Exchange Rates and Monetary Dynamics in Sierra Leone: 
Evidence from a Modified Money Demand Function

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and 
Santigie Mohamed Kargbo\textsuperscript{43}

Abstract
The study has examined the impact of foreign monetary developments on the demand for real broad money (M2) balances in Sierra Leone. The Autoregressive Distributed Lag (ARDL) modelling technique is employed to estimate the long run relationship and short run dynamics using quarterly data for the period 1983Q1 to 2008Q4. The results suggest that there exists a cointegrating relationship between real M2 and its determinants. In the long run, the coefficient of the exchange rate exerts a negative and statistically significant effect on the demand for real M2, providing evidence of the currency substitution phenomenon. The short run dynamics also indicate the presence of currency substitution but the coefficient of the exchange rate is not significant, which is attributed to the mix of both currency substitution and wealth effects. The results also find statistically significant negative coefficient of the foreign interest rate, being consistent with the argument of the capital mobility effect. The CUSUM and CUSUMSQ stability tests indicate that the model is relatively stable over the study period. Based on the stability results, we conclude that M2 is an appropriate intermediate target in the conduct of the monetary targeting policy framework in Sierra Leone.

JEL Classification Codes: E41, E52, F31
Keywords: Exchange Rate, Money Demand, Currency Substitution, ARDL Approach.

Economists have long recognized the need to understand the behaviour of money demand in the conduct of monetary policy. In recent years, the empirical analysis of the relationship between money demand and its determinants and stability of demand for money have received considerable attention in response to the dynamics of the financial environment, characterized by increased financial innovation and integration, financial sector reforms and shifts in exchange rate policy (see Prakash and Pandey, 2009). A stable and predictable money demand function is important for the conduct of monetary policy. This enables policy makers to forecast money demand and determine the appropriate growth rates of money supply needed to control inflation. The stability of the money demand function is

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necessary for money supply to have a predictable influence on real variables (see Sriram, 1999 and Khan and Sajjid, 2005).

Sierra Leone has adopted the monetary targeting framework in the conduct of monetary policy. This framework requires a stable and predictable relationship between money demand and its determinants. Given the fact that the broad monetary aggregate (M2) is the intermediate target in the country’s monetary targeting policy framework, establishing the stability of this function is of particular interest to policy makers especially in the context of the structural and institutional changes that have characterized the economy following the adoption of financial liberalization policies. Since 1989 when the structural adjustment programme (SAP) was launched, several reforms have been undertaken to ensure a competitive and efficient financial sector to support development of the economy. These reforms included the adoption of a floating exchange rate regime, liberalization of interest rates and trade, elimination of price controls, removal of some foreign exchange controls and adoption of indirect controls of monetary policy based on market-related instruments.

The adoption of these reforms have significantly changed the environment in which monetary policy operates, which suggests that the domestic demand for money cannot be appropriately estimated without considering the impact of foreign monetary developments such as variations in the exchange rates and foreign interest rates. In particular, the change in the exchange rate policy might have lead to changes in cash management practices (see Choi and Jung, 2009, quoted in Rao and Kumer, 2009), which could result in instability of the underlying relationship between money demand and its determinants if ignored in the analysis. Owoye and Onafowora (2007) argue that if the residents change their money holdings due to foreign monetary developments, then the exclusion of foreign effects could lead not only to model misspecification, but it could lead to a restrictive interpretation of the characteristics of the money demand function.

Despite the large and growing literature on the stability of money demand functions, this issue has received very little attention in the empirical literature in Sierra Leone. Although Tucker (2004) has provided valuable insight into the stability of the broad money demand function, however, a limitation of this study is that stability was evaluated without accounting for the role of foreign monetary developments.

In Sierra Leone, the continuous depreciation of the Leone following the adoption of the floating exchange rate regime in the early 1990s has created an environment in which most transactions are quoted in foreign currencies, particularly the United States Dollars and foreign currency deposits at commercial banks have increased significantly. Accordingly, the currency substitution index has increased substantially, reaching a peak of 35.57 percent in 2007 although the ratio improved slightly to 31.34 percent in 2008. This suggests the
existence of currency substitution problem in the country\textsuperscript{44}, which could cause the instability of money demand function and undermine the effectiveness of monetary policy (see Sovannroeun, 2008).

In view of these developments, important policy questions have emerged that need to be empirically investigated. What impact have foreign monetary developments had on the stability of broad money demand function in Sierra Leone? In particular, does the exchange rate matter in determining demand for money in Sierra Leone?

The objectives of the paper are to shed light on the stability of the broad money demand function in Sierra Leone in the context of the influence of monetary developments; and to provide empirical evidence on the existence of the currency substitution phenomenon. To our knowledge, no known study has empirically investigated the currency substitution phenomenon in Sierra Leone, which suggests the need to fill this gap in the country’s empirical literature. The study employs the Autoregressive Distributed Lag (ARDL) modelling approach using quarterly data over the period 1983Q1 to 2008Q4.

The structure of this paper is organized as follows. In section 2, we briefly examine the trends in monetary growth, exchange rates and currency substitution in Sierra Leone. Section 3 reviews the literature on money demand with emphasis on the role of foreign monetary developments. The model, estimation technique and data are described in section 4. The empirical results are analyzed in section 5 while section 6 concludes with some policy recommendations.

