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Interest rates, money supply, institutional quality, and exchange rate stability in Nigeria

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ABSTRACT

The purpose of this paper was to examine the intricate relationship between interest rate and exchange rate, exploring their interdependencies, mechanisms, and implications for policy management and economic stability in Nigeria, and to also shed light on the complex dynamics that govern these two fundamental pillars of financial markets, as well as the appropriateness of the continuous use of interest rates to manage the Nigeria's currency exchange rate. This is because, since the mid-2000s, the Central Bank of Nigeria (CBN) has consistently used interest rate adjustment as a policy tool to manage exchange rate volatility, with mixed outcomes. The study utilised a dataset consisting of 68 quarters of time series data, spanning from 2006Q1 to 2022Q4, and adopted the Autoregressive Distributed Lag (ARDL) model to evaluate the influence of interest rates, money supply growth, and institutional quality on exchange rate stability in Nigeria, employing an *ex-post facto* research approach. Using the ARDL to test the hypothesis, the study found that monetary policy rate and money supply have long-run insignificant cointegrating relationships with exchange rate in Nigeria (Adj R2=0.642; F-stat (4, 63) = 53.813, p<0.05). The study concluded that interest rates have a significant impact on exchange rates in Nigeria. The study found that the independence of the CBN and adoption of capital mobility, and a fixed exchange rate mechanism in Nigeria are a violation of the principle of "impossible trinity" of fixed exchange rates and recommended a review of the exchange rates management policy.

Contribution/Originality: The originality of this paper lies in the introduction of institutional quality and money supply growth as control variables of the independent variables, interest rate, to test the influence of institutional quality in addition to monetary policy adjustments on the management of Nigeria's currency exchange rate, using ARDL.

1. INTRODUCTION

Interest rates and exchange rates management are closely related concepts in the realm of economics and finance, particularly in the context of managing a country's currency value. They are fundamental concepts in economics and finance, exerting significant influence on a country's economic performance and financial stability. The interaction between these two variables is multifaceted, characterised by intricate feedback loops and dynamic adjustments.

Interest rate can be defined as the return on earning assets or the opportunity cost of deferring current consumption into the future. Examples of interest rates include savings rate, lending rate, and discount rate

(Adebowale & Akosile, 2018). Central banks and monetary authorities set these rates. The behaviour of the interest rate largely determines the attraction of a country's products to investors, as well as the value of its currency. This is because when a country's interest rates rise, it becomes more attractive for foreign investors to hold assets denominated in that country's currency. This increased demand for the currency can lead to an appreciation in its exchange rate. Conversely, when a country's interest rates fall, the appeal of holding assets denominated in that currency diminishes, leading to a potential depreciation in the exchange rate.

Exchange rate is the conversion ratio between one currency and another, usually in the form of currency pairs (Dincer, Shingal, & Tekin-Koru, 2022; Tunc, Babuşçu, Hazar, & Solakoglu, 2020). It is the mathematical representation of the international medium of exchange, which is a method of settling foreign accounts or debts arising from international economic activities. Exchange rate is a vital macroeconomic performance indicator in any economy, and its movement is an important variable for the people of a given country as it directly influences the price of basic commodities. Changes in the global economy primarily cause exchange rate fluctuations, and with the rapid development of economic globalisation, international trade has penetrated and impacted all aspects of life (Guei & Choga, 2022).

Exchange rate is a critical indicator for settling international trade and plays a pivotal role in changing the economic mechanism. Numerous factors, such as economic, political, and cultural influences, impact its volatility. On the topic of foreign exchange, researchers have provided several interpretations. Foreign exchange is defined as the value of a nation's currency in relation to another currency (Adebowale & Akosile, 2018; Benson, Eya, & Yunusa, 2019; Ewubare & Ushie, 2022). Over time, the exchange rate of a country's currency can increase or decrease in relation to another currency due to several variables. Depreciation of a currency can diminish its purchasing power in the global market, whereas appreciation can result in current account difficulties. This might lead to the currency becoming overvalued.

Managing interest rates and exchange rates poses significant challenges for policymakers, particularly in an increasingly interconnected and volatile global financial system. Central banks must balance domestic policy objectives with external considerations, mindful of the potential spillover effects on other economies and the risk of destabilising capital flows. A favourable exchange rate is expected to lower the cost of living, especially for developing countries that rely heavily on imports for consumption. For instance, the exchange rate between the naira and the US dollar significantly influences and moulds production activities in Nigeria. Nigeria relies heavily on the US dollar for imports, making it vulnerable to dollar fluctuations. Therefore, any fluctuations in the dollar's value will have a direct impact on Nigeria. Financial professionals and analysts are urging the Nigerian government to establish a partnership with China in order to reduce reliance on the US currency and enhance the value of the Nigerian naira, which has been depreciating. Given the importance of currency rates in both domestic and foreign economic activity, company owners are convinced that variations in exchange rates have tangible impacts, particularly on oil prices and a country's economic performance (Osıgwe, 2015).

We can analyse the correlation between the interest rate and the exchange rate by studying the demand and supply of foreign currency in the foreign exchange market. Speculators typically take advantage of higher interest rates in other countries to engage in foreign exchange trading and capitalise on increased profits. The comparatively higher interest rate may entice investors in Ghana to invest in Nigeria by acquiring Naira-based securities with the aim of generating a greater income. This would also enhance the value of the naira. Therefore, we anticipate that an increase in the interest rate will lead to an appreciation of the currency, specifically the naira, compared to the cedi. Conversely, a decrease in the interest rate would result in a devaluation of the naira.

Nigeria's interest rate strategy is to not only stimulate savings and investment but also to facilitate a favourable exchange rate, ensure financial stability, and alleviate pressure on the balance of payments (Ajayi, Oladipo, Ajayi, & Nwanji, 2017; Kalu & Mike, 2019). Following the financial sector regulator's partial deregulation of interest rates in 1987 in response to shifts in supply and demand for loanable money, interest rates have fluctuated. In 2006, the

Central Bank of Nigeria (CBN) eliminated all interest rate restrictions to promote savings, invest in productive sectors of the economy, and stabilise the completely liberalised exchange rate market. This is in line with the findings of Kalu and Mike (2019) and Ndubuaku, Ifeanyi, Nze, and Onyemere (2017).

Interest rates and exchange rates are central pillars of the international financial system, exerting profound influence on economic outcomes and financial market dynamics. The intricate relationship between these two variables underscores the complexity of monetary policy and the challenges of maintaining exchange rate stability in a globalised economy. A nuanced understanding of the mechanisms driving interest rates and exchange rates is essential for policymakers, investors, and market participants alike as they navigate the complexities of the modern financial landscape.

