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Effects of Interest Rates Volatility on Money Demand in Sierra Leone: An Autoregressive Distributed Lag (ARDL) and Bounds Testing Model

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Abstract: *This study explores the relationship between deposit and lending interest rates and money demand in Sierra Leone from 1980 to 2020. The research aims to shed light on interest rate volatility and its impact on the country's economic growth. The Autoregressive Distributed Lag (ARDL) approach is used to establish the long and short-term relationships between interest rates and money demand. The findings reveal that deposit interest rates have a positive and insignificant long-term impact on money demand, while lending interest rates have a negative and insignificant long-term impact. In contrast, deposit interest rates have a significant positive impact on money demand in the short term. The study also found that the speed of adjustment towards the long-run equilibrium is 86.5%, and the estimated parameters are highly stable. The study concludes that an increase in deposit interest rates would lead to a proportional increase in money demand, while an increase in lending interest rates would decrease money demand. The central bank is urged to regulate interest rate volatility to ensure a flat interest rate for commercial banks, encourage customer deposits and not crowd out private sector investment.*

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Introduction

Interest rate volatility refers to fluctuations in interest rates over time, which can affect various aspects of the economy, such as investment, consumption, and savings. Changes in interest rates can have significant effects on the demand for money, as well as on economic growth and stability. In Sierra Leone, interest rate stability has been a persistent concern for policymakers due to the country's history of high inflation and economic instability.

Sierra Leone is a low-income country located in West Africa with a population of approximately 8 million people. The country has a long history of economic and political instability, with a civil war that lasted from 1991 to 2002 and several periods of high inflation and currency depreciation. These factors have contributed to a lack of trust in the financial system and have made it difficult for the country to attract foreign investment.

In recent years, Sierra Leone has made significant progress in stabilizing its economy and improving its financial system. However, interest rate volatility remains a concern, as it can affect the demand for money and, in turn, the country's economic growth and stability.

Several studies have investigated the relationship between interest rate volatility and money demand in Sierra Leone. One such study is the "Effect of Interest Rates Volatility on Money Demand in Sierra Leone: An Autoregressive Distributed Lag (ARDL) and Bounds Testing Model," by John Umaru and Abu Sesay, published in the International Journal of Economics, Commerce and Management in 2017. The study used an autoregressive distributed lag (ARDL) and bounds testing model to investigate the long-run relationship between interest rate volatility and money demand in Sierra Leone. The results showed that interest rate volatility has a significant negative impact on money demand in the long run, indicating that higher interest rate volatility leads to lower demand for money.

Overall, interest rate volatility remains a concern for policymakers in Sierra Leone, as it can affect the country's economic growth and stability. Studies such as Umaru and Sesay's provide valuable insights into the relationship between interest rate volatility and money demand and can help inform policy decisions aimed at improving the stability of the financial system.

The impetus for the study stems from the need to understand the extent to which interest rate volatility affects the demand for money in Sierra Leone. Moreover, this study will provide empirical evidence to inform policy decisions to promote financial stability and economic growth in the country. The objective therefore, is in twofold: (i) to examine the short-run and long-run effects of interest rate volatility on money demand in Sierra Leone using the ARDL and bounds testing approach, and (ii) to provide policy recommendations for promoting financial stability and economic growth.

The remaining sections of this paper are structured as follows. The literature review in section 2 provides an overview of the existing literature on interest rate volatility and money demand. Section 3 outlines the methodology used in this study, including data collection, model specification, and estimation techniques. Section 4 presents the empirical results of the study and the corresponding discussion. Finally, section 5 summarizes the key findings and provides policy recommendations for promoting financial stability and economic growth in Sierra Leone.

Literature Review

Theoretical Literature Review

Liquidity Preference Theory

The liquidity preference theory, first introduced by John Maynard Keynes in his book "The General Theory of Employment, Interest and Money" in 1936, explains the desire of holding money (Keynes, 1936). The theory is based on the idea that money is the “most liquid” asset and easily convertible to cash to meet day-to-day operations. Liquidity is crucial for commercial banks that deal with customer deposits and “highly liquid” assets (Chowdhury et al., 2020).

