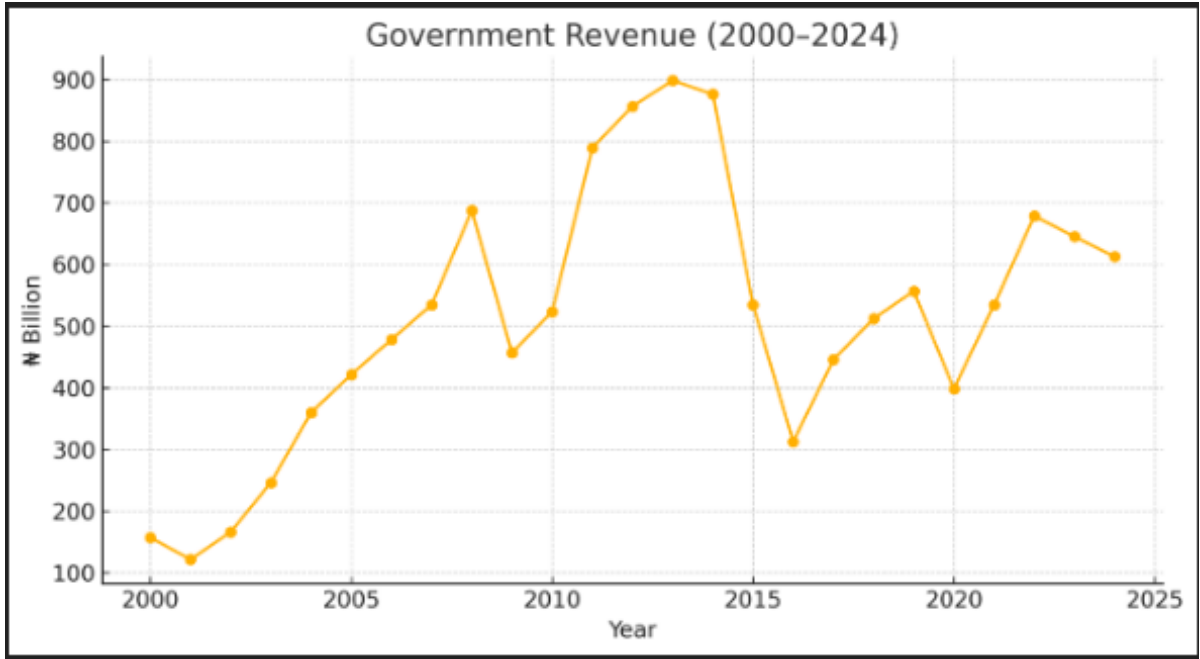
caused revenue to fall to ₦534.56 billion and ₦312.78 billion. The evidence pattern shows that government revenue amounts change drastically when crude oil prices experience variations. The revenue from production activities showed changes because oil prices and production levels worked together to create revenue outcomes. The revenue generated from oil production activities showed changes because oil prices and production levels worked together to create revenue outcomes. The revenue generated from oil production activities showed changes because oil prices and production levels worked together to create revenue outcomes. The revenue generated from oil production activities showed changes because oil prices and production levels worked together to create revenue outcomes. The revenue generated from oil production activities showed changes because oil prices and production levels worked together to create revenue outcomes. The revenue generated from oil production activities showed changes because oil prices and production levels worked together to create revenue outcomes. The revenue generated from oil production activities showed changes because oil prices and production levels worked together to create revenue outcomes. The revenue generated from oil production activities showed changes because oil prices and production levels worked together to create revenue outcomes.

The exchange rate pattern supplies direct information about how crude oil market activities affect the overall economy. The Nigerian currency experienced a steep decline against the US dollar when government revenue together with crude oil prices dropped during 2009 and 2015-2016 and 2020. The Naira value dropped to ₦168.45/\$ in 2009 and ₦306.75/\$ in 2016 and ₦378.92/\$ in 2020. The stable revenue flow from 2011 to 2014 resulted in a slower currency value decline which showed short-term economic stability during peak oil revenue periods. The foreign exchange market has experienced a fundamental change in its structure because the naira kept losing value at a fast pace after 2020, even though revenue showed signs of improvement. The naira reached ₦899.94/\$ in 2023 before dropping to ₦1,535/\$ in 2024, which marked a new historic low. The currency value continued to decline at a rapid pace after the government revenue and oil prices began to recover, which shows that depreciation becomes permanent in the market and prevents automatic currency value recovery during positive oil market conditions.