The transmission mechanism between interest rates and exchange rates operates through various channels. The differences in interest rates between countries drive capital flows as investors seek higher returns on their investments. Thus, capital flows influence exchange rates by altering the demand and supply dynamics of currencies in the foreign exchange market. Central banks use interest rate policies to achieve macroeconomic objectives such as price stability, full employment, and economic growth. Changes in interest rates can affect exchange rates directly through shifts in investment patterns, as well as indirectly through their impact on economic fundamentals. Market expectations regarding future interest rate movements and exchange rate trends play a crucial role in shaping current exchange rate dynamics. Forward rates, derived from interest rate differentials, reflect market participants' expectations about future exchange rate movements.

In addition to the impact of interest rates, money supply, which has an inverse relationship with interest rates, as well as social and institutional factors, impede Nigeria's exchange rate stability. As a developing economy plagued by insufficient capital, the rent-seeking culture and elevated corruption tendencies within the financial system, coupled with a significant increase in general interest rates, can have devastating effects on the Nigerian exchange rate, exerting enormous pressure on business entities and the economy as a whole. Therefore, interest rate, money supply growth, and institutional quality negatively impact Nigeria in terms of production and consumption through the transmission mechanism of exchange rates, among other monetary variables.

1.1. Background

Over the years, the Nigerian exchange rate has fluctuated widely against major currencies, especially the United States Dollar. Thus, since the mid-2000s, the CBN has adopted the use of interest rate adjustments as a policy tool to manage Nigeria's exchange stability. The monetary authority periodically increases the benchmark interest rate to attract foreign investments into the economy, thereby strengthening the Nigerian currency, the naira.

Researchers have differing opinions about the exact impact of interest rates on exchange rates. While some researchers are of the opinion that a negative link exists between interest rates and exchange rates, others argue that there is a positive link. Regrettably, researchers have conducted relatively few studies on the correlation between interest rates and exchange rates in Nigeria. Therefore, it is essential to investigate how interest rates impact the stability of Nigeria's exchange rate. Also, the majority of earlier studies considered the relationship between interest rate and exchange rate while neglecting the impact of money supply and institutional quality. To address this significant gap in the literature, this study included money supply growth and institutional quality as crucial control variables. It examined the relationship between interest rate, money supply growth, institutional quality, and exchange rate in Nigeria, both separately and collectively.

The study is important because it adds to what has already been done by using a unique set of variables, like the monetary policy rate and the prime lending rate, to look at how interest rates affect the stability of the exchange rate, which is measured by the Naira to US dollar rates. The study further enhanced previous research by incorporating growth in money supply and institutional quality as control variables for the independent variable, thereby enhancing the quality of the research outcome. This is because in developing countries, including Nigeria, research suggests

that institutional quality influences the performance of the countries' economic prospects, including exchange rate stability.

Finally, understanding the interplay between interest rates and exchange rates is crucial for Nigerian policymakers, investors, and market participants seeking to navigate the complexities of the global financial landscape during this time. The study's findings also helped to answer the question of whether the continued use of interest rates as a policy tool to manage exchange rate volatility is achieving the desired policy objectives in Nigeria.

The study consists of five sections. Section one discussed the background to the study, including the objectives, motivation, and significance of the study, while the second section focused on the review of the literature. Section three discussed the methodology used for the study, while section four presented the results and analysis of the findings. Section five summarizes the study's conclusion.

2. REVIEW OF THE LITERATURE

2.1. Theoretical Framework

The Interest Rate Parity (IRP) theory is the fundamental basis for understanding the link between interest rates and exchange rates. The IRP asserts that fluctuations in the exchange rate will counterbalance any disparities in interest rates between nations in a global economy with unrestricted money movement. This guarantees the equalisation of returns on comparable financial assets denominated in various currencies. This concept is critical for understanding the relationship between interest rates and exchange rates and how they affect each other.

John Keynes formalised the theory of interest rate parity in 1923. The theory focuses on how fluctuations in current and future exchange rates affect the disparity between foreign and domestic interest rates. The hypothesis posits that the disparity in interest rates between a nation and its trading counterparts is responsible for the fluctuation in the nominal exchange rate.

The parity criterion asserts that the domestic interest rate must be equivalent to the sum of the international interest rate and the anticipated fluctuation in exchange rates. The interest rate differential between a domestic economy and the global market is equivalent to the anticipated fluctuation in the domestic exchange rate. This theory states that the extra cost or reduction in the forward exchange rate for the foreign currency reflects the difference in interest rates between the two currencies. However, this only applies if one financial market does not buy and sell shares or currencies in order to profit from another.

Teall (2018) supported this idea by suggesting that investors borrow from countries with lower interest rates and invest in countries with higher rates in order to exploit the arbitrage opportunity. As a result, capital will migrate from an economy with low interest rates to one with high interest rates. Interest rate differentials and changes in exchange rates are considered to be the primary factors influencing international private capital flows, as stated by Keynes (1923) and Levich (2011). Depending on the presence or absence of a forward contract, we can classify interest rate parity as either uncovered or covered.

The uncovered interest rate parity hypothesis is a conventional and significant method for determining short-term exchange rates (Kurihara, 2015). When there is no possibility of arbitrage, interest rate parity is considered covered, even when using a forward contract. In cases of covered interest rate parity, investors would be indifferent as to whether they should invest in the interest rate of their domestic economy or the interest rate of a foreign one.

This theory is relevant to our study because it posits that exchange rates quickly adjust to changes in relative interest rates between two currencies in order to limit the chances of arbitrage. Interest rate differentials among international financial markets often mirror shifts in future economic fundamentals that influence exchange rate determination.

2.2. Empirical Review

There are only a few empirical studies that provide valuable insights into the relationship between interest rates and exchange rates across different countries and time periods. The different case studies and empirical studies also highlight the role of coordinated policy interventions and speculative pressures in shaping exchange rate dynamics amid changing interest rate environments.

Babalola (2021) investigated the influence of interest rates on Nigeria's exchange rate from January 2007 to April 2021. The data set was acquired on a monthly basis from the online database of the Central Bank of Nigeria (CBN). The study used lending rate, Treasury bill rate, savings/deposit rate, and time deposit rate as proxies for interest rates and utilised auto-regressive distributed lag and cointegration methods for the analysis. The findings indicate that, in the short term, only the Treasury bill rate has a substantial influence on the foreign exchange rate. Nevertheless, over time, all four variables used to represent interest rates had a substantial influence on the foreign exchange rate in Nigeria. Despite its relatively low speed, the adjustment or switch was both correctly signed and significant.

