Exchange Rate Volatility and the Effectiveness of Monetary Policy in Nigeria: An Empirical Analysis (2010-2026)

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Abstract

The persistence volatility of the Nigerian naira currency value poses a significant challenge to the capacity of the Central Bank of Nigeria (CBN) to fulfill its fundamental mandate, namely price stability and core macroeconomic stability. This research examines the effectiveness of monetary policy in Nigeria from 2010Q1 and 2026Q1 in the presence of exchange rate volatility. The studies use a Vector Autoregression (VAR) model to examine the dynamic interdependence of the following variables: monetary policy rate (MPR), exchange rate volatility (estimated using a GARCH (1,1)) model, inflation rate (INF), and industrial production index (IPI) as an output proxy. The results show that exchange rate volatility undermines the conduction of monetary policy in Nigeria. Precisely, jolts to exchange rates volatility generates long-term inflationary strains and impedes the ability of CBN to boost real economy output using interest rate changes. The variance decomposition analysis also indicates that the exchange rate volatility contributes a significant amount of the forecast error variance of the inflation as well as output, which is higher than the direct contribution of the monetary policy rate itself in later periods. The research finds that, when exchange rate fluctuations are high and unpredictable, the traditional monetary policy interest rate mechanism loses its strength, since the driving force of price and output formation in the country is made up of import-based inflation and capital flow uncertainty. Some suggestions are put forward, such as the fact that the CBN should focus on exchange rate stability by having a coherent and transparent foreign exchange management system, increasing the utilization of complementary macro-prudential instruments, and strengthening the domestic financial market to enhance policy resilience.

Keywords: Exchange rate Volatility, Monetary policy effectiveness, Vector autoregression, Inflation, Central bank of Nigeria.

1. Introduction

The aim to achieve price stability and to attain sustainable economic development is the most significant mandate of the majority of the central banks, including the Central Bank of Nigeria (CBN). Monetary policy in Nigeria, which is mainly executed by manipulating the monetary policy rate (MPR), open market operations (OMOs), and reserve requirements, is a very important macroeconomic management instrument (CBN, 2023). The success of these policy tools is

however determined by a stable and predictable economic environment, at least in the foreign exchange market. Deep and sustained exchange rate volatility has been a feature of Nigeria in the last 10 years, whereby the country has suffered recurrent episodes of devaluation, large parallel market premiums, and speculative pressures (Obi et al., 2022). A combination of structural and cyclical dynamics that have led to this volatility is reliance on exports of crude oil, imbalance between supply and demand in foreign exchange markets, reversal of capital flow, and most recently, global economic shocks such as the COVID-19 pandemic and geopolitical tension (Adeleye et al., 2021).

The exchange rate volatility causes great noise in the transmission of the monetary policy. It makes the inflation perspective difficult by having a direct effect on the prices of imports (pass-through effect) and an indirect impact on the inflation expectations (Ahmad and Al-Mukit, 2020). Moreover, volatility may discourage long-term investment, perhaps local and foreign, by causing more uncertainty in the actual returns to investment projects (Udom & Onyekachi, 2023). In the case of a highly import dependent economy as that of Nigeria, whereby manufactured goods and raw materials, including refined petroleum products, are mostly imported, the movement of the exchange rate has direct and significant effects on the domestic prices and costs of production. The CBN is therefore in most cases caught in a policy dilemma as it is torn between the tightening of the monetary policy to check inflation (mostly imported), and its wish to reduce the rates to spur a dragging economy.

Regardless of the recognized difficulties, there is a necessity of a new, complex empirical evaluation of the degree to which the volatility of the exchange rate in Nigeria has undermined the efficiency of monetary policy in the recent period (2020-2026), i.e. the period of unprecedented global and domestic economic instability. Although the literature that has been preserved examined some part of this relationship, a great number of studies were conducted before the massive policy change and the market dynamics that happened over the past five years (Okoro & Ezeabasili, 2021). The current research thus aims to fill this gap by offering a rigorous and data-driven research of the nexus between the exchange rate volatility and monetary policy efficacy in Nigeria between 2010 and 2026. The research question is as follows: How has exchange rate volatility reduced the efficiency of the monetary policy in maintaining price and output stability in Nigeria?

The importance of the given research is multi-faceted. It has appropriate empirical data that can enable the CBN to continue doing its monetary policy reforms and in its pursuit of an ideal monetary-fiscal exchange rate policy mix. It also adds to the wider scholarly discussion of the limitations of monetary policy in emerging market economies that have unstable commodity exports with fragile financial markets. The rest of this paper is organized in the following way: Section 2 will review the applicable theoretical and empirical literature. Section 3 will explain the methodology, the model specification as well as the estimation methods. The empirical results are provided and discussed in Section 4. Lastly, the study is concluded in Section 5, and recommendations are provided on how to work out the policy.

