VELOCITY OF MONEY WITHIN THE FRAMEWORK OF MONETARY TARGETING IN SIERRA LEONE

Alfred J. H. Aruna

Abstract

A pre-requisite for monetary targeting strategy is a stable money demand function, which in turn requires stability in velocity. The study investigates the impact of financial development on the velocity of money in Sierra Leone, over the time horizon 1970-2013. The method of principal components is employed to construct a Financial Sector Development index (FSD) used to proxy development in the sector. Using the Autoregressive Distributed Lag (ARDL) approach, the results confirm that financial sector growth has a significant negative relationship on income velocity in Sierra Leone. The pair-wise granger causality test reveals that there is no causality between financial development and income velocity thus underscoring the fact that Sierra Leone is still in its early stages of financial development. Money growth also Granger causes velocity of money and thus changes in the past values of money growth can be used to predict the change in the present value of velocity of money. Hence, the Friedmanite Hypothesis is verified in the case of Sierra Leone. Thus, the study recommends that the monetary authority should improve access to banking and financial services especially in rural areas as a vast majority of the rural community is financially excluded so as to improve financial development and overall economic growth.

Keywords: Income Velocity, Financial Development, Monetary Targeting Auto regressive distributed Lag ARDL

Jel Classification: E40, B26, E52, C13

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INTRODUCTION

Velocity has to do with the amount of economic activity associated with given money supply. Velocity of money is usually measured as a ratio of GDP to a country's total supply of money (Rami, 2011). The level of any given stock of money corresponds to a whole range of potential spending levels depending upon the magnitude of velocity of money (Rami, 2011). In view of this, velocity of money assumes crucial importance in monetary policy formulation. Monetary contraction aimed at containing inflationary pressure is not likely to succeed if the contractionary impulse is neutralized by a simultaneous rise in the velocity of money.

The Bank of Sierra Leone currently uses the monetary targeting framework in the conduct of monetary policy, with the broad money (M2) as the intermediate target. The monetary targeting framework is premised on the assumption that portfolio equilibrium induces a reasonable predictive relationship between money and prices. The strength of this approach is the capacity to accurately estimate the demand for money function given that if money demand function is accurately estimated, a policy that targets the growth of nominal money has the prospect of stabilising inflation at desired levels and at reasonable cost. However, if it is becoming increasingly difficult to estimate the demand for money function, an approach that places less emphasis on money growth may produce better macroeconomic outcomes.

The difficulty encountered in accurately estimating the demand for money function is considered to have contributed to the demise of monetary targeting frameworks among the industrial and emerging market economies and their replacement, since the early 1990s, with variants of inflation targeting.

Financial sector development has long been recognised as one of the key drivers of economic growth (Ghirmay, 2004; Beck and Hesse, 2009; Kouki, 2013; Walle, 2014). Financial innovations have been a major driver of financial inclusion and financial sector development (Demirgüç-Kunt et al., 2014). Many developing countries have taken a keen interest in developing and improving the sophistication of their financial systems (Mwega, 2011). Sierra Leone presents an interesting case study of the evolution of the financial sector. In the recent few years, the sector has experienced increased adoption and usage of financial innovations that include, among others, the introduction of automated teller machines, debit and credit cards, development of electronic banking products and mobile money services.

Evidence from elsewhere shows that new developments in the financial sector alter the stability and predictability of the money velocity (Arrau and Gregorio, 1991). Stability in the money velocity plays a vital role in ensuring the effectiveness of monetary policy through its influence in determining the predictability of key monetary aggregates and money demand (Baliamoune-Lutz and Haughton, 2004; Akinlo, 2012; Dritsaki and Dritsaki, 2012; Ndirangu and Nyamongo, 2015). Consequently, instabilities in the
money velocity may be detrimental to the effectiveness of monetary policy. Like many other developing countries, the money velocity in Sierra Leone has been declining for the past two decades. Earlier studies suggest that this could be attributed to shocks in the financial system associated with financial innovations (Blundell et al., 1984; Arrau and Gregorio 1991; Friedman, 1984; Bahmani-Oskooee et al., 2014). Hence, this study investigates the impact of financial development on velocity of money in Sierra Leone. Specifically, the study seeks to investigate the relationship between financial development and velocity of money and examine the direction of causality between financial development and velocity of money. The direction of causality between broad money growth and velocity of money is also examined.

Whereas a growing strand of the literature on the impact of financial innovations has emerged in the recent past (Mbiti and Weil, 2011; Weil et al., 2012; Jack and Suri, 2014; Adam and Walker, 2015; Opolot et al., 2013; Ndirangu and Nyamongo, 2015), most of this literature use a single indicator of financial development or different indicators separately in the model. This study differs from the many existing literature by incorporating the role of financial sector development into the equation. To the extent that the financial sector in Sierra Leone is rudimentary, it is unlikely that the use of one or more indicators separately will reflect the developmental level of the sector. As the choice of the financial development indicator may influence the ultimate findings of the study, it will be more appropriate to combine the indicators together as they tend to complement each other, to generate a financial sector development index as a proxy for government policy in the sector. This research contributes to the empirical literature on the velocity of money in that regard.

While the estimation of demand for money function has received some attention from economists in Sierra Leone, such as Kallon (2009); David and Santigie (2010); velocity of money has not received any attention. In addition, despite the huge literature on financial development and velocity of money for both developed and developing countries, we are not aware of any work in the case of Sierra Leone. Hence, this research also fills the gap. This study is therefore pertinent, as it will serve as a guide to constructing appropriate financial sector reforms and in evaluating the effectiveness of these reforms since the country is at present undertaking reforms to achieve a more competitive, healthier, and deeper financial system.

After section one which introduces the study, the rest of the paper is given as follows. Section two reviews the relevant literature to the study. It discusses a brief theoretical and empirical literature of impact of financial development on income velocity within the framework of monetary targeting. Section three presents the methodology and model specification. Section four presents the model estimation and analysis of results, whilst section five concludes the paper and makes policy recommendations.
LITERATURE REVIEW

Theoretical Literature

Inquiry into determinants of velocity of money is pegged on Classical, Keynesian and Friedman expositions on quantity theory of money demand. This section reviews competing and complementary theories centered on the equation of exchange in an attempt to evaluate theoretical contributions on velocity of money.

Quantity theory of money: Classical View

The Classicalists use the equation of exchange to show the relationship between inflation rate and the growth of money supply. The clearest classical postulation begins by defining velocity of money as the number of times money changes hands in a given period of time or the rate at which money circulates. Classicists held that velocity of money can be measured as a ratio of the value of total spending divided by the quantity of money such that:

\[ V = \frac{PT}{M} \]  

Where: M= money stock; V= velocity of circulation; P= price level; T= number of transactions

Multiplying both sides by M yields the equation of exchange which relates the total value of all transactions (nominal income) to the quantity and velocity of money.

\[ MV = PT \]

The equation of exchange shows that nominal income changes in the same direction as growth of money supply. The theory proposed by Fisher adopts three key assumptions. First, quantity of money was exogenously determined by the economy’s monetary authority, and second, the level of transaction was also fixed given the classical assumption of full employment of resources. Thirdly and more important to this discourse, velocity of money was determined by technical and institutional factors which would make it constant in the short run. Fisher’s theory has been criticized as being too simplistic to the extent that it only looks at money as a medium of exchange and posits that demand for real money balances is a function of income and not interest rates.

