Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 10, No. 2, 785-799
2026
Publisher: Learning Gate
DOI: 10.55214/2576-8484.v10i2.12235

Regime-switching dynamics of exchange rate movements and stock market performance in Nigeria: A Markov-switching VAR approach

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Abstract: This study investigates the regime-dependent effects of exchange rate movements on stock market performance in Nigeria from 1999Q1 to 2023Q4 using a Markov-Switching Vector Autoregression (MS-VAR) framework. The primary objective is to assess how the relationship between the Real Effective Exchange Rate (REER) and the All-Share Index (ASI) varies across different economic regimes. Preliminary analysis revealed a strong positive correlation (0.796) between REER and ASI, with both series being non-stationary at levels but integrated of order one. The MS-VAR model identified two distinct regimes: Regime 1, a stable state with 94.5% persistence representing normal economic conditions, and Regime 2, a volatile state representing short-term economic stress. In Regime 1, exchange rate movements positively influenced stock market performance (coefficient = 0.056), while in Regime 2, the impact was stronger (coefficient = 0.079). Impulse response analysis indicated that exchange rate shocks exert their highest effect on the stock market in the short term (0.047), diminishing to 0.022 in the long term. The findings underscore the importance of considering economic regimes in understanding the exchange rate–stock market nexus, offering insights for policymakers, investors, and financial analysts in managing market risks.
Keywords: *Exchange rate, Markov-Switching VAR, Nigeria, Regime dependence, Stock market performance.*

1. Introduction

The stock market is an important tool for economic growth because it helps channel resources, encourages savings, and provides a platform for investment [1]. Its performance is strongly affected by macroeconomic variables such as exchange rates, interest rates, and inflation, which influence investor behavior, company profits, and market conditions [2]. As global financial markets become more connected, understanding these factors has become even more important for policymakers and investors [3-5]. Recent global events, including the 2008 financial crisis and the COVID-19 pandemic, have shown how closely stock markets react to economic changes [6]. Studies by the IMF found that GDP growth explained about 25% of stock market returns, inflation about 15%, and exchange rates 10–20% across 17 advanced economies from 1980 to 2020 [7]. Exchange rates are especially important, as the move to floating exchange rates increased currency volatility and its effects on policy, competitiveness, and financial decisions [8-10]. Research across 45 emerging markets also shows that interest rates and FDI inflows influence stock market performance [11].

In Nigeria, the relationship between macroeconomic variables and stock market performance is particularly important. As Africa's largest economy and a major oil exporter, Nigeria's stock market is affected by both domestic and international economic forces. The Nigerian Stock Exchange has experienced significant ups and downs over the past twenty years, reflecting both domestic economic challenges and global market trends. Recent data from the Central Bank of Nigeria shows that the All-Share Index experienced a compound annual growth rate of about 12% between 2000 and 2022, but this

History: Received: 11 December 2025; Revised: 28 January 2026; Accepted: 2 February 2026; Published: 24 February 2026
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growth has been broken up by periods of sharp decline, such as the 45.8% drop in 2008 during the global financial crisis [12]. The value of transactions on the NSE has also shown a lot of change, with the total value traded increasing from ₦262 billion in 2000 to ₦916 billion in 2022, but experiencing big year-on-year differences, sometimes going over 50% [13].

The Real Exchange Rate of the Nigerian Naira has been particularly problematic, with the official exchange rate getting weaker from ₦99/USD in 2000 to over ₦460/USD by the end of 2022, representing a decline of more than 360% [14]. This weakening has had far-reaching effects on how competitive Nigerian firms are and on investor feelings. Data from the Nigerian Stock Exchange and the Central Bank of Nigeria show the unstable nature of this relationship. Between 2015 and 2021, the correlation coefficient between the Naira/USD exchange rate and the NSE All-Share Index was -0.62, showing a strong negative relationship [15]. This suggests that as the Naira weakens against the USD, there is a tendency for the stock market to decline, reflecting the import-dependent nature of many listed companies. Similarly, inflation, as measured by the Consumer Price Index, has remained very high, averaging 12.3% each year between 2000 and 2022, with peaks going over 18% in some years [16].

The main problem in this area is that the relationship between exchange rate movements and stock market performance in Nigeria is not stable over time. Past studies have attempted to measure the relationships between macroeconomic variables and stock market performance in Nigeria, but results have been mixed and often say different things. Okoebor [17] found that exchange rate changes explained 23% of the differences in the NSE All-Share Index between 2010 and 2020, while inflation accounted for 17%. However, Adeleye et al. [18] reported a much weaker relationship, with exchange rates and inflation together explaining only 12% of stock market returns over a similar period. These differences show that the relationship between exchange rates and stock market performance may not be the same across different time periods or economic conditions. The relationships may change or switch between different states or regimes, depending on whether the economy is going through good times or bad times, policy changes, or external shocks [19].

