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Effect of crude oil price volatility and stock market performance in Nigeria (2010–2025): evidence from multiple volatility measures

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Abstract

Purpose: This study examines the effect of crude oil price volatility on stock market performance in Nigeria from 2010 to 2025 using multiple volatility measures. Specifically, it assesses the effects of realised (historical), conditional, implied and asymmetric crude oil price volatility on stock market performance.

Methodology: The study utilised weekly secondary data covering January 2010 to December 2025, comprising 835 observations. Stock market performance was measured using weekly changes in the Nigerian Exchange All-Share Index, while crude oil price volatility was captured using realised volatility, Generalised Autoregressive Conditional Heteroskedasticity (GARCH) volatility, the CBOE Crude Oil Volatility Index (OVX), and Exponential GARCH (EGARCH) volatility. Exchange-rate change, inflation change and Monetary Policy Rate change were included as control variables. The study employed descriptive statistics, unit-root tests, volatility modelling and autoregressive regression with Heteroskedasticity and Autocorrelation Consistent (HAC/Newey–West) standard errors.

Results and conclusion: The findings revealed that realised volatility, GARCH volatility, OVX and EGARCH volatility had no statistically significant effects on stock market performance in Nigeria during the period under study. Although the four measures capture different dimensions of crude oil price uncertainty, the results were broadly consistent across the alternative specifications. The study therefore concludes that crude oil price volatility, irrespective of whether it is measured historically, conditionally, implicitly or asymmetrically, did not independently exert a statistically significant effect on Nigerian stock market performance over the study period.

Implication of findings: The findings suggest that investors, portfolio managers, regulators and policymakers should exercise caution in relying on crude oil price volatility as a standalone indicator of movements in the Nigerian stock market. Greater attention should be given to domestic macroeconomic conditions, market-specific factors and other channels through which developments in the crude oil market may influence stock market performance.

Keywords: Crude oil price volatility; Stock market performance; Realised volatility; GARCH; OVX; EGARCH.

1. Introduction

The level of development in an economy is very much dependent upon the rate of investment in the country combined with the efficient financial system necessary to maintain macroeconomic stability to significantly improve productivity. Capital market is an integral part of the financial system, which mobilizes long-term capital effectively by attracting resources from a large number of savers in a cost-efficient manner and by converting the funds of investors into long-term capital. Therefore, the capital markets play a pivotal role in driving the economic development of countries by mobilizing long-term capital for productive investment. These markets are crucial in fostering industrial and economic growth by facilitating the efficient allocation of resources from savers to those in need of capital, which is vital for the financial system of any country. Globally, capital markets are integral to maintaining macroeconomic stability and improving productivity by ensuring that funds flow towards high-potential investments.

The Nigerian Stock Exchange (NSE) underwent a significant transformation in 2021 when it was fully demutualized, transitioning from a member-owned not-for-profit entity to a shareholder-owned, profit-

making entity. This led to the formation of the Nigerian Exchange Group Plc (NGX Group) with its subsidiaries, including the Nigerian Exchange Limited (NGX Exchange), NGX Regulation Limited (NGX REGCO), and NGX Real Estate Limited (NGX RELCO). As of June 17, 2023, it is a multi-asset Exchange with 156 equities, 146 bonds, 12 Exchange Traded Funds (ETFs), and 56 memorandum listings with a total market capitalization of over ₦32.126 trillion as at June 17, 2023 (Nigerian Exchange Group Plc [NGX Group], 2023). Despite the structural transformation and expansion of the Nigerian Stock Exchange (NSE), the market has experienced persistent challenges, with noticeable declines in key indicators such as the All-Share Index (ASI) and market capitalization over the years.

Such market performance is highly influenced by many variables, especially macroeconomic variables. There are various research works which have examined the consequences of movements in economic factors on the equity market performance. For example, Omodero and Mlanga (2019) examined the effects of inflation, exchange rate and interest rate on stock market performance in Nigeria, while John (2019) also investigated the relationship between macroeconomic variables and stock-market performance. Their findings generally indicate that macroeconomic conditions can influence equity-market movements. Among the most widely examined factors are exchange rate, inflation, interest rate and crude oil price (Ibrahim, 2017).

One of the key factors influencing stock market performance in Nigeria, and globally, is the volatility of crude oil prices. Crude oil is one of the most important raw materials of the industrialized nations. It generates heat, drives machinery, vehicles and airplanes. Almost all chemical products, such as plastics, detergents, paints, and even medicines can be produced by the components of crude oil. It is obvious that crude oil has a great impact on the world economy (Zolfaghari & Sahabi, 2017). For countries like Nigeria, which is heavily reliant on oil exports, fluctuations in oil prices can have profound effects on the financial markets. A decline in oil prices can reduce government revenue and lower corporate profits, particularly for major oil and gas companies. This often diminishes investor confidence, leading to falling stock prices (Nguyen & Nguyen, 2020). Conversely, oil price increases can boost profits for these oil-exporting companies and raise their stock prices, but they may also increase production and transportation costs for non-oil industries such as manufacturing, aviation and logistics, thereby affecting their stock performance.

Market risk is one of the main sources of uncertainty for any participant in the financial market, including listed companies, institutional investors and financial institutions that hold risky assets. In general, market risk refers to the possibility that the portfolio value will decrease due to changes in market factors. An example of market factors is a change in the price of securities, indices of securities, interest rates and currency rates. Market risk has a significant influence on the value of the exposed financial institution (Musawa & Mwaanga, 2017). Unpredicted changes in the market situation can potentially lead to big losses; therefore, market risk must be estimated by institutions involved in security markets. The concept of volatility plays a key role in this regard. Volatility of the asset refers to the uncertainty of the value of the returns from holding risky assets over a given period of time (Wei & Guo, 2017).