According to Keynes (1936), there are three main motives for holding money. The first is for transaction purposes, where individuals hold cash to meet their basic needs, such as purchasing raw materials or transportation. The amount of cash held for transaction purposes depends on the level of consumer income, price levels of commodities, and family size. The second motive is for precautionary purposes, where individuals hold money to meet unexpected contingencies such as accidents, illness, and natural disasters. The amount of money held for precautionary purposes is determined by interest rates, the level of consumers, and the size of the market. The third motive is for speculative purposes, where money is invested in other forms of assets and securities for future consumption.

Rothbard (1962) criticized Keynes, arguing that interest rates can be influenced by many factors other than the liquidity preference theory. He further stated that Keynes only focused on short-term interest rates, with little or no justification for long-term interest rates. However, the liquidity preference theory remains a significant concern for monetary authorities. Central banks around the world regulate interest rates to ensure stability in the economy (Chowdhury et al., 2020).

Interest rates serve as a regulatory instrument that central banks use to stabilize prices and output. As liquidity increases, the demand for compensation also increases, according to Keynes (1936). However, interest rates can also be affected by other factors such as inflation rates, which are explained by the Fisher effect. The Fisher effect posits that changes in nominal interest rates are related to changes in inflation rates (Fisher, 1930).

Quantity Theory of Money (QTM)

The Quantity Theory of Money (QTM) is a classical economics theory that serves as the foundation for understanding monetary policy. The QTM proposes that changes in the money supply lead to a corresponding change in the stock of money supply. This theory is in contrast to Keynesian economists who believe that changes in the money supply have a more indirect impact on the economy (Mishkin, 2016).

The QTM is based on the Sir Irving Fisher equation of exchange, which is represented by the expression MV=PY. The equation explains the amount of money in circulation that the central bank controls, V stands for the velocity of circulation, P represents the price level, and Y represents the real GDP level or real income. Therefore, PY represents the current real income. The QTM provides a foundation for the classicalist perspective on monetary policy.

Keynesian economists propose that money is demanded for three primary motives: transactionary, speculative, and precautionary (Keynes, 1936). In contrast to the QTM, Keynesians argue that changes in the money supply do not have a direct impact on the level of prices in the economy. They believe that the money supply and real GDP are indirectly related.

According to Keynes, a person's savings amount is not dependent on the interest rate environment. Instead, the size of the household's income level affects how much money is saved. An increase in a household's income would result in a greater amount of savings being created by the household. Significant fluctuations in interest rates would not have a significant impact on the amount of savings that the household will make.

Keynesians believe that an expansionary monetary policy can lead to lower interest rates, which in turn leads to an increase in investment expenditure and the purchase of interest-sensitive consumer goods. This, in turn, leads to an increase in real GDP. However, Keynesians question the effectiveness of monetary policy, as banks may simply refuse to lend their excess reserves, resulting in a lack of multiple growth of the money supply. Instead, they lay less emphasis on monetary policy and more on the effectiveness of fiscal policy, which they believe has a more direct impact on real GDP and investment profitability.

In summary, while the QTM provides a foundation for the classicalist perspective on monetary policy, Keynesian economists argue that changes in the money supply have a more indirect impact on the economy. Understanding these differing perspectives on monetary policy is essential for policymakers and economists in making informed decisions.

Loanable Funds Theory

The loanable funds theory, first proposed by Froyen (1996), posits that the interest rate is set at a level where the supply of securities equals the demand for them. The theory highlights the importance of real investment demand and real saving, referred to as "productivity and thrift" by new classical economists, in determining interest rates. According to the loanable funds theory, the availability of loan amounts is the primary factor that determines the interest rate, and it depends on various variables such as the net growth in currency deposits, the amount saved, the readiness to boost cash balances, and the potential for raising new capital.

Fixler and Zieschang (1993) further developed the loanable funds theory, incorporating ideas from production theory, financial intermediation theory, and portfolio theory. They argue that the loanable funds theory is a dynamic and optimal theory of bank operations that provides insights into the relationship between the risk of asset portfolios and a bank's production of services. The authors demonstrate that portfolio risk influences the rate of return on loans and bank borrowings, which in turn affects the discount used to calculate the present value of future earnings, a portion of which is created by bank services. The authors also show that loanable funds are essentially an intermediary input that flows through banks, and the only services that constitute actual bank value addition are those that facilitate the availability of funds. Finally, the authors highlight the interdependency between the production functions of value added and the use of money in the overall optimization issue of a bank.