2. Literature Review

2.1. Transmission of Monetary policy based on theory.

Monetary policy effectiveness in attaining a macroeconomic stability depends essentially on the soundness of its transmission mechanism. The complex mechanisms through which the policy

instruments of the central bank, which is mainly the monetary policy rate, affect the aggregate demand, output and finally the price level are possible through this mechanism. An efficient transmission system will make sure that there is an accurate and predictable transmission of policy signals to the wider economy. According to the theoretical literature, various critical channels can be identified, each of which has its own paths and assumptions, and all of them result in the strength of monetary policy measures.

The most traditional channel that is central to the textbook monetary theory is the interest rate channel. It works on the neoclassical effect of the cost-of-capital. Increasing the interest rate used by a central bank such as the Central Bank of Nigeria (CBN) (a contractionary policy) will directly have the impact of raising the short-term interest rates in the money markets. This growth, via arbitrage and expectations, spreads to more duration deposit and lending rates. An increase in real interest rates increases both the cost of borrowing to the firms (investment in capital goods and inventories) and households (mortgages, consumer durables and other credit financed consumption). This weens aggregate investment and consumption spending and the resultant effect is a decline in aggregate demand, which in effect causes a price pressure downwards. Conversely, an expansionary policy lowers interest rates, stimulating borrowing and spending, thereby boosting demand and output, with potential inflationary consequences if the economy is near full capacity. The efficacy of this channel hinges on the degree of interest rate pass-through from the policy rate to retail bank rates, the interest elasticity of investment and consumption, and the overall sensitivity of aggregate demand to interest rate changes (Mishkin, 2021).

In an open economy like Nigeria, the exchange rate channel is critically important and often interacts powerfully with the interest rate channel. The theoretical underpinning here is rooted in the uncovered interest parity (UIP) condition and the resulting capital flows. A contractionary monetary policy that raises domestic interest rates relative to foreign rates, *ceteris paribus*, makes domestic financial assets more attractive. This attractiveness induces capital inflows, increasing demand for the domestic currency (the Naira) and causing it to appreciate. An appreciation makes imports cheaper in domestic currency terms and exports more expensive for foreign buyers. The fall in import prices directly reduces the domestic price of imported final goods, intermediate inputs, and raw materials, contributing to lower inflation—a direct "pass-through" effect. Simultaneously, the reduction in net exports (due to costlier exports and cheaper imports) contributes to a contraction in aggregate demand, further disinflationary. The expansionary policy scenario works in reverse: lower interest rates trigger capital outflows, currency depreciation, imported inflation via higher import costs, and a potential boost to aggregate demand from improved net exports (Obstfeld & Rogoff, 2022). The strength of this channel depends on the degree of capital mobility, the substitutability between domestic and foreign assets, the openness of the economy (trade-to-GDP ratio), and the pricing behavior of firms in international trade.

Beyond these traditional channels, the credit channel amplifies the effects of the interest rate channel by focusing on the supply side of credit. It is subdivided into the bank lending channel and the balance sheet channel. The bank lending channel posits that contractionary monetary policy, by reducing bank reserves and raising the cost of interbank funding, can limit the supply of bank loanable funds. Banks, facing reduced liquidity and higher funding costs, may ration credit by tightening lending standards and reducing loan volumes, especially to smaller, bank-dependent borrowers. This credit supply shock further suppresses investment and consumption. The balance sheet channel operates through the net worth of potential borrowers. Higher interest rates from a contractionary policy weaken the balance sheets of firms and households by increasing debt

servicing costs, reducing cash flows, and often causing asset prices (like collateral values) to fall. This deterioration in financial positions increases the premium for external finance due to heightened moral hazard and adverse selection problems, making it even harder and more expensive to obtain credit, thereby amplifying the initial interest rate effect (Mishkin, 2021).

Finally, the asset price channel (or wealth channel) links monetary policy to consumption and investment via valuations of assets such as equities and real estate. A reduction in interest rates makes bonds less attractive, leading investors to rebalance portfolios towards equities, driving up stock prices. Higher equity prices increase the value of household financial wealth, which can boost consumption through the wealth effect. Furthermore, higher stock prices lower the cost of equity capital for firms, making it cheaper to finance new investment projects through equity issuance—the Tobin's q theory. Similarly, lower interest rates generally support higher real estate prices, which also boosts household wealth and the collateral value for loans, further stimulating spending. A contractionary policy would depress asset prices, working in the opposite direction.

In the Nigerian context, the theoretical smooth operation of these channels is often impeded by structural and institutional rigidities. The interest rate channel is weakened by a shallow financial system, high levels of non-performing loans that blunt banks' responsiveness to policy signals, and a large informal sector that operates outside the formal banking nexus. The credit channel is particularly potent but problematic; while banks may reduce lending in response to tight policy, the impact is often uneven and can exacerbate credit crunches for productive sectors. The asset price channel is less developed due to the relatively small size of the capital market relative to the economy. Consequently, the exchange rate channel often becomes the most visible and immediate transmission pathway. However, as highlighted in the initial text, its effectiveness is critically dependent on a stable and predictable foreign exchange market. When the exchange rate is subject to high volatility—characterized by sharp, unpredictable fluctuations—the theoretical link between policy rate adjustments and orderly exchange rate movements breaks down. Volatility induces uncertainty, which can deter stabilizing speculative capital flows, lead to hoarding and speculative attacks, and cause discontinuous, overshooting adjustments. This environment severely compromises the central bank's ability to use the policy rate to reliably influence the exchange rate for inflation targeting purposes, thereby attenuating the overall monetary transmission mechanism and undermining policy effectiveness (Jibrin et al., 2020).

