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Assessing the Impact of Multiple Exchange Rates on Macroeconomic Stability: Implications for Exchange Rate Unification in Nigeria

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Abstract

This study investigates the impact of Nigeria's multiple exchange rate volatilities on macroeconomic stability, focusing on implications for exchange rate unification. Using GJR-GARCH (1,1) models and a structural VAR (SVAR) framework, we analyze Naira/US$ exchange rates across official, interbank, and bureaux de change markets from January 2010 to December 2022. Results show significant volatility clustering, particularly in the BDC market, where past volatility strongly influences current rates. Depreciation of the Naira leads to short-term volatility increases, which neutralize over time. The SVAR analysis reveals that exchange rate volatility in the BDC market has the most significant impact on inflation and lending rates, while shocks in the official and interbank rates are more predictable with milder long-term effects. The variance decomposition highlights that exchange rate volatility is driven primarily by its own shocks in the short term, with the influence of macroeconomic fundamentals, like real GDP and money supply, growing over time. These findings support the Central Bank of Nigeria's policy to unify exchange rates, which would reduce discrepancies, improve transparency, and stabilize the forex market. However, long-term stability requires broader reforms to strengthen macroeconomic fundamentals, particularly real GDP growth.

Keywords: Exchange rates, Asymmetric, GARCH, Variance Decomposition

JEL: F31, F41, C58, O55

1. Introduction

An economy's capacity to maintain macroeconomic stability is greatly impacted by the existence of numerous exchange rates, which may lead to market inconsistencies, economic distortions, corruption, and rent-seeking behaviour (Reinhart & Rogoff, 2004). According to Ghosh, Ostry, and Qureshi (2014), this

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approach often causes the official exchange rate to be overvalued, which hurts export competitiveness and contributes to trade imbalances. Cost differences between importing raw materials and selling finished goods are passed on to consumers, thereby intensifying inflationary pressures (Mishkin, 2007). In addition, since exchange rate regulations are unpredictable, having several exchange rates erodes investor trust and discourages long-term investment (Foot, 1990). Furthermore, there are limitations on the central bank's capacity to carry out effective monetary policy, which makes managing the money supply and inflation more difficult (Fischer, 2001). Additionally, it might result in the misallocation of foreign currency, leading to current account deficits and depleted foreign reserves, thereby raising concerns about the balance of payments (Edwards, 1993).

Like many other developing and emerging economies, Nigeria has grappled with exchange rate instability due to a multiple exchange rate system, where several currency rates coexisted, undermining the value of its currency and straining its foreign reserves. The best evidence for this is the Central Bank of Nigeria's (CBN) incapacity to defend the naira against the dollar and other major currencies to which it is pegged, mostly because of the need of preserving macroeconomic stability and the bank's quick depletion of reserves. Although it is seen to be vital to maintain a suitable exchange rate system, doing so is not a sufficient requirement to meet targeted macroeconomic goals. For growth constraints in an economy to be removed, exchange rates must be stable and properly aligned (Cottani, Cavallo, and Khan, 1990). In order to attain stability in the foreign currency market, the CBN introduced multiple exchange rates under the managed float exchange rate regime between 2014 to mid-2023. The purpose of the multiple exchange rates was to allocate foreign exchange to exporters and SMEs under different foreign exchange rate windows such as the CBN exchange rate window, the Investor & Exporter (I&E) exchange rate window, and the Bureau de change (BDC) exchange rate window. This was aimed at preserving the value of the domestic currency, maintain a favourable external reserves position and ensure external balance without compromising the goal of maintaining internal balance and macroeconomic stability.

Despite concerted efforts by the CBN to stabilize exchange rates, the Nigerian Naira (NGN)[1] continued to experience significant fluctuations against the US dollar across all exchange rate windows. This volatility was exacerbated by the volatilities that have characterised global oil prices since 2014, exposing Nigeria's economy to heightened vulnerability to external shocks. As highlighted by Hausmann, Pritchett, and Rodrik (2006), developing countries such as Nigeria tend to exhibit greater real exchange rate volatility compared to developed nations due to their increased susceptibility to external shocks. Moreover, the sustainability of exchange rate stability achieved through CBN interventions has been called into question due to the looming threat posed by declining accretion of oil revenue to foreign exchange reserves. The wide depreciation of the Naira further exacerbates exchange rate volatility, underscoring the profound macroeconomic implications of the existence of multiple exchange rates.

[1] The official currency of Nigeria

To promote transparency and price discovery in the foreign exchange market, among other benefits[2], in June 2023, the Central Bank of Nigeria (CBN) announced a significant policy shift by unifying all segments of the forex exchange (FX) market. This move marked a departure from the long-standing practice of maintaining multiple exchange rates. In light of these changes and the shift towards exchange rate unification, it is crucial to examine the implications of this policy shift on Nigeria's economy. Thus, the questions that remain pertinent and which become the study's hypothesis are: How do the dynamics of exchange rate volatility differ across exchange rate markets before the recent exchange rate unification policy? To what extent does the volatility of exchange rates impact macroeconomic stability, and what consequences do they have for the exchange rate unification policy?

In light of the above, this study assessed the impact of multiple exchange rates on Nigeria's macroeconomic stability, with implications for the exchange rate unification policy. Specifically, it evaluates the dynamics of exchange rate volatility across three segments of the Nigerian foreign exchange market—the official exchange rate, interbank market, and bureau de change (BDC) sector. Nevertheless researchers have shown considerable interest in examining the relationship between exchange rate volatility and macroeconomic indicators like economic growth, stock market, inflation, trade, oil, amongst others, in Nigeria, revealing diverse findings depending on the specific macroeconomic variables analyzed and the methodologies employed (see Okafor, 2024; Gbadebo, 2023; Isah and Ekeocha, 2023; Umaru et at., 2018; Ehikioya, 2019; Etale and Ochuba, 2019; Oluwaseyi et al.2015; Akpan and Atan, 2011; Aliyu, 2010). Additionally, others like Oyinlola (2018) and Ohwadua and Akanji (2023) measured the persistence of exchange rate volatility in dual foreign exchange windows - Interbank Foreign Exchange Market (IFEM) and Bureau De Change (BDC) Market rates. Unlike previous studies, which focused primarily on the current impact of official exchange rates or dual exchange rates, this study explores how past exchange rate shocks influence current and future volatility across three segments of the Nigerian foreign exchange market, with an emphasis on the asymmetric impacts captured by the GJR-GARCH model[3]. It also examines the effects of exchange rate volatility on five key macroeconomic variables: inflation, lending rates, money supply, foreign reserves, and Real GDP through the structural VAR (SVAR) approach. By utilizing both GJR-GARCH and SVAR models, the study captures both asymmetrical volatility responses and the broader macroeconomic implications through impulse response analysis and variance decomposition. Furthermore, this research is the first to empirically analyze the implication of Nigeria's now-abolished multiple exchange rate system on exchange rate unification, filling a crucial gap in understanding the long-term macroeconomic consequences of this regime.

The study, using GARCH models, reveals significant volatility dynamics in Naira/US$ exchange rates across Nigeria's official, interbank, and bureaux de change (BDC) markets, with the BDC market showing the highest levels of volatility clustering. Past

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2 See Ozili (2024) for benefits of exchange rate unification

3 GJR-GARCH model refers to Glosten-Jagannathan-Runkle Generalized Autoregressive Conditional Heteroskedasticity (GJR-GARCH) model used to evaluate asymmetric shocks.

volatility has a greater impact on current rates in the BDC market, and depreciation triggers more short-term volatility than appreciation. These results support the hypothesis that exchange rate volatility, especially in the BDC market, has significant and lasting impacts on inflation and lending rates. The SVAR model's impulse response function indicates that BDC market volatility significantly affects key macroeconomic variables like inflation and lending rates, while shocks in the official and interbank markets are more predictable and have less severe long-term impacts. Short-term volatility is largely driven by exchange rate mechanisms themselves, though macroeconomic fundamentals, such as real GDP and money supply, become more influential over time.