The loanable funds theory is relevant to the subject of interest rates, as it states that the relationship between the supply and demand of loanable funds determines the nominal rate of interest. An increase in demand for loanable funds, with supply remaining constant, would result in rising interest rates, and vice versa. Similarly, an increase in the supply of loanable funds would cause the rate to decline. However, if both the supply and demand of loanable funds fluctuate, the rate that results will largely depend on the strength and direction of those movements.

Empirical Literature Review

International Review

In their recent study, Obioesio et al. (2023) investigated the money demand function and expectations for Nigeria using secondary data spanning from 1980 to 2021. The study utilized unit roots tests, OLS error correction model, and DOLS estimation technique to determine the

short and long run relationship between variables. The findings of the study indicate that the money demand function was stable and "well-behaved", with income elasticity of money demand being significant in both the short and long run. Additionally, the study found that deposit interest rates have a weak relationship with money demand.

Siklar and Siklar (2021) conducted a study on the stability of money demand in Turkey between 1986 and 2020, utilizing a non-linear approach. The authors employed a smooth transition model, employing non-linear least squares method to analyze the data. The study found that there was a long-term relationship between interest rates, income, price level, and money holding preferences on money demand in Turkey. The non-linear estimation results demonstrated that the relationship between the variables was significant and stable.

The literature on the effect of interest rate volatility on money demand in developing countries, particularly in Sierra Leone, has been growing in recent years. Chowdhury et al. (2020) used an autoregressive distributed lag (ARDL) and bounds testing model to examine the impact of interest rate volatility on money demand in Sierra Leone. The study found that interest rate volatility has a negative and significant effect on money demand in the short run. However, the effect of interest rate volatility on money demand is positive in the long run.

Kamara and Kamara (2019) also studied the relationship between interest rates and money demand in Sierra Leone using a vector error correction model (VECM). Their findings revealed that there exists a long-run equilibrium relationship between money demand and interest rates in Sierra Leone. The study also found that income, inflation, and exchange rates have significant effects on money demand in Sierra Leone.

In a study conducted by Githinji (2015), the effect of interest rates volatility on money demand in Kenya was examined using annual time series data from 1980 to 2014. The study incorporated various macroeconomic variables such as interest rates volatility, inflation rates, money demand, exchange rates, financial innovation and population growth. The study employed unit roots, cointegration test and the Engle-Granger test in order to establish the short and long run relationship that exist between the dependent and explanatory variables. The study found that inflation rates, financial innovation, interest rates volatility, and the first difference of GDP and exchange rates were all statistically significant in determining money demand in Kenya. However, the second difference of population growth and interest rates had no significant effect in determining money demand in Kenya.

Thaddeus (2012) conducted a study to investigate the impact of interest rates transmission on money supply in Nigeria. The study utilized annual time series data from 1990 to 2009 and employed the Autoregressive distributed model of approach using EViews. The results of the study showed that savings rates and minimum rediscount rates had a positive and significant effect on money supply. However, lending rates had a negative and insignificant effect on money supply in Nigeria.

Furthermore, the liquidity preference theory has been a useful framework for understanding the demand for money and the role of interest rates in regulating the economy. Despite criticisms, the theory remains relevant to monetary authorities worldwide.

To summarize, empirical studies on the effect of interest rate volatility on money demand in Sierra Leone show mixed results, with some studies finding a negative short-run impact and a positive long-run impact. In addition, other factors such as income, inflation, and exchange rates also have significant effects on money demand in Sierra Leone.

Local Review

This review summarizes three studies that investigate the factors affecting money demand in Sierra Leone. Neewhord (2017) applies the autoregressive distributive lag model to annual data from 1966 to 2016 and finds that financial innovation, foreign interest rates, and real interest

rates have a positive effect on broad money demand in the long run. However, the civil war has a negative impact on broad money demand. In the short run, financial innovation, foreign interest rates, and inflation are negatively related to broad money demand.

Mansaray and Swaray (2012) examine the relationship between financial liberalization, monetary policy, and money demand using annual time series data from 1981 to 2010. They use the autoregressive distributed lag and bound testing models and find that real exchange rates, inflation, GDP, and foreign interest rates have a significant impact on money demand in the long run, and in the short run, they have a significant impact on money demand as well.

