



**STABILITY OF MONEY DEMAND  
IN SIERRA LEONE USING AUTOREGRESSIVE  
DISTRIBUTED LAG (ARDL) APPROACH 1980 – 2018**

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**Abstract:**

This work seeks to investigate whether money demand is stable in Sierra Leone. The study uses annual data for the period 1980 to 2018. A standard money demand is defined and estimated using the Autoregressive Distributed Lag (ARDL) approach. This technique permits error correction modeling to examine the short and long-run relationship between money demand and its determinants. The determinants of money demand (MD) are Real Gross Domestic Product GDP(Y) Real Exchange Rate (RER), Real Interest rate (RIR), GDP Deflator used as a proxy for inflation rate were empirically examined to determine their relative statistical significance as they affect money demand. In advance of adopting the ARDL Approach, the time series properties of the variables in the model were examined using the ADF and PP tests. All variable was found to be I(1) - stationary at the first difference, therefore the use of ADRL Approach is suitable and ideal. The model used in this study has passed all of the diagnostic tests – specification, serial correlation, heteroscedasticity, and structural stability. Hence the estimated model cannot be spurious. Therefore, these results are not misleading, rather they are reliable. The test of stability was done using CUSUM and CUSUMSQ plots, and both suggest that there exists a stable relationship between real broad money demand in Sierra Leone and its determinants.

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## 1. Introduction

Money demand is very important in macroeconomic policy making especially to monetary authorities. In the case of Sierra Leone, not so many papers have been written on the subject. The focus on the stability of money demand is economically ideal as this aspect plays a crucial role in achieving the goals of monetary policy. The success of a given monetary policy is highly (if not mostly) dependent upon money demand stability. A stable money demand is a prerequisite for effective monetary policy, especially for countries pursuing a monetary targeting framework. The stability of money demand enables monetary authorities to adequately estimate the effect of monetary policy on economic activities, enabling them to carry out policy actions with greater confidence and efficiency. Therefore, unpredictable changes in money demand can adversely affect the implementation and result of monetary policy. Macroeconomic policies are those policies formulated and implemented to affect the aggregate economy: they are used to attend to issues affecting the economy as a whole (Duramany-Lakkoh, 2021).

The economic relationship between individuals and the macroeconomy is best captured by the money demand relationship (Nakorji and Asuzu, 2019). Money demand affects both monetary and fiscal policy, but its effect on the former is notorious. Apparently as cited above, money demand with its stability is more influential on monetary policy and most studies ever conducted focus on, as a primary objective, its effect on the formulation, implementation, and result of monetary policy. However, this does not mean that the effects on fiscal policy are trivial and must be neglected. This study also examines the aspect(s) of fiscal policy that is affected by money demand and its stability. For instance, a tax cut could be contractionary. Using ISLM analysis, and a money demand function that depends on consumption in place of income, a tax cut will increase money demand, and the net effect on national output will remain ambiguous (Mankiw and Summers, 1988). If the private sector demand for money is a function of tax revenue as well as national income and the rate of interest, then a tax multiplier may be positive and the progressive income tax may be a built-in destabilizer (Holmes and Smyth, 1972). Therefore, it is perhaps possible that certain fiscal policies such as tax hikes fail to achieve their desired objectives because policymakers fail to recognize the effect of money demand (Samuels and Duramany-Lakkoh, 2023).

The demand for money is a derived demand as money is required to satisfy other demands in the economy, and it refers to the desire to hold money. Generally, and inevitably, money is needed to support the functioning of the economy in diverse ways. Money demand reflects the degree of willingness to hold money by economic agents (Mankiw, 1997). The determinants and stability are two aspects of the money demand function. The relevance of the money demand function has compelled economists ranging from both developing and developed countries, to conduct empirical researches on its determinants and stability. The money demand function is affected by various factors, which are inflation, fiscal deficit, interest rate, exchange rate, real income, government, tax revenue, oil shock, etc. (Hassan *et al.*, 2016). The relationship between

variables mentioned above as they affect money demand stability has always been of vital importance to researchers of money demand stability. The determinants of money demand functions have significant implications for the selection of appropriate monetary instruments (Nakorji and Asuzu, 2019). Factors affecting money demand do so in different ways and with different degrees of strength. It is therefore plausible to study the determinants and their respective impact on money demand in Sierra Leone to ascertain whether the money demand is stable (Duramany-Lakkoh, 2020).

### **1.1 Problem Statement**

The effectiveness of monetary policy formulation and implementation in Sierra Leone will always be compromised if money demand dynamics are not well defined. The presence of a well-defined money demand function is necessary to ensure that the quantum of money within the economy can be accurately, with a high degree of certainty, predetermined. Works on the study of money demand in Sierra Leone have been done for years ranging up to a few years before 2018. This work will have a scope that reaches 2018.