\textbf{TRENDS IN MONETARY GROWTH, EXCHANGE RATES AND CURRENCY SUBSTITUTION IN SIERRA LEONE}

The trends in monetary growth as shown in figure 1 suggests that broad money growth peaked at 37.8 percent in 1999 from a relatively lower growth of 11.27 percent in 1998. This was partly attributed to the decline in external budgetary support; hence the overall budget deficit was almost entirely financed by borrowing from the domestic banking system. In 2000, however, financing of the budget deficit was largely from foreign sources and the private sector, culminating in a significant reduction in broad money growth of 12.08 percent.

\textsuperscript{44} The International Monetary Fund (IMF) dollarization index is used as a measure of currency substitution. The index is calculated by taking the ratio of foreign currency deposits to the monetary aggregate (M2) adjusted for currency (Leones) in circulation.
Following the intensification of the rebel war in 1999, which caused the collapse of economic activities and temporary closure of commercial banks and foreign exchange bureaux, the average exchange rate of the Leone to the US $ depreciated by 15.39 percent but appreciated by 5.41 percent in 2001 following continuous improvement in foreign exchange inflows and the introduction of the weekly foreign exchange auction by the Bank of Sierra Leone in 2000. However, the delays in programmed external support to the budget resulted in increased reliance on the banking system to finance the budget deficit, which partly accounted for growth in broad money by 33.67 percent in 2001.

In 2004, M2 grew by 20.12 percent which was lower that the growth rates of 29.56 percent in 2002 and 21.85 percent in 2003. This was due partly to the huge inflow of budgetary support coupled with a reduction in government expenditure that resulted in a decrease in government indebtedness to the banking system. However, the excess demand for foreign exchange lead to depreciation in the exchange rate by 15.17 percent.

M2 expanded by 31.30 percent in 2005, which was partly explained by the delays in donor inflows for budgetary support and weak domestic revenue mobilization, necessitating the financing of budget deficit by the Central Bank. However, the exchange rate depreciated by a relatively lower level of 6.97 percent. The depreciation of the Leone was due to the rise in the level of imports related to increased economic activities. This was not accompanied by a corresponding increase in receipts from exports.

The trends in the currency substitution ratio indicate a growing problem in Sierra Leone as the ratio peaked to 35.57 percent in 2007 from 31.78 percent in 2006 although it slightly improved to 31.34 percent in 2008. As Feige (2002) argues, a country is classified as highly dollarized if its dollarization index is 30 percent and above.

**LITERATURE REVIEW**

The theories of money demand are some of the topical issues discussed in monetary economics literature. It is generally acknowledged that the demand for money is the demand for real balances and is expressed as a function of scale variable which measures economic activity and a set of opportunity cost variables to reflect the forgone earnings should agents decide not to hold assets which are alternatives to money.

The literature identifies two approaches that relate the behavioral assumptions of economic agents to demand for money, i.e., the transactions and the asset or portfolio balance approaches. The transactions motive emphasizes mainly money's role as a medium of exchange. For this approach, money is viewed essentially as an inventory held for transaction purposes. The transaction costs of going between money and other liquid financial assets justify holding such inventories even though other assets offer higher yields (Judd and Scadding, 1982). This is emphasized in the seminal works by Baumol (1952) and Tobin (1956), according to which demand for money balances increases proportionally with the volume of transactions in the economy.

On the other hand, the portfolio balance approaches suggest that people hold money as a store of value and that money is only one of the assets among which people distribute their wealth. People attach importance to the expected rate of return for the assets held relative to the transactions necessities and take into account the risk factor for these assets because of the changing ratio of returns against each other (see Korap, 2007). Friedman (1956) in the new quantity theory and Tobin (1958) emphasized the importance of risk factor and portfolio decision to demand for money.

In open economy macroeconomics, money is considered as part of a portfolio, which consists of domestic financial assets, real assets, and foreign assets. Traditional studies on demand for money have often ignored the influence of foreign monetary developments. Following widespread implementation of the flexible exchange rate policy, it is becoming clear that the policy does not insulate the domestic economy and money supply from foreign monetary disturbances. Therefore, recent developments in the literature point to the
need to capture the effects of foreign monetary developments such as the exchange rates and foreign interest rate in specifying money demand functions. Mundell (1963) was the first to indicate that the demand for money could depend on the exchange rate in addition to income and interest rate. Arango and Nadiri (1981) argue that the demand for money could be influenced by fluctuations in exchange rate expectations and foreign interest rates in addition to changes in domestic variables such as permanent income, domestic interest rate and price expectations. The currency substitution literature suggests that portfolio shifts between domestic and foreign money provide a role for a foreign exchange variable (see Agenor and Khan, 1996). The capital mobility literature focuses on the foreign interest rate variable (McKinnon, 1983).

