



BANK OF SIERRA LEONE POLICY BRIEF

Financial Innovation and the Stability of Money Demand Function in Sierra Leone

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Abstract

This study seeks to investigate the stability of the money demand function in Sierra Leone taking financial innovation into account by estimating an autoregressive distributed lag (ARDL) model with data for the period 1980 to 2016. The empirical results show that there is a stable long-run relationship between real broad money and its determinants. The estimated results also reveal that in the long-run, financial innovation, real income, inflation rate and exchange rate significantly impact real money balances in Sierra Leone. Specifically, financial innovation has a negative effect on real money balances. In the short-run, only financial innovation and inflation have effect on real money balance. The stability tests reveal that the demand for real money balances in Sierra Leone is stable. The results imply there is need for the Bank of Sierra Leone to continue the use of monetary targeting to conduct monetary policy and continue to deepen its financial technology drive.

The Bank of Sierra Leone (BSL) Policy Brief is a publication of the Research and Statistics Department of the Bank of Sierra Leone. The BSL policy briefs are short forms of published papers or completed papers of staff of the Bank in non-technical or constrained technical forms, with policy implications for macroeconomic management in Sierra Leone. Papers with policy implications for inflation, financial stability, growth and external sector resilience are prioritised.

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1. Introduction

The principal objective of the Bank of Sierra Leone's monetary policy is to achieve price stability, which is defined as low and stable inflation that supports economic growth. To achieve this objective, the Bank has over the past decades implemented monetary policy within the monetary targeting framework. The effectiveness of this framework to guide the conduct of monetary policy and achieve the price stability objective rests on the assumption that there exists a stable and predictable relationship between the demand for money and its determinants. Therefore, interrogating the determinants and stability of the money demand function in Sierra Leone is crucial in the control of inflation, which contributes towards the achievement of macroeconomic stability in Sierra Leone.

Given its policy relevance, the demand for money has been a subject of considerable research in Sierra Leone. Earlier attempt to estimate the determinants and stability of money demand was by

Kallon (1992). This study was revisited in 2009. Following Kallon (1992), other authors have also estimated the money demand function using different methodologies and sample periods. This include (Tucker, 2003; Bathalomew & Kargbo, 2009; Mansaray & Swaray, 2012 and Neewhord, 2019). A common observation from these studies is that the money demand function in Sierra Leone remained stable, giving credence to the use of the monetary targeting framework by the Bank of Sierra Leone. However, in spite of the importance of financial innovation in the stability of money demand function, with the exception of Neewhord (2019), these studies did not account for financial innovation. Financial innovation arising from financial and monetary reforms should be included in the money demand function (Arrau & Gregorio, 1991); otherwise, the model would be mis-specified. According to Dunne and Kasekande (2016), financial innovation has been identified as one of the main reasons for the observed instability in money demand in many advanced and developing economies. This is particularly relevant for Sierra Leone given that the financial sector has witnessed significant reforms over the last two decades. These reforms⁴ could have an impact on the stability of money demand in the context of Sierra Leone.

⁴ These reforms are reflected in increase in the number of financial institutions, especially banks; improvement in the payments system infrastructure such as the Automated Clearing House (ACH), Real Time Gross Settlement (RGTS) to handle large volume transactions and the Script less Securities Settlement (SSS) systems; digital payment services ranging from ATMs, debit cards, POS, mobile money services, internet banking services and agent banking.

The data on real gross domestic product, nominal exchange rate and the interest rate spread were sourced from World Bank's world development indicators database (2019) while the remaining data were obtained from the IMF International Financial Statistics (IFS) database.

Given the developments in the financial sector, the important empirical questions then are (i) what are the potential determinants of money demand in light of the recent financial sector reforms? and (ii) is the money demand function for Sierra Leone stable? The paper estimated money demand function for Sierra Leone by introducing financial innovation among the traditional determinants of money demand.

The rest of the policy brief is organized as follows: In section 2, we discuss a brief review of the literature. Section 3 gives the methodology; section 4 presents the empirical results and section 5 is the conclusion.