The linkage between money demand and the real sector of Sierra Leone is very relevant and can be only useful if the determinants of money demand in Sierra Leone are accurately identified and the stability status of money demand is known. For several decades, Sierra Leone has suffered monetary phenomena such as inflation, depreciation, price instability, etc., and has failed to enjoy sustained economic growth. All of these have something to do with the failure (minimal success) of implemented monetary techniques and policies. The Bank of Sierra Leone most recently has endeavored efforts to curb high inflation, and mitigate significant currency depreciation: all of which are necessary for economic stability (Duramany-Lakkoh, *et al.*, 2021). The role of studies of money demand in aiding the Central Bank in its efforts is the provision of relevant information about money demand that prevents a mismatch between the aim of the bank and the trend of money demand.

## **2. Literature Review**

A detailed review of various relevant theories of money demand, together with empirical studies on the topic is provided in this chapter. The chapter provides both a global and national perspective of the variable. It also contains the trend of the variables for the study period. Money demand is a key concept in macroeconomics. It is the variable through which the public interacts with the monetary authorities in facilitating monetary policy. The Bank of Sierra Leone may for instance through one of its ways increase the money supply so as to permit commercial banks to charge lower interest rates and hence the demand for money in the economy should increase. The above strategy is called an expansionary monetary policy and it is used to achieve various goals such as alleviating or otherwise mitigating a recessionary climate, boosting aggregate demand which may increase output and cause economic growth, etc. All else constant, if the money demand

responds as expected, the goals of the monetary policy will be achieved successfully. However, money demand may not respond as required and this sometimes causes existing monetary policy to fail. This phenomenon is generally referred to as liquidity trap and it arises mainly because policymakers fail to accurately define and/or predict the behavior of the money demand and its stability over time. The below examination of money demand will therefore provide an in-depth understanding of money demand and its dynamics. This will help to accurately relate the concept of money demand in Sierra Leone and hence give valid judgment about its determinants and stability. Individuals and businesses wish to hold money partly in cash and in the form of assets. The demand for money arises from two functions of money: The store of value and the medium of exchange (Jhingana, 2022).

## **2.1 Theoretical Literature**

### **2.1.1 Classical Theory of- (Approach to) Money Demand**

According to the classical approach, individuals desire to hold money in the form of cash to facilitate economic transactions – the purchases of goods and services. Therefore, the demand for money in any given economy depends on the volume of transactions. The fact that money serves as a generally acceptable medium of exchange makes it possible for the exchange of goods and services in the economy to be very simple and easy. However, a second function of money - (store of value) is also relevant in this approach.

This approach may be divided into two major approaches:

### **2.1.2 Fisher's Approach: (Transaction Approach) – Quantity Theory of Money**

Fisher's quantity theory of money was developed in his book "Purchasing Power of Money" in 1911. He stated that money demand arises from, and because of cash transactions of goods and services. According to Fisher, there exists a direct relationship between the quantity of money and the price level. The Fisher approach made emphasis on the function of money as a medium of exchange. He expressed this idea using the below-given equation: the equation summarizes that the quantity of money in an economy determines the level of prices.

$$MV = PT$$

Where,

M = the quantity of money in circulation,

V = velocity of money in circulation, that is the number of times money changes hands or goods and services are bought,

P = prevailing price level,

T = volume of transaction.

MV represents the supply side of money and PT denotes the demand side of money. Demand for money is dependent upon the level of transactions undertaken in the economy. Transaction demand is constantly proportional to income.

In equilibrium,  $M_s$  (money supply) and  $M_d$  (money demand) are equal and therefore the effect of transactions on money supply is determined by the effect of transactions in the economy on money demand.

$$M_d = PT.$$

### 2.1.3 Modern Theory of – (Approach to) Money Demand

#### 2.1.3.1 Keynesian Approach

According to the Keynesian theory, demand is a function of income and interest rate. The money demand function is unstable according to Keynes, contrary to Friedman. He postulated that a low interest rate will increase money demand, since the opportunity cost of holding money will be low and that people will prefer to hold money and expect interest to rise. This implies that demand for money is interest elastic.

Keynes's function of money demand is specified below:

$$M_d = f(Y, i)$$

Where:

$M_d$  = demand for real money balance,

$Y$  = real income, and

$i$  = interest rate.

According to John Maynard Keynes, money demand arises from three motives of holding money. Namely: transactions motive, speculative motive, and precautionary motive. In Keynes's liquidity preference theory, transaction demand for money ( $M_t$ ) is a function of income ( $Y$ ), precautionary demand for money ( $M_p$ ) is a function of income ( $Y$ ), and speculative demand for holding money ( $M_s$ ) depends on the rate of interest ( $i$ ).

Money is demanded for day-to-day transactions. This demand for money is positively and proportionally related to income. There is generally and obviously an imbalance between payments and receipts. Keynes highlighted this by emphasizing that most people earn income on an interval basis – weekly, monthly, etc. and hence the need to hold money to meet current daily transactions is justified.

