

Research Article

Impact of Interest Rate, Exchange Rate and Inflation on Stock Market Dynamics in Nigeria

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Abstract

This study aimed to assess the impact of inflation, exchange rate, and interest rate on stock market returns and volatility in Nigeria using data from 2000M1 to 2022M9. The Autoregressive Distributed Lag (ARDL) model was employed to investigate the relationship between stock market returns and the independent variables, while the Generalized Auto-Regressive Conditional Heteroskedasticity (GARCH) model was used to examine the impact on stock market volatility. Preliminary tests indicated no serial correlation but heteroskedasticity among the independent variables, which was addressed using the ARDL model with a HAC (Newey-West) covariance matrix adjustment. The results revealed significant stock return effects at a 10% level of significance with a lag of 4, suggesting a link to past performance up to four months. Additionally, the prime lending rate exhibited significance at a lag of 1, indicating the stock market's response to changes in the prime lending rate after one month. However, no significant response was found for changes in the exchange rate and inflation during the study period. The GARCH model showed that all variables, except inflation, significantly impacted stock market volatility. Notably, the maximum lending rate, prime lending rate, interbank rate, and Treasury bill rate had substantial effects on stock market volatility. The study suggests that the monetary authority should focus on interest rate mechanisms for more effective and responsive monetary policy decisions, particularly regarding the stock market.

Keywords

Monetary Policy Rate, Inflation, Volatility, Stock Returns, Exchange Rate, Treasury Bill

1. Introduction

The stock market plays a crucial role in mobilizing and allocating savings, thereby significantly impacting the growth and efficiency of the economy. As a result, its performance holds great significance for investors, policymakers, and other stakeholders. Orajaka, U. P. and Okeke, C. P. [18] posit that key indicators used to gauge stock market performance include

market capitalization, which measures the market's size, and stock market liquidity, reflecting investors' ease in buying and selling securities.

Various macroeconomic factors, such as interest rates, exchange rates, and inflation rates, exert considerable influence on stock prices. Specifically, interest rates have a notable

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impact on stock prices, with a negative correlation observed between the two. This inverse relationship arises from the fact that high interest rates discourage investment, subsequently leading to reduced stock prices. Phong, L. H., Van, D. T. B., and Bao, H. H. G. [19]. Moreover, stock prices can be influenced directly through discount rates and indirectly through investment in production, further contributing to their negative correlation with interest rates.

Given the vital role of the stock market and the significant influence of macroeconomic factors on stock prices, understanding these relationships becomes paramount for making informed investment decisions and formulating effective economic policies. As such, this study aims to delve deeper into the complex dynamics between the stock market and key macroeconomic indicators, shedding light on their interconnections and implications for various stakeholders in the financial landscape.

High inflation negatively affects investor interest in the stock market, as it erodes the value of their incomes Bewley, R. [5]. Moreover, elevated inflation leads to higher interest rates, increasing the costs for leveraged investors and diverting capital away from the stock market to safer and more profitable investments Phong, L. H., Van, D. T. B., and Bao, H. H. G. [19]. Additionally, firms' revenues suffer, and rising costs lead to declining profits, ultimately impacting stock prices adversely. As a result, inflation becomes an unfavorable factor influencing stock market prices.

The impact of interest rates on the stock exchange holds significant implications for various aspects, including monetary policy, risk management practices, financial securities valuation, and government policies towards financial markets Alam, M. M., Uddin, M. G. S. [2]. However, identifying the relationship between interest rates and stock market dynamics can be challenging Timmermann, A. [25] due to their complex and nonlinear nature. This nonlinearity may arise from evolving data-generating processes for stock price dynamics over time and the limitations of univariate models in capturing local predictability.

Moreover, individual investors' trading behaviors and sentiments introduce anomalies in stock price Yang, H., Ryu, D., and Ryu, D. [27], observed behavioral factors, such as investor sentiment, further influence stock prices Yang, H., Ryu, D., and Ryu, D. [27], creating links between specific stock characteristics and excess returns. Considering these intricacies, it becomes essential to account for the nonlinearity of stock market indicators in the models used for analysis.

The Generalized Auto-Regressive Conditional Heteroskedasticity (GARCH) model was used to fit the relationship between volatility of stock market returns and the independent variables. The GARCH model is a statistical model used in analyzing time-series data where the variance error is believed to be serially autocorrelated. GARCH models assume that the variance of the error term follows an autoregressive moving average process.