Following the introductory section, the remainder of the paper is structured as follows: Section two presents a review of the theoretical and empirical literature. Section three outlines the methodology and data sources, providing an overview of the modelling procedures for exchange rate volatility using the asymmetric GJR-GARCH (1,1) models. This section also explains and specifies the structural VAR approach used to model the relationship between multiple exchange rates and macroeconomic aggregates. Section four details the empirical results, while section five discusses the findings. Finally, section six concludes the paper.

2. Literature Review

The theoretical literature on the pass-through effect of exchange rate volatility has remained a subject of debate due to its effects on macroeconomic aggregates of developing countries. Theoretical literature like the study by Obstfeld and Rogoff (1998) opined that persistent exchange rate fluctuations are detrimental to macroeconomic stability of developing economies. This situation holds since developing countries experience a stronger volatility of the exchange rate than developed countries due to their exposure to real and nominal shocks (Hausmann, Pritchett, and Rodrik, 2006). Thus, Obstfeld and Rogoff (1998) theoretically establish that exchange rate volatility is detrimental to the domestic economies directly or indirectly. Directly, exchange rate volatility affects economic agents by reducing the ability to smooth consumption for productive or leisure purpose. The indirect effect makes firms to set higher prices as premium risks against exchange volatility. Kandil (2004) established that economic openness makes exchange rate volatility detrimental to output growth and inflation. While Eichengreen (2008) and Holland et al. (2011) posit that the severity of exchange rate volatility determines its impact on economic growth.

Furthermore, the discussions on the impact of multiple exchange rates though have long wound down in modern economies, such practices remained commonplace in developing countries through the 1980s and 1990s and into the present. According to Reinhart & Rogoff (2004), Multiple exchange rates cause market inconsistencies, economic distortions, corruption, and rent-seeking behaviour, all of which have a substantial negative influence on an economy's ability to sustain macroeconomic stability. A system like this often leads to an official exchange rate that is overpriced, which reduces export competitiveness and creates trade imbalances (Ghosh, Ostry, & Qureshi, 2014). The misallocation of foreign currency resources exacerbates balance of payments problems by resulting in current account deficits and diminished foreign reserves (Edwards, 1993). Ultimately Reinhart & Rogoff (2014) showed that any exchange rate classification algorithm that does not differentiate between unified rate systems (characterized by a single official exchange rate without a significant black or parallel market) and all other systems is fundamentally flawed.

A number of empirical studies in the literature establish different effect of exchange rate volatility on the macroeconomy. Alagidede and Muazu (2016) analysed the effect of exchange rate volatility on economic growth proxy by per capita GDP growth rate in Ghana. The study uses the Generalised Methods of Moments (GMM) technique with data for the period of 1980 to 2013. Their findings shows that exchange rate volatility has a negative significant impact on economic growth, thus suggesting its inhibiting effect on Ghana's economic growth. A similar analysis was carried out for six West African countries including Nigeria and Ghana by Umaru et at., (2018). The study adopts the Pooled Ordinary Least Squares, Fixed Effect, and Random Effect techniques with data covering the period of 1980 to 2017. In the selected countries, exchange rate volatility was deleterious to economic growth evidenced in the negative significant relationship. Ehikioya (2019) investigates the impact of exchange rate volatility on Nigeria's economic growth using monthly data from January 1980 to December 2017. The analysis was carried out with the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) and GMM techniques. Empirical findings reveal the persistence of exchange rate volatility across time and has a negative significant impact on Nigeria's economic growth.

Studies from developed countries also show similar outcome to what is obtained in developing countries. Morina et al, (2020) finds that the exchange rate volatility has a significant negative effect on the economic growth of Central and Eastern European Countries. The study examined the effect of exchange rate volatility on economic growth using the fixed effect panel estimation technique for the period 2002 to 2018. Their results were consistent across different measures of exchange rate volatility adopted in the study. Besides the economic growth impact of exchange rate volatility, extant studies in the literature also examined the impact of exchange rate volatility on other macroeconomic aggregates. For instance, Ozturk (2006) carried out a literature survey on the effect of exchange rate volatility and trade. A significant number of studies reviewed reveals that excessive exchange rate volatility is detrimental to trade growth. The empirical results obtained by Aliyu (2010) also confirmed that domestic exchange rate volatility has a negative and significant impact on non- oil export in the period 1986 quarter 1 to 2006 quarter 4. The analysis was performed using a Vector Error Correction (VEC) model.

In the case of Nigeria, Etale and Ochuba (2019) examined the effect of exchange rate volatility economic growth in Nigeria using a multiple regression analysis. The analysis span from period 2000 to 2017. Contrary to previous studies, the study finds that exchange rate volatility has a significant positive effect on economic growth. Akpan and Atan (2011) analysed the effect of exchange rate fluctuation on Nigeria's real output growth with the aid of a GMM technique. They found no direct relationship between exchange rate fluctuations and real output growth. Oluwaseyi et al. (2015) investigates the impact of exchange rate volatility on investment, interest rate, inflation and economic growth in Nigeria using the VEC method. Their period of analysis was from 1986 to 2014. First, their findings established an existence of a long-term relationship between exchange rate volatility and the macroeconomic aggregates selected. Also, exchange rate volatility has a negative and significant impact on investment and growth, but a positive impact on inflation and interest rate. The study by Bello et al. (2022) where the non-linear Generalised Autoregressive Distributive Conditional Heteroscedasticity (GARCH) model was used, reveals persistent volatility in exchange rate movement in Nigeria from 1986Q1 to 2019Q4. However, Okafor (2024) reveals that short-term exchange rate volatility negatively impacts money supply, while long-term volatility positively affects money supply and inflation rates, with both effects occurring in different time frames.

Other than the studies above, empirical evidence also indicates that exchange rate movement could occur from macroeconomic structural shocks resulting in its volatility. For instance, the study by Liu (2021) examined macroeconomic and financial uncertainty on China's foreign exchange stability using the latent threshold time-varying model (LT-TVP-VAR). The study, which uses monthly data from August 2005 to December 2017, indicates that monetary and financial uncertainty moderates' pressure on exchange rate appreciation; but at the depreciation stage of the domestic currency, both uncertainties strengthened the exchange market pressure. Similarly, Yousaf and Mukhtar (2023) revealed that macroeconomic shocks engender a significant behaviour in exchange stability in developing countries. Their framework was based on SVAR panel data analysis across 84 developing countries for the period of 1991 to 2020. The study by Antwi et. al. (2020) uses the VAR framework to analyse the impact of macroeconomic variables on Ghana's exchange rate behaviour. The empirical findings show a significant effect of GDP on exchange variability, with inflation rate, lending rate and money supply having no direct effect in the period 2000 to 2019.

Furthermore, many studies have recognized the use of SVAR in examining the effect of structural shocks on macroeconomic variables. For instance, Salehi, Behname, and Adibian (2021) and Afonso and Gonçalves (2021) have dwelled on structural shocks using SVAR to capture how structural shocks affect some key macroeconomic variables. The study by Verma and Bansal (2021) on the impact of macroeconomic variables on the performance of stock exchange also underscored the importance of incorporating a range of macroeconomic factors study of this nature.