The desire and/or need to hold money (cash balances) for contingencies or unforeseen circumstances is called precautionary demand for money. The future is uncertain and so people hold cash balance to meet unforeseen expenditures like sickness, accident, unemployment, and other uncertainties. This demand for money is positively dependent upon income and is called idle balance.

Money is also demanded for speculative dealings, that is, for investment in bonds and other securities. According to Keynes, the prices of these securities are inversely related to the rate of interest. Therefore, speculative/investment demand for money which is unstable, is a decreasing function of interest rate; the higher the rate of interest the lower the speculative demand for money and vice versa.

According to Keynes, people hold money or bonds; only one at a time. That is, individuals alternate the holding of money between cash and bonds. In liquidity trap situations, speculative demand is perfectly elastic and people will generally prefer to hold money in cash rather than invest in bonds. The demand for money becomes perfectly elastic and moreover, the supply of money will not affect the rate of interest. The demand for money for transactions and speculation is called *active balance*; whereas the demand for money for precautionary purposes is called idle balance. That is,  $M_t + M_s =$  active balance, and  $M_p =$  passive/idle balance.

The major drawback in Keynes theory of money demand is his idea that people can either hold their assets all in money or bonds. This assumption has been criticized as being quite unrealistic, as individuals can hold financial wealth in a combination of both cash and bonds. This is rectified or gave rise to the portfolio approach to the demand for money balance by Tobin, Baumol, and Freidman.

#### **2.1.4. Post-Keynesian Approach**

##### **2.1.4.1 Baumol's Inventory Theoretic Approach**

In his popular work, "The Transaction Demand for Cash and Inventory Theoretic Approach" 1952, he stated that people hold money as a form of inventory optimum cash balance holding. The opportunity cost of holding money is the interest income receivable forgone. When the interest rate on assets increases, individuals adjust their portfolio by transferring some money towards those interest-bearing assets, and vice-versa. Therefore, people would hold money in a form in which the cost of holding it is minimized.

##### **2.1.5 The Inventory Theory: The Baumol-Tobin Mode**

The two economists Baumol (1952) and Tobin (1956) separately observed that the choice of when to exchange bonds for money is very important to individuals. They argued that the benefit of holding money is convenience and the cost is the interest forgone when money is held rather than interest-bearing assets. They assumed that the exchange of interest-bearing bonds attracts brokerage fees or general transaction costs: a larger money balance decreases the related transaction costs, but will definitely have opportunity cost, which is the interest forgone. Together, they developed a theory of money demand to show that income elasticity of the demand for money is less than one, that is, a change in money demand that is brought about by a change in income is less than proportionate; this implies economies of scale in cash management. The relationship is specified below:

$$(M/P) = \sqrt{(a_0 y)/2r},$$

Where:

$(M/P)$  = real money balance,

$a$  = transactions cost,

$y$  = real income, and

$r$  = real interest rate.

Generally, the Baumol-Tobin model for money demand shows that demand for money decreases ( $r$ ) with the interest and increases with the transaction cost ( $a$ )

According to them,

Bond Holding =  $f$  (income, number of bond transactions)

$$\text{Average Bond Holding (ABH)} = \frac{n-1}{2n} * y$$

$$\text{Average Cash Holding (ACH)} = \frac{y}{2} - \frac{(n-1)}{2n} * y$$

$$\text{Cost} = n * a$$

Where

$n$  = number of bond transactions, and

$a$  = cost per transaction,

Revenue = rate of interest \* ABH.

If  $r$  increases, cash holdings decrease since people choose to keep more money in the bank, and hence demand for money decreases.

When income increases, both bond holdings and cash holdings increase. However, the increase in cash holdings is less than the bond holdings. This implies that the income elasticity of demand for money is less than one.

### 2.1.6 Friedman's Theory of Money Demand (1956) – (Capital Theoretic Approach)

The restatement of The Quantity Theory of Money. According to Milton Friedman, contrary to John Maynard Keynes who said money demand is unstable, the demand for money is the most stable function. Friedman stated that the quantity theory of money is the theory of money demand rather than income and prices. He noted two types of demand for money: Demand for transaction purposes and demand for assets (interest-bearing assets). In this approach, Friedman considers the demand for money as an application of a general theory of demand for capital assets. In other words, money is treated as a capital good. His theory is based on the Cambridge approach and is referred to as the "*modern theory of demand*". The demand for money is therefore expressed as follows:

Friedman stated that money demand depends on three major factors:

Total wealth is to be held in various forms (bonds, equities money, human capital, non-human goods). Total wealth comprises all types of income. Permanent income = long-term average expected income. The price or return on the various assets; and the preferences of asset holders.

