

Asymmetric Effect of Capital Inflows of Surges and Sudden Stops on the Nigerian Stock Market Volatility: During the Pre-and Post- Unified Exchange Rate Era, 2019-2025

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ABSTRACT: This study examines the asymmetric effects of capital inflow surges and sudden stops on stock market volatility in Nigeria: During the pre-and post- unified exchange rate era. The primary aim is to determine if positive shifts in foreign portfolio investment (FPI surges) reduce volatility while negative shifts (FPI stops) amplify it. The analysis draws on realized asymmetric stock index volatility (RASIV), derived from All-Share Index weekly returns, combined with monthly time-series data on monetary policy rate (MPR), and exchange (EXR) and foreign portfolio investment (FPI: decomposed into (FPI⁺ surges and FPI⁻ stops)) that are utilized as exogenous variables. The sample spans 2019 to 2025. Volatility is initially modeled using ARCH(2) and EGARCH techniques to account for clustering, persistence, and asymmetry. The resulting volatility series forms the dependent variable (RASIV) in an NARDL model, with FPI decomposed into positive (LFPI_POS) and negative (LFPI_NEG) cumulative sums to isolate asymmetric long-run and short-run dynamics. Results from the ARCH(2) model highlight significant short-term volatility clustering, primarily driven by the most recent shock. The EGARCH model demonstrates strong persistence and a pronounced magnitude effect, where larger shocks elevate volatility irrespective of direction, but the asymmetry parameter proves insignificant, indicating no clear leverage effect favoring negative shocks. The NARDL bounds test confirms co-integration relationship between study variables. However, long-run coefficients for FPI surges and stops, along with short-run dynamics, remain statistically insignificant, suggesting limited asymmetric influence from capital flows on volatility.. In conclusion, Nigerian stock volatility exhibits clear clustering, high persistence, and sensitivity to shock size during this period, yet asymmetric responses to FPI surges and stops appear muted—likely due to dominant external factors such as global risk aversion and commodity cycles, alongside domestic policy measures. These insights recommend prioritizing macro-prudential frameworks, exchange rate flexibility, and economic diversification to enhance market resilience over targeted capital flow restrictions.

KEYWORDS: Stock market volatility, Capital inflow surges, sudden stops, foreign portfolio investment, Asymmetric effects, ARCH, EGARCH, NARDL, Nigeria

JEL Classification Codes: F32, G15, C58, E44, G12

1.INTRODUCTION

The integration of emerging market economies into global financial markets has brought substantial benefits through access to foreign capital, but it has also exposed them to significant risks associated with volatile capital flows. Capital inflows can finance investment, enhance liquidity, and support economic growth, yet abrupt reversals—often termed "sudden stops"—have historically triggered financial instability, currency depreciations, asset price collapses, and recessions (Calvo, 1998). In emerging markets (EMs), where domestic financial systems are typically underdeveloped and reliance on external financing is high, these dynamics are particularly pronounced. Capital inflow surges, characterized by rapid increases in gross inflows (typically driven by non-residents), can fuel credit booms, asset bubbles, and overheating, while sudden stops—sharp contractions in inflows—often lead to fire sales, liquidity crunches, and heightened macroeconomic volatility (Forbes & Warnock, 201; Sula, 2010). Forbes and Warnock (2012), in their seminal analysis of capital flow waves using gross flow data across 58 economies from 1980 to 2009, distinguish four types of episodes: surges (sharp rises in foreign-driven inflows), stops (sharp falls in such inflows), flight (sharp rises in domestic outflows), and retrenchment (sharp falls in domestic outflows). Their findings underscore that global factors, particularly global risk aversion (proxied by the VXO index), dominate the incidence of these episodes, with contagion through

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trade and banking linkages amplifying stops and retrenchments in EMs. Surges are linked to real exchange rate appreciation, real estate booms, banking crises, and inflation, whereas stops correlate with currency depreciations, slower growth, and elevated interest rates. Critically, the authors note that "waves of capital flows can present substantial macroeconomic challenges, whether it is the waves of capital inflows that cause currency appreciation and/or asset bubbles or the 'undertows' as capital outflows cause a collapse in exchange rates and asset prices" (Forbes & Warnock, 2012, p. 235). These waves disproportionately affect EMs due to their thinner markets and greater sensitivity to external shocks. A growing body of evidence points to asymmetric effects of these capital flow episodes on financial markets. Negative shocks from sudden stops tend to generate stronger and more persistent impacts on asset prices and volatility than positive surges, consistent with leverage effects and risk aversion dynamics in behavioral finance (e.g., the asymmetric response documented in cross-border equity flow studies). For instance, recent analysis of SANEK countries (South Africa, Algeria, Nigeria, Egypt, Kenya) using nonlinear autoregressive distributed lag (NARDL) models reveals that cross-border equity flow volatility exerts significant asymmetric short- and long-run effects on equity market returns, with negative volatility shocks exerting stronger downward pressure (asymmetric equity flow volatility study, 2025). Similarly, U.S. monetary policy tightening has been shown to trigger more pronounced capital outflows and stock market contagion in EMs than easing phases (Zehri, 2024). These asymmetries arise because inflows often chase momentum and liquidity in bullish conditions, inflating valuations temporarily, whereas outflows during risk-off episodes trigger margin calls, forced selling, and panic, amplifying volatility through feedback loops.

In this context, exchange rate regimes play a pivotal mediating role. Multiple or segmented exchange rate systems exacerbate distortions, arbitrage opportunities, and uncertainty, deterring sustainable capital inflows while amplifying volatility when flows reverse. Nigeria's experience exemplifies this. Prior to mid-2023, the country operated a managed float regime with multiple windows (official CBN rate, Investors' and Exporters' (I&E) window, Bureau de Change, etc.), leading to persistent arbitrage, rent-seeking, round-tripping, and parallel market premiums that distorted price discovery and discouraged genuine foreign investment (Ozili, 2024). Fuel subsidy costs ballooned partly due to these distortions, exceeding ₦7 trillion (US\$15.2 billion) in 2022 alone. On June 14, 2023, under president Tinubu's administration and the new Central Bank of Nigeria (CBN) leadership, Nigeria unified its exchange rates by collapsing all segments into a single "willing buyer, willing seller" market-determined rate at the I&E window. This imperfect free-float regime aimed to eliminate arbitrage, enhance transparency, improve price discovery, boost foreign exchange supply, and—crucially—attract higher capital inflows while restoring investor confidence and sovereign creditworthiness (Ozili, 2024). As Ozili (2024) argues, unification was expected to yield "higher capital importation, increased investor confidence, improved sovereign credit rating, increased transparency in the foreign exchange market, and improved business environment." Early post-unification data confirm a dramatic rebound: foreign portfolio inflows into the Nigerian stock market surged by over 846% to ₦103 trillion in the first nine months of 2025 compared to the same period in 2023. The Nigeria's total capital importation for January–September 2025 was \$11 million, up 156% in dollar terms from \$4.3 million in the same period of 2024 (Finance in Africa, compiling NBS data).

Yet, this "Unified Exchange Rate Era" has also heightened concerns about volatility. Portfolio flows—often labeled "hot money"—is inherently procyclical and sensitive to global risk, U.S. interest rates, and domestic policy credibility. While inflows have boosted Nigerian Exchange (NGX) liquidity and transactions (reaching record ₦2.7 trillion in the first four months of 2025). Pre-unification studies already documented linear associations: foreign portfolio investment (FPI) inflows and outflows significantly influence stock market capitalization, with outflows paradoxically showing positive long-run effects on capitalization in some error-correction models, possibly reflecting rebalancing or signaling effects (Andabai, 2024, covering 1994–2023). Volatility in foreign capital inflows has also been linked to dampened economic growth in Nigeria (Nwosa, 2020). However, these analyses predate or overlook the structural break introduced by unification and fail to address potential asymmetries in how surges versus stops affect stock market volatility specifically.

Despite the purported benefits of exchange rate unification in attracting capital and fostering market efficiency (Ozili, 2024), the Nigerian stock market remains vulnerable to the asymmetric effects of capital inflow surges and sudden stops. Portfolio-dominated inflows, which accounted for the bulk of the post-2023 surge, introduce procyclical volatility: surges may temporarily compress volatility through liquidity provision and momentum trading, but sudden stops—triggered by global risk aversion, domestic policy slippage, or naira depreciation pressures—exacerbate it disproportionately via leverage effects, herding, and liquidity spirals. This asymmetry threatens financial stability, erodes domestic investor confidence, distorts resource allocation, and undermines the very growth objectives that unification sought to advance. Empirical gaps compound the issue. While global literature establishes the prevalence and drivers of flow waves (Calvo, 1998; Forbes & Warnock, 2012; Sula, 2010) and some Nigerian studies examine linear FPI-stock market linkages (Andabai, 2024; Oyerinde, 2019) or inflow volatility-growth nexuses

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(Nwosa, 2020), few—if any—have rigorously investigated asymmetric impacts on stock return volatility (e.g., via GARCH-type or quantile models) in the specific post-unification context. Recent SANEK evidence hints at asymmetries in flow volatility-return relationships (2025), but Nigeria-specific, volatility-focused analysis under the unified regime is absent. This lacuna is critical: without understanding whether stops inflict greater volatility than surges amplify stability (or vice versa), policymakers cannot design targeted macroprudential tools, capital flow management measures, or circuit breakers. Investors, meanwhile, face heightened uncertainty in pricing Nigerian equities, potentially deterring the long-term FDI that unification was meant to complement portfolio flows. In an era of elevated global uncertainty—rising U.S. rates, geopolitical tensions, and commodity price swings—the Nigerian stock market's exposure risks broader spillover to real economy outcomes, including inflation pass-through, fiscal pressures, and poverty exacerbation.