Cambridge Approach to Money Demand

Cambridge version suggested that money was both a medium of exchange and a store of wealth. It was introduced by Alfred Marshal and Professor Pigou in the 1920’s. These
economists used Fisher’s equation of exchange to demonstrate that people’s level of wealth also affects demand for money. Cambridge economists adopted the income version and believed that in nominal terms, wealth was a proportion of nominal income such that:

\[ M = kY \] \hspace{1cm} (3)

Where \( k = 1/v \), the constant of proportionality. Although Cambridge economists assumed that \( k \) is constant, they allowed it to fluctuate because of the decision to use money as a store of wealth. Therefore, the greater the proportion of nominal income held—when \( k \) is high—the smaller the velocity of money, the opposite is also true. To this end, both Cambridge and Fisher used the equation of exchange. Its weakness lies in this that it does not pay attention to the fact that effective demand for goods and services does not necessarily vary at all closely with the quantity of money. To understand variations in effective demand, we must analyze the excess of changes in expenditure. The second weakness is that it pays inadequate attention to the fact that the price level does not necessarily change in proportion with changes in effective demand.

**Keynesian Liquidity Preference Theory**

Keynes agreed with the Cambridge version on the importance of interest rates in determination of demand for money. Keynes provided three motives explaining why people demand money; the transaction motive, precautionary motive and speculative motive. Keynes believed that individuals had expectations about interest rate movement such that if they expect interest rates to rise above the normal value, then they would part with money balances in order to make returns. However, if interest rates are expected to fall, individuals would rather hold their assets in liquid form. To this end, demand for real money balances had a direct relationship with income but an inverse relationship with interest rates such that:

\[ \frac{M^d}{P} = f(Y, i) \] \hspace{1cm} (4)

Where the individual’s income, \( Y \), has a direct relationship with real money demand whilst the rate of interest, \( i \), has an inverse relationship with income. Taking the inverse of equation (4) and multiplying both sides by Income yields the velocity such that:

\[ V = \frac{GDP}{M^d} = \frac{PY}{M^d} = \frac{Y}{f(Y, i)} \] \hspace{1cm} (5)
From equation (5), Keynes’ liquidity preference theory shows that velocity is constantly fluctuating as it is influenced by level of interest rates. Keynes explained that changes in money supply may reduce interest rates thus inducing people to hold idle cash and thereby reducing velocity of money. Therefore prices do not necessarily have to change with changes in money supply. To this end, Keynes held that since velocity is positively related to interest rates, then it follows that it is constantly changing depending on the prevailing market interest rates. However, it has been pointed out that rate of interest is not purely a monetary phenomenon. Real forces like productivity of capital and thriftiness or saving by the people also play an important role in the determination of the rate of interest.

**Friedman Money Demand Theory**

In the modern version of the quantity theory, Friedman argued against treating Velocity of Money (VM) as a parameter and explored the variables which could determine the size of VM. Since then VM has been gaining due attention of researchers. After recent developments of the monetary theoretic approach to balance of payments and its integration into aggregate macroeconomic model, developed by Polak and rigorously formulated by Mundell and Fleming, the role of VM has gained increasing importance in the analysis of monetary policy and its effectiveness.

Hence, the Modern Quantity Theory could be formulated as:

\[
\frac{M'}{P} = f(Y_p, h, r, e^{inf}) \times Y 
\]

Where \( Y_p \) = permanent income; \( h \) = human/non-human wealth; \( r \) = interest rate; \( e^{inf} \) = expected inflation that can be defined either by past rate of inflation or an average of growth of P over past P. According to Friedman, demand for real money balances is positively related to permanent income and negatively related to the opportunity cost of holding money as measured by \( r \).

Standard models of aggregate demand treat money and credit asymmetrically; money is given a special status, while loans, bonds, and other debt instruments are lumped together in a "bond market" and suppressed by Walras' Law. This makes bank liabilities central to the monetary transmission mechanism, while giving no role to bank assets.

Arrau et al. (1991) argued that the traditional specifications of money demand have been commonly plagued by persistent over-prediction, implausible parameter estimates, and highly autocorrelated errors. In their paper they argued that some of those problems stem from failure to account for the impact of financial innovation. They found out that
financial innovation is an important determinant of money demand and its fluctuations and that this importance increases with the rate of inflation.

Roubini and Sala-i-Martin (1992) analyzed the relation between the trade regime, the degree of financial development and the growth performance of a large cross section of countries at the theoretical and empirical levels. They argued that one of the reasons why some governments may choose to repress the financial sector is that it delivers easy inflationary revenue since financial repression induces private agents to carry a larger stock of nominal money, the base for the inflation tax. This financial repression reduces the growth rate of the economy.

Bernanke and Blinder (1998) show how to modify a textbook IS-LM model so as to permit a more balanced treatment. As in Tobin (1970) and Brunner-Meltzer (1972), the key assumption is that loans and bonds are imperfect substitutes. In the modified model, credit supply and demand shocks have independent effects on aggregate demand; the nature of the monetary transmission mechanism is also somewhat different. The main policy implication from their research is that the relative value of money and credit as policy indicators depends on the variances of shocks to money and credit demand. If money demand shocks are more important than credit demand shocks, then a policy of targeting credit is probably better than a policy of targeting money.

Indeed, the work of the monetary economists on velocity of money has led to resurgence of empirical research works worldwide. Some of these empirical works are reviewed below.

**Empirical Literature**

Many attempts have been made to examine the behaviour of velocity and the impact development in the financial sector has on it.

The study by Kharadia (1988) examined the behaviour of income velocity of money in India. The study could not find evidence in support of constant income velocity as per capita income and money supply varied. The study revealed that administrative controls that maintained interest rates within a narrow range sterilized their impact to the velocity of money. The various measures of changing financial conditions including currency-demand deposit ratio, bank assets-national income ratio, and the household financial assets, national income ratio were all significant in the estimated model.

Bordo and Jonung (1990) studied the behaviour of velocity for a number of countries. Specifically, the paper looked into the nature and causes of a U-shaped secular trend in velocity on a century-long scale for the selected countries. They found that institutional changes in the financial sector proceed in roughly two phases. In the first phase, increasing monetization of the economy takes place such that velocity is expected to
decline as demand for money (transaction balances) grows faster than income. Bordo, Jonung and Siklos (1997) used currency-to-money as a measure of degree of monetization. The second phase is characterized by growing financial sophistication during which the number of substitutes for bank notes and deposits grows. They measured the degree of financial development as the ratio of total non-bank financial assets to total financial assets.

Anyanwu (1994) examined the determinants of income velocity of money in Nigeria over the period 1960-1992. The paper showed that interest rate, inflation rate, real gross national product, exchange rate, and financial deregulation had significant impact on the velocity of money. Moreover, velocity was found to feedback into interest rate and economies of scale were revealed by the long-run income elasticity of velocity which was marginally less than unity.

King’ori (2003) studied the extent to which real and monetary factors affected income velocity of money in Kenya for the period 1992:1 to 2002:12. The study used autoregressive distributed lag model and an error correction model to examine the long run relationship between velocity of money as the dependent variable and real income, real exchange rate, expected inflation rate, and bank asset to GDP ratio as independent variables. The study established that financial innovation as proxied by bank asset to GDP ratio was highly significant. Real interest rates were found to be significant but inflation rate was found to be insignificant. The broad money velocity function was found to be stable implying that broad money was suitable for monetary policy formulation.

Akhtaruzzaman (2009) investigated the income velocity of money for Bangladesh using data for the period 1973–2007. Based on co-integration analysis, he found that the velocity for both M1 and M2 negatively related to real GDP (growth) and financial development (demand deposit – time deposit ratio) reflecting the early stages of economic and financial development in the country; and that the two variables jointly account for about half of the variance of the speed of income velocity.

Gill (2010) examined the determinants of the income velocity of money in Pakistan for the period 1973/4 to 2005/6 (33 years) using the Johansen cointegration technique. The study found that real income (per capita real GDP), financial development (91 day Treasury bill ratio), consumer price index (inflation) and interest rate (call money rate) all had a positive relationship with the velocity of money. Accordingly, it concluded that the constancy of the velocity of money does not hold in the changing economic situation of Pakistan and should be taken into account in formulating an effective and credible monetary policy in the economy.
Adam, Kessy, Nyella, and O’Connell (2010) attempted to forecast the velocity of income in Tanzania in view of the importance of the variable for a central bank that uses monetary targeting framework. Their results showed that the vector autoregressive model, based on structural money demand equation, outperformed the various univariate approaches both within sample and over a short period out-of-sample horizon. Consequently, they concluded that the existence of a stable cointegrating relationship between velocity and the determinants of money demand suggests that VAR-based forecast may have substantial value in monetary programme formulation.