Although there is no universal definition of currency substitution, the literature most often interprets the term in two ways: firstly, that foreign money is used along with the domestic currency in transacting; secondly, that a change in relative cost of holding one currency induces a change in the ratio of domestic to foreign money holdings demanded (see Yildirim, 2003). McKinnon (1983, 1985, 1996), on the other hand, distinguishes between direct and indirect currency substitution. Direct currency substitution means that people switch between two or more currencies, which compete as a means of payment within the same commodity domain. The substitution between domestic and foreign money is influenced by the expected change in the exchange rate. Indirect currency substitution refers to investors switching between currencies and non-monetary financial assets, such as bonds, denominated in different currencies, which in turn indirectly influences the domestic demand for transaction balances. In other words, the indirect currency substitution literature suggests that the foreign interest rate is a focus variable, especially if foreign securities are a relevant investment alternative (see Sriram, 2009).

Currency substitution has important implications for the macroeconomic performance of countries. If currency substitution exists, changes in the opportunity cost of holding foreign money balances should generate a reallocation of money holdings and, consequently, lead to instability of the domestic money demand (Batten and Hafer, 1984). Monetary policy will be affected by this instability which may lead to the loss of monetary independence.

The notion of currency substitution is important particularly for developing countries because the extent of currency substitution is closely associated with underdeveloped financial markets and high and volatile inflation rates (see Kaplan et al, 2008). In countries where inflation is high or where opportunities for portfolio diversification are limited or ceilings are imposed on domestic interest rates, assets denominated in domestic currency lose their capacity to provide an efficient edge over time. Hence, the degree of currency substitution tends to be high if transactions costs incurred in switching from domestic-currency assets to foreign-currency assets are low (Agenor and Montiel, 1996).
Generally, there are two competing theories on the impact of exchange rate depreciation on the holdings of the domestic currency. On the one hand, depreciation of the domestic currency increases the wealth of people and demand for domestic currency increases. On the other hand, people substitute foreign currency for domestic currency to hedge against depreciation and therefore hold less domestic currency. Empirical studies have provided evidence in support of both views even though the currency substitution evidence seems to dominate. Lee and Chung (1995) found that the exchange rate has a negative and statistically significant effect on the demand for money in Korea, suggesting the presence of currency substitution effect. Bahmani-Oskooee and Techaratanachai (2001) examined whether currency depreciation has resulted in currency substitution phenomenon in Thailand. Using cointegration approach, they found that depreciation of the Thai Baht has resulted in a decline in Baht holdings in Thailand. Using a similar approach, Prock et al (2003) investigated the currency substitution phenomenon in some Latin American Countries (Argentina, Brazil and Mexico). By employing the vector error correction (VEC) model, the results found that currency substitution occurred to a greater extent in Argentina and Brazil than Mexico. Using the Johansen (1988) and Johansen and Juselius (1990) procedures, Muhd-Zulkhibri (2004) found evidence of the currency substitution effect in the long-run in Malaysia but not in the short-run. Similarly, the earlier study by Ibrahim (2001) also supported the currency substitution effect in Malaysia. By employing the Johansen cointegration tests, Kaplan et al (2008) found the presence of currency substitution in Turkey.

Bahmani-Oskooee and Tanku (2006) examined the effect of the black market exchange rate, official exchange rate or the premium on the demand for money function to account for currency substitution in 25 Least Developed Countries (LDCS). Using the bounds testing approach to cointegration, the study found short-run effects on the demand for money in these countries which do not seem to persist in the long run. Using the same methodology, Sovannroeun (2008) examined the stability of narrow money demand (M1) function in Cambodia and found evidence of the currency substitution effect in Cambodia.

On the other hand, some studies have also supported the wealth effect argument of exchange rate depreciation. Khan and Sajjid (2005) have examined the long run and short run determinants of broad money demand in Pakistan over the period 1982Q2 to 2002Q4. By adopting the autoregressive distributed lag modeling technique, the results supported the wealth effect argument and also provided evidence of the capital mobility effect in Pakistan. Similarly, the findings by Hosein (2007) also supported the wealth effect argument in Iran when the demand for narrow money (M1) was estimated.

In West Africa, few empirical studies have incorporated the effects of foreign monetary developments in analyzing money demand functions. For example, by employing the Johansen’s approach, Owoye and Onafowora (2007) and Yinusa and Akinlo (2008) found evidence of the currency substitution effect in Nigeria. The results of Owoye and
Onafowora (2007) also supported the argument of capital mobility effect in Nigeria. On the contrary, the findings by Sriram (2009) did not suggest any impact of foreign monetary developments on the demand for money in the Gambia. However, this issue has not been addressed in the empirical literature on Sierra Leone. The study by Tucker (2004) analyzed the stability of the broad money demand (M2) function in Sierra Leone without including the influence of foreign monetary developments. Using the Johansen’s cointegration approach, the study found a stable relationship between M2 and its determinants. In view of the dynamics in the exchange rates following the adoption of the financial liberalization policies in Sierra Leone, there is need for an empirical study to investigate the currency substitution phenomenon.

MODEL SPECIFICATION, ARDL APPROACH AND DATA

Model Specification

Following the literature, the demand for real money demand function is based on the theories that economic agents may hold money either as an inventory to smooth differences between income and expenditures, or for its yield as an asset in a portfolio. Specifically, these motives suggest that the demand for real money balances is a function of a scale variable and a set of opportunity cost variables. The scale variable captures the function of money as a medium of exchange and it is usually represented by income. The opportunity cost variable(s) proxy the alternatives to holding money balances and include the rate of interest and rate of inflation. Hence, the money demand function could be specified as:

\[ \text{LRM}_t = \beta_0 + \beta_1 \text{LRGDP}_t + \beta_2 \text{TBR}_t + \beta_3 \text{INF}_t + \epsilon_t \]  

Where LRM is log of real broad money balances (M2), LRGDP is log of real GDP, INF is Inflation rate, TBR is domestic interest rate (Treasury bills rate) and \( \epsilon_t \) is the error term.