This study addresses these gaps by examining the asymmetric effects of capital inflow surges and sudden stops on Nigerian stock market volatility during the Unified Exchange Rate Era (June 2023 onward). Employing robust econometric techniques (e.g., ARCH, asymmetric EGARCH, NARDL Approach) on high-frequency NGX data alongside capital flow measures from Central Bank of Nigeria (CBN), and National Bureau of Statistics (NBS), it tests whether negative flow shocks exert stronger volatility impacts than positive ones, controlling for global risk, domestic macro variables, and the regime shift. By doing so, it contributes novel evidence to the capital flow literature while offering actionable insights for Central Bank of Nigeria (CBN), Security and Exchange Commission (SEC), and investors in Africa's largest economy.

2. LITERATURE REVIEW

2.1 Conceptual Framework

International capital flows have become an important component of financial globalization, particularly in emerging economies where foreign investment contributes to financial market development and economic growth. Among these flows, foreign portfolio investment (FPI) refers to investments made by foreign investors in financial assets such as stocks, bonds, and other securities in a host country (Aizenman & Pinto, 2005). Unlike foreign direct investment, FPI is generally short-term and highly sensitive to changes in macroeconomic conditions and investor sentiment.

Capital inflows: it often occurs in the form of capital inflow surges and sudden stops. Capital inflow surges represent large and rapid increases in foreign investment into a country's financial markets, usually driven by favorable economic conditions, higher returns, and improved investor confidence (Reinhart & Reinhart, 2009). These inflows increase liquidity in financial markets and may support stock market growth. However, sudden stops occur when foreign investors abruptly withdraw their investments due to economic instability, financial crises, or adverse policy changes. Sudden stops can lead to capital flight, reduced market liquidity, and increased financial instability (Calvo, 1998).

Stock market volatility: it refers to the degree of fluctuations in stock prices over time and is often used as an indicator of financial market uncertainty (Schwert, 1989). It is also an indicator of the confidence in the economy or a pointer to where the economy is heading to. In Nigeria, stock market performance is commonly measured using the All Share Index of the Nigerian Exchange Group, which tracks the price movements of all listed equities in the market. High volatility in stock markets may reflect uncertainty arising from macroeconomic shocks, capital flow reversals, or changes in monetary policy.

Macroeconomic variables: such as Monetary Policy Rate (MPR) and Exchange Rate (EXR) also play significant roles in influencing stock market volatility. The monetary policy rate, determined by the Central Bank of Nigeria, affects interest rates, liquidity conditions, and investment decisions. Similarly, exchange rate fluctuations influence foreign investors' decisions because depreciation of the domestic currency may reduce investment returns and increase uncertainty in financial markets (Obstfeld & Rogoff, 1996). Given the volatile nature of foreign portfolio investment, positive changes in capital inflows (surges) and negative changes (sudden stops) may have asymmetric effects on stock market volatility. Therefore, understanding the asymmetric relationship between capital inflows and stock market performance is crucial for financial stability and policy formulation.

2.2 Theoretical Framework

This study is anchored on the Portfolio Balance Theory and the Efficient Market Hypothesis (EMH). The Portfolio Balance Theory (Branson, 1977; Branson & Henderson, 1985) explains how investors allocate their wealth among different financial assets in domestic and international markets. According to the theory, investors diversify their portfolios across countries to maximize returns and reduce risk (Branson & Henderson, 1985). When investors perceive favorable economic conditions in a country, they increase their investments in that country's financial assets, leading to capital inflow surges. Conversely, unfavorable economic conditions may lead investors to withdraw their investments, causing capital outflows or sudden stops. These changes in capital flows can significantly influence asset prices and stock market volatility.

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The Efficient Market Hypothesis, developed by Eugene Fama, posits that financial markets efficiently incorporate all available information into asset prices (Fama, 1970). According to this theory, stock prices respond quickly to new information regarding macroeconomic conditions, monetary policy changes, and international capital flows. As a result, changes in foreign portfolio investment, interest rates, or exchange rates may immediately affect stock market prices and volatility. In addition, the Financial Liberalization Theory suggests that opening financial markets to international capital flows can enhance market efficiency and increase investment opportunities (McKinnon, 1973; Shaw, 1973). However, excessive reliance on foreign capital flows may expose financial markets to external shocks and increase volatility, particularly when sudden stops occur. These theories collectively explain how capital flows and macroeconomic variables influence stock market behavior and volatility.

2.3 Empirical Framework

Several empirical studies have examined the relationship between capital flows and stock market performance in both developed and emerging economies.

Bekaert & Harvey (2000) investigated the impact of financial liberalization on stock market volatility in emerging markets. Using econometric analysis, they found that capital inflows improve market liquidity and reduce volatility in the long run, although sudden reversals of capital flows may increase market instability.

Similarly, Kaminsky & Reinhart (1999) examined the role of capital flow reversals in financial crises. Their findings revealed that sudden stops in capital inflows often lead to financial instability and sharp declines in asset prices in emerging markets.

Forbes & Warnock (2012) analyzed episodes of capital flow surges and sudden stops across countries. Their results indicated that global financial conditions, such as interest rates and risk appetite, significantly influence the occurrence of capital inflow surges and reversals.

In the Nigerian context, Uwaleke (2012) examined the relationship between foreign portfolio investment and stock market development. The study found that foreign portfolio investment contributes positively to market capitalization and liquidity but may increase volatility due to the speculative nature of short-term capital flows.

Adelegan (2008) investigated the impact of foreign portfolio investment on the Nigerian stock market using time series analysis. The findings showed that foreign investment significantly influences stock market returns and contributes to market expansion.

Olowookere & Akomolafe (2019) analyzed the effects of foreign capital flows on stock market performance in Nigeria and found that foreign portfolio investment significantly affects stock market returns and volatility.

Using nonlinear econometric techniques, Shin, Yu & Greenwood-Nimmo (2014) introduced the Nonlinear Autoregressive Distributed Lag (NARDL) model to capture asymmetric relationships between economic variables. Their approach demonstrates that positive and negative changes in explanatory variables may have different effects on economic outcomes.

Similarly, Balcilar, Gupta & Miller (2015) examined the asymmetric effects of capital flows on stock market volatility in emerging economies using nonlinear models. Their findings revealed that capital inflow surges stabilize financial markets, while sudden stops increase volatility and financial instability.

Despite these empirical contributions, limited studies have examined the asymmetric effects of capital inflow surges and sudden stops on stock market volatility in Nigeria during the unified exchange rate era. This study therefore contributes to the literature by applying ARCH, EGARCH, and NARDL models to examine the asymmetric dynamics of capital flows and stock market volatility in Nigeria between 2019 and 2025.

2.4 Gaps in the Literature

Although a considerable body of literature exists on the relationship between capital flows and stock market performance, several important gaps remain in both theoretical and empirical discussions, particularly in the context of emerging economies such as Nigeria.

First, most existing studies have largely examined the aggregate impact of foreign capital inflows on stock market performance without distinguishing between different forms of capital flow dynamics such as surges and sudden stops. For example, studies such as those by Geert Bekaert and Campbell Harvey focus mainly on the general effects of capital inflows on emerging equity markets, while studies by Graciela Kaminsky & Carmen Reinhart emphasize the role of capital flow reversals in financial crises. However, these studies do not explicitly analyze the asymmetric nature of capital flows, where positive inflow shocks (surges) may have different effects from negative shocks (sudden stops). Since capital flows are often volatile and asymmetric in nature, analyzing them in aggregated form may obscure important dynamics that influence stock market volatility.

Second, a significant proportion of empirical studies on capital flows and stock market performance have focused primarily on developed or broad emerging market economies, with relatively limited attention to the Nigerian financial market. While some Nigerian studies such as those by Uche Uwaleke & Olusegun Adelegan examine the relationship between foreign portfolio

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investment and stock market development, their analyses are mostly limited to the general impact of foreign investment on market performance indicators such as market capitalization or stock returns. These studies do not explicitly investigate the volatility dynamics of the stock market, which is a critical measure of financial market stability.

Third, many previous studies have relied primarily on linear econometric techniques such as ordinary least squares (OLS), vector autoregression (VAR), and standard autoregressive distributed lag (ARDL) models. While these approaches provide useful insights into the relationships among variables, they may not adequately capture nonlinear and asymmetric relationships that are common in financial markets. Financial markets often respond differently to positive and negative shocks due to investor behavior, market sentiment, and risk perception. The introduction of the Nonlinear Autoregressive Distributed Lag (NARDL) model by Youngho Shin, Byungchul Yu, & Matthew Greenwood-Nimmo (2014) provides an opportunity to analyze asymmetric relationships by decomposing explanatory variables into positive and negative partial sums. However, only a limited number of studies have applied this approach to examine the asymmetric effects of capital flows on stock market volatility in Nigeria.