2.2. Exchange Rate Volatility: Determinants and Measurements

The central characteristic of the Nigerian macroeconomic environment, which has been described, is exchange rate volatility that refers to the inclination of nominal or real exchange rate to make significant and recurring changes within a specific time span. Its continuity is not an accident but a product of an involved interplay of determinant forces, exogenous and endogenous to the Nigerian economy. These determinants need to be understood wholesomely in order to diagnose the underlying cause of the mechanism of transmission failure.

On the outside, the exchange rate of Nigeria is highly susceptible to the oil market shocks across the world. Since the country is a monocultural export economy in which foreign exchange earnings are more than 80 percent of the total foreign exchange and the government receives a large portion of fiscal revenue in the form of the international price of Bonny Light crude, the case of the international price of Bonny Light crude is one of the key external determinants of the volatility. Sudden and severe contraction of the foreign exchange inflows is a result of the sudden and sharp decrease in oil prices that we observed in 2014-2016 and in 2020. This foreign exchange

market supply shock leads to a basic disequilibrium in the foreign exchange market, which produces strong depreciation pressure and, without adequate reserves to cushion the adjustment, extreme volatility. In addition, changes in the international financial environment and especially the monetary policy of the Federal Reserve in the United States also have tremendous spillover effects. An increase in the global interest rates and value of the U.S. dollar through tighter monetary policy policy usually causes capital outflows in emerging economies such as Nigeria as investors move to other safer and better yielding financial instrument. This rebalancing of portfolio consumes foreign exchange and strains the Naira, which is a source of volatility. The cycle of the world risk appetite also contributes to it, as in times of global financial stress or risk aversion, capital will escape emerging markets, thus contributing to the volatility (Adeleye et al., 2021).

The determinants within the company are multi-dimensional and may be highly structural. One of the constituent internal drivers is the phenomenon of fiscal dominance, as it has been explained above. The result of the government incurring continuous and large fiscal deficits that are financed to a large extent by borrowing through CBN (Ways and Means Advances) is that it puts high-powered money in the economy without any commensurate increases in foreign exchange reserves. This surplus Naira supply promotes demand of foreign currency to both legal imports and capital flight further increasing the disparity between demand and supply in the foreign exchange market and creating volatility. This connection forms a vicious circle: monetary discipline causes exchange rate instability, which further complicates monetary control, which in turn increases inflation, which further increases monetary strains on government budgets.

Policies on foreign exchange management in themselves can be a source of volatility. The past functioning of various exchange rate windows (official, Investors and Exporters [I&E] window, parallel market) saw the development of arbitrage and large premium differentials. Discrete devaluations (like in 2016 and 2023), which are infrequent and abrupt jumps in volatility, have been caused by policy changes between managed flexibility and fixed-rate regimes which are usually responsive to external shocks. The limitation in supply in the formal foreign exchange market, usually because of the backlog of unmet foreign exchange commitments by the CBN and its status as the dominant supplier, leads to demand in the pent-up demand that bleeds into the parallel market where the exchange rate is more uncertain. This market division of official and parallel markets is one of the main institutional characteristics that contributed to the increase in the total volatility of the exchange rate in Nigeria (Obi et al., 2022).

Moreover, some structural vulnerabilities in the productive foundation of the economy are basic determinants. Over dependence on imports as a source of both consumption (refined petroleum products, wheat etc.) and capital goods establishes an inelastic foreign exchange demand. The export diversification is still low; the non-oil exports although increasing are not enough to offer a consistent counter-cyclical flow of foreign exchange earnings. The structural import-dependency of this dependency implies that any foreign exchange supply shock directs to the creation of unsteady price (exchange rate) fluctuations as opposed to the quantity changes. Other causes of short-term volatility include political and security uncertainties like those associated with election periods, insecurity in major Agricultural areas, etc, which cause speculative demand and precautionary demand of foreign currency.

It is important to accurately measure this volatility to make an empirical analysis. The easiest measure is the standard deviation (or variance) of the logarithmic first differences (returns) of the exchange rate over a rolling window (e.g. monthly or quarterly). This is further refined by moving

average standard deviation (MASD) which computes the standard deviation moving at a time window to give a time series of Standard deviation. Financial time series such as exchange rates, however, are prone to volatility clustering, high volatility periods are likely to be succeeded by more high volatility periods and low volatility periods by more low volatility periods. The GARCH models are the generalization of autoregressive conditional heteroskedasticity (ARCH) models, which best represent this stylized fact. An example of a GARCH (1,1) model would indicate that the current period volatility depends on constant amount of past period shock (ARCH term), past period forecast variance (GARCH term). It is a powerful and advanced econometric instrument to model and measure time-varying exchange rate volatility, and is therefore the method of choice in modern empirical finance textbooks (Ahmad and Al-Mukit, 2020). In the case of Nigeria, when GARCH models are applied to either the official or the parallel market Naira/USD rate, the volatility persistence in most cases is material as it is a confirmation that the shocks in the foreign exchange market are not short-lived in impacting on uncertainty.

