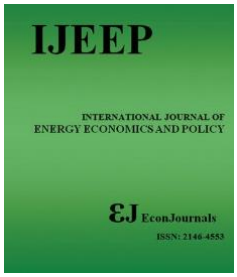

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Crude Oil Price Volatility and the Nigerian Economy

Chukunalu Mgbomene[1], Felix Onoriode Ashakah[1]*, Felix Chukwuka Metieh[1], Esther Nkechi Okoro[2], Henry Chinedu Dim[3], Festus Ndidi Opara[1]

[1]Department of Economics, Delta State University, Abraka, Delta State, Nigeria, [2]Department of Economics, Wigwe University, Isokpo, Rivers State, Nigeria, [3]Department of Insurance and Actuarial Science, Imo State University, Owerri, Nigeria.
*Email: Ashakah.felix@delsu.edu.ng

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ABSTRACT

This research analyzed crude oil price volatility and the Nigerian economy for the period 1990:Q1-2023:Q4. The independent variables were crude oil price, exchange rate and oil revenue while the dependent variables were GDP, government revenue, foreign exchange reserve and income level (per capita income). Four models were formulated. Data were analyzed using the Generalized Autoregressive Conditional Heteroskedasticity (GARCH). The results revealed strong evidence of volatility clustering in crude oil prices; the availability of new crude oil prices increased conditional volatility by a high magnitude. There was a significant negative effect of crude oil price volatility on the growth of the Nigerian economy while crude oil price volatility increased Nigeria's foreign reserve, government revenue and income level. In addition, the exchange rate and oil revenue significantly increased the crude oil price volatility – an economic growth nexus in Nigeria. The study concluded that crude oil price hurts the Nigerian economy. However, crude oil price volatility exerted a positive effect on government revenue, foreign exchange reserve and income level in Nigeria during the period of the study. It was recommended that the government should devise a strategy to deviate the economy away from oil dependency to make the economy less vulnerable to oil price shocks.

Keywords: Government Revenue, Income Level, Conditional Volatility, Crude Oil Price Volatility, Foreign Exchange Reserve.
JEL Classifications: C53, E32, E64, F43

1. INTRODUCTION AND BACKGROUND TO THE STUDY

Since the early studies of Derby (1982) and Hamilton (1983), oil price volatility and its relationship to economic development have continued to create and draw researchers' interest. Although the authors' empirical data suggests that exogenous shocks to oil prices have a large influence on economic growth, this evidence appears not to hold in the mid-1980s, when serious declines in oil prices did not result in an output boom during the era. Throughout the years, this occurrence has sparked a number of discussions among researchers. The consequences of rising oil prices on a nation's economic activity, and the amount of that impact, is heavily influenced by whether the country imports or exports oil. For example, oil exporters such as Nigeria, Kuwait, Saudi Arabia, and Libya benefit from increased foreign reserves and improved balance of payments conditions. This is especially true when the receipts from oil exports exceed the expenditure for imports and other merchandise. However, oil importers are expected to face high production costs, unemployment, balance-of-payments imbalances, and resource depletion. On the other hand, a drop in oil prices tends to help importers while putting exporters on the losing side.

The current focus of the debate on oil price volatility in the international market is how volatility affects output decisions made by producers such as the Organization of Petroleum Exporting Countries (OPEC), independent petro-states such as Russia, and

private oil-producing companies such as ExxonMobil. This is because oil is a commodity, and as such, its price fluctuates more than more stable investments like equities and bonds. The patterns of oil prices in the worldwide market show that the price of oil plummeted alarmingly from a peak of $104/barrel by the third quarter of 2014. More specifically, the OPEC average monthly basket price of oil peaked at $107.89/barrel in the second quarter of 2014 and fell dramatically to $59/barrel in the fourth quarter of 2014. It further decreased to $54.4 during the first quarter of 2015, resulting in Nigeria facing a quick and large dip in revenue inflow from oil sales (Gumi et al., 2016). By 2020, oil price per barrel rose marginally to $82.95, in 2023 it remained $82.95 and by end of 2024, it had dropped to $79.86 (Statista, 2024).

Nigeria as a country relies heavily on oil for economic existence. According to the 2023 BP Statistical Energy Survey, Nigeria's proved oil reserves were 37.1 billion barrels by the end of 2023, accounting for around 2.2% of global reserves. Furthermore, the nation has proved natural gas reserves of 5.1 trillion cubic meters, which contributes to 2.7% of the global total at the end of 2015, growing to 10 trillion by 2023. Nigeria's oil output averaged 2.1 million barrels/day in 2015, with a refinery capacity of 407,800 barrels/day. This figure is expected to fall to 1.4 million bpd by 2023. Furthermore, petroleum exports are valued at 41,818 million dollars, accounting for 45,365 million dollars in total export value (OPEC annual statistics report 2023). This industry earns around 91% of foreign profits and contributes 82% of the government revenue.

Like a number of oil-exporting countries, the Nigerian government often uses a projected oil price as a baseline for its yearly budget, which serves as the foundation for government spending and other fiscal planning. Any price above the expected price is termed a reserve. Thus, Nigeria's foreign reserves peaked at $547.36 billion in 2013 and fell to $351.02 billion in 2023 (CBN, 2023). One of the motives for retaining external reserves is to provide a buffer and security for the home currency and the economy as a whole. According to Akpan and Ala (2016), external reserves management, together with fiscal policy, provides a coherent framework for preserving macroeconomic equilibrium and minimizing external shocks that may impact the economy. Because the Nigerian economy is an import-dependent economy and relies heavily on the earnings from the sale of crude oil, any fluctuation in the price of crude oil always has an influence on both the supply and demand sides of the economy. To preserve economic stability, the government need a consistent and predictable flow of foreign reserves to ensure the economy's steady exchange rate. To achieve this, oil prices must be moderately high on the international market, and the country's oil supply must be stable.

In a mono-economy like Nigeria, oil price fluctuations make forecasting the economy's future difficult owing to the depletion of oil money and the poor distribution and abuse of this currency (Abass and Ibekwe, 2022). Since Nigeria imports refined oil, there has been much disagreement over whether this is required. The International Monetary Fund (IMF, 2023) estimates show that oil price per barrel fell to $41.5 in 2020 and the price has remained at $82.95 as at end of 2023. In a mono-economy like Nigeria, oil price fluctuations make forecasting the economy's future difficult owing to the depletion of oil money and the poor distribution and abuse of this currency (Abass and Ibekwe, 2022). Since Nigeria imports refined oil, there has been much disagreement over whether this is required.