Finally, the studies reviewed above showed a mixed impact of exchange rate and/or its volatility across macroeconomic aggregates like economic growth, inflation, trade, amongst others. While existing studies mostly focused on overall impact of exchange rate or its volatility on economic growth or combinations of macroeconomic aggregates, only few considered the distortionary impact of multiple exchange rates on macroeconomic stability and its potential implications for unified exchange rate. Asserted in the literature, the operation of multiple exchange rates could have differential effects on macroeconomic stability, especially in a developing country like Nigeria, hence the need for this research.

3. Methodology

3.1. Data Sources and Construction

The study utilizes the monthly time series data consisting of 156 observations on exchange rate, inflation rate, money supply, foreign exchange reserve, interest rate and real GDP. The data were obtained from the Central Bank of Nigeria's (CBN) statistical bulletin as well as the CBN's website (www.cenbank.org), covering the period of January 2010 through December 2022. In order to use monthly real GDP as a target variable for the economic activity index, we convert the quarterly GDP into monthly series using a linear interpolation method as provided by the E-VIEW statistical package. The strategy was chosen because it avoids the high disparities that are most likely to result in exposure misclassification.

For the exchange rate, we use data that consists of three-monthly Naira/US$ exchange rates found in three segments of the Nigeria Foreign Exchange Market, namely Wholesale Dutch Auction System (WDAS), Inter-bank Foreign Exchange Market (INTB) and Bureau de Change (BDC). The nominal exchange rates (N/US$) covered the monthly exchange rate of WDAS, interbank rate and BDC from January 2010 to December 2022, totalling 156 observations. The focus of the research is on the deregulated era of the Nigerian foreign exchange market, when the Central Bank of Nigeria (CBN) established an Autonomous Foreign Exchange Market (AFEM) for the sale of foreign exchange to end-users through selected authorized dealers at a market-determined exchange rate. Monthly exchange rate data from the three market groups were converted to monthly exchange rate returns, which were stated as:

$$r_t = \ln\left(X_t / X_{t-1} \right) * 100 \quad (1)$$

Where X_t is the current period spot exchange rate is X_{t-1} is the preceding period spot exchange rate, r_t is the current period spot exchange rate returns and $\ln$ is natural logarithm. Natural lognormal is preferred as it computes continuous compound returns.

The money supply $(M2)$ variable is proxied by broad money measured on monthly basis in millions of naira. The output variable refers to real GDP $(RGDP)$ measured on annual basis in millions of local currencies (naira). The inflation variable (INF) is the annual percentage change in the consumer price index and used to proxy macroeconomic (in) stability. Foreign external reserve (RES) is measured on monthly basis in million US$. The prime lending rate is considered as the effective interest rate (LDR) The full definition of variables is provided in the appendices.

3.2. Empirical Model Specification

3.2.1. Modelling exchange rate volatility

Before we examine how various macroeconomic aggregates respond to exchange rate, we used the GARCH methodology to model exchange rate volatility. Financial time series, such as the exchange rate, differ from normal time series in that they involve volatility clustering, a leptokurtic distribution, and the leverage effect. The leverage effect or the asymmetric quality of financial time series data is amplified during a financial shock like the 2007-2008 global financial crisis or pandemic, such as the COVID 19 pandemic, making it impossible to model and analyze the volatility of, say, an exchange rate series using traditional methods (variance or standard deviation). These methods are absolute and cannot conceive the characteristics of financial data (time series) like volatility clustering, asymmetries, leverage effect and long memory. Hence, the need to strengthen the time varying volatility models such as the ARCH (Autoregressive Conditional Heteroskedastic) or GARCH (Generalized Autoregressive Conditional

Heteroskedastic) (Rastogi, 2014; Yousef, 2020) with asymmetric models.

To model and compare volatility of the different exchange rates, specifically, Naira/US$ official exchange rate, interbank rate and the BDC we use symmetric GARCH (1,1) models as well as the asymmetric GJR-GARCH (1,1) models introduced by Glosten, Jagannamthan, and Runkle (1993) in the framework of Bollerslev (1986). This framework is based on Engle's (1982) ARCH model. The GJR-GARCH (1,1) model is a simple extension of standard GARCH, which allows the conditional variance to have a different response to past positive and negative shocks. As a first step toward modeling volatility, the conditional mean must be correctly and sufficiently specified; otherwise, consistent estimates of the true conditional variance would be impossible to construct, and statistical inference and empirical analysis would be incorrect (Rachev, et al. 2007). As a result of this, the conditional mean model is specified thus:

$$r_1=\varnothing+\delta r_{t-1}+\varepsilon_t \quad (2)$$

Where r_t are returns of time series at time t, $\varnothing$ is the mean value of the returns, δ is the coefficient of AR (p) term in the mean equation that accounts for serial correlation in the exchange rate return, ε_t is the error term, which is assumed to be normally distributed with zero mean and conditional variance σ_t^2. The conditional variance equation models are specified as follows:

$$\sigma_t^2=\omega+\alpha_1\varepsilon_{t-1}^2+\beta_1\sigma_t^2\varepsilon_{t-1} \quad (3)$$

$$\sigma_t^2=\omega+\alpha_1\varepsilon_{t-1}^2+\beta_1\sigma_t^2\varepsilon_{t-1}+\gamma_1 I_{1-1}\mu_{t-1}^2 \quad (4)$$

With I being an indicator function that expressed by

$$I_{t-1}=\begin{cases}1 & when\ \mu_{t-1}^2<0\ \ (positive\ shock)\\ 0 & when\ \mu_{t-1}^2\geq 0\ \ (negative\ shock)\end{cases}$$

where ω denote the constant variance that correspond to the long run average, α_1 is the first order ARCH term which transits volatility news from the previous period, and β_1 represents the first order GARCH term, which is new information that was not available when the previous forecast was made (Engle & Patton, 2001), γ_1 is the GJR-GARCH asymmetric coefficient that represent leverage effects and asymmetric effects of shocks on the Naira/US$ exchange rates volatility. The condition for non-negativity is $\omega<0$, $\alpha_1>0$, $\beta_1\geq 0$ and $\alpha_0+\gamma\geq 0$..

The p -value and t -statistics are used to test the statistical significance of the conditional variance parameters. The p -value of parameters should be greater than the chosen 5% significance level under the null hypothesis of no volatility clustering in the Naira/US$ exchange rates, and computed t -statistics should be less than theoretical t (±1.96). The sum of α_1 and β_1 indicates volatility clustering persistence and ranges from 0 to 1. The closer ($\alpha_1+\beta_1$) to 1, the more persistent volatility clustering is. The presence of asymmetric effects was investigated using the GJR-GARCH (1, 1) model of Eq. (3) and the sign and significance of the coefficient. A zero coefficient would imply that positive and negative shocks of the same magnitude have the same effect on Naira/US$ volatility. If γ=0, the effect of a shock is asymmetric. If the coefficient is positive, negative shocks produce more volatility in the near future than positive shocks. Conversely, a negative coefficient would suggest the opposite, although such a result is generally less common in financial time series.

3.2.2. Modelling Multiple Exchange Rate – Macroeconomic Aggregates Relationship

After modelling exchange rate volatility, the next step is to analyze how macroeconomic shocks affect the three different exchange rate measures (OFFR, INTBR, BDCR). For this, an 8-variable VAR model will be estimated, including the three exchange rate measures along with five key macroeconomic variables: inflation, lending rate, money supply, foreign reserves, and real GDP. This setup allows us to investigate the dynamic responses of exchange rates and macroeconomic variables to various shocks.