Hence, the continued decline in the oil price may be good news for the oil importing countries if the oil is used in production. Consequently, one expects that a low input price means a lower total cost and a greater profit, which also means more cash for future investment by the company, leading to a higher stock price for that company (Nguyen and Nguyen, 2020). However, for the oil exporting countries a decline in the oil price leads to a loss of revenue, which could negatively affect the country's output and expenditure, especially if the country is heavily reliant on oil revenue (Mohalhal, 2015). At the same time, the declining oil price may lead to opportunities for the country to diversify its exports. Nevertheless, it

is important to understand that factors that affect the oil market can also affect the stock market, or vice versa.

The Nigerian stock market has faced persistent challenges, marked by high volatility and declining performance over the years. As of 2020, the market capitalization was significantly impacted, with fluctuations driven by both domestic and global factors. Notably, the impact of crude oil price volatility, political instability, and macroeconomic conditions has compounded the market's struggles. These factors have undermined investor confidence and hindered the market's ability to stabilize, despite efforts to implement various reforms (Nigerian Stock Exchange [NSE], 2020).

The Nigerian economy remains heavily mono-cultural, where over 90% of export earnings and a large share of government revenue depend on crude oil (Nigerian National Petroleum Corporation, 2020). Consequently, the Nigerian stock market remains highly sensitive to fluctuations in global crude prices, as several major listed firms operate within the oil and gas sector. As of May 2025, seven companies were listed under the Oil and Gas sector of the Nigerian Exchange, namely Japaul Gold & Ventures Plc, Aradel Holdings Plc, Oando Plc, Conoil Plc, Eterna Plc, MRS Oil Nigeria Plc and TotalEnergies Marketing Nigeria Plc (Nigerian Exchange Limited [NGX], 2025). Based on NGX listings and market-cap data as of 31 December 2024, the Oil and Gas companies had a combined market capitalization of ₦7.414 trillion, representing 11.81% of the NGX's total equity market capitalization of ₦62.775 trillion (NGX Group, 2024). However, the effect of crude oil price movements on the stock market may also depend on prevailing macroeconomic conditions in the economy.

The inclusion of macroeconomic control variables, such as exchange rates, inflation, and interest rates, is essential to understanding the dynamics between crude oil price volatility and stock market performance. These factors can influence both oil prices and stock market movements and must be accounted for to avoid confounding effects. Exchange rates can impact the financial performance of companies involved in international trade and oil exports, especially in oil-dependent countries like Nigeria (Hussain et al., 2019). Inflation can affect purchasing power and investor sentiment, thereby influencing stock market performance (Omodero & Mlanga, 2019). Likewise, interest rates influence the cost of capital and investment decisions and may consequently affect stock market performance (John, 2019). Consequently, these variables are included in this study to control for broader macroeconomic conditions. Recent evidence from the Nigerian Exchange also indicates that exchange rate, inflation and interest rate have differing effects on stock market performance across market segments (Abdullahi et al., 2026).

Empirically, many studies have measured the impact of crude oil price volatility on stock market performance, such as Tulcanaza-Prieto and Lee (2019), Joo and Park (2021), Nwude et al. (2021), Ajala et al. (2021), Oke et al. (2023), Tumala (2023), Muhammad et al. (2023), and Eze (2024). However, limited studies exist for underdeveloped oil-exporting countries like Nigeria, and much of the empirical literature still tends to treat volatility as a single construct. This approach may be inadequate, as different dimensions of volatility capture different aspects of uncertainty. Realised (historical) volatility reflects past market fluctuations; conditional volatility models time-varying persistence and volatility clustering; implied volatility incorporates forward-looking market expectations; while asymmetric volatility allows for differential responses to positive and negative oil price shocks. Liu et al. (2022) emphasized that the impact of oil price volatility on stock returns is nonlinear and varies across countries, particularly between oil-exporting and oil-importing economies and between developing and developed countries. Furthermore, Siddiqui (2014) and Ogiri et al. (2013) suggested the need for further research to examine the effects of oil price volatility on stock market indices using weekly or, more objectively, daily data on oil prices and stock indices, since higher-frequency data better capture volatility dynamics and

immediate market responses. This research therefore attempts to bridge these observed gaps by adopting a multidimensional volatility framework—examining realised, conditional, implied and asymmetric crude oil price volatility—using weekly data. Based on the identified gaps, the study was guided by four specific objectives: to assess the effect of realised (historical) crude oil price volatility on stock market performance in Nigeria, to examine the effect of conditional crude oil price volatility, to examine the effect of implied crude oil price volatility, and to evaluate the effect of asymmetric crude oil price volatility on stock market performance in Nigeria.

2. Literature Review

2.1 Conceptual Review

Crude oil price volatility refers to the degree of fluctuation and uncertainty in crude oil prices over time. It may be captured from different perspectives, including realised volatility based on past price movements, conditional volatility modelled through GARCH, implied volatility reflected in market expectations such as OVX, and asymmetric volatility, which captures differing volatility responses to positive and negative Matar (2013). In this study, these measures are treated as complementary dimensions of crude oil price uncertainty.

Stock market performance refers to changes in the overall value and return of securities traded in the market. It may be measured using indicators such as market capitalisation, liquidity, turnover ratio and market indices. In Nigeria, the All-Share Index is widely used as an aggregate indicator of stock market performance (Yusuf et al., 2025). Accordingly, this study represents stock market performance with the Nigerian Exchange All-Share Index and operationalises it using weekly ASI returns.

2.2 Empirical Review

Ogbulu (2018) investigated the impact of crude oil prices and foreign exchange rate movements on stock market prices in Nigeria. In addition, the paper examined whether there is any volatility pass-through between the dollar price of Nigerian crude oil, foreign exchange rate of the Naira and stock market prices respectively. Data employed for the study were monthly values of the Nigerian Stock Exchange (NSE) All-Share Index (ASI), dollar price of Nigerian crude oil (DPO) and the official exchange rate of the Naira to the US Dollar (FXR) from January 1985 to August 2017. The methodology adopted for the study included ADF unit root tests, Johansen cointegration tests, the ECM technique, Granger causality tests, variance decomposition as well as the GARCH (1,1) to model the volatility relationships among the variables. The findings revealed that crude oil price significantly impacts stock market prices. In addition, the findings showed that the volatility of the dollar price of Nigerian oil in the world oil market is significantly transmitted to the volatility of stock market prices in Nigeria. The pass-through effect of exchange-rate volatility to the volatility of stock market prices was also positive and significant.