Some empirical efforts have been made to unravel the connection between oil price and Nigerian economy (Agu and Nyatanga, 2024; Ahmed and Habiba, 2022; Jack and Akidi, 2024; Kutu and Ohonba, 2024; Okoro, 2024; Onodje et al., 2024; etc.). In most of these studies, conflicting positions are noticeable but general findings show that while oil price changes have significant relationship with macroeconomic variables, it does not significantly affect output growth in Nigeria. Though most of the studies employ Vector Autoregression to estimate shocks and observe the reactions of macroeconomic variables to the oil price shocks but they did not give consideration to the issue of volatility clustering of oil price on key growth indicators. However, study by Mordi and Adebiyi (2019) examined the asymmetric effect of oil price on output and price with conclusion that impact of negative oil price shocks has greater effect than positive oil price shocks on the two variables (output and price). To properly extend the frontier of knowledge in this area, this study uses GARCH modeling. This is very important as many studies in the past were not able to establish a volatility clustering in oil prices and key macroeconomic variables and this calls for concern given the importance of the sector to foreign earning and foreign reserve management in Nigeria.

Again, as one of the largest oil producers in Africa, Nigeria's economy heavily relies on oil revenues, which constitute a substantial portion of its national income. When crude oil prices rise, it is imperative that Nigeria experiences economic growth, increased government revenues, and improved foreign exchange reserves. However, these benefits are frequently undermined by periods of price decline, leading to budget deficits, reduced public spending, and economic instability. The volatility of oil prices poses myriad of challenges for Nigeria. Fluctuating prices can disrupt long-term economic planning, complicate fiscal policies, and hinder development initiatives. Thus the problem identified by this study lies in the need to comprehend and forecast future growth in GDP, income level, foreign reserve and government revenue given the volatility in crude oil prices. When we have a proper understanding of this through forecasting by GARCH modeling, then policy direction that will set the economy on a sustained growth notwithstanding the price of crude oil will be made possible.

The main objective of this research is to examine the relationship between crude oil price volatility and the Nigerian economy. To achieve this main objective, the study specified the following specific objectives which are to:

i. Ascertain the extent to which volatility in crude oil prices affect Nigeria's economic growth;
ii. Determine the impact of crude oil price volatility on government revenue in Nigeria;
iii. Examine the volatility in crude oil prices and how it affects income level in Nigeria; and
iv. Investigate how volatility in crude oil prices affect Nigeria's foreign exchange reserve.

In line with the specific objectives of the study, the following null hypotheses are tested in the study:

H_{01}: There is no significant relationship between volatility in crude oil prices and Nigeria's economic growth.

H_{02}: Volatility in crude oil prices do not significantly impact government revenue in Nigeria.

H_{03}: Volatility in crude oil prices do not significantly influence income level in Nigeria.

H_{04}: Volatility in crude oil prices has no significant influence on Nigeria's foreign exchange reserve.

The significance of studying the relationship between crude oil price volatility and the Nigerian economy, lies in several critical areas. First, understanding these effects provides valuable insights into the economic vulnerabilities that arise from heavy dependence on oil sector. Given that oil accounts for a significant portion of Nigeria's GDP and government income, volatility in prices can lead to profound economic instability. This research can help policymakers identify strategies to mitigate risks associated with price volatility. Second, the study contributes to the broader discourse on sustainable economic development. As global energy dynamics evolve and the world increasingly shifts toward renewable energy sources, insights gained from Nigeria's experience can inform other oil-dependent economies about the importance of diversification and resilience.

The scope of this study encompasses a comprehensive examination of various economic dimensions. The research analyzes the relationship between volatility in crude oil prices and key economic indicators such as GDP growth, government revenue, income level and foreign exchange reserve. This analysis aims to identify patterns and correlations over a defined time period, providing insights into how these fluctuations impact Nigeria's overall economic stability. To provide a robust analysis, the research covers a defined historical timeframe, allowing for an examination of oil price trends. While the primary focus will be on Nigeria, broader trend analysis of the data on crude oil price will be carried out from 1990 through 2023.

2. LITERATURE REVIEW

2.1. Conceptual Review

Oil price volatility is linked with oil price oscillations. Volatility is therefore defined as periods in which markets exhibit large fluctuations over a long period of time, followed by periods of relative quiet. Every economic series swing, either favorably or adversely, upward or downward, but is not constant throughout time. Oil price volatility stems from changes or swings in either the demand or supply side of the global oil market (Hamilton, 1983). This might be due to a variety of causes, including political unrest in the oil-rich Middle East and rising oil consumption in Asia. This disruption has had a greater impact on oil-importing countries over time. Nigeria, for example, is a blessed nation with vast deposits of material resources ranging from crude oil, coal, and zinc, among others. However, due to mismanagement of these resources, Nigeria has turned to importing refined petroleum products as a result of the failure of local refineries in the late 1980s, which has continued till now, exposing the economy to the severity of oil price changes (Obioma, 2006).

On the other side, oil revenue is made up of crude oil sales, taxes on oil exploration businesses, and oil rents. But the greatest of them all is crude oil sales, which are naturally the result of oil prices and crude oil production volumes. Oil revenue might alternatively be defined as the total amount of income generated by the selling of crude oil in an economy. Thus, in an oil-producing economy like Nigeria, oil money is the source of public project financing. Therefore, it is expected that the generated revenue should be properly managed to promote economic growth and the wellbeing of the people.

Falling oil prices may cause difficulty for oil exporting countries by depleting revenue due to reduced profits or even losses. Nigeria is blessed with several assets, most notably huge natural resources, fertile land, and an enterprising people (Gravito et al., 2016). After a record of economic development due to substantial reforms and better political system, evidenced by a successful democratic dispensation, the economy sank due to the sharp drop in oil prices and political chaos arising from insurgency attacks and regional agitation for independence. The drop in oil prices has caused the currency (Naira) to plummet, exacerbating long-standing widespread and severe destitution as well as infrastructure deterioration. This has harmed both the cost and style of living of the vulnerable poor, who make up the majority of the population. Gravito et al. (2016) found that 82% of Nigerians are impoverished, living on <$2 a day, compared to 26% in South Africa. As a result, there has been increased misery, aggravated by the high degree of unemployment produced by little or no job development due to over-reliance on oil.

The overreliance on the oil and gas sector is causing significant economic difficulties. Certainly, the domestic sector is highly diverse, with energy accounting for only 13% of GDP. However, oil is the country's sole substantial export, making it the principal source of foreign money, accounting for around 70% of total government revenue. However, the impact of oil price volatility varies across oil-importing and exporting nations. As a result of demand and supply transmission processes, oil prices have a considerable influence on economic activity. From the supply side, crude oil is the fundamental input to production, and a rapid spike in oil price may cause enterprises' production costs to rise, resulting in decreased output. Oil price changes have an influence on consumption and investment due to demand-side effects. As a result, consumption is indirectly impacted by its positive relationship with the amount of money available for spending and saving after income taxes are deducted (i.e. disposable income). For example, the collapse in oil prices contributed to an economic recession in 2015, with an estimated 2.8% GDP growth rate in Nigeria (CBN, 2023).

The real GDP per capita is used as a measure of total economic well-being. Output per person is a good indicator of living levels. This allows for qualitative elements like as literacy and health, however they are not explicitly addressed. An increase in per capita real GDP indicates a boost in overall economic well-being.