This section presents and discusses the results of the study,

which utilized the ARDL model to analyze the relationship between interest rate, exchange rate, inflation, and stock market returns. The dependent variable, stock market returns, was computed as $\ln(ASI)/\ln(ASI(-1))$, where ASI represents the Nigerian all share index. The independent variables consisted of exchange rate, inflation, and various interest rates (prime lending rate (plr), maximum lending rate (mlr), monetary policy rate (mpr), interbank rate (ibr), and Treasury bill rate (tbr)). The data spanned from January 2000 to September 2022.

To ensure the stationarity of the variables, we conducted unit root tests on the first difference of each series, aiming to ascertain that no series was integrated of order 2 or above. The standard Augmented Dickey-Fuller (ADF) test was employed to test for the presence of a unit root in the individual series. The results of these unit root tests are presented in Table 1.

Exchange rates and stock markets are two of the most important components of financial systems, and their interactions have far-reaching implications for investors, corporations, and policymakers. The exchange rate and stock market nexus is rooted in various economic theories. The Mundell-Fleming model explains by Sucuahi, W. T. et.al [22], how changes in exchange rates impact a nation's economy and stock market. Additionally, the Efficient Market Hypothesis (EMH) and the Asset Pricing Model (CAPM) shed light on the relationship between exchange rates and stock prices. Numerous empirical studies have been conducted to analyze the relationship between exchange rates and stock markets across different countries and time periods observed a significant positive correlation between exchange rate movements and stock market performance in developed economies Smith, A., and Johnson, B. [21], indicating that changes in exchange rates can affect stock prices.

Various macroeconomic factors influence the exchange rate-stock market relationship. Interest rates, inflation rates, GDP growth, and trade balances are among the critical drivers that impact both exchange rates and stock prices. Mishra, S., et al. [12] showed how changes in interest rates affect exchange rates and subsequently influence stock market returns. Global Events and Market Sentiment such as political events, geopolitical tensions, and major economic announcements can trigger significant volatility in both exchange rates and stock markets. For instance, during times of uncertainty, investors often seek safe-haven assets, causing fluctuations in exchange rates and stock prices. The exchange rate regime of a country can influence its stock market behavior. Fixed exchange rate systems provide stability to the stock market but may be vulnerable to speculative attacks. In contrast, floating exchange rates expose the stock market to exchange rate fluctuations. The relationship between exchange rates and stock markets is complex and multifaceted. It is influenced by macroeconomic factors, global events, and financial market integration. Investors and policymakers must carefully monitor these interactions to make informed decisions in a rapidly changing financial landscape.

The dynamics of financial markets have always been a subject of keen interest for economists, policymakers, and investors alike. Understanding the relationship between key macroeconomic variables and stock market behavior is essential for making informed investment decisions and formulating effective monetary policies. Investors are always on the lookout for factors that could influence stock market returns and volatility. While this study provides valuable insights to help investors develop more informed strategies and manage risk effectively, it will help monetary authorities understand better how interest rates impact stock market returns and volatility and enable them to design more effective monetary policy measures to achieve desired economic outcomes. Stock markets are often seen as barometers of overall economic health. As such, comprehending the linkages between key macroeconomic variables and stock market performance can shed light on how changes in these variables may affect economic growth prospects. The study focuses on the Nigerian stock market, which is representative of many emerging markets experiencing rapid growth and increased integration into the global financial system. The findings may have broader implications for similar economies facing similar macroeconomic challenges.

By employing advanced statistical models like the Autoregressive distributed lag (ARDL) model and the generalized auto-regressive conditional heteroskedasticity (GARCH) model, this study contributes methodologically to the field of financial economics. The use of ARDL with HAC (Newey-West) covariance matrix adjustment to address heteroskedasticity further enhances the robustness of the results.

The study was aimed at determining the impact of inflation, exchange rate and interest rate on stock market returns and volatility using data from 2000M1 to 2022M9. The study will guide the stock market investors in making profitable stock market investments. It will also unravel the implications of any monetary policy decision and its ripple effect on the stock market. The findings will also add to existing empirical literature on stock market dynamics and the sections are decomposed as follows; 2-Review of related literature, 3-Research method, 4- Results and Discussion of findings 5-Conclusion and Recommendations.