2. Brief Review of the Literature

Given the policy relevance of money demand function, a number of empirical studies have attempted to estimate the money demand function for Sierra Leone. Earlier attempt was by Kallon (1992). The study was revised in 2009 utilizing the Johansen's cointegration methodology for the period 1964-2005. The 2009 study reaffirmed the central findings in his study (Kallon, 1992) that there is a stable long-run relationship between the quantity of real money balances and its determinants. Tucker (2003) also using the Johansen's cointegration approach to investigate the stability of broad money demand (M2) function in Sierra Leone found that there is a stable long-run relationship between money demand and its determinants through foreign developments was excluded in the study. Bathalomew and Kargbo (2009) used quarterly data for the period 1983Q1-2008Q4 to investigate the relationship between money demand and its determinants in Sierra Leone using the Autoregressive Distributed Lag (ARDL) model. They found that the demand for broad money is stable in the long run. Mansaray and Swaray (2012) used ARDL modelling and Granger causality test to assess the impact of financial liberalization on money demand in Sierra Leone during the period 1981-2010.

The empirical outcome suggests a stable demand for real money balances, despite several and ongoing financial reforms in the Sierra Leonean economy. Neewhord (2019) also estimated the money demand function for Sierra Leone that includes financial innovation and testing for structural breaks in the data. The study found that the money demand was stable in spite of the financial sector reforms. A review of the empirical literature for Sierra Leone suggests that the key determinants of money demand include, real income, interest rate, exchange rate and financial innovation. Recent developments have motivated the need to include foreign interest for open economies where there are diverse forms of portfolio assets.

However, previous studies on Sierra Leone ignored the potential impact of financial innovations on the stability of money demand. As far as the authors are aware there is only one published study (Neewhord

(2019) that has estimated the money demand function for Sierra Leone by taking cognizance of the role of financial innovation. However, in his model specification, the domestic interest which is a crucial opportunity cost variable was left out and the narrow definition of financial innovation⁵ was used in the model. The paper is motivated by the desire to close the empirical gap for Sierra Leone by re-estimating money demand which explicitly takes into account interest rate spread as an opportunity cost variable and include a measure of financial innovation in the model.

3. Methodology

Based on the traditional money demand theories as well as the empirical model utilized by Dunne and Kasekende (2016), a money demand function was estimated for Sierra Leone with data from 1980-2016. The model variables were; real gross demand product (lrgdp), inflation (Inf), exchange rate (lexch), interest rate spread (Intspr), financial innovation (finv), and United State Treasury bills rate (ustb). Also, a dummy variable (dum) capturing the iron ore boom in 2013 was introduced in the model. The model was estimated following tests for stationarity using the ADF and PP tests, whose outcomes implied the Pesaran et al (2001) cointegration test and estimation was appropriate. The test was necessary to avoid spurious regression, which occurs when variables are not stationary and model is estimated using Ordinary Least Squares (OLS). Also, it was done to ensure I(2) variables are not used in the model, as the ARDL of Peseran et al (2001) approach does not support the presence of I(2) variables a the model.

In addition to traditional residual diagnostics tests, tests for parameter stability were conducted to determine the stability of the estimated model. The Cumulative Sum (CUSUM) and Cumulative Cum of Squares (CUSUMSQ) stability tests, based on the recursive regression residuals, were carried out to test the stability of the estimated money demand function.

4. Empirical Results and Discussions

Appendix 1 shows the results of the tests for stationarity of the model variables which shows these are combination of level and first difference stationarity variables in the model. This test for cointegration

⁵ Financial innovation is defined as the “introduction of new liquid assets that partially replace traditional money in agents portfolio, technological progress in banking series that reduces the cost of transactions, efficient and changes in the regulatory environment that facilitate transactions”. Similarly, Arrau et al. (1995) deliberated on financial innovation as a permanent change to the money demand that was not caused by any of the traditional opportunity cost variable such as a the interest rate.