One common method used in the macroeconomic literature to consider the interdependence of relationships between variables is to build vector autoregressive models (VAR). This method is appropriate for dealing with structural changes and testing the long-term policy implications. The VAR method is used in recent literature to trace out the isolated impact of shocks to variables on the economy. VAR enables simultaneity in the interaction of included variables in a system and provides a platform for identifying the isolated impact of each variable. A VAR model is typically specified in terms of vectors and takes the following form:

$$X_t=A_tX_{t-1}+A_2X_{t-2}+\dots+A_pX_{t-p}+\varphi D_t+\varepsilon_t \quad (3)$$

Where $X_t \equiv [x_{1t},\dots,x_{kt}]'$, is a set of variables collected in a $(k\times1)$ vector, A_j denotes a $(k\times k)$ matrix of autoregressive coefficients for $j = 1, 2, K, p$, and φ denotes a $k\times d$ matrix of coefficients on deterministic terms collected in the $d\times1$ vector D_l. The vector $\varepsilon_t \equiv [\varepsilon_{1t},\dots,\varepsilon_{kt}]'$ is a k-dimensional white noise process, i.e., $E(\varepsilon_t)=0, E[\varepsilon_t\varepsilon_t]=\Omega,$ and $E[\varepsilon_t\varepsilon_s']=0$ for $s\neq t$, with Ω a $(k\times k)$ symmetric positive definite matrix. The k equations of the VAR can be estimated separately by ordinary least squares (OLS) conditioned on the first p observations $(denoted\ X_{-p+1,}+X_{-p+2,}\dots,+X_0)$ and based on the sample $X_{1,}X_{2,}K,X_T$.

Although VAR models are suitable for describing how variables interact over time, they however, fall short in two key areas. First, VAR models do not account for contemporaneous relationships—those that happen at the same time—between variables, even though these are often expected based on economic theory. For instance, variables like interest rates, inflation, and exchange rates can influence each other within the same period. Since VAR models ignore these immediate connections, they are not ideal for testing theories that rely on such interactions. Second, the shocks in a VAR model are not truly independent, because the error terms across different equations tend to be correlated. This means the model struggles to correctly identify structural shocks, which makes it harder to understand the real cause-effect relationship between variables.

To resolve the deficiencies highlighted above, a SVAR (Structural Vector Autoregression) model is used in this study by explicitly accounting for contemporaneous relationships and separating out the structural shocks. This approach makes the analysis more consistent with economic theory and provides a clearer picture of the underlying dynamic relationship between the set of macroeconomic variables and the appropriate policy instruments. Thus, the empirical model within the SVAR framework is specified as follows:

$$A_0y_t=A_+x_t+\varepsilon_t, \qquad \varepsilon_t\sim N(0, I_n) \quad (4)$$

Here, the regressor matrix $x_t = [1, y'_{t-1}, \ldots, y'_{t-p}]'$, which includes lagged values of the dependent variables, is of dimension $(np+1) \times 1$, where n is the number of variables and p is the number of lags. The matrix $A_+ = [c, A_{1,\ldots,} A_p]$ (of size n × np + 1) contains the structural coefficients for the lagged dependent variables and the constant term c. The vector ε_t represents structural economic shocks, which are assumed to follow a normal distribution with an identity covariance matrix. The matrix A_0 captures the contemporaneous relationships among the variables in y_t, and its inverse, A_0^{-1}, shows how structural shocks instantly affect the variables in y_t.

For estimation purpose, we re-write the VAR model in reduced form as follows:

$$y_t = Bx_t + u_t, \qquad u_t \sim N(0, \Sigma) \tag{5}$$

Where u_t represents the reduced-form errors, and $B = A_0^{-1}A_+$ is the reduced-form coefficient matrix. Unlike the structural shocks ε_t, which are assumed to be orthogonal with the SVAR framework, the reduced-form errors u_t are correlated, and their covariance matrix Σ is constant and diagonal (Bernanke, 1986; Asteriou, 2006). The connection between the reduced-form errors and the structural shocks is given by:

$$u = A_0^{-1}\varepsilon_t \tag{6}$$

The challenge of identifying the structural VAR lies in determining A_0^{-1} using the reduced form parameters B and Σ. The decomposed reduced form error variance matrix is shown as:

$$\Sigma = A_0^{-1}(A_0^{-1})' \tag{7}$$

This decomposition is central to the identification problem, as discussed in Kilian and Lütkepohl (2017). Identification via sign restrictions exploits the fact that the decomposition is not unique. For any orthonormal matrix Q, another valid impact matrix is given by:

$$\tilde{A}_0^{-1} = A_0^{-1}Q \tag{8}$$

Each candidate decomposition results in different structural shocks $\tilde{\varepsilon}_t$. To ensure these shocks are economically meaningful, they must satisfy certain identifying restrictions. These restrictions are imposed on the contemporaneous relations matrix A_0 and on the structural impact matrix A_0^{-1} helping to identify specific shocks such as exchange rates policy shock or an expectations shock.

To specify a SVAR model that explicitly addresses how the five macroeconomic variables respond to shocks in the three exchange rate measures, we set up a system that allow the three exchange rate volatility measures (OFFR, INTBR, BDCR) to contemporaneously influence the macroeconomic variables (inflation, lending rate, money supply, foreign reserves, and real GDP). Equation (9) is the representation of the SVAR framework:

$$\begin{pmatrix} \mu_t^{OFFR} \\ \mu_t^{INTBR} \\ \mu_t^{BDCR} \\ \mu_t^{INF} \\ \mu_t^{LDR} \\ \mu_t^{M2} \\ \mu_t^{FOR} \\ \mu_t^{RGDP} \end{pmatrix} = \begin{pmatrix} S_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ S_{21} & S_{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ S_{31} & S_{32} & S_{33} & 0 & 0 & 0 & 0 & 0 \\ S_{41} & S_{42} & S_{43} & S_{44} & 0 & 0 & 0 & 0 \\ S_{51} & S_{52} & S_{53} & S_{54} & S_{55} & 0 & 0 & 0 \\ S_{61} & S_{62} & S_{63} & S_{64} & S_{65} & S_{66} & 0 & 0 \\ S_{71} & S_{72} & S_{73} & S_{74} & S_{75} & S_{76} & S_{77} & 0 \\ S_{81} & S_{82} & S_{83} & S_{84} & S_{85} & S_{86} & S_{87} & S_{88} \end{pmatrix} \begin{pmatrix} \varepsilon_t^{OFFR} \\ \varepsilon_t^{INTBR} \\ \varepsilon_t^{BDCR} \\ \varepsilon_t^{INF} \\ \varepsilon_t^{LDR} \\ \varepsilon_t^{M2} \\ \varepsilon_t^{FOR} \\ \varepsilon_t^{RGDP} \end{pmatrix} \tag{9}$$

In this matrix: μ_t^{OFFR} (the official exchange rate) is affected by its own shock; μ_t^{INTBR} (the inter-bank rate) is affected by both μ_t^{OFFR} and μ_t^{INTBR}; and μ_t^{BDCR} (the bureau de change rate) is influenced by all three shocks: μ_t^{OFFR},

μ_t^{INTBR} and μ_t^{BDCR}. The S_{ij} terms represent the structural coefficients that define the contemporaneous relationships between the variables. This matrix structure captures how shocks to one variable can propagate through the system, affecting other variables in real-time, consistent with the SVAR approach. The use of Cholesky decomposition would impose restrictions (like the upper-triangular nature of this matrix) to help identify the shocks.

