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Regional Volatility Linkages: Impact of Neighbouring Currencies on Nigeria's Currency Instability

Abdurrauf Babalola

Al-Hikmah University, Ilorin Nigeria

e-mail: abdclement@yahoo.com

ORCID: 0000-0001-8389-6639

Kudu Ibn Muhammad

Al-Hikmah University, Ilorin Nigeria

e-mail: mkmuhammad2016@gmail.com

ORCID: 0000-0001-8568-0743

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Abstract: This study examines the effect of the exchange rate volatility of currencies of countries bordering Nigeria, namely the Benin Republic, Niger, Chad and the Cameroon Republic on Nigeria's exchange rate volatility using monthly observations for 1st January 2001 to 31st December 2021. The study employed the Generalised Auto-Regressive Conditional Heteroscedasticity method to analyse the dataset. The study found that fluctuations in the currencies of these countries have a significant impact on the volatility of Nigeria's currency naira. As a result, it is recommended that policymakers and government agencies strengthen security along the Nigeria-Cameroon, Nigeria-Benin, Nigeria--Chad, and Nigeria-Niger borders to more strictly regulate imports and support the stability of Nigeria's currency. The Nigerian government should encourage less importation from these countries through import-substitute production and higher exportation from Nigeria as such could lead to the appreciation of the naira.

Keywords: ARCH, bordering counties currency, exchange rate volatility, GARCH

1. Introduction

The exchange rate is vital to the economy as it measures a country's currency competitiveness. The exchange rate's flexibility, along with the type and quantity of capital investment a country receives, depends on how its currency fares against others (Adenekan et al., 2019).

Moreover, an indispensable factor in a country's trade portfolio, current account balance, external status, and export competitiveness is its exchange rate policy (Kouam & Sunjo, 2022). Due to its significant impact on trade relations, including the competitiveness and overall economic growth of the nation, as well as Nigeria's dependence on mono-product (oil), the exchange rate has historically played a significant role in the country's monetary policy (Ajao, 2010). The discourse on rate of exchange is established by the trade policy of a nation, and its relative value to other currencies affects its balance of payments, international trade, and economic performance as a whole (Kouam & Sunjo, 2022).

Nigeria borders with four nations: Niger to the north, Chad and Cameroon to the north-east and east, the Gulf of Guinea and the Atlantic Ocean to the south, and Benin to the West (Kouam & Sunjo, 2022); it engages in cross-border trade with these neighbours. According to Hashim and Meaglaer (1999), the amount of cross-border trade is particularly high in West Africa, with Nigeria serving as the hub for a sizable share of the trade that moves within the continent (Aliyu, 2009). Due to their closeness to Nigeria's two busiest borders – the Republic of Niger and the Republic of Benin – Lagos and Kano are the two biggest cross-border commerce hubs in the country. Bloom (2014) also stated that both economies rely heavily on their legal and illicit cross-border trade. It serves as a crucial artery for transportation throughout the ECOWAS region and is a vital component of the Abidjan-Lagos transportation and migration corridor. Similarly to commerce between Nigeria and the Republic of Niger, which has been ongoing for generations, the two countries' trade is mostly focused on agricultural items, petroleum, textiles, and manufactured goods (Iliyasu, 2019).

Bloom (2014) mentioned that Cameroon and Nigeria have a 1700 km shared border and a significant trading relationship. According to a report from the President of Cameroon in 2015, Nigeria has become the second-largest exporter to Cameroon behind China (Iliyasu, 2019). Hashim and Meaglaer (1999) asserted that trade between Nigeria and the Niger Republic is crucial to maintaining food security and friendly ties between the two nations. While Nigeria continues to supply cereals to most of that Republic (about 65 per cent approximately), Niger remains Nigeria's largest cattle supplier (Botta & Prestorious, 2009).

Nigeria and the Republic of Benin share an about 700 km border. Studies conducted by the Laboratoire d'Analyse et d'Expertise Sociale revealed that both Nigeria and Benin built their growth strategies around the trade of re-exportation: Benin imports products from Europe and Asia and exports them to the Nigerian market (Damiam & Samuel, 2022).

The ECOWAS region's francophone nations that share a single currency include the Republic of Niger, Benin, and Cameroon. According to Hadjimichael and Galy (1997), the CFA franc is tied to the euro through a monetary cooperation agreement between France and the members of the Communauté Financière Africaine. Additionally, a joint operative account at the French Treasury as well as the entire zone's pooling of its foreign exchange reserves are maintained (Damiam & Samuel, 2022). Variations in the value of currency ensure that they will influence international trade, and the value of the currency is assumed to change its real value and, as a result, have a direct impact on a country's international trade balance (Dornbusch & Giovanni, 1990).