Per capita consumption is another quantitative indicator used to quantify well-being development. According to Pradhan (2021), in developing nations, consumption is often regarded as the preferred single metric of well-being among economists. Arora (2023) provides support to the above thesis by emphasizing that consumption as a measure of people's well-being is favorable since it is something that is directly significant to consumers and is not included in the GDP.

2.2. Theoretical Framework

The Dutch sickness idea was developed to explain the Netherlands' poor economic performance after the discovery of North Sea oil. According to this notion, when a country has a natural resource boom, its currency rate rises, making its industrial exports less competitive. According to Ismail (2010), the Dutch disease may be understood as the process by which a boom in an asset of nature sector results in declining non-resource convertible. This same trend enhances the specialization of the natural resource sector, consequently, leaving the economy more sensitive to resource specific shocks. Corden and Neary (1982) classified the effect of Dutch disease on the economy into two categories: The resource movement effect and the expenditure effect. The resource movement effect is the aspect in which an increase in the price of the found resource causes the marginal product of value of the resource to grow, which therefore boosts wage rates in the newly discovered resource sector. The spending effect, on the other hand, can be seen as the increase in revenue accounted for by the natural resource discovered, particularly when its price dramatically increases. The huge income obtained paves the way for imports to increase, as well as domestic absorption for both tradable and non-tradable goods.

Proponents of the Renaissance growth model, on the other hand, believe that both oil price changes and fluctuations have a negative impact on economic growth, albeit in different ways (Lee, 1998 in Oriakhi and Iyoha, 2023). They also agreed that there is a link between crude oil prices and economic growth in both developed and developing economies; However, empirical data has shown that the impacts vary even within these nations. Similarly, both exporting and importing nations suffer the impact of variations in oil prices in various ways, depending on the internal system for stability.

This study is thus based on the Dutch illness and Renaissance growth concept. Both ideas provide a comparable but significantly different understanding of how oil affects the local economy. While a strongly oil-dependent economy suffers from unfavorable variations in crude oil prices, positive fluctuations cause the economy to expand. However, the economy's substantial reliance on oil exposes it to price shocks, which poses a significant risk to its overall viability. Thus, the link between changes in crude oil prices and economic growth can be best understood when these two theories are placed side-by-side with the findings from this study. The findings serve as a yardstick for testing the applicability of the theories in the case of the Nigerian economy.

2.3. Empirical Review

Augustine (2019) investigated the relationship and size of the effects of exchange rate fluctuations on oil prices, as well as their influence on Nigeria's economic performance. The variables used were gross domestic product, oil price, real exchange rate, trade openness, inflation, terms of trade, global gross domestic product, and global crude oil output. The two- stage least squares estimation result found that a 1% increase in the price of oil would positively influence the economic performance of Nigeria by a magnitude of 4%.

Madueme and Nwosu (2020) investigated oil price shocks and macroeconomic factors in Nigeria using yearly data from 1970 to 2008. The study employed the generalized autoregressive conditional heteroscedasticity model. The study discovered that capital spending and oil prices show positive indications, implying that oil prices stimulate economic growth. However, spikes in oil prices cause worry of undermining the economy. Similarly, Alley et al. (2014) appraised oil price shocks and Nigerian economic growth over the period 1981-2012. Estimation results from general method of moment revealed that, oil price shocks had negative and inconsequential impact on economic growth, while oil price itself has a positive relationship and a significant impact on economic growth.

Babajide and Soile (2015) studied oil price shocks and Nigeria's economic activity. The empirical study was conducted utilizing the VAR framework. The findings revealed that oil price shocks had an inverse influence on practically all of the variables utilized in the research; also, the asymmetric link between oil price shocks and GDP could not be substantiated because the effects were found to be small in all test results. The results clearly showed that oil price declines influenced the majority of macroeconomic indices than rises. Attamah and Okolo (2021) explored how crude oil price fluctuation affects the cost of living in Nigeria. Generalized autoregressive conditional heteroscedasticity was used to assess the impact of crude oil price volatility on Nigeria's shifting consumable price levels. Crude oil prices have a positive and large influence on Nigeria's consumer price index due to their volatility. The consumer price index's volatility in the preceding period, as well as knowledge about its prior volatility, had a major impact on its present volatility.

Imarhiagbe (2021) used monthly data from January 1995 to December 2019 to perform an empirical research on the 'conditional mean and external reserves volatility': The influence of crude oil price. The data was analyzed using GARCH-M and EGARCH-M. The study discovered that the 'volatility term' was statistically significant in the mean equations, indicating that the mean varies with volatility. It also demonstrated that fluctuations in oil prices have a direct impact on the volatility of external reserves. Ogbonna and Ebimobowei (2017) conducted an empirical analysis on the influence of petroleum revenue on Nigeria's economy between 1970 and 2009. The findings found that oil money had a favorable but non-significant effect on the country's GDP per capita. On the contrary, oil revenues tend to have a negative impact on inflation. This implies that oil income enriches a few well situated individuals in Nigeria due to its minimal influence on per capita GDP.

Abass and Ibekwe (2022) investigated the effects of oil price fluctuations on Nigeria's economic growth. The analysis found

that variations in oil prices had a major influence on Nigeria's economic growth. Furthermore, it was demonstrated that the interest and inflation rates had a considerable detrimental impact on Nigeria's economic growth. Ahmed and Habiba (2022) evaluated the influence of oil price and oil production on Nigeria's economic development from 1989 to 2020 using the Autoregressive Distributed Lag (ARDL) model. The ARDL limits test findings revealed the presence of co-integration among the variables. The ARDL model results showed a favorable link between oil prices and economic growth in both the short and long run. However, the analysis discovered that oil production has a negative influence on real GDP in the near run, but its effect in the long term is statistically negligible.

Ifeonyemetalu et al. (2022) investigated the impact of oil price volatility on Nigerian economic growth between 1984 and 2017. The study used the Generalized Auto-Regressive Conditional Heteroscedasticity (GARCH) (1, 1) model to evaluate the impact of oil price changes on Nigeria's economic advancement. The results suggested that oil prices had a positive and considerable influence on economic advancement in Nigeria. Furthermore, while oil price volatility has a positive impact on economic advancement, it is not large. Baghebo and Atima (2023) conducted a similar study on the influence of petroleum on Nigerian economic growth. They discovered that oil revenues had a statistically significant and negative influence on economic growth. In a study conducted by Abdul-Rahamoh et al. (2013), income from a country's natural resources, such as the petroleum profit tax, had a positive and significant impact on economic growth and development. The study used the OLS estimation technique to analyze data from 1970 to 2010 on the abundance of petroleum and its associated income.

Oriakhi and Iyoha (2023) examined the effects of oil price fluctuations on Nigerian economic development using quarterly data from 1970 to 2010. Empirical results from the variance autoregressive (VAR) model confirmed that oil price fluctuations affect real GDP. This shows that the level of government expenditure is determined by the price of oil at the current exchange rate. Oyalabu and Oyalabu (2023) used the Renaissance growth model to investigate the impact of crude oil prices on Nigerian economic development from 1985 to 2019. The data included crude oil price (independent or exogenous variable), real effective exchange rate, inflation rate, GDP growth rate, interest rate, and gross national spending. The Auto-Regressive Distributed Lag revealed a positive but statistically insignificant association between crude oil prices and economic growth in Nigeria.