According to equation (1), real money balances are assumed to be positively related to real income \( (\beta_1 > 0) \), consistent with the transactions motive for holding money. The opportunity cost of holding money relative to financial assets (TBR) is expected to yield a negative influence on money demand \( (\beta_2 < 0) \). Similarly the opportunity cost of holding money (INF) relative to real value of physical assets is expected to exert negative effect on money demand \( (\beta_3 < 0) \).

However, the above specification is more appropriate for a closed economy and is not likely to depict the characteristics of a small open economy like Sierra Leone. It is increasingly
recognized that the foreign sector plays an important role in determining demand for money in open and small open economies. Several studies have shown the existence of a relationship between money demand and exchange rates (see for example, Arango and Nadiri, 1981; Bahmani-Oskooee, 1991; Ibrahim, 2001; Bahmani-Oskooee and Tanku, 2006; and Sovannroeu, 2008). Similarly, some studies have underscored the importance of foreign interest rate in determining money demand because of its effects on the desired stock of real cash balances and exchange rate expectations (see Arango and Nadridi, 1981 and Booth and Chawdhury, 1992) or to capture the effects of capital mobility (see McKinnon, 1983; Khan and Sajjid, 2005; and Owoye and Onafowora, 2007). In particular, due to limited productive capacity, Sierra Leone relies largely on imported consumer and capital goods to meet domestic demand. This puts an upward pressure on the foreign exchange market, especially as the country continues to experience inadequate foreign exchange largely attributed to limited export capacity and declining external donor assistance. As such, the holdings of money balances are likely to be affected by changes in exchange rates.

Based on the above, the demand for real broad money (M2) balances in Sierra Leone can be expressed as:

\[
LRM_2 = \beta_0 + \beta_1 T + \beta_2 LRGDP + \beta_3 INF + \beta_4 TB + \beta_5 LEXC + \beta_6 IRF + \gamma_1 WAR + \gamma_2 POL + \varepsilon
\]  

(2)

Where LEXC is the log of a measure of the exchange rate, IRF is foreign interest rate, WAR is a dummy variable to capture the effects of the civil war and POL is a dummy variable to control for financial liberalization. The coefficient of LEXC is indeterminate a priori. An increase in the exchange rate (depreciation of the Leone) increases the value of assets denominated in foreign currencies in terms of domestic currency. If agents interpret the increase as a rise in wealth, then the demand for domestic money balances would increase \((\beta_5 > 0)\) i.e. the wealth effect. On the other hand, a depreciation of the domestic currency may induce expectations of further depreciations, leading to a portfolio shift from the domestic currency to the foreign currency. The shifts in portfolio will lead to a decrease in the demand for the domestic currency i.e. the currency substitution effect \((\beta_5 < 0)\).

The literature suggests that an increase in foreign interest rate that increases the return on foreign assets relative to those on domestic assets may cause agents to decrease their demand for domestic money holdings (see McKinnon, 1983). In this case, an estimate of \(\beta_6\) is expected to be negative \((\beta_6 < 0)\).
The inclusion of the trend captures the effects of gradual financial innovation following financial liberalization and it can lead to sensible estimates of the stable, long run money demand function (see Cho and Miles, 2008). Financial innovation allows agents to economize, over time, on cash holdings, suggesting a negative effect on the demand for real money balances. Put simply, the financial liberalization process is expected to increase opportunities for investment in alternative financial assets and result in a decrease in money holdings. However, the coefficient could also be positive reflecting increasing tendency to hold cash balances as the economy becomes gradually monetized.

**Estimation Procedure**

The study utilizes the ARDL modelling approach to analyze the relationship between money demand and its determinants and determine its stability. This approach has several advantages over the traditional methods of cointegration tests such as the Engle-Granger (1987) and Johansen and Juselius (1990) cointegration methods. The test is applicable irrespective of whether the underlying regressors are purely I(0), purely I(1), or mutually cointegrated. Secondly, using the appropriate lags in the ARDL model will address the problems of both serial correlation and endogeneity (see Pesaran and Shin, 1999; and Jalil et al, 2008). In this approach, all the variables are assumed to be endogenous and the long run and short run parameters of the model are estimated simultaneously (Khan et al, 2005). Moreover, the ARDL approach is known to have superior small sample properties than that of Johansen and Juselius cointegration technique (see Pesaran and Shin, 1999). Also, the ARDL technique generally provides unbiased estimates of the long-run model and valid t-statistics even when some of the regressors are endogenous (see Constant and Yue, 2010).