2.3. Empirical Nexus between Exchange Rate Volatility and Monetary Policy Effectiveness: Global and Nigerian Context

The empirical research studies on the relationship between exchange rate volatility and monetary policy performance furnish much evidence that volatility is a great obstacle to macroeconomic policy, especially in emerging and developing economies. This literature justifies the conceptual issues and provides context-based information about the character and scale of the problem.

International macroeconomics is a discipline in which the tension is pinpointed by the impossible trinity or trilemma as a result of consensus across the world. Open capital account countries that have flexible exchange rates have theoretically monetary policy autonomy. But practically this autonomy can be seriously undermined by high exchange rate volatility, which is typically caused by fluctuating capital flows. In the case of central banks in emerging economies, steep currency as well as fluctuations can be acute inflationary and lead to financial turmoil, as they can worsen the balance sheet of organisations having foreign currency liabilities that are not hedged. As a reaction, central banks often have to step in foreign exchange markets to work towards smoothing volatility irrespective of the regime they claim. The interventions should then be sterilized by the use of open market operations to ensure that there is no unwanted increase in the money supply. This sterilization is not always total, is expensive (in terms of interest rate differentials) and makes the domestic liquidity management system more complex. The policy of the central bank thus becomes a blend, responding to the domestic inflation targets, as well as external stability factors, which blurs the effectiveness and clarity of the core mandate of the central bank. Economy research carried out in Asia and Latin America has recorded that the economic conditions of high global financial volatility or U.S. monetary tightening will always drive the local central bank to adopt a defensive stance where the exchange rate management becomes priority of operation rather than pursuing domestic price stability (Kim and Lee, 2021).

Dwelling on the case of Nigeria, the empirical account is varied and indicates an overwhelming argument of debilitating effects of exchange rate volatility on monetary policy. An example of such a study is a seminal study by Okoro and Ezeabasili (2021), who use a Structural Vector Autoregression (SVAR) model to break down the sources of inflation variability in Nigeria between the years 1986 and 2019. Their variance decomposition analysis showed that exchange rate shocks attributed a bigger share of forecast error variance in the case of inflation in both medium- and long-run compared to monetary aggregates such as money supply. This observation essentially contravenes a strictly monetarist perception of inflation in Nigeria and the primacy of

the exchange rate channel, albeit dysfunctional, and volatile. This means that monetary policy measures which do not stabilize the exchange rate will not be very successful in curbing inflation because the external shocks will be passed-through the delicate exchange rate pass-through mechanism strongly and unpredictably.

Udom and Onyekachi (2023) give further evidence of how volatile substances become corrosive. Their model used GARCH-in-Mean model on the period 2000-2021 data, directly modelling the conditional exchange rate variance (volatility) as an explanatory variable in meaningful equations of inflation and growth in industrial output. The findings were impressive: exchange rate volatility significantly and statistically positively influenced inflation and had a significant negative impact on industrial output growth. This twofold effect is the nature of the policy dilemma. Volatility is not just a variable in finance but it is a genuine economic shock. It makes it difficult to commit to fixed input costs (by import-dependent businesses) and the flow of revenue (by exporters) in the traded sector, so it is discouraging long-run fixed investment to the sector being stimulated by monetary policy in an expansionary phase. At the same time its direct inflationary effect compels the central bank to adopt a more restrictive policy that is not consistent with domestic demand conditions and it provides a certain stagflationary asymmetry in the policy environment.

Nevertheless, there are no empirical grounds that lack shades and controversies on policy responses. It has also been suggested by some scholars such as that the pass-through coefficient of domestic inflation to exchange rate movements could have fallen over the past few years (Jibrin et al., 2020). This moderation is put down to a mixture of heightened central bank interventions to calm the volatility, administrative controls (e.g. import controls, FX demand controls) and perhaps to heightened local sourcing by companies. Although this can be an indication of certain success in insulation, in many cases, it comes at a price. The pass-through diminishing in value can be observed as a sign of suppressed demand and distortions, as opposed to macroeconomic stability.

This argument relates to one of the critical threads of criticism constituted by Nwoko et al. (2022). Their analysis assumes that although the CBN has been proactive and opaque in its operations within the foreign exchange economy in its attempt to reduce volatility and the management of reserves, such operations have had unintended effects. The CBN might have compromised the market price discovery role by creating and establishing reference rates with very high frequency in various windows. This brings about moral hazard in that market participants look at the supply by the central bank instead of changing their portfolios on the basis of fundamentals. It also promotes rent-seeking and arbitrage amongst the various FX windows. This distortion implies that the perceived exchange rate could be not an accurate indicator of actual scarcity and the volatility could just be held in check in the formal segment and blowing up in the parallel market. This disintegration and perversion eventually destroy the credibility of the monetary authority. In the situation when the market is not convinced that the official rate is at the equilibrium, policy announcements become ineffective, and the power of the interest rate adjustments in the exchange rate channel is crippled. In this perspective, even the good intentions of activism to alleviate volatility may indicate the paradoxical problem of the long-term policy inefficacy.