Mohammed, Mohammed, and Nketiah-Amponsah (2021) examined the relationship between exchange rate volatility and interest rates in Ghana. The study used a quarterly time series dataset from 2000 to 2017. The Autoregressive Distributed Lag Model and the Vector Error Correction Model were used to look into the long-term and short-term relationships between the variables. The study used the Central Bank's policy rate as a proxy for interest rates and money supply, inflation, and the Ghana Stock Exchange composite index as control variables. In the long run, the Central Bank's policy rate and money supply, inflation, and the Ghana Stock Exchange composite index all influenced exchange rate volatility, according to the study. However, the short-run model revealed that the Central Bank's policy rate and its past values significantly influence exchange rate volatility.

Musa and Sanusi (2020) examined the relationship between interest rate policy and exchange rate volatility in Nigeria, depending on whether the capital account is open or closed. The study used an Autoregressive Distributed Lag Model (ARDL) to estimate annual time series data from 1981 to 2017 sourced from the Central Bank of Nigeria (CBN) and the World Development Indicators (WDI). The study found that an increase in interest rate will depreciate the exchange in the long run regardless of whether the capital account is open or closed, and in the short run only when the capital account is open. As a result, the study recommended using interest rates to manage short-term temporary pressure on exchange rate volatility, as well as enforcing effective capital controls.

Antwi, Issah, Patience, and Antwi (2020) investigated the impact of macroeconomic factors on Ghana's currency rate using a multivariate modelling approach known as Vector Autoregression (VAR). The study used 76 quarterly observations from 2000–2019 to analyse the impact of broad money supply (M2), lending rate, inflation, and real Gross Domestic Product (GDP) on the management of the exchange rate in Ghana. The study's findings indicated that inflation, money supply, and loan rate do not have a Granger causality relationship with the exchange rate in Ghana. However, they do exert an indirect influence on the exchange rate. The study therefore suggests that the Bank of Ghana should implement a sound exchange rate strategy that involves decreasing the lending rate and money supply, in order to effectively reduce inflation. Consequently, this would generate opportunities for additional investments in the productive sector, leading to an expansion in the country's GDP and subsequently enhancing the value of its foreign currency.

Hashchyshyn, Marushchak, Sukhomlyn, and Tarasenko (2020) conducted a study to examine the effects of raising the key policy rate on a country's currency exchange rate. They reviewed studies conducted in 30 countries and used a meta-analysis procedure to combine the impact estimates. The study focused particularly on the case of Ukraine. The study discovered that there is a positive and statistically significant effect of short-term interest rate changes on the exchange rate. However, the study did not find any meaningful long-term association between interest rate changes and the exchange rate. Additionally, the study found that raising the primary policy rate in Ukraine temporarily increases the value of the Ukrainian currency, the hryvnia.

Konya, Küçüksucu, and Karaçor (2020) examined the correlation between panel data analysis techniques and several economic factors, such as money supply, inflation, interest rate, exchange rate, export, import, and oil prices. The study focused on emerging nations that share comparable characteristics with Turkey, covering the period from January 2010 to December 2018. The study employed co-integration analysis to examine the enduring correlation between the variables. The investigation discovered a persistent correlation among the variables. More precisely, they discovered that the exchange rate had a favourable impact on the money supply.

In their study, Andrieş, Căpraru, Ihnatov, and Tiwari (2017) examined the correlation between interest rates and exchange rates in Romania, a small, open emerging economy. They employed wavelet-based approaches for their analysis. The investigation revealed a negative association in the short run, validating the sticky price theories. In the long term, a positive relationship was observed, verifying the theoretical predictions of the purchasing power parity hypothesis. The study also found that in a small, open emerging economy that implements a direct inflation-targeting monetary policy mechanism, the connection between exchange rates and interest rates is fundamentally distinct from that in a developed economy. The study therefore suggested that the central bank must prioritise both variables equally in order to successfully achieve its monetary policy aims.

Ali, Mahmood, and Bashir (2015) employed the Vector Error Correction Model (VECM) and co-integration models to examine the influence of inflation, interest rates, and money supply on the volatility of currency rates in Pakistan. They observed that monetary policies play a vital role in maintaining price stability and decreasing unemployment. They determined that an elevated money supply and a rise in interest rates affect exchange rate volatility, leading to an increase in price levels, by analysing monthly data from July 2000 to June 2009.

Asari et al. (2011) conducted a study to examine the impact of interest rates and inflation on currency rate volatility in Malaysia. The study, conducted using the VECM approach, produced mixed results. The results revealed a direct correlation between interest rates and inflation, as well as an inverse correlation between interest rates and exchange rate volatility. Consequently, the study reached the conclusion that interest rates can effectively control exchange rate volatility in Malaysia.

3. METHODOLOGY

3.1. Research Design

The study employed an ex-post facto research approach to investigate the influence of interest rates on exchange stability in Nigeria during the period from 2006 Q1 to 2022 Q4. We deemed the research approach acceptable due to its prior application in similar studies, the established theoretical connections between interest rates and exchange rate stability, and the availability of relevant data for this analysis. Previous studies, such as those by Akadiri and Akadiri (2021), Gambacorta and Mistrulli (2014) and Nampewo (2021) have employed this research methodology.

3.2. Statement of Hypotheses

The objective of this study is to analyse the impact of interest rates on exchange rate stability in Nigeria. Therefore, the testable hypotheses are:

H_{01}: *Interest rates have no significant impact on exchange rate stability in Nigeria.*
H_{a1}: *Interest rates have a significant impact on exchange rate stability in Nigeria.*

3.3. Method of Data Analysis

This study utilised time series data and employed both descriptive and inferential statistics to examine the correlation between interest rates, money supply growth, institutional quality, and exchange rate in Nigeria. The descriptive analysis utilised statistical variables such as mean, minimum, maximum, and standard deviation. We evaluated the presence of multicollinearity and the degree of correlation among the explanatory variables using the Variance Inflation Factor (VIF) and Pearson's Product Moment Correlation.

We conducted unit root tests on the variables to assess their time series characteristics prior to conducting the regression analysis.