The exchange rates of many nations have fluctuated significantly over time since the breakdown of the Bretton-Woods arrangement in 1973, and there has been an increase in interest in exchange rate forecasting as a result (Williamson, 1994). According to an analysis of regional trade statistics in Africa, commerce between nations varies in direct proportion to their level of development. The sub-region's most economically developed nations account for the majority of commerce. Nigeria's largest 'custom' at the Abidjan Port Authority, where almost 20% of the commodities volume shipped via Abidjan right

from 1996 have been emanating from Nigeria, making Côte d'Ivoire Nigeria's top trading associate in Africa (Bloom, 2014). Benin, which relies on re-exporting goods to Nigeria under informal trade agreements, and Cameroon where Nigeria has overtaken China as the country's second-largest client, are close associates to the Nigerian economy, which allows many goods to flow through trans-border activities, legal or illegal, and are stakeholders in the financial health of the economy, in terms of international partnership. In addition to this, Kim (2022) mentioned that the key link between economies is the impact that currency fluctuations have both directly and indirectly on the exchange rate between a national currency and a foreign currency.

Lastly, Kabari and Macarthy (2019) looked at the unpredictability of the exchange rates of five different currencies: the euro, the British pound, Saudi Arabian riyal, Swiss franc, and the Nigerian naira, with a focus on the latter. They discovered that each of these currencies has a sizable impact on the volatility of the Nigerian currency.

The primary issue that this work tried to solve is the influence of the exchange rate volatility of the currencies of countries bordering Nigeria on the naira exchange rate volatility. This study investigate whether the fluctuations in the exchange rates of currencies of these countries could have a significant impact on its currency volatility. According to Kim (2022), Niger, Benin, and Cameroon engage in cross--border commerce with Nigeria, and currency fluctuations in one nation will undoubtedly affect the currencies of the other nations. This problem has not been solved from the viewpoint of the neighbouring countries. Some research questions to answer were as follows: Does the exchange rate volatility of the Benin Republic impact on Nigeria's currency value? What impact does the exchange rate volatility of the Niger Republic have on the value of the naira? Could the exchange rate instability of Cameroon affect Nigeria's currency value? Therefore, the core issue was to determine the impact of volatility in the exchange rate of the bordering countries on the exchange rate volatility of the naira.

Many researchers addressed the exchange rate volatility of Nigeria’s currency such as Yakub et al. (2018), Bolfek and Wronska-Bukalska (2020), Khan (2020), Haruna et al. (2019) to name but a few. However, none studied whether the exchange rate volatility of Nigeria’s neighbouring countries has impacted on Nigeria’s exchange rate – hence the reason for this study.

Today, both nations and the greater sub-region depend on the trade with their neighbours. The Beninese economy, in particular, is deeply reliant on unofficial trade with its enormous neighbour, particularly the practice of re-exporting products (Bloom, 2014). In addition to exporting manufactured goods and cereals, Nigeria is heavily dependent on importing cattle from Niger. It also imports other manufacturing goods from Cameroon (Edward & Levy-Yeyati, 2005).

By identifying the impact of the four closest bordering countries – Niger, Chad, Benin, and Cameroon – on the exchange rate instability of Nigeria, this article adds to the research conducted by various researchers on exchange rate volatility from this unique area. In particular, this research will bring benefit the government to become more aware of the activities of its neighbours in terms of the naira exchange rate. In addition, it will be also useful to Nigerian Customs, Immigration and relevant policymakers on how to take proactive and responsible actions on its borders (Fapetu & Oloyede, 2014).

2. Literature review

The exchange rate compares one currency to another at the point of trading (Ozata, 2020). The value of a currency is a crucial economic variable that influences both the cost of locally produced goods on global markets and the cost of imported goods on home markets (Khordehfrosh & Mansour, 2015). It is the cost of an overseas currency to a local currency, and it is only the rate at which one nation's domestic money is exchanged for another nation's foreign currency (Babalola, 2019). If the exchange rate rises, the domestic currency depreciates or is devalued, there will be a rise in the units of money

to a foreign currency; and if the exchange rate falls, the native currency appreciates, the unit of money to buy one foreign currency will be unquestionably lower (Isitna & Neville, 2006).

Exchange rates are influenced by monetary policies that alter the money supply, interest rates, and terms of providing financial services (Cover & Mallick, 2012). The nature of exchange rate variability has altered significantly since 1973, with the collapse of the fixed parity system, the abandonment of Bretton Woods, and the adoption of flexible exchange rates. There is compelling evidence that systems with flexible exchange rates cause volatility to increase significantly. Before the demise of the Bretton Woods system, exchange rates were set at an official rate, and adjustments came in the form of sporadic, discrete jumps in the rate level (Obi et al., 2016). Exchange rates have been free to vary more or less continually in response to market forces since 1973. The size of the short-term variations in exchange rates surprised many people in the early years because it was anticipated that they would decrease as markets developed the capability of adapting to changes in market conditions. However, volatility has not decreased (Olopa & Abogan, 2013).