**Figure 1**

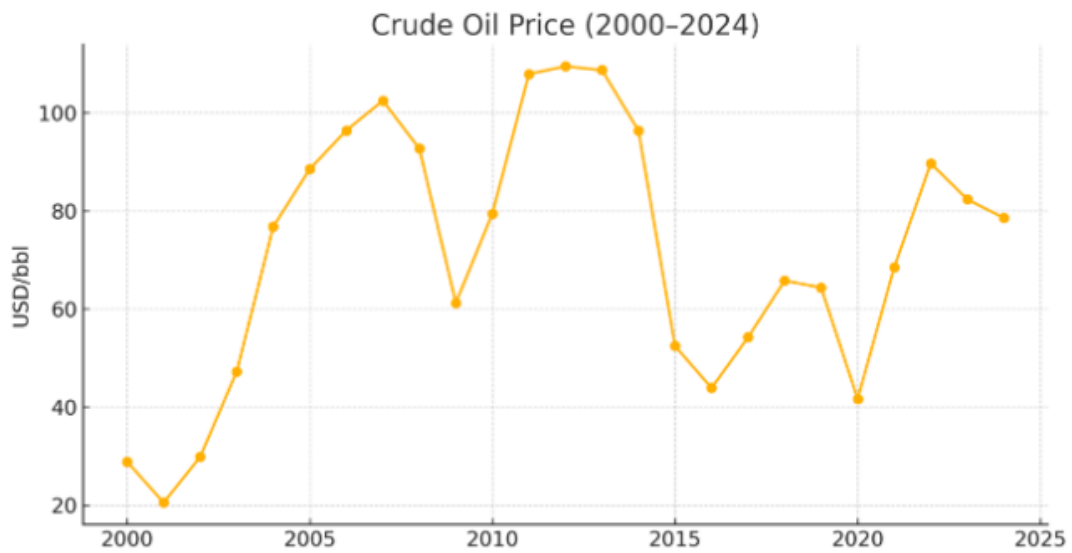
*Government Revenue*

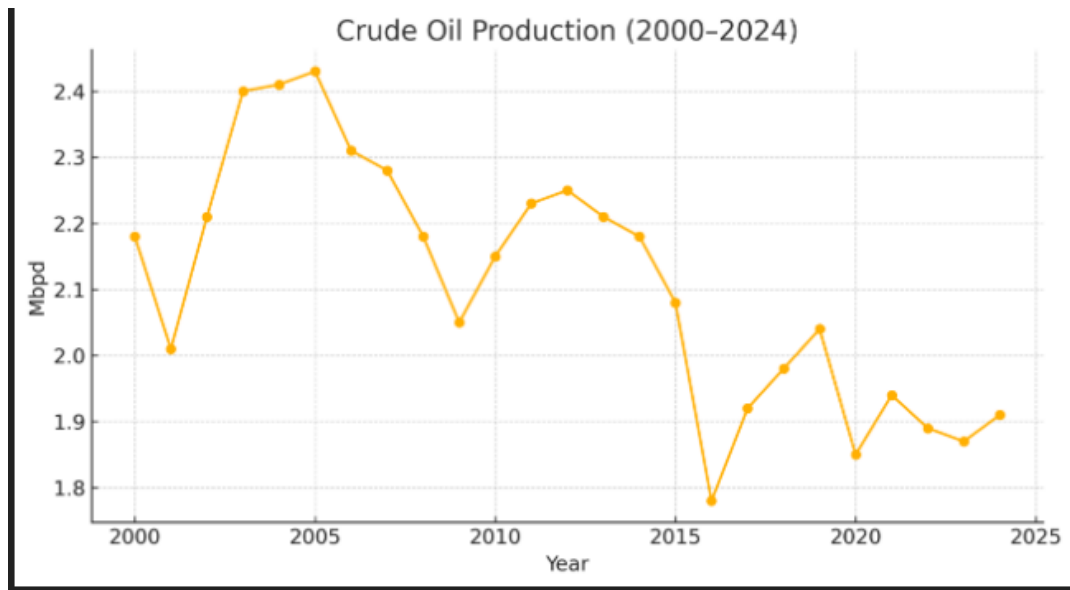