Rami (2011) investigated velocity of money function for India using time series data from 1972 to 2004. The study used auto regressive lag model with velocity of money as the dependent variable and real income, short term interest rates, population of banks, share of monetary assets, degree of monetization and stock of money as independent variables. The study found out that velocity of broad money was highly predictable. Institutional factors namely population of banks and degree of monetization were found to be significant in velocity of broad money (M3) but degree of monetization was found to be insignificant in determining narrow money.

Akinlo (2012) on financial development and income velocity in Nigeria; using cointegration and error correction mechanism, the result showed a positive relationship between velocity and income growth which suggests that Nigeria might possibly be at later stages of economic growth. However, exchange rate has a negative relationship with income velocity in the short run model. The opportunity cost variables namely interest rate and expected rate of inflation were not significant in the short run model, thus conclusive inference cannot be drawn from them. This positive effect of financial development variable (demand deposit-time deposit ratio) possibly arises from the fact that financial innovation encourages the use of money substitutes or quasi money that reduces the demand for money and, thus, brings the speed of velocity of money up. He, therefore, concluded that any attempt by government or monetary authorities in the country to exercise greater command over resources by printing more money would precipitate inflationary pressure.

Okafor et al (2013) set out to empirically investigate the determinants of income velocity of money in Nigeria, using quarterly time series from 1985:1 to 2012:4. The paper confirmed a positive and statistically significant relationship between the growth of income and the velocity of money, which supported the quantity theory of money. Interest rate also had a positive and significant relationship with the income velocity of money. The financial sector development variable adopted, growth rate of stock market capitalization, had a negative relationship with the income velocity of money. The variance decomposition and impulse response results identified inflation rate as the most significant variable to innovations in the income velocity. The results showed that
the monetary authority cannot obtain additional leverage by issuing more money without generating high inflationary pressure.

Ng’ımor and Muthoga (2015) examined financial development and velocity of money in Kenya using ARDL, the results showed that real exchange rate, had an important negative influence on income velocity. Real GDP had a positive effect on income velocity. The results also confirmed that financial sector growth has a significant negative relationship on income velocity. The study recommended that policies on financial sector development should focus on stabilization of real exchange rate in order to maintain a stable money demand function.

Nampewo and Opolot (2016) investigate the impact of financial innovations on the stability of money velocity in Uganda. Their results suggest that financial innovations have not altered the long-run stability of money velocity in Uganda. Thus, given the importance of financial innovations in enhancing access to financial services, they recommend that more technological advances and diversification of financial products should be enhanced so as to improve financial sector development and overall economic growth.

From the empirical review, the relationship between financial development and velocity of money has been examined using either a single indicator of financial development (Akhtaruzzaman, 2008; Kingori, 2003; and Anyanwu, 1994) or different indicators separately (Ng’ımor and Muthoga, 2015; Okafor et al, 2013 and Akinlo, 2012).

**METHODOLOGY AND MODEL SPECIFICATION**

**Theoretical Model Specification**

The methodology adopted was based on modern quantity theory of money approach as proposed by Friedman. This theory was adopted because it not only conforms to Keynesian and Cambridge versions but also accommodates institutional and opportunity cost factors in its analysis of velocity of money function. Therefore, this study combined the classical argument with Friedman’s money demand function as follows:

The classical equation of identity, equation (2), can be presented as:

\[ V = \frac{PY}{M^s} \] .................................................................(7)

Where \( PY \) is equivalent to the nominal GDP, while \( M^s \) is money supply.
Therefore,
\[ V = \frac{GDP}{M^s} \] .............................................(8)

The ultimate domestic real money demand function for a small open economy like Sierra Leone can be expressed as:

\[
\frac{M^d}{P} = f\{(Y^f_t, REER^{\alpha_2}, \pi^{\alpha_3}, FSD^{\alpha_4}, M2GDP^{\alpha_5}, OPN^{\alpha_6}, \varepsilon)\} \] .............................................(9)

\[ M^d = P \cdot f\{(Y^f_t, REER^{\alpha_2}, \pi^{\alpha_3}, FSD^{\alpha_4}, M2GDP^{\alpha_5}, OPN^{\alpha_6}, \varepsilon)\} \] .............................................(10)

Assuming equilibrium exists in the money market, then:

\[
\frac{M^d}{P} = M^s \Rightarrow M^d = P\{(Y^f_t, REER^{\alpha_2}, \pi^{\alpha_3}, FSD^{\alpha_4}, M2GDP^{\alpha_5}, OPN^{\alpha_6}, \varepsilon)\} = M^s \] .............................................(11)

From the equation of exchange holds that:

\[
V = \frac{GDP}{M^d} = \frac{GDP}{M^s} = \frac{GDP}{P\{(Y^f_t, REER^{\alpha_2}, \pi^{\alpha_3}, FSD^{\alpha_4}, M2GDP^{\alpha_5}, OPN^{\alpha_6}, \varepsilon)\}} \] .............................................(12)

**Empirical Model Specification**

Consistent with the objectives of the study and in accordance with the literature, the study applied natural logarithm to equation (12) and estimated a log-linear model of the following form:

\[
\ln V_t = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 \ln REER_t + \alpha_3 \pi_t + \alpha_4 \ln FSD_t + \alpha_5 M_2GDP_t + \alpha_6 OPN_t + \varepsilon_t \] .............................................(13)

By incorporating the effects of the war and the financial liberalisation periods, equation (13) is modified as follow:

\[
\ln V_t = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 \ln REER_t + \alpha_3 \pi_t + \alpha_4 \ln FSD_t + \alpha_5 M_2GDP_t + \alpha_6 OPN_t + \alpha_7 WAR + \alpha_8 trend + \varepsilon_t \] .............................................(14)
Where: $\alpha_0$ is the intercept; $\alpha_1$ is the elasticity; $Y_t$ Income at time t; $REER_t$ real exchange rate at time t; $i_t$ Interest rate at time t; $\pi^e_t$ Expected inflation rate at time t; $FSD_t$ index for Financial Sector Development at time t; $M_2 GDP_t$ is monetization at time t; $OPN_t$ is openness at time t; $WAR$ dummy variable to account for the rebel incursion; trend is the time trend.

The following are expected: $\alpha_1 > 0$ or $\alpha_2 < 0$, $\alpha_3 < 0$, $\alpha_4 < 0$, $\alpha_5 < 0$ or $> 0$; and $\alpha_6 > 0$ or $< 0$. We applied natural logarithm in order to effectively linearise exponential trend (if any) in the time series data since the log function is the inverse of an exponential function (Asteriou and Hall, 2007).

Many studies have found VM as a negative function of per capita income but this result contradicts the quantity theory. Fry (1989) points out that the sign of correlation between VM and per capita income (negative or positive) depends on the stage of economic development, especially the stage of financial development. At the initial stage, velocity should fall with higher growth of income but at a later stage, velocity and income become positively correlated. This is because the initial stage in economic development is characterized by increasing monetization of the economy that is, spread of banking habits and relatively rapid expansion of purely financial or monetary transactions which contribute to proportionately higher demand for money making income elasticity of money demand highly elastic and hence, velocity is likely to fall.

At advanced stages, financial development affects VM positively so that VM increases with financial development. These stages are characterized by transaction efficiency, financial innovation, and technological progress which ensure the availability and use of money substitutes and provide a wide range of money substitutes or quasi-money that reduce the demand for money which brings the speed of velocity of money up.

Expected inflation is incorporated as a measure of the opportunity cost of holding money and it is expected to be negative. Since substitution can occur between money and alternative financial assets, a rise in expected inflation leads to a lower cost of holding money, and therefore, velocity decreases (Akinlo, 2012).