Financial Innovation (FINV) which is a proxy for the financial sector development on the money demand. Financial innovation is measured as the ratio between (M2/M1) and provides information on the rate at which cash is converted into money substitutes such as credit cards, ATM cards and Debit cards, POS and mobile money that enhances a medium of exchange and store of value.

was done. The result revealed there is cointegration. This result is not reported here to save space. Hence, the long-run and short-run money demand model were estimated. Table 1 shows the estimated long-run and short-run model of money demand for Sierra Leone.

Table 1: The Estimated Model of Money Demand

Variable	Long Run Model			Variable	Short Run Model		
	Coefficients	statistics	P-values		Coefficients	statistics	P-values
C	-17.3643	-7.4924	0.0000***	-	-	-	-
Trend	0.1114	6.8751	0.0000***	$\Delta lrm2(-1)$	0.0509	0.4797	0.6379
lrgdp	1.0332	4.4321	0.0004***	$\Delta lrgdp$	0.0729	1.0981	0.2884
Inf	-0.0070	-2.9786	0.0089***	Δinf	-0.0035	-4.7415	0.0002***
lexch	-0.3710	-7.2772	0.0000***	$\Delta lexch$	-0.1046	-1.0139	0.3257
Intspr	-0.0164	-1.8609	0.0812*	$\Delta lexch(-1)$	0.1305	1.1782	0.2559
finv	-0.5825	-2.7496	0.0142**	$\Delta intsprd$	-0.0068	-1.4839	0.1573
dum	0.6482	6.0845	0.0000***	$\Delta finv$	0.1847	1.0637	0.3032
ustb	0.0227	1.5970	0.1298	$\Delta finv(-1)$	0.6921	3.3067	0.0045***
				$\Delta ustb$	-0.0107	-0.8244	0.4218
				Δdum	-0.1135	-1.0284	0.3191
				ECM_{t-1}	-0.7580	-7.2583	0.0000***

Note *, **, *** are 1%, 5% and 10% significant level respectively.

The long run result shows that the coefficient of financial innovation is negative and significant. Hence, financial innovation reduces money demand in the long run. The result is consistent with theoretical literature which suggests that increased financial innovation will reduce the demand of economic agents for cash. This is consistent with previous studies (for example Dunne & Kasekende, 2016). The long-run coefficient of real income is positive and significant at the one percent level. The magnitude of the coefficient suggests that a percentage increase in real income leads to a one percent increase in the demand for real money balances. The unit-elastic income coefficient of demand for money is consistent with the theory and the findings of Kallon (2009). As expected, the sign of the coefficient of inflation is negative and significant in the long run. This implies that people tend to substitute cash balances for physical assets as the rate of inflation increases. Similar results were obtained in previous studies by Bathalomew and Kargbo (2009) and Hossain (2007).

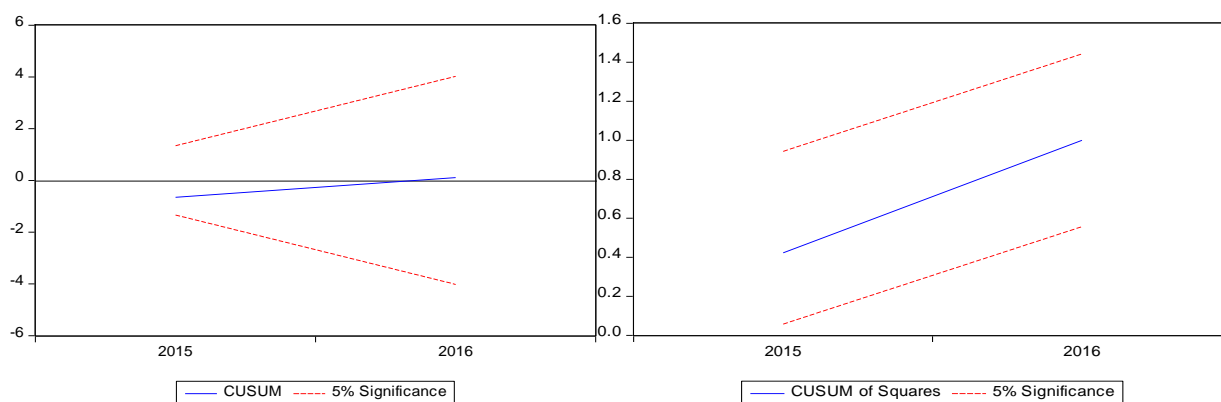
The result also indicates that the coefficient of exchange rate is negative and significant at the 1 percent level—a percentage increase in nominal exchange rate (depreciation) decreases the demand for real money balances by 0.37 percent. The negative coefficient is consistent with the substitution enhancing effect as economic agent's hedge to maintain the future purchasing power of the domestic currency. This outcome is consistent with Bathalomew and Kargbo (2009) for Sierra Leone but contradicts Khan and Sajjid (2005) for Pakistan and Mansaray and Swaray (2012) for Sierra Leone, who found a positive effect of exchange rate on real money balances. Interest rate spread does carry the expected negative sign but is insignificant,