The problem is important because investors, policymakers, and companies in Nigeria often make decisions without knowing that the relationship between exchange rate movements and stock market performance can shift between different economic conditions [20, 21]. This has caused losses during major events such as the 2014–2016 oil crash, which pushed the ASI down by 17.4% in 2015 [21] and the COVID-19 shock, which led to a 14% fall in market capitalization in early 2020 [20]. If this issue is not addressed, investors may continue using strategies that fail during unstable periods, policymakers may apply policies that only work in one type of economic state, foreign investor confidence may weaken, and companies may mismanage currency risks, slowing economic growth.

The literature shows several gaps: many studies assume the exchange rate–stock market relationship stays the same over time, even though global and local events suggest it changes across regimes [6]. Only a few studies examine how the effects differ during good and bad economic periods, and past studies rarely separate exchange rate valuation from volatility. Most researchers also use linear methods that cannot capture regime changes, unlike the Markov-Switching VAR model, which is more suitable for Nigeria's unstable economy [19]. This study fills these knowledge, evidence, empirical, methodological, and variable gaps by using MS-VAR and focusing on Nigeria's oil-dependent and volatile environment to provide more helpful information for investors, policymakers, and companies.

2. Literature Review

2.1. Theoretical Framework

The Purchasing Power Parity (PPP) theory provides a foundational basis for understanding how exchange rate movements influence stock market performance. Rooted in the law of one price, PPP argues that exchange rates adjust to equalize the purchasing power of currencies across countries [22]. Although practical limitations such as transaction costs, trade barriers, and non-tradable goods lead to short-run deviations, PPP remains a key benchmark for long-run exchange rate equilibrium [23, 24].

ISSN: 2576-8484
Vol. 10, No. 2: 785-799, 2026
DOI: 10.55214/2576-8484.v10i2.12235

Deviations from PPP affect firm competitiveness, capital flows, and monetary policy, three major channels through which exchange rates impact stock markets [25-27].

In Nigeria, research shows that PPP holds in the long run but not in the short run, causing significant exchange rate volatility that influences stock performance and foreign investment behavior [28]. Thus, PPP provides an essential theoretical lens for examining regime-dependent effects of exchange rate fluctuations on Nigeria's stock market.

2.2. Empirical Review

Empirical studies examining the relationship between macroeconomic variables and stock market performance have produced mixed and often contradictory findings, reflecting differences in econometric techniques, sample periods, market structures, and the behaviour of financial variables across countries. Evidence from Nigeria shows considerable divergence. For example, Okoebor [17] found a positive relationship between selected macroeconomic indicators and stock market performance, supported by cointegration evidence, while studies such as Tamunowariye and Anaele [19] reported that exchange rate volatility significantly depresses stock market returns. Similarly, GARCH-based analyses reveal that macroeconomic uncertainty, particularly exchange rate and inflation shocks, tends to induce volatility in stock prices, though the direction and magnitude vary by study [29, 30]. Some Nigerian studies report negative volatility spillovers from money market instruments and interest-rate dynamics to stock returns [31], whereas others document positive effects from monetary aggregates and industrial production on market performance [32]. These inconsistencies underscore the heterogeneity in macro-financial interactions within Nigeria's evolving financial environment.

Beyond Nigeria, cross-country evidence reinforces the lack of consensus. Studies in emerging markets such as Palestine, India, China, and Indonesia show diverse outcomes depending on financial market depth and exchange rate regimes. For instance, Alashi [3] and Parker and Boxer [33] found that exchange rate depreciation reduces stock returns and productivity, while Cuestas and Tang [34] reported no significant contemporaneous relationship between stock and foreign exchange markets in China. Commodity-dependent economies like Indonesia exhibit significant short- and long-run sensitivity of export flows to currency volatility [4] while studies in India show that exchange rate volatility can either increase or decrease stock return volatility depending on the currency pair examined [35]. Evidence from South Africa [36] and East African markets [37] further indicates that macroeconomic indicators influence stock performance differently depending on inflationary cycles, monetary policy regimes, and structural characteristics of financial markets.

The empirical evidence suggests that while macroeconomic fundamentals such as exchange rates, interest rates, inflation, GDP, and money supply generally influence stock market dynamics, the direction, intensity, and stability of these effects differ across countries and time periods. The divergences observed across studies, including mixed evidence on whether exchange rate volatility exerts positive, negative, or insignificant effects, highlight the need for models capable of capturing regime shifts and nonlinearities. Consequently, recent literature emphasizes the suitability of volatility-sensitive and regime-switching models such as GARCH, EGARCH, VAR-AGARCH, and Markov-Switching VAR to better explain structural breaks and dynamic interactions between macroeconomic variables and stock markets, especially in emerging economies like Nigeria, where market conditions frequently oscillate between stable and crisis regimes.

3. Methodology

3.1. Research Design

This study adopts a quantitative research design, employing a time series econometric approach to investigate the dynamic relationship between exchange rate fluctuations and stock market performance in Nigeria. Specifically, the research focuses on the All-Share Index (ASI) as a measure of stock market performance and the Real Exchange Rate (RER) as the key macroeconomic determinant.

3.2. Sources of Data

The study relies on secondary data obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin. Quarterly data covering the period from 1999 to 2023 was used for both the ASI and RER. These two variables are selected due to their critical role in reflecting the performance of the Nigerian stock market and the value of the domestic currency in real terms. The availability and reliability of these data series allow for rigorous empirical analysis and ensure consistency across the study period.