We conducted both the Augmented Dickey Fuller unit root test and the Phillip and Perron unit root test. We estimated the time series regression using the linear autoregressive distributed lag model. Pesaran and Pesaran (1997) demonstrated the applicability of the ARDL approach to variables with varying degrees of cointegration, which justified the decision to utilise this econometric technique. This is when variables possess a mixed order of I(0) and I(1), such as (1); (ii) the ARDL method is applicable to datasets with small or finite sample sizes (Pesaran, Shin, & Smith, 2001) (iii) simultaneous estimation of the short-run and long-run parameters is possible; and (iv) the method can accommodate structural breaks in time series data.

The ARDL approach to cointegration allowed the researchers to analyse both the short-term dynamics and the long-term relationship between the dependent variables, exchange rate and interest rate, money supply growth, and institutional quality.

3.4. Model Specification

The study investigated the impact of interest rates on exchange rates in Nigeria. The model for this relationship was based on the Interest Rate Parity Theory and the fundamental equation that governs the relationship between interest rates and currency exchange rates. The study adopted a multiple linear regression model to analyse the data. The model is appropriate for estimating the relationship between two or more independent variables and one dependent variable. While the model is not entirely different from past studies, the specific model used for the study included more variables than previously considered in studies of this nature in Nigeria by including money supply growth and institutional quality as independent variables. Therefore, the study used and changed models from earlier research by Wang et al. (2021) and Obamuyi and Demehin (2012) to find the model's functional relationship, which is shown in Equation 1:

$$EXR = f(MPR, PLR, MS, INSTQ) \quad (1)$$

Where EXR is the exchange rate, MPR is monetary policy rate, PLR is prime lending rate, MSG is money supply growth, and INSTQ is institutional quality. The estimable form of Equation 1 is specified in Equation 2.

$$EXR_t = \beta_0 + \beta_1 MPR_t + \beta_2 PLR_t + \beta_3 MSG_t + \beta_4 INSTQ_t + \mu_t \quad (2)$$

β_0 is the constant term and μ_t is the disturbance term. The parameters β_i (i= 1, 2 …, 4) are the coefficient of the respective variables.

The ARDL model for exchange rate is shown below:

$$\Delta EXR_t = \alpha_0 + \sum_{i=0}^{n1} \alpha_1 \Delta EXR_{t-i} + \sum_{i=0}^{n2} \alpha_2 \Delta MPR_{t-i} + \sum_{i=0}^{n3} \alpha_3 \Delta PLR_{t-i} + \sum_{i=0}^{n4} \alpha_4 \Delta MSG_{t-i} + \sum_{i=0}^{n5} \alpha_6 \Delta INSTQ_{t-i} +$$
$$\beta_1 MPR_{t-1} + \beta_2 PLR_{t-i} + \beta_3 MS_{t-1} + \beta_4 INSTQ_{t-1} + u_t \quad (3)$$

3.5. Apriori Expectation

The Interest Rate Parity states that in order to take advantage of interest differential opportunity, investors borrow from countries with lower interest rates and invest in countries with higher rates, thus strengthening the value of the currency with high interest due to the increased demand. Therefore, the study expected that an increase in lending and monetary policy rates and strong institutional quality would lead to an improvement in exchange rate, while an increase in money supply growth would result in a depreciation in the value of exchange rate.

4. PRESENTATION OF RESULTS AND ANALYSIS OF FINDINGS

4.1. Descriptive Statistics and Correlation

4.1.1. Descriptive Statistics

The study analysed quarterly data from Nigeria spanning from 2006Q1 to 2022Q4. Table 1 presents the descriptive statistics for both the dependent and independent variables, including the mean, maximum, minimum, standard deviations, and number of observations. We assessed the dependent and independent variables individually.

Table 1. Descriptive statistics of interest rates and exchange rate.

Variables	Mean	Maximum	Minimum	Standard deviation	Obs.
EXR	235.288	441.820	117.750	112.048	68
PLR	16.027	19.420	11.200	2.010	68
MPR	11.504	16.170	6.000	2.484	68
MSG	4.031	27.691	-7.269	5.289	68
INSTQ	0.011	0.427	-0.402	0.248	68

Note: Table 1 shows the mean, maximum, minimum, and standard deviation of the variables. The variable being measured is the exchange rate (EXR). The independent variables consist of prime lending rate (PLR), Monetary policy rate (MPR), Money supply growth (MSG), and institutional quality (INSTQ). The sample period spans from the first quarter of 2006 to the fourth quarter of 2022, encompassing a total of 68 quarterly observations. We utilised EVIEWS 12 for the estimation process.

4.1.1.1. Interpretation of the Descriptive Statistics

Exchange rate has a mean value of 235.29 with a standard deviation of 112.05. The mean value of 235.29 suggested that, on average, the exchange rate in Nigeria fluctuates at 235.29 between 2006Q1 and 2022Q4. Meanwhile, the standard deviation of 112.05 is relatively high, indicating that the exchange rate in Nigeria was highly susceptible to change between the periods 2006 Q1 and 2022 Q4. The minimum value of 117.75 and the maximum value of 441.82 indicated that Nigeria has different levels of exchange rates for the naira relative to the US dollar. This further indicates that the exchange rate of the naira is not stable relative to the US dollar; thus, the naira depreciates continuously.

4.1.2. Pearson Correlation Analysis

This section examines the level of correlation between the interest rate variables of Prime Lending Rate (PLR), Monetary Policy Rate (MPR), Money Supply Growth (MSG), Institutional Quality (INSTQ), and Exchange Rate (EXR) in Nigeria from 2006Q1 to 2022Q4.

Table 2. Correlation matrix for interest rates and exchange rate.

Variables	EXR	PLR	MPR	MSG	INSTQ	VIF
EXR	1.000					N/A
PLR	-0.644	1.000				1.108
MPR	0.539	-0.236	1.000			2.517
MSG	-0.132	-0.089	-0.110	1.000		1.040
INSTQ	0.518	-0.058	0.752	-0.170	1.000	2.415

Note: Table 2 shows the Pearson pairwise correlation matrix. Exchange rate (EXR) is the dependent variable, while prime lending rate (PLR), monetary policy rate (MPR), money supply growth (MSG), and institutional quality (INSTQ) are the regressors. The time frame under consideration spans from the first quarter of 2006 to the fourth quarter of 2022, encompassing a total of 68 quarterly observations. We used EVIEWS 12 to conduct the estimating process. The correlations are located below the main diagonal, whereas the final row labelled VIF serves as the test for multicollinearity.