As the exchange rate is a key tool for a country to utilize to gauge its economic health, it is crucial to effectively monitor and control exchange rate volatility. A country's real economy sector and monetary sector’s economic activity can both be destroyed by a sharp increase in exchange rates.

Previous studies researched the link between exchange rate dynamics and macroeconomic performance, and some of them demonstrated that exchange rate pliability enhances a broader economy by influencing how quickly people adapt to turbulence (Edwards & Levy-Yeyati, 2005; Mundell, 1961). Researchers like Servén (2003), Demir (2010) and Belke and Gros (2001) demonstrated the existence of the adverse effects of exchange rate fluctuation on real economic activity that would in turn influence an increase in gross domestic product, such as international commerce, capital accumulation and formation, and employment.

Exchange rate volatility, as shown by Edwards and Levy-Yeyati (2005), enables fixed external shocks by supplying more adaptive capacity while avoiding lengthy and expensive processes of adjustment. According to Cerra et al. (2013) and Furceri and Zdzienicka (2011), nations with fluctuating exchange rates suffer less manufacturing losses during financial crises than those with fixed exchange rates.

Volatility signifies uncertainty and jeopardy. It is the amount of risk or dispersion related to the size of changes in the value of a security, and represents how much the price of an asset deviates from the mean price (Adam et al., 2022). Volatility is the rate at which the price of the security increases or decreases for a given set of returns. It indicates the price behaviour of a security and explains the fluctuations that may happen in a short-term period (Edwards & Levy-Yeyati, 2005). According to Fidelity International, volatility is an investment term that refers to the period a market or security experiences unpredictable sharp price movement, related to sudden price falls and rises in the market. Liberalisation of monetary policy and the restrictions on credibility carried out by the currency rate regime are additional opinions in favour of increased exchange rate flexibility and volatility (Dornbusch & Giovannini, 1990; Mundell, 1961).

The prominent concepts of currency rate include mint parity, purchasing power parity, and the balance of payment. The operation of the global gold standard and the mint parity theory are related. According to this hypothesis, money was made of gold or something valuable that could be exchanged for gold at a set rate. A certain quantity of gold was once employed to measure the value of the legal tender unit. The country’s central bank used to be permanently prepared to buy and sell gold at a defined price. The new price of gold refers to the currency rate at which the nation's legal tender may be converted into gold. Accordingly, the forces of supply and demand between gold points and the gold points' ability to keep the exchange rate from shifting outside of them are what decide the exchange rate under this system (Babalola, 2019).

The relative cost of goods across countries is what gives foreign exchange its power. Therefore, nations with high inflation rates frequently see falling currency prices, because an economy with hyperinflation

would have expensive goods for sale abroad, discouraging outsiders from buying them. Inferentially, the rate of inflation in the two nations influences their relative exchange rates (Babalola, 2019).

Under open currency rates, the value of a country's currency depends on its balance of payments. When a country enjoys a positive balance of payments, the exchange rate will appreciate, and vice versa. According to the hypothesis, the dynamics of source and request for foreign currency control the currency rate (Babalola, 2019; Jhingan, 2011). The country's foreign exchange reserves are mostly used to provide for or absorb this. The central bank feeds the market with foreign exchange reserves when short-term demand for foreign currency in the flexible market exceeds supply, effectively limiting currency depreciation (Babalola, 2019).

Economics textbooks state that determinants of exchange rate volatility are variables such as interest rates, inflation, political stability, public debt, the balance of trade, and economic health, among others.

In empirical studies, a large body of research established that currency rate fluctuation has a major influence on economic advancement. Currency rate fluctuations have a negative impact on private investment, according to Adamu (2005). Using the GARCH model, Mordi (2006) found that improper currency rate administration can lead to distortions in patterns of purchasing and manufacturing and that excessive exchange instability generates threats with disrupting implications for the economy.

Vieira et al. (2013) analysed 82 industrialised and developing states between 1970 and 2009 to confirm the influence of instability in the real exchange rate (RER) using the generalised method of moment as a tool of analysis. The results demonstrated that an unstable RER has a significant inverse influence on changes in gross domestic product.

Hussaini et al. (2013) selected Nigeria as a case study to work on monetary models and exchange rate determination. Using time series data, they applied the Monetary Flex Price Model (MFPM), among other models, and found that the MFPM outperforms other models in predicting the exchange rate. It was also found that relative money supply, income levels, and real interest rates are stronger predictors of the US dollar to the naira exchange rate. It was revealed that the MFPM estimate was supported by their finding that the coefficient separating the local money supply from the international money supply is close to 1.

Bala and Joseph (2013) studied exchange-rate instability in Nigeria, using GARCH models for the monthly dataset from January 1985 to July 2011 for the naira/US dollar return, and from January 2004 to July 2011 for the naira/GB pound and the naira/euro returns. They found the presence of volatility in the currencies used and indicated that volatility persisted. However, when volatility models that incorporated breakpoints were employed, the results improved.