An ARDL representation of equation 2 is given as:

\[
\Delta LRM2_t = \beta_0 + \beta T + \sum_{i=1}^{n} \beta_{i, \Delta LRM2_{i-1}} + \sum_{i=1}^{n} \beta_{i, \Delta GDP_{i-1}} + \sum_{i=1}^{n} \beta_{i, \Delta INF_{i-1}} + \sum_{i=1}^{n} \beta_{i, \Delta TB_{i-1}} + \sum_{i=1}^{n} \beta_{i, \Delta EXC_{i-1}}
\]

\[
+ \sum_{i=1}^{n} \gamma_{i, \Delta IRF_{i-1}} + \gamma_{LRM2_{i-1}} + \gamma_{LRGD_{i-1}} + \gamma_{INF_{i-1}} + \gamma_{TB_{i-1}} + \gamma_{EXC_{i-1}} + \psi_{IRF_{i-1}} + \phi_{WAR} + \phi_{POL} + \nu_t
\]

As mentioned in Pesaran and Pesaran (1997), there are two stages for implementing the ARDL approach to cointegration procedure. First, the test for the existence of cointegration among the series is examined by testing the null hypothesis of no cointegration \( H_0 : \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = 0 \) against the alternative hypothesis of the existence of cointegration i.e. \( H_0 : \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq \gamma_6 \neq 0 \) using an F-test. The F-test has a non-standard distribution which depends upon (i) whether variables included in the
ARDL model are I(0) or I(1), (ii) the number of regressors, and (iii) whether the ARDL model contains an intercept and/or a trend. Two sets of critical values are reported in Pesaran and Pesaran (1997); the upper critical bound that assumes that all the series are I(1) and the lower critical bound values assume that the series are all I(0). If the computed F-statistic is higher than the upper bound of critical values, the null hypothesis of no cointegration is rejected. If the F-statistic lies below the lower bound, the null hypothesis cannot be rejected and the test is inconclusive if the F-statistic falls between the lower and upper critical value. When the latter occurs, there will be need to determine the order of integration of the series. If all the series are I(1), then the decision will be based on the upper critical value; when the series are all I(0), the decision is taken on the basis of the lower critical bound (Shrestha and Chowdhury, 2005).

Once a long-run relationship has been established, in the second stage, a further two-step procedure to estimate the model is carried out. First the orders of the lags in the ARDL model are selected using an appropriate lag selection criterion such as the Schwartz Bayesian Criterion (SBC) or Akaike Information Criterion (AIC), and in the second step, the selected model is estimated by the ordinary least squares technique. In the final stage, the error correction model is estimated. The coefficient of the lagged error correction term measures the speed of adjustment to restore long run equilibrium after a short run shock.

To ascertain the goodness of fit of the estimated ARDL model, the diagnostic and stability tests are conducted. The diagnostic tests involve serial correlation, functional form misspecification, normality and heteroscedasticity. The tests of cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) are used to determine the stability of the estimated model. If the plots of CUSUM and CUSUMSQ tests lie within the critical bounds of the 5 percent significance level, then we fail to reject the null hypothesis that all the coefficients in the regression are stable.

Data

The model of the demand for real money balances is estimated using quarterly data over the sample period 1983Q1 to 2008Q4. Following Bahmani-Oskooee and Tanku (2006) and Hossein (2007), the nominal exchange rate is used. The foreign interest rate is proxied by the US Federal Fund Rate (IFR). Nominal GDP, M2, consumer price index (CPI), official exchange rate, foreign interest rate and treasury bill rate were obtained from the International Financial Statistics (IFS) CD-ROM and the Bank of Sierra Leone.
Real broad money balances were obtained by dividing M2 by the consumer price index (CPI, 2000=100)\(^45\). The official exchange rate is the quarter average of the Leone per unit of the US Dollar. Quarterly series on GDP are not available and therefore nominal GDP data was first interpolated to obtain quarterly series using the approach of Lisman and Sandee (1964). The series were then converted into real GDP using quarterly CPI. POL is a dummy variable to control for financial liberalization (1986, 1989-2008= 1, 0 otherwise), and WAR is dummy variable to capture the effect of the civil war (1991-2001=1, 0 otherwise).

EMPIRICAL RESULTS

Unit Root Tests

Even though the ARDL approach to cointegration does not require prior testing of the series for unit roots, recent empirical studies have indicated that this procedure is necessary to avoid the problem of spurious results (see Jalil et al, 2008). The results of the ADF test are reported in table 1. These results suggest that real GDP, real broad money balances and foreign interest rate are stationary at first difference. However, the exchange rate, rate of inflation and Treasury bills rate are stationary at levels. The results therefore underline the need for the bounds test to determine cointegrating relationship among the series.

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\(^45\) Broad money supply (M2) is defined as currency in circulation outside banks plus demand deposits (local and foreign currency), savings and time deposits held at commercial banks. However, there are no liquidity requirements for foreign currency deposits.
Table 1: ADF Unit Root Test Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF Statistic</th>
<th>Lag Length</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intercept without trend</td>
<td>Intercept with trend</td>
<td></td>
</tr>
<tr>
<td>LRGDP</td>
<td>-0.072331</td>
<td>-1.0193</td>
<td>3</td>
</tr>
<tr>
<td>DLRGDP</td>
<td>-9.1217</td>
<td>-9.3331</td>
<td>2</td>
</tr>
<tr>
<td>LEXC</td>
<td>-6.5401</td>
<td>-8.2703</td>
<td>3</td>
</tr>
<tr>
<td>DLEXC</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>INF</td>
<td>-8.8081</td>
<td>-8.7589</td>
<td>3</td>
</tr>
<tr>
<td>DINF</td>
<td>-6.3845</td>
<td>-6.3931</td>
<td>2</td>
</tr>
<tr>
<td>DTBR</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>LRM2</td>
<td>0.34045</td>
<td>-0.92491</td>
<td>3</td>
</tr>
<tr>
<td>DLRM2</td>
<td>-4.5297</td>
<td>-5.8692</td>
<td>3</td>
</tr>
<tr>
<td>IRF</td>
<td>-2.3683</td>
<td>-3.0627</td>
<td>1</td>
</tr>
<tr>
<td>DIRF</td>
<td>-5.3835</td>
<td>-5.4759</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: Critical Values: without trend = -2.89; with trend = -3.46