4.1.1.2. Interpretation of Correlation Analysis

According to the correlation analysis in Table 2, there is evidence that monetary policy rate and institutional quality have a positive relationship with exchange rate in Nigeria; this implies that increases in the monetary policy rate and institutional quality will lead to an increase in the exchange rate. On the other hand, prime lending interest rate and money supply growth have a negative relationship with the exchange rate; thus, an increase in prime lending rate and money supply growth will lead to a fall in exchange in Nigeria.

We conducted a multicollinearity test and found that the variance inflation factor (VIF) for each explanatory variable was below 10. The Variance Inflation Factors (VIF) for prime lending interest rate, monetary policy rate, money supply growth, and institutional quality were 1.108, 2.517, 1.040, and 2.415, respectively. As a result, the four regressors used in the calculated model exhibited no correlation with one another.

4.1.3. Result of the Stationarity Test

A stationarity test was conducted to analyse the time series characteristics of the variables throughout the investigation. We employed two statistical tests, the Augmented Dickey Fuller (ADF) test and the Phillip-Perron (PP) unit root test, to determine the stationarity of the series. Table 3 presents the findings.

Table 3. Result of the unit root test.

Variables	ADF	PP	Remarks
EXR	-2.158	-2.212	
ΔEXR	-7.495***	-7.470***	I(1)
PLR	-2.001	-2.318	
ΔPLR	-6.871***	-6.861***	I(1)
MPR	-2.261	-2.443	
ΔMPR	-4.694***	-4.766***	I(0)
MSG	-5.847***	-8.547***	
ΔMSG	-10.634***	-37.186***	I(1)
INSTQ	-2.241	-2.139	
ΔINSTQ	-3.721***	-3.567***	I(1)

Note: Table 3 displays the unit root test. The dependent variable in this analysis is exchange rate (EXR), whereas the independent variables, or regressors, are prime lending rate (PLR), monetary policy rate (MPR), money supply growth (MSG), and institutional quality (INSTQ). The time frame under consideration spans from the first quarter of 2006 to the fourth quarter of 2022, encompassing a total of 68 quarterly observations. We used EVIEWS 12 for the estimating process. At a significance level of 5%, the critical value for the intercept and trend is -3.50, whereas the critical value for the intercept alone is -2.93. The symbols *** represent statistical significance at both 5% and 1% levels.

4.1.3.1. Interpretation of the Unit Root Test

The unit root test results shown in Table 3, along with the stationarity tests using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, show that Exchange Rate (EXR) was stable after the first difference. The unit root statistics for the ADF and PP unit root tests, which show more negative values than the crucial values at the 5 percent significance level, explain the observed result.

In addition, the data shows that all the regressors display first difference stationarity, except for the Monetary Policy Rate (MPR), which demonstrates stationarity at the level of significance of 5 percent. The study examines several regressors, including Prime Lending Rate (PLR), Money Supply Growth (MSG), and Institutional Quality (INSTQ). The analysis utilised the Autoregressive Distributed Lag (ARDL) model approach for cointegration, as provided by Pesaran and Pesaran (1997). This method considers the different levels of integration of the variables. This model allows for the incorporation of both level and first difference stationary variables. It is clear that the Autoregressive Distributed Lag (ARDL) method is the right one for cointegration analysis because it lets you look at both long- and short-term changes in the model at the same time.

Table 4. Interest rates and exchange rate stability.

Panel A: Long run estimates				
Dependent variable: EXR				
Variable	**Coefficient**	**S.E**	**t-stat**	**Prob**
C	3.732	0.534	6.991	0.000
PLR	-0.062	0.020	-3.068	0.004
MPR	-0.022	0.028	-0.757	0.454
MSG	-0.020	0.018	-1.132	0.264
INSTQ	0.860	0.338	2.546	0.015
Panel B: Short -run estimates				
Variable	Coefficient	S.E	t-stat	Prob
D(EXR(-1))	-0.038	0.138	-0.276	0.784
D(PLR)	0.001	0.005	0.107	0.916
D(PLR(-1))	0.003	0.005	0.598	0.553
D(MPR)	0.006	0.005	1.127	0.266
D(MPR(-1))	0.009	0.006	1.446	0.156
D(MSG)	-0.002	0.001	-2.042	0.048
D(MSG(-1))	0.000	0.001	-0.179	0.859
D(INSTQ)	-0.097	0.114	-0.855	0.398
D(INSTQ(-1))	-0.010	0.143	-0.068	0.947
ECT(-1)	-0.112	0.028	-3.971	0.000
Panel C: Diagnostic tests		Statistic	Prob.	
Bound test		6.343	0.000	
Adjusted R-square		0.642		
F-Statistic		53.813	0.000	
Serial correlation		0.137	0.872	
Heteroscedasticity		1.433	0.157	
Linearity test		1.729	0.177	
Normality		1.054	0.590	
		CUSUM	CUSUMSQ	
Stability test		Stable	Stable	

Note: Table 4 presents the long-term estimates, short-term estimates, and diagnostic tests for the correlation between interest rates and exchange rates. exchange rate (EXR) is the dependent variable, while the prime lending rate (PLR), monetary policy rate (MPR), money supply growth (MSG), and institutional quality (INSTQ) are the independent variables.

4.1.3.2. Interpretation of the Regression Analysis

Based on the estimated model in Table 4, the estimated equation is given as:

$$EXR_t = \beta_0 + \beta_1 MPR_t + \beta_2 PLR_t + \beta_3 MSG_t + \beta_4 INSTQ_t + \mu_t$$

$$EXR_t = 3.732 - 0.022 MPR_t - 0.062 PLR_t - 0.020 MSG_t + 0.860 INSTQ_t$$

4.1.3.3. Bound Test

Using the bound test to determine the likelihood of a long-term relationship, the findings indicate that the bound test statistics of 6.343 are statistically significant at 5 percent level. This is because the statistical significance of 6.343 exceeds the critical values of 4.26, 3.5, and 3.13 at 1 percent level. This implies that the variables have the possibility of a long-run co-integrating relationship. Based on the possibility of a long-run relationship between interest rates and exchange rates, the study then estimates the long-run and short-run elasticity. Table 4 reports the empirical results for the model on the short- and long-run effects of interest rates and exchange rates.

4.1.3.4. The Long-Run Dynamics

Panel A of Table 4 presents the estimated long-run coefficients (elasticities) for the ARDL model. In the long run, there is evidence that prime lending rate has a negative relationship with exchange rate. This implies that an increase in prime lending rate will lead to a decrease in exchange rate in Nigeria. Thus, a 1 percent increase in prime lending rate will lead to a 0.062 percent decrease in exchange rate. The results also revealed that prime lending rate

has a significant relationship with exchange rate in Nigeria (PLR = -0.062, t-test = -3.068, p < 0.05). This implies that prime lending rate is a significant factor influencing changes in exchange rate in Nigeria.