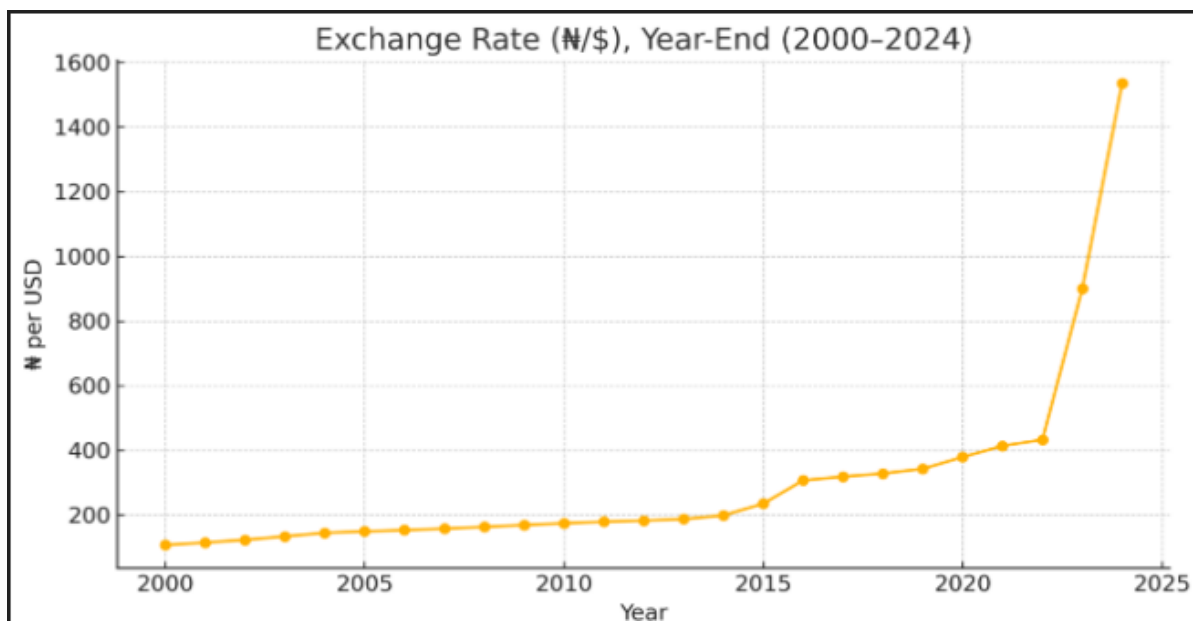
**GRAPHICAL REPRESENTATION OF DATA**