However, exchange rate was used here as the alternative measure of opportunity costs of assets substitution. This is based on the argument that in developing countries, the asset choice of wealth holders is largely limited between money and real assets, and not so much between money and financial assets. The exchange rate variable is expected to
have a positive effect on the velocity function due to increased international trade occasioned by economic reforms. If the domestic currency is expected to depreciate, the domestic portfolio holders would readjust their portfolios in favour of foreign assets. Depreciation causes a higher cost of holding local currency so that velocity should increase.

The rapid growth of institutions, especially the influx of banks, affects the way people conduct their economic transactions. This is why it is important to include a measure of financial development. The sign of the measure of financial development is either positive or negative as the case may be, and for this study, an index for financial sector development (FSD) was adopted.

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 (Apergis, 2015). Financial innovation allows agents to economize, over time, on cash holdings, suggesting a negative effect on the demand for real money balances and hence an increase in velocity. 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 (decrease in velocity) as the economy becomes gradually monetized (David and Santigie, 2010).

**Data Sources and Measurement of Variables**

Due to underdeveloped financial markets in Sierra Leone and consequently lack of data on stock market development, the indicators of financial development that are used in the study only reflect developments in the banking sector (Kargbo and Adamu, 2009).

Several indicators of financial depth have been used in the empirical literature as proxy for development of the financial sector. However, in this study four financial development indicators will be used: ratio of banking deposit liabilities to GDP (BDLG), ratio of domestic credit to the private sector to GDP (DCPSG), the ratio of private sector credit in domestic credit (PSCDC), and the ratio of currency to deposit (C/D).

Since the literature does not explicitly specify the most effective measure of financial development, an appropriate technique to avoid these problems will be to generate an index comprising all four indicators. Thus, a financial sector development index (FSD) will be constructed to represent government policy in the financial sector (following Khan et al, 2006; Kargbo and Adamu 2009).
Real GDP was measured by dividing nominal GDP by the consumer price index (CPI 2000=100. The dummy variable WAR will take the value of 1 in period of the civil war (1991-2001) and zero otherwise. Velocity of broad money (VM2) is calculated as the ratio of GDP to broad money. Y is real per capita income and this is obtained by dividing GDP by the population. GDP is gross domestic product and REER is the real effective exchange rate. The real effective exchange rate (REER) is used to estimate the real exchange rate because it is weighted by the trade shares of exporting partners (thus controlling for third country effect). Moreover, most studies that have estimated real exchange rate models have used the notion of real effective (multilateral) rather than real bilateral exchange rate. Finally, expected inflation is measured using the adaptive expectations model which implies that expected inflation is determined by previous inflation.

The study employed secondary data. Yearly time series data from 1970-2013 were obtained from the International Financial Statistics (IFS), World Development Indicators (WDI) and the Bank of Sierra Leone (BSL). Currency in circulation and monetization were respectively obtained from the Bank of Sierra Leone and the International Financial Statistics. The rest of the other annual series were obtained from the World Development Indicators. The brevity of the sample period is dictated by the availability of consistent data, most of which are compiled on an annual basis.

**MODEL ESTIMATION AND ANALYSIS OF RESULTS**

The ARDL approach to cointegration and error-correction model was applied to investigate the long run relationships as well as the dynamic interactions between velocity of money and financial development. The testing procedure involves the following steps. The study first investigated the time series properties of our data by using the Augmented Dickey–Fuller (ADF) and Phillips-Perron tests and the Zivot-Andrew tests was applied to test for structural breaks. The unit root test was used to check the stationarity position of our series. In the second step, we developed an index for financial development using Principal Components Analysis and in the next step we tested for cointegration using the autoregressive distributed lag (ARDL) framework. Finally, we tested for causality between financial development and velocity of money and causality between money growth and velocity of money.

The ARDL has several advantages over the other techniques of cointegration. One of the main advantages of this technique is that it can be applied irrespective of whether the variables are $I(0)$, $I(1)$ or fractionally cointegrated while the standard cointegration techniques require that the variables be integrated of the same order (Pesaran and Pesaran, 1997). Furthermore the error correction model (ECM) can be derived from ARDL through a simple linear transformation and once the order of the ARDL has been determined, OLS may be used for the purpose of estimation and identification.
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(Pesaran et al., 2001). The ECM integrates the short run adjustments with long run equilibrium without losing long run information.

The ARDL framework can be implemented by modelling equation 14 as a conditional ARDL:

$$\Delta V_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta V_{t-i} + \sum_{i=1}^{r} \alpha_i \Delta Y_{t-i} + \sum_{i=1}^{r} \alpha_i \Delta LnREER_{t-i} + \sum_{i=1}^{r} \alpha_i \Delta LnFSD_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta M_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta GDP_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta OPN_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta LnY_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta LnREER_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta LnFSD_{t-i} + \delta_{t}.$$ 

Where: $\Delta$ is the first difference operator. The parameters, $\alpha_i$, denote the short run multipliers and $\delta_{ji}$ is the long-run parameter of the model to be estimated through the error correction framework in the ARDL model, $\alpha_0$ is the constant term (drift) while $V_t$ is white noise error term.

Once cointegrating relationship was ascertained, the long run and error correction estimates of the ARDL model were obtained.

The error correction representation of the series is specified as follows:

$$\Delta V_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta V_{t-i} + \sum_{i=1}^{r} \alpha_i \Delta Y_{t-i} + \sum_{i=1}^{r} \alpha_i \Delta LnREER_{t-i} + \sum_{i=1}^{r} \alpha_i \Delta LnFSD_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta M_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta GDP_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta OPN_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta LnY_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta LnREER_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta LnFSD_{t-i} + \eta ECM_{t-i} + \phi_t WAR + \phi_t POL + \phi_t trend + \nu_t.$$ 

Where: $\eta$ is the speed of adjustment parameter and ECM is the residuals obtained from equation (16) (i.e. the error correction term). The coefficient of the lagged error correction term ($\eta$) is expected to be negative and statistically significant to further confirm the existence of a cointegrating relationship.

To ensure the goodness of fit of model, the diagnostic and stability tests are also conducted. The diagnostic test examines the serial correlation, functional form, normality and heteroscedasticity associated with the selected model. Pesaran and Pesaran (1997) suggest using Brown, Durbin, and Evans (1975) stability test. This technique is also known as cumulative (CUSUM) and cumulative sum of squares.
(CUSUMSQ). The CUSUM and CUSUMSQ statistics are updated recursively and plotted against the breaks points. If the plots of CUSUM and CUSUMSQ statistics stay within the critical bonds of five percent level of significance, the null hypothesis of stable coefficients in the given regression cannot be rejected.

**Construction of FSDI**

Following the expositions of Ang and McKibbin (2007), Khan, Qayyum and Ghani (2006), and Kargbo and Adamu (2009), the principal component analysis (PCA) is used to construct a financial sector development index from four proxies of financial development.

The ratio of banking deposit liabilities to GDP (BDLG) was used as the first proxy for financial development, which was calculated by subtracting currency in circulation from M2 and dividing by nominal GDP. The second measure of financial development was the ratio of domestic credit to the private sector to GDP (DCPSG). The next ratio, private sector credit to domestic credit (PSCDC) shows the share of credit to the private sector in total domestic credit and measures the extent to which the banking system channels funds to the private sector to facilitate investment and growth. And the final measure is the currency to deposit ratio (C/D).

Table 1 summarizes the results derived from the method of principal components. The eigenvalues indicate that about 89 percent of the standardized variance is explained by the first and second principal components while the third and fourth principal components account for the remaining 11 percent of the variation.