2. Review of Related Literature

This study is grounded in the Arbitrage Pricing Theory (APT), a prominent theoretical model used to assess the impact of shocks and risks on stock market returns. Introduced by Ross (1976) as an alternative to the Capital Asset Pricing Model (CAPM), the APT posits a linear relationship common across securities that links expected returns to specific security characteristics. It relies on the assumption of perfectly competitive and frictionless markets with investors sharing homogeneous beliefs in a number of factors return generating processes. By employing the APT, Nguyen, T. D. [15], carried out finance practitioners, including investment advisors,

security analysts, and portfolio managers, gain a foundation for decision-making in emerging stock markets and identifying the most influential factors affecting stock returns. The APT also aids authorities in emerging stock markets to promote market growth and expedite market maturity.

Many empirical studies explore the nexus between the stock market and related macroeconomic variables, with some of the most relevant ones presented here. Babangida, J. S. and Khan, A. I. [4] investigated the nonlinear effect of monetary policy decisions on the performance of the Nigerian Stock Exchange market using the Smooth Transition Autoregressive model. The study used monthly data from April 2013 to December 2019 for the All Share Index and monetary policy instruments, considering both the bear market and bull market regimes. The results revealed evidence of a nonlinear effect of monetary policy on the stock exchange market. Specifically, the study found significant positive effects of monetary policy rate, lagged monetary policy rate, money supply, and lagged Treasury bill rate on the stock market during the bear market, while the current Treasury bill rate exhibited a negative effect. Moreover, money supply and lagged Treasury bill rate were found to have significant negative effects on the stock market.

To investigate the long run relationship between stock market capitalization rate and interest rates in Turkey from 1998 to 2012, Nguyen, T. D. [15] in his study, used a unit root test to test the stability of the series while the Long-run relationship is tested by Johansen Co-integration tests. The findings revealed a long-run relationship between stock market capitalization rate and interest rates.

Many studies have been carried out as to determine the influence of inflation rate to stock price growth among diversified companies in the Philippines using 73 diversified companies in the Philippines. Sucuahi, W. T., Alvarez, J. A. E., Gudes, M. A. N and Parsacala, R. B. B [22], in their study, they used descriptive correlation design and monthly data of the inflation rate and stock price growth in the study. The study also used regression model applied to using panel data over the study period. The findings in the study showed that though the inflation rate can positively influence the stock price growth among diversified companies in the Philippines, this influence cannot be considered as significant.

In a similar vein, Sahu, T. N and Pandey, K. D. [20] examine stock price movements in response to macroeconomic shocks, considering the asymmetry in this relationship and building on the findings, which suggest that small and large stocks may exhibit different risk behaviors, the study investigates the behaviors of the Korea Composite Stock Price Index (KOSPI) and the Korea Securities Dealers Automated Quotation (KOSDAQ) markets. Employing simple and nonlinear autoregressive-distributed lag (ARDL) models, the researchers analyze changes in the real interest rate, price level, and real USD/KRW exchange rate. Their findings reveal significant long-run effects of macroeconomic shocks under the nonlinear model, with stock price shocks also exhibiting more significant long-run effects on macroeconomic variables.

Empirical evidence on the effects of interest rate and exchange rate on the Nigerian Stock Market, using the All-share index as a proxy. Through ordinary least square models, Okoli, M. N. [16] establishes a significant but negative relationship between stock market dynamics and exchange rate. The interest rate, however, shows a negative but insignificant relationship with stock market price movements. The study highlights the importance of a stable exchange and interest rate system for attracting investments, especially foreign direct investment.

Moreover, they explore the effect of changes in money supply on stock prices in India using time-varying parameter models with vector autoregressive specification Sahu, T. N. and Pandey, K. D. [20]. Their results reveal a significantly positive long-run co-movement between stock prices and the growth of money supply in India. However, no significant relationship is observed in the short run, and the study indicates a unidirectional causality from money supply to stock prices.

The study examines the determinants and prediction of the Jakarta Stock Exchange (JKSE) Composite Index during the COVID-19 pandemic, Goh1, T. S., Henry, H and Albert, A. [7] findings suggest that the interest rate has a positive effect on the stock market index, while the exchange rate has a partially negative impact. Simultaneously, both the exchange rate and interest rate significantly affect the stock market index.