Fourth, many empirical studies investigating stock market volatility have focused primarily on the application of volatility models such as ARCH and GARCH without integrating these models with asymmetric macroeconomic relationships. For instance, the Autoregressive Conditional Heteroskedasticity (ARCH) model developed by Robert F. Engle (1982) and the Exponential GARCH (EGARCH) model introduced by Daniel B. Nelson (1991) are widely used in financial econometrics to model volatility clustering and leverage effects in financial markets. However, several studies using these models often focus only on market returns without incorporating macroeconomic variables such as exchange rate, monetary policy rate, and capital flows into the volatility analysis. Consequently, the interaction between capital flow dynamics and stock market volatility remains insufficiently explored.

Fifth, the existing literature rarely considers the recent structural changes in Nigeria's foreign exchange regime, particularly the unified exchange rate policy introduced in recent years. Exchange rate reforms can significantly influence international capital movements and investor behavior, thereby affecting stock market volatility. However, most previous Nigerian studies on foreign portfolio investment and stock market performance were conducted before the introduction of the unified exchange rate regime. As a result, there is limited empirical evidence on how capital inflow surges and sudden stops affect stock market volatility in Nigeria under the new exchange rate environment. Sixth, many studies have focused primarily on stock market returns or market capitalization as indicators of stock market performance, rather than focusing specifically on stock market volatility, which is a more appropriate measure of financial market instability and risk. Understanding volatility dynamics is particularly important in emerging markets like Nigeria, where financial markets are often sensitive to external shocks and capital flow reversals.

Furthermore, existing studies rarely adopt a combined methodological framework that integrates volatility modeling with asymmetric macroeconomic analysis. Most studies either focus solely on volatility models such as GARCH-type models or on macroeconomic models such as ARDL. The integration of ARCH/EGARCH models with the NARDL framework provides a more comprehensive approach for analyzing both the volatility behavior of the stock market and the asymmetric effects of capital inflows. However, this combined methodological approach remains largely underexplored in the Nigerian context.

In light of these limitations, this study seeks to fill the identified gaps in the literature by examining the asymmetric effects of capital inflow surges and sudden stops on Nigerian stock market volatility during the unified exchange rate era (2019–2025). Specifically, the study contributes to the existing literature by decomposing foreign portfolio investment into positive and negative components, applying ARCH and EGARCH models to capture stock market volatility, and utilizing the NARDL framework to analyze asymmetric short-run and long-run relationships between capital flows and stock market volatility in Nigeria. This integrated approach provides deeper insights into the dynamics of capital flows and their implications for financial market stability.

3. METHODOLOGY

3.1 Research Design

This study adopts a quantitative ex-post facto research design. The ex-post facto design is appropriate because the study relies on historical time series data that already exist and cannot be manipulated by the researcher. The objective is to empirically investigate the asymmetric effects of capital inflow surges and sudden stops on stock market volatility in Nigeria during the pre- and post-unified exchange rate era (2019–2025). The study combines volatility modeling and asymmetric dynamic modeling techniques. Specifically, ARCH and EGARCH models are used to estimate and analyze the volatility behavior of the Nigerian stock market, while the Nonlinear Autoregressive Distributed Lag (NARDL) model is employed to capture the asymmetric long-run and short-run effects of positive and negative changes in foreign portfolio investment (FPI).

The research design is therefore structured in three stages:

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Volatility estimation stage using ARCH and EGARCH models to model stock market volatility, Decomposition stage where Foreign Portfolio Investment (FPI) is decomposed into positive changes (surges) and negative changes (sudden stops) and the third stage is Asymmetric dynamic relationship stage using the NARDL framework to examine how the decomposed capital flows affect stock market volatility. This approach allows the study to capture both volatility clustering and asymmetric responses in financial markets.

Stock market volatility is derived from the returns of the ASI. Hence, the stock return is generated as:

$$RASl = 100 * \log (ASl_t/ASl_{t-1}) \dots\dots\dots(1)$$

3.2 Nature and Sources of Data

This study utilizes secondary time-series data to examine the asymmetric effect of capital inflow surges and sudden stops on stock market volatility in Nigeria; during the pre-and post- unified exchange rate era (2019–2025). Secondary data are appropriate because they are already compiled, published, and widely used in empirical macroeconomic and financial research. The data are collected on a weekly and monthly basis in order to adequately capture short-run fluctuations and volatility dynamics in the Nigerian stock market. The key variables used in this study include Return on All Share Index Volatility (RASIV) and its data are weekly which are obtained from the Nigerian Exchange Group statistical database and financial market reports. Monetary Policy Rate (MPR) and its data are sourced from the Central Bank of Nigeria Statistical Bulletin and Monetary Policy Committee communiqués. Exchange Rate (EXR) and its data are obtained from the Central Bank of Nigeria Statistical Bulletin and the CBN database, and Foreign Portfolio Investment (FPI). The Foreign Portfolio Investment variable is further decomposed into positive and negative partial sums (FPI⁺ and FPI⁻) to represent capital inflow surges and sudden stops respectively. The data on FPI are sourced from the Central Bank of Nigeria Statistical Bulletin and the capital market reports of the Nigerian Exchange Group. Overall, the combination of these data sources ensures reliability, consistency, and credibility, as the institutions providing the data are recognized authorities in Nigeria's financial and macroeconomic statistics.

3.2.1 Measurement and explanation of Variables in the Study

This section explains how the variables used in the study are measured and operationalized in the empirical analysis. The study investigates the asymmetric effects of capital inflow surges and sudden stops on the Nigerian stock market volatility; during the pre-and post- unified exchange rate era (2019–2025). The variables include Return on All Share Index Volatility (RASIV), Monetary Policy Rate (MPR), Exchange Rate (EXR), and Foreign Portfolio Investment (FPI), which is decomposed into positive and negative changes (FPI⁺ and FPI⁻).

Return on All Share Index Volatility (RASIV): Return on All Share Index Volatility (RASIV) represents the dependent variable in this study and measures the level of volatility in the Nigerian stock market. It is derived from the returns of the All Share Index, which reflects changes in the overall performance of listed equities on the Nigerian Exchange Group. The returns are computed as the logarithmic difference of the All Share Index values. The volatility of these returns is then estimated using ARCH and EGARCH models. Higher values of RASIV indicate greater instability or fluctuations in stock market performance.

Monetary Policy Rate (MPR): Monetary Policy Rate (MPR) is used as an independent variable and represents the benchmark interest rate set by the Central Bank of Nigeria. It reflects the stance of monetary policy in the economy and influences liquidity conditions, borrowing costs, and investment decisions. In this study, MPR is measured as the official percentage rate announced by the Central Bank of Nigeria.

Exchange Rate (EXR): Exchange Rate (EXR) refers to the value of the Nigerian naira relative to the United States dollar. It captures the effect of currency fluctuations on the stock market and international capital flows. Exchange rate volatility can influence foreign investors' confidence and investment decisions in the Nigerian stock market. In this study, EXR is measured as the nominal exchange rate (₦/US\$) obtained from the Central Bank of Nigeria statistical database.

Foreign Portfolio Investment (FPI): Foreign Portfolio Investment (FPI) represents investments by foreign investors in financial assets such as equities and bonds in Nigeria's capital market. It reflects the degree of international participation in the Nigerian stock market and is considered a major driver of financial market volatility.

For the purpose of capturing asymmetric effects, FPI is decomposed into two components:

FPI⁺ (Positive Changes): This represents capital inflow surges, which occur when there is an increase in foreign portfolio investment into the Nigerian stock market.

FPI⁻ (Negative Changes): This represents capital inflow sudden stops or capital outflows, which occur when foreign investors withdraw funds from the market.

The decomposition of FPI into positive and negative partial sums allows the study to capture asymmetric responses of stock market volatility to capital inflow movements within the Nonlinear Autoregressive Distributed Lag (NARDL) framework.

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3.2.2 A Priori Expectations of the Variables

The a priori expectations describe the theoretically expected relationship between the dependent variable and the explanatory variables used in the study. These expectations are based on established financial and macroeconomic theories as well as previous empirical studies. The study investigates the asymmetric effects of capital inflow surges and sudden stops on stock market volatility in Nigeria during the unified exchange rate era (2019–2025). The dependent variable is Return on All Share Index Volatility (RASIV), which represents fluctuations in the Nigerian stock market, proxied by the All Share Index of the Nigerian Exchange Group. The independent variables include Monetary Policy Rate (MPR), Exchange Rate (EXR), and Foreign Portfolio Investment (FPI), which is decomposed into positive changes (FPI⁺) and negative changes (FPI⁻).

The Monetary Policy Rate is the benchmark interest rate used by the Central Bank of Nigeria to regulate liquidity in the economy. An increase in the policy rate often leads to higher lending rates, reduced borrowing, and lower investment in the stock market. This may increase market uncertainty and volatility. Therefore, MPR is expected to have a positive relationship with stock market volatility. $MPR > 0$

Exchange Rate (EXR): Exchange rate fluctuations influence international capital movements and investor confidence. A depreciation of the Nigerian naira increases uncertainty for foreign investors and may lead to capital outflows, which can destabilize the stock market. Hence, exchange rate is expected to have a positive relationship with stock market volatility. $EXR > 0$.