**Table 1: Principal Components Analysis**

<table>
<thead>
<tr>
<th>Prin. components</th>
<th>Eigenvalues</th>
<th>% of variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.50101</td>
<td>0.6253</td>
<td>0.6253</td>
</tr>
<tr>
<td>2</td>
<td>1.06114</td>
<td>0.2653</td>
<td>0.8905</td>
</tr>
<tr>
<td>3</td>
<td>0.30437</td>
<td>0.0761</td>
<td>0.9666</td>
</tr>
<tr>
<td>4</td>
<td>0.13348</td>
<td>0.0334</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor Loadings</th>
<th>Factor Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCPSG</td>
<td>0.7192</td>
<td>0.39188 (Factor 2)</td>
</tr>
<tr>
<td>BDLG</td>
<td>0.9567</td>
<td>0.55855 (Factor 1)</td>
</tr>
<tr>
<td>PSCDC</td>
<td>0.9785</td>
<td>0.7379 (Factor 2)</td>
</tr>
<tr>
<td>C/D</td>
<td>-0.2769</td>
<td>0.01154 (Factor 1)</td>
</tr>
</tbody>
</table>

*Source: Computed by author*
The factor scores indicate the contributions of DCPSG, BDLG, PSCDC, and C/D to the standardized variance of the first and second principal component as 39.2 percent, 55.9 percent, 73.79 percent, and 1.2 percent respectively. These contributions are the weights used to construct the financial sector development index, denoted as FSD.

Table 2: KMO Test

<table>
<thead>
<tr>
<th>Variable</th>
<th>KMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCPSG</td>
<td>0.5687</td>
</tr>
<tr>
<td>BDLG</td>
<td>0.4662</td>
</tr>
<tr>
<td>PSCDC</td>
<td>0.3573</td>
</tr>
<tr>
<td>CD</td>
<td>0.7084</td>
</tr>
<tr>
<td>Overall</td>
<td><strong>0.5241</strong></td>
</tr>
</tbody>
</table>

*Source: Computed by author.*

The KMO Measure of Sampling adequacy of 0.5241 in Table 2 shows that the variables are highly correlated and hence we are justified in using PCA.

**Financial Sector Development Index (FSD)**

Table 3 and Figure 1 show the trends in the financial sector development index. The graph reveals a declining trend in the performance of the sector since the mid 1970s.

Table 3: Financial Sector Development Index

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FSD</td>
<td>29.1</td>
<td>17.6</td>
<td>7.5</td>
<td>12.0</td>
<td>15.7</td>
<td>3.6</td>
<td>3.8</td>
<td>4.0</td>
<td>10.4</td>
<td>20.5</td>
<td>20.5</td>
<td>22.8</td>
<td>18.0</td>
</tr>
</tbody>
</table>

*Source: Computed by author*

The index deteriorated from 29.08 percent in 1970 to 7.46 percent in 1985. The deteriorating trend could be attributed to financial repression that characterized the sector during this period. Negative real rates of interest reached double digits in the 1980s which inhibited the mobilization of financial savings. Also, directed credit to
government from the banking system accounted for over 80.0 percent of total credit (Davies, 2007), which implies that the level of credit allocated to the private sector was minimal. However, the index surged to 12.01 percent in 1989 when a new economic recovery programme was initiated and peaked to 15.65 percent in 1993 following the implementation of financial reform policies including interest rate liberalization in 1992 and elimination of directed credit. The index dropped sharply to 3.64 percent in 1994 and averaged around 3.87 percent between 1995 and 1996.

This deteriorating trend in the 1990s partly reflects the adverse impact of the civil war on the performance of the banking sector, in terms of the level of financial savings mobilized, monetization and credit allocated to the private sector. With cessation of hostilities in 2002, the index reflected a gradual improvement in financial sector performance. Financial savings mobilization and credit allocated to the private sector have gradually increased in the post war era, reflecting increased confidence in the banking sector as financial sector reform measures are continually being implemented (Kargbo and Adamu, 2009). As such, the index rose to 22.81 percent in 2009 but slightly decreased to 18.0 percent in 2013.

Unit Root Tests Results

Tables 4 and 5 show that the ADF and PP statistics for expected inflation is stationary at levels. Except velocity, real effective exchange rate, real gross domestic product, openness, and monetization which do not exceed the critical values (in absolute terms) are non stationary at level for both ADF and PP statistics.
Table 4. Augmented Dickey-Fuller (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>LV</td>
<td>-2.0969</td>
<td>-2.1332</td>
<td>1</td>
</tr>
<tr>
<td>DLV</td>
<td>-6.7941</td>
<td>-6.7209</td>
<td>0</td>
</tr>
<tr>
<td>LY</td>
<td>-0.6921</td>
<td>0.7738</td>
<td>1</td>
</tr>
<tr>
<td>DLY</td>
<td>-6.092</td>
<td>-6.7219</td>
<td>0</td>
</tr>
<tr>
<td>LFSD</td>
<td>-2.0147</td>
<td>-1.6952</td>
<td>1</td>
</tr>
<tr>
<td>DLFSD</td>
<td>-7.2398</td>
<td>-7.4813</td>
<td>0</td>
</tr>
<tr>
<td>LnREER</td>
<td>-2.5419</td>
<td>3.3028</td>
<td>1</td>
</tr>
<tr>
<td>DLRREER</td>
<td>-6.0475</td>
<td>-5.9875</td>
<td>2</td>
</tr>
<tr>
<td>( \pi^e )</td>
<td>-3.130511</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>M\textsubscript{2}GDP</td>
<td>-2.123403</td>
<td>-2.167854</td>
<td>1</td>
</tr>
<tr>
<td>DM\textsubscript{2}GDP</td>
<td>-6.879841</td>
<td>-6.809968</td>
<td>0</td>
</tr>
<tr>
<td>OPN</td>
<td>-2.192688</td>
<td>-2.189732</td>
<td>1</td>
</tr>
<tr>
<td>DOPN</td>
<td>-7.614071</td>
<td>-7.905895</td>
<td>0</td>
</tr>
</tbody>
</table>

Note critical values: without trend = -2.93; with trend = -3.52 at 5% respectively

However, when first differences are taken on each of the variables, the \( ADF \) and the PP statistics are higher than their respective critical values (in absolute terms) implying stationarity after first differences. It implies that (velocity, real effective exchange rate,
real gross domestic product, openness, and monetization) are each integrated of order one or I(1) according to both the ADF and PP tests.

Table 6 shows that for most of the series, t-statistics are less than the 5 percent critical values calculated, except for the financial development indicator and monetization. At the 5 percent level, the Zivot and Andrews test provides strong evidence that most of the series (velocity, real effective exchange rate, real gross domestic product and openness) have unit root except for financial development and monetization which have a structural breakpoint in 1989 and 1987 respectively.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intercept without Trend</th>
<th>Intercept with trend</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV</td>
<td>-2.2233</td>
<td>-2.2541</td>
<td>Non-Stationary</td>
</tr>
<tr>
<td>DLV</td>
<td>-6.788</td>
<td>-6.7172</td>
<td>Stationary</td>
</tr>
<tr>
<td>LY</td>
<td>-0.8523</td>
<td>1.1684</td>
<td>Non-Stationary</td>
</tr>
<tr>
<td>DLY</td>
<td>-6.2177</td>
<td>-6.7424</td>
<td>Stationary</td>
</tr>
<tr>
<td>LFSD</td>
<td>-1.9444</td>
<td>-1.5774</td>
<td>Non-Stationary</td>
</tr>
<tr>
<td>DLFSD</td>
<td>-7.2735</td>
<td>-8.5254</td>
<td>Stationary</td>
</tr>
<tr>
<td>LREER</td>
<td>-2.6024</td>
<td>-2.8375</td>
<td>Non-Stationary</td>
</tr>
<tr>
<td>DLREER</td>
<td>-6.7555</td>
<td>-6.5315</td>
<td>Stationary</td>
</tr>
<tr>
<td>πe</td>
<td>-2.945</td>
<td></td>
<td>Stationary</td>
</tr>
<tr>
<td>M2GDP</td>
<td>-2.2841</td>
<td>-2.3162</td>
<td>Non-Stationary</td>
</tr>
<tr>
<td>DM2GDP</td>
<td>-6.8742</td>
<td>-6.8051</td>
<td>Stationary</td>
</tr>
<tr>
<td>OPN</td>
<td>-2.1775</td>
<td>-2.2176</td>
<td>Non-Stationary</td>
</tr>
<tr>
<td>DOPN</td>
<td>-7.6172</td>
<td>-8.1167</td>
<td>Stationary</td>
</tr>
</tbody>
</table>

Note critical values: without trend = -2.93; with trend = -3.52 at 5% respectively

Hence, for Sierra Leone structural break about economic activity appear around 1992 corresponding to the beginning of rebel war in 1991 while breakpoints for financial sector activities and monetization mostly occurred during the period of 1985-1989 that
corresponds to the start period of financial liberalization within the context of structural adjustment in the ECOWAS area.