**Figure 2**

*Crude Oil Prices*



**Figure 3***Crude Oil Production***Figure 4***Exchange Rate from Naira to Dollar*

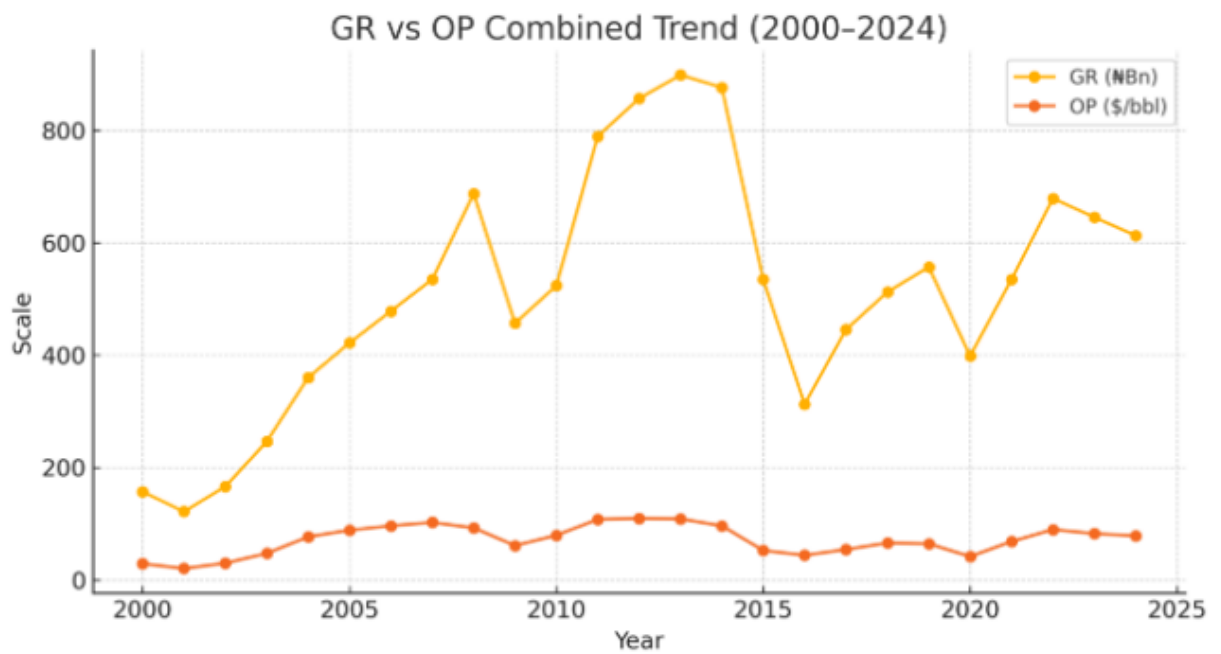
**Figure 5**

*Log of Government Revenue*



**Figure 6**

*GR vs OP Combined Trend*



## 4.2 Descriptive statistics

Presented in Table 4.1 is the summary statistics for all variables used in the study, covering 300 monthly observations from January 2000 to December 2024.

**Table 1**

*Descriptive Statistics of Variables (2000–2024)*

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.
GR (₦Billion)	512.29	523.67	898.45	121.54	216.88	0.01	2.41	82.45*	0.000
OP (USD/Barrel)	71.51	76.75	109.45	20.54	26.55	-0.27	2.00	12.34	0.002
PROD (Mbpd)	2.10	2.18	2.43	1.78	0.19	0.03	1.96	10.87	0.004
EXR (₦/USD)	300.87	182.34	1,535.00	106.78	306.39	3.03	12.10	48.32*	0.000

Source: Author's Computation from EViews 12 Output

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

The descriptive statistics show that Nigeria experienced major changes in its oil-based economic indicators from 2000 through 2024. The government collected an average monthly revenue of ₦512.29 billion, which showed high volatility because the standard deviation reached ₦216.88 billion. The oil market reached its highest revenue point of ₦898.45 billion during the boom period but experienced its lowest revenue of ₦121.54 billion during market downturns. The distribution maintains a balanced structure because its skewness value stands near zero, yet it shows major fluctuations across the entire duration.

The average cost for crude oil barrels stands at \$71.51 which indicates that international market shocks have a strong impact on prices. The market price showed extreme volatility between its lowest point of \$20.54 and highest point of \$109.45 which proved both steep price declines and market recoveries. The average production rate of crude oil stayed at 2.10 Mbpd but the industry faced ongoing production challenges because of militancy activities and pipeline vandalism and output restrictions which caused drops to 1.78 Mbpd.

The exchange rate (EXR) shows the most severe volatility, averaging ₦300.87 per USD, but rising steeply from ₦106.78/\$ in 2000 to ₦1,535.00/\$ in 2024, especially after

currency liberalisation and external shocks. The Jarque-Bera statistics indicate that GR and EXR show major deviations from normal distribution at the 1% significance level while OP and PROD show deviations at the 5% and 10% significance levels respectively. The subsequent analysis demands robust modelling and non-linear econometric techniques because of this non-normal behaviour.

### 4.3 Correlation matrix and multicollinearity test

**Table 2**

*Correlation Matrix*

Variable	GR	OP	OPV	PROD	EXR	log(MS)	PROD_SHOC K
<b>GR</b>	<b>1.000</b>						
<b>OP</b>	0.687** *	<b>1.000</b>					
<b>OPV</b>	- 0.412** *	- 0.328** *	<b>1.000</b>				
<b>PROD</b>	0.523** *	0.234** *	- 0.187**	<b>1.000</b>			
<b>EXR</b>	0.765** *	0.456** *	- 0.298** *	0.312** *	<b>1.000</b>		
<b>log(MS)</b>	0.821** *	0.512** *	- 0.345** *	0.398** *	0.892** *	<b>1.000</b>	
<b>PROD_SHOC K</b>	- 0.289** *	- 0.198** *	0.432** *	- 0.567** *	- 0.221** *	- 0.256** *	<b>1.000</b>