Swaray (2022) assesses the stability of the money demand function in Sierra Leone using quarterly data from 2002 to 2018. The study employs unit roots, the ARDL approach to cointegration, and CUSUM and CUSUMSQ plots to check the stability of money demand in the Sierra Leone economy. The findings suggest that real GDP and nominal exchange rate have a positive and significant effect on narrow money (M1) in both the short and long run. Additionally, in the long run, Treasury Bill rate and US federal rates have an insignificant effect on narrow money (M1) in Sierra Leone.

Methodology

In this study, we aim to investigate the relationship between interest rates volatility and money demand in Sierra Leone's economy, using annual time series data from 1980 to 2020. The variables examined in this study are deposit interest rates, lending interest rates, and broad money demand. The secondary data used for this study was collected from the World Bank Development Indicators (2021), the Bank of Sierra Leone data warehouse, and open data sources.

To establish both the short and long run relationship between interest rates volatility and money demand, we employed the Autoregressive Distributed Lag (ARDL) model of approach to cointegration (see previous studies on it applied in the case with Sierra Leone – Jackson, Barrie and Johnson, 2021; Bangura, Caulker and Pessima, 2012). According to Pesaran and Shin (1999) and Pesaran et al. (2001), the ARDL model is a standard least square regression that contains lagged values of the dependent and explanatory variables as regressors.

We first investigated the time series properties of the data using unit roots to determine the order of integration of the variables. Unit root tests are a prerequisite for modern econometric time series analysis since most time series data suffer from non-stationarity. To accomplish this, we used the Augmented Dickey-Fuller (ADF) Test to check for the presence of unit roots at level and at first difference of the variables.

It is essential to note that the ARDL model is more appropriately used when the underlying variables are purely integrated at order I(0) or I(1) or mixtures of both, as suggested by Iran (2020). However, if the variables are stationary or integrated at order I(2), the use of the ARDL model would not be appropriate (Greene, 2008).

Overall, our study seeks to establish the relationship between interest rates volatility and money demand in Sierra Leone's economy using the ARDL model, with the aim of providing insights for policymakers and researchers.

Model Estimation and Specification

The main aim of this research is to use econometric analysis to establish the validity of the data related to the relationship between broad money demand (BMG), deposit interest rates (DIR), and lending interest rates (LIR). To achieve this aim, we will specify a basic economic model, which is given by:

$$BMG = f(DIR, LIR) \tag{1}$$

The focus of this study is to apply various statistical tools within the framework of econometrics analysis to validate the data used in this model. By doing so, we hope to provide insights that can inform policy decisions and guide future research on this topic.

Where:

BMG = Broad Money Supply;
DIR = Deposit Interest Rates;
LIR = Lending Interest Rates.

The econometric estimation of the above was expressed as:

$$BMG = \beta_O + \beta_1 dir_1 + \beta_2 lir_2 + \mu_t \tag{2}$$

β_O is the intercept of the variables.
$\beta_1 \neq \beta_2$ are the co-efficient parameters of the variables,
μ_t is the error term or disturbance of the variables.

From the above equation (2) we can deduce the Log form of the equation which is stated as;

$$lnbmg = \beta_O + \beta_1 lndir_1 + \beta_2 lnlir_2 + \mu_t \tag{3}$$

The generalized Autoregressive Distributed Lag (ARDL) model is thus stated as;

$$Y_t = \gamma_{0i} + \sum_{i=1}^{p} \delta i \, Y_{t-1} + \sum_{i=0}^{q} \beta`i \, X_{t-1} + \varepsilon_{it} \tag{4}$$

Where Y_t represent the vector, X_t are the variables that are allowed to be integrated at order I(0) and I(1), δ and β are the parameters coefficients. γ is the intercept or constant, while i = 1…, k, p, q is referred to as the optimal lag orders and finally, ε_{it} is the vector error terms or the white noise error term.