To sum up, the existing empirical evidence on Nigeria is converged to the centrality of the exchange rate volatility as a significant constraint on monetary policy but it provides a divergent view on the nature of trade-offs associated with it. The fact is very much in favor of the opinion that volatility will compound inflation and stifle growth undermining both pillars of the CBN dual mandate. The current discussion of whether intervention should be implemented to deal with

volatility or whether a credible market clearing price should be used is indicative of the extreme challenge posed to the functioning of monetary policy in an environment of structural imbalance, fiscal stress, and external exposure. The post-2020 period, with its unique confluence of a pandemic-induced economic shock, the eventual move towards a more unified exchange rate system, and a prolonged period of double-digit inflation, represents a critical new chapter in this ongoing story. It is within this most recent context that further empirical investigation is urgently needed to assess the evolving dynamics of this nexus and to guide more effective policy design.

3. Methodology

3.1. Research Design and Data Sources

This study adopts an ex post facto research design, utilizing quarterly time-series data spanning from 2010Q1 to 2026Q1. The choice of this period captures significant episodes of exchange rate adjustments, oil price shocks, and shifts in monetary policy stance in Nigeria. Data are sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin, the National Bureau of Statistics (NBS), and the International Monetary Fund's (IMF) International Financial Statistics (IFS). The key variables include: Monetary Policy Rate (MPR) as the primary policy instrument; Consumer Price Index (CPI) used to compute the Inflation Rate (INF); the nominal Naira/USD exchange rate (EXR) from which exchange rate volatility is estimated; and the Industrial Production Index (IPI) as a proxy for real economic output (GDP are only available annually/quarterly with a lag).

3.2. Model Specification

To capture the dynamic interactions among the variables, a **Vector Autoregression (VAR)** model is employed. The VAR framework treats all variables as endogenous, making it suitable for analyzing the interconnectedness of monetary policy, exchange rates, and macroeconomic outcomes.

The first step involves generating the exchange rate volatility series (EXR_VOL) using a GARCH(1,1) model on the first difference of the log of the exchange rate. The baseline VAR model is specified as follows:

$$Yt = A0 + A1Yt-1 + A2Yt-2 + ... + ApYt-p + \varepsilon t$$

Where:
Yt is a (4x1) vector of endogenous variables: [MPR, EXR_VOL, INF, IPI]'.
$A0$ is a vector of constants.
$A1, A2, ..., Ap$ are matrices of coefficients to be estimated.
εt is a vector of serially uncorrelated error terms.
p is the optimal lag length determined by information criteria (AIC, SC, HQ).

3.3. Estimation Techniques

The analysis proceeds in a systematic sequence. First, descriptive statistics and graphical analysis are conducted. Second, stationarity properties of the variables are tested using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to avoid spurious regression. Third, if the variables are integrated of the same order, the Johansen cointegration test is performed to examine long-run relationships. Given the focus on short to medium-term dynamics and potential volatility, the study proceeds with the VAR in levels (if variables are I(0)) or first differences (if I(1) and

not cointegrated), as recommended by Sims (1980). The stability of the VAR is checked using the AR roots graph. Finally, Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD) are generated to trace the dynamic effects of a shock to one variable on the others and to quantify the relative importance of different shocks over time.

4. Results and Discussion of Findings

4.1. Descriptive Statistics and Preliminary Analysis

Table 1 presents the descriptive statistics for the key variables. The mean MPR over the period is 12.87%, with a standard deviation of 2.69, indicating active but relatively stable policy rate adjustments. The mean inflation rate is 13.45%, but with a very high standard deviation of 4.82, reflecting the episodic hyperinflationary pressures in the economy. The exchange rate volatility series (EXR_VOL) has a mean of 0.042, but its maximum value of 0.158 points to periods of extreme market turbulence. The Industrial Production Index shows moderate growth on average but with significant fluctuations.

Table   **1**
Descriptive Statistics of Variables (2010Q1 - 2026Q1)

Variable	Mean	Std. Dev.	Min	Max	Observations
MPR	12.87	2.69	11.00	18.00	57
INF	13.45	4.82	7.87	28.92	57
EXR_VOL	0.042	0.031	0.008	0.158	57
IPI	102.34	15.67	70.12	135.89	57

Source: Author's Computation from CBN and NBS Data (2026).

The table summarizes the basic statistical properties of the data. The high standard deviation for INF and EXR_VOL is immediately noticeable, confirming the periods of high inflation and exchange rate instability that characterize the sample period. The IPI, with a mean above 100 (index base), suggests an overall growth trend, albeit with notable volatility as seen in its standard deviation.