3.3. Model Specification

The estimation of MS-VAR models typically employs maximum likelihood estimation using the Expectation-Maximization (EM) algorithm or Bayesian methods. The log-likelihood function for a two-regime MS-VAR model can be expressed as:

$$L(\emptyset) = \sum_{t=1}^{T} \log [f(y_t|Y_{t-1,}S_t = 1)P(S_t = 1|Y_{t-1,}) + f(y_t|Y_{t-1,}S_t = 2)P(S_t = 2|Y_{t-1,})$$

where $\emptyset$ represents the model parameters, $f(y_t|Y_{t-1,}S_t = 1)$ is the conditional density of y_t given past observations and the current state, and $P(S_t = 1|Y_{t-1,})$ are the filtered probabilities of being in each state [38].

Analyzing Exchange Rate Fluctuations and the All-Share Index

To assess the significance of exchange rate fluctuations on the All-Share Index, researchers can examine the regime-dependent coefficients $A_{12}(S_t)$ and conduct impulse response analysis. The regime-specific impulse response functions can be calculated as follows:

$$\frac{\partial Y_{t+h}}{\partial \in_t} = \psi_h(S_t)$$

where $\psi_h(S_t)$ are the regime-dependent impulse response matrices at horizon h [39].

Additionally, researchers can analyze the smoothed probabilities $P(S_t = k|Y_{T,})$ to identify periods of different regimes and relate these to historical events or policy changes in Nigeria's foreign exchange market.

Utilizing the MS-VAR framework on Nigerian financial data, this study aims to uncover detailed insights into the evolving relationship between exchange rates and the stock market over time. This methodology may help pinpoint periods of heightened vulnerability or resilience to currency fluctuations, fostering a deeper understanding of the dynamic and possibly nonlinear interactions between these essential financial variables within the Nigerian economy.

3.4. Method of Data Analysis

Before estimating the MS-VAR model, the study will conduct pre-estimation diagnostics to ensure the adequacy of the time series data. Descriptive statistics will summarize the central tendencies and variability of ASI and RER. Correlation analysis will examine the strength and direction of the linear association between the two variables. Additionally, unit root tests, such as the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, will be applied to determine stationarity, ensuring that the series are suitable for modeling and mitigating the risk of spurious regression.

3.5. Estimation Techniques

The MS-VAR model accommodates different regimes or states of the economy, each characterized by distinct dynamic relationships among the variables. When analyzing exchange rates and stock market performance, this approach can capture periods of high and low volatility or different exchange rate regimes (e.g., fixed versus floating), which may exert varying influences on the stock market [40].

General MS-VAR Model Specification

A general K-regime, p-lag MS-VAR model can be represented as:

ISSN: 2576-8484
Vol. 10, No. 2: 785-799, 2026
DOI: 10.55214/2576-8484.v10i2.12235

$$Y_t = \mu(S_t) + \sum_{j=1}^{p} A_j(S_t)Y_{t-j} + \epsilon_t$$

where:

Y_t is an n x 1 vector of endogenous variables (e.g., exchange rate and All-Share Index).

$\mu(S_t)$ is an n x 1 vector of regime-dependent intercepts.

- $A_j(S_t)$ are n x n matrices of regime-dependent autoregressive coefficients.

- ϵ_t ~N(0, $\sum S_t$) is an n x 1 vector of regime-dependent error terms.

- $S_t \in$ {1, ..., K\} is the unobserved state variable following a K-state Markov chain.

The transition between regimes is governed by a Markov process with transition probabilities:

$$P(S_t = j|S_{t-1,} = i) = p_{ij}$$

where p_{ij} represents the probability of transitioning from state *i* to state *j* [41].

Two-Regime MS-VAR Model Specification

To identify the significant influence of exchange rate fluctuations on the All-Share Index in Nigeria, a two-regime MS-VAR model can be specified as follows:

$$\begin{bmatrix} RER_t \\ ASI_t \end{bmatrix} = \begin{bmatrix} \mu_{RER}(S_t) \\ \mu_{ASI}(S_t) \end{bmatrix} + \begin{bmatrix} A_{11}(S_t) & A_{12}(S_t) \\ A_{21}(S_t) & A_{22}(S_t) \end{bmatrix} \begin{bmatrix} RER_{t-1} \\ ASI_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{RERt} \\ \epsilon_{ASIt} \end{bmatrix}$$

where:

- RER_t is the exchange rate at time *t*.
- ASI_t is the All Share Index at time *t*.
- $\mu_{RER}(S_t)$ and $\mu_{ASI}(S_t)$ are regime-dependent intercepts.
- $A_{ij}(S_t)$ are regime-dependent autoregressive coefficients.
- ϵ_{RERt} and ϵ_{ASIt} are regime-dependent error terms.

This specification allows for varying dynamic relationships between exchange rates and the stock market in different regimes, potentially capturing periods of heightened sensitivity or decoupling between the two variables [42].