Foreign Portfolio Investment – Positive Changes (FPI⁺): Positive changes in foreign portfolio investment represent capital inflow surges, where foreign investors increase their investment in the domestic capital market. Increased capital inflows improve market liquidity, deepen financial markets, and enhance investor confidence. Therefore, FPI⁺ is expected to reduce stock market volatility. $FPI^+ < 0$

Foreign Portfolio Investment – Negative Changes (FPI⁻): Negative changes in foreign portfolio investment represent capital inflow sudden stops or capital outflows. When foreign investors withdraw funds from the market, liquidity declines and uncertainty increases, leading to greater stock market volatility. Thus, FPI⁻ is expected to increase stock market volatility. $FPI^- > 0$, Hence, $\alpha_1 > 0$. $\alpha_2 > 0$. $\alpha_3 > 0$, $\alpha_4 < 0$

3.3 Method of Data Analysis

The study employs several econometric techniques to examine the asymmetric effect of capital inflows on stock market volatility in Nigeria.

3.3.1 Unit Root Test

Prior to estimation, the time series properties of the variables are examined using the Augmented Dickey–Fuller (ADF) unit root test. The purpose is to determine whether the variables are stationary at level I(0) or first difference I(1). This step is necessary because the NARDL technique requires variables to be either I(0) or I(1) but not I(2).

The ADF regression is specified as:

$$\Delta y_i = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^p \delta_i \Delta y_{it} - i + \varepsilon_t \dots \dots \dots (2)$$

Where Δ = the first difference operator (e.g. $y_i - y_{i-1}$)

α = The constant

β = The deterministic time trend

γ = The coefficient of interest.

t = the time trend; p is the lag length;

ε_t = the white noise error time.

3.3.2 ARCH Model

To examine volatility clustering in the Nigerian stock market, the Autoregressive Conditional Heteroskedasticity (ARCH) model proposed by Engle (1982) The ARCH model assumes that the variance of the error term is time-varying and depends on past squared residuals and it is specified as follow;

$$RASIV_t = \omega + \alpha * \varepsilon_{t-1}^2 + \gamma_1 * MPR_{t-1} + \gamma_2 * EXR_{t-1} + \gamma_3 * FPI_{t-1} \dots \dots \dots (3)$$

Where,

$RASIV_t$ = conditional variance at time t (σ_t^2 or h_t)

ω = constant term (> 0)

ε_{t-1}^2 = Lagged squared residual from the mean equation (standard ARCH term)

MPR_{t-1} , EXR_{t-1} , FPI_{t-1} = Lagged values of monetary policy rate, exchange rate, foreign portfolio investment

3.3.3 EGARCH Model

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To capture asymmetric volatility responses to positive and negative shocks, the study employs the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model developed by Nelson (1991). Unlike the ARCH model, EGARCH allows bad news and good news to affect volatility differently, which is important for stock market analysis. The EGARCH model is specified as:

$$\ln(\sigma_t^2) = \omega + \beta \ln(\sigma_{t-1}^2) + \alpha \left| \varepsilon_{t-1} / \sigma_{t-1} \right| + \gamma \varepsilon_{t-1} / \sigma_{t-1} \dots \dots \dots (4)$$

Where:

(σ_t^2) = conditional variance

γ = asymmetry coefficient

ε_t = error term

If $\gamma \neq 0$, it indicates asymmetric volatility effects in the stock market.

3.3.4 Decomposition of Foreign Portfolio Investment

Following Shin, Yu and Greenwood-Nimmo (2014), Foreign Portfolio Investment (FPI) is decomposed into positive and negative partial sums to capture capital inflow surges and sudden stops.

The decomposition is expressed as:

Positive Changes (Surges): $FPI_t^+ = \beta_0 + \sum_{i=1}^t \max(\Delta FPI_i, 0)$

Negative Changes (Sudden Stops): $FPI_t^- = \beta_0 + \sum_{i=1}^t \min(\Delta FPI_i, 0)$

Where:

FPI^+ = capital inflow surges

FPI^- = capital inflow sudden stops

3.3.5 NARDL Model Specification

To estimate the asymmetric effects of capital inflows on stock market volatility, the study adopts the Nonlinear Autoregressive Distributed Lag (NARDL) model developed by Shin et al. (2014).

The NARDL model allows the estimation of short-run and long-run asymmetry.

The NARDL model is expressed as:

$$\Delta RASIV_t = \alpha + \beta_1 RASIV_{t-1} + \theta^+ FPI_{t-1}^+ + \theta^- FPI_{t-1}^- + \delta MPR_{t-1} + \zeta EXR_{t-1} + \sum_{i=1}^p \phi_i \Delta RASIV_{t-i} + \sum_{j=0}^{q_1^+} \pi_j^+ \Delta FPI_{t-j} + \sum_{j=0}^{q_1^-} \pi_j^- \Delta FPI_{t-j} + \sum_{k=0}^{q_2} \lambda_k \Delta MPR_{t-k} + \sum_{m=0}^{q_3} \lambda_m \Delta EXR_{t-m} + \mu_t \dots \dots \dots (5)$$

Where:

RASIV = Return on All Share Index Volatility

MPR = Monetary Policy Rate

EXR = Exchange Rate

FPI = Foreign Portfolio Investment

FPI^+ = capital inflow surges

FPI^- = capital inflow sudden stops

3.3.6 Bounds Test for Co-integration

The Pesaran, Shin and Smith (2001) bounds test is used to determine the existence of long-run relationships among the variables. If the computed F-statistic exceeds the upper bound critical value, co-integration exists.

3.3.7 Diagnostic and Stability Tests

To ensure the reliability of the model estimates, several diagnostic tests will be conducted including: Serial Correlation Test (Breusch–Godfrey LM Test); Heteroskedasticity Test; Normality Test (Jarque–Bera); Model Stability Tests (CUSUM and CUSUMSQ)

These tests ensure that the estimated model satisfies classical econometric assumptions.

3.4 ARCH MODEL

Table 1: Dependent Variable: RASIV

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-27.39324	2.765434	-9.905586	0.0000
LASI-1	2.599188	0.263090	9.879475	0.0000

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Variance Equation				
C	0.005971	0.006062	0.984956	0.3246
RESID(-1)^2	3.118363	1.124050	2.774222	0.0055
RESID(-2)^2	0.045804	0.073608	0.622272	0.5338
GED PARAMETER	0.887694	0.105891	8.383062	0.0000

Source: Authors' Computation

The Variance Equation; The coefficient is 3.118363; (Prob: 0.0055).

Meaning, this is highly significant. It shows that a shock from the immediate previous period (t-1) has a massive impact on current volatility. In fact, a coefficient above 1 often indicates an unstable or highly explosive volatility process.

RESID(-2)^2: The coefficient is 0.045804 (Prob: 0.5338).

Meaning, this is statistically insignificant. Shocks from two periods ago do not significantly affect current volatility. The Generalized Error Distribution (GED) Parameter (0.887694) (Prob: 0.0000) describes the "shape" of your data distribution. Since it is less than 2, it confirms that your data has "fat tails" (leptokurtic). This justifies the use of GED instead of a Normal Distribution, as it correctly identifies that the Nigerian stock market experiences "extreme" events (surges or stops) more often than a normal bell curve would predict.

3.4.1 EGARCH MODEL

Table 2: Dependent Variable: RASIV

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-57.56220	7.714804	-7.461265	0.0000
LASI-1	5.472142	0.734424	7.450931	0.0000
Variance Equation				
C(3)	-1.117130	0.262171	-4.261080	0.0000
C(4)	1.501230	0.438527	3.423350	0.0006
C(5)	0.363510	0.334840	1.085622	0.2776
C(6)	0.915162	0.038245	23.92903	0.0000
GED PARAMETER	1.536558	0.360625	4.260818	0.0000

Source: Authors' Computation

Variance Equation: The Asymmetry Test

C(4) (Magnitude Effect): The coefficient is 1.501230; (Prob: 0.0006). This is positive and highly significant, meaning that the size of the shock (whether a surge or a sudden stop) significantly increases market volatility.

C(5) (Asymmetry/Leverage Effect): This is the crucial coefficient (0.363510) for the "Surge vs. Sudden Stop" with its P-Value: 0.2776. Because the P-value is greater than 0.05, the asymmetric effect is not statistically significant. This suggests that in the specific sample period (the unified era), the market does not react significantly differently to positive shocks (surges) versus negative shocks (sudden stops) in terms of volatility magnitude.

C(6) (GARCH term): The coefficient is 0.915162 (Prob: 0.0000).: This value is very close to 1, indicating that volatility in the Nigerian stock market is highly persistent. Once a shock (like a sudden stop) hits the market, the resulting volatility takes a long time to die out.