Wealth holders distribute their total wealth among its various forms so as to maximize utility from them. And that money demand depends on  $Y$ ,  $P$ , and  $r$ . Therefore, money demand is a function of income ( $Y$ ), interest rate ( $r$ ), and prices ( $P$ ). That is,

$$M^d = f(Y, P, r)$$

Friedman noted that interest forgone and the rate of increase in prices – inflation – are the costs of holding money. And that there are certain factors such as tastes and preferences that affect the demand function of money. The elasticity of demand for money is more than unity, whereas interest elasticity is insignificant.

$$M^d = \frac{M}{p} = f\left(y, w, p, r_b, r_e, \frac{1}{p} \cdot \frac{\Delta p}{\Delta t}, u\right)$$

$\frac{M}{p}$  = real money balance;

$M$  = money stock;

$P$  = price level;

$Y$  = permanent income;

$r_b$  = rate of return on bonds;

$r_e$  = rate of return on equities;

$\frac{1}{p} \cdot \frac{\Delta p}{\Delta t}$  = expected inflation ( $\pi^e$ );

$u$  = other factors of expected income;

$w$  = ratio of human wealth to non – human wealth.

$$M^d = f(y, w, p, m, r_b, r_e, \pi^e, u)$$

Therefore, money demand is a function of income ( $Y$ ), interest rate ( $r$ ), and prices ( $P$ ). That is,

$$M^d = f(Y, P, r)$$

## 2.2 Empirical Literature

Kallon (2009), employing the same methodology as Rutayisire (2010), investigated the demand for money in Sierra Leone using annual data on real money balances, consumer price index (CPI), exchange rate, real GDP, and US Treasury bill rates as proxy for foreign interest rate for the period 1964 to 2005. Using the Johansen methodology to cointegration, Kallon (2009) finds that the estimated income elasticity of long-run money demand in Sierra Leone is not significantly different from unity with a numerical value of 1.5194 suggesting there are no economies of scale in money-holding in Sierra Leone.

Using the ARDL-modeling technique, Bathalomew and Kargbo (2010) in their study examined the effect of foreign monetary developments on demand for real broad money (RM2) balances in Sierra Leone for the period 1983Q1 to 2008Q4. Their results suggest a co-integrating relationship between real M2 and all its determinants - real GDP,

domestic interest rate, and inflation rate. The long-run relationships exhibit a currency substitution phenomenon, whereas the short-run dynamics suggested the presence of currency substitution, as well as wealth effects. The indicators also reveal stability in the demand for M2 as an appropriate or ideal intermediate target in the conduct of the monetary aggregates targeting framework in Sierra Leone.

According to Mansaray and Swaray (2012), using the ARDL approach to cointegration, both long-run and short-run real GDP, and Inflation had positive and negative effects on real money balances respectively: this suggests that real income and the opportunity cost of holding money are the two vital components of domestic money holding in Sierra Leone. They also added that financial reforms may alter the way liquidity constraints function in the economy. They found a positive relationship between money demand and all three variables – income, interest rate, and inflation: Stability tests conducted indicated that M1 is stable whereas M2 is not. This is in line with Yoshida and Rasche (1990) – financial innovation and structural changes are factors that may disturb the stability of money demand.

The study of Tuluzawu (2013) established a long-run relationship for both M1 and M2 in Zimbabwe. His result showed that a positive relationship exists between money demand and all of interest rates, inflation, and income. And stability test conducted showed that M1 was stable but M2 was not.

Sriram (2000) using quarterly data from 1998 to 2007 employed The Johansen Approach to study the long-run demand for real money balance in The Gambia and to examine the various factors that will adjust in response to any temporary disequilibrium. He found that the long-run relationship is unstable and this was due to changing the velocity of M2, political and climate-related shocks, and lack of good quality data. This was done using Johansen & Juselius (1990) multivariate cointegration approach to determine the existence of a cointegration relationship between real broad money and its determinants.

Using Quarterly data from 1976 to 1996 on the following variables: real money balances, real income, inflation rate, and expected currency depreciation, Siklos (1995) estimated long-run and short-run money demand functions for Tanzania. Using the Johansen (1988) maximum likelihood approach to cointegration, his result showed that there was a stable long-run equilibrium money demand function. This implies estimation of the long-run demand for money can be quite easily done.

### **3. Methodology of Research**

#### **3.1 Model Specification**

The presentation of the model specification for money demand in Sierra Leone is based on both theoretical and empirical work examined in chapter two. Accounts of theoretical literature and empirical works show that money demand is influenced by income and interest rates. For instance, The Keynesian specification, The Baumol-Tobin approach, The Classical model, etc. Also, Sierra Leone has suffered inflation over the years of study

and as a result, the effect of such inflation on money demand may be significant. Friedman's theory and others expressed those changes in the price level – inflation can cause changes in money demand. Finally, Sierra Leone is highly import-dependent and therefore the effect of the exchange rate on the demand for money cannot be trivial. The above point is a brief justification of the variables used in the below model specification.

$$M_{dt} = f(GDP_t, RER_t, RIR_t, GDPDfl_t) \quad (1)$$

Where:

Md = Money Demand;

GDP(Y) = Real Gross Domestic Product;

RER ( $\epsilon$ ) = Real Exchange Rate;

RIR(r) = Real Interest rate; and

GDP Dfl( $\pi$ ) = GDP Deflator (Used as proxy for inflation rate).