4. Empirical Results

4.1. Preliminary analysis

Table 1 presents the descriptive statistics of the indicators used in our study so that we can have a fair understanding of the data patterns and the nature of the estimations and diagnostics to be performed. For this purpose, the variables monthly logarithmic changes are used. The mean value of the real GDP return is 0.055, with a standard deviation of 0.0499, indicating a larger degree of variability than the other series. With the exception of the foreign reserve, the variables are not normally distributed, as evidenced by the p-value of the Jarque bera test. Again, with the exception of foreign reserves, the monthly returns series for exchange rates and other macroeconomic series are positively skewed, implying that the distribution of exchange rates and other macroeconomic variables returns is not symmetric. Positive skewness in the official rate (3.081), interbank market rate (5.510), and bureaux de change rate (1.106) descriptive statistics indicates that the Naira/US$ exchange rate depreciates more frequently than it appreciates. The return on GDP series is highly skewed while interest rate return is negatively skewed.

The value of the kurtosis shows a non-normal distribution in the three forms of exchange rates and the macroeconomic variables, suggesting that our exchange rate distribution is leptokurtic. The exchange rates' non–normality is comparable to empirical evidence in the literature (see Koay and Kwek, 2006 for instance). The coefficient of variation (CV), calculated as the ratio of standard deviation to mean, measures the relative dispersion of the variables, whereas the standard deviation represents absolute variability. The higher the CV, the larger the variability. This allows us to compare the relative volatility of our series directly despite the variations in means. The inflation rate appears to be the most volatile variable, followed by real GDP. When compared to the interbank and official exchange rates, the bureau de change exchange rate is more volatile. The foreign exchange reserve has the lowest CV of -33.9, making it the least volatile series.

Table 2 above shows the correlation amongst the variables utilized in this study. According to the table, inflation, interest rate exchange rate, money supply, foreign reserves and real GDP are negatively correlated with official, inter-bank and bureau de change exchange rates return. The highest correlation is between interest rate and real GDP at -0.876 while the lowest is between industrial production and inflation at 0.02.

In order to test the stationarity of series used, the Augmented Dickey–Fuller (ADF) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) tests are employed. The ADF and KPSS statistics, respectively, test the null hypothesis that a series is non-stationary or stationary. The two tests are used with a constant term as well as a constant term and a trend term. The results in Table 4.3 show that all variables are non-stationary in level form but become stationary in first difference form.

Table 1. Summary of Descriptive Statistics

	OFFR	ITR	BDCR	INF	LDR	M2	RES	RGDP
Mean	0.007	0.007	0.009	0.000	-0.004	0.010	-0.001	0.055
Median	0.001	0.000	0.001	0.001	-0.002	0.008	-0.007	0.012
Maximum	0.116	0.240	0.129	0.057	0.125	0.128	0.107	5.658
Minimum	-0.030	-0.021	-0.141	-0.039	-0.169	-0.057	-0.097	-0.053
Std. Dev.	0.020	0.029	0.037	0.023	0.029	0.027	0.037	0.499
C.V	2.648	4.107	4.360	58.023	-7.641	2.729	-33.924	9.011
Skewness	3.081	5.510	1.106	0.558	-0.561	0.739	0.424	10.958
Kurtosis	14.316	38.913	6.705	3.104	14.887	5.173	3.522	123.385
Jarque-Bera	906.140	7702.819	75.176	6.855	778.072	37.674	5.419	81726.050
Probability	0.000	0.000	0.000	0.032	0.000	0.000	0.067	0.000
Sum	0.970	0.930	1.122	0.051	-0.506	1.305	-0.143	7.251
Sum Sq. Dev.	0.050	0.110	0.181	0.067	0.113	0.096	0.178	32.342
Observations	131	131	131	131	131	131	131	131

Source: Authors' Computation

Table 2. Correlation Matrix

	OFFR	INTBR	BDCR	INF	LDR	M2	RES	RGDP
OFFR	1.0000							
INTBR	0.1196	1.0000						
BDCR	0.1059	0.2735	1.0000					
INF	-0.2992	-0.0810	-0.2514	1.0000				
INT	-0.0053	-0.0873	-0.1187	0.1202	1.0000			
M2	-0.0035	0.0773	0.0391	0.2382	-0.4907	1.0000		
RES	-0.3778	-0.2413	-0.2300	-0.0178	-0.0056	0.1035	1.0000	
RGDP	-0.0214	0.0999	0.1016	0.0320	-0.8759	0.5260	-0.0264	1.0000

Source: Authors' Computation

Because the goal of this study is to assess the impact of multiple exchange rates for macroeconomic stability in Nigeria, as well as determine the potential implication it has for exchange rate unification, it is appropriate to use non-linear models to determine the volatility of the multiple exchange rates and any significant volatility clustering of exchange rate returns series. As a result, the GARCH models are estimated in the following sections.

4.2. Estimation of Exchange rate volatility models

The first objective of this study aims at investigating the significance of past exchange rate shocks in shaping current volatility, with a particular focus on the varying impacts observed in the bureau de

Table 3. Unit Root Tests

	Intercept (Trend & Intercept)	Intercept (Trend & Intercept)	Results	Intercept (Trend & Intercept)	Intercept (Trend & Intercept)	Results
OFFR	-0.7663 (-2.2545)	1.2852*** (0.1549)**	**Non-Stationary**	-3.0361** (2.7034)***	0.1542 (0.0435)	**Stationary**
INTBR	-0.7663 (-2.2545)	1.2852*** (0.1549)**	**Non-Stationary**	-3.0361** (2.7034)***	(0.1542) (0.1496)	**Stationary**
BDCR	-0.2802 (-2.5116)	1.3276*** (0.1766)**	**Non-Stationary**	-5.166*** (-7.839)***	0.1293 (0.0704)	**Stationary**
INF	-0.3143 (-1.8386)	1.2767*** (0.1355)*	**Non-Stationary**	-8.4275*** (8.4136)***	0.1235 (0.1012)	**Stationary**
LDR	0.3999 (0.289)	1.2258*** (0.1481)**	**Non-Stationary**	-4.3896** (-2.399)**	0.0983 (0.0792)	**Stationary**
M2	0.986 (0.381)	0.5015** (0.2097)**	**Non-Stationary**	14.5449*** (10.0059)***	0.1731 (0.1022)	**Stationary**
RES	-1.0961 (-2.6186)	1.3967*** (0.2151)**	**Non-Stationary**	-10.1403*** (10.1552)***	0.0815 (0.0217)	**Stationary**
RGDP	-1.7447 (-1.7651)	1.3242** (0.1242)*	**Non-Stationary**	-8.2031*** (-8.1943)***	0.0974 (0.0754)	**Stationary**

Source: Authors' Computation

change sector compared to the official and interbank segments. The asymmetric GJR-GARCH (1,1) models estimated outcomes for the Naira/US$ official exchange rate, the interbank market exchange rate, and the bureau de change exchange rate is shown in Table 4. The data is adequate and robust as it contains no conditional heteroskedasticity and there is no indication of serial correlation in the Ljung-Box statistics on the standardized residuals and standardized squared residuals of the calculated GARCH models. Moreover, despite relatively low LM statistics, the ARCH LM test shows no indication of conditional heteroskedasticity.

The long-term average volatility of the Naira–US dollar exchange rate differs across the three segments of Nigeria's foreign exchange market, with the bureau de change market exhibiting the highest degree of persistence and sensitivity to past shocks, followed by the interbank market, while the official market remains relatively more stable. The results reflect unbiased variance. The coefficients are very significant and the key ARCH characteristics show that past period exchange rate shocks are pertinent to understanding the volatility of the present exchange rate across all sectors. The bureaux de change section has the greatest ARCH coefficient, which suggests that the BDC's past period shocks have a stronger impact on present volatility. These findings underscore the differentiated impacts of market shocks and volatility persistence across Nigeria's foreign exchange market segments, highlighting the complexities and operational challenges within the multiple exchange rate system prior to the unification policy. The high sensitivity of the bureaux de change market

Table 4. Results of GJR- GARCH(1.1) exchange rates model.