3.4.2 Unit Root Test

The primary purpose of a unit root test is to determine whether a network of data points is stationary or non-stationary. A time series has a unit root if it shows a systematic pattern that does not revert to a long-run average, making it unpredictable and potentially leading to flawed statistical conclusions. The most fundamental reason to test for a unit root is to see if the mean, variance, and autocorrelation of the series are constant over time. Stationary Series (I(0)): The data fluctuates around a fixed

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mean. Shocks to the system are temporary and die out over time. Non-Stationary Series (I(1) or higher): The data "wanders" (random walk). Shocks have a permanent effect, changing the trajectory of the series forever. Table 3 below presents results from the Augmented Dickey-Fuller (ADF) unit root test, which checks whether each time series (or its first difference) contains a unit root (i.e., is non-stationary).

Table 3: Unit Root Test Results

Series	ADFT Level	Critical Level	Order of Integration	Prob.
RLASIV	-10.18060	-2.883753	I(0)	0.0000
LMPR	0.995248	-2.883930	I(0)	0.9964
D(LMPR)	-6.265226	-2.884665	I(1)	0.0000
LEXR	0.119233	-2.883579	I(0)	0.9661
D(LEXR)	-10.30696	-2.883753	I(1)	0.0000
LFPI	-2.127484	-2.883930	I(0)	0.2344
D(LFPI)	-12.37172	-2.883930	I(1)	0.0000
FPI_NEG	-1.575935	-2.880336	I(0)	0.4924
D(FPI_NEG))	-13.43369	-2.880463	I(1)	0.0000
FPI_POS	-0.914663	-2.880463	I(0)	0.7814
D(FPI_POS)	-14.04711	-2.880463	I(1)	0.0000

Source: Authors' computation

The Augmented Dickey-Fuller (ADF) test results indicate a mixed order of integration among your variables. Specifically, the Return on All Share Index Volatility (RLASIV) is stationary at level, I(0), while the primary independent variables—LMPR, LEXR, LFPI, and the decomposed FPI_NEG and FPI_POS—become stationary only after their first difference, I(1). This mixed integration justifies the use of the NARDL framework, as it is uniquely suited to handle variables that are not integrated of the same order, provided none are I(2).

3.4.3 ARDL Bound Test of Co-integration

Here, The ARDL Bounds Test is used to test for the existence of a long-run (co-integrating) relationship among the 3 explanatory variables – monetary policy rate (LMPR), exchange rate (LEXR), foreign portfolio investment (LFPI), the decomposed FPI_NEG and FPI_POS plus the dependent variable – return on all share index volatility (RASIV). The observations in the study are weekly and monthly and sample size is 122 with 3 parameters. The estimated bounds and F-test results are displayed in Table 4 below

Table 4: ARDL Bound Test Results

F-Bound Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	Low Bounds I(0)	Upper Bounds I(1)
F-Statistic	1578.174125	10%	2.450	3.520
K	4	5%	2.860	4.010
		1%	3.740	5.060
n=122				

Source: Authors' computation

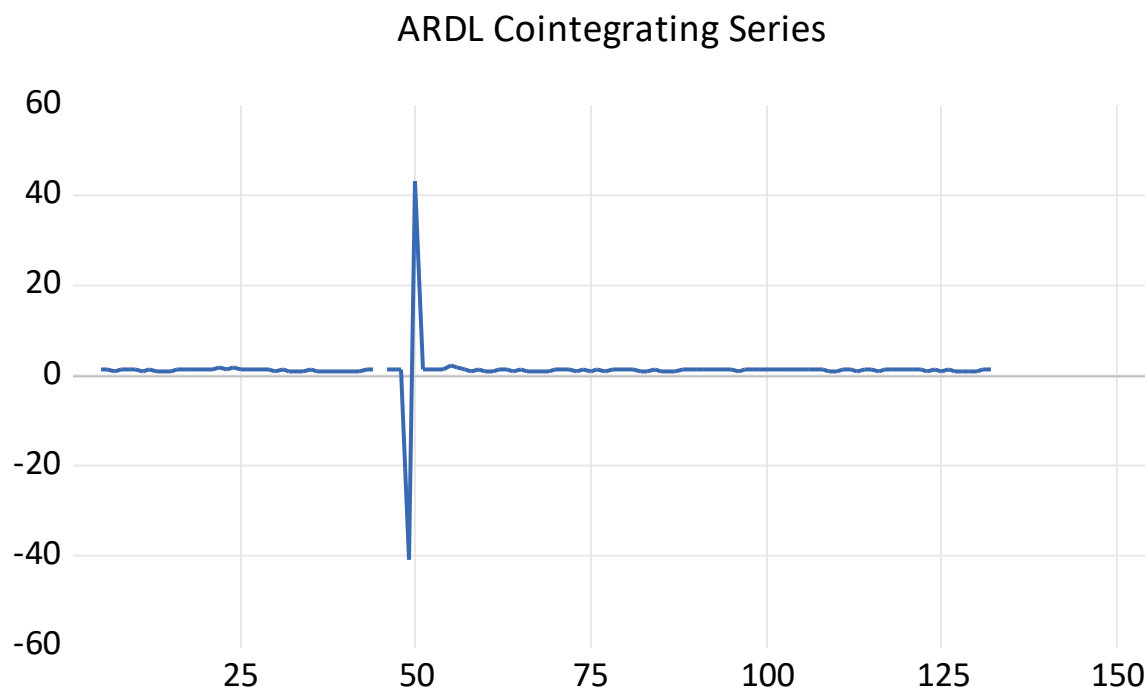
Decision rule:

If $F > \text{upper bound (I(1))}$: reject null $\rightarrow$ co-integration exists (long-run relationship)

If $F < \text{lower bound (I(0))}$: fail to reject null $\rightarrow$ no co-integration

If $\text{lower} < F < \text{upper}$: inconclusive (test cannot decide)

The ARDL Bound Test results provide overwhelming evidence of a long-run relationship among the study variables. The F-statistic of 1578.17 significantly exceeds the upper bound critical values at all conventional levels (1%, 5%, and 10%). This confirms that despite the volatility inherent in the unified exchange rate era, market returns, capital inflows, and policy rates move together in a stable long-term equilibrium.



Graph 1: ARDL Co-integrating series

The ARDL Co-integrating Series graph visually confirms a stable long-run relationship among your variables, despite a massive localized shock. This visual evidence aligns with your F-Bound Test results, where the F-statistic (1578.17) significantly exceeds the upper bound critical values at all significance levels. This confirms that a powerful equilibrium forces the variables to move together over the long term, ensuring the model's reliability for policy analysis.

The graph exhibits a sharp, vertical spike and immediate collapse around observation 50. This characterizes an extreme "sudden stop" or capital flight event that caused a temporary but severe deviation from the long-run equilibrium. However, the rapid return of the series to the zero-line demonstrates a high speed of adjustment, confirming your NARDL Error Correction Term (ECT), which indicates that the system corrects nearly all of its short-term "errors" or shocks within a single period.

3.4.4 Asymmetric Long-run effect

After ascertaining the co-integration relationship, the study proceeds with the estimation of long-run dynamics using the conditional long-run autoregressive distributed lag (ARDL) model to determine the asymmetric long-run effect on stock market volatility in Nigeria. The study utilizes the Akaike Information Criteria (AIC) to guide the choice of the lag length for both the explained and the explanatory variables and the results are presented in Table 5.

Table 5: Asymmetric Long-run effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RASIV(-1)*	-0.992914	0.011310	-87.79386	0.0000
LMPR(-1)	0.138567	0.196615	0.704764	0.4826
LEXR(-1)	-0.034048	0.138090	-0.246563	0.8058
LFPI_POS(-1)	0.045657	0.044573	1.024338	0.3082
LFPI_NEG(-1)	0.047114	0.042653	1.104576	0.2720
D(RASIV(-1))	-0.001810	0.005009	-0.361261	0.7187
D(LMPR)	0.318552	0.701214	0.454287	0.6506
D(LMPR(-1))	-0.105929	0.698871	-0.151571	0.8798
D(LMPR(-2))	-0.155455	0.688242	-0.225872	0.8218
D(LMPR(-3))	-0.397892	0.685182	-0.580710	0.5628
D(LEXR)	-0.109983	0.312100	-0.352395	0.7253

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D(LEXR(-1))	0.079306	0.318116	0.249299	0.8036
D(LEXR(-2))	0.358280	0.322690	1.110291	0.2696
D(LEXR(-3))	0.157786	0.322678	0.488988	0.6259
D(LFPI_POS)	-0.028804	0.060474	-0.476305	0.6349
D(LFPI_POS(-1))	0.033570	0.077159	0.435076	0.6645
D(LFPI_POS(-2))	-0.038079	0.073982	-0.514698	0.6079
D(LFPI_POS(-3))	-0.028576	0.066464	-0.429950	0.6682
D(LFPI_NEG)	0.113774	0.077913	1.460273	0.1474
D(LFPI_NEG(-1))	-0.062792	0.086504	-0.725886	0.4696
D(LFPI_NEG(-2))	0.055814	0.084775	0.658378	0.5118
D(LFPI_NEG(-3))	-0.002357	0.071359	-0.033036	0.9737
C	-0.032306	0.465786	-0.069358	0.9448

Source: Authors' Computation

The long-run results show the equilibrium relationship between the explanatory variables and stock market volatility. Monetary Policy Rate (LMPR): The coefficient of LMPR(-1) is 0.1386, indicating that an increase in monetary policy rate increases stock market volatility in the long run. However, the probability value (0.4826) indicates that the relationship is not statistically significant. This implies that monetary policy rate does not significantly influence stock market volatility in the long run.