Equation one (1) is expressed below using a linear specification in natural logarithm.

$$M = \alpha_0 + \alpha_1 Y_t + \alpha_2 r_t + \alpha_3 \log \epsilon_t + \alpha_4 \pi_t + \varepsilon_t$$

### 3.2 Estimation Techniques

The estimation process involved in the examination of money demand determinants and stability in Sierra Leone of this work employs The Autoregressive Distributed Lag (ARDL) Approach. This strategy permits an error correction modeling approach to examine short and long run relationships between money demand in Sierra Leone and its determinants.

#### 3.2.1 Cointegration

Cointegration is also a very important statistical property of time series variables. If two or more time series are sharing a common stochastic drift, they are said to be cointegrated - Johansen (1991). That is, when two or more time series are individually integrated but their combination is integrated of a lower order, then the time series are cointegrated.

The autoregressive distributed lag (ARDL) Cointegration Test, otherwise known as Bound Test which was developed by Pasaran et al, (2001) is adopted in this study to test for the cointegration relationships among variables in the model regardless of whether the variables under consideration are I (0) or I (1) or a combination of both. If there is exists a cointegrating vector, the ARDL model of the cointegrating vector is re-parameterized into error correction model (ECM). After tests are completed and cointegration is established, then it means that the time series have got a long-run relationship. Hence the long-run model can be estimated. After estimating the long-run relationship between money demand and its determinants, it is also important to establish the short-run dynamics of the model. This is done by the estimation of the error-correction model.

### 3.2.2 Error Correction Model

The error correction model (ECM) is a dynamic model that provides both the long-run trend and the short-run deviations from the trend. The long-run component is also known as the cointegrating component. To derive the short-run component, the error term of the long-run mode is used. The error term is made the subject of the relation and then lagged once, then tested afterward then tested to determine whether it is stationary. The resultant error term is called the error correction term and is the short-run component. The error correction model is then the sum of the long-run cointegrating component and the short-run component. This error correction model simply means we are reconciling the long-run relationship with short-run dynamics.

$$\Delta M_t^d = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta M_{t-1} + \sum_{i=1}^p \alpha_{2i} \Delta Y_{t-1} + \sum_{i=1}^p \alpha_{3i} \Delta r_{t-1} + \sum_{i=1}^p \alpha_{4i} \Delta \epsilon_{t-1} + \sum_{i=1}^p \alpha_{5i} \Delta \pi_{t-1} + \delta ECM_{t-1} + \mu_t$$

### 3.2.3 Stability of the Model

The money demand in Sierra Leone, like those of other countries is subject to stability diagnostic testing. If the model for money demand is estimated to be stable, it will be useful in policy formulation and analysis. The CUSUM Test will be used to serve the purpose. Therefore, to ensure goodness of fit of the model, this study conducts diagnostic and stability tests. The diagnostic test determines the serial correlation, functional form, normality and heteroscedasticity associated with the model. This technique is also known as cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ). The CUSUM and CUSUMSQ statistics are updated recursively and plotted against the break points. If the plots of CUSUM and CUSUMSQ statistics stay within the critical bounds of five percent level of significance, then the null hypothesis of stable coefficient in the given regression cannot be rejected.

### 3.2.4 Data Sources, Type and Description

Secondary data from reliable sources including, Bank of Sierra Leone, World Bank - World Development Indicators, World Economic Outlook, International Monetary Fund, etc are used in this research. This work utilizes annual time-series data from 1980 to 2018. Data collected include annual values/figures of variables including Broad Money, Real GDP, Real Interest Rate, Real Exchange Rate, and GDP Deflator- as proxy for Inflation.

## 4. Presentation and Interpretation of Results

This chapter presents and discusses the results of this study. The aim is to show the empirical result of the interaction of money demand with its determinants in Sierra Leone. It provides results on descriptive statistics, Stationarity, lag length, bound testing and cointegration, ADRL long run relationships as well as short run relationships, granger causality, diagnostic test, and stability of the model.

## 4.1 Stationarity

**Table 1:** Unit Root Test Results

Variables	Augmented Dickey-Fuller		Phillips Perron		Order of integration
	Level	1 <sup>st</sup> difference	Level	1 <sup>st</sup> difference	
BM	-1.741481	-6.317260	-1.692010	-6.317260	I (1)
GDP	0.230978	-5.345602	0.325241	-5.304687	I (1)
RIR	-3.902405	-2.556721	-3.780034	-10.79463	I (1)
LNREER	-2.815080	-4.778654	-1.485005	-4.763538	I (1)
GDP Deflator	-3.341593	-5.065791	-3.058460	-11.37165	I (1)

Source: Eviews 11 output.