The results also indicate that monetary policy rate has a negative relationship with exchange rate. This implies that an increase in monetary policy rate will lead to a decrease in exchange rate. Thus, a 1 percent increase in exchange rate will lead to a 0.022 percent decrease in exchange rate. The results revealed that monetary policy rate has an insignificant relationship with exchange rate in Nigeria (MPR = -0.022, t-test = -0.757, p > 0.05). This implies that monetary policy rate is not a significant factor influencing changes in exchange rate in Nigeria.

Furthermore, there is evidence that money supply growth has a negative relationship with exchange rate in Nigeria. This implies that an increase in money supply will result in a decrease in exchange rate. Thus, a 1 percent increase in money supply growth will lead to a 0.020 percent decrease in exchange rate. The results revealed that money supply growth has an insignificant relationship with exchange rate in Nigeria (MSG = -0.020, t-test = -1.132, p > 0.05). This implies that money supply growth is not a significant factor influencing changes in exchange rate in Nigeria.

In addition, there is evidence that institutional quality has a positive relationship with exchange rate. This implies that increases in institutional quality will lead to an increase in exchange rate. Thus, a 1 percent increase in institutional quality will lead to a 0.860 percent increase in exchange rate. The results revealed that institutional quality has a significant relationship with exchange rate in Nigeria (INSTQ = 0.860, t-test = 2.546, p < 0.05). This implies that institutional quality is a significant factor influencing changes in Nigeria's exchange rate.

4.1.3.5. Short-Run Dynamics

This sub-section has two distinct objectives. Firstly, it is to assess if the changes and statistical significance observed in the long-term model also persist in the short-term model. The second step involves assessing the extent of readjustment towards equilibrium by analysing the error correction term. The error correction term ECT_{t-1} quantifies the short-term adjustment process, indicating the speed at which variables adapt to a disturbance and return to a state of balance. To ensure stability, it is critical that the ECT_{t-1} coefficient be negative and have a statistically significant value.

The results show that in the short run, prime lending rate has a positive and insignificant relationship with exchange rate in Nigeria. This result is at variance with the negative relationship experienced in the long run. In addition, there is evidence that monetary policy rate has a positive and insignificant relationship with exchange rate in the short run. This is also at variance with the results in the long run. Furthermore, the findings revealed that in the short run, money supply growth has a negative and significant relationship with the exchange rate, whereas institutional quality has a negative but insignificant impact on the exchange rate in Nigeria.

The results from the short run show that the cointegrating term is found to have the right sign and is significant as expected, implying that any deviation from the steady state is easily corrected for, in Nigeria. Thus, the estimated coefficient for the ECT_{t-1} reported in Panel B of 4.7 is negative and statistically significant (ECT = -0.112, t-test = -3.971, p < 0.05). This suggests that the following quarter corrects deviations from the exchange rate equilibrium path by approximately 11 percent. In other words, the adjustment process is relatively slow in Nigeria. The statistical significance of the ECT_{t-1} further confirms the presence of a long-run equilibrium relationship between interest rates and exchange rates in Nigeria.

The adjusted R-square stands at 0.642, indicating that the prime lending rate, monetary policy rate, money supply growth, and institutional quality account for about 64 percent of exchange rate changes, with the remaining 36 percent attributed to other factors not included in the model.

The F-test, which tests the null hypothesis that all coefficients in the model are zero, indicates the overall fit of the model. In this case, the F-test is significant at the 5% level, indicating that the model as a whole is a good fit for the data. Alternatively, the F-test statistic of 53.813 with a probability value of 0.000 implies that prime lending rate,

monetary policy rate, money supply growth, and institutional quality are joint significant factors influencing changes in exchange rate in Nigeria.

4.1.3.6. Decision Rule

The F-test statistic of 53.813, with a 5% level of significance and a degree of freedom of (4, 63), demonstrates statistical significance at the 0.05 level. This indicates the rejection of the null hypothesis, which holds that interest rates have no significant impact on exchange rate in Nigeria, and the acceptance of the alternative hypothesis, which asserts a significant impact.

4.1.3.7. Post-Estimation Test

To verify the precision and coherence of the parameters estimates and draw suitable conclusions from the findings, we conducted five diagnostic tests. The first test is the serial correlation test, which determines whether the error term may be uncorrelated. The second step involves verifying whether the error terms have equal, finite variances. This assumption is known as homoscedasticity. Heteroscedasticity is a violation of this assumption. Thirdly, there is the normalcy test, which assesses the extent of asymmetry, flatness, and peakedness in the distribution. The lack of significance in the Jarque-Bera test indicates that the data follows a normal distribution. The fourth test is the linearity test, which is employed to determine if the model is stated in a linear manner. If the Ramsey RESET test yields no significant results, it indicates a linear model statement. The stability test, which uses the CUSUM and CUSUMSQ methods, is the fifth test. To ensure the estimated model's stability, the CUSUM and CUSUMSQ statistics plots must remain within the boundaries of a 5% significance level, represented by two straight lines.

The results indicate that the consecutive error terms do not exhibit serial correlation. The F-statistic of 0.137 and a probability value of 87 percent, which is above the 5 percent threshold, support this. Therefore, we cannot reject the null hypothesis of serial correlation in the residuals. The study found that there was no correlation between the successive error factors in the estimated model for interest rates and exchange rate in Nigeria. The heteroscedasticity results indicate that the F-statistic of 1.433, with a probability value of 16 percent, is not statistically significant at a 5 percent level of significance. Therefore, we cannot reject the null hypothesis of homoscedasticity. This suggests that there is evidence supporting the assumption that the error terms have equal variances.
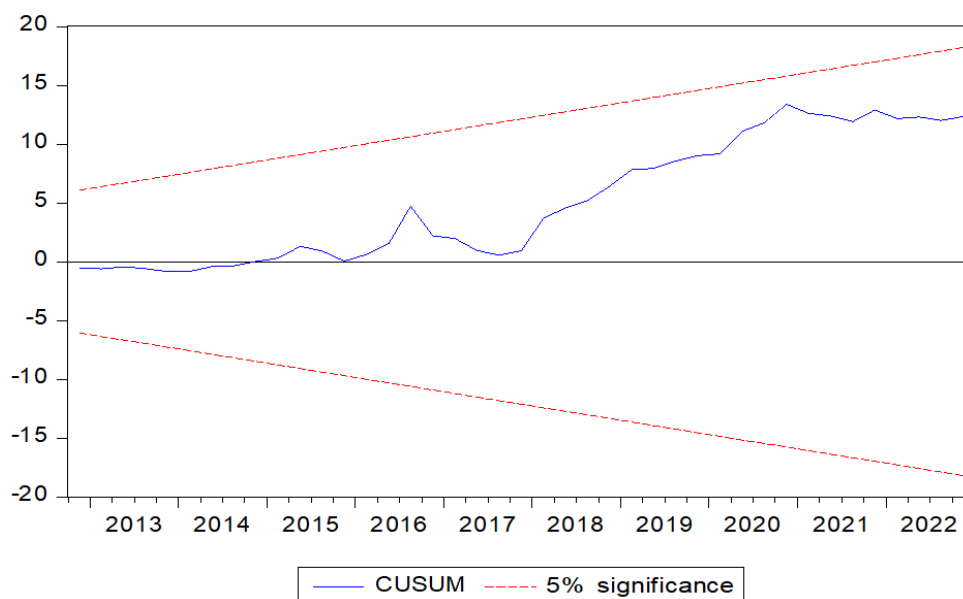