Syarifuddin et al. (2014) also investigated how Indonesian monetary policy responded to exchange rate volatility. The research goal was to determine how persistent the Indonesia's exchange rate fluctuations were and how, as a result, the central banks could implement effective money control in setting the policy interest rate or intervening in foreign exchange markets to stabilise the exchange rate. TGARCH was utilised to analyse the unpredictability of the USD/IDR exchange rate. The study found that the monetary policies implemented by the central bank caused a decline in the exchange rate, and the finding indicated that the exchange rate instability (USD/IDR) was seemingly durable in Indonesia.

Another empirical study on the effect of money control on currency rates was conducted by Babajide et al. (2016). The goal was to employ the general method of moments to determine how the exchange rate affected the conduct of monetary policy in the US, UK, Canada, and Norway. The conclusion was reached that, whereas exchange rate variability and exchange rate level have a considerable influence on the conduct of monetary policy in small open countries, the exchange rate variability has little effect on monetary policy in large and relatively closed economies like the US.

Aftab et al. (2017) examined the influence of money regulations on the currency rate of Nigeria, specifically in the period between 1998 and 2008, using the OLS method and correlation matrix. They discovered that monetary factors of broad and narrow money are major policy variables that favourably influence exchange rate swings in Nigeria.

Haruna et al. (2019) used monthly exchange-rate return records between January 1985 and July 2011 for the naira/US dollar return as well as between January 2004 and July 2011 for the naira/GB pound, and the naira/euro returns to analyse exchange-rate instability employing GARCH models. It related the estimates of various GARCH model variants with a break to exogenously set breakpoints for the US dollar rates. Their findings showed that the three currencies are volatile, and except for models with instability breaks, most asymmetric models could not accept the presence of a leverage effect. The results showed that the estimation of volatility models with breaks produced better results than GARCH models without breaks.

The Error Correction Model (ECM) was used in the study by Aregbeyen and Fasanya (2019) to analyse the effect of money regulation on the exchange rate growth in Nigeria using time-series data between 1975 and 2010. The authors demonstrated that there is a long-term association between the variables and that the exchange rate is an important monetary policy tool that, in line with theoretical predictions, propels growth in Nigeria. The influence of the money supply on the exchange rate was determined to be minimal.

Between 1985 and 2015, Bolfek and Wronska-Bukalska (2020) employed the system GMM estimators on a sample of 45 developing and emerging economies and discovered that monetary policies had an inverse impact on exchange rate movement in some ECOWAS countries. In light of this, the Central Bank of Nigeria would profit from stabilising the foreign exchange market as soon as possible to prevent further instability. The study also demonstrated that Nigeria's trade flows, particularly in the short term, could suffer from neglecting exchange rate volatility.

Khan (2020) looked at how Ghana's monetary policy affected the country's exchange rate and international trade. The study used secondary data that included pricing rate, growth rate, conversion factors, and social inclusion (GDP); many pieces of evidence and trade indicators were used to categorise monetary policies. The use of linear regression revealed that monetary policies, alternative conversion factors, and growth rate (GDP) had a considerable influence on exchange rates and international commerce.

Daniel and Tosin (2020) evaluated the effect of exchange rate instability, among other variables, on agricultural commodities in the Nigerian economy. The dataset was monthly data between 2000 and 2018, and by employing a Non-linear Auto-Regressive Distributed Lag model they realised that fluctuations in the exchange rate have a symmetric influence on agricultural commodity prices.

Additionally, in Nigeria, Kanu and Nwadiubu (2020) looked at how exchange rate instabilities affected foreign trade. The study was conducted under the assumption that instabilities in exchange rates affect the amount of export and import trading activity. From 1996 to 2018, secondary data were used in the study, and relations were found when using econometric methods. Among the factors under examination, the research found a mixed result. Even though some of the tests did not adequately and predictably reveal the connection between exports, imports, and the real effective exchange rate, others did. Estimates from the VAR model showed that export, import, and REER have an inverse relationship during the current periods. In a given year, a unit increase in exports and imports caused a 0.9% and 0.4% fall in REER, respectively.

According to Kim (2022), there was evidence of an inverse association between exchange rate unpredictability and economic growth in 95 developing nations between 1976 and 1985. In their 1995 analysis of the factors influencing economic growth in 88 industrialised and developed nations between 1960 and 1992. The study established that exchange rate instability has an inverse influence on output growth by decelerating the increase of factor productivity.

Some other empirical research related to this study included those by Latief and Lefen (2018), Yakub et al. (2018), and Jamal and Bhat (2022).