It is shown from above Table 1 that all the variables are integrated of order one I(1), which is stationary at first difference. The decision rule states that we accept the null hypothesis if the absolute critical value at a 5% level of significance is greater than the absolute t-statistic value. At first difference, the corresponding critical values at 5% are less than the t-statistic values of these variables, and therefore, the null hypothesis is rejected by accepting the alternative hypothesis, and concluding that M2, GDP, RIR, and REER are stationary at first differencing for both ADF and PP tests, which shows that these variables are integrated order one I (1). However, as it is clear that the corresponding critical values at level for each of the variables are greater than the t-statistic values, we accept the null hypothesis at level and conclude that the variables are non-stationary at level. The unit root test results above confirmed the absence of I(2) variables, the ARDL framework is used, as it is suitable for the estimation process.

## 4.2 Cointegration and Bound Testing

To ascertain whether a long-run relationship exists among variables and the nature of such relationship, the bound testing approach to cointegration is essential. This work seeks to determine the main determinants of money demand since the stability of money demand in Sierra Leone somehow depends on its long-run determinants. The decision rule states that the null hypothesis, of no co-integration, must be accepted if the f-statistic is less than the lower bound. However, if the computed F-statistic is less than the lower critical bound, then the test fails to reject the null hypothesis, suggesting that a long-run relationship does not exist.

**Table 2:** Bound test cointegration result

Test statistic	Value	Significance	I (0)	I (1)
f-statistic	8.444875	10%	2.45	3.52
k	4	5%	2.86	4.01
		2.5%	3.25	4.4
Asymptotic: n = 1000		1%	3.74	5.06

Source: Eviews 11 output.

Table 2 provides that a long run relationship exists between the demand for money and its determinants since the F-statistic is greater than both the lower bound and that of the lower critical bound at all level of significance.

### 4.3 Long-Run Result and Analysis

**Table 3: ARDL Long-Run Results**

Variables	Coefficient	Std. Error	t-Statistic	Probability
GDP	1.33E-12	5.44E-13	2.441770	0.0209
RIR	-0.522259	0.278694	-1.873950	0.0710
LNREER	7.033943	2.927169	2.402984	0.0229
GDP DFL	-0.363538	0.174316	-2.085513	0.0459

Source: Eviews 11 output.

The result from the long-run estimates in Table 3 reveals that gross domestic product (GDP) and real exchange rate (REER) are strong long-run determinants of demand for money in Sierra Leone. The result also reveals a positive relationship between both the real exchange rate and real GDP and the demand for money in Sierra Leone in the long run. And that both variables are statistically significant at the 5 percent significance level. This result is consistent with the findings of Akinlo (2006), Omotor and Omotor (2011), An increase in real exchange rate (REER) - a depreciation of the Leone, and/or growth in income (Real GDP) will cause money demand to rise. Precisely, a 1% increase in LNREER will bring about a 7.034% increase in the demand for M2; a 1% increase in Real GDP will cause about 1.33% rise in money demand. Also, both the real interest rate and GDP Deflator bear a negative relationship with the demand for money. This result conforms to Chin-Hong and Lee-Chea (2010). For the case of GDP Deflator, a 1% rise in the domestic price level results to about 0.33% decline in the demand for broad money. The resulting signs of real interest rate and real GDP are consistent with Keynes liquidity preference theory (Keynes theory of money demand). However, real interest rate is not significant at 5% level of significance.

### 4.4 ARDL Short Run Result and Analysis

The estimation of short-run model with the Autoregressive Distributed Lag Model (ARDL) is based on the Akaike Information Criterion (AIC) employed.

The R-squared value of 0.707003 indicates that about 71% of the variation in the demand for broad money (the dependent variable –M2) in Sierra Leone is explained by its determinants, and this implies that the relationship between the demand for M2 and all the independent variables is well modeled. Therefore, this is a very good fit. Also, to note is that the probability value of the F-statistic (0.000000) shows that this model is highly statistically significant. In addition, the Durbin-Watson statistic of 1.94126 justifies the existence of no autocorrelation in the residuals and hence the estimated model cannot be spurious. Therefore, these results are not misleading, rather they are reliable. From the short-run results in Table 5 above, the coefficient of the error correction term ECT (-1) is

negative: -0.324582 and it is statistically significant at one percent level. This indicates that approximately 32.46 percent of the disequilibrium caused by previous year's shocks converges back to the long run equilibrium in the current year at a fast rate.