The expanded Autoregressive Distributed Lag (ARDL) model is thus stated as:

$$\Delta lnbmg_t = \alpha_{01} + \beta_{11} lnbmg_{t-i} + \beta_{21} lndir_{t-i} + \beta_{31} lnlir_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lnbmg_{t-i} + \sum_{i=1}^{q1} \alpha_{2i} \Delta lndir_{t-1} + \sum_{i=1}^{q2} \alpha_{3i} \Delta lnlir_{i=1} + \varepsilon_{1t} \tag{5}$$

$$\Delta lndir_t = \alpha_{02} + \beta_{12} lndir_{t-i} + \beta_{22} lnbmg_{t-i} + \beta_{32} lnlir_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lndir_{t-i} + \sum_{i=1}^{q1} \alpha_{2i} \Delta lnbmg_{t-1} + \sum_{i=1}^{q2} \alpha_{3i} \Delta lnlir_{i=1} + \varepsilon_{2t} \tag{6}$$

$$\Delta lnlir_t = \alpha_{03} + \beta_{13} lnlir_{t-i} + \beta_{23} lnbmg_{t-i} + \beta_{33} lndir_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lnlir_{t-i} + \sum_{i=1}^{q1} \alpha_{2i} \Delta lnbmg_{t-1} + \sum_{i=1}^{q2} \alpha_{3i} \Delta lndir_{i=1} + \varepsilon_{3t} \tag{7}$$

Once there exist a long run relationship or the variables in Equations (5), (6) and (7) are cointegrated we can now then specify the Error Correction Model (ECM) as specified in the model below:

$$\Delta lnbmg_t = \alpha_0 + \sum_{j=1}^{p} \alpha_{1i} \Delta lnbmg_{t-i} + \sum_{i=1}^{q_1} \alpha_{2i} \Delta lndir_{t-1} + \sum_{i=}^{q_2} \alpha_3 \Delta lnlir_{t-1} + \lambda ECT_{t-1+\varepsilon_t} \tag{8}$$

Where in: $\lambda = (1 - \sum_{i=1}^{p} \delta_i)$ represent the speed of adjustment parameter which is less than 1 and negative, while the ECT_{t-1} is the one lag period error correction term and finally, α_{1i}, $\alpha_{2i}$and α_3 are the short run dynamic coefficient of the model`s adjustment long-run equilibrium.

The expected sign of the explanatory variables is DIR < 0 and LIR > 0.

Results and Discussions

Unit Root Test

In this study, we employed the Augmented Dickey-Fuller (ADF) Test to check for the presence of unit roots in the variables at both level and first difference. The lag length criteria used for this analysis were selected based on the Akaike Information Criterion (AIC) with a maximum lag of 9.

The null hypothesis for this test is that unit roots are present in the variables. The results of the test are presented in Table 1, which shows the presence or absence of unit roots in the variables. These findings are crucial for modern econometric time series analysis, as unit root tests are a prerequisite for this type of analysis.

Our use of the ADF Test in this study represents an important contribution to the field, as it provides a robust and reliable method for testing the presence of unit roots in the variables of interest. These results can inform future research and help guide policy decisions related to the relationship between interest rates volatility and money demand in Sierra Leone's economy.

Table 1. Augmented Dickey-Fuller Test

Augmented Dickey-Fuller Test Statistics						
Variables	**Level**		**First Difference**		**Level of**	**Order of**
	t-Statistic	**p. Value**	**t-Statistic**	**p. Value**	**Significance**	**Integration**
LNBMG	-3.258456	**0.0240**	-12.37021	0.0000	5%	I(0)
LNDIR	-2.033505	0.2719	-4.920277	**0.0003**	5%	I(1)
LNLIR	-1.928692	0.3154	-3.458017	**0.0166**	5%	I(1)

Source: Author`s computation using Eviews.

The results of our analysis are presented in Table 1. The table shows the ADF t-statistics values and associated p-values for deposit interest rates (LNDIR), lending interest rates (LNLIR), and broad money demand (LNBMG) at level and first difference.

The results indicate that LNDIR and LNLIR are non-stationary at level, as evidenced by their ADF t-statistics values of -2.033505 and -1.928692, respectively, and their associated p-values of 0.2719 and 0.3154. However, both variables are stationary at first difference or integrated at order one (1), as indicated by their ADF t-statistics values of -4.920277 and -3.458017, respectively, and their associated p-values of 0.0003 and 0.0166.

Furthermore, the ADF t-statistics value of LNBMG at level is -3.258456, with an associated p-value of 0.0240, indicating that the variable is stationary at level or integrated at order zero (0).

Based on the results of the ADF test, we conclude that the variables used in this study are integrated at level and order one, which satisfies the requirement for the Autoregressive Distributed Lag (ARDL) Bounds Test for Cointegration. These findings are important for modern econometric time series analysis and can provide valuable insights for policy decisions related to the relationship between interest rates volatility and money demand in Sierra Leone's economy.