Table 6. Zivot-Andrews Unit Root Test with Structural Breaks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Zivot-Andrews test</th>
<th>Break Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV</td>
<td>-4.671</td>
<td>1987</td>
</tr>
<tr>
<td>DLV</td>
<td>7.663</td>
<td>1997</td>
</tr>
<tr>
<td>LY</td>
<td>-2.578</td>
<td>1992</td>
</tr>
<tr>
<td>DLY</td>
<td>-9.317</td>
<td>1992</td>
</tr>
<tr>
<td>LFSD</td>
<td>-5.95</td>
<td>1989</td>
</tr>
<tr>
<td>LREER</td>
<td>-4.364</td>
<td>1989</td>
</tr>
<tr>
<td>DLREER</td>
<td>-8.363</td>
<td>1985</td>
</tr>
<tr>
<td>$\pi^e$</td>
<td>-4.091</td>
<td>1994</td>
</tr>
<tr>
<td>D$\pi^e$</td>
<td>-9.631</td>
<td>1989</td>
</tr>
<tr>
<td>M2GDP</td>
<td>-5.738</td>
<td>1987</td>
</tr>
<tr>
<td>OPN</td>
<td>-3.836</td>
<td>2006</td>
</tr>
<tr>
<td>DOPN</td>
<td>8.479</td>
<td>1993</td>
</tr>
</tbody>
</table>

Note critical values: with intercept and trend = -5.08 at 5%

Cointegration Analysis

Since the focus of this study is to investigate the impact of financial development on velocity of money, it is imperative to test for the existence of a long-run equilibrium relationship among all the variables within the framework of the bound testing approach to cointegration. A lag length of two is used in the bounds test in line with the Swartz Information Criterion (SIC). Pesaran and Pesaran (1997) also suggests a maximum lag length of two in the bounds testing approach to cointegration when using
After the lag length was determined, the F test statistic, computed within the framework of the VECM model has been compared with the upper and lower critical values in Narayan (2004). Narayan (2004) has provided critical values that are considered to be more appropriate for ARDL modeling using small samples as compared to Pesaran and Pesaran (1997) and Pesaran et al. (2001). These critical values are based on small sample size between 30 and 80 observations, unlike Pesaran and Pesaran (1997) and Pesaran et al. (2001) which are based on 500 and 1000 observations and suitable for large sample size.

Table 7 reports the bounds test results for financial development and velocity of money. The case when velocity of money is used as the dependent variable. The presence of long-run relationship between financial development and velocity of money in equation (14) has been tested using the bounds test approach to cointegration. The calculated F-statistics reported in Table 4 shows that, for equation (14) where the $LV_t$ is the dependent variable, $F_{LV_t} = 5.3557$.

It is conspicuous from the F-statistics results that there exists a long-run relationship among velocity of money, real effective change rate, expected inflation, financial development, openness, real GDP, and monetization in equation (14) because of the F-statistic (5.3557) is higher than the top critical bound value (5.225) at 1 percent significance level. This implies that the null hypothesis of no cointegration among the variables in equation (14) can be rejected.

Table 7: Bounds Test Results (LVt as the dependent variable)

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>Lag</th>
<th>Bounds Critical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.3557</td>
<td>2</td>
<td>I(0)</td>
</tr>
<tr>
<td>F-Statistic</td>
<td></td>
<td></td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10%</td>
</tr>
</tbody>
</table>


Thus the existence of long-run relationship among the variables in equation (14) implies cointegration. The study then proceeded to estimate the long-run ARDL model in equation (14) in order to obtain the long-run coefficients and their asymptotic standard errors.
Static Long-run Results

Table 8 reports the static long-run results and the diagnostic test statistics of the estimated ARDL model based on the short-run estimates. From Table 8, any disequilibrium in the system as a result of a shock can be corrected in the short-run by the error correction term. Hence, the error correction term is generated as follows which estimated the short-run adjustments to equilibrium.

\[ ECM = LV + 0.382 \times LY + 0.095 \times LREER + 0.002 \times \pi^e + 0.077 \times LFSD + 0.039 \times M_2GDP - 0.001 \times OPN + 0.069 \times WAR + 3.038 \times C + 0.011 \times T \]

From Table 8, it is seen that real GDP per capita, expected inflation, real effective exchange rate, financial development, and monetization have the expected signs and exert statistically significant effects on income velocity in the long run. It thus follows that a 1 percent increase in income decreases income velocity by 0.38 percent in Sierra Leone according to the finding in this study.

According to the results, the per capita income (y) has a significant negative sign with velocity. Fry (1989) indicates that the sign of association between velocity and real income (negative or positive) depends upon the stages of economic development especially the stage of financial development (FSD). At the early stage, velocity should fall with the growth of income but at a later on stage, velocity and income become positively correlated. At advanced stages, financial development affects VM positively so that VM increases with financial development.

These stages are characterized by transaction efficiency, financial innovation, and technological progress which ensure the availability and use of money substitutes and provide a wide range of money substitutes or quasi-money that reduce the demand for money which brings the speed of velocity up. While some researchers mention the possibility of a U-shaped velocity function with respect to economic development, the hypothesis has not been tested empirically. Bordo and Jonung (1990) mention that forces (speed of monetization and more intensive use of money stock) that pull VM in different directions may operate simultaneously and VM may remain stable. The negative relation between velocity and income growth shows that Sierra Leone might possibly be at early stages of financial development. The result is consistent with the findings of Short (1973) for West Malaysia and country region Singapore, Akhtamzzaman (2009) for Bangladesh and Omer (2010) for Pakistan among others. However, the result seems to contradict findings by Akinlo (2012) and Ng’imor and Muthoga (2015) for Kenya.

The results also show that a percentage increase in real exchange rate decreases rate of income velocity by 0.095 percent. The negative relationship between real exchange rate
and income velocity indicate that depreciation of the local currency leads to capital flight as investors prefer foreign assets to domestic assets. This result is consistent with the finding of Akinlo (2012) and Okafor et al (2013).

The coefficient of change in rate of inflation was negative and statistically significant at the 1 percent level. The results show that a percentage increase in inflation decreases rate of income velocity by 0.0018 percent. This implies that inflation is a significant variable that negatively impacts velocity. This is consistent with theory and empirical studies in developing countries, households prefer to hold their wealth in real assets rather than liquid assets if they anticipate inflation increase. The result is consistent with the findings of Ng’imor and Muthoga (2015) for Kenya, Okafor et al (2013) for Nigeria, and Omer (2010) for Pakistan. The coefficient of the financial sector development variable (FSD) is negative and statistically significant at the 1 percent level. This suggests that a one percent increase in financial development will decrease velocity by 0.08 percent.