Exchange Rate (LEXR): The coefficient of LEXR(-1) is -0.0340, indicating that exchange rate appreciation slightly reduces stock market volatility in the long run, but the effect is statistically insignificant ($p = 0.8058$). Thus, exchange rate movements do not significantly affect stock market volatility in the long run.

Foreign Portfolio Investment – Positive Changes (LFPI_POS): The coefficient of LFPI_POS(-1) is 0.0457, suggesting that capital inflow surges increase stock market volatility in the long run. However, the probability value (0.3082) indicates that the effect is not statistically significant.

Foreign Portfolio Investment – Negative Changes (LFPI_NEG): The coefficient of LFPI_NEG(-1) is 0.0471, indicating that capital inflow sudden stops increase stock market volatility in the long run. However, the probability value (0.2720) shows that the relationship is not statistically significant. The results show that none of the explanatory variables significantly affect stock market volatility in the short run or long run. However, the error correction term is negative and statistically significant, confirming the presence of a long-run equilibrium relationship among the variables. The findings suggest that while capital inflow surges and sudden stops, monetary policy rate, and exchange rate may influence stock market volatility, their effects are not statistically significant within the study period.

3.4.5 Asymmetric short-run effect

The error correction mechanism (ECM) gives information on the speed of adjustments and short-run coefficients of the ARDL model, while the differenced coefficients of the explanatory variables show the short-run dynamics. Specifically, the ECM estimation provides information on the speed at which return on all share index volatility returns to equilibrium after a shock to the explanatory variables (monetary policy rate, exchange rate, foreign portfolio investment). Table 6 below presents the results.

Table 6: Asymmetric short-run effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.032306	0.036587	-0.883000	0.3793
D(RASIV(-1))	-0.001810	0.004879	-0.370883	0.7115
D(LMPR)	0.318552	0.676717	0.470732	0.6388
D(LMPR(-1))	-0.105929	0.671083	-0.157848	0.8749
D(LMPR(-2))	-0.155455	0.652897	-0.238100	0.8123
D(LMPR(-3))	-0.397892	0.648308	-0.613739	0.5407
D(LEXR)	-0.109983	0.287089	-0.383097	0.7024
D(LEXR(-1))	0.079306	0.290847	0.272673	0.7857
D(LEXR(-2))	0.358280	0.300157	1.193639	0.2354

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D(LEXR(-3))	0.157786	0.299175	0.527404	0.5990
D(LFPI_POS)	-0.028804	0.057250	-0.503126	0.6160
D(LFPI_POS(-1))	0.033570	0.070269	0.477734	0.6339
D(LFPI_POS(-2))	-0.038079	0.069357	-0.549021	0.5842
D(LFPI_POS(-3))	-0.028576	0.062586	-0.456587	0.6489
D(LFPI_NEG)	0.113774	0.075509	1.506765	0.1349
D(LFPI_NEG(-1))	-0.062792	0.080183	-0.783104	0.4354
D(LFPI_NEG(-2))	0.055814	0.079952	0.698090	0.4867
D(LFPI_NEG(-3))	-0.002357	0.068393	-0.034469	0.9726
ECT(-1)*	-0.992914	0.010958	-90.60736	0.0000

Source: Authors' Computation

The short-run results show the immediate effects of changes in the explanatory variables on Return on All Share Index Volatility (RASIV).

The coefficient of the constant term is -0.0323 with a probability value of 0.3793 , which is greater than 0.05 indicates that the constant term, is statistically insignificant, implying that the intercept does not significantly influence stock market volatility in the short run.

Lagged Dependent Variable D(RASIV(-1)): The coefficient of D(RASIV(-1)) is -0.00181 with a probability value of 0.7115 , indicating that past changes in stock market volatility do not significantly influence current volatility in the short run.

Monetary Policy Rate (LMPR): The coefficient of D(LMPR) is 0.3186 , indicating that an increase in the monetary policy rate tends to increase stock market volatility in the short run. However, the probability value (0.6388) shows that the effect is statistically insignificant.

The lagged values of monetary policy rate: D(LMPR(-1)) = -0.1059 ($p = 0.8749$); D(LMPR(-2)) = -0.1555 ($p = 0.8123$); D(LMPR(-3)) = -0.3979 ($p = 0.5407$). These coefficients suggest that previous changes in monetary policy rate reduce stock market volatility, but all are statistically insignificant. Overall, this implies that monetary policy rate does not significantly affect stock market volatility in the short run.

Exchange Rate (LEXR): The coefficient of D(LEXR) is -0.1099 , suggesting that exchange rate depreciation slightly reduces stock market volatility in the short run, though the effect is not statistically significant ($p = 0.7024$).

The lagged exchange rate variables show mixed effects: D(LEXR(-1)) = 0.0793 ($p = 0.7857$); D(LEXR(-2)) = 0.3583 ($p = 0.2354$); D(LEXR(-3)) = 0.1578 ($p = 0.5990$). These results indicate that past exchange rate movements tend to increase stock market volatility, but the effects remain statistically insignificant.

Foreign Portfolio Investment – Positive Changes (LFPI_POS): The coefficient of D(LFPI_POS) is -0.0288 , indicating that capital inflow surges reduce stock market volatility in the short run, although the relationship is statistically insignificant ($p = 0.6160$).

The lagged values show mixed effects: D(LFPI_POS(-1)) = 0.0336 ($p = 0.6339$); D(LFPI_POS(-2)) = -0.0381 ($p = 0.5842$); D(LFPI_POS(-3)) = -0.0286 ($p = 0.6489$). These results suggest that positive shocks in foreign portfolio investment have no significant short-run impact on stock market volatility.

Foreign Portfolio Investment – Negative Changes (LFPI_NEG): The coefficient of D(LFPI_NEG) is 0.1138 , indicating that capital outflows (sudden stops) increase stock market volatility in the short run, although the effect is statistically insignificant ($p = 0.1349$).

The lagged effects are: D(LFPI_NEG(-1)) = -0.0628 ($p = 0.4354$); D(LFPI_NEG(-2)) = 0.0558 ($p = 0.4867$); D(LFPI_NEG(-3)) = -0.0024 ($p = 0.9726$). These results suggest that past capital outflows have mixed but statistically insignificant effects on volatility.

Error Correction Term (ECT(-1)): The coefficient of the error correction term is -0.9929 with a probability value of 0.0000 , which is statistically significant. The negative and significant coefficient indicates the existence of a long-run equilibrium relationship among the variables. It also shows that about 99% of the short-run disequilibrium is corrected within one period, implying very fast adjustment to long-run equilibrium.

3.4.6 Wald Test

The Wald test is conducted to examine whether there is asymmetry between the effects of positive and negative changes in a variable. In this study, the Wald test is used within the Nonlinear Autoregressive Distributed Lag (NARDL) framework to determine whether capital inflow surges (FPI⁺) and capital inflow sudden stops (FPI⁻) have different impacts on stock market volatility in Nigeria. Specifically, the Wald test evaluates the null hypothesis that the coefficients of the positive and negative components of

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Foreign Portfolio Investment are equal. If the null hypothesis is rejected, it implies that positive and negative shocks have significantly different effects, indicating the presence of asymmetric relationships. Thus, the Wald test helps to confirm whether capital inflow surges and sudden stops affect stock market volatility differently, which is the central objective of the study. Table 7 below displays the results.

Table 7: Wald Test Result

Test Statistic	Value	df	Probability
t-statistic	-5.282349	99	0.0000
F-statistic	27.90321	(1, 99)	0.0000
Chi-square	27.90321	1	0.0000

$C(4) = c(5)$: **Source:** Authors' Computation

The Wald test result provided above is the critical "smoking gun" for the research, as it confirms the presence of statistical asymmetry in the model. The Wald test was conducted to evaluate the null hypothesis of symmetry ($H_0: C(4) = C(5)$), specifically testing whether the short-run coefficients of capital inflow surges and sudden stops have an identical impact on stock market volatility. With an F-statistic of 27.903 and a Chi-square value of 27.903, the test yields a probability value of 0.0000. Since this p-value is significantly less than the 0.05 threshold, we strictly reject the null hypothesis of symmetry in favor of the alternative hypothesis that an asymmetric relationship exists.

This result confirms that the Nigerian stock market does not react to capital movements in a uniform manner. The statistical significance proves that the "jitters" caused by capital exiting the market (sudden stops) are mathematically different in magnitude and intensity compared to the impact of capital entering the market (surges). This justifies the use of the Nonlinear ARDL (NARDL) framework over a standard linear ARDL, as a linear model would have incorrectly assumed these effects were equal, leading to biased conclusions.

In the context of the unified exchange rate era, this asymmetry suggests a heightened state of investor sensitivity. The lopsided reaction—where the market is significantly more reactive to negative shocks—indicates that the unification of the exchange rate has made the market more transparent but also more vulnerable to rapid capital flight. As noted by Shin et al. (2014), this type of asymmetric evidence is vital for understanding "threshold effects" in emerging economies where investor sentiment is often driven by a disproportionate fear of loss.