Bounds Cointegration Test Results

Table 2 reports the results of the F-test for the existence of cointegration among the variables. Because the F-test is sensitive to the number of lags used, two, four and six lags are imposed on each first differenced variable (see Hosein, 2007). When two lags are used, there is evidence of the existence of cointegrating relationship at the 1 percent level when real broad money balances is taken as dependent variables, as the calculated F-statistic (6.4470) is higher than the upper critical bound (5.331). Similarly, when the regression is normalized on inflation rate, there is also evidence of another cointegrating relationship. However, based on the demand for real money balances literature M2, is taken as the dependent variable. On the contrary, when four and six lags are used and the regressions are normalized on real money balances, there is no evidence of a cointegrating relationship among the variables.
Table 2: Bounds Test Results

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>F-Statistic</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lag 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LRM2</td>
<td>6.4470</td>
<td>Cointegration</td>
</tr>
<tr>
<td>LRGDP</td>
<td>1.9577</td>
<td>No cointegration</td>
</tr>
<tr>
<td>LEXC</td>
<td>1.0508</td>
<td>No cointegration</td>
</tr>
<tr>
<td>TB</td>
<td>3.7019</td>
<td>No cointegration</td>
</tr>
<tr>
<td>INF</td>
<td>6.3377</td>
<td>Cointegration</td>
</tr>
<tr>
<td>IFR</td>
<td>1.9908</td>
<td>No cointegration</td>
</tr>
<tr>
<td>Lag 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LRM2</td>
<td>3.0220</td>
<td>No cointegration</td>
</tr>
<tr>
<td>LRGDP</td>
<td>1.0790</td>
<td>No cointegration</td>
</tr>
<tr>
<td>LEXC</td>
<td>2.5083</td>
<td>No cointegration</td>
</tr>
<tr>
<td>TB</td>
<td>3.4951</td>
<td>No cointegration</td>
</tr>
<tr>
<td>INF</td>
<td>2.7225</td>
<td>No cointegration</td>
</tr>
<tr>
<td>IFR</td>
<td>2.5233</td>
<td>No cointegration</td>
</tr>
<tr>
<td>Lag 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LRM2</td>
<td>3.0969</td>
<td>No cointegration</td>
</tr>
<tr>
<td>LRGDP</td>
<td>1.1325</td>
<td>No cointegration</td>
</tr>
<tr>
<td>LEXC</td>
<td>1.7887</td>
<td>No cointegration</td>
</tr>
<tr>
<td>TB</td>
<td>4.0760</td>
<td>Cointegration</td>
</tr>
<tr>
<td>INF</td>
<td>3.7128</td>
<td>No cointegration</td>
</tr>
<tr>
<td>IFR</td>
<td>2.0936</td>
<td>No cointegration</td>
</tr>
</tbody>
</table>

Notes: Critical values from the bounds test are obtained from Pesaran and Pesaran (1997) - Case III: restrict intercept and trend, 10% CV [2.782, 3.827], 5% [3.189, 4.329], 1% [4.011, 5.331].

Static Long-run Coefficients

The estimates of the long-run coefficients are reported in table 3. The coefficient of real income has the expected positive sign and significant at the 1 percent level, suggesting that a 1 percent increase in real income increases the demand for real money balances by 0.40 percent. The positive effect of real income on real money balances is consistent with the transactions demand for money motive and agrees with the findings by Khan and Sajjid (2005) and Hosein (2007).

The coefficient of the exchange rate exerts a statistically significant negative effect on real money balances, confirming that in the long-run expectations of further depreciation of the domestic currency will reduce the holdings of real money balances. The result is evidence of the existence of currency substitution in Sierra Leone and is consistent with the findings by Lee and Chung (1995), Ibrahim (2001), Muhd-Zulkhibri (2004), Owoye and Onafowora (2007), Yinusa and Akinlo (2008) and Sovannroen (2008). The coefficient indicates that a
1 percent depreciation of the domestic currency reduces the demand for real money balances by 0.28 percent. On the contrary, Khan and Sajjid (2005) and Hosein (2007) found positive and statistically significant effect of the exchange rates on real money balances.

The rate of inflation has negative effect on real money balances, which indicates that rising levels of inflation will lead agents to substitute away from money holdings into physical assets. The result agrees with economic theory and consistent with Muhd-Zulkhibri (2004), Khan and Sajjid (2005) and Hosein (2007). The coefficient suggests that a 1 percent rise in inflation will lead to a reduction in real money balances holdings by 96 percent.