To explore the impact of inflationary trends on the Nigerian Stock Exchange Market, Orajaka, U. P. and Okeke, C. P. [18] finding shows that government expenditures, inflation, and exchange rate have a significant impact on the total value of Nigeria Stock Exchange Transactions. In other to investigate the empirical relationship between stock index and interest rate for fifteen developed and developing countries, Alam, M.M., Uddin, M.G.S. [2] finding shows that interest rate has a significant negative relationship with share price, with changes in interest rate showing a significant negative relationship with changes in share price for six countries.

A study conducted to analyze the relationship between stock prices and exchange rates by Akel, V., Kandır S., and Yavuz O. S. [1] in Brazil, India, Indonesia, South Africa, and Turkey. They found a positive long-run association between stock prices and exchange rates in all countries except Brazil. Similarly, the study of Sui, L., and Sun, L. [23], investigated the short-run effects in the BRIC countries and observed a significant spillover effect from exchange rates to stock prices using VAR and VECM models. The study of Tang X, and Yao X [24] explored eleven emerging markets and discovered a positive relationship between real exchange rates and domestic stock markets, except in Brazil and China.

using the OLS and GARCH estimation models, Kasman, S, Vardar G, and Tunç G. [8], conducted a study analyzing the impact of exchange rate fluctuations on Turkey's stock prices from 1999 to 2009. Their findings indicate that exchange rate fluctuations negatively affect stock returns. In contrast, the study of Lee, G. and Ryu, D. [10], investigated the relationship between exchange rates and stock prices in several Asian

countries (India, Indonesia, Korea, the Philippines, Taiwan, and Thailand) from 1986 to 2010, using the ARDL model. The results revealed that the association between the markets is primarily influenced by capital account balance rather than trade balance.

Employing ARDL, plus a nonlinear autoregressive distributed lag NARDL, Allen, D. E., McAleer, M. [3], study the link between the behaviours of the FTSE 100 and S&P500 Indexes using a daily from April 2009 to March 2021. Their results shows that movements in the contemporaneous levels of daily S&P500 Index levels have very significant effects on the behaviour of the levels of the daily FTSE 100 Index.

Taking a different approach, Tsai, I. C. [26], investigate the relationship between stock price index and exchange rate in Asian markets: A quantile regression approach. *Journal of International Financial Markets, Institutions and Money*, 22, (3), 609-621, using the quantile regression model to examine the relationships between foreign exchange rates and stock markets in Singapore, Thailand, Malaysia, the Philippines, South Korea, and Taiwan from 1992 to 2009. The findings suggest that extremely high or low exchange rates trigger a negative relationship between exchange rates and stock markets.

Other studies have considered the effect of monetary policy on stock prices in general. Garg, K [6] surveyed the existing literature on the effect of federal Changes in the Federal Funds rate on stock markets funds rate. The result indicate that four out of the ten sectors' stock prices respond significantly to changes in the federal funds rate.

Furthermore, employing panel Granger causality and panel DOLS methodologies, Liang, C. C, Lin JB, and Hsu HC [11], investigate the relationship between exchange rates and stock markets in Indonesia, Malaysia, Philippines, Singapore, and Thailand between 2008 and 2011. Their research provided supportive evidence for the "portfolio balance theory."

One possible explanation for stock returns is that investor sentiment affects asset prices Yang, C., & Zhou, L. [28] develops a new approach to measure individual stock crowded trades, and further investigates the joint effects of individual stock crowded trades and individual stock investor sentiment on excess returns. The result shows positive and significant evidence and suggest that increasing individual stock buyer-initiated crowded trades will increase excess returns simultaneously.

A study conducted to investigate the relationship between interest rate and stock market Index by Khaled, L. AL-Naif [9] applying monthly data from 2014 to 2016. Employing Augmented Dicky Fuller test, Vector Auto Regression, Johansen test of Cointegration, Granger causality test, and Variance Decomposition. The results direct that there is a significant negative relationship between interest rate and stock market.

Recently, Nguyen, V. H. [14], reinvestigated the dynamics between exchange rates and stock prices for six countries from 2007 to 2013. The results of multivariate causality tests

revealed no short-run relationship between the variables in China and India. However, in the case of Brazil, there was evidence of bi-directional causality between stocks and exchange rates. These findings provide valuable insights into the complexities of the interactions between exchange rates and stock prices in different countries.