2.1. Research Gap

Many researchers have discussed the exchange rate volatility of Nigeria's currency such as Yakub et al. (2018) and Dahiru et al. (2021). However, to the best of the authors' knowledge or rather based on the available literature, none have talked about how the exchange rate volatility of countries bordering Nigeria has impacted on the naira exchange rate. Therefore, this article intended to fill this gap by studying the effect of the exchange rate instability in neighbouring countries on the exchange rate volatility of the Nigerian currency

3. Data and Techniques of Analysis

The major considered variables are the exchange rates of the currencies of the four countries with the focus on Nigeria, namely the exchange rate of USD/Naira, USD/CFAF of Cameroon, USD/CFAF of Niger, and USD/CFAF of Benin.

The aim was to determine the impact of the volatility in the Cameroon, Niger and Benin currencies on the volatility of the naira.

The data were extracted from the World Bank website, which included the exchange rate of Nigeria, Cameroon, Niger and Benin regarding the US dollar (*Bureau de Change*). The data set spanned from 2001 through 2021, monthly.

There are various models for modelling volatility. The aim was that any proposed model should have the ability to predict the volatility variables required in a volatility model which can model and quantify the uncertainty. Typically, the volatility model is used to measure the absolute magnitude of return. Statistically, volatility, otherwise used as instability is always measured as the sample standard deviation:

$$the\ \hat{\sigma} = \sqrt{\frac{1}{n-1}}\sum_{t=1}^{n}(x_t - \mu)\text{^}2 \tag{1}$$

such that x_t is the return on quarter t and μ is the mean return on n days period, sometimes $squared\ is$ also used as a volatility measure. Zakaria (2013) suggested that before examining the volatility in a variable, the residual should first be tested. The test of adequacy of the ARCH/GARCH model was estimated using a diagnostic or portmanteau test of the model fitted to whether or not it accurately explained the variations in the dataset.

4. Research methodology

4.1. Model specification

The GARCH (1.1) model, as shown by the corelogram in Table 6, was employed to model the instability of the exchange rate and determine the impact of the unpredictability in the exchange rate of the currencies of the Benin Republic, Niger, Cameroon and Chad on the exchange rate volatility of the naira, adapted from the work of Haruna et al. (2019). Below is the specification of the model.

Mean equation (GARCH (1.1))

$$XNG = f(XBN, XCH, XCM) \tag{2}$$

$$XNG = C_0 + C_1XBN + C_2XCH + C_3XCM + \varepsilon_t, \tag{3}$$

where:

XNG = Nigeria Exchange Rate.

XBN = Benin/Niger Exchange Rate.

XCH = Chad Exchange Rate.

XCM = Cameroon Exchange Rate.

ε_t = Residual term.

The exchange rates of the Benin and Niger Republics were the same as for USD, therefore the study decided to rule out both countries. To reduce the trend and non-normality issues, the natural logarithms of equation 3 were taken, thus

$$lXNG = C_0 + C_1 lXBN + C_2 lXCH + C_3 lXCM + \varepsilon_t. \quad (4)$$

Variance equation of the model

$$\sigma_t^2 = C_4 + C_5\sigma_{t-1}^2 + C_6\varepsilon_{t-1}^2 + C_7 * lXBN + C_8 * lXCH + C_9 XCM + \varepsilon_t \ldots . C_i, \quad (5)$$

where (i = 0 … 9) are the coefficients relating the independent to the dependent variable.

The residual derived from the mean equation was used to obtain the variance equation,

where: σ_t^2 = variance (of error terms). It indicates the current month's volatility of the naira exchange rate, σ_{t-1}^2= previous month's residual volatility of the naira exchange rate. It indicates the GARCH effect, ε_{t-1}^2= squared residual of the previous period. It points out the previous month's exchange rate evidence about the volatility, known as the ARCH term.

$lXBN$= log of Benin/Niger *Cefa* exchange rate volatility,

$lXCM$ = log of Cameroon *Cefa* exchange rate volatility,

$lXCH$ = log of Chad *Cefa* exchange volatility; $XBN, lXCM$, and $lXCH$ are variance regressors that could influence the unpredictability of the naira's exchange rate.

A priori expectation is that all the exchange rates of the neighbouring nations would have a direct and significant influence on the exchange rate volatility of the Nigerian currency since goods and services flow into the nation either legally or illegally.

5. Results

5.1. Descriptive Statistics

The evidence from Table 1 shows that the mean value of LXNG was 5.18 while the average of LXCM was 6.30. The average of LXCH was 6.32 and the average value of LXBN was 6.29. From the result of the standard deviation in Table 1, LXNG had the highest variation, while LXBN had the lowest dispersion around the mean value. The mean and standard deviation figures of the variables were very close to one another, implying that the variables were equally measured and suitable for analysis in the model. The skewness values of all the variables indicated greater than zero values, which suggests that the variables had a thick tail to the right, though very mild except for LXCH which was quite high.