Yin et al. (2019) investigated whether oil-market uncertainty could predict international stock market returns. Oil-market uncertainty was measured using the oil volatility risk premium, while the analysis was conducted at both daily and monthly frequencies. The study employed in-sample, out-of-sample and time-varying predictive approaches to determine whether oil-market uncertainty provided additional information for forecasting global stock returns. The findings showed that oil-market uncertainty had only weak predictive power for stock returns. The result remained largely unchanged during economic expansions and recessions and during periods of relatively high and low market

volatility. The authors concluded that oil-market uncertainty provided limited additional information for predicting stock returns and that its forecasting performance was generally inferior across the different analytical approaches employed.

The effects of oil price volatility on stock markets were also investigated by Joo and Park (2021). The authors examined stock returns data from May 2001 to December 2019 in ten major oil-importing countries: China, France, Germany, India, Italy, Japan, Korea, the Netherlands, Spain, and the U.S. Two analytical approaches, quantile regression and quantile-on-quantile regression, were utilised to provide a comprehensive understanding of the relationship between oil price volatility and stock returns. The empirical findings indicated that the effects of oil price uncertainty on stock returns are asymmetric and dependent on both the level of stock returns and oil market conditions. Specifically, increasing oil price volatility negatively affects stock returns when both oil price volatility and stock returns are low. However, when stock returns are high and oil price volatility is low, rising oil price volatility leads to an increase in stock returns. This study highlights the need to consider the asymmetric effects of oil price volatility on stock markets and suggests that these effects vary based on the levels of stock returns and oil market conditions.

Similarly, Ajala et al. (2021) examined the asymmetric effect of oil prices on exchange rate and stock price in Nigeria. Using a nonlinear modelling framework, the study examined whether positive and negative changes in oil prices exerted different effects on stock prices. The findings indicated the presence of asymmetric responses, showing that stock prices did not respond uniformly to positive and negative oil-price movements. The study therefore emphasised the importance of accounting for asymmetry when examining the oil price–stock market relationship in Nigeria.

Furthermore, Nwude et al. (2021) examined the influence of crude oil price fluctuations on selected measures of stock market performance in Nigeria. The study employed monthly data covering the period from January 1997 to December 2016. Brent crude oil price was used to measure oil-price movements, while selected stock market indicators were used to represent market performance. The data were analysed using the Vector Autoregressive model, impulse-response functions and variance-decomposition analysis. The findings revealed that variations in crude oil prices were slowly transmitted to some stock market performance variables. However, crude oil price fluctuations had a limited effect on the Nigerian stock market and did not sufficiently account for changes in market activities. The study therefore concluded that the performance of the Nigerian stock market could not be adequately explained by crude oil price fluctuations alone.

In a related study, Muhammad et al. (2023) investigated the asymmetric relationship between crude oil prices and stock market performance in Nigeria using a Nonlinear Autoregressive Distributed Lag (NARDL) framework. Monthly data covering the period January 2014 to June 2023 were sourced from the Central Bank of Nigeria and the Nigerian Exchange Group. The study decomposed oil price movements into positive and negative changes in order to capture asymmetric effects. The empirical results confirmed the presence of both short-run and long-run asymmetric effects of crude oil prices on stock market performance. Specifically, increases in oil prices were found to significantly raise stock prices in both the short and long run, while decreases in oil prices exerted a negative impact on stock market performance. The findings suggest that oil price volatility transmits to the stock market through exchange rate adjustments and investor expectations, reinforcing the vulnerability of the Nigerian stock market to oil price shocks.

Tumala (2023) extended the literature by applying a GARCH-MIDAS model to examine the effect of disentangled crude oil shocks on stock market volatility in Nigeria and South Africa. Using high-frequency daily stock returns combined with low-frequency oil market indicators over the period 2010–2022, the study demonstrated that oil price volatility significantly influences stock market volatility, with demand-driven oil price shocks exerting stronger effects than supply-driven shocks. The findings emphasise that conditional oil price volatility plays a crucial role in shaping stock market risk dynamics in oil-dependent economies such as Nigeria.

Moreover, Oke et al. (2023) examined the effects of crude oil price volatility on stock market development in Nigeria over the period 1993 to 2019. Unlike earlier studies that focused mainly on stock returns, the authors employed indicators of stock market development such as market capitalisation ratio, total value traded ratio, and turnover ratio. Using an Error Correction Model (ECM) and the Autoregressive Distributed Lag (ARDL) approach, the study found evidence of a significant and positive relationship between oil price volatility and stock market development in Nigeria. The results indicate that fluctuations in crude oil prices influence investors' confidence and liquidity conditions in the stock market. The authors concluded that Nigeria's stock market remains highly sensitive to oil price volatility due to the economy's heavy dependence on crude oil revenues.

Furthermore, Eze (2024) conducted an empirical evaluation of the effect of crude oil price volatility on stock market performance in Nigeria using annual data spanning from 1986 to 2021. The study was motivated by the central role of crude oil as a major driver of Nigeria's economic activities and its potential influence on capital market performance. Adopting the Arbitrage Pricing Theory (APT) as the theoretical framework, the author employed the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model alongside Granger causality tests to capture the volatility dynamics and causal relationships. The Nigerian All-Share Index (ASI) was used as a proxy for stock market performance, while oil price volatility, exchange rate, inflation rate, interest rate, and real GDP growth were included as explanatory variables. The findings revealed that crude oil price volatility exerts a positive and statistically significant effect on stock market returns in Nigeria, both in the short and long run. The study further established the existence of volatility clustering and confirmed that oil price volatility remains a major determinant of stock market performance in Nigeria.