Table 8: Long-run estimates based on SBC-ARDL (2, 2, 0, 0, 1,2,2,2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-Ratio (Prob.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LY</td>
<td>-0.382</td>
<td>0.139</td>
<td>-2.762 (0.012)**</td>
</tr>
<tr>
<td>LREER</td>
<td>-0.095</td>
<td>0.028</td>
<td>-3.377 (0.003)*</td>
</tr>
<tr>
<td>$\pi^e$</td>
<td>-0.002</td>
<td>0.0004699</td>
<td>-3.823 (0.001)**</td>
</tr>
<tr>
<td>LFSD</td>
<td>-0.077</td>
<td>0.021</td>
<td>-3.724 (0.000)**</td>
</tr>
<tr>
<td>M2GDP</td>
<td>-0.039</td>
<td>0.016</td>
<td>-7.701 (0.000)**</td>
</tr>
<tr>
<td>OPN</td>
<td>0.001</td>
<td>0.0015</td>
<td>0.941 (0.357)</td>
</tr>
<tr>
<td>WAR</td>
<td>-0.069</td>
<td>0.0500</td>
<td>-1.387 (0.180)</td>
</tr>
<tr>
<td>$\alpha_0$</td>
<td>-3.038</td>
<td>2.750</td>
<td>-1.105 (0.282)</td>
</tr>
<tr>
<td>Trend</td>
<td>-0.011</td>
<td>0.003</td>
<td>-3.353 (0.003)**</td>
</tr>
</tbody>
</table>

Diagnostic Tests

<table>
<thead>
<tr>
<th>Test Statistics</th>
<th>LM Version</th>
<th>F Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Correlation</td>
<td>CHSQ (1) = 1.082(0.298)</td>
<td>F(1, 20) = .529(0.708)</td>
</tr>
<tr>
<td>Functional Form</td>
<td>CHSQ (1) = 0.244(0.622)</td>
<td>F(1, 20) = 0.117(0.736)</td>
</tr>
<tr>
<td>Normality</td>
<td>CHSQ (2) = 0.829(0.661)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Heteroscedasticity</td>
<td>CHSQ (1) = 1.308(0.253)</td>
<td>F(1, 40)=1.286(0.264)</td>
</tr>
</tbody>
</table>

Note: ***, ** (*) imply significance at the 1, 5 & 10 percent levels respectively.

Source: Computed by Author using Microfit Version 4.1 developed by Pesaran and Shin (1999).
With increasing financial maturity, people hold more money in time deposit which slows the speed of velocity via lowering the value of credit and money multiplies and thus explaining the inverse relationship between velocity of money and financial development. The result also shows that a 1 percent increase in degree of monetization decreases income velocity by 0.039 percent. These results conform to theory and support the assertion that as financial deepening and innovation improves the economy holds and transact less with liquid cash. The results are also consistent with the findings of King’ori (2003), Ng’imor and Muthoga (2015), and Akinlo (2012).

The time trend is negative and significant, indicating a negative effect on the demand for real money balances and hence an increase in velocity. In other words, the rate of growth in financial innovation increases opportunities for investment in alternative financial assets and results in decrease in money holdings. The war dummy variable has a negative effect on real money holdings and is significant at the 5 percent level.

**Short-run Dynamic Results**

The existence of a cointegrating relationship between velocity of money and its independent variables provides support for the estimation of a short-run dynamic model. From Table 9, it is seen that real GDP per capita, expected inflation, real exchange rate, financial development, and monetization have the expected signs and exert statistically significant effects on income velocity in the short run. It thus follows that a 1 percent increase in income decreases income velocity by 0.36 and 0.48 percent in both the contemporaneous and lagged coefficients respectively in Sierra Leone according to the finding in this study and these are significant at the 1 percent level.

The negative signs of per capita income indicate that income affects the velocity inversely showing similarity with results of past studies. This also implies that the economy of Sierra Leone is still operating in the early stage of development. This result contradicts the quantity theory. Fry (1989) points out that the sign of correlation between VM and per capita income (negative or positive) depends on the stage of economic development, especially the stage of financial development. At the initial stage, velocity should fall with higher growth of income as demonstrated in the short-run model but at a later stage, velocity and income become positively correlated. This is because the initial stage in economic development is characterized by increasing monetization of the economy that is, spread of banking habits and relatively rapid expansion of purely financial or monetary transactions which contribute to proportionately higher demand for money making income elasticity of money demand highly elastic and hence, velocity is likely to fall. This result is consistent with the findings of Akhtaruzzaman (2009) for Bangladesh but contradicts that of Akinlo (2012).

As in the long run, the coefficient of real effective exchange rate has the expected negative sign which suggests the presence of the currency substitution phenomenon. A 1.0 percent increase in the exchange rate decreases velocity by 0.13 percent in the short-run. The depreciation of the exchange rate causes the income velocity to decrease as the domestic portfolio holders readjust their portfolio in favour of foreign assets. The continued depreciation of the exchange rate in both the short-run and long-run could be as a result of the speed of monetization and more intensive use of money stock for most of the period under consideration.

On the other hand, expected inflation rate was found having a significant short-run negative relationship with velocity of money. A 1 percent increase in expected inflation leads to 0.000137 percent decrease in velocity. This result is as expected. When prices increase, velocity of money declines as the payment pattern and shopping habits change. This result is consistent with the findings of Akinlo (2012), Anyanwu (1994), Fry (1989), and Okafor et al (2013).

Financial development raises the capacity of financial intermediaries to supply funds. This is confirmed by the negative and statistically significant effect of the LFSD at the 1.0 percent level. The magnitude of the coefficient implies that a 1.0 percent increase in financial development decreases velocity by 0.06 percent. Hence, short run changes in financial development index have negative and statistically significant effect on income velocity at the 1.0 percent level. This is because the initial stage in economic development is characterized by increasing monetization of the economy (that is, spread of banking habits and relatively rapid expansion of purely financial or monetary transactions) which contributes to proportionately higher demand for money making income elasticity of money demand highly elastic. Hence, velocity is likely to fall. This result is consistent with the findings of Rami (2011) for India, Omer (2010) for Pakistan, King’ori (2003) for Kenya, Adams et al (2010) for Kenya, and Ng’imor and Muthoga (2015) for Kenya. However, it contradicts the findings of Akinlo (2012) for Nigeria.

Moreover, as in the long-run, the result also shows that increase in degree of monetization by 1.0 percent decreases income velocity by approximately 0.05 percent in the short-run. This result conforms to theory and support the assertion that as financial deepening and innovation improves the economy holds and transact less with liquid cash (King’ori, 2003, Akinlo, 2012).

The time trend is positive and significant, indicating that there has been an upward movement in the holdings of real money balances as the economy becomes gradually...

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monetized. The war dummy has a negative effect on income velocity of money and is significant at the 1.0 percent level.

It is theoretically argued that a genuine error correction mechanism exists whenever there is a cointegrating relationship among two or more variables. As argued by Bahmani-Oskooee and Bohl (2000), this evidence of cointegration is more efficient than the bound test. This simply means that overlooking the co-integratedness of the variables would have introduced mis-specification in the underlying dynamic structures and it should also be pointed out that literature on cointegrated systems supports that only EC_{t-1} is needed to represent the co-integrating scheme (Akinlo, 2012). The error correction term is thus obtained from the negative and significant lagged residual of the cointegration regression. It determines the speed of adjustment to long-run equilibrium. The negative coefficient is an indication that any shock that takes place in the short-run would be corrected in the long-run. The rule of thumb is that, the larger the error correction