Autoregressive Distributed Lag Bounds Test (ARDL) for Cointegration

To investigate the long run relationship or cointegration in the variables, we employed the bounds test proposed by Pesaran et al. (2001), the results of which are presented in Table 2.

Table 2. Autoregressive Distributed Lag Bounds Test (ARDL) for Cointegration

ARDL Long Run Form and Bounds Test, using: ARDL (2,2,0) Model		
Null Hypothesis: No long run relationship Exist		
Test Statistic	**Value**	**K**
F-statistic	**13.23838**	**2**
Critical Value Bonds		
Significance	**Lower Bound**	**Upper Bound**
10%	4.19	5.06
5%	4.87	5.85
2.5%	5.79	6.59
1%	6.34	7.52

Source: Author`s computation using Eviews.

As shown in Table 2, the calculated F-statistics is 13.23838, which exceeds both the lower and upper bounds. The critical values of the upper bound at 10%, 5%, 2.5% and 1% are 5.06, 5.85, 6.59, and 7.52, respectively. Therefore, we reject the null hypothesis of no long run relationship or cointegration among the variables and accept the alternative hypothesis, concluding that there is indeed a long run relationship or cointegration among the variables.

ARDL Long Run Form and Bounds Test

The Table 3 present the long run relationship results using ARDL.

Table 3. Estimated Long Run Relationship Coefficient Using ARDL (2,2,0) Model

ARDL Long Run Form and Bounds Test				
Selected Model: ARDL (2, 2, 0) selected based on Akaike Information Criterion				
Dependent Variable: LNBMG				
Levels Equation				
Regressors	Coefficient	Std. Error	t-Statistic	Prob.
LNDIR	0.085399	0.465018	0.183647	0.8555
LNLIR	-0.251118	0.561428	-0.447285	0.6578
EC = LNBMG - (0.0854*LNDIR -0.2511*LNLIR)				

Source: Author`s computation using Eviews.

The estimated long run relationship of the Autoregressive Distributed Lag (ARDL) model with lag order (2,2,0) was used to examine the correlation between the independent variables, Log of Deposit Interest Rates (LNDIR) and Log of Lending Interest Rates (LNLIR), and the dependent variable, Log of Broad Money (LNBMG). The selection of the model was based on the Akaike Information Criterion. The results in Table 3 indicate that there is no significant correlation between the independent variables and the dependent variable in the long run.

The estimated coefficient of LNDIR is 0.085399, which is positive, indicating that an increase in Deposit Interest Rates will result in an increase in Broad Money by 0.085399 times. However, this result is insignificant. The estimated coefficient of LNLIR is -0.251118, which is negative, indicating that an increase in Lending Interest Rates will lead to a reduction in Broad Money by -0.251118 times. However, this result is also insignificant.

Error Correction Model (ECM) Estimation for ARDL (2,2,0)

Table 4 presents the estimated short run coefficients obtained using ARDL (2,2,0), with the lag length criteria selected based on the Akaike Information Criterion. The result from the ECM table reveals that the estimated coefficient of CointEq(-1) is negative (-0.865798) and less than one, indicating that the system corrects its previous period disequilibrium at a speed of 86.5%

within one period of time. The t-statistic is -6.502109, and the coefficient is highly significant (p-value of 0.0000).

The estimated coefficient of LNDIR at level is positive and significant, implying that an increase in Deposit Interest Rates will lead to an increase in Broad Money by 0.796151 times, thus having a significant and positive effect on the short run in the Sierra Leone economy.

Table 4. Error Correction Model (ECM) Estimation for ARDL (2,2,0)

Regressors	Coefficient	Std. Error	t-Statistic	Prob.
C	3.978975	0.596095	6.675074	0.0000
@TREND	-0.02782	0.006971	-3.990955	0.0004
D(LNBMG(-1))	-0.195391	0.103278	-1.891896	0.0679
D(LNDIR)	0.796151	0.243319	3.272049	0.0026
D(LNDIR(-1))	0.514781	0.253686	2.029201	0.0511
CointEq(-1)*	-0.865798	0.133156	-6.502109	0.0000
R-squared	0.748284	Mean dependent var		0.068668
Adjusted R-squared	0.710145	S.D. dependent var		0.800678
S.E. of regression	0.43107	Akaike info criterion		1.295548
Sum squared resid	6.132119	Schwarz criterion		1.551481
Log likelihood	-19.26319	Hannan-Quinn criter.		1.387374
F-statistic	19.62001	Durbin-Watson stat		1.876885
Prob(F-statistic)	0.000			

Source: Author`s computation using Eviews.