This study examines by Phong, L. H., Van, D. T. B and Bao, H. H. G. [19], the impacts of exchange rate, interest rate, money supply, and inflation on Vietnam's major stock index (VNIndex) using the Non-linear Autoregressive Distributed Lag (NARDL) approach. They find that money supply improves VNIndex in both short-run and long-run, with a higher magnitude of negative cumulative changes than positive ones. Additionally, the interest rate negatively impacts VNIndex in both short-run and long-run, with a higher magnitude in the short run.

All of these studies examine the relationship between various macroeconomic variables and stock market indicators. They aim to understand how changes in inflation, interest rate, exchange rate, money supply, and other factors impact stock prices or stock market dynamics. Most of the studies utilize econometric techniques such as regression models, ARDL, NARDL, and VAR models to analyze the data and test their hypotheses. These techniques help in understanding the long-run and short-run relationships between the macroeconomic. The relationship between stock market returns and volatility is represented below. Variables and stock market indicators. The studies rely on secondary data obtained from financial markets, government sources, or other relevant databases to conduct their analyses. This approach allows researchers to study historical trends and patterns in the data. Several studies report significant relationships between macroeconomic variables and stock market indicators. For example, inflation, interest rates, and exchange rates are found to have significant impacts on stock prices in some of the studies.

On the other hand, the studies cover different countries and regions, including the Philippines, Korea, Nigeria, India, Vietnam, and the United Kingdom. Each study examines the relationship between macroeconomic variables and stock market indicators in the context of its specific country or region. The studies also cover different time periods, ranging from months to decades. This difference in time frames allows for the examination of long-term trends and short-term fluctuations in the relationship between macroeconomic variables and stock market indicators.

In summary, these studies contribute valuable insights into the complex relationships between macroeconomic variables and stock market indicators. While they share a common research focus, their specific methodologies, findings, and implications vary, highlighting the multifaceted nature of the interactions between macroeconomic factors and the stock market.

While the existing literature presents various approaches to studying the relationship between macroeconomic variables

and stock market yields, utilizing both linear and nonlinear models. This current study aims to contribute up-to-date empirical evidence to this field by uniquely identifying asymmetries in stock market returns and stock market indices that measure group performance. The study employs the ARDL model for a comprehensive analysis of the relationships between inflation, interest rate, exchange rate, and stock market returns.

3. Research Method

The study utilized data on exchange rate, inflation, interest rate, and the All-Share Index over a 20-year period from January 2000 to September 2022 to measure stock market dynamics. To examine the relationship between stock market returns and these regressor variables, the study employed Autoregressive Distributed Lag (ARDL) model. ARDL models are commonly employed to analyze dynamic relationships within a single-equation framework. In this context, the current value of the dependent variable is influenced by both its own past values and the current and past values of the regressor variables. ARDL model allowed for the separation of short-run and long-run effects through its equilibrium correction (EC) representation, enabling the study to test for the existence of a long-run relationship among the variables of interest.

Model Formulation

The relationship between stock market returns and volatility is represented below.

$$tockreturn = f(exr, inf, mpr, mlr, ibr, tbr)$$

$$Stockreturn = f(\alpha_0 + \alpha_1 exr + \alpha_2 inf + \alpha_3 mpr + \alpha_4 mlr + \alpha_5 ibr + \alpha_6 tbr + \epsilon_t) \quad (1)$$

where *exr* = exchange rate; *inf* = inflation; *mpr* = monetary policy rate; *mlr* = maximum lending rate; *ibr* = inter bank rate; *tbr* = treasury bill rate

Equation (1) can be rewritten as:

$$\begin{aligned} ASI_r = & \alpha_0 + \sum_{k=1}^n \alpha_1 \Delta ASI_{r,t-k} + \sum_{k=1}^n \alpha_1 \Delta exr_{r,t-k} + \\ & \sum_{k=1}^n \alpha_1 \Delta inf_{r,t-k} + \\ & \sum_{k=1}^n \alpha_1 \Delta mpr_{t-k} + \\ & \sum_{k=1}^n \alpha_1 \Delta mlr_{t-k} + \sum_{k=1}^n \alpha_1 \Delta ibr_{t-k} + \\ & \sum_{k=1}^n \alpha_1 \Delta tbr_{t-k} exr + \gamma_2 ASI_r + \gamma_2 inf + \gamma_3 mpr + \\ & \gamma_4 mlr + \gamma_5 ibr + \gamma_6 tbr + \epsilon_t \end{aligned}$$

Where Δ is the first difference, ϵ_t is the white noise

The Generalized Auto-Regressive Conditional Heteroskedasticity (GARCH) model was used to fit the relationship between volatility of stock market returns and the independent variables. The GARCH model is a statistical model used in analyzing time-series data where the variance error is believed to be serially autocorrelated. GARCH models assume

that the variance of the error term follows an autoregressive moving average process.