Table 1. Descriptive statistics

	LXNG	LXCH	LXBN	LXCM
Mean	5.1845	6.3250	6.2961	6.3009
Median	5.0473	6.2934	6.2883	6.2940

Maximum	6.0203	10.7072	6.6521	6.6523
Minimum	4.7037	6.0283	6.0295	6.0295
Std. Dev.	0.3987	0.3378	0.1296	0.1315
Skewness	0.7978	9.8994	0.5800	0.4672
Kurtosis	2.1549	121.3229	3.2921	3.0391
Jarque-Bera	34.228	151119.2	15.0273	9.1849
Probability	0.0000	0.0000	0.0005	0.0101
Sum	1306.502	1593.919	1586.607	1587.823
Sum Sq. Dev.	39.9004	28.6451	4.2161	4.3426
Observations	252	252	252	252

Source: authors' computation (2022).

Skewness along with kurtosis measures the degree of peakedness, combined to give the Jarque-Bera statistic which is the accurate measure of the normality distribution. The Jarque-Bera statistic was built on a null hypothesis of normality. The result indicates that the variables were not normally distributed because their corresponding p-values were less than 0.05.

5.2. Correlation Matrix

Table 2 presents the correlation matrix that explains the type and the degree of correlation between the response variable and explanatory variables of the model.

Table 2. Correlation matrix

	LXNG	LXCH	LXBN	LXCM
LXNG	1			
LXCH	0.0306	1		
LXBN	0.1686	0.2914	1	
LXCM	0.2263	0.2899	0.9942	1

Source: authors' computation (2022).

Table 2 shows that there exists a positive association between the variables. There is a positive relation between LXNG and all the explanatory variables.

5.3. Result of Variance Inflation Factor (VIF)

Table 3 shows the VIF result, which was used to test for the presence of multicollinearity.

Table 3. Variance Inflation Factor

Variable	Coefficient Variance	Uncentered VIF	Centred VIF
C	80.6698	352.2008	NA
DLXCM	0.0081	8.2847	8.2773
DLXBN	0.0080	8.2868	8.2779
LXCH	2.0111	352.1788	1.0003

Source: authors' computation (2022).

From Table 3, using the centred VIF, it is clear that there was an absence of multicollinearity because the corresponding centred VIF figures are less than 10. Therefore, if the corresponding figures are greater than 10, it shows that there is the presence of multicollinearity and vice versa.

5.4. Tests for Stationarity

Table 4 presents the two stationarity tests employed, namely the Augmented Dickey-Fuller (ADF) and the Phillip Peron (PP) tests.

Table 4. Results of Unit Root Test

VAR	ADF @LEVEL	PROB (5%)	PP@ LEVEL	PROB	ADF@ 1ST DIFF	PROB (5%)	PP@ 1ST DIFF	PROB	REMARKS
LXBN	–2.31	0.17	–2.31	0.171	–15.75	0.000	–15.76	0.00	I(1)
LXCH	–13.95	0.000	–14.52	0.000	–11.06	0.000	–158.08	0.00	1(0)
LXCM	–2.21	0.20	–2.22	0.201	–15.60	0.000	–15.62	0.00	1(1)
LXNG	0.29	0.98	0.23	0.974	–13.40	0.000	–13.39	0.00	1(1)

Sources: authors' computation (2022).

The ADF and PP Statistic tests in Table 4 revealed that the variables have an admixture of 1(0) and 1(1). The variables LXBN, LXCM, and LXNG are I(1) while LXCH is I(0).

5.5. Results of Tests of Volatility in the Naira's Exchange Rate

It can be seen from Figure 1 that there was an extended period of slight instability from January 2001 to March 2021, as well as a long period of high volatility from April 2021 to December 2021.