3.6. Post-Estimation Diagnostic Tests

Post-estimation diagnostics will be conducted to validate the MS-VAR model. The Ljung-Box Q-test will assess autocorrelation in residuals, ensuring that temporal dependencies have been adequately captured. The Jarque-Bera test will evaluate residual normality to verify model assumptions. Additionally, smoothed probabilities of regimes will be analyzed to identify periods of high or low stock market sensitivity to exchange rate changes, providing insights into structural breaks and market vulnerability.

3.7. Description of Variables

Table 1.
Description of Variables.

Variable	Symbol	Measurement	Type	Expected Relationship
All Share Index	ASI	NSE All Share Index	Dependent	–
Real Exchange Rate	RER	Domestic currency per USD (real)	Independent	–/+

Source: Author's compilation (2025)

4. Discussions and Results

4.1. Descriptive Statistics

Table 2 presents descriptive statistics for ASI and RER, 100 quarterly observations.

Table 2.
Descriptive Statistics.

Statistics	ASI	EXR
Mean	26918.04	100.4169
Maximum	54334.26	134.3423
Minimum	5151.277	68.45684
Std. Dev.	13027.06	18.94848
Skewness	0.092116	-0.126203
Kurtosis	2.37579	1.839143
Sum	2691804	10041.69
Observations	100	100
Correlation Matrix		
Variables	ASI	EXR
ASI	1.000000	
EXR	0.795929	1.000000

The descriptive statistics show that the All-Share Index (ASI) has a mean value of 26,918.04 over the study period, with a maximum value of 54,334.26 and a minimum value of 5,151.277. The standard deviation of 13,027.06 indicates considerable variation in the stock market index over the period from 1999Q1 to 2023Q4. The skewness value of 0.092116 is close to zero, suggesting that the distribution of ASI is nearly symmetrical. The kurtosis value of 2.37579 is less than 3, indicating a platykurtic distribution with lighter tails compared to a normal distribution.

The Real Effective Exchange Rate (EXR) has a mean value of 100.4169, with a maximum of 134.3423 and a minimum of 68.45684. The standard deviation of 18.94848 shows moderate variation in the exchange rate over the study period. The skewness value of -0.126203 indicates a slight negative skew, meaning the distribution has a slightly longer left tail. The kurtosis value of 1.839143 is also less than 3, suggesting a platykurtic distribution.

The correlation matrix reveals a strong positive relationship between ASI and EXR, with a correlation coefficient of 0.795929. This high positive correlation suggests that as the exchange rate increases (meaning the Naira weakens), the All-Share Index tends to increase as well. This positive relationship may seem counterintuitive, but it could be explained by the fact that many companies listed on the Nigerian Stock Exchange benefit from a weaker currency through increased export revenues or revaluation of foreign assets.

4.2. Unit Root Test

Table 3.
Augmented Dickey-Fuller (ADF) Unit Root Test Results.

ADF Unit Root Test at Level				**ADF Unit Root Test at First Difference**				**Order of Integration**
ADF-statistics	**P-Values**	**5% Critical Values**	**Remarks**	**ADF-statistics**	**P-Values**	**5% Critical Values**	**Remarks**	
-3.275	0.519	-4.443	Not Stationary	-5.003	0.0329	-4.860	Stationary	I(1)
-1.766	0.395	-2.892	Not Stationary	-4.772	0.0001	-2.892	Stationary	I(1)

Note: LASI = Log of All Share Index; RER = Real Effective Exchange Rate.

4.2.1. Interpretation

The Augmented Dickey-Fuller (ADF) unit root test was conducted to determine the stationarity properties of the variables used in this study. The test was performed at both levels and first differences to establish the order of integration for each variable.

For the Log of All Share Index (LASI), the ADF test statistic at level is -3.275 with a p-value of 0.519. Since this value is greater than the 5% critical value of -4.443 and the p-value exceeds 0.05, we fail to reject the null hypothesis of a unit root. This indicates that LASI is not stationary at the level. However, when the first difference is taken, the ADF statistic becomes -5.003 with a p-value of 0.0329, which is less than the 5% critical value of -4.860. This means that LASI becomes stationary after first differencing, indicating that it is integrated of order one, I(1).

For the Real Effective Exchange Rate (RER), the ADF test statistic at the level is -1.766 with a p-value of 0.395. This value is greater than the 5% critical value of -2.892, indicating that RER is not stationary at the level. When the first difference is applied, the ADF statistic becomes -4.772 with a p-value of 0.0001, which is significantly less than the 5% critical value of -2.892. This confirms that RER becomes stationary after first differencing, meaning it is also integrated of order one, I(1).

The finding that both LASI and RER are integrated of order one, I(1), is important for empirical analysis. It suggests that both variables contain unit roots at their levels but become stationary after first differencing. This property justifies using the Markov Switching Vector Autoregression (MS-VAR) model, which can handle non-stationary variables and capture regime-switching dynamics between exchange rate movements and stock market performance in Nigeria. The fact that both variables have the same order of integration also supports the possibility of a long-run relationship between them, which the MS-VAR model can effectively capture across different economic regimes.