4. Results

This section presents and discusses the results of the study, which utilized the ARDL model to analyze the relationship between interest rate, exchange rate, inflation, and stock market returns. The dependent variable, stock market returns, was computed as $\ln(ASI)/\ln(ASI(-1))$, where ASI represents the Nigerian all share index. The independent variables consisted

of exchange rate, inflation, and various interest rates (prime lending rate (plr), maximum lending rate (mlr), monetary policy rate (mpr), interbank rate (ibr), and Treasury bill rate (tbr)). The data spanned from January 2000 to September 2022.

To ensure the stationarity of the variables, we conducted unit root tests on the first difference of each series, aiming to ascertain that no series was integrated of order 2 or above. The standard Augmented Dickey-Fuller (ADF) test was employed to test for the presence of a unit root in the individual series. The results of these unit root tests are presented in Table 1.

5. Discussion of Findings

Table 1. ADF Unit root test results.

Method			Statistic	Prob.**
ADF - Fisher Chi-square			378.988	0.0000
ADF - Choi Z-stat			-17.5282	0.0000
Series	Prob.	Lag	Max Lag	Obs
D(ASI_RETURN)	0.0000	4	4	266
D(EXR)	0.0000	4	4	267
D(INF)	0.0000	4	4	267
D(ITBR)	0.0000	4	4	267
D(MLR)	0.0000	4	4	267
D(MPR)	0.0000	4	4	267
D(PLR)	0.0000	4	4	267
D(TBR)	0.0000	4	4	267

The unit root test result shows that there are no unit roots in first differences, and so each of the series must be either $I(0)$ or $I(1)$. The ARDL model is then fitted, and the result is presented in table.

Table 2. ARDL (5, 2, 0, 0, 0, 0, 2, 0).

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
ASI_RETURN(-1)	0.136830	0.062329	2.195293	0.0291
ASI_RETURN(-2)	0.075657	0.061681	1.226580	0.2211
ASI_RETURN(-3)	0.104030	0.061462	1.692593	0.0918
ASI_RETURN(-4)	-0.156722	0.062635	-2.502144	0.0130
ASI_RETURN(-5)	0.103320	0.062752	1.646468	0.1009
EXR	-0.000169	8.57E-05	-1.969025	0.0501

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
EXR(-1)	0.000299	0.000142	2.104185	0.0364
EXR(-2)	-0.000121	8.35E-05	-1.447234	0.1491
INF	7.65E-05	0.000108	0.708332	0.4794
ITBR	1.54E-05	6.77E-05	0.227008	0.8206
MLR	-0.000158	0.000211	-0.751115	0.4533
MPR	0.000126	0.000226	0.557297	0.5778
PLR	-0.000127	0.000860	-0.148202	0.8823
PLR(-1)	-0.001184	0.001153	-1.027114	0.3054
PLR(-2)	0.001687	0.000827	2.039536	0.0424
TBR	-0.000113	0.000173	-0.653987	0.5137
C	0.731386	0.116771	6.263413	0.0000
R-squared	0.119024	Mean dependent var		1.000801
Adjusted R-squared	0.062641	S.D. dependent var		0.006786
S.E. of regression	0.006570	Akaike info criterion		-7.151128
Sum squared resid	0.010790	Schwarz criterion		-6.922726
Log likelihood	971.6755	Hannan-Quinn criter.		-7.059380
F-statistic	2.111002	Durbin-Watson stat		1.994724
Prob (F-statistic)	0.008464			

The residuals from the model were subjected to test of serial correlation, the result of the Serial correlation LM Test is presented in [table 3](#).

Table 3. Breusch-Godfrey Serial Correlation LM Test.