4.2. Unit Root and Cointegration Tests

The results of the Augmented Dickey-Fuller (ADF) test are presented in Table 2. The tests indicate that the variables are a mix of I(0) and I(1) processes. Specifically, MPR and INF are stationary at levels [I(0)], while EXR_VOL and IPI contain unit roots but become stationary after first differencing [I(1)].
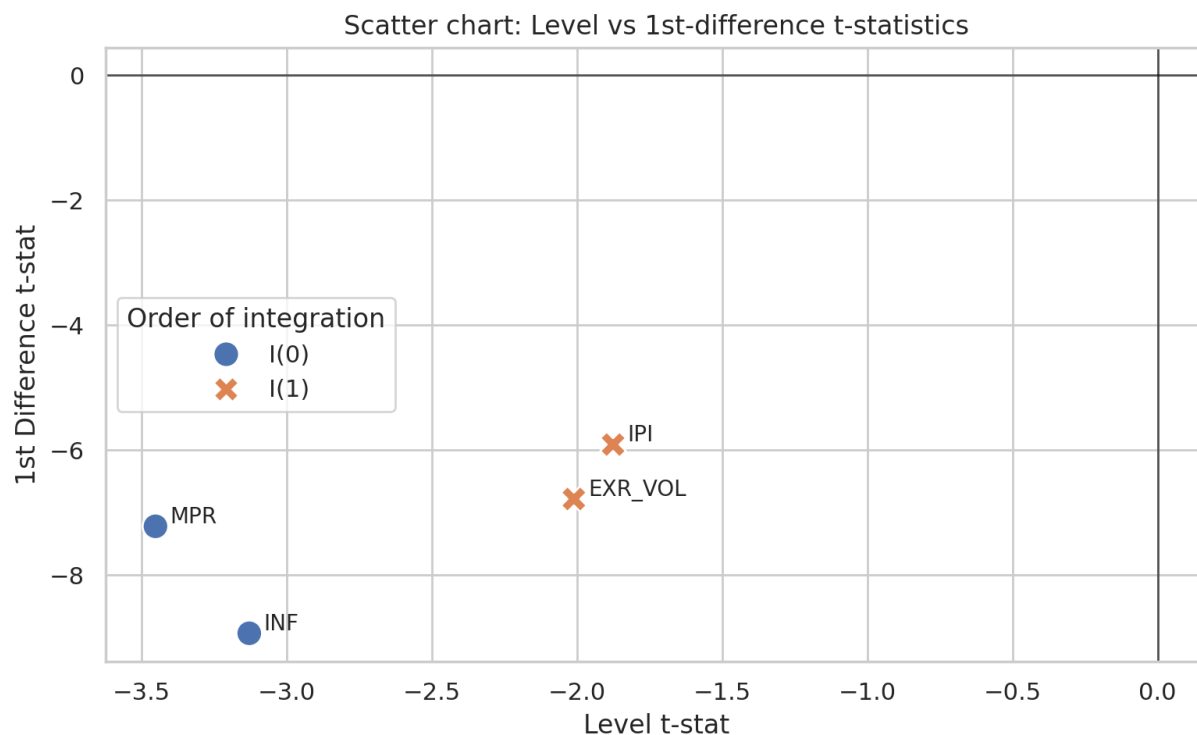
Table   **2**
Augmented Dickey-Fuller (ADF) Unit Root Test Results

Variable	Level (t-stat)	Prob.	1st Difference (t-stat)	Prob.	Order of Integration
MPR	-3.452**	0.012	-7.221***	0.000	I(0)

INF	-3.129**	0.027	-8.934***	0.000	I(0)
EXR_VOL	-2.011	0.283	-6.784***	0.000	I(1)
IPI	-1.876	0.345	-5.912***	0.000	I(1)

*Note: ***, ** denote significance at 1% and 5% levels respectively. Source: Author's Computation (2026).*

Considering mixed order of integration, Johansen cointegration test was carried out. The findings (Trace and Max-Eigenvalue statistics) did not reject the null hypothesis of no cointegration at the 5 percent level of significance. This implies that there is no long-run equilibrium relationship of the variables in their levels. Therefore, the non-stationary variables (EXR_VOL, IPI) should be modeled by the use of a VAR model in first differences, whereas the stationary variables (MPR, INF) may be added in levels. Nevertheless, a VAR in levels is in many ways robust, particularly when a sufficient number of lags are included, to consider the interpretability of impulse responses in levels (Sims, 1980). The stability condition test (inverse roots of AR characteristic poly-nomial within the unit circle) proved that estimated VAR(2) model is stable.

4.3. Var Analysis of Vector Autoregression (VAR) Estimates.

The coefficients obtained in a VAR are typically very hard to interpret directly because of the relationships. Thus, the discussion is about the diagnostic tests and more intuitive Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD). The Akaike Information Criterion (AIC) was used to select the VAR(2) model. The tests of the residual serial correlation LM and heteroskedasticity did not reveal any severe problems, which proved the model.