4.3. Markov Switching Vector Autoregression Analysis

The Markov Switching Vector Autoregression (MS-VAR) model is a powerful tool that goes beyond the traditional VAR framework by allowing relationships between variables to change between different states or regimes. This approach is particularly useful for examining how exchange rate changes affect the All-Share Index in Nigeria, especially since the Nigerian economy experiences different conditions at different times.

4.3.1. Transition Probabilities Summary Statistics

Table 4 shows the statistics for the transition probabilities in the MS-VAR model. These probabilities indicate how likely the economy is to move between different regimes or stay in the same regime. The model identifies two regimes: Regime 1 and Regime 2.

Table 4.
Descriptive Statistics of Transition Probability.

	P(1|1)	P(2|1)	P(1|2)	P(2|2)
Mean	0.945158	0.054842	1	1.59E-07
Median	0.945158	0.054842	1	1.59E-07
Maximum	0.945158	0.054842	1	1.59E-07
Minimum	0.945158	0.054842	1	1.59E-07
Sum	92.62544	5.374561	97.99998	1.56E-05
Observations	98	98	98	98

The probability of staying in Regime 1 when already in Regime 1, denoted as P(1|1), is 0.945158. This very high value means that once the economy enters Regime 1, it is highly likely to remain there. The mean, median, maximum, and minimum values are all the same at 0.945158, showing that this probability is constant across all observations. This suggests that Regime 1 is a very stable economic state that persists over time.

The probability of moving from Regime 1 to Regime 2, shown as P(2|1), is only 0.054842. This low value indicates that transitions from Regime 1 to Regime 2 are rare and unlikely. This further confirms that Regime 1 is a stable state with few disruptions that would cause a shift to Regime 2. It appears that Regime 1 represents a period of economic stability or low fluctuations.

The probability of transitioning from Regime 2 back to Regime 1, denoted as P(1|2), is 1.0. This indicates that once the system enters Regime 2, it almost always returns to Regime 1. This demonstrates that Regime 2 is temporary in nature. The disruptions in the economy leading to Regime 2 are typically short-lived, and the system quickly reverts to stability.

Finally, the probability of staying in Regime 2 when already in Regime 2, shown as P(2|2), is extremely small at 1.59E-07 (essentially zero). This very small value indicates that Regime 2 is almost always temporary, and once the system enters Regime 2, it is highly likely to exit quickly and transition back to Regime 1. This reinforces the idea that Regime 2 corresponds to a volatile economic state that does not last long.

4.3.2. MS-VAR Intercepts and Coefficient Estimates

Table 5 presents the regression results for both Regime 1 and Regime 2, showing how the Real Effective Exchange Rate (RER) influences the Log of Average Share Index (LASI). The table displays regime-specific intercepts and coefficients for past values of both LASI and RER.

In Regime 1, the intercept for LASI is 0.050733 with a z-statistic of 0.86578. This value is not statistically significant, indicating that under Regime 1 conditions, the influence of the exchange rate on the stock market index is relatively weak. However, in Regime 2, the intercept for LASI is higher at 0.117064 with a z-statistic of 1.96249, which is statistically significant. This suggests that during periods of economic stability represented by Regime 2, exchange rate changes have a stronger impact on stock market performance in Nigeria.

Table 5.
MS-VAR Intercepts VAR Estimates.

	Regime 1		**Regime 2**		**Common**	
	LASI	**RER**	**LASI**	**RER**	**LASI**	**RER**
C	0.050733 (0.05860) [0.86578]	0.055546 (0.01659) [3.34881]	0.117064 (0.05965) [1.96249]	0.078819 (0.01611) [4.89170]		
LASI(-1)					1.507818 (0.08290) [18.1880]	-0.021242 (0.02212) [-0.96030]
LASI(-2)					-0.561455 (0.09516) [-5.89982]	0.020520 (0.02262) [0.90732]
RER(-1)					-0.087683 (0.18593) [-0.47160]	1.590334 (0.04649) [34.2064]
RER(-1)					0.180195 (0.21719) [0.82968]	-0.616901 (0.04645) [-13.2820]
SIGMA-LASI					0.000786 (0.00028) [2.81621]	-1.95E-05 (3.7E-05) [-0.52686]
SIGMA-RER					-1.95E-05 (3.7E-05) [-0.52686]	6.21E-05 (1.1E-05) [5.42188]

Note: Standard errors in ( ) & z-statistics in [ ]

For the Real Effective Exchange Rate coefficients, Regime 1 shows a coefficient of 0.055546 with a z-statistic of 3.34881, which is statistically significant. This indicates a positive and significant

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 10, No. 2: 785-799, 2026
DOI: 10.55214/2576-8484.v10i2.12235

relationship between exchange rate movements and stock market performance in this regime. In Regime 2, the coefficient for RER is even higher at 0.078819 with a z-statistic of 4.89170, which is also highly significant. This higher coefficient confirms that exchange rate changes have an even more pronounced effect on stock market performance during stable economic conditions.