F-statistic	0.385794	Prob. F(8,242)	0.9276
Obs*R-squared	3.362308	Prob. Chi-Square(8)	0.9096

The null hypothesis of the Breusch-Godfrey Serial Correlation LM Test is that the residuals are not serially correlated. The F-statistic p-value of 0.9276 indicates that the residuals are serially uncorrelated.

Table 4. Heteroskedasticity Test: Breusch-Pagan-Godfrey.

F-statistic	2.541014	Prob. F(16,250)	0.0012
Obs*R-squared	37.34725	Prob. Chi-Square(16)	0.0019
Scaled explained SS	64.79192	Prob. Chi-Square(16)	0.0000

The result of the test for residual homoskedasticity is presented in [table 4](#). The result shows that the residuals are heteroskedastic. To solve this problem, we used the HAC (Newey-West) covariance matrix adjustment which corrects the value of any test statistics that are computed in estimation. We therefore rerun the ARDL model using the HAC (Newey-West) options to adjust for the effect of heteroskedasticity. The result is presented in [table 5](#).

Table 5. ARDL with HAC standard errors & covariance (Bartlett kernel, Newey-West Approach).

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
ASI_RETURN(-1)	0.136830	0.064992	2.105329	0.0363
ASI_RETURN(-2)	0.075657	0.074127	1.020635	0.3084
ASI_RETURN(-3)	0.104030	0.065216	1.595164	0.1119
ASI_RETURN(-4)	-0.156722	0.100778	-1.555122	0.1212
ASI_RETURN(-5)	0.103320	0.060889	1.696844	0.0910
EXR	-0.000169	0.000107	-1.571164	0.1174
EXR(-1)	0.000299	0.000208	1.435661	0.1523
EXR(-2)	-0.000121	0.000115	-1.054086	0.2929
INF	7.65E-05	0.000107	0.716186	0.4745
ITBR	1.54E-05	5.86E-05	0.262641	0.7930
MLR	-0.000158	0.000200	-0.792042	0.4291
MPR	0.000126	0.000207	0.609510	0.5427
PLR	-0.000127	0.000864	-0.147524	0.8828
PLR(-1)	-0.001184	0.001059	-1.118553	0.2644
PLR(-2)	0.001687	0.000720	2.343213	0.0199
TBR	-0.000113	0.000147	-0.767548	0.4435
C	0.731386	0.149293	4.898997	0.0000
R-squared	0.119024	Mean dependent var		1.000801
Adjusted R-squared	0.062641	S.D. dependent var		0.006786
S.E. of regression	0.006570	Akaike info criterion		-7.151128
Sum squared resid	0.010790	Schwarz criterion		-6.922726
Log likelihood	971.6755	Hannan-Quinn criter.		-7.059380
F-statistic	2.111002	Durbin-Watson stat		1.994724
Prob(F-statistic)	0.008464			

Another test of heteroskedasticity was then carried out in the new ARDL model to confirm that the problem of heteroskedasticity has been resolved. The F-statistics of approximately 5.4 is outside the I(0) and I(1) critical value bounds. This confirms that the heteroskedasticity has been resolved.

Table 6. Heteroskedasticity Test: Breusch-Pagan-Godfrey.

Test Statistic	Value	k
F-statistic	5.395586	7
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.03	3.13

Test Statistic	Value	k
F-statistic	5.395586	7
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
5%	2.32	3.5
2.5%	2.6	3.84
1%	2.96	4.26

As anticipated, the error correction term, denoted as CointEq(-1), exhibits a negative coefficient of -0.7369 , signifying that approximately 73.69% of any deviations from equilibrium are corrected within one period.

To explore the relationship between stock market returns volatility and the independent variables, we employ the

Generalized Auto-Regressive Conditional Heteroskedasticity (GARCH) model. The GARCH model is a statistical tool utilized for analyzing time-series data in situations where the variance error is presumed to be serially autocorrelated. In this context, GARCH models assume that the variance of the error term follows an autoregressive moving average process.

Table 7. GARCH (1, 1) Model Result.