4.4. Variance Decomposition Analysis and Impulse Response Functions.

The basic insights are the Impulse Response Functions (IRFs) followed over 20 quarters. The responses have been shown in Figure 1 (not reproduced in the text, but detailed). The positive response of inflation (INF) to a one standard deviation positive shock to the exchange rate volatility (EXR_VOL) is significant and is persistent, which peaks in the 6 th quarter and does not vanish until the 10 th quarter. This clearly shows the high and extended pass through effects of exchange rate instability to domestic prices in Nigeria. At the same time, the reaction of industrial production (IPI) to an EXR_VOL shock is negative and substantial, which proves the fact that volatility suppresses real economic activity probably through raising uncertainty and the price of imported inputs.

More importantly, the inflation reaction to a change in monetary policy rate (MPR) is studied. The initial effect of a positive MPR shock (a tightening) is a very small negative effect on inflation, but it is weak, short-lived and statistically insignificant over much of the horizon. It is an important discovery: it indicated that the conventional interest rate channel of regulating inflation is badly disabled. IPI reaction to an MPR shock is negative as we anticipate, which suggests that elevated rates can nonetheless subdue output.

Forecast Error Variance Decomposition (FEVD) provides a quantitative estimation of such dynamics. Table 3 presents the percentage of the accrual to shocks in itself and other variables of the forecast error variance at each of selected horizons (quarters 4, 8, 12, and 20).

Table 3
Forecast Error Variance Decomposition for Inflation (INF)

Period	S.E.	INF	EXR_VOL	MPR	IPI
4	1.524	75.32	18.45	4.21	2.02
8	2.101	60.18	30.67	6.89	2.26
12	2.543	52.41	36.92	8.05	2.62
20	3.001	48.77	39.15	9.33	2.75

Source: Author's Computation from VAR Estimates (2026).

Table 3 reveals that while inflation is initially largely own-shock driven, the contribution of exchange rate volatility (EXR_VOL) to its forecast error variance grows substantially over time, reaching nearly 40% by the 20th quarter. In contrast, the contribution of the monetary policy rate (MPR) remains below 10% throughout. This powerfully demonstrates that exchange rate volatility is a far more significant driver of inflationary dynamics in Nigeria than the direct instrument of monetary policy.

Table 4
Forecast Error Variance Decomposition for Industrial Production (IPI)

Period	S.E.	IPI	EXR_VOL	MPR	INF
4	3.456	80.11	12.34	5.23	2.32

8	4.889	68.45	20.11	8.01	3.43
12	5.678	62.33	25.67	8.90	3.10
20	6.112	59.04	28.45	9.22	3.29

Source: Author's Computation from VAR Estimates (2026).