Based on the survey of the existing literature, it is observed that a substantial number of studies have examined the relationship between crude oil price volatility, macroeconomic variables and stock market performance using different econometric techniques and have arrived at mixed and sometimes conflicting conclusions. Undoubtedly, these studies have made significant contributions to the oil–stock market literature; however, several important gaps remain, particularly in the context of an emerging oil-dependent economy such as Nigeria. Most empirical studies, especially those focusing on Nigeria and other developing economies, rely predominantly on monthly or annual data, as evidenced in Ogbulu (2018), Nwude et al. (2021), Eze (2024), and Oke et al. (2023). The use of low-frequency data may be inadequate in capturing short-run volatility dynamics and rapid stock market responses to crude oil price shocks, particularly during periods of heightened uncertainty. Furthermore, empirical findings on the effect of crude oil price volatility on stock market performance remain mixed and inconclusive. While studies such as Eze (2024) and Oke et al. (2023) document significant relationships between oil-price movements and stock market performance in Nigeria, Muhammad et al. (2023) and Ajala et al. (2021) provide evidence of asymmetric effects, whereas Nwude et al. (2021) report weak or limited effects. Other international studies also report negative, weak or asymmetric effects depending on market conditions, oil-exporting status, methodology and sample period (Yin et al., 2019; Joo & Park, 2021). These variations

suggest that the oil–stock market relationship is sensitive to country-specific characteristics, volatility measures and econometric techniques employed.

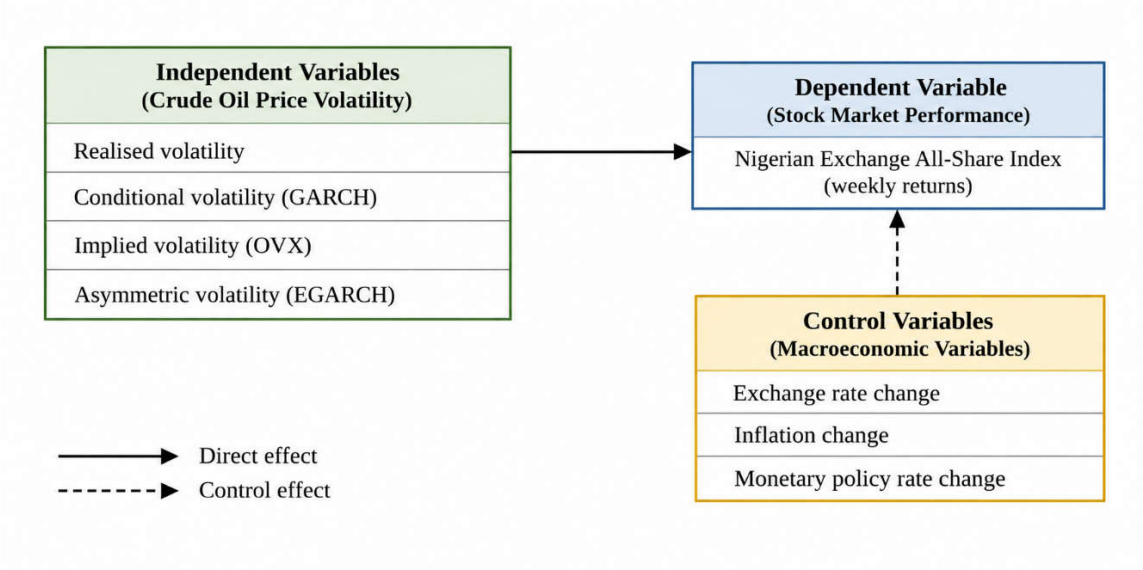
In addition, despite growing interest in volatility modelling, most Nigerian studies focus mainly on conditional volatility or linear oil-price changes, with little attention paid to realised, implied and asymmetric volatility. However, recent evidence suggests that different volatility measures capture distinct dimensions of uncertainty and may exert different effects on stock market performance (Yin et al., 2019; Joo & Park, 2021; Muhammad et al., 2023). Empirical studies that jointly examine these volatility measures in the Nigerian context remain scarce. Moreover, although recent literature acknowledges the importance of nonlinearity and asymmetry in the oil–stock market nexus, empirical evidence for Nigeria is still limited, as earlier studies largely assume linear relationships, which may underestimate the differential effects of oil-price increases and decreases on stock market performance (Ajala et al., 2021; Muhammad et al., 2023). In view of these limitations, the present study seeks to contribute to the existing literature by examining the effect of crude oil price volatility on stock market performance in Nigeria using weekly data, which allows for a better capture of short-run volatility dynamics. The study further distinguishes itself by examining realised, conditional, implied and asymmetric crude oil price volatility, while incorporating key macroeconomic variables such as inflation, exchange rate and interest rate.

2.2 Research Hypotheses

Based on the empirical evidence reviewed, the study proposed the following hypotheses:

H_{01}: Realised (historical) crude oil price volatility has no significant effect on stock market performance in Nigeria.
H_{02}: Conditional crude oil price volatility has no significant effect on stock market performance in Nigeria.
H_{03}: Implied crude oil price volatility has no significant effect on stock market performance in Nigeria.
H_{04}: Asymmetric crude oil price volatility has no significant effect on stock market performance in Nigeria.

Figure 1: Conceptual Framework of the Study



2.3 Theoretical Review

Arbitrage Pricing Theory (APT)

The Arbitrage Pricing Theory (APT), developed by Ross (1976), is a multifactor asset-pricing theory which explains that the return on an asset may be influenced by several systematic risk factors. Unlike a single-factor approach, APT allows different macroeconomic and market-related factors to influence stock returns. This makes the theory relevant to the present study because crude oil price volatility may constitute an important source of systematic risk, particularly in an oil-dependent economy such as Nigeria.

This study adopts APT to explain the influence of crude oil price volatility on stock market performance in Nigeria. The theory's multifactor nature allows crude oil price volatility to be examined alongside other macroeconomic factors such as exchange rate, inflation and interest rate. In this study, realised, conditional, implied and asymmetric crude oil price volatility represent different dimensions of oil-market uncertainty whose effects on stock market performance are examined within the APT framework.