Table 3: Estimates of Long-run Coefficients based on AIC- ARDL (1,0,2,0,1,1,0,1)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>5.2795</td>
<td>1.2653</td>
<td>4.1725***</td>
</tr>
<tr>
<td>T</td>
<td>0.021896</td>
<td>0.0041359</td>
<td>5.2941***</td>
</tr>
<tr>
<td>LRGDP</td>
<td>0.39670</td>
<td>0.14261</td>
<td>2.7817***</td>
</tr>
<tr>
<td>LEXC</td>
<td>-0.28442</td>
<td>0.064266</td>
<td>-4.4257***</td>
</tr>
<tr>
<td>INF</td>
<td>-3.1612</td>
<td>1.1126</td>
<td>-2.8414***</td>
</tr>
<tr>
<td>TB</td>
<td>0.00198</td>
<td>0.0017832</td>
<td>1.1104</td>
</tr>
<tr>
<td>IFR</td>
<td>0.0087688</td>
<td>0.019374</td>
<td>0.45261</td>
</tr>
<tr>
<td>WAR</td>
<td>-0.37634</td>
<td>0.10686</td>
<td>-3.5271***</td>
</tr>
<tr>
<td>POL</td>
<td>0.11735</td>
<td>0.12568</td>
<td>0.93378</td>
</tr>
</tbody>
</table>

Note: *** implies significant at the 1 percent level.

Diagnostic Tests

<table>
<thead>
<tr>
<th>Test Statistics</th>
<th>LM Version</th>
<th>F Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Serial Correlation</td>
<td>CHSQ(4) = 6.4447[0.168]*</td>
<td>F(4, 82) = 1.3972[0.242]*</td>
</tr>
<tr>
<td>B: Functional Form</td>
<td>CHSQ(1) = 0.2047[0.651]*</td>
<td>F(1, 85) = 0.1726[0.679]*</td>
</tr>
<tr>
<td>C: Normality</td>
<td>CHSQ(2) = 0.95134[0.621]*</td>
<td>Not applicable</td>
</tr>
<tr>
<td>D: Heteroscedasticity</td>
<td>CHSQ(1) = 3.8898[0.049]*</td>
<td>F(1, 99) = 3.9654[0.049]*</td>
</tr>
</tbody>
</table>

Note that \( \Delta RM_2 = 100 * \left[ \exp(\beta \Delta INF) - 1 \right] \), where \( \beta = -3.1612 \) and \( \Delta INF = 1 \) (see Wooldridge, 2003 p. 188 for details).
The time trend is positive and significant, indicating that there has been an upward movement in the holdings of real money balances following liberalization. The war dummy variable has a negative effect on real money holdings and is significant at the 1 percent level. However, the foreign interest rate, treasury bills rate and policy dummy are not significant in the long run.

Short-run Dynamics – ARDL (1,0,2,0,1,1,0,1)

The existence of a cointegrating relationship between real money balances and its determinants provides support for the estimation of a short-run dynamic model. The estimates of the error correction model are reported in table 4. The literature suggests that the coefficient of the lagged error correction term should be negative and statistically significant to further confirm the existence of a long-run relationship. As shown in table 4, the coefficient has the expected negative sign and it is significant at the 1 percent level. The coefficient implies that 22 percent of the disequilibrium of the previous quarter’s shock converges back to the long run equilibrium in the current quarter.

Table 4: Short-run Dynamics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>C o n s t a n t</td>
<td>1.1787</td>
<td>0.44970</td>
<td>2.6211***</td>
</tr>
<tr>
<td>dT</td>
<td>0.0048884</td>
<td>0.0019282</td>
<td>2.5353***</td>
</tr>
<tr>
<td>dLRGDP</td>
<td>0.088568</td>
<td>0.037523</td>
<td>2.3603***</td>
</tr>
<tr>
<td>dLEXC</td>
<td>-0.019715</td>
<td>0.033338</td>
<td>-0.59135</td>
</tr>
<tr>
<td>dLEXC1</td>
<td>0.089519</td>
<td>0.027375</td>
<td>3.2701***</td>
</tr>
<tr>
<td>dINF</td>
<td>-0.70578</td>
<td>0.077203</td>
<td>-9.1419***</td>
</tr>
<tr>
<td>dTB</td>
<td>-0.0015041</td>
<td>0.0008080</td>
<td>-1.8614*</td>
</tr>
<tr>
<td>dIFR</td>
<td>-0.033701</td>
<td>0.011144</td>
<td>-3.0242***</td>
</tr>
<tr>
<td>dWAR</td>
<td>-0.084022</td>
<td>0.021239</td>
<td>-3.9561***</td>
</tr>
<tr>
<td>dPOL</td>
<td>-0.035013</td>
<td>0.030471</td>
<td>-1.1491</td>
</tr>
<tr>
<td>ecm(-1)</td>
<td>-0.22326</td>
<td>0.060632</td>
<td>-3.6822***</td>
</tr>
</tbody>
</table>

Note: ***, **, * imply significant at the 1, 5 and 10 percent levels respectively.