Olayungbo (2023) investigated oil price's relative Granger causality link with Nigeria's Naira/US Dollar rate of exchange, balance of trade, and foreign currency reserves, using quarterly data from 1986:Q4 to 2021:Q1. Following the evidential outcomes, oil price was found cointegrated with foreign currency reserves, implying the presence of long-run affiliation. In the short run, it was also clear that oil prices had a large Granger effect on foreign currency reserves, with no causal relationship between international oil prices and trade balances or Naira/US dollar exchange rates. Bankole and Shuaibu (2023) used a Vector Autoregressive (VAR) model to analyze the link between oil prices and foreign currency reserve holdings. The Mundell Fleming configuration was used to study the expected relationship as it pertains to Nigeria. Their findings revealed a long-run foreign currency accumulation effect from oil (crude) price, as well as a relatively minimal holding effect on foreign currency reserves in the short run.

Adedipe (2024) investigated the co-movement and causation link between international oil price fluctuations and local food price inflation in Nigeria, showing convincing evidence to establish a causal relationship between oil price distortions and food price volatility in Nigeria. The Granger causality test revealed that causation flows from international oil price to domestic food price, implying that volatility in international oil price considerably influences the predictability of local food prices. Kutu and Ohonba (2024) investigated the dynamic link between crude oil price volatility and income generation in Nigeria over a 41-year period (1981-2021). The study used the Auto Regressive Distributed Lags model to investigate the long- and short-term effects of oil price volatility on revenue generation. According to the study, crude oil price volatility had little effect on overall income in Nigeria over the long term. Oil revenue has a significant and beneficial impact on total revenue, emphasizing its importance in revenue production.

Onodje et al. (2024) evaluated the effect of crude oil prices on the Nigerian currency rate, with an emphasis on differentiating between the impact of positive and negative changes in oil prices. The study used a monthly flow of data from 1996:1 to 2019:6, and implemented a non-linear ARDL (NARDL) model with two oil price proxies, Brent crude and West Texas Intermediary prices, using Wald tests to assess co-integration and asymmetric effects. The findings indicated that both favourable and inverse changes in Brent crude prices had a strong influence on exchange rates in the immediate and future terms, with differences only observed in the magnitude of the effect as the exchange rate decreased for both positive and negative oil price changes.

Agu and Nyatanga (2024) investigated how variations in oil prices effect Nigerian economic growth using quarterly data from 1980 Q1 to 2018 Q4. The researchers used the new Hamilton Index to the Structural Vector Autoregressive (SVAR) architecture. The study found that negative fluctuations in oil prices had a bigger impact on economic growth than other forms of oil price movements.

Manasseh et al. (2024) examined oil price movement and income creation in Nigeria before and during the covid-19 outbreak. Measures such as crude oil pricing, domestic production, crude oil export and income, and revenue generation were evaluated before, during, and after the covid-19 epidemic. The research demonstrated that during the Covid-19 epidemic, oil prices and income creation were significantly impacted because to restrictions on people's movements and economic activities. As a result, the analysis indicated a severe reduction in crude oil prices, exports, and domestic production (MBD), particularly during the first quarter of 2020.

Akinlo (2024) studied the influence of lower/higher oil prices on income inequality in Nigeria using yearly data from 1981 to 2018. The results of the nonlinear autoregressive distributed lag approach (NARDL) and vector error correction modeling techniques revealed that changes in oil prices had an asymmetric influence on income inequality only in the short term. Negative oil price shocks considerably decreased income disparity, but positive shocks increased it, albeit not significantly. Jack and Akidi (2024) examined the empirical reaction of Nigerian foreign reserves to changes in world oil prices. Using the process Autoregressive Distributed Lag (ARDL), the study revealed that in the short run, external reserves increased with rising Brent crude oil prices, though insignificantly; trade openness had a negative and insignificant effect; and the Naira to Dollar exchange rate depreciation enhanced the country's external reserves. Using the ARDL method, Oyeniran and Alamu (2024) analyzed the optimal level of foreign currency reserves for Nigeria by adapting to Frenkel and Jovanovic's (1981) "buffer stock model." The study revealed that changing costs of accumulating reserves and volatility in exchange rates were critical factors for Nigeria's optimal external currency reserves level.

2.4. Gap in Literature

Empirical evidence shows that there is ample literature on the effect of oil price volatility on the economy of Nigeria and other developing and developed countries. However, recent studies such as Bankole and Shuaibu (2023), Jack and Akidi (2024), Oyeniran and Alamu (2024), etc. examined oil price changes using variables like external currency reserves level, inflation rate, interest rate etc. Additionally, these studies adopted methodologies such as ARDL and VAR analysis to achieve the specific objectives. The study of oil price fluctuation and economic growth using only one intervening variable (exchange rate) has not been carried out by any previous researcher to the best of the author's knowledge. Also, examining volatility clustering in oil price and how it affects key growth indicator such as GDP, foreign reserve, income level and government revenue is a gap in literature which this present study seeks to close.

Again, there were few studies on oil price fluctuations in Nigeria that used monthly or quarterly data. Such works include Imarhiagbe (2021), Babajide and Soile (2015), Babayev (2010), Oriakhi and Iyoha (2023). There is need for more specific studies that will examine monthly data on crude oil price and how it affects the key growth indicators and that will yield more robust conclusions.

3. RESEARCH METHODOLOGY

The analytical nature of this research work calls for the use of historical data otherwise known as secondary data and as such this study adopts quasi-experimental research design. This is because the study of the relationship between oil price volatility and the Nigerian economy deals with past values of oil price and other associated variables and their relationship with economic growth indicators. The analysis of the data using econometric procedures makes it analytical research since the result of the analysis forms the bedrock of the findings and conclusions to be drawn.

The analytical research design involves gathering and tabulation of the data for ease of comprehension. Subsequently, the data are subjected to unit root test in order to ascertain the stationarity or otherwise of the data. Then the long run relationship is tested before the model is estimated using the GARCH modeling technique.

The data for the study are from the 2023 editions of the Central Bank of Nigeria Statistical Bulletin, National Bureau of Statistics (NBS) Annual abstracts and Organization of Petroleum Exporting Countries (OPEC) annual publications for various years. The data are converted to quarterly series using the linear conversion method in Eviews 9. This method is mostly reliable for time series econometric analysis involving volatility

3.1. Model Specification

Following the empirical work of Oyalabu and Oyalabu (2023), it was observed that there are key factors that affect oil price which invariably affect the economy. They include exchange rate, interest rate, inflation rate and gross national expenditure. Mordi (2006) held that oil price is prone to volatility hence its effect on the economy does not remain constant over time. In trying to establish this fact, Oyalabu and Oyalabu (2023) specified a model using crude oil price, exchange rate, interest rate, inflation rate and gross national expenditure as independent variables with GDP being the dependent variable. However, the model is modified by specifically identifying exchange rate and oil revenue as key intervening variables in the oil –price – economic growth nexus.

$$GDP = f(COP) \quad (1)$$

$$GDP = f(COP, EXR, OIR) \quad (2)$$

Where GDP is gross domestic product, COP is crude oil price, EXR is exchange rate and OIR is oil revenue.