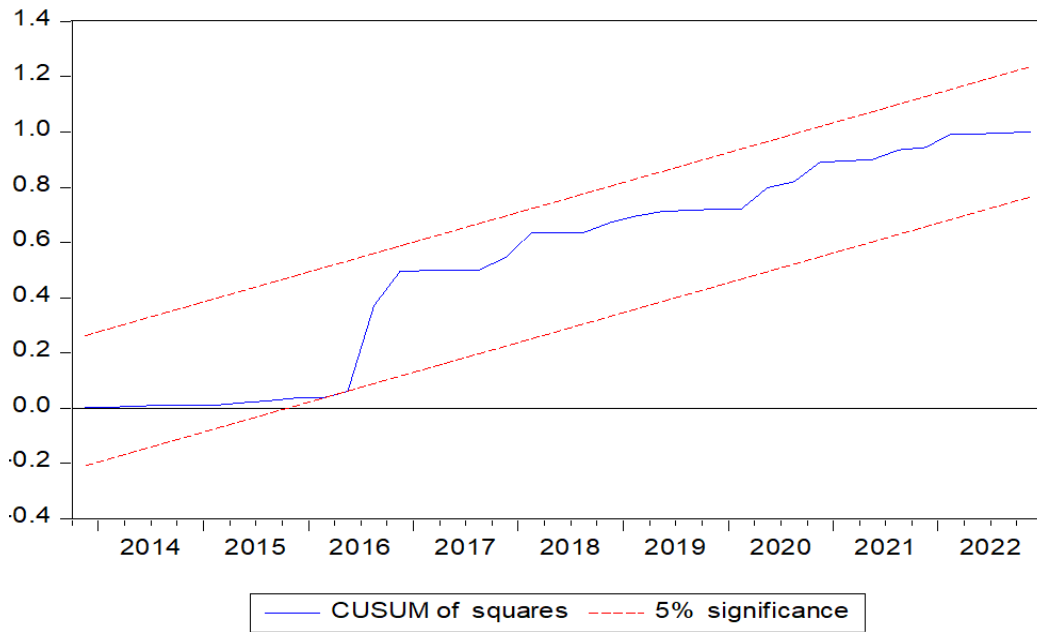**Figure 1.** Stability test - Plots of cumulative sum of residual.

Figure 2. Stability test - Plots of cumulative sum of square residual.

Furthermore, the Ramsey RESET test, which measures linearity, is not statistically significant. This comes with an F-statistic of 1.729 and a probability value of 18 percent, which is greater than 5 per level. Thus, the result confirms the correct specification of the estimated model and establishes a linear relationship between interest rates and exchange rates in Nigeria. Similarly, the Jarque-Bera statistic for the normality test yielded an F-statistic of 1.054, accompanied by a probability statistic of 59 percent, surpassing the 5 percent level of significance. Therefore, we did not reject the null hypothesis of normality. The CUSUM and CUSUMSQ numbers in Panel C, as well as Figures 1 and 2, demonstrate that the model is stable. Two straight lines indicate that the plots of the CUSUM and CUSUMSQ numbers remain within a 5% significance level.

4.2. Discussion of Empirical Findings

To achieve the objective of the study, the Autoregressive Distributed Lag (ARDL) model was used, and there is evidence of a long-run cointegrating relationship between interest rates and exchange rates. The long-run and short-run elasticities revealed the following results in the presence of a long-run cointegrating relationship: in the long run, prime lending interest rate, monetary policy rate, and money supply growth rate have a negative relationship with exchange rate, while institutional quality has a positive relationship with exchange rate in Nigeria. Additionally, there is evidence that prime lending rate and institutional quality have a significant relationship with the exchange rate in Nigeria; however, monetary policy rate and money supply growth have no long-run significant relationship with exchange rate in Nigeria.

The result shows that in the short run, prime lending rate, monetary policy rate, and money supply growth have a positive relationship with exchange rate in Nigeria, while institutional quality has a negative relationship with exchange rate. In addition, there is evidence that, in the short run, only money supply growth has a significant impact on exchange rate in Nigeria, while prime lending rate, monetary policy rate, and institutional quality have no significant relationship with the exchange rate in Nigeria. Also, the results of the hypothesis testing support the rejection of the null hypotheses that there is no significant effect of interest rates on exchange rate in Nigeria and the acceptance of the alternative hypothesis that there is a significant effect of interest rates on exchange rate in Nigeria.

The results of this study relate to the findings of some previous studies. One of them is Babalola (2021), which examined the impact of interest rates on the exchange rate in Nigeria using lending rate, Treasury bill rate, saving/deposit rate, and time deposit rate as proxies for interest rate. The study found that, in the short run, only

Treasury bill rate has a significant impact on the foreign exchange rate. However, in the long run, all four interest rate proxies have a significant impact on Nigeria's foreign exchange rate. Mohammed et al. (2021) studied the relationship between exchange rate volatility and interest rates in Ghana using the ARDL model and the VECM to investigate the long-run and short-run relationships between the variables. The study used the Central Bank's policy rate as a proxy for interest rate and money supply, inflation, and the Ghana Stock Exchange composite index as control variables. The study found that, in the long run, all the interest rate proxies influenced exchange rate volatility. However, in the short-run model, only the Central Bank's policy rate and past exchange rate values significantly influenced exchange rate volatility.