R-Squared: 0.79471
R-Bar-Squared: 0.76129
S.E. of Regression: 0.048325
F-stat. (10, 90): 33.2926[.000]
Mean of Dependent Variable: 0.0024073
S.D. of Dependent Variable: 0.098910
Residual Sum of Squares: 0.20084
Equation Log-likelihood: 170.8164
Akaike Info. Criterion: 155.8164
Schwarz Bayesian Criterion: 136.2030
DW-statistic: 1.9580

Mean of Dependent Variable: 0.0024073
S.D. of Dependent Variable: 0.098910

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As in the long run, the coefficient of real GDP has the expected positive coefficient and is significant in the short-run. The coefficient of exchange rate has negative sign, which suggests the presence of the currency substitution phenomenon but is not significant. This may be due to the mix of both currency substitution and wealth effects in the short run. The wealth effect argument is supported by the positive and statistically significant (at 1 percent) impact of a one-period lagged effect of the exchange rate on real money balances.

The coefficient of the foreign interest rate has a negative sign and statistically significant at the one percent level. This result supports the argument of capital mobility effect and agrees with the findings by Khan and Sajjid (2005) and Owoye and Onafowora (2007). Similarly, short run changes in the Treasury bills rate have the expected negative effect and significant at the 10 percent level, implying that in the short run a rise in the return on alternative financial assets reduces the holdings on real money balances. The negative effect is consistent with theoretical expectations and agrees with the findings by Muhd-Zulkhibri (2004) for Malaysia.

The rate of inflation exerts a statistically significant negative effect on the demand for real money balances at the 1 percent level. The trend and war dummy variable have positive and negative effects respectively in the short-run. However, the policy dummy is also not significant in the short run. The adjusted R-squared of 0.76 suggests a good fit and the overall regression is significant at 1 percent level.

Diagnostic and Stability Tests

The diagnostic test statistics of the AIC selected ARDL (1,0,2,0,1,0,1,1) based on short-run estimates are reported in table 3. The results indicate that the model passes the tests of serial correlation, functional form misspecification and non-normality of the errors but suggest the presence of heteroscedasticity. Since the estimated ARDL model is of mixed order of integration i.e. I(0) and I(1) series, it is natural to detect heteroscedasticity (see Shrestha and Chowdhury, 2005).

The plot of the CUSUM test shows that the estimated model is stable over the study period as it lies within the 5 percent critical bound (figure 1). However, the CUSUMSQ test as shown in figure 2 indicates that the model is not completely stable within the 5 percent critical bounds although the deviation seems to be temporary as the plot returns completely back to lie within the critical bounds.
Figure 1

Plot of Cumulative Sum of Recursive Residuals

The straight lines represent critical bounds at 5% significance level

Figure 2

Plot of Cumulative Sum of Squares of Recursive Residuals

The straight lines represent critical bounds at 5% significance level
CONCLUSION AND POLICY RECOMMENDATIONS

The study has examined the impact of foreign monetary developments on the demand for real broad money (M2) balances in Sierra Leone. The Autoregressive Distributed Lag (ARDL) modeling technique is adopted to estimate the long run relationship and short run dynamics using quarterly data for the period 1983Q1 to 2008Q4. The test suggests that there exists a cointegrating relationship between real broad money balances and its determinants, which is further confirmed by the negative and statistically significant coefficient of the lagged error correction term in the short run dynamic model.

The short run dynamics suggest that the exchange rate exerts a negative but insignificant effect on the demand for real money balances. The negative sign is an indication of the existence of currency substitution in Sierra Leone but the insignificant impact may be attributed to the mix of both currency substitution and wealth effects. The wealth effect is supported by the statistically significant positive coefficient of a one-period lagged effect of the exchange rate variable in the short-run. The results also provide evidence of the capital mobility effect, as the foreign interest rate exerts a statistically significant negative effect on real M2.

The rate of inflation has a negative effect on the demand for money balances, suggesting that people substitute away from holding money balances into physical assets as inflation rate rises. Similarly, the negative and statistically significant effect of the coefficient of Treasury bill rate implies that agents reduce their holdings of real money balances by investing in alternative financial assets. The trend and real GDP have positive effects on real broad money demand while the dummy variable WAR exerts a negative impact.

In the long run, the coefficient of the exchange rate has negative and statistically significant effect on the holdings of real money balances, providing evidence of the currency substitution phenomenon in Sierra Leone. The inflation rate and WAR dummy also have negative effects on the holdings of real money balances.

The results of the CUSUM and CUSUMSQ stability tests indicate that the model has remained relatively stable over the study period in spite of the temporary deviations from the critical bounds of the CUSUMSQ test. In other words, the parameters of the broad money demand function were found to be stable despite the adoption of financial liberalization policies and the impact of foreign monetary developments. The stability of the function therefore suggests that M2 is an appropriate intermediate target in the conduct of the monetary targeting policy framework in Sierra Leone. However, the significance of foreign interest rate in the short-run is an indication that the economy is vulnerable to external shocks from capital mobility effects. In particular, the existence of the currency
substitution effect suggests that the economy is vulnerable to both domestic and external shocks which may undermine the ability of the central bank to exert control over money supply. Therefore, a policy suggestion is that the liquidity requirements should be broadened to include foreign currency deposits held at the commercial banks to ensure effective control over money supply.
REFERENCES


Batten, D. S and Hafer, R. ‘Currency substitution and the link between money and GNP in the U.S.: 1972-83”, *Econ Papers* No. 024