Efficient Market Hypothesis (EMH)

The Efficient Market Hypothesis (EMH), associated with Fama (1970), explains that stock prices reflect available information and adjust as new information enters the market. Accordingly, changes in stock prices may occur as investors respond to new economic and financial information.

The EMH is relevant to this study because information concerning crude oil price movements and volatility may affect investors' expectations and consequently be reflected in stock market performance. In an oil-dependent economy such as Nigeria, information arising from realised, conditional, implied and asymmetric crude oil price volatility may therefore influence the behaviour of stock market participants. Thus, while APT explains crude oil price volatility as a potential systematic risk factor, EMH provides a supporting explanation of how information concerning oil-market uncertainty may be incorporated into stock prices.

3. Methodology

The study adopted an ex post facto research design to determine the effect of crude oil price volatility on stock market performance in Nigeria. Time-series data were employed in line with the nature of the variables and the objectives of the study. Stock market performance was represented by the Nigerian Exchange All-Share Index (ASI), while crude oil price volatility was measured using realised volatility, GARCH conditional volatility, OVX implied volatility and EGARCH asymmetric volatility. Exchange rate, inflation rate and Monetary Policy Rate were included as macroeconomic control variables.

Weekly time-series data covering January 2010 to December 2025 were employed, comprising 835 observations. The ASI was obtained from Investing.com and cross-checked against NGX against the Nigerian Exchange Group (NGX), while Brent crude oil prices were sourced from Investing.com. Brent was selected because of its strong relationship with Nigeria's export-grade crude oil and its widespread use in international oil pricing. Exchange-rate data were obtained from Investing.com, while inflation and Monetary Policy Rate data were obtained from the Central Bank of Nigeria. The CBOE Crude Oil Volatility Index (OVX) was obtained from the Federal Reserve Economic Data (FRED) and the Chicago Board Options Exchange (CBOE).

3.1 Variables Measurements and Descriptions

The Nigerian Exchange All-Share Index remained the indicator of stock market performance, but its weekly return was employed in the regression analysis. The weekly stock market return was calculated as:

$$NGXR_t = 100 \times \ln(ASI_t / ASI_{t-1})$$

where $NGXR_t$ represents the weekly return on the Nigerian Exchange All-Share Index, ASI_t represents the current week's index value, and ASI_{t-1} represents the previous week's index value. Brent crude oil return was similarly calculated as:

$$BR_t = 100 \times \ln(BP_t / BP_{t-1})$$

where BR_t represents weekly Brent crude oil return, BP_t represents the current week's Brent crude oil price, and BP_{t-1} represents the previous week's Brent crude oil price. Brent returns were used in estimating realised, GARCH conditional and EGARCH asymmetric volatility.

The study employed four measures of crude oil price volatility. Realised volatility was computed from rolling historical Brent crude oil returns, with the 8-week realised volatility selected as the principal measure. Conditional volatility was generated using a GARCH model, which allows current volatility to depend on previous shocks and previous conditional variance. Implied volatility was represented by the CBOE Crude Oil Volatility Index (OVX), which captures market expectations concerning future crude oil price uncertainty. Asymmetric volatility was generated using the EGARCH model, which allows positive and negative crude oil price shocks to exert different effects on volatility. The volatility-model comparison supported the use of the GARCH series for conditional volatility and the EGARCH series for asymmetric volatility.

Exchange-rate change, inflation-rate change and Monetary Policy Rate change were included as control variables. The transformations were necessary following the unit-root results and to prevent the use of non-stationary level variables in the short-run regressions. Exchange-rate change was calculated as the logarithmic percentage change in the naira-to-US-dollar exchange rate, while inflation and MPR were expressed as first differences. These variables were retained because exchange rate, inflation and interest rate may independently influence stock market performance and could otherwise confound the estimated effect of crude oil price volatility.

3.2 Method of Data Analysis

The analysis was conducted using Python and Jupyter Notebook. The major packages employed included pandas and NumPy for data preparation, statsmodels and scipy for econometric and statistical analysis, arch for volatility modelling, matplotlib for graphical presentation. Preliminary analysis involved descriptive statistics, correlation analysis, multicollinearity tests and unit-root tests. The Augmented Dickey–Fuller, Phillips–Perron and Kwiatkowski–Phillips–Schmidt–Shin tests were employed to determine the stationarity properties of the variables. The Variance Inflation Factor and correlation analysis were also used to examine possible multicollinearity among the explanatory variables.

Following the stationarity and cointegration tests, the final models were specified using stock market return, crude oil volatility measures and changes in the macroeconomic variables. This specification was adopted because the level variables were non-stationary and a stable long-run relationship was not established. Consequently, the analysis focused on the short-run relationships among the variables using their appropriate stationary transformations.

An AR(1) specification was adopted following comparison of AR(0), AR(1), AR(2) and ARMA(1,1) mean equations using the Akaike Information Criterion, Schwarz Bayesian Information Criterion, parameter significance and residual diagnostics. The AR(1) specification includes the previous week's stock market return to capture short-run dependence in stock market performance. The general model is specified as:

$$NGXR_t = \beta_0 + \beta_1 NGXR_{t-1} + \beta_2 VOL_t + \beta_3 EXRC_t + \beta_4 INFC_t + \beta_5 MPRC_t + \mu_t$$

where $NGXR_t$ represents ASI Return; $NGXR_{t-1}$ represents the one-period lag of ASI Return; VOL_t represents the relevant crude oil volatility measure; $EXRC_t$ represents exchange-rate change; $INFC_t$ represents inflation-rate change; $MPRC_t$ represents the change in Monetary Policy Rate; β_0 is the intercept; β_1–β_5 are the estimated coefficients; and μ_t is the error term. Because four volatility measures were employed, the general model was estimated separately for realised volatility, GARCH conditional volatility, OVX implied volatility and EGARCH asymmetric volatility. Thus, Models A, B, C and D respectively examine whether each dimension of crude oil price volatility significantly affects Nigerian stock market performance while controlling for the same macroeconomic conditions.