Expanding the model to include the growth indicators, we have the model as:

$$\ln GDP_t = \alpha_0 + \alpha_1 * \ln COP_{t-1} + \alpha_2 * \ln EXR_{t-1} + \alpha_3 * \ln OIR_{t-1} + \varepsilon_{it} \quad (3)$$

$$\ln GREV_t = \beta_0 + \beta_1 * \ln COP_{t-1} + \beta_2 * \ln EXR_{t-1} + \beta_3 * \ln OIR_{t-1} + \varepsilon_{2t} \quad (4)$$

$$\ln PCI_t = \lambda_0 + \lambda_1 * \ln COP_{t-1} + \lambda_2 * \ln EXR_{t-1} + \lambda_3 * \ln OIR_{t-1} + \varepsilon_{3t} \quad (5)$$

$$\ln FER_t = \gamma_0 + \gamma_1 * \ln COP_{t-1} + \gamma_2 * \ln EXR_{t-1} + \gamma_3 * \ln OIR_{t-1} + \varepsilon_{4t} \quad (6)$$

Where: GDP = Gross domestic product, GREV = Government revenue, PCI = Per capita income, FER = Foreign exchange reserve, COP = Crude oil price volatility (obtained from the GARCH model), EXR = Exchange rate, OIR = Oil revenue, α_0 = Intercept of the model, $\beta_1$and β_2 = Unknown coefficients of the model to be estimated, t−1 = Time lag effect and 'ln' is the natural logarithm connotation.

3.2. Estimating the Volatility of Oil Price Using GARCH

The major property of financial time-series which are high-frequency values include volatility clustering, excess kurtosis, heavy-tailed distribution, leverage impact, and long memory qualities (Omari et al., 2017). These properties have traditionally been investigated using the Autoregressive Conditional Heteroscedasticity (ARCH) and Generalized Form (GARCH) models. The preceding equation (7) represents the variance equation in differenced logarithmic oil price. Before beginning to describe volatility models, it is important to provide a quick explanation of the term volatility, at least for the sake of clarification. Volatility refers to the spread of all likely outcomes of an uncertain variable. Statistically, volatility is often measured as the sample standard deviation:

$$\hat{\sigma} = \sqrt{\frac{1}{\tau - 1}\sum_{t-1}^{\tau}(\tau_1 - \mu)^2} \quad (7)$$

Where r_t is the return on day t and μ is the average return over the T-day period. Sometimes, variance, σ^2 is used also as a volatility measure (Omari et al., 2017). Volatility is related to, but not exactly the same as, risk. Risk is associated with undesirable outcome, whereas volatility as a measure strictly for uncertainty and could be due to a positive outcome (Pradhan, 2021). This study uses the variance of oil price as a measure of volatility.

The main purpose of modeling volatility is being able to forecast future trends. The symmetric and asymmetric effect of GARCH family models have been used here to model the volatility of oil price. Symmetric effect models such as GARCH (p,q) and asymmetric effect have been captured through the adoption of GARCH (p,q) and Exponential GARCH (p,q).

Conditional variance equation for ARCH (q): The conditional variance equation is calculated as a constant + the previous value of the squared error:

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \cdots + \alpha_i u_{t-i}^2 \quad (8)$$

It should be noted that α_1 has to be positive since σ_t^2 itself and u_{t-1}^2 has to be positive as they are squared terms. Increasing the value of q in ARCH(q) model where q is the number of lags in conditional variance equation, would eventually remove ARCH effect from residuals, and this probably is not the most parsimonious model. The parsimonious model however simply means accurately modeling a variable with the fewest possible parameters. We will estimate GARCH (1,1) model since this is more parsimonious (uses fewer parameters in the conditional variance equation).

3.3. Measuring Forecast Accuracy

The Root mean square error (RMSE), Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE) are well-known models in measuring forecast accuracy of a time series. The formulas of the three models are as bellow;

$$RMSE = \sqrt{\sum_{t}^{n}\frac{e_t^2}{n}} \quad (9)$$

Where $e_t = y_t - \bar{y}_t$ with y_t being the actual value of returns, and being the fitted value from one of the estimated models with the same date. Finally, n is the number of forecasted observations.

$$MAE = \frac{\sum_{t-1}^{n} y_t - x_t}{n} \quad (10)$$

Where y_t is prediction, x_t is the value and n is the number of forecasted observations.

$$MAPE = \frac{1}{n}\sum_{t-1}^{n}\frac{A_t - F_t}{A_t} \quad (11)$$

Where A_t is actual value, F_t is forecast value and n is the number of forecasted observations. There are two different forms of each model; dynamic and static. Dynamic Models allow you to make a multiple-step-ahead forecast, while Static Models consist of a series of rolling single-step ahead forecasts.

3.4. A-Priori Expectation

In consonance with economic theories, an increase in oil price means that there is positive trend in the world oil market; therefore it is expected to produce a direct and positive effect on economies of developing nations such as Nigeria. It follows that a decrease in oil price is expected to deplete the country's economy. This is the volatility effect of oil price. Exchange rate also is expected to exert positive effect on crude oil price towards influencing the growth indicators positively.

Therefore, in equation (3), the expectation is such that: $\alpha_1 > 0$, $\beta_1 > 0, \lambda_1 > 0$, and $\gamma_1 > 0$. i.e. the volatility in oil price is expected to have positive effect on the economic growth and other indicators likewise the intervening variable exchange rate.

4. DATA ANALYSIS AND DISCUSSION

The standardization of the data was made possible by converting the variables into their natural logarithm forms in Eviews version 9. The trend of progression in the variables is such that GDP, crude oil price, exchange rate and oil revenue showed steady increase over the years and as such they are deemed to have constant and trend. Even though crude oil price showed evidence of fluctuations in many years, the fluctuation effect on the economy is the subject of the main objective of this study. The average of the quarterly figures gives us the annual rate or value.

It is also worthy of note that the data on crude oil price volatility was generated using the GARCH effect "proc" menu in Eviews 9. This represents the GARCH variance series for crude oil price and is the volatility effect that this study is measuring.

4.1. Descriptive Statistics

The descriptive statistics involves a critical examination of the mean, standard deviation, Kurtosis and Skewness of the data in

order to understand the statistical patterns and the suitability of the data for the analysis (Table 1).

The average GDP for the period was N45,229 trillion. With a standard deviation of N2,0271 trillion, it is observed that about one-half of the combined average GDP deviated from the mean which implies that GDP is spread out over a wide range and has a wide variance, relative to the mean. Again, government revenue and foreign exchange reserve averaged N5,492 trillion and USD 283,521 billion for the period with standard deviations of 4,752 and 201,719 respectively. This implies that both data are not far from the mean. Similar scenario is seen in the mean and standard deviation for per capita income (PCI), exchange rate (EXR) and oil revenue (OIR). For crude oil price (COP), the average is $49.7 while the standard deviation is 31.49; as such, the data has minimal deviation from the mean point.