The first lag of LASI, denoted as LASI(-1), shows very different patterns across the two regimes. In Regime 1, LASI(-1) has a coefficient of 1.507818 with a z-statistic of 18.1880, which is highly significant. This means that past values of the stock market index strongly influence current stock market performance, indicating high market persistence or momentum. However, in Regime 2, LASI(-1) has a very small coefficient of -0.021242 that is not statistically significant, suggesting that past stock market performance has minimal effect on current performance during stable periods.

For the exchange rate lags, the first lag of RER shows contrasting results between regimes. In Regime 1, RER(-1) has a coefficient of -0.087683 that is not statistically significant, meaning that previous exchange rate changes do not meaningfully impact the stock market during times of economic instability. In Regime 2, however, RER(-1) has a coefficient of 1.590334 with a z-statistic of 34.2064, which is highly significant. This suggests that past exchange rate movements significantly influence the stock market during stable economic periods, highlighting greater sensitivity of stock market performance to exchange rate changes when the economy is stable.

The Sigma values, representing the variance of residuals, provide information about ups and downs in the relationships. In Regime 1, Sigma-LASI is 0.000786 with a z-statistic of 2.81621, indicating higher ups and downs in the stock market index in response to exchange rate changes. In Regime 2, Sigma-LASI is much smaller at -1.95E-05, suggesting reduced ups and downs and a more stable relationship between the exchange rate and stock market performance.

4.3.3. MS-VAR Transition Matrix Parameters

Table 6 shows the transition matrix parameters, providing important information about how the system switches between economic states. The table includes coefficients, standard errors, z-statistics, and probabilities for the transition probabilities P11-C and P21-C.

The transition matrix shows ρ11 = 0.945158, representing the probability of staying in Regime 1 when currently in Regime 1. This high value confirms that once the system enters Regime 1 (likely an economic state of stability), it has a very high probability of remaining there, showing high persistence. The probability of transitioning from Regime 1 to Regime 2, shown as ρ12 = 0.054842, is relatively low, indicating that transitions from Regime 1 to Regime 2 are infrequent.

Table 6.
MS-VAR Transition Matrix Parameters.

Variable	Coefficient	Std. Error	z-Statistic	Prob.
P11-C	2.846887	0.532380	5.347467	0.0000
P21-C	15.65179	1.473417	10.62278	0.0000

The transition probability from Regime 2 to Regime 1, ρ21 = 1.000000, shows that when the system is in Regime 2, it is almost certain to switch back to Regime 1. This indicates a dominant transition path from Regime 2 to Regime 1, highlighting the instability or temporary nature of Regime 2. The probability of staying in Regime 2, ρ22 = 1.59E-07, is extremely small, suggesting that once the system enters Regime 2, it is almost certain to exit this state quickly.

$$\rho_{ij} = \begin{bmatrix} \rho_{11} & \rho_{12} \\ \rho_{21} & \rho_{22} \end{bmatrix} = \begin{bmatrix} 0.945158 & 0.054842 \\ 1.000000 & 1.59\mathrm{E}-07 \end{bmatrix}$$

The coefficient P11-C equals 2.846887 with a z-statistic of 5.347467 and a probability of 0.0000, indicating strong statistical significance. This large positive coefficient shows a strong tendency for the system to remain in Regime 1. The coefficient P21-C equals 15.65179 with a z-statistic of 10.62278 and a probability of 0.0000, also highly significant. This very large positive coefficient suggests that transitions to Regime 2 are strongly influenced by certain factors that drive significant shifts in the economic environment.

These results suggest that the Nigerian economy exhibits two distinct regimes with very different characteristics. Regime 1, characterized by high persistence, represents periods of relative economic stability where exchange rate changes and stock market performance are relatively predictable. Regime 2 is temporary in nature, representing periods of highs and downs or economic stress that are short-lived. This indicates that periods of crisis or significant economic shocks cause temporary disruptions in the exchange rate and stock market but do not persist over the long term.

4.3.4. MS-VAR Impulse Response Function

Table 7 presents the impulse response function results, showing how LASI and RER respond to shocks over different time periods: P1-P3 (short term), P4-P6 (medium term), and P7-P10 (long term).

The response of LASI to RER shocks shows a positive but weakening pattern over time. In the short term (P1-P3), the response is 0.046856, indicating a notable positive relationship between exchange rate movements and stock market performance. This implies that during periods of exchange rate appreciation or depreciation, the Nigerian stock market experiences a positive response. However, this response decreases to 0.040999 in the medium term (P4-P6) and further diminishes to 0.022001 in the long term (P7-P10). This pattern suggests that the impact of exchange rate changes on the stock market diminishes over time as other economic factors come into play.

Table 7.
MS-VAR Impulse Response Function.

Variables	**Response of LASI**			**Response of RER**		
Periods	**P_1-P_3**	**P_4-P_6**	**P_7-P_{10}**	**P_1-P_3**	**P_4-P_6**	**P_7-P_{10}**
LASI	0.046856	0.040999	0.022001	-0.000699	0.004313	0.014025
RER	-0.002533	-0.003605	-0.002656	0.014636	0.015740	0.012245

The response of RER to LASI shocks follows an opposite pattern. In the short term (P1-P3), RER shows a negative response of -0.002533, indicating a slight weakening of the exchange rate following an increase in stock market performance. This negative response becomes more pronounced at -0.003605 in the medium term (P4-P6) but moderates slightly to -0.002656 in the long term (P7-P10). This suggests that stock market performance has a marginally negative impact on the exchange rate over time, possibly reflecting investor expectations or capital flows as market conditions change.