Diagnostic tests were conducted to assess the adequacy of the estimated models, including tests for serial correlation, heteroskedasticity, residual normality, functional form and multicollinearity. Where residual serial correlation or heteroskedasticity remained, Heteroskedasticity and Autocorrelation Consistent (HAC/Newey–West) standard errors were employed. The Newey–West adjustment provides coefficient standard errors, t-statistics and probability values that remain consistent in the presence of heteroskedasticity and autocorrelation. Statistical significance was evaluated at the 5 per cent level.

4. Results and Discussion

Table 1: Descriptive Statistics of Final Study Variables

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum	Skewness	Excess Kurtosis
ASI Return	835	0.242	2.617	−14.493	15.615	0.172	6.782
Brent Return	835	−0.030	4.813	−29.071	31.352	−0.319	6.140
Realised Volatility (8-week)	835	4.126	2.440	0.892	22.058	3.091	15.971
GARCH Conditional Volatility	831	4.536	1.791	2.411	16.350	3.458	16.763
OVX	835	36.604	15.334	14.500	190.080	4.287	32.516
EGARCH Volatility	831	4.509	1.636	2.236	16.170	2.937	14.528
Exchange-Rate Change	835	0.271	3.091	−13.776	45.316	8.140	101.080
Inflation Change	834	0.001	0.449	−7.190	2.300	−5.463	86.897
MPR Change	834	0.025	0.308	−2.000	6.000	12.208	211.918

Note: ASI = Nigerian Exchange All-Share Index; OVX = CBOE Crude Oil Volatility Index; MPR = Monetary Policy Rate. Jarque–Bera tests reject normality for every reported variable ($p < 0.001$).
Source: Author's computation using Python, 2026.

Table 1 presents the summary statistics of the study variables for the period under review. ASI Return has a mean value of 0.242 per cent with a standard deviation of 2.617, while Brent Return records a mean of −0.030 per cent with a standard deviation of 4.813. The 8-week realised volatility has a mean value of 4.126 with a standard deviation of 2.440, while GARCH conditional volatility and EGARCH volatility record mean values of 4.536 and 4.509, respectively. OVX has a mean value of 36.604 with a standard deviation of 15.334. Exchange-rate change, inflation change and MPR change have mean values of 0.271, 0.001 and 0.025, respectively.

The skewness results show that most of the variables are positively skewed, indicating that their distributions have longer right tails. OVX, exchange-rate change, MPR change and the volatility measures have particularly high positive skewness, showing the presence of some unusually large positive observations during the study period. Brent Return and inflation change are negatively skewed, while ASI Return is close to being symmetrical. The excess kurtosis values also show that the return, volatility and macroeconomic-change series are highly peaked and contain extreme observations. Finally, the Jarque–Bera probability values for all the variables are less than 0.001, indicating that the series are not normally distribute.

Table 2: Combined ADF, PP and KPSS Unit Root Test Results

Variable	Form	ADF Statistic (p-value)	PP Statistic (p-value)	KPSS Statistic (p-value)	Stationarity Decision	Order
ASI	Level	1.949 (1.000)	2.057 (1.000)	0.755 (0.010)	Non-stationary	I(1)
ASI Return	First difference	−25.014 (<0.001)	−25.819 (<0.001)	0.332 (0.100)	Stationary	—
Brent Crude Oil Price	Level	−2.181 (0.501)	−2.181 (0.500)	0.519 (0.010)	Non-stationary	I(1)
Brent Return	First difference	−27.894 (<0.001)	−27.895 (<0.001)	0.055 (0.100)	Stationary	—
Exchange Rate	Level	−0.886 (0.958)	−1.058 (0.936)	0.694 (0.010)	Non-stationary	I(1)
Exchange-Rate Change	First difference	−27.972 (<0.001)	−27.962 (<0.001)	0.259 (0.100)	Stationary	—
Inflation Rate	Level	−1.168 (0.687)	−1.311 (0.624)	2.647 (0.010)	Non-stationary	I(1)
Inflation Change	First difference	−11.696 (<0.001)	−30.212 (<0.001)	0.181 (0.100)	Stationary	—
MPR	Level	0.263 (0.976)	0.023 (0.960)	2.682 (0.010)	Non-stationary	I(1)
MPR Change	First difference	−29.021 (<0.001)	−29.275 (<0.001)	0.245 (0.100)	Stationary	—
OVX	Level	−6.677 (<0.001)	−6.664 (<0.001)	0.450 (0.056)	Stationary	I(0)
Realised Volatility (8-week)	Level	−5.606 (<0.001)	−4.916 (<0.001)	0.513 (0.039)	Stationary based on ADF/PP	I(0), retained

Note: Each I(1) level series is followed by its stationary first difference. Cells report statistic (p-value). ADF and PP test the null of a unit root; KPSS tests the null of stationarity. For RV8, ADF and PP reject a unit root while KPSS rejects stationarity; it is retained as I(0) on ADF–PP agreement.

Source: Author's computation using Python, 2026.

Table 2 shows that ASI, Brent crude oil price, exchange rate, inflation and MPR are non-stationary at level but become stationary after transformation. OVX is stationary at level. Although the KPSS test provides contrary evidence for the 8-week realised-volatility measure the ADF and PP tests support its stationarity at level; it was therefore retained as I(0), while acknowledging the conflicting KPSS evidence. The ARDL bounds test produced an F-statistic of 1.5425, which is below the 5 per cent lower-bound critical value of 2.5055, indicating the absence of a stable long-run relationship. The analysis therefore proceeded with stationary short-run models.

Table 3: Selected GARCH and EGARCH Volatility Model Estimates

Parameter / Statistic	GARCH(1,1)	EGARCH(1,1)
ω (constant)	0.667 (0.374)	0.156** (0.044)
α (shock/magnitude)	0.115** (0.034)	0.211*** (<0.001)
β (persistence)	0.860*** (<0.001)	0.951*** (<0.001)
γ (asymmetry)	—	−0.113*** (<0.001)
Persistence measure	0.975 (α+β)	0.951 (β)
Log-likelihood	−2353.059	−2343.023
AIC	4726.118	4708.046
BIC	4773.344	4759.995
Residual ARCH-LM p-value	0.698	0.221

Note: The innovation distribution is skewed-t for both selected models. Coefficient p-values appear in parentheses. In GARCH, persistence is measured by α+β; in EGARCH, β measures log-volatility persistence. Residual ARCH-LM tests use standardised residuals. *** p < 0.01; ** p < 0.05; * p < 0.10.
Source: Author's computation using Python, 2026.