**Table 4: Short Run Results**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.806137	0.647227	-5.880685	0.0000
D(GDP)	-1.57E-12	5.30E-13	-2.956564	0.0061
D(GDP DFL)	-0.073746	0.018510	-3.984171	0.0004
D(RIR)	-0.039061	0.034804	-1.122310	0.2709
ECT(-1)*	-0.324582	0.046826	-6.931697	0.0000
R-squared	0.707003	Mean dependent var		0.012344
Adjusted R-squared	0.671489	S.D. dependent var		3.068383
S.E. of regression	1.758672	Akaike info criterion		4.089074
Sum squared resid	102.0666	Schwarz criterion		4.304546
Log likelihood	-72.69241	Hannan-Quinn criter		4.165737
F-statistic	19.90732	Durbin-Watson stat		1.949126
Prob (F-Statistic)	0.000000			

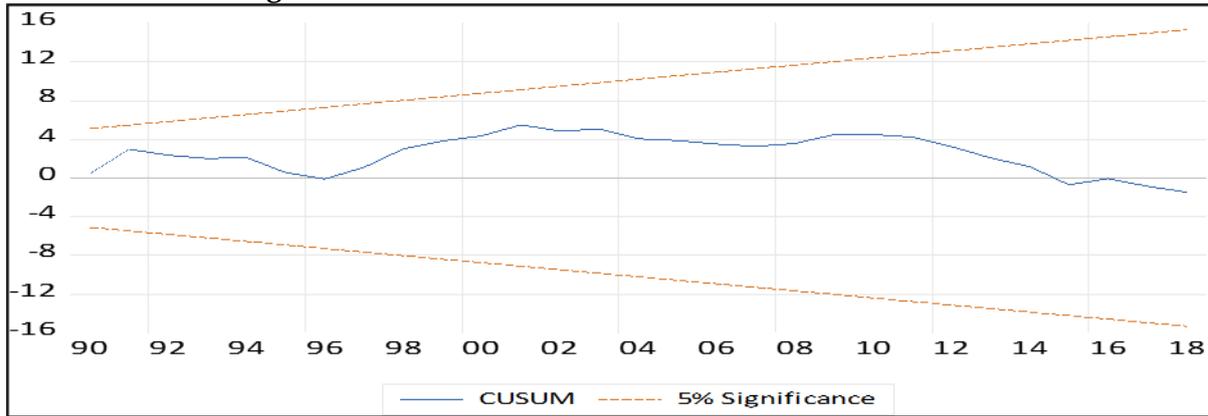
Source: Eviews 11 output.

Real GDP, GDP Deflator, and Real interest rate bear a negative relationship with the demand for M2. Although Real interest rate conforms to the theoretical explanations of its relationship with money demand, it is statistically insignificant at 5% level. Both GDP and DGP Deflator are statistically-significant short-run determinants of money demand in Sierra Leone. Increases in Real GDP and/or GDP Deflator cause a decrease in money demand in the short-run. The explanation for this is that in the short-run, very low-income earners, who are predominant in Sierra Leone, tend to save more when they experience an increase in their income, and tend to compress their consumption and spending when the price level rises, and hence their demand for money will also fall. For any 1% increase in Real GDP, and the GDP Deflator, demand for M2 falls by 1.6% and 07.4% respectively. This idea is consistent with the life cycle hypothesis theory of consumption.

#### 4.5 Stability of the Model

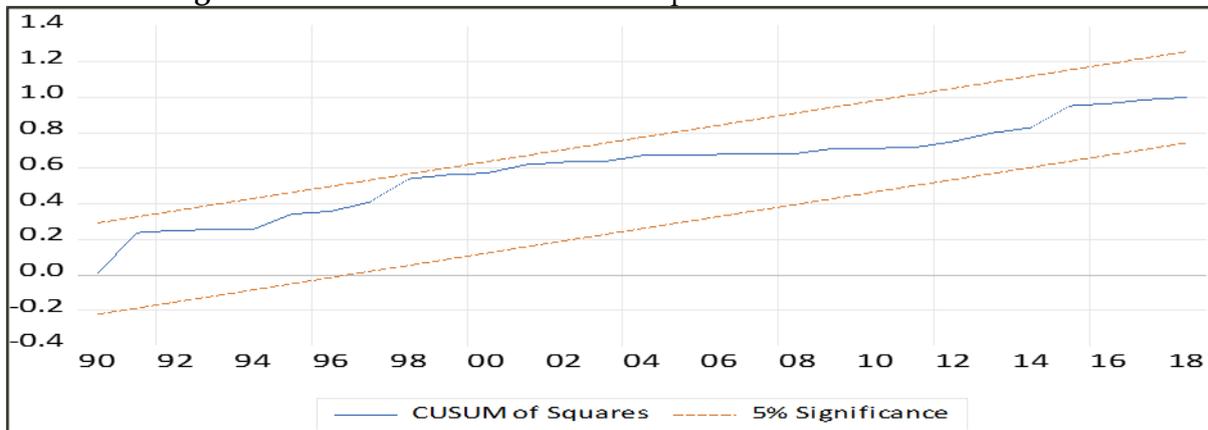
According Pesaran and Smith (1997), the test for the stability for parameters using cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) plots should be conducted after the model is estimated. Unstable parameters give bias results which are obviously unreliable for policy making. Therefore, to get rid of any bias in the results of the estimated model due to unstable parameters, the test for stability is conducted.