Hashchyshyn et al. (2020) conducted a study on the impact of increasing the key policy rate on the Ukrainian exchange rate. The study found a short-term appreciation of the Ukrainian currency, the hryvnia, in response to an increase in the key policy rate in Ukraine. Between 2010M1 and 2018M12, Konya et al. (2020) investigated the relationship between panel data analysis methods, money supply, inflation, interest rate, exchange rate, export, import, and oil prices in emerging economies with similar characteristics as Turkey. The study found that exchange rate had a positive effect on money supply. Andrieş et al. (2017) studied the relationship between interest rates and exchange rates in a small, open emerging economy of Romania using wavelet-based methodologies. The study found that in the short term, the relationship is negative, while over the long term, the relationship is positive.

Ali et al. (2015) used VECM and co-integration models to investigate the impact of inflation, interest rates, and money supply on the volatility of exchange rate in Pakistan and found that exchange rate volatility is influenced by high money supply and an increase in interest rate, which in turn raises the price level. Using the VECM approach, Asari et al. (2011) examined the impact of interest rates and inflation on exchange rate volatility in Malaysia. The results showed a positive relationship between interest rates and inflation but an inverse relationship between interest rates and exchange rate volatility.

5. CONCLUSION

The objective of the study was to examine the impact of interest rates on exchange rates in Nigeria. Using the Autoregressive Distributed Lags (ARDL) model to test the hypothesis, the study found that interest rates have a significant impact on exchange rate in Nigeria. The study therefore concluded that interest rates are significant factors influencing exchange rate in Nigeria.

The empirical analyses and findings revealed mixed results. In the long run, there is evidence that prime lending rate, monetary policy rate, and money supply growth rate have a negative relationship with exchange rate, whereas institutional quality has a positive relationship with exchange rate in Nigeria. Furthermore, there is evidence that prime lending rate and institutional quality have a significant long-term relationship with exchange rate in Nigeria, whereas monetary policy rate and money supply growth have no significant long-term relationship with exchange rate.

The result shows that in the short run, prime lending rate, monetary policy rate, and money supply growth have a positive relationship with exchange rate in Nigeria, while institutional quality has a negative relationship with exchange rate. In addition, there is evidence that, in the short-run, only money supply growth has a significant impact on exchange rate in Nigeria, while prime lending rate, monetary policy rate, and institutional quality have no significant relationship with the exchange rate in Nigeria. Also, the results of the hypothesis testing support the rejection of the null hypotheses that there is no significant effect of interest rates on exchange rate in Nigeria and the acceptance of the alternative hypothesis that there is a significant effect of interest rates on exchange rate in Nigeria.

As expected, the study found that interest rates have a negative impact on the exchange rate in Nigeria. This implies that the increase in interest rates led to lower exchange rates. The study also unexpectedly found that money supply growth also has the same effect on exchange rate in Nigeria. However, the combined effects of interest rates, money supply growth, and institutional quality accounted for only 64.2% of changes in exchange rate. The study also

found that the independence of the CBN, coupled with the adoption of free capital mobility and a fixed (or semi-fixed) exchange rate by the Nigerian government, is a violation of the principle of the "impossible trinity" of the fixed exchange rate mechanism.

In order to adhere to the concept of "impossible trilemma" in managing foreign exchange, the study suggested that the Nigerian government should review its exchange rate management policy and consider putting in place capital controls, switching to a floating exchange rate policy, or limiting the independence of the monetary authority.

5.1. Implications of the Study

The findings from this study have important implications for policymakers, investors, academics, and researchers in Nigeria and around the world. Investors and shareholders will find the results of this study valuable in guiding their investment decisions, while policymakers, the government agencies tasked with enforcing financial regulations and policies, will discover this study highly useful in adopting and implementing policy initiatives.

Investors: The study found that interest rates and money supply growth are very significant factors affecting the exchange rate in Nigeria, together accounting for approximately 60% of exchange rate volatility. This indicates that foreign investors need reliable and timely information on interest rates in order to make informed investment decisions in Nigeria. This study provides investors with useful information about the significance of monetary policy actions to their investment returns, asset allocation, portfolio investment diversifications, and many other decisions capable of adding economic value.

Policymakers: The study's findings contributed to Nigerian policymaking because of the limited effect of interest rates and money supply management (monetary policy actions) on exchange rate volatility. At best, monetary policy actions accounted for less than 64.2% of the exchange rate volatility in Nigeria. The remaining significant actions come from a fiscal and structural point of view and are outside of the CBN's purview. This work thus provides very valuable insights into identifying some efficient and effective methods of infusing interest rates with exchange rate management. The findings would presumably assist policymakers in Nigeria to understand that the sole dependence on the monetary authority to drive the exchange rate in the desired direction is not optimal.

Theory: This study made some theoretical contributions to the literature. The study reviewed the Interest Rate Parity theory as the underpinning theory(s) for the study and presented the theoretical framework, entailing the relevance of the theories to the study and the *apriori* expectations, thereby contributing to the existing knowledge from the theoretical point of view. The theory validates the ideology that interest rates are impacted by exchange rate volatility in Nigeria.

Literature: This study adds to the existing body of knowledge, enhancing it further. This is because researchers who are desirous of relevant information on interest rates and their impacts on exchange rate stability would find this study useful. Additionally, the study's findings on the impact of interest rates on exchange rates could serve as a reference point for future researchers, potentially sparking further research efforts.

Academia and Future Researchers: This study yielded results that were both consistent with previous studies and inconsistent with those already in existence. These findings contributed to the pool of studies from which future studies would draw data. These contributions included theoretical, conceptual, and empirical findings.

5.2. Limitation of the Study

The major limitation of the study was the unavailability of data on a weekly and monthly basis, as the initial plan for the study. Since this was not possible, the researchers reverted to using readily available quarterly data.

5.3. Suggestions for Further Research

To broaden the scope of knowledge and conduct additional research on interest rates and exchange rate stability, the study proposes the following recommendations:

i.   Further research should consider cross-country studies sharing a similar political and economic structure;

ii.   A similar study should be conducted for countries on other continents than Africa to determine the factors affecting their exchange rate. This will aid in the development of global policies and practices specific to different continents, which will improve exchange rate stability; and

iii. Further research is needed to explore the relationship between interest rates and exchange rates using more frequent data, such as daily, weekly, or monthly data. This was a major limitation of the present study, as the available information did not support the use of monthly data, which may have enhanced the results' reliability.

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