Again, the data are all skewed to the right had side of the standard normal curve given the positive values of the skewness and kurtosis. Jarque Bera statistics have probability values that are all <0.05 critical value. This means that the assumption of normality in the data is not fulfilled and as such we conclude that the data are not normally distributed. The non-normally distributed data implies that uneven mean distribution is assumed in the data this necessitates the need to take the natural logarithm of the data in order to obtain a standardized data that is free from spuriousity.

4.2. Test for Unit Root

The Table 2 shows the summary of the unit root test. The Augmented Dickey Fuller Unit Root test shows that the variables are all stationary at first difference, thus:

Table 2 shows that all the variables became stationary after first differencing; which implies that the variables are integrated of order one I~(1). Further implication of this is that the statistical properties of the variables are constant after first differencing hence they do not change or differ over the time period studied. Thus, we have confirmed the predictive ability of the series subject to confirmation of their long run convergence.

4.3. Test for Long Run Relationship

Given that the variables were integrated of order one I(1), it becomes imperative that we employ the Johansen cointegration test in order to ascertain the long run relationship that exists amongst the variables. This is summarized in the Table 3.

The Johansen co-integration test uses both the Trace test and the Likelihood Eigen value test to determine the long run relationship amongst variables. The first row in each of the table test the hypotheses of no co-integrating relation, the second row test the hypothesis of one co-integrating relation and so on, against the alternative of full rank of co-integration. From the result in Table 3, using the Trace test of detecting co-integration test, we can see that there are 3 co-integrating equations in the first model (COP and GDP), one cointegrating equation in the second and third models (COP and GREV; COP and FER), while the fourth model has two cointegrating equations (COP and PIC). Therefore, since there exist at least one cointegrating equation in each of the models, we conclude that there is a long run relationship between crude oil price fluctuation and economic growth indicators (GDP, GREV, FER and PCI) Nigeria.

4.4. Estimating Volatility in Crude Oil Price

Estimating a GARCH process typically involves an estimation of two interrelated equations (Nelson, 1991). That is the mean equation and the variance equation. EGARCH (1, 1) model is the most popular form of conditional volatility, especially for financial data where volatility shocks are very persistent. As opposed to the standard GARCH model which necessitates that all estimated coefficients are positive, EGARCH does not require non negativity constraint (Nelson, 1991), the result is summarized in Table 4.

The GARCH model presented in the Table 4 seems plausible. The coefficient of crude oil price (COP) is theoretically plausible and statistically highly significant. The D-W statistic of 1.921 does not point to serial correlation problems. The constant which is negative implies that the economy is moving on a negative trend given that crude oil price is held constant. This underlines the importance of crude oil and the study of its volatility in determining optimal growth of the economy. Moreover, the sum of conditional variance parameters, i.e. RESID$(-1)^2$ and GARCH(-1) or the sum of the $\alpha + \beta$ in Table 4 is 0.944, which is <1, but very high. This implies GARCH(1,1) process for the error term "ε" is weakly stationary and depicts the high volatility persistency inherent in crude oil price movements.

The coefficient to RESID$(-1)^2$, is 0.713202 and is significant at the conventional 5% level. This implies very strong evidence of volatility clustering and also that availability of new information increases conditional volatility by a magnitude of 0.713. Similarly, GARCH(-1) parameter is 0.2311 and is also highly significant at

Table 1: Summary of the descriptive statistics

Descriptive Stat.	GDP	GREV	PCI	FER	COP	EXR	OIR
Mean	45229.70	5492.259	1411.433	283521.9	49.68088	161.2174	3319.309
Median	41997.18	5509.938	1530.538	337461.6	40.65328	130.7400	3547.055
Maximum	77408.17	21699.96	3261.820	712262.0	112.5953	769.9144	9236.609
Minimum	21347.71	85.65625	249.0606	19869.44	11.82438	7.756250	64.91875
Standard deviation	20271.36	4752.797	877.2010	201719.5	31.49704	142.6564	2574.447
Skewness	0.162832	0.747883	0.333597	0.139196	0.591781	1.525422	0.274815
Kurtosis	1.389810	3.315708	1.893353	1.629058	2.013199	5.898250	2.002957
Jarque-Bera	15.29302	13.24292	9.462278	11.08957	13.45605	100.3425	7.345069
Probability	0.000478	0.001331	0.008816	0.003908	0.001197	0.000000	0.025412
Observations	136	136	136	136	136	136	136

Source: Extracted from Eviews Analysis

the conventional 5% level, which implies presence of a GARCH term and that there is autoregressive persistence of conditional volatility (Figure 1).

The movement of the GARCH graph represents the reaction of the economy to volatility in crude oil price for the period under review. There is up and down movements noticed from 1990 through to 2023. Particularly, there is very high volatility from 2005 to 2009 and again from 2015 to 2019. The year 2020 also witnessed high volatility. The upwards trends represent the periods crude oil price deviated from the zero mean line and this portends serious implications for the economy. Thus, the implication is that the volatility clustering experienced in crude oil price moves the economy towards a high-price regime thereby raising other macroeconomic variables.

Table 2: Summary of unit root test

Variable (s)	ADF test statistics		Decision	Order of integration
	At level	At 1st difference		
GDP	−2. 2917	−4.3906	Stationary at 1st difference	I (1)
GREV	−1.6842	−6.7376	Stationary at 1st difference	I (1)
PCI	−1.3001	−8.0094	Stationary at 1st difference	I (1)
FER	−2.3104	−3.7285	Stationary at 1st difference	I (1)
COP	−2.0001	−3.8903	Stationary at 1st difference	I (1)
EXR	2.5743	−9.7647	Stationary at 1st difference	I (1)
OIR	−2.2286	−3.4678	Stationary at 1st difference	I (1)

Critical value at 5% level=−3.4448
Critical value at 5% 1st difference=−3.4459
Source: Extracted from E-views 9 Output

4.5. Volatility in Crude Oil Price with the Intervening Variables

The above analysis shows the single-effect of crude oil price volatility on the economy. However, this present study deviates from previous studies by introducing other key intervening variables (exchange rate and oil revenue). Table 5 summarizes the GARCH model with the intervening variables.

The GARCH model with intervening variables presented in Table 5 also appears close to what is being experienced in the real life situation. The coefficient of crude oil price is negatively related to GDP and statistically significant. This implies that there is a significantly negative effect of crude oil price fluctuation on Nigeria's economic growth (GDP).

For the other three dependent variables (government revenue, foreign exchange reserve and per capita income), crude oil fluctuation showed positive effects on these variables increasing them by 52.5, 382.3 and 6.6 units respectively. This implies that the fluctuations in crude oil prices has significantly positive effect on government revenue in Nigeria, it increases Nigeria's external reserve and enhances income level in Nigeria. Similar positive and significant effects were witnessed for other intervening variables (exchange rate and oil revenue).