	Official	Interbank	Bureau de Change
ϕ (constant)	0.0013 (0.5984) [0.5267]	0.0031 (0.3200) [0.9945]	0.0036 (0.0157)** [2.4167]
δ	0.8208 (0.0000)*** [4.3866]	0.3315 (0.0000)*** [8.9344]	0.1764 (0.0002)*** [3.7039]
ω (constant)	0.0001 (0.0000)*** [4.4145]	0.0004 (0.0003)*** [3.6534]	0.0000 (0.0001)*** 3.8373
α_1 ARCH	0.5621 (0.0028)*** [2.9903]	0.6376 (0.0205)** [2.3174]	0.8926 (0.0524)* [1.9396]
β_1 GARCH	0.2572 (0.7731) [0.2883]	0.2905 (0.0003)*** 3.6530	0.3138 (0.0001)*** [4.0430]
γ_1 GJR	0.2315 (0.0658)* [1.8399]	-0.3972 (0.0167)** [2.3923]	-0.6653 (0.0000)*** 6.3442
$(\alpha_1 + \beta_1)$	0.8193	0.9281	1.2064
ARCH-LM (5)	0.0161 (0.9999)	0.2968 (0.9139)	0.7657 (0.5763)
Ljung-Box Q (25)	0.056 (0.612)	0.006 (0.985)	0.148 (0.106)

*, ** and *** denote 10%, 5% and 1% level of significance respectively

Source: Authors Computations

to past shocks highlights the need for specific interventions in this segment to ensure overall market stability and support the broader objective of exchange rate unification.

4.3. Structural VAR (SVAR) Results

To achieve the second objective of this study, the implication of multiple exchange rates for macroeconomic stability is investigated by examining the reactions of the macroeconomic fundamentals to the volatilities in Naira/US$ across the three segments of the Nigerian foreign exchange market. In other words, we investigate the effect of official exchange rate, interbank market and bureau de change exchange rate volatilities on inflation, interest rate, money supply, foreign reserves and real GDP using the impulse response function (IRF) based on SVAR model and the SVAR forecast error variance decompositions (FEVD). Using SVAR's IRF and FEVD is a robust approach to investigating how volatilities in the official, interbank, and bureau de change exchange rates impact key macroeconomic variables. The IRF allows for a detailed examination of the dynamic responses of inflation, interest rates, money supply, foreign reserves, and real GDP to exchange rate shocks, while the FEVD breaks down the contribution of each shock to the variability of these macroeconomic indicators.

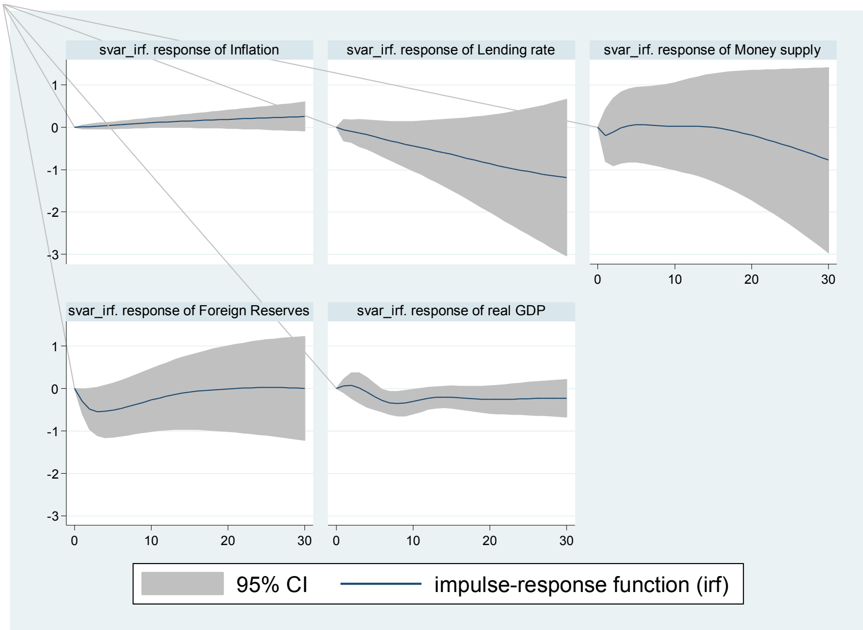
The impulse response functions (IRFs) with two lags are depicted in Figure 1. The IRF trace out the dynamic response (over a period of 30 months) of inflation, lending rate, money supply, foreign reserves and real GDP to exogenous shocks (measured by a one standard deviation increase) emanating from official, interbank and bureau de change naira/ US$ exchange rate in Nigeria. We report the 95% confidence intervals for all graphs (see grey-shaded area). According to the impulse response analysis, a one standard deviation shock to the official exchange rate causes inflation to decline initially, with the effect stabilizing around the 12th month. However, inflation begins to rise again after this point, implying that while official exchange rate shocks may suppress inflation in the short run, they lead to rising inflationary pressure in the long run. In contrast, shocks to the interbank rate initially reduce inflation, with the largest effect around the third month. Although the impact diminishes over time, it remains negative throughout the period, indicating that interbank rate shocks help control inflation. Shocks to the bureau de change (BDC) exchange rate cause inflation to increase initially, peaking around the 10th month, but the effect gradually declines. Nonetheless, inflation remains elevated by the 30th month, suggesting a more transient but lasting inflationary impact.

For lending rates, a one standard deviation shock to the official exchange rate leads to a consistent and gradually increasing negative impact over time. This implies that shocks to the official exchange rate reduce lending rates, lowering the cost of borrowing in the long run. In contrast, shocks to the interbank rate initially raise lending rates slightly in the first month, but the effect turns negative by the third month and remains moderately negative throughout the 30 months, suggesting a gradual downward pressure on lending rates. A shock to the BDC exchange rate, however, causes a sharp and persistent rise in lending rates. Starting with a modest increase in the first month, the effect grows rapidly, peaking around the 12th month and remaining positive throughout the period. This indicates that BDC exchange rate shocks increase lending rates, possibly reflecting the inflationary impact on borrowing costs.

Regarding the money supply, a one standard deviation shock to the official exchange rate initially results in an increase in money supply, with a sharp rise in the first month. However, this positive effect gradually diminishes over time, turning negative by the 19th month and continuing to decline through the 30th month. This suggests that while official exchange rate shocks initially boost the money supply, they eventually lead to a contraction in money supply in the long term. On the other hand, shocks to the interbank rate consistently reduce money supply throughout the period. The contraction begins in the first month and deepens up to the 30th month, indicating a tightening of liquidity conditions. A shock to the BDC exchange rate causes a persistent and growing increase in money supply, with the positive effect continuing through the entire period. This reflects an expansionary impact on the money supply, likely tied to inflationary pressures from the informal exchange market.