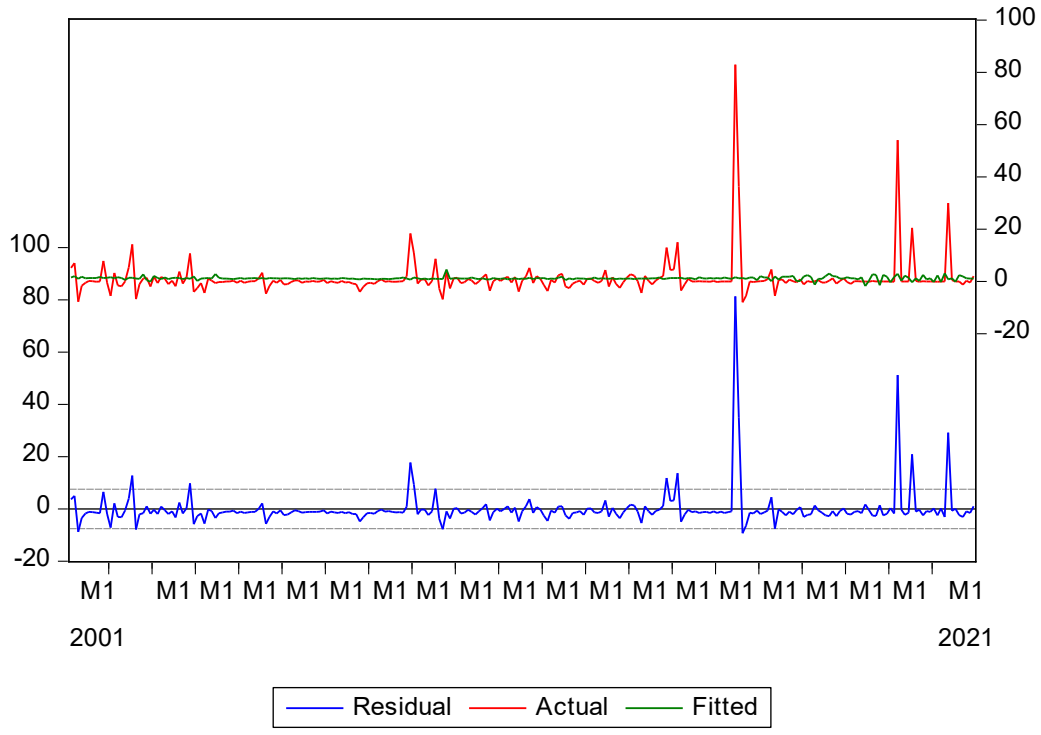

Figure 1. Mean Residuals of the Model

Sources: authors' computation (2022).

This was characterised by different periods of low movements, and high and very high fluctuations, an indication of volatility since there were consistent periods of fluctuations in the residual, signifying the presence of non-homoscedastic conditions which could be denoted by the ARCH and GARCH model.

5.6. Results of ARCH and GARCH Models

There are different methods for estimating the ARCH and GARCH models, including the Normal Gaussian distribution, the Student t with fixed (degree of freedom) and the Generalised Error Distribution (with fixed parameters). The conditions for selecting the best variant were used to select the presented Normal Gaussian Distribution model.

Normal Gaussian Distribution

In these statistics, the ARCH is insignificant, implying that the preceding month Nigeria's exchange rate information (ARCH) can affect the present month's naira's exchange rate volatility. Under the distribution as shown in Table 5, GARCH is also insignificant. It shows that the previous months' naira's exchange volatility (GARCH) can inspire the present month's instability of Nigerian's currency exchange rate.

This means that the naira's exchange rate volatility is subjective to its ARCH and GARCH shocks.

The Cameroon's currency exchange rate volatility is significant because its corresponding probability was less than 5%, meaning that its volatility or outside shock can affect the instability of Nigeria's currency.

Table 5. Results of Normal Distribution

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001808	0.003974	0.455107	0.6490
	Variance Equation			
C	0.000461	0.000315	1.464444	0.1431
RESID(-1)^2	0.015587	0.011394	1.368048	0.1713
GARCH(-1)	0.530874	0.320526	1.656261	0.0977
DLXCM	0.006037	0.000262	23.04430	0.0000
DLXCH	0.003366	0.001586	2.122	0.0339
DLXBN	–0.005224	0.001408	–3.710	0.0002
R^2	–0.010930	Mean dependent var		0.0052
Adjusted R^2	–0.010930	S.D. dependent var		0.0329
S.E. of regression	0.033121	Akaike info crit.		–4.0413
Sum squared resid	0.274248	Schwarz crit.		–3.9430
Log-likelihood	514.1807	Hannan-Quinn crit.		–4.0017
Durbin-Watson stat	1.649214			

Source: authors' computation (2022).

Moreover, Chad's currency exchange rate volatility is significant, meaning that its volatility (outside shocks) can induce volatility in the naira's exchange rate. Similarly, Benin's exchange rate volatility is significant indicating that its exchange rate volatility or external shock can stimulate the volatility of Nigeria's naira exchange rate.

5.6.1. Diagnostic Test of Normal Distribution

Results of Correlogram of Standardised Residual Squared

The study tested for serial correlation in the normal distribution and the outcomes are presented in Table 6.

Table 6. Correlogram of Standardised Residual Squared

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.|* |	.|* |	1	0.111	0.111	3.1257	0.077
*|. |	*|. |	2	–0.091	–0.105	5.2426	0.073
.|. |	.|. |	3	–0.003	0.020	5.2454	0.155
.|. |	.|. |	4	–0.007	–0.019	5.2564	0.262
.|. |	.|. |	5	–0.038	–0.034	5.6236	0.345
.|. |	.|. |	6	–0.018	–0.012	5.7119	0.456
.|. |	.|. |	7	–0.001	–0.004	5.7121	0.574
.|. |	.|. |	8	0.024	0.023	5.8648	0.662
.|. |	.|. |	9	–0.014	–0.022	5.9183	0.748
.|. |	.|. |	10	–0.019	–0.011	6.0097	0.814

Source: authors' computation (2022).

- Indicates significance at 10%.

From the table, where the AC and PAC are the coefficients of Autocorrelation and Partial Correlation, it can observed that all the probabilities were greater than 5%, thus implying that the GARCH model with Normal distribution has no serial correlation, which is desirable. What is more, this indicates the GARCH (1,1) model, for reasons of parsimony.