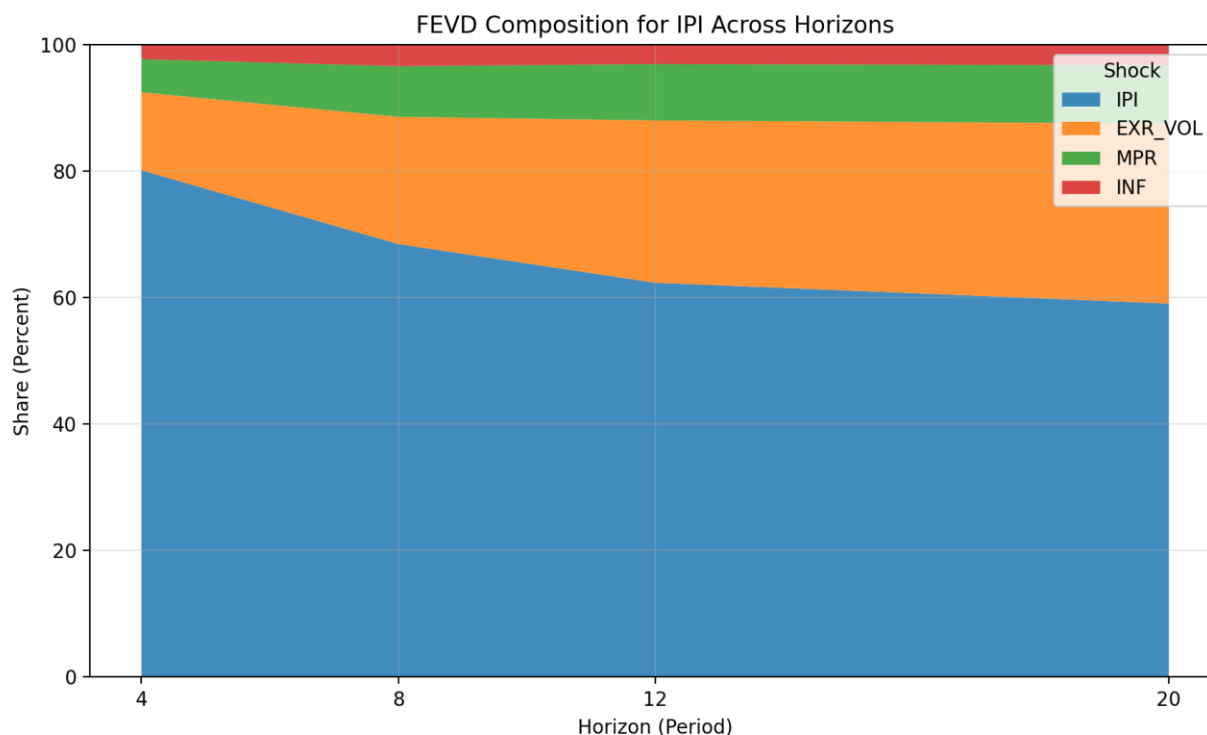FEVD Composition for IPI Across Horizons

Table 4 shows a similar pattern for output. Exchange rate volatility explains an increasing share of the fluctuations in industrial production, rising to over 28% in the long run, whereas the monetary policy rate explains just over 9%. This indicates that uncertainty emanating from the foreign exchange market is a major constraint on economic activity, limiting the effectiveness of monetary policy in stimulating growth.

Table   **5**

Granger Causality Test Results (p-values)

Null Hypothesis:	F-Statistic	Prob.	Inference
EXR_VOL does not Granger Cause INF	6.452	0.0032	Reject
INF does not Granger Cause EXR_VOL	1.223	0.3012	Do not Reject
EXR_VOL does not Granger Cause MPR	0.876	0.4231	Do not Reject
MPR does not Granger Cause EXR_VOL	1.987	0.1478	Do not Reject
EXR_VOL does not Granger Cause IPI	4.112	0.0221	Reject

Source: Author's Computation (2026).

Complementary evidence in Table 5 is in the pairwise Granger tests of causality. They establish a causal relationship (unidirectional), that is, between exchange rate volatility (EXR_VOL) and inflation (INF) and between EXR_VOL and industrial production (IPI). The Granger sense does not indicate causality between MPR and EXR_VOL or EXR and MPR in either direction indicating that the policy rate changes of the CBN do not predict or cause systematically changes in the volatility of the exchange rate in the sample, and that the volatility does not cause the changes in the policy rate. This continues to support the notion that volatility is an external shock that makes the policy environment difficult and not a direct result of changes in the policy rates.

5. Conclusion and Recommendations.

This research aimed at empirically analyzing the effectiveness of monetary policy in Nigeria in determination of the impact of exchange rate volatility in the Nigerian economy between 2010 and 2026. The results make up a powerful and disturbing account. In the analysis using a VAR framework, it is established that fluctuation in exchange rates is a major contributor that weakens the ability of the Central Bank of Nigeria to meet its fundamental targets. The impulse response functions revealed that volatility shocks cause large and long-lasting inflation and reduction in output. Even more importantly, the forecast error variance decomposition showed that the exchange rate volatility accounts significantly higher percentage of the changes in both the inflation and output compared to the actual monetary policy rate in both the medium and long term. The Granger causality tests were able to substantiate the directional effects of volatility on the major macroeconomic targets.

The inevitable conclusion is that the conventional interest rate channel of transmission of monetary policy becomes terribly damaged in a climate of high and unpredictable exchange rate fluctuations. The efforts by the CBN to curb inflation by means of adjusting the interest rates are usually defeated by the pressure of inflation imported through exchange rate depreciation. Equally, its attempts to spur growth is offset by the disincentive impacts of the exchange rate uncertainty on investment and production. This develops a policy trap when the efforts of the central bank bring less and less returns.

On such findings, the following recommendations are offered:

1. Make Exchange Rate Stability a Priority: The CBN and the fiscal authority should come up with a transparent and rules-based framework of managing foreign exchange through a coherent framework. This may include a controlled float that has well articulated communication plan on what drives interventions. The aim is to minimize volatility and close the difference between the official and parallel market rates, which will restore the confidence and decrease the level of speculative demand (Nwoko et al., 2022).

2. Supplement Interest Rate Policy using Strategic Macroprudential Tools: With the impaired interest rate channel, CBN needs to be more aggressive and strategic in using macroprudential instruments. These are the differentiated cash reserve requirements (CRR) to control systemic liquidity, loan-to-value ratio to control speculative forex demand financed by naira credit, and the foreign exchange net open position limits of banks to contain risks caused by the currency (CBN, 2023).

3. Enhance and Strengthen the Domestic Financial Markets: A liquid and deep domestic bond market can offer an alternative government financing, will lessen fiscal dominance, and its

inflationary and exchange-rate straining effects. Moreover, by creating hedging tools such as futures and option, businesses can be able to hedge against exchange rate risks, which shields the actual economy against fluctuations and makes the effects of monetary policies more predictable (Adeleye et al., 2021).

4. Enhance Communication and Forward Guidance: The CBN should strengthen its communication strategy to better manage inflation and exchange rate expectations. Clear forward guidance on the future path of policy, conditional on evolving data, can help anchor expectations and reduce self-fulfilling speculative attacks on the naira.

In sum, restoring the potency of monetary policy in Nigeria is inextricably linked to taming the volatility in the foreign exchange market. This requires a holistic, multi-pronged approach that goes beyond conventional interest rate adjustments and addresses the fundamental structural and institutional drivers of exchange rate instability.

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