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-Ratio</th>
<th>[Prob]</th>
</tr>
</thead>
<tbody>
<tr>
<td>dLVM1</td>
<td>0.149</td>
<td>0.054</td>
<td>2.762</td>
<td>(0.010)***</td>
</tr>
<tr>
<td>dLY</td>
<td>-0.361</td>
<td>0.122</td>
<td>-2.961</td>
<td>(0.006)***</td>
</tr>
<tr>
<td>dLY1</td>
<td>-0.488</td>
<td>0.150</td>
<td>-3.260</td>
<td>(0.003)***</td>
</tr>
<tr>
<td>dLY1</td>
<td>-0.130</td>
<td>0.044</td>
<td>-2.969</td>
<td>(0.007)***</td>
</tr>
<tr>
<td>dLY1</td>
<td>-0.00013698</td>
<td>0.0003482</td>
<td>-3.934</td>
<td>(0.003)***</td>
</tr>
<tr>
<td>dLY1</td>
<td>-0.059</td>
<td>0.018</td>
<td>-3.293</td>
<td>(0.003)***</td>
</tr>
<tr>
<td>dLY1</td>
<td>-0.0000</td>
<td>0.002</td>
<td>-23.900</td>
<td>(0.000)***</td>
</tr>
<tr>
<td>dOPN</td>
<td>-0.001</td>
<td>0.000</td>
<td>1.261</td>
<td>(0.218)</td>
</tr>
<tr>
<td>dWAR1</td>
<td>-0.082</td>
<td>0.031</td>
<td>-2.630</td>
<td>(0.014)**</td>
</tr>
<tr>
<td>dC</td>
<td>-12.524</td>
<td>4.079</td>
<td>-3.077</td>
<td>(0.003)***</td>
</tr>
<tr>
<td>dT</td>
<td>0.009</td>
<td>0.002</td>
<td>-3.488</td>
<td>(0.002)***</td>
</tr>
<tr>
<td>ECM(-1)</td>
<td>-0.76254</td>
<td>0.14765</td>
<td>-5.164</td>
<td>(0.000)***</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.987</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.E. of Regression</td>
<td>0.024</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean of Dependent Var.</td>
<td>0.006</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Sum of Squares</td>
<td>0.012</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R-Bar-Squared 0.97539
F-stat. F(15,26) 109.654(0.000)
S.D. of Dependent Variable 0.152
Equation Log-likelihood 111.957
coefficient (in absolute term), the faster the variables equilibrate in the long-run when shocked Acheampong (2007). Hence, the coefficient implies that 76 percent of the disequilibrium of the previous year’s shock converges back to the long run equilibrium in the current year.

### Diagnostic and Parameter Stability Tests

The diagnostic test statistics of the selected ARDL model based on short-run estimates are reported in Table 8. The results indicate that the model passes the tests of serial correlation, functional form misspecification, non-normality of the errors, and heteroscedasticity. The model also has a high adjusted R-squared (97.5 percent) implying a high predictive power of the determinants. The high adjusted R-squared and high F-statistic shows a tight fit for the model.

Figures 2 and 3 report the plots of the CUSUM and CUSUMSQ for the estimated ARDL model. The graphs indicate the absence of any instability of the coefficients because the plots of these graphs are confined within the 5 percent critical bounds of parameter stability suggesting that all the coefficients of the estimated model are stable over the study period.

### Fig. 2 CUSUM

However, our results are in line with Narayan et al. (2009) who use panel cointegration to estimate the money demand function in South Asian countries of India, Pakistan, Bangladesh, Sri Lanka and Nepal. Based on their finding of stable money demand
function for the above countries (except Nepal), they suggested that the monetary targeting is a viable option for conduct of monetary policy for the central banks of these countries including Pakistan.

Fig. 3 CUSUMSQ

Plot of Cumulative Sum of Squares of Recursive Residuals

An in-sample forecast of the endogenous variable (Velocity of money) is made and the actual and forecast values are reported in Figure 4.

Fig. 4 ACTUAL AND FORECAST VALUES

Plot of Actual and Fitted Values

As could be seen from the Figure, the model is capable of tracking the historical values of endogenous variable with reasonable accuracy. The fits were quite impressive and they did track the actual dates. The ability of the model to capture turning points was remarkable. The model does forecast the actual variable well. That is, the model has a good predictive ability.

Pair-wise Granger Causality Test Results
The result of the pair-wise granger causality test is presented in Table 10. It reveals that there is no causality between financial development and velocity of money in Sierra Leone. This underscores the fact that Sierra Leone is still in its early stages of financial development confirming earlier results revealed in both the long-run and short-run estimates. Furthermore, there is no causal relationship between financial development and broad money growth in Sierra Leone.

Table 10. Pairwise Granger Causality Tests

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Stat</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2G does not Granger Cause LVM2</td>
<td>41</td>
<td>4.09076</td>
<td>0.0139</td>
</tr>
<tr>
<td>LVM2 does not Granger Cause M2G</td>
<td>41</td>
<td>1.93122</td>
<td>0.1431</td>
</tr>
<tr>
<td>LFSD does not Granger Cause LVM2</td>
<td></td>
<td>0.22803</td>
<td>0.8762</td>
</tr>
<tr>
<td>LVM2 does not Granger Cause LFSD</td>
<td>41</td>
<td>0.27112</td>
<td>0.8458</td>
</tr>
<tr>
<td>LFSD does not Granger Cause M2G</td>
<td></td>
<td>0.92348</td>
<td>0.4399</td>
</tr>
<tr>
<td>M2G does not Granger Cause LFSD</td>
<td>41</td>
<td>0.79655</td>
<td>0.5044</td>
</tr>
</tbody>
</table>

Source: Computed by author

Moreover, the results reveal that money growth Granger causes the velocity of money at the 5 percent level of significance but velocity does not Granger cause money growth based on the standard F-test. This shows that the causality is unidirectional. This result implies that changes in the past values of money growth can be used to predict the change in the present value of velocity of money.

With the optimal lag of three years, the null hypothesis that M2 growth volatility does not Granger-cause income velocity is rejected at 5 percent. Hence, the Friedman hypothesis that "An exceptional volatility of monetary growth increases the degree of perceived uncertainty and thereby increases the demand for money" (Friedman, 1984) is verified in the case of Sierra Leone.

CONCLUSION AND POLICY RECOMMENDATIONS

Conclusion

The velocity of money is one of the most narrowly watched variables by the monetary authorities in a monetary targeting regime to estimate the safe limit of monetary growth and to formulate a sound monetary policy. It is, therefore, a matter of concern for monetary authorities to have reliable information about macroeconomic variables that have impact on the variation of velocity.
The negative sign of the growth of income shows that at the early stages of financial development, the velocity and income become negatively correlated and real income does not impact on the velocity. Inflation rate and exchange rate have negative influence on the velocity of money. It is the behaviour of velocity that determines the degree of effectiveness to which the action of monetary authority contributes to economic growth, without fuelling inflation. The interest rate proxied by expected inflation has a negative relationship with the velocity of money. Since substitution can occur between money and alternative financial assets, a rise in the expected inflation leads to a lower cost of holding money so that velocity decreases. The depreciation of the Leone would make the domestic portfolio holders realign their portfolios in favour of foreign assets. And depreciation causes a higher cost of holding local currency so that velocity increases. This could be responsible for the negative relationship between the exchange rate and the velocity of money. The financial sector development index had a negative relationship with the velocity of money. An increase in financial development would reduce the amount of cash held by individual in a stable economy and, thereby, increase the velocity of money. The implication of this result is that the economy of Sierra Leone is operating at the early stages of financial development.

Based on the foregoing analysis, we can conclude that the velocity of money has a relationship with GDP per capita, financial development, monetization, expected inflation rate and exchange rate in Sierra Leone.

Policy Recommendations

Several policy implications can be derived from these findings. Firstly, it is recommended that pro-growth policies should be intensified in order to boost investment and financial development as development in the financial sector seems to have an impact on velocity of money in Sierra Leone especially in the long-run. Financial inclusion could also be identified as an important driver for financial development in Sierra Leone. Furthermore, the monetary authority should improve access to banking and financial services especially in rural areas as a vast majority of the rural community is financially excluded.

Secondly, fluctuation of real exchange rate has a significant impact on the dynamics of money demand function. Given that Sierra Leone is a net importer and in light of increased liberalization and opening of the economy, the monetary authority should ensure that real exchange rate depreciation remains in check to avoid capital flight.

Finally, inflation expectation has a negative and statistically significant influence on velocity. A direct implication of the above result is that forecasting future values of the speed of velocity by the Bank of Sierra Leone is important for estimating the safe limit of monetary expansion which is likely to increase the effectiveness of monetary policy.
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