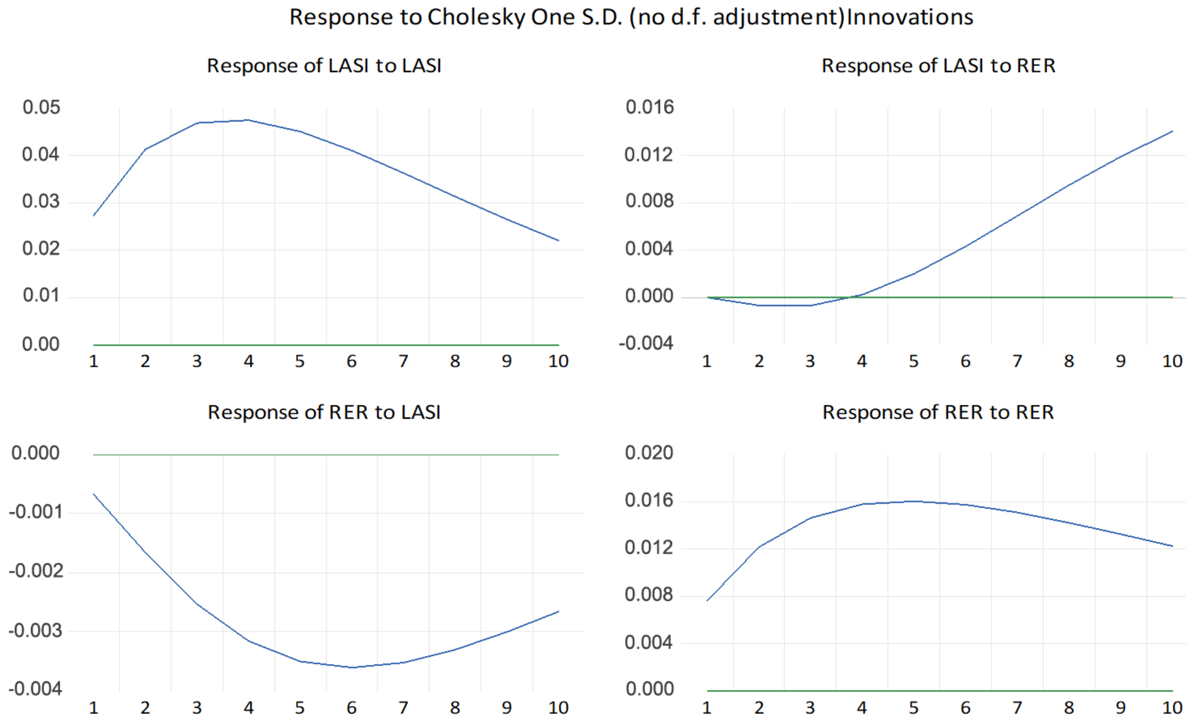

Figure 1.
MS-VAR Impulse Response Graph.

The graph illustrates that LASI shows a gradual increase in the first few periods, peaking around period 4 at 0.047428, then slowly declining over subsequent periods. This suggests that a positive shock to LASI initially has a significant impact, but its effect diminishes over time as the market stabilizes. The response of RER remains consistently negative across periods, with an initial reaction of 0.007646 in period 1, gradually stabilizing at lower levels by period 10.

4.3.5. MS-VAR Forecast Error Variance Decomposition

Table 8 presents the variance decomposition results, showing the proportion of variation in each variable attributable to shocks in itself and the other variable over different periods.

Table 8.
MS-VAR Variance Decomposition.

Variables	Variance Decomposition of LASI			Variance Decomposition of RER		
Periods	**P_1-P_3**	**P_4-P_6**	**P_7-P_{10}**	**P_1-P_3**	**P_4-P_6**	**P_7-P_{10}**
LASI	99.97978	99.77815	96.57168	0.020222	0.221852	3.428316
RER	2.236763	3.677448	4.180752	97.76324	96.32255	95.81925

For LASI, the variance decomposition shows that the stock market index is highly driven by its own shocks. In the short term (P1-P3), 99.97978% of the variance in LASI is explained by its own innovations, suggesting that stock market movements are mainly influenced by internal market dynamics rather than external factors like exchange rate changes. This dominance continues in the medium term (P4-P6) at 99.77815%, though with a slight reduction. In the long term (P7-P10), the influence of internal shocks remains strong at 96.57168% but has weakened further. Meanwhile, RER contributes only 2.236763% to LASI variance in the short term, increasing to 3.677448% in the medium term and 4.180752% in the long term.