Source: Author's Computation

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

Government revenue shows positive relationships with oil price at 0.687 and exchange rate at 0.765 and money supply at 0.821 which shows these elements function as fundamental drivers of oil revenue according to theoretical predictions. The resource curse hypothesis finds support from the negative relationship between government revenue and oil price volatility at -0.412 because this pattern shows that price instability results in lower fiscal revenues. The analysis of oil price volatility shows three market factors which display adverse relationships with oil prices at -0.328 and production levels at -0.187 and exchange rates at -0.298 which indicates market instability emerges during difficult market conditions. The data shows that production shocks lead to decreased

government revenue and production levels while creating higher market volatility which proves that supply disturbances result in increased price instability.

## 5 SUMMARY AND CONCLUSIONS

The study concluded that fluctuations in international crude oil prices remain a major source of financial disruption to Nigeria's economy because of the country's high dependence on oil revenue. The research showed that government revenue reacts strongly to both price fluctuations and the associated market instability that emerges from these changes. The GARCH framework analysis showed how market fluctuations spread through fiscal systems to disrupt revenue estimates which causes reduction in government development implementation power. The research shows that price volatility creates two distinct effects on government budgets since it changes prices and creates long-lasting unstable financial patterns which damage fiscal stability. The explanation shows that high oil prices have not consistently led to long-term economic stability but price decreases have consistently resulted in major budget shortfalls. The current economic system in Nigeria makes the country vulnerable to outside market disturbances which creates major challenges for government planning and capital investment and social service delivery. Tackling the impact of oil price volatility therefore demands far-reaching reforms in fiscal management, institutional strengthening, and economic diversification rather than temporary or reactive policy responses.

In light of the findings arising from this study, it is recommended that the government of Nigeria create a fiscal plan that removes public spending from the unpredictable short-term variations in oil revenue because oil price volatility creates major revenue losses for the country. The budget planning process should base its decisions on long-term oil price predictions instead of using current market prices, and excess revenue from high-price periods should be directed into the sovereign wealth fund to support revenue shortfalls.

Also, the positive effect of crude oil prices on revenue reinforces the need for deliberate measures to reduce the dominance of oil in national income. A clear diversification roadmap should be implemented to lower dependence on oil revenue from the current 60–70% to below 40% within the next decade. The government needs to create

strategic policies that support agriculture and manufacturing and technology and tourism sectors to develop infrastructure that will attract investments and generate employment opportunities. The continuous irregular pattern of oil price volatility requires institutions to develop predictive systems which will assist them in handling revenue risk.

In addition, Nigeria needs to develop its medium-term expenditure frameworks while establishing counter-cyclical fiscal policies to minimize the recurring financial consequences of oil price fluctuations on its public finances. The government should stop increasing its budget during times of high oil prices because it needs to focus on creating sovereign wealth funds and debt repayment systems which will protect vital social programs and infrastructure projects when revenues decline.

This research presents actual data which shows how crude oil price instability affects Nigerian government income during multiple decades that include both rising and falling periods of the international oil industry. The research shows through GARCH analysis that financial losses from market volatility exist separately from oil prices which means price hikes alone cannot stabilize the market. The study demonstrates that Nigeria's oil market reacts differently to shocks while proving that market volatility creates a self-reinforcing pattern that affects upcoming oil price fluctuations. The research findings help us understand fiscal risk in economies that rely on natural resources while creating better methods for handling government funds, assessing financial threats, and guiding economic transformations.

The study examined how oil price volatility affects government revenue, but scientists need to conduct additional research in multiple areas. Future research should analyze how market instability influences the different components of government revenue which include petroleum profit tax, royalties, and signature bonuses. Research needs to determine how oil price shocks affect government spending and economic development through different stages of economic growth and recession. The research requires a comparative study between Nigeria and other oil-producing nations that maintain strong institutional systems to determine how governance quality influences market volatility effects. The development of a sovereign wealth fund model that suits Nigeria's fiscal system requires additional research to proceed. The research on global energy transition effects on long-term fiscal stability will guide Nigeria in developing strategies for its post-oil economic transition.

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