The D-W statistics of 1.884, 1.994, 1.773 and 1.836 did not point to serial correlation problems. The intercepts which are all negative implies that GDP, government revenue, foreign exchange reserve and per capita income are moving on a negative trend given that crude oil price is held constant at zero. This is strong evidence that crude oil price determines the movement of the macroeconomic variables and its volatility affects the overall economic growth of Nigeria.

Table 3: Johansen cointegration test

	Trace statistic				Max-eigen statistic		
Hypothesized No. of CE (S)	Eigen-value	Trace statistics	5% critical value	Prob.	Max-Eigen statistics	5% crit. value	Prob.
COP and GDP							
None*	0.287040	86.57851	47.85613	0.0000	44.32116	27.58434	0.0002
At most 1*	0.194232	42.25735	29.79707	0.0011	28.29074	21.13162	0.0041
At most 2	0.066136	13.96661	15.49471	0.0839	8.963604	14.26460	0.2892
At most 3*	0.037471	5.003007	3.841466	0.0253	5.003007	3.841466	0.0253
COP and GREV							
None*	0.341016	78.63867	47.85613	0.0000	54.63439	27.58434	0.0000
At most 1	0.112260	24.00427	29.79707	0.2002	15.59896	21.13162	0.2491
At most 2	0.047084	8.405318	15.49471	0.4231	6.317991	14.26460	0.5728
At most 3	0.015808	2.087327	3.841466	0.1485	2.087327	3.841466	0.1485
COP and FER							
None*	0.251737	59.84190	47.85613	0.0025	37.99006	27.58434	0.0016
At most 1	0.084975	21.85185	29.79707	0.3068	11.63337	21.13162	0.5841
At most 2	0.061413	10.21848	15.49471	0.2643	8.302801	14.26460	0.3487
At most 3	0.014517	1.915676	3.841466	0.1663	1.915676	3.841466	0.1663
COP and PCI							
None*	0.483384	139.4545	47.85613	0.0000	86.51957	27.58434	0.0000
At most 1*	0.270564	52.93492	29.79707	0.0000	41.32839	21.13162	0.0000
At most 2	0.059258	11.60653	15.49471	0.1768	8.002243	14.26460	0.3785
At most 3	0.027139	3.604288	3.841466	0.0576	3.604288	3.841466	0.0576

Source: Extracted from E-views 9 Output

Figure 1: Conditional standard deviation GARCH graph

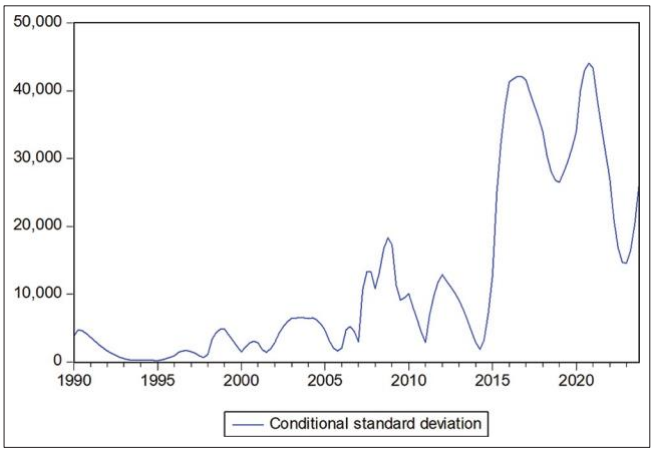

Table 4: Estimating crude oil price volatility

Mean Equation				
Variable	**Coefficient**	**Standard error**	**z-Statistic**	**Prob.**
COP	388.0698	1.812533	214.1036	0.0000
C	−121.2814	2.149336	−56.42736	0.0000
Variance equation				
C	4.323352	16.38235	0.263903	0.7919
RESID(−1)^2	0.713202	0.135196	5.275319	0.0000
GARCH(−1)	0.231124	0.068406	3.378726	0.0007
R-squared	0.880395	S.E. of regression		17345.08
Adjusted R-squared	0.879657	Durbin-Watson stat		1.921344

Source: Extracted from Eviews 9 output

Furthermore, the sum of the conditional variance parameters, i.e. RESID(−1)^2 and GARCH(−1) or the sum of the $\alpha + \beta$ for the GDP model is 1.099075, which is >1. For the GREV model, the sum is 1.3154, the sum for the FER model is 1.0409 an he sum for the PCI model is 1.2879. The implication is that the GARCH(1,1) process for the error terms "ε" is highly explosive and could trigger serious structural break in the economy. Also, there is high conditional variance and high standard deviation which has the potential of making crude oil price to have rapid change-effect on the economy. The process depicts high volatility persistency inherent in crude oil price movements.

The coefficients of the models' RESID(−1)^2 are significant at the conventional 5% level. This implies very strong evidence of volatility clustering in crude oil price and also that availability of new information increases conditional volatility by a magnitude above 1. Similarly, the GARCH(−1) parameters are positive except for GDP model (−0.0961, 0.1980, 0.4945 and 0.2493) and are all significant at the conventional 5% level, which implies that the GARCH term is significant with high autoregressive persistence of conditional volatility.

4.6. Test of Hypotheses

The hypotheses are tested using the t-statistic values from the GARCH model which introduced the intervening variables (Table 6). The decision is to reject the null hypothesis if the probability value of the t-statistic is <0.05 critical value.

Table 5: Estimating oil price volatility with exchange rate and oil revenue

Mean equation for GDP				
Variable	**Coefficient**	**Standard error**	**z-Statistic**	**Prob.**
COP	−1.768586	0.785309	−22.52088	0.0000
EXR	1.679561	0.809181	20.75632	0.0000
OIR	−24.94405	20.66278	−1.207197	0.2274
C	−28.94741	7.349622	−39.38626	0.0000
Variance equation				
C	17.19427	8.477325	2.028266	0.0425
RESID(−1)^2	1.195193	0.315326	3.790343	0.0002
GARCH(−1)	−0.096118	0.085808	−1.120156	0.2626
R-squared	0.958105	Durbin-Watson stat		1.884015
Adjusted R-squared	0.957051			
Mean equation for government revenue				
Variable	**Coefficient**	**Standard error**	**z-Statistic**	**Prob.**
C	−1080.215	21.28660	−50.74625	0.0000
COP	52.50339	1.172907	44.76347	0.0000
EXR	15.39886	0.094743	162.5337	0.0000
OIR	0.465602	0.012528	37.16399	0.0000
Variance equation				
C	−455.2589	315.5436	−1.442777	0.1491
RESID(−1)^2	1.117404	0.318743	3.505653	0.0005
GARCH(−1)	0.198009	0.081301	2.435516	0.0149
R-squared	0.970771	Durbin-Watson stat		1.994402
Adjusted R-squared	0.970107			
Mean equation for foreign exchange reserve				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	−24297.69	7090.260	−3.426912	0.0006
COP	382.2717	387.6035	0.986244	0.3240
EXR	387.2845	36.13916	10.71648	0.0000
OIR	58.82731	4.646527	12.66049	0.0000
Variance equation				
C	−48250662	48904037	−0.986640	0.3238
RESID(−1)^2	0.546392	0.180687	3.023977	0.0025
GARCH(−1)	0.494458	0.090470	5.465440	0.0000
R-squared	0.699168	Durbin-Watson stat		1.773183
Adjusted R-squared	0.692331			
Mean equation for per capita income				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	−255.4376	8.641543	−29.55926	0.0000
COP	6.645983	0.631726	10.52036	0.0000
EXR	−0.611188	0.047158	−12.96036	0.0000
OIR	0.193609	0.007604	25.46283	0.0000
Variance equation				
C	22.91981	56.63178	0.404716	0.6857
RESID(−1)^2	1.038611	0.267857	3.877483	0.0001
GARCH(−1)	0.249254	0.064551	3.861353	0.0001
R-squared	0.663297	Durbin-Watson stat		1.835971
Adjusted R-squared	0.655645			