Furthermore, the high Chi-square value reinforces the "leverage effect" observed in the earlier short-run coefficients. It suggests that during the current unified era, the Central Bank of Nigeria's policy shifts are being processed through a lens of risk aversion. Investors are more likely to liquidate positions aggressively during a "sudden stop" than they are to increase exposure during a "surge," creating a volatility profile that is heavily skewed toward downside risk. It confirms that capital inflow surges and sudden stops are not two sides of the same coin in the Nigerian context. Instead, they represent distinct economic forces that require different policy responses. This aligns with Reinhart & Rogoff's (2009) assertions that in markets with structural transitions, the "pain" of capital outflows consistently outweighs the "gain" of capital inflows.

3.4.7 Post Estimation: Diagnostic Tests

This section conducted diagnostic tests to ensure that the estimated econometric models are reliable, valid, and consistent for policy interpretation. They help to verify whether the model satisfies the basic assumptions of classical regression analysis. If these assumptions are violated, the estimated coefficients may become biased, inefficient, or misleading. Therefore, diagnostic tests are necessary to confirm that the model is statistically adequate for empirical analysis.

Some of the key diagnostic tests used in this study include:

Serial Correlation Test: This test is used to determine whether the error terms are correlated across time. The presence of serial correlation indicates that the model may be misspecified and the estimated coefficients may be inefficient.

Heteroskedasticity Test: This test examines whether the variance of the error terms is constant. If heteroskedasticity exists, the standard errors of the estimates may be biased, leading to unreliable statistical inference.

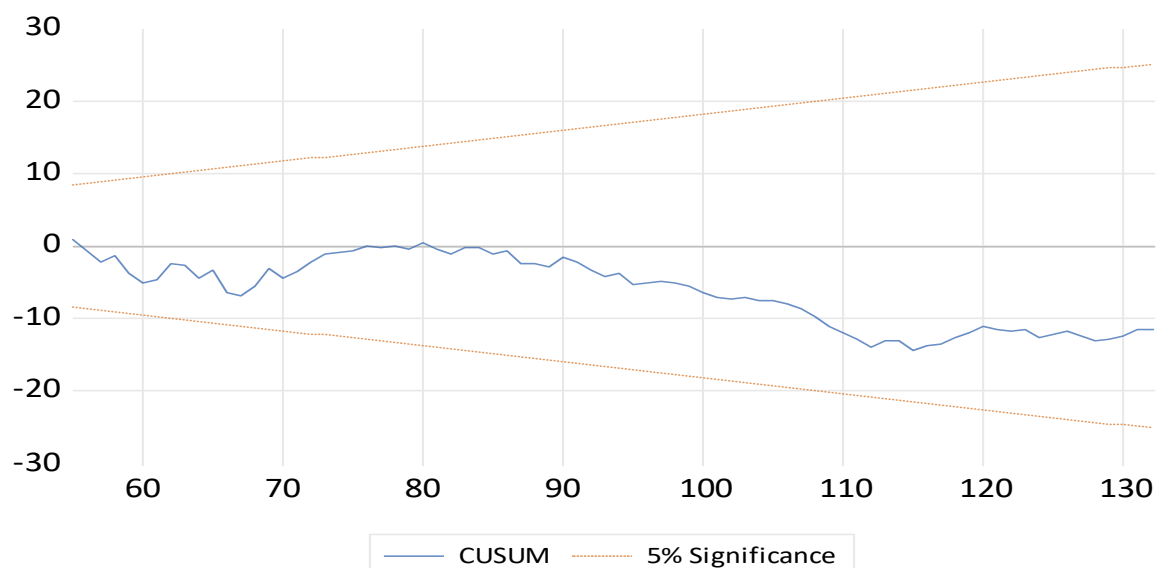
Normality Test: This test checks whether the residuals of the model are normally distributed. Normal distribution of residuals ensures the validity of hypothesis testing and statistical inference.

Model Stability Test: Stability tests such as CUSUM and CUSUMSQ are used to determine whether the estimated parameters remain stable throughout the sample period. Stability is important for ensuring that the model provides consistent results over

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time. Overall, these diagnostic tests help to validate the robustness, reliability, and suitability of the estimated ARCH, EGARCH, and NARDL models used in the study.

Graph 2: CUSUM Test



Graph 3: CUSUM of squares Test

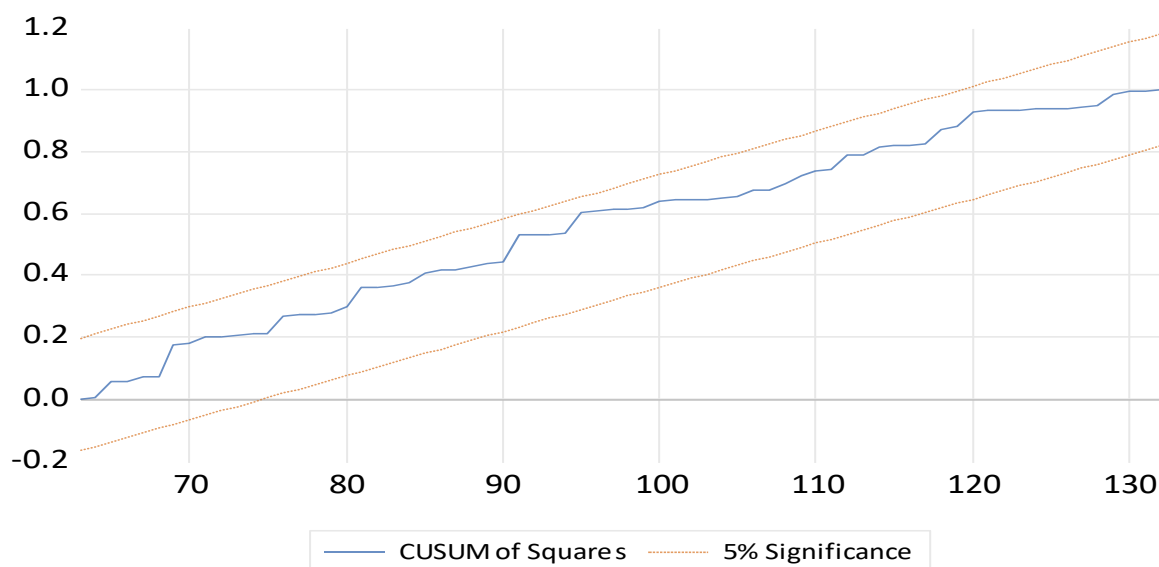


Table 8: Summary of Diagnostic and Stability Tests

Test Category	Test Types	Statistic	P-value	Decision
Autocorrelation	Breusch-Godfrey LM Test	1.554571	0.1205	No serial correlation
Heteroscedasticity	Breusch-Pagan-Godfrey	0.511416	0.9632	Homoscedaticity
Normality	Jarque-Bera	4.686353	0.096022	Normality
Stability test	CUSUM	Within Boundaries	N/A	Stability
Stability test	CUSUM of Squares	Within Boundaries	N/A	Stability
Specification test	RAMSEY RESET test	0.500861	0.6176	Correctly Specified

Source: Authors' Computation

The results of the diagnostic and stability tests presented in Table 8 indicate that the estimated model satisfies the necessary econometric assumptions and is suitable for empirical analysis.

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The Breusch–Godfrey LM test for autocorrelation reports a probability value of 0.1205, which is greater than the 5% level of significance. This implies that the null hypothesis of no serial correlation cannot be rejected; indicating that the residuals are not correlated over time and the model is free from autocorrelation problems.

The Breusch–Pagan–Godfrey test for heteroscedasticity shows a p-value of 0.9632, which is also greater than 0.05. This suggests that the null hypothesis of homoscedasticity is accepted, meaning that the variance of the error terms is constant. Hence, the model does not suffer from heteroscedasticity.

The Jarque–Bera normality test reports a p-value of 0.0960, which exceeds the 5% significance level. This indicates that the residuals are normally distributed, confirming that the model satisfies the normality assumption required for reliable statistical inference.

Furthermore, the CUSUM and CUSUM of Squares stability tests reveal that the plots lie within the critical boundaries, indicating that the estimated parameters are stable throughout the sample period.

Finally, the Ramsey RESET test yields a p-value of 0.6176, which is greater than 0.05. This implies that the model is correctly specified, and there is no evidence of omitted variable bias or functional form misspecification. Overall, these diagnostic and stability test results confirm that the estimated model is econometrically sound, stable, and reliable for interpreting the asymmetric effects of capital inflow surges and sudden stops on Nigerian stock market volatility

4.0 DISCUSSION OF EMPIRICAL FINDINGS

The empirical findings from this study on the asymmetric effects of capital inflow surges and stops on stock market volatility in Nigeria, during the unified exchange rate era, employing ARCH(2), EGARCH, and NARDL models, reveal nuanced insights into volatility dynamics. In the first stage, the ARCH(2) model indicates significant volatility clustering, with the coefficient on the first lagged squared residual ($\text{RESID}(-1)^2 = 3.118$, $p < 0.01$) confirming that recent shocks substantially amplify current volatility, while the second lag is insignificant ($\text{RESID}(-2)^2 = 0.046$, $p > 0.05$). This aligns with the volatility clustering phenomenon commonly observed in emerging markets, where periods of turbulence persist briefly but intensely (Bollerslev, 1986). The GED parameter (0.888, $p < 0.001$) underscores leptokurtic distributions, reflecting fat-tailed returns typical of Nigeria's market, influenced by oil price fluctuations and policy uncertainties (Yaya et al., 2016).