Results of the Heteroskedasticity Test

Table 7 shows the outcomes of the heteroskedasticity test conducted using the F-statistics.

Table 7. Results of the Heteroskedasticity Test

F-statistic	0.2567	Prob. F(1,248)	0.6129
Obs*R^2	0.2585	Prob. Chi-Square(1)	0.6112

Source: authors' computation (2022).

The outcome of the heteroskedasticity test revealed that there was an absence of heteroskedasticity since the p-value of the F-stats and the Obs*R^2 were larger than 0.05. This also means that GARCH (1,1) with normal distribution had no ARCH effect, which was desirable.

5.7. Discussion of Findings

Although there are few articles on this subject, this study examined the impact of neighbouring countries' currency volatility on the exchange rate of the naira. The correlation matrix shows the presence of a positive relation within the variables, and by implication, there was also a positive relation between Nigeria's currency exchange rate volatility (LXNG) and all the predictors (Cameroon's, Chad's, Benin's and Niger's exchange rates). An increase in the exchange rate of the neighbouring countries to the USD dollar will increase the naira's exchange rate to USD 1. The impact of the volatility of these currencies was determined based on the exchange rate of the naira, employing the ARCH/GARCH model.

The study was conducted under the assumption that instabilities in exchange rates affect the amount of export and import trading activity. It was found that the Cameroon currency (CFA franc (XAF)) had a significant influence on the exchange rate volatility of the Naira. Similar outcomes were obtained for the Chad and Benin (Niger) currency (CFA franc (XOF)). The result of the presence of volatility in the

naira exchange rate was in accordance with the study by Bala and Joseph (2013), who used two measurements (naira/GB pound and naira/euro returns).

The result of this study is also supported by the findings of Kanu and Nwadiubu (2020), who examined how exchange rate fluctuations affected foreign trade in Nigeria, in which the foreign trade could be likened to trade with the neighbouring countries in question (Benin, Cameroon, the Chad and Niger Republics). Kanu and Nwadiubu (2020), also found a significant impact of exchange rate on foreign trade, which in turn supports the results of this study. Therefore, when there is volatility in the exchange rates of the exporting country, this implies that such an importing country will experience such volatility in its exchange rate.

It is not surprising that the exchange rate in Nigeria has increased, as there is a lot of movement of goods in and out of the country, both legal and illegal, which involves currency trading. This increase in the exchange rate means that the value of the currency has decreased. Therefore, when the currency of Nigeria's neighbouring countries loses its value, the value of Nigeria's currency tends to fall as well. Illegal trading has been intensive, and this was causing a kind of regional volatility linkage, thus making the country vulnerable to fluctuations in its exchange rate.

6. Conclusion

Based on the analysis carried out on the impact of the volatility of the exchange rate of currencies of neighbouring countries on Nigeria's currency, it was concluded that there existed volatility in the exchange rate of the naira. It was also found that the volatility of the currency of Cameroon (XAF), Chad, Benin and Niger XOF, had a significant influence on the instability of the exchange rate of the naira. Hence, based on the results obtained from the analysis carried out and the findings derived, it is recommended that policy makers and government agencies implement favourable policies on Nigeria’s borders with Cameroon, Benin and Niger, to restructure the transborder exports and imports of goods in a way that it will favour Nigeria’s currency. There should be less imports from these neighbouring countries, and greater exports from Nigeria which would lead to the appreciation of the naira. The national agencies should also take drastic steps and action in curbing illicit trading in and out of the country, to reduce instability in the naira’s exchange rate.

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Analiza związków zmienności regionalnej: wpływ sąsiednich walut na niestabilność waluty Nigerii

Streszczenie: W artykule zbadano wpływ zmienności kursów walut krajów graniczących z Nigerią, tj. Republiki Beninu, Nigru, Czadu i Republiki Kamerunu, na zmienność kursu walut Nigerii, wykorzystując obserwacje miesięczne za okres od 1 stycznia do 31 grudnia 2021 roku. W badaniu zastosowano metodę uogólnionej autoregresyjnej heteroskedastyczności warunkowej. Przeprowadzone analizy wykazały, że wahania kursów walut tych krajów mają istotny wpływ na zmienność waluty naira Nigerii. W rezultacie zaleca się, aby decydenci i agencje rządowe wzmocniły bezpieczeństwo wzdłuż granic Nigerii z Kamerunem, Nigerii z Beninem, Nigerii z Czadem i Nigerii z Nigrem w celu bardziej rygorystycznej regulacji importu i wspierania stabilności waluty Nigerii. Rząd Nigerii powinien zachęcać do mniejszego importu z tych krajów poprzez produkcję substytucyjną importu i większy eksport z Nigerii, ponieważ to może prowadzić do aprecjacji nairy.

Słowa kluczowe: ARCH, waluta powiatów graniczących, zmienność kursu walutowego, GARCH