Table 3 presents the selected skewed-t GARCH(1,1) and EGARCH(1,1) models. For the GARCH model, the shock coefficient was positive and significant (α = 0.115, p = 0.034), while the persistence coefficient was also significant (β = 0.860, p < 0.001). The combined persistence value of 0.975 indicates that volatility shocks dissipated slowly but remained mean-reverting. For the EGARCH model, the magnitude coefficient (α = 0.211, p < 0.001) and persistence coefficient (β = 0.951, p < 0.001) were significant. The negative and significant asymmetry coefficient (γ = −0.113, p < 0.001) indicates that negative shocks produced a stronger volatility response than positive shocks of the same magnitude. The residual ARCH-LM results for GARCH (p = 0.698) and EGARCH (p = 0.221) indicate that the selected models adequately captured the conditional heteroskedasticity in Brent returns. To avoid multicollinearity arising from the simultaneous inclusion of closely related crude oil volatility measures, realised, GARCH, OVX and EGARCH volatility were entered separately in Models A–D.

Table 4: Main AR(1) Regression Results

Variable	Statistic	Model A Realised (RV8)	Model B GARCH	Model C OVX	Model D EGARCH
Constant	Coefficient	0.096	0.027	0.497*	0.265
	HAC p-value	0.579	0.893	0.052	0.314
ASI Return (t−1)	Coefficient	0.141***	0.141***	0.136***	0.140***
	HAC p-value	<0.001	<0.001	<0.001	<0.001
Crude Oil Volatility	Coefficient	0.025	0.037	−0.008	−0.016
	HAC p-value	0.535	0.387	0.270	0.799
Exchange-Rate Change	Coefficient	0.016	0.016	0.019	0.017
	HAC p-value	0.545	0.560	0.463	0.529
Inflation Change	Coefficient	−0.285**	−0.288**	−0.256*	−0.275*
	HAC p-value	0.045	0.042	0.075	0.052
MPR Change	Coefficient	0.046	0.048	0.047	0.045
	HAC p-value	0.850	0.841	0.845	0.852
Observations	N	834	831	834	831
Adjusted R^2	Fit statistic	0.0176	0.0175	0.0193	0.0170

Note: The Statistic column identifies every reported figure. Coefficient rows contain the point estimates; the following rows contain HAC/Newey–West p-values computed with ten lags. *** p < 0.01; ** p < 0.05; * p < 0.10.
Source: Author's computation using Python, 2026.

Table 4 presents the main AR(1) regression results for the four crude oil volatility measures. The coefficient of lagged ASI Return was positive and statistically significant in all four models, ranging from 0.136 to 0.141 (p < 0.001), indicating modest short-run persistence in Nigerian stock market returns. Realised volatility had a positive but statistically insignificant coefficient of 0.025 (p = 0.535), while GARCH volatility was also positive and insignificant at 0.037 (p = 0.387). OVX recorded a negative but insignificant coefficient of −0.008 (p = 0.270), while EGARCH volatility was negative and insignificant at −0.016 (p = 0.799). Therefore, H_{01}, H_{02}, H_{03} and H_{04} were not rejected, indicating that none of the four crude oil volatility measures had a statistically significant direct short-run effect on stock market performance in Nigeria.

Among the control variables, exchange-rate change and MPR change were positive but statistically insignificant across all four models. Inflation change was negative in all the specifications and statistically significant at the 5 per cent level in Models A and B, while it was marginally significant at the 10 per cent level in Models C and D. This indicates that increases in inflation were associated with lower short-run ASI Returns, although the strength of the relationship varied across the models. This finding is consistent

with Olurin and Oladipo (2025), who reported a significant negative long-run effect of inflation on stock market performance in Nigeria.

Table 5: Diagnostic Tests for the Main AR(1) Models

Diagnostic Test	Model A	Model B	Model C	Model D
Breusch–Godfrey p-value	0.002	0.003	<0.001	0.002
Breusch–Pagan p-value	0.164	0.362	<0.001	0.006
Residual ARCH-LM p-value	<0.001	<0.001	<0.001	<0.001
Jarque–Bera p-value	<0.001	<0.001	<0.001	<0.001
Ramsey RESET p-value	0.405	0.417	0.214	0.265
Maximum VIF	1.007	1.009	1.023	1.012

Note: BG = Breusch–Godfrey; BP = Breusch–Pagan; JB = Jarque–Bera; RESET = Ramsey RESET. Maximum VIF excludes the intercept. HAC/Newey–West standard errors with ten lags were used for coefficient inference. Source: Author's computation using Python, 2026.

Table 5 shows that residual serial correlation, non-normality and remaining ARCH effects were present in the four models. The Breusch–Pagan test indicated heteroskedasticity in Models C and D, while the RESET and VIF results did not indicate serious functional-form or multicollinearity problems. Consequently, HAC/Newey–West standard errors were retained to obtain inference robust to residual autocorrelation and heteroskedasticity.

Table 6: Robustness Checks of the Main Direct-Effect Results

Robustness Specification	Volatility Coefficient	HAC p-value	Conclusion
Realised volatility: 4-week window	−0.014	0.690	Main conclusion unchanged
Realised volatility: 12-week window	0.025	0.504	Main conclusion unchanged
RV8 without controls	0.022	0.572	Main conclusion unchanged
GJR-GARCH conditional volatility	−0.011	0.837	Main conclusion unchanged

Note: The 4- and 12-week realised-volatility models include the stationary controls; the RV8 no-controls model omits them. The GJR-GARCH model provides the alternative asymmetric-volatility measure.
Source: Author's computation using Python, 2026.