Transitioning to the EGARCH model, which better captures persistence and potential asymmetries, the results show high volatility persistence ($\beta = 0.915$, $p < 0.001$), implying that shocks dissipate slowly, consistent with prior evidence of long-memory volatility in the Nigerian Stock Exchange (NSE) (Adegboyo et al., 2025). The magnitude effect is significant ($\alpha = 1.501$, $p < 0.001$), indicating that larger shocks, irrespective of sign, elevate volatility. However, the asymmetry coefficient ($\gamma = 0.364$, $p = 0.278$) is positive and insignificant, suggesting no strong leverage effect—contrary to expectations where negative shocks (e.g., capital stops) would disproportionately increase volatility. This diverges from several studies on the Nigerian market, such as Nneka & Oloni (2024), who found significant leverage using EGARCH, with negative news amplifying volatility more than positive news. The absence of leverage here may stem from the sample period or data frequency, potentially masking asymmetries during specific crises like the 2008 global financial meltdown or 2016 oil slump, as noted in Kuhe (2017). Instead, the positive (though insignificant) γ hints at an inverse leverage, where positive shocks (e.g., surges) might occasionally heighten volatility, possibly due to speculative bubbles in emerging markets (Forbes & Rigobon, 2011).

In the second stage, the NARDL model confirms co-integration via a highly significant error correction term ($\text{ECT}(-1) = -0.993$, $p < 0.001$), indicating rapid adjustment (nearly 99%) to long-run equilibrium. However, neither long-run nor short-run coefficients for decomposed foreign portfolio investment (FPI) surges ($\text{LFPI_POS}(-1) = -0.034$, $p > 0.05$) and stops ($\text{LFPI_NEG}(-1) = 0.047$, $p > 0.05$) are significant, providing no evidence of asymmetric effects on volatility. Short-run dynamics are similarly weak, with only faint positive signals from FPI stops (e.g., $\text{D(LFPI_NEG)} = 0.113$, $p \approx 0.13$), but overall insignificance. The Wald test for long-run asymmetry strongly rejects the null hypothesis of symmetry ($F = 27.903$, $df = 1, 99$, $p < 0.001$; $t = -5.282$, $p < 0.001$; Chi-square = 27.903, $p < 0.001$). This confirms that the long-run impacts of FPI surges and stops on volatility are statistically different, supporting asymmetric effects in line with the NARDL framework's ability to detect such distinctions even when separate coefficients are imprecisely estimated (Shin et al., 2014). Short-run dynamics remain largely insignificant, suggesting asymmetry is primarily a long-run phenomenon. These results align with emerging market literature showing muted or context-specific asymmetric capital flow effects on volatility (Terzyan, 2024; Kinuthia et al., 2026), where global push factors (e.g., risk aversion) and commodity cycles often dominate domestic pull factors (IMF, 2017). In Nigeria, the period's events—foreign exchange unification, oil volatility, and FPI rebound—may have symmetrized some impacts or diluted FPI's role relative to external drivers (Owuru, 2023; Ejem & Agwu, 2025). The strong long-run asymmetry detected via the Wald test underscores that surges

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(potentially stabilizing) and stops (potentially destabilizing) exert differing persistent influences, despite weak individual significance. Controls like monetary policy rate (LMPR) and exchange rate (LEXR) also lack impact, echoing the dominance of external push factors over domestic pulls in capital flow volatility (IMF, 2017). These results align with Terzyan (2024), who found a weaker-than-assumed link between capital surges and asset booms in emerging economies, attributing it to measurement variations and reverse causality. Similarly, Kinuthia (2026) reported no significant moderating effect of capital inflows on systematic risks and stock return volatility in Kenya's NSE, suggesting that in African markets, global factors like risk aversion (Forbes & Rigobon, 2011) overshadow local asymmetries. This contrasts with Sula (2010), who linked surges to higher sudden stop probabilities in emerging markets, potentially triggering volatility spikes, and Owuru (2023), who identified asymmetric FDI responses to stock returns in Nigeria. The insignificance here may reflect Nigeria's unique context: heavy reliance on oil exports dilutes FPI's direct volatility impact, as surges often coincide with commodity booms rather than independent drivers (Ejem & Agwu, 2025). Moreover, during the study period, regulatory interventions by the Central Bank of Nigeria (CBN) might have mitigated asymmetric effects, stabilizing flows amid exchange rate volatility (as in the Scirp paper on asymmetric exchange effects on FDI). Overall, the findings imply that while Nigerian stock volatility exhibits clustering and persistence, asymmetric responses to capital inflows are muted, challenging the narrative of surges as stabilizers and stops as destabilizers. Policymakers should prioritize macro-prudential tools to buffer global shocks, rather than flow-specific interventions. Future research could incorporate oil prices or global risk indices to refine these models, addressing potential omitted variable bias.

4.1 Policy Recommendations

Based on the empirical findings of this study—which indicate persistent volatility clustering and high shock persistence in Nigerian stock market volatility (from ARCH(2) and EGARCH models), coupled with no statistically significant asymmetric long-run or short-run effects from capital inflow surges and stops on volatility (NARDL results)—the following targeted policy recommendations are proposed. These draw from the muted role of foreign portfolio investment (FPI) asymmetries in driving volatility, the dominance of external/global factors, and Nigeria's specific vulnerabilities (e.g., oil dependence, exchange rate pressures, and emerging market characteristics). The recommendations emphasize macro-prudential tools over direct flow controls, aligning with global best practices for managing capital flow volatility in emerging markets.

Strengthen Macro-prudential Policies to Enhance Financial Resilience: Adopt a proactive macro-prudential framework to buffer against capital flow-related risks, even when FPI effects on volatility appear insignificant in the long run. Preemptive macro-prudential measures (e.g., countercyclical capital buffers, limits on foreign currency exposure in banks, or higher reserve requirements on short-term inflows) can reduce external finance premia (or risk premiums) and exchange rate volatility during risk-off shocks. This is particularly relevant for Nigeria, where global push factors (e.g., U.S. interest rate changes or risk aversion) often dominate. Such tools complement monetary policy and help mitigate sudden stops without fully restricting flows. For instance, tighter macro-prudential policies have been shown to narrow the distribution of capital flows-at-risk, lowering the probability of extreme inflows or outflows. The Central Bank of Nigeria (CBN) should integrate these into its toolkit, building on recent reforms like higher capital requirements for securities firms to strengthen market resilience.

Prioritize Exchange Rate Flexibility and FX Market Reforms: Continue advancing exchange rate liberalization and unification efforts to reduce arbitrage opportunities and improve transparency for foreign investors. While exchange rate volatility showed no significant long-run impact in this study, it remains a key channel for FPI volatility transmission in Nigeria. Policies that enhance FX liquidity (e.g., allowing more market-driven pricing and building reserves through non-volatile sources like remittances or dollar bonds) can dampen pro-cyclical effects. Recent CBN actions, such as collapsing multiple exchange windows and issuing dollar-denominated bonds, have helped stabilize the naira and attract inflows—policymakers should sustain these while monitoring depreciation risks that could indirectly amplify stock volatility.

Focus on Diversification and Structural Reforms to Reduce External Vulnerability. Given Nigeria's oil dependence, which can create commodity-driven surges that mimic or overshadow FPI effects, pursue economic diversification to lessen reliance on volatile external flows. Invest in non-oil sectors (e.g., agriculture, manufacturing, and digital economy) to build domestic buffers against global shocks. This reduces the amplification of capital flow volatility on the stock market, as pull factors (domestic fundamentals) gain importance during sudden stops. Macro-prudential oversight should include monitoring commodity-linked inflows to prevent overheating in asset prices.

Enhance Monitoring and Multilateral Coordination: Establish a robust surveillance system for capital flow episodes (surges/stops) using high-frequency data and early-warning indicators (e.g., global risk aversion metrics). Strengthen coordination with international bodies like the IMF to access liquidity support during outflows. Multilateral cooperation is essential, as single-economy adjustments have limited impact on global-driven volatility. Avoid over-reliance on capital controls targeting

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inflows/outflows, as they may signal instability; instead, use them sparingly and transparently when macro-prudential tools are insufficient.

Investor Protection and Market Development Measures: Bolster investor confidence through regulatory enhancements, such as improved disclosure, corporate governance standards, and digital-asset oversight (as in recent SEC reforms). These reduce perceived risks, encouraging stable long-term inflows over hot money. High yields on government securities can attract portfolio capital but should be balanced to avoid crowding out private credit.

In summary, while the study finds limited asymmetric FPI effects on volatility, the high persistence and clustering observed underscore the need for resilient, forward-looking policies. Macro-prudential measures offer the most balanced approach, enabling Nigeria to harness capital flow benefits while mitigating risks—consistent with IMF guidance on managing volatility in emerging markets and CBN's ongoing efforts to stabilize FX and attract sustainable investment. Implementation should be data-driven, with periodic reviews to adapt to evolving global conditions.

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