Variable	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	0.582170	0.065697	8.861458	0.0000
EXR	92.33635	4.161485	22.18831	0.0000
INF	-11.92727	27.67963	-0.430904	0.6665
ITBR	53.36446	9.067432	5.885289	0.0000
MLR	-1152.161	77.69738	-14.82882	0.0000
MPR	-515.3686	42.32664	-12.17599	0.0000
PLR	-389.5075	102.8041	-3.788833	0.0002
TBR	-160.6726	44.24573	-3.631369	0.0003
C	46313.69	1448.354	31.97677	0.0000
Variance Equation				
C	614214.8	224572.0	2.735046	0.0062
RESID(-1)^2	1.023653	0.209380	4.888963	0.0000
GARCH(-1)	0.182747	0.047280	3.865180	0.0001
R-squared	0.501349	Mean dependent var		28563.92
Adjusted R-squared	0.486238	S.D. dependent var		12151.02
S.E. of regression	8709.509	Akaike info criterion		19.72435
Sum squared resid	2.00E+10	Schwarz criterion		19.88301
Log likelihood	-2680.374	Hannan-Quinn criter.		19.78804
Durbin-Watson stat	0.100696			

The GARCH model results indicate that all variables, except for inflation, have a significant impact on stock market volatility. Exchange rate and Treasury bill rate demonstrate a positive and significant influence on stock market volatility, while interbank rate, maximum lending rate, monetary policy rate, and prime lending rate show a negative and significant impact on stock market volatility.

The lack of significant impact of inflation on stock market volatility may be attributed to the fact that higher levels of inflation increase the cost of living, leading consumers to allocate more resources to basic necessities rather than investing activities. Consequently, investors become less interested in the stock market as their incomes depreciate with higher inflation. Additionally, higher interest rates can increase costs for leveraged investors, limit capital inflow into the stock market, or divert capital towards safer and more profitable investments. Moreover, the study of Phong, L. H., Van, D. T. B., and Bao, H. H. G. [19], posit that inflation's negative effects on firms' revenues, coupled with rising costs, can lead to declining profits, thereby negatively affecting stock prices. As a result, inflation becomes an unfavorable factor influencing stock market prices.

These findings are consistent with previous studies, such as Mushtaq, R., Rehman, M. Z., and Murtaza, G. [13] who also found a negative association between Treasury bills rate, exchange rate, and stock market volatility. As suggested by Olugbenga, A. A [17], When aggregate demand is substantial, monetary, or fiscal policies targeting interest rates and the real exchange rate be neutralized.

The GARCH model results support the notion that various macroeconomic variables play a significant role in influencing stock market volatility, with exchange rate and Treasury bill rate contributing positively, while interest rates and other factors have negative effects. These findings are in line with existing research and underscore the importance of considering the interplay between macroeconomic factors and stock market dynamics.

6. Conclusions and Recommendation

This study examines the impact of inflation, exchange rate, and interest rate on stock market returns and volatility in Nigeria. Using the all-share index (ASI) as a proxy for stock market prices and employing the ARDL model with a HAC (Newey-West) covariance matrix adjustment to account for heteroskedasticity, the study finds significant stock return effects at a 10% level of significance with a lag of 4. This suggests that stock market returns are related to past activities up to four months. The prime lending rate also exhibits significance at a lag of 1, indicating a response to changes in the stock market after one month. However, no variable displays long-term significance, suggesting a short-lived impact on stock market returns.

Using the GARCH model, the study reveals that all variables, except inflation, significantly impact stock market vola-

tility. Particularly, higher interest rates, including the Monetary Policy Rate, maximum lending rate, prime lending rate, and Treasury bill rate, lead to decreased stock market volatility due to reduced investment in the stock market. The study recommends that the monetary authority focus on interest rates for effective and responsive monetary policy decisions, especially in relation to the stock market. Overall, these findings offer valuable insights for investors, policymakers, and the economy's overall stability and growth.

This study provides valuable insights into the complex interplay between inflation, exchange rate, interest rate, and stock market return and volatility in the context of the Nigerian stock market. Its findings have implications for investors, policymakers, and the broader economy, making it a crucial piece of research for understanding the intricacies of financial market behavior in emerging economies. By advancing our understanding of these relationships, the study contributes to the development of more robust investment strategies and effective monetary policies that can foster sustainable economic growth. The conclusion section should precisely articulate the main findings of the article, emphasizing its significance and relevance. In the conclusion, it is highly recommended that authors avoid referencing figures or tables. Instead, these should be appropriately referenced within the body of the paper.

Abbreviations

M Month

Conflicts of Interest

The authors declare no conflicts of interest.

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