For RER, the variance decomposition shows that the exchange rate is significantly influenced by its own shocks. In the short term (P1-P3), 97.76324% of the variance in RER is explained by its own innovations. This remains dominant in the medium term (96.32255%) and long term (95.81925%), though slightly decreasing. The contribution of LASI to RER's variance is small, starting at 0.020222% in the short term and increasing to 0.221852% in the medium term and 3.428316% in the long term.

These results indicate that while exchange rate changes have a relatively minor influence on the stock market in the short to medium term, this influence grows slightly in the long term. The stock market's performance is mainly shaped by its own shocks, with little immediate response to exchange rate changes. This suggests that exchange rate changes have less significant direct impacts on Nigeria's stock market in the short run, but their influence may increase over the longer term.

4.3.6. Residual Diagnostic Tests

Table 9 presents diagnostic tests conducted on the MS-VAR model residuals. The residual normality test shows a test statistic of 195.1355 with a p-value of 0.0000. This result indicates that the residuals significantly deviate from normality, as the p-value is below the 0.05 significance level. The rejection of normality suggests that the residuals are not normally distributed, which could indicate the presence of outliers, skewness, or other patterns that the model is not capturing.

Table 9.
Diagnostic Test.

Residual Diagnostic Test	Test-Statistic	P-Value
MS-VAR Residual Normality Tests	195.1355	0.0000
MS-VAR Portmanteau Tests for Autocorrelations (Q-Stat)	13.98313	0.0073

The portmanteau test for autocorrelations (Q-stat) shows a test statistic of 13.98313 with a p-value of 0.0073. Since the p-value is below 0.05, the null hypothesis of no autocorrelation is rejected. This implies that the residuals exhibit significant autocorrelation, suggesting that the model has not captured all relevant time-based relationships in the data.

4.3.7. MS-VAR Stability Test

The stability test is necessary to determine if the MS-VAR model is stable. A stable model is appropriate for estimation and analysis.

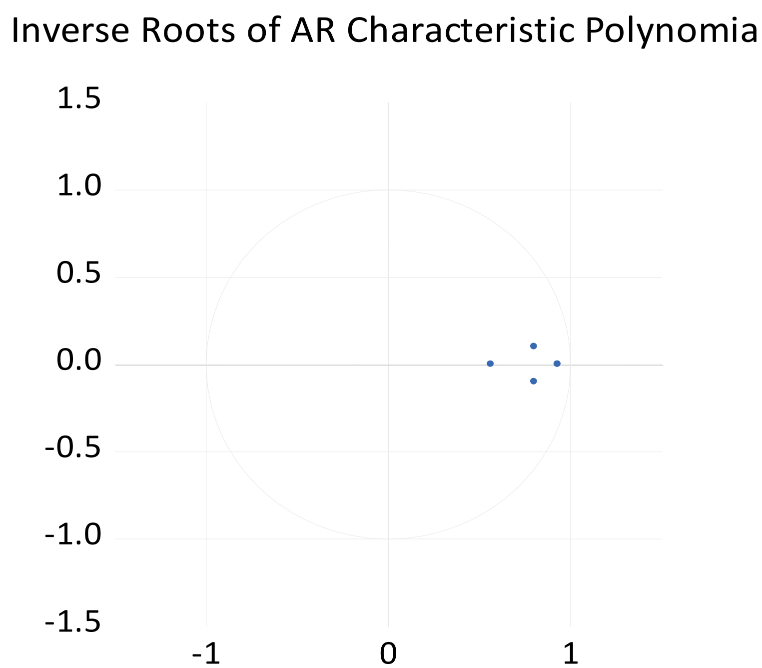

Figure 2.
Stability Graph.

The stability graph shows that all points are within the modulus, indicating that the impact of shocks is manageable and finite. The MS-VAR model is very stable, suggesting it is suitable for policy analysis and for drawing meaningful conclusions about the relationship between exchange rate movements and stock market performance in Nigeria.

5. Conclusions and Recommendations

5.1. Conclusion

This study analyzed the impact of exchange rate fluctuations on Nigeria's stock market (All Share Index) from 1999 to 2023 using a Markov-Switching Vector Autoregression model. Results revealed two distinct regimes: Regime 1, a stable state with high persistence, and Regime 2, a temporarily volatile state reverting quickly to stability. Exchange rate changes positively affected stock market performance in both regimes, with a stronger impact during stable periods. Past stock market values were highly influential in Regime 1, while in Regime 2, past exchange rate movements showed greater sensitivity. Impulse response analysis indicated that exchange rate shocks have short-term effects on the stock market, which decline over time, while variance decomposition confirmed that the stock market is largely driven by its internal dynamics. Overall, the relationship between exchange rates and stock market performance is regime-dependent, emphasizing the importance of considering economic conditions in financial policy and investment decisions.

5.2. Recommendations

Policymakers and investors should incorporate economic regime conditions when formulating financial and investment strategies, as exchange rate movements affect the stock market differently during stable and volatile periods. Regulatory authorities should implement measures to stabilize exchange rate volatility to enhance stock market resilience. Investors are advised to consider both past stock market trends and exchange rate dynamics in their portfolio decisions, particularly during periods of economic uncertainty, to optimize returns and manage risks effectively.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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