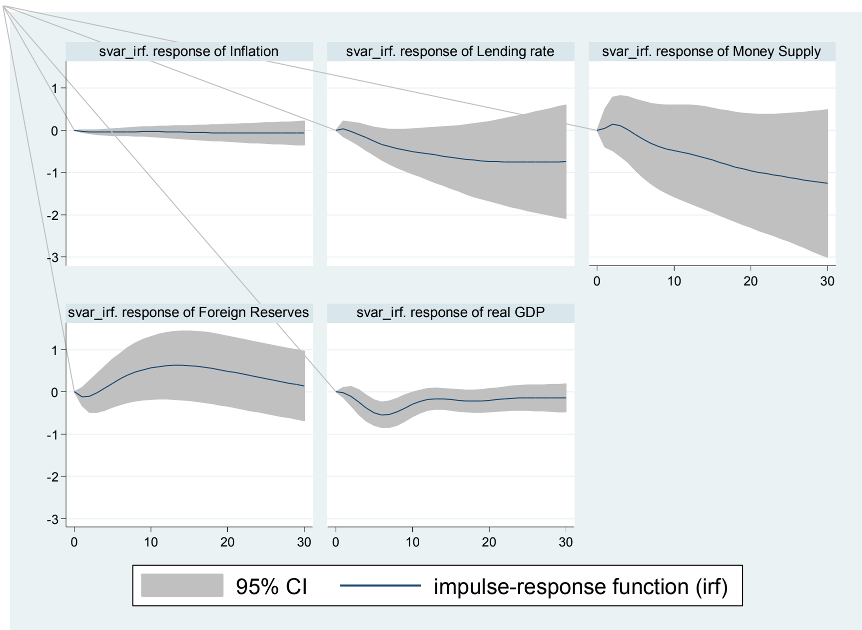
Shocks from:

Official Exchange rate



Shocks from:

Interbank Market



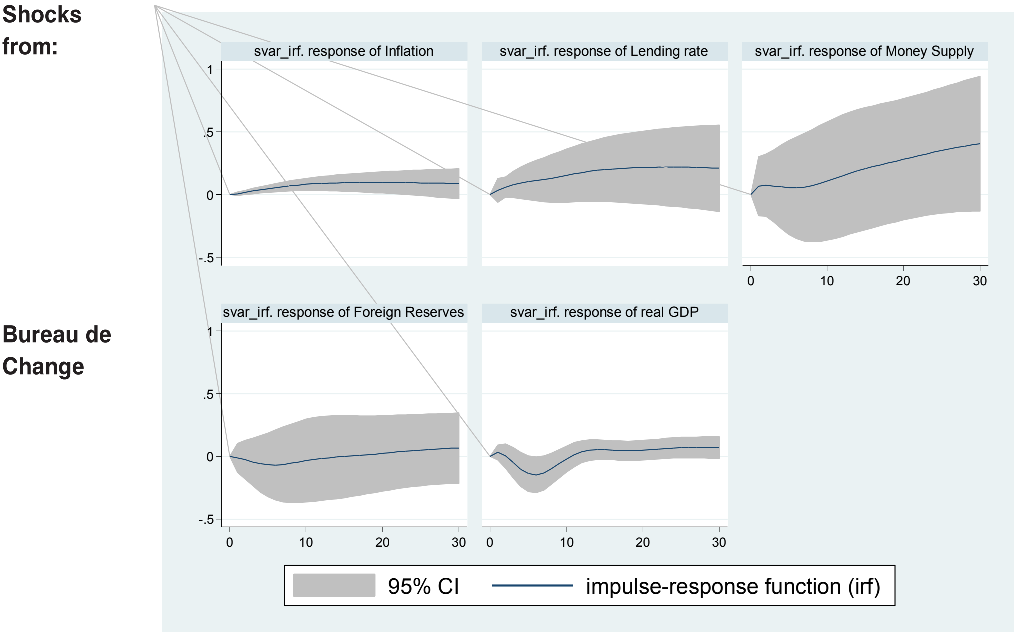


Figure 1. Responses of Macroeconomic fundamentals to shocks in Exchange rate Volatilities

Source: Graphed by the authors

The findings of the SVAR forecast error variance decomposition (FEVD) analysis in Table 5 reveal that macroeconomic variables (inflation, real GDP, lending rate, money supply and foreign reserves) have a relatively limited impact on exchange rate volatility, particularly in the short term. For instance, the official exchange rate accounts for 100% of its own shocks in the first period, and this decreases to 84.27% by the sixth period, continuing to decline to 21.79% by the 30th period, with real GDP contributing 11.97%, and other variables like money supply and inflation contributing much smaller shares. As time progresses, the influence of macroeconomic variables gradually increases, although even by the 30th period, these variables account for only about 29% of the shocks to the official exchange rate. The interbank exchange rate follows a similar pattern, with nearly 100% of its variation explained by its own shocks in the first period, declining to 29.21% by the 30th period as the influence of other factors like the official exchange rate (32.52%) and real GDP (24.78%) becomes more significant. The BDC rate also experiences a decrease in the proportion of its volatility explained by its own shocks, falling from 87.78% in the first period to 32.93% by the 30th period, with increasing contributions from real GDP (25.35%) and money supply (11.27%).

While macroeconomic variables such as inflation, lending rates, and money supply contribute relatively little to exchange rate volatility in the short term, their impact gradually increases over time. In the variance decomposition of the official exchange rate, these variables collectively explain less than 5% of the variation in the first six periods, with their contributions remaining modest even

Table 5. SVAR Forecast Error Variance Decomposition (FEVD) Results

	Official rate	Interbank rate	Bureau de Change rate	Inflation	Lending rate	Money Supply	Real GDP	Official rate
Variance decomposition for Official Exchange rate								
1	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	84.271	0.458	1.318	0.410	0.338	1.193	11.971	0.041
12	62.432	0.873	6.154	0.186	0.953	2.427	26.754	0.222
18	43.248	3.626	14.009	0.235	1.424	4.388	32.244	0.827
24	29.991	6.416	20.944	0.454	1.568	7.410	31.791	1.427
30	21.786	8.139	25.799	0.782	1.393	11.269	29.031	1.800
Variance decomposition for Interbank exchange rate								
1	0.016	99.984	0.000	0.000	0.000	0.000	0.000	0.000
6	0.445	92.687	0.862	0.168	1.878	0.535	1.574	1.851
12	13.673	63.525	4.457	0.142	7.351	0.665	7.186	3.001
18	27.588	42.805	3.922	0.197	8.288	0.523	14.408	2.268
24	32.098	33.524	3.615	0.337	7.517	0.451	20.706	1.753
30	32.516	29.206	4.269	0.543	6.664	0.450	24.776	1.577
Variance decomposition of Bureau de change rate								
1	11.765	0.459	87.776	0.000	0.000	0.000	0.000	0.000
6	4.388	5.643	77.952	0.042	2.141	0.944	5.346	3.544
12	13.122	3.645	56.746	0.090	4.822	5.911	11.787	3.878
18	17.108	3.912	42.689	0.296	5.256	9.031	18.884	2.823
24	17.140	4.379	36.127	0.614	5.517	10.519	23.208	2.495
30	16.251	5.014	32.933	0.973	5.935	11.275	25.351	2.268

Source: Authors Computations

by the 30th period, where inflation accounts for just 0.78%, and lending rates contribute 1.39%. The increasing role of real GDP is particularly notable, with its contribution to official exchange rate volatility rising from 11.97% in the sixth period to 29.03% by the 30th period. This trend is also observed in the interbank and BDC rates, where real GDP's contribution grows substantially over time.