Table 6 shows that the main findings were robust to alternative realised-volatility windows, the exclusion of macroeconomic controls and the use of GJR-GARCH as an alternative asymmetric-volatility specification. All the volatility coefficients remained statistically insignificant; therefore, the principal conclusions for the four objectives were unchanged.

4.1 Discussion of Findings

The finding on realised crude oil price volatility showed that historical variations in crude oil prices did not significantly affect weekly stock market performance in Nigeria. This is consistent with Nwude et al. (2021), who found that crude oil price fluctuations had only a limited effect on the Nigerian stock market and could not adequately explain market activities. However, the finding differs from Oke et al. (2023) and Eze (2024), who reported significant effects of crude oil price volatility on stock market performance in Nigeria. The differences may be related to the frequency of the data, study period, measures of stock market performance and estimation techniques employed.

Conditional crude oil price volatility measured through GARCH was also statistically insignificant. Although the GARCH estimates confirmed significant and persistent volatility in Brent crude oil returns, the resulting conditional-volatility series did not significantly affect ASI Return. This differs from Tumala (2023), who reported a significant influence of crude oil volatility on stock-market volatility using a GARCH-MIDAS framework. One possible explanation is that Tumala (2023) examined volatility transmission or stock-market volatility, whereas the present study examines aggregate stock market return. Therefore, substantial volatility within the crude oil market may not necessarily produce a significant movement in average Nigerian stock returns.

The insignificant effect of OVX indicates that forward-looking uncertainty in the crude oil market did not have a stable direct effect on Nigerian stock market performance. This finding is consistent with Yin et al. (2019), who found that oil-market uncertainty provided only weak additional information for explaining or predicting stock returns. It differs from Joo and Park (2021), who found that the effect of oil-price volatility on stock returns was significant under particular market conditions. Their findings suggest that the relationship may vary with prevailing oil-market and stock-market conditions rather than remain constant across the entire sample period.

Similarly, asymmetric crude oil price volatility measured through EGARCH did not significantly affect ASI Return, despite the significant asymmetric behaviour observed within Brent crude oil volatility itself. This differs from Muhammad et al. (2023) and Ajala et al. (2021), who reported asymmetric effects of crude oil price changes on stock market performance in Nigeria. The difference may be associated with the measurement of asymmetry, as the present study uses an EGARCH conditional-volatility series, while other studies model positive and negative oil-price changes or volatility spillovers directly.

Overall, the consistency of the results across realised, conditional, implied and asymmetric volatility suggests that the insignificant direct effect is not dependent on a single measure of crude oil volatility. The findings provide limited support for treating crude oil price volatility as an independent systematic factor explaining aggregate Nigerian stock market performance under the Arbitrage Pricing Theory. Its influence may instead operate through domestic macroeconomic conditions, sector-specific exposure or other market channels.

5. Conclusion and Recommendations

The study concludes that crude oil price volatility had no statistically significant direct short-run effect on stock market performance in Nigeria during the period examined. Although Brent crude oil returns exhibited volatility clustering, persistence and asymmetric responses to shocks, realised, conditional, implied and asymmetric crude oil price volatility did not significantly affect aggregate stock market performance. The consistency of the findings across the four measures suggests that crude oil volatility alone is insufficient to explain movements in the Nigerian stock market.

The absence of a significant direct effect does not imply that crude oil developments are economically unimportant to Nigeria. Rather, their influence may operate indirectly through government revenue, exchange-rate conditions, inflation, corporate earnings and sector-specific exposure. In relation to the Arbitrage Pricing Theory, the findings therefore provide limited support for crude oil volatility as an independent systematic factor affecting aggregate stock market performance.

Based on the findings, the following recommendations are made:

1. Investors and portfolio managers should not rely solely on realised crude oil volatility when making short-term investment decisions. Historical oil-price movements should be considered alongside company fundamentals, inflation, exchange-rate conditions and sectoral performance.

2. Financial analysts should treat GARCH-based crude oil volatility as a supplementary risk measure rather than an independent indicator of Nigerian stock market movements and should interpret it together with relevant domestic financial and macroeconomic conditions.

3. OVX should primarily be used as an indicator of forward-looking uncertainty in the international crude oil market rather than as a standalone indicator of Nigerian stock market performance. Its interpretation should be supported by domestic and market-specific information.

4. Institutional investors should assess asymmetric crude oil exposure at the sectoral and company levels rather than assume that all listed firms respond uniformly to oil-price shocks. The Nigerian Exchange

and Securities and Exchange Commission should also encourage greater use of sector-specific indices to facilitate such assessments.

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Appendix

Appendix Table A1: Variable Construction and Data Sources

Variable	Measurement / Construction	Source
ASI Return	$100 \times \ln(ASI_t/ASI_{t-1})$	Investing.com; NGX verification
Brent Return	$100 \times \ln(BP_t/BP_{t-1})$	Investing.com
Realised Volatility (8-week)	8-week rolling SD of Brent Return	Author's computation
GARCH Conditional Volatility	Conditional SD; skewed-t GARCH(1,1)	Author's estimation
OVX	Weekly Cboe oil implied-volatility index	Investing.com/Cboe; FRED gap repair
EGARCH Volatility	Conditional SD; skewed-t EGARCH(1,1)	Author's estimation
Exchange-Rate Change	$100 \times \ln(EXR_t/EXR_{t-1})$	Investing.com
Inflation Change	First difference of headline YoY inflation	Central Bank of Nigeria
MPR Change	First difference of Monetary Policy Rate	Central Bank of Nigeria

Note: Weekly sample: January 2010–December 2025 (835 observations). SD = sample standard deviation; BP = Brent price; EXR = USD/NGN exchange rate.

Reproducibility

The data-processing workflow, volatility-model estimation, four AR(1) regressions, diagnostics and supporting materials are retained in the accompanying research repository at: https://github.com/HamzaMuhd/Research. The repository contains Python scripts, Jupyter notebooks, processed datasets, output tables, a README, a data dictionary and methodological documentation. Access may depend on repository permissions; third-party data remain subject to their providers' terms.