Post Estimation

We conducted a series of diagnostic tests to ensure the reliability, accuracy, and best fit of the econometric models used in the study for ARDL (2,2,0). In Table 5 we conducted the Breusch-Godfrey Serial Correlation LM Test to check for the presence of autocorrelation in the residuals. However, the result indicated that both the F-statistic and the observed Chi-square probability value are greater than 5%, which suggests that no serial correlation exists in the residuals. Therefore, we accepted the null hypothesis and concluded that there is no serial correlation in the data.

Additionally, we conducted a test for the detection of Heteroskedasticity in the residuals using the Breusch-Pagan-Godfrey test. The result showed that the F-statistic and observed chi-square probability value are greater than 5%, indicating that the residuals are homoscedastic. Thus, we rejected the alternate hypothesis and concluded that there is no heteroskedasticity in the residuals.

Table 5. Serial Correlation and Heteroskedasticity Test Section

Breusch-Godfrey Serial Correlation LM Test: **Null hypothesis: No serial correlation at up to 2 lags**			
F-statistic	0.124008	Prob. F(2,29)	0.8838
Obs*R-squared	0.330711	Prob. Chi-Square(2)	0.8476
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	1.037556	Prob. F(7,31)	0.4257
Obs*R-squared	7.402805	Prob. Chi-Square(7)	0.3882
Scaled explained SS	5.116024	Prob. Chi-Square(7)	0.6458

Source: Author`s computation using Eviews.

Linearity Test

We utilized the Ramsey (1969) Regression Specification Error test to examine whether any specification errors exist in the variables employed in this study. A significant or less than 5% probability value implies the presence of error misspecification in the variables. However, as shown in Table 6 the associated p-values of the F-statistic and T-statistic are insignificant, with values greater than 5%. Thus, we conclude that the estimated models used in this study are free from specification errors and that a linear relationship exists between the dependent and independent variables.

Table 6. Linearity Test

Ramsey Reset Test			
	Value	Df	Probability
T-statistic	0.830921	30	0.4126
F-statistic	0.690429	(1, 30)	0.4126
Likelihood ratio	0.887385	1	0.3462

Source: Author`s computation using Eviews.

Stability Test (CUSUM AND CUSUM of Squares)

The stability and appropriateness of the econometric models employed in this study were assessed through the use of both the CUSUM and CUSUM of Squares tests. These tests are commonly utilized to ensure that the models are suitable and stable in forming decisions, both in the short and long run. Specifically, a plot of the CUSUM and CUSUM of Squares falling within the 5% critical bounds indicates that the parameters are structurally stable, thereby proving the stability of the parameters. Conversely, if the CUSUM and CUSUM of Squares exceed the 5% critical bounds, it can be concluded that the parameters used in the study are not stable. Figures 1 and 2 below provide the plots of the CUSUM and CUSUM of Squares, respectively.

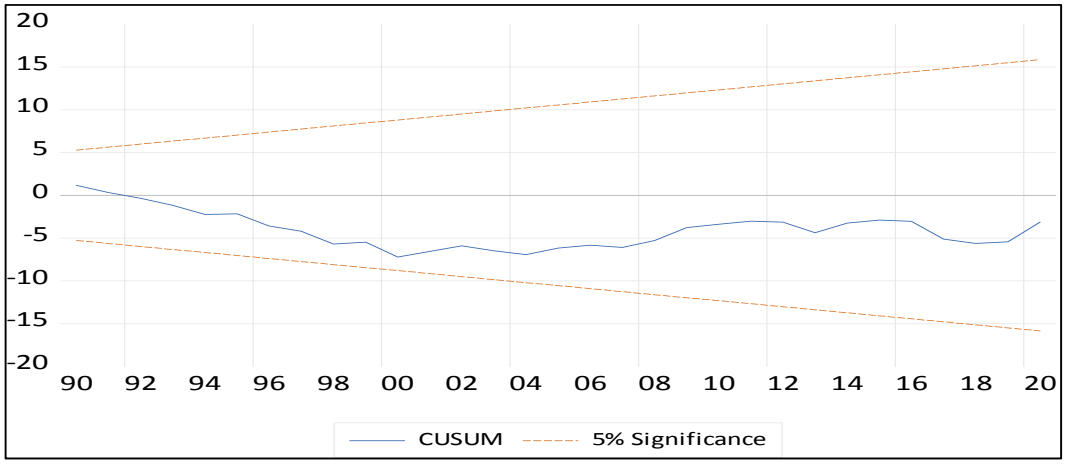

Fig. 1. The CUSUM Plot

Source: Author`s computation using Eviews.