implying that economic agents in Sierra Leone are insensitive to interest rate dynamics. Similarly, foreign interest rate does not have the expected negative sign and is insignificant. The result also shows that the dummy capturing the 2013 iron ore boom is significant at one percent, indicating that during the economic iron ore boom, economic agents demanded more money to undertake transactions.

Furthermore, the short run dynamics and error correction model results from Table 1 shows that where they are significant in the short run, all the significant coefficients of the variables in the long run model maintain their signs except the coefficients of financial innovation. Apart from inflation and financial innovation, all the other variables in the short run model are not statistically significant. In addition financial innovation is significant in the short run with a lag. Inflation has a negatively effect on real money balances in the short run. That is, as the level of inflation increases economic agents’ demand for real money balances declines. The coefficient of the error correction term is properly signed (-0.7580) and significant, a confirmation that long-run equilibrium relationship exists between money demand and its determinants. Its magnitude indicates that about 75 percent of the disequilibrium error is corrected within one year.

The model stability, which was done using the CUUSUM and CUSUM of Squares of residuals, reveals that the estimated money demand function is stable⁶. Figure 1 shows the model stability test.

Figure 1: CUSUM and CUSUMSQ Stability Tests



⁶ We carried out tests for the validity of the OLS assumptions. The results shows that the model is free from residual non-normality, heteroscedasticity and serial correlation. In addition, the functional form test shows that the model is free from omitted variable problem.

5. Conclusion

Knowledge of the determinants of money demand and its stability is important for the conduct of monetary policy. The stability is more important for a country using monetary targeting in the conduct of monetary policy, which is the case in Sierra Leone. The study therefore investigated the determinants of money demand in Sierra Leone and tested its stability. By using annual data from 1980 to 2016, an ARDL model was estimated and the long run result showed that the long-run demand for money is determined positively by income, negatively by exchange rate (Leones per US Dollar) , negatively by financial innovation, negatively by inflation while interest rate spread and foreign interest rate were not found to be significant. Financial innovation was also found to have a significant short-run negative effect on the demand for money in Sierra Leone. This was the case found also for inflation rate. The stability test of the money demand function shows it is stable.

The stability of the money demand function implies that the Bank of Sierra Leone should maintain its monetary targeting framework that is currently used to conduct monetary policy. In addition, as financial innovation is found to reduce the demand for money, the effort by the Bank of Sierra Leone to build the Payments Systems infrastructure and financial inclusion should be strengthened while there may be challenges in deepening the process.

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Appendix

Table 1: Augmented Dickey Fuller Test and Phillip Perron Unit Roots Test results

Variables	ADF in levels	ADF in First Differen	PP in Levels	PP in First	Differenc
LRM2	-0.716	-5.371***	-0.281	-5.437***	
LRGDP	-0.109	-5.449***	-0.033	-5.455***	
INF	-1.360	-6.471***	-2.758*	-10.105***	
EXCH	-4.032***	-6.561***	-3.611**	-2.919**	
INTSPR	-1.760	-1.973	-3.322**	-9.861***	
FINV	-0.181	-5.906***	-0.186	-5.973***	
ustb	-1.519	-5.611***	-1.814	-5.304***	

***, **, * denotes 1%, 5% and 10% significant level respectively