Source: Extracted from Eviews 9 output

4.7. Discussion of Findings

The analysis of the relationship between crude oil price volatility and the Nigerian economy was the main focus of this study. The study used data on exchange rate and oil revenue as intervening

Table 6: Summary of hypotheses test

Hypotheses	t-statistic	P-value	Decision rule
H_{01}: There is no significant relationship between fluctuations in crude oil prices and Nigeria's economic growth	−22.521	P=0.0000 <0.05	The null hypothesis is rejected. We conclude that there is significant effect of crude oil price fluctuation on the growth of the Nigerian economy
H_{02}: Fluctuations in crude oil prices do not significantly impact government revenue in Nigeria	44.763	P=0.0000 <0.05	We reject the null hypothesis and conclude that fluctuations in crude oil prices significantly influence income level in Nigeria
H_{03}: Fluctuations in crude oil prices do not significantly influence income level in Nigeria	10.5204	P=0.0000 <0.05	We reject the null hypothesis and conclude that fluctuations in crude oil prices significantly influence income level in Nigeria.
H_{04}: Fluctuations in crude oil prices has no significant influence on Nigeria's foreign exchange reserve	0.9862	P=0.3240 >0.05	We accept the null hypothesis and conclude that fluctuations in crude oil prices has no significant influence on Nigeria's foreign exchange reserve

Source: Author's compilation

variables. The dependent variables were GDP, government revenue, foreign exchange reserve and per capita income. The data on crude oil price volatility was generated through the GARCH variance series and was subsequently utilized in the GARCH model. The data were tested for stationarity and found to be I(1) stationary process. Also, the cointegration test showed that there was long run relationship amongst the variables.

The volatility effect of crude oil price on the economy using the GARCH model showed that the coefficient of crude oil price was theoretically plausible and statistically highly significant. The constant which was negative implied that the economy was moving on a negative trend given that crude oil price is held constant, thus explaining the critical role of crude oil price and the study of its volatility in determining optimal growth in the economy. The GARCH(1,1) process for the error term "ε" was weakly stationary and depict the high volatility persistency inherent in crude oil price movements. In addition, very strong evidence of volatility clustering was found and the availability of new information increased conditional volatility. The economic implications of these findings can be found in the assertions of Madueme and Nwosu (2020) where they held that given the negative effect of oil prices on the economy and the high volatility persistency inherent in oil prices movements are significant determinants of growth of the economy. Also, Ifeonyemetalu et al. (2022) and Oyalabu and Oyalabu (2023) opined that oil price volatility has the effect of reducing investment activities in Nigeria thus shocks to oil price affects economic growth: positive growth affects the economy positively while negative shock affects the economy negatively.

However, on a contrary view, Oriakhi and Iyoha (2023) held that the risks inherent in oil price changes appears to have positive effect on the local economy as the high influx of foreign capital in the form of excess crude funds enhances money supply and investments. However, in whatever angle this is looked at, one important factor is the finding made here which points to the high volatility of crude oil price and its resultant positive effect on the economy.

Furthermore, the introduction of exchange rate and oil revenue showed high persistence of volatility in crude oil price, particularly, from 1990 through to 2023. There was very high volatility from 2005 to 2009 and again from 2015 to 2019. The year 2020 also witnessed high volatility. The upwards trends represent the periods crude oil price deviated from the zero mean line and this portends serious implications for the economy. Thus, the implication is that the volatility clustering experienced in crude oil price moves the economy towards a high-price regime thereby raising other macroeconomic variables te intervening variables proved to exert positive effects on crude oil price which increases government revenue, foreign reserve and per capita income. Oyeniran and Alamu (2024) and Jack and Akidi (2024) proved that the intervening effect of exchange rate accounted for slow and negative growth in Nigeria's external reserve. Also, our present finding corroborated that of Akinlo (2024) which asserted that income inequality's response to negative shocks in oil prices is stronger. However, the volatility clustering in crude oil price appeared to negatively affect the economy of Nigeria but positively affects foreign reserve and government revenue including income level with the interplay of exchange rate and oil revenue inflow.

5. CONCLUSION AND RECOMMENDATIONS

This study made use of the GARCH model in analyzing the effect of crude oil price volatility on the Nigerian economy. The variables that were introduced in addition to crude oil price in the model included exchange rate and oil revenue. The data on crude oil price was generated from the GARCH variance series and used in the analysis.

The conclusion drawn from this study is that there is high volatility in crude oil price which has adversely affected the rate of growth in the economy. However, crude oil price fluctuations exerted positive effect on government revenue, foreign exchange reserve and income level in Nigeria for the period reviewed. However, the risks associated with rapid changes in crude oil price was found to be significant since the Nigerian economy is highly oil-dependent hence the absence of crude oil revenue depletes the major economic growth indicators. The following recommendations are considered necessary:

1. Since the Nigerian economy responds rapidly to changes in crude oil price i.e. high volatility clustering, the Nigerian government should devise a strategy to deviate the economy away from oil-dependency through the creation of an institution that will take it as a priority towards ensuring

crude oil prices do not dictate movements of macro-economic aggregates.

2. In addition, Nigeria should accelerate efforts to diversify its economy beyond oil. While oil remains a crucial part of the Nigerian economy, the dependence on oil revenue makes the country vulnerable to price shocks.
3. The volatility in crude oil price can be made to benefit the Nigerian economy by adequately utilizing oil revenue in growing sectors that will ensure long term sustainable growth. The model estimates showed positive and significant effect of oil revenue on foreign reserve, government revenue and income level. This should be sustained by growing investments using oil revenue.
4. The negative effect of oil revenue on GDP arises from the appreciating exchange rate which lowers the value of Nigeria's external reserve. The risk of the Nigerian naira falling to the US dollar can be hedged by utilizing the foreign reserve accumulation to stabilize the local currency and also making sure that part of the country's foreign reserve are kept in local currency so as to boost its value.
5. Nigeria should improve the efficiency and reliability of its oil production to ensure greater revenue stability.

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