5. Discussion of Results

Nigeria has experienced considerable exchange rate instability due to the presence of a multiple exchange rate system, where different rates coexist across various market segments. This system often undermines the value of its national currencies, strains foreign reserves, and poses challenges for maintaining macroeconomic stability. This study thus employs the asymmetric GJR-GARCH (1,1) models to explore the implications of exchange rate volatility across different market segments, such as official, interbank, and informal markets, and through the SVAR techniques of impulse response and forecast error variance decomposition examines response of key macroeconomic variables including inflation, lending rates, money supply, foreign reserves, and real GDP to the volatilities of exchange rate across three market segments. Our findings based on the first objective show significant insights into the volatility characteristics of the Naira/US$ exchange rate across the official, interbank, and bureau de change (BDC) markets. The coefficients of the GJR-GARCH (1,1) models indicate that past shocks in exchange rates are key drivers of current volatility across all market segments, with the BDC market showing the highest sensitivity. This finding implies that past events in the BDC sector contribute substantially to current exchange rate fluctuations, indicating higher volatility persistence in that segment compared to the official and interbank markets. This result is in line with Oaikhenan and Aigheyisi (2015), who showed that volatility of the naira exchange rate was characterised by clustering, strong leverage effect and moderate degree of persistence in the official markets than in the bureau de change segment of exchange rate market. The finding is also in tandem with Oyinlola (2018), whose study showed that persistence is generally explosive in the BDC market as compared to interbank market where the persistence was high but not explosive especially under asymmetric models. Moreover, the fact that the BDC market exhibits the largest ARCH coefficient reinforces the notion that informal market shocks tend to have more significant and lasting impacts on exchange rate dynamics. These results are particularly relevant in the context of Nigeria's multiple exchange rate system, underscoring the operational challenges posed by the BDC segment.

For the second objective, findings from the impulse response functions (IRF) offer valuable insights into how key macroeconomic variables—such as inflation, interest rates, money supply, foreign reserves, and real GDP—respond to shocks from the official, interbank, and BDC exchange rates over time. The dynamic responses highlight differentiated impacts based on the source of the exchange rate shock. Official exchange rate shocks initially reduce inflation and lending rates, but inflation rises after the 12th month, while lending rates remain low in the long run. Interbank market shocks consistently reduce inflation and lending rates, stabilizing both over time. In contrast, bureau de change (BDC) shocks lead to a persistent increase in inflation and a sharp rise in lending rates, reflecting the volatility of this informal market. The sharp rise in inflation in response to BDC exchange rate shocks highlights the significant volatility present in this market segment. This finding aligns with Mukalayi (2021), who concluded that high exchange rate volatility increases uncertainty regarding future price levels, making inflation expectations more unpredictable.

Regarding money supply, official rate shocks initially expand it but lead to a long-term contraction, while interbank shocks consistently reduce it, and BDC shocks cause sustained increases. Foreign reserves tend to stabilize after initial volatility from official exchange rate shocks, while real GDP exhibits moderate long-term responses to exchange rate fluctuations. These findings contrast with Duarte (2003), who found little evidence that other macroeconomic variables systematically respond to exchange rate dynamics. Duarte predicted a sharp increase in real exchange rate volatility when shifting from pegged to floating rates, without a similar effect on other variables. Similarly, Dagume (2022) reported mixed results on exchange rate volatility's impact on six macroeconomic variables in South Africa, showing positive effects on growth, inflation, and interest rates, but negative effects on FDI, GDP, and trade openness.

Furthermore, the FEVD analysis provides additional insights into the proportion of variance in macroeconomic variables explained by shocks from different exchange rate markets. The findings reveal that exchange rate volatility is predominantly driven by its own shocks, especially in the short term, with macroeconomic fundamentals playing a smaller role. A key observation is that exchange rate volatility is primarily driven by its own shocks, particularly in the early months. For the official exchange rate, 84.27% of its volatility in the first six periods is explained by its own shocks, with real GDP contributing 11.97. A similar trend is observed in the interbank and BDC markets, where initial volatility is primarily driven by their own shocks. However, over time, factors such as real GDP and money supply increasingly contribute to volatility, particularly in the informal BDC market. This aligns with the findings of Sharma and Setia (2017), who noted that policy shocks significantly impact output, inflation, and exchange rates over a long-time forecasting horizon.

Although this study offers valuable insights into the impact of multiple exchange rates on macroeconomic stability and the implications it could have on exchange rate unification policy in Nigeria, it has several limitations. First, it focuses mainly on direct effects of exchange rate volatility on only five macroeconomic aggregates, with limited attention to indirect spillovers on broader economic variables like employment and income distribution. These broader economic variables could also be significantly influenced by exchange rate unification, especially given Nigeria’s dependency on imports and the potential inflationary impacts of such a policy shift. The reliance on econometric models like GJR-GARCH and VAR may not fully capture informal market dynamics or unrecorded capital flows that exist in Nigerian economy. Additionally, the analysis is constrained by historical data, focusing on the period before the recent unification of exchange thereby excluding the long-term effects of the recent unification policy. Furthermore, the study does not deeply explore fiscal policy implications, particularly the impact on government revenue and expenditure. Future research should address these gaps by examining spillover effects, informal sector dynamics, and fiscal policy challenges in the context of exchange rate unification.

6. Conclusion and Policy Implication

This study investigates the effects of Nigeria's multiple exchange rates on macroeconomic stability, prior to exchange rate unification and its implication for the new policy. Using GARCH models, we analyse the volatility dynamics of Naira/US$ rates in official, interbank, and bureaux de change markets from January 2010 to December 2022. Initial analysis revealed non-stationarity, non-normal distribution, and significant volatility clustering in exchange rate returns, supporting the use of non-linear GARCH models. ARCH parameter estimates indicate past exchange rate volatility influences current rates, particularly in bureaux de change markets. GARCH parameter coefficients highlight volatility clustering in Nigeria's interbank and bureaux de change rates, with greater clustering observed in the latter. Depreciation leads to higher short-term volatility than appreciation, supporting the recent CBN decision, which would possibly allow multiple rates to converge to a single rate set by market forces.

Our estimate of the SVAR impulse response function, which was designed to assess the transmission mechanisms of exchange rate volatility to macroeconomic stability in Nigeria revealed that volatility in the bureau de change (BDC) market, in particular, has the most significant impact on key macroeconomic variables, such as inflation and lending rates, suggesting that informal market segments pose substantial risks to macroeconomic stability. Conversely, shocks in the official and interbank exchange rates exhibit more predictable patterns, with less dramatic long-term impacts. A significant finding from the FEVD is that exchange rate volatility is predominantly influenced by its own shocks in the short term across the three exchange markets, with macroeconomic fundamentals playing a smaller role. This suggests that rather than being greatly impacted by larger macroeconomic circumstances, the main causes of exchange rate volatility are intrinsic to the exchange rate mechanisms themselves. However, as time progresses, the contributions of factors such as real GDP and money supply grow.

The practical and managerial implications of these findings are significant for policymakers and financial market regulators. The pronounced volatility in the bureaux de change (BDC) market suggests that special attention is needed in regulating informal market segments, as they play a disproportionately large role in influencing inflation and lending rates. This highlights the need for targeted interventions in the BDC segment to mitigate its destabilizing effects on the economy. For policymakers, the study underscores the importance of exchange rate unification, as it can help reduce short-term volatility and create a more transparent and stable foreign exchange market. The gradual convergence of exchange rates into a single rate determined by market forces is expected to diminish arbitrage opportunities, enhance investor confidence, and improve the overall stability of the financial system. However, this approach needs to be complemented by broader economic reforms aimed at strengthening macroeconomic fundamentals, particularly boosting real GDP growth, to ensure long-term exchange rate stability.

From a managerial perspective, financial institutions and businesses that engage in foreign exchange transactions must account for the different volatility profiles across exchange rate segments. Strategic planning and risk management practices should incorporate measures to hedge against short-term fluctuations, especially in the BDC market, which has shown higher volatility clustering. Furthermore, corporate managers should monitor policy shifts closely, particularly in the implementation of exchange rate unification policies, as these could impact exchange rate dynamics and influence business operations and investment decisions.

In conclusion, the study provides actionable insights for both policymakers and financial managers, emphasizing the need for a balanced approach to exchange rate management that accounts for the unique characteristics of Nigeria's foreign exchange markets while supporting long-term economic growth.

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