**Figure 1: Plot of Cumulative Sum of Recursive Residuals**



Source: Eviews 11 output

**Figure 2: Plot of Cumulative Sum of Squares of Recursive Residuals**



Source: Eviews 11 output

Results for CUSUM and CUSUMSQ are shown in Figure 4.2 and Figure 4.3 respectively. Both figures, the plots of CUSUM and CUSUMSQ for the estimated ARDL model, depict that there is the absence of instability of the coefficients as the plots of all coefficients fall within the critical bounds at 5 percent significance level. The conclusion is that the estimated coefficients in the model are stable over the study period. This result conforms to WAMA (2012) and Kallon (2009, 1992).

## 5. Findings, Conclusion and Policy Recommendations

The primary aim of this work is to determine whether the demand for money in Sierra Leone is stable for the period 1980 to 2018, given its determinants, and to give plausible policy recommendations on matters affecting or depending on money demand, such as its determinants and monetary policy respectively. To achieve this, The ARDL Approach to cointegration is utilized to examine both the short run and long run dynamics of the demand for broad money in Sierra Leone and its determinants.

## 5.2 Findings and Conclusion

In advance of adopting the ARDL Approach, the time series properties of the variables in the model were examined using the ADF and PP tests. All variable was found to be I(1) - stationary at the first difference, therefore the use of ADRL Approach is suitable and ideal. The model used in this study has passed all of the diagnostic tests – specification, serial correlation, heteroscedasticity, and structural stability. Hence the estimated model cannot be spurious. Therefore, these results are not misleading, rather they are reliable. Bounds test results justified that a cointegration relationship exists between the demand for broad money and its determinants. Long-run determinants of money demand include Real Effective Exchange rate (REER) Real Gross Domestic Product (RGDP), GDP Deflator (GDP DFL) and Real interest rate (RIR). However, RIR is only significant at 10% level. Short run determinants of money demand include Real Gross Domestic Product (RGDP), GDP Deflator (GDP DFL), and Real interest rate (RIR). However, RIR is not significant at 5% level. Both RGDP and GDP DFL bear a negative relation with the demand for money. The R-squared value of 0.707003 indicates that about 71% of the variation in the demand for broad money (the dependent variable –M2) in Sierra Leone is explained by its determinants, and this implies that the relationship between the demand for M2 and all the independent variables is well modeled. Therefore, this is a very good fit. Also, to note is that the probability value of the F-statistic (0.000000) shows that this model is highly statistically significant.

The test of stability was done using CUSUM and CUSUMSQ plots, and both suggest that there exists a stable relationship between real broad money demand in Sierra Leone and its determinants.

## 5.3 Policy Implications and Recommendations

The demand for money in is stable over the study period and this indicates predictability of money demand pattern in Sierra Leone, which is good news for macroeconomic policy making in the country. One of the policy implications of the above findings is that the Central Bank of Sierra Leone could easily target the broad money aggregate to achieve its monetary policy objectives, and if the BSL is successful in doing that it is likely that monetary policies will be effective. Another is that the REER is the most significant long run determinants of money demand in Sierra Leone. The variable, as well as income has a positive relationship with money demand. An increase in exchange rate, that is, a depreciation (which is likely) of the Leones causes an increase in the demand money, whereas an appreciation (which is unlikely) brings a fall in money demand. Therefore, targeting the exchange rate is a necessary and an effective way of influencing money demand. To stabilize the REER of Sierra Leone, BSL should ensure there is price stability in the country – an effective management of inflation, and the export performance of the country must be improved as well. The strong significance of REER as a determinant of the demand for M2 in Sierra Leone can be attributed to that fact that Sierra Leone is highly dependent upon import. To avoid unexpected changes in exchange rate that are brought about by increase in demand for imports, and changes in import prices, there has to be

import substitution strategies for the country. An increase in income levels in the country causes money demand to rise and vice versa. Therefore, variations in Real GDP are good indications of what money demand is likely to be.

In the short run, increases in income and the price level cause money demand to fall. The negative relationship that subsists between income and money demand indicates that in the short run, increases in income will cause Sierra Leoneans to hold other assets rather than money. The price level affects money demand in one of three ways: one is through its effect on REER, two is through RIR, and three is its effect on daily transactions. Therefore, whether increases in price level will cause an increase in money demand, or will bring about a decrease in money demand as indicated by the above findings is dependent upon which of the three channels of effect we want to use.

Policy makers should avoid targeting RIR to affect money demand as the variable is not a significant determinant of money demand in both the short and long run.

### **Conflict of Interest Statement**

The authors declare no conflicts of interest.

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