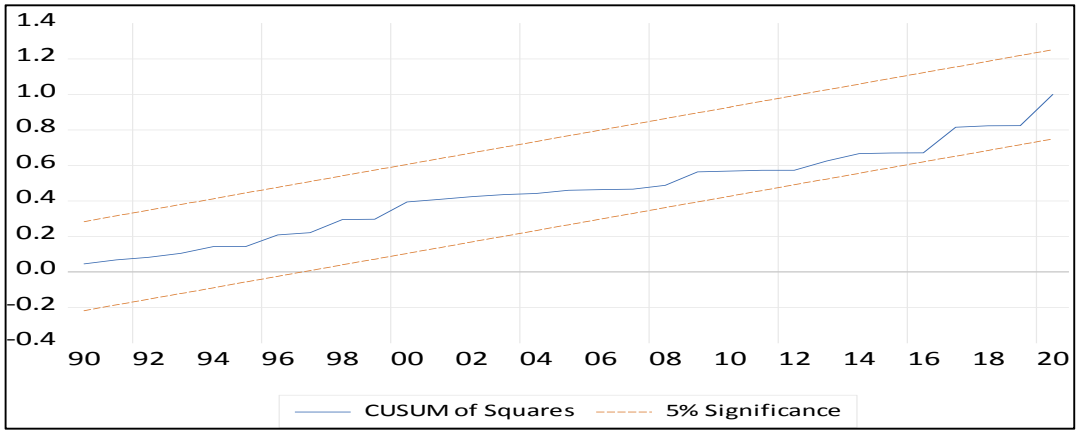

Fig. 2. The Cumulative Sum of Squares Recursive Plot

Source: Author`s computation using Eviews.

The results of the estimated CUSUM and CUSUM of Squares tests indicate that the parameters used in this study are highly stable. Specifically, the plots of the CUSUM and CUSUM of Squares fell within the 5% critical bounds, providing further evidence of the stability of the parameters.

Conclusions

This paper examines the short and long-term impact of deposit interest rates and lending interest rates on money demand in Sierra Leone using annual time series data from 1980 to 2020. The study employed the Autoregressive Distributed Lag (ARDL) model to determine the short and long-term relationship between interest rates volatility and money demand. Additionally, the Augmented Dickey-Fuller (ADF) Test was used to verify the presence of unit roots in the variables at both levels and first differences. The results indicate that Money Demand was stationary at level, while Deposit Interest Rates and Lending Interest Rates were stationary at first difference, and there is a long-term relationship or cointegration among the variables used.

In the long run, the study finds that Deposit Interest Rates have a positive but insignificant relationship with Money Demand in Sierra Leone, while Lending Interest Rates have a negative and insignificant relationship with Money Demand in the long run. However, in the short run, Deposit Interest Rates have a positive and significant impact on Money Demand in Sierra Leone. The results from the error correction model (ECM) further suggest that the system corrects its previous period disequilibrium at a speed of 86.5% within a certain period of time. Furthermore, the estimated CUSUM and CUSUM of Squares indicate that the parameters used in the study are highly stable.

Based on the empirical findings, the study concludes that an increase in deposit interest rates would lead to a proportional increase in money demand, while an increase in lending interest rates would result in a decrease in money demand. Therefore, the study recommends that the Bank of Sierra Leone establish a flat interest rate for commercial banks to enable them to set favorable deposit interest rates that will encourage/increase customer deposits. Meanwhile, the central bank should also monitor commercial banks to ensure they implement competitive lending interest rates that do not crowd out private sector investment.

This study provides valuable insights into the relationship between interest rates and money demand in Sierra Leone, which can help policymakers to design effective monetary policies that promote economic growth and stability.

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