# Empirical Relationship between Money Demand and Interest Rates in Sri Lanka

**R C P Padmasiri**
**O G Dayaratna Banda**

## Abstract

The interest elasticity of the demand for money is an important indicator in an effective counter-inflationary monetary policy. The objective of this study is to examine the nature and the extent of the relationship between the demand for money and nominal interest rates in Sri Lanka on the basis of the Baumol-Tobin theory of the demand for money. The ARDL approach to co-integration is used to evaluate the overall impact of interest rates on the demand for money. The results of the unit root test show that the interbank call loan rate is stationary at level form [I (0)], while the saving rate, 3 month, 6 month and 12 month fixed deposit rates, Treasury bill rates, banking rates and loan rates with securities are stationary in the 1st difference. There are joint long-run co-integration relationships among the variables of demand for money, deposits rates and lending rates in Sri Lanka. The results of ARDL suggest that there is a negative relationship among the normal saving deposit rates, fixed deposit rates, lending rates and real money demand, while there is a positive relationship between the real GDP and real money demand in the long run. The results of the short-run dynamic coefficients associated with the long-run relationships obtained from the ECM show a high percentage value of the disequilibria of the previous year's shock is adjusted back to equilibrium. The results suggest that the Central Bank of Sri Lanka needs to formulate sound monetary policies that will ensure a stable demand for the money function, thereby encouraging economic growth in the country. A policy of attracting more participants (non-government) and private sector funds to the money market is necessary as this will deepen the market and make the market more dynamic and amenable to monetary policy.

**Keywords:** Money Demand, Interest Rates, Baumol-Tobin Model, Autoregressive Distributed Lag Model, Error Correction Model, Sri Lanka.

**Mr. R C P Padmasiri,** Development Officer, Economic Research Unit, Department of Export Agriculture. e-mail: chamanipa@yahoo.com

**Dr. O G Dayaratna-Banda,** is a Senior Lecturer, Department of Economics and Statistics, University of Peradeniya. e-mail: ogdayab@gmail.com

## Introduction

Sri Lanka has experienced periods of relatively high inflation followed by persistent periods of average price stability. There have been fluctuations in inflation rates over time during the past few decades. While monetary policy plays a key role in price stabilization, economic growth and reducing unemployment, these macroeconomic objectives tend to show conflicting behaviour in certain situations. Macroeconomic management requires careful and astute selection of policy parameters to achieve objectives. The effectiveness of monetary policy tends to depend to a great extent on the nature and efficiency of the monetary transmission mechanism. Since policy interest rates appear to constitute the primary instruments of monetary policy, interest elasticity of demand for money will determine to a great extent the investment behaviour of the economy and, hence, the performance of aggregate economic activity.

The monetary policy of Sri Lanka is targeted to maintain sustainable growth of money consistent with economic growth, price stability, and financial system stability. Implementation of monetary policy relies on a monetary programme based on forecasts of economic growth, inflation and other key macroeconomic variables. The primary instrument of the monetary policy of the Central Bank of Sri Lanka (CBSL) is the interest rate. CBSL is authorized to choose appropriate instruments for meeting particular situations as demanded by existing economic conditions and financial markets. The interest elasticity of the demand for money is an important indicator for understanding and evaluating the effectiveness of anti-inflationary and pro-growth policy. Therefore, identifying the empirical relationship between the demand for money and interest rates in Sri Lanka is crucial for an effective formulation of monetary policy.

Under the speculative motive of demand for money, the Keynesian approach predicts that there is a negative relationship between interest rates and the demand for money. While the theoretical possibility of the relationship between the demand for money and interest rate is clear in various theories, how that relationship practically plays out in a particular country has to be understood by empirical evaluations of the linkages between interest rates and the demand for money.

The objective of this study is, therefore, to empirically examine the nature and the extent of the relationship between interest rates and the demand for money in Sri Lanka on the basis of the Baumol-Tobin theory of demand for money. The modified

version of a model combining the Baumol-Tobin model and the inventory theoretic model provides the theoretical underpinning of the empirical investigation.

By employing the bounds testing (ARDL) approach to co-integration together with the Error Correction Model, the study found both interest rates and the demand for money to be bound together in the long-run. There is a co-integration relationship between both the demand for money and deposit interest rates and the demand for money and lending interest rates in the long run. The associated equilibrium correction coefficient is also significant confirming the existence of long-run relationships. The equilibrium correction is fairly fast and is restored by the first quarter of the year. The estimated result of the log run ARDL parameter also indicates that there is a negative relationship between the demand for money and deposit interest rates as well as money demand and lending interest rates. Therefore, both estimations suggest that there is a positive relationship between money demand and real output in the long-run in Sri Lanka. These results imply that the purchasing power of money tends to increase beyond the level it would otherwise have reached, which means that the general level of money prices tends to decrease. Inversely, when the demand for money diminishes, the purchasing power of money tends to fall below the level it would otherwise have reached and the general level of money prices will tend to increase. Increases in interest rates will lead to increases in the price level. The results suggest that the monetary transmission mechanism in Sri Lanka is relatively efficient, and policy- makers need to integrate non-bank and other sectors of the financial markets in the purview of the monetary transmission mechanism.

The paper is organized as follows: Section two discusses the existing literature on the relevant field justifying the basis for this paper. Section three presents the theoretical foundation of the paper which attempts to derive empirical equations for estimations by combining the Baumol-Tobin model and the inventory theoretic model. Section four presents the empirical results and the discussion. The final section is devoted to summarizing the results of the study and providing the conclusion.

## Review of Literature

The relationship between the demand for money and interest rates has been intensively addressed in economic theory. Irving Fisher believed that velocity is determined by the institutions in an economy that affect the way individuals conduct

transactions. Fisher's view that velocity is fairly constant in the short run transforms the equation of exchange into the quantity theory of money, which states that nominal income is determined solely by movements in the quantity of money. Fisher believed that people hold money only to conduct transactions and have no freedom of action in terms of the amount they want to hold (Fisher 1896).

The Cambridge School restated the Fisher proposition indicating the level of transactions and the institutions affecting the way people conduct transactions. Individuals are allowed some flexibility in their decisions to hold money and are not completely bound by institutional constraints such as whether they can use credit cards or not to make purchases. Accordingly, the Cambridge approach did not rule out the effects of interest rates on the demand for money (Baumol 1952).

Keynes postulated that there are three motives behind the demand for money: the transactions motive, the precautionary motive and the speculative motive (Keynes 1936). Keynes believed that interest rates have an important role to play in influencing the decisions regarding how much money to hold as a store of wealth. Under this theory, individuals believe that interest rates gravitate to some normal value. When interest rates are below the normal value, people expect interest rates on bonds to increase in the future implying capital losses on them. People will be more likely to hold their wealth as money rather than bonds, and the demand for money will be high.

Milton Friedman stated that the demand for money must be influenced by the same factors that influence the demand for any asset, and then applied the theory of asset demand to money. The demand for money is a function of resources available to individuals and the expected returns on other assets relative to the expected return on money (Friedman 1959).

William Baumol and James Tobin independently developed models on the demand for money with similar implications, which demonstrated that even money balances held for transactions purposes are sensitive to the level of interest rates (Baumol 1952, Tobin 1956). The Baumol-Tobin model states that as interest rates increase, the amount of cash held for transaction purposes will decline, which, in turn, means that velocity will increase along with interest rates. The transactions component of the demand for money is negatively related to the level of interest rates.

Studies on estimating the relationship between the demand for money and interest rates have taken two directions. The first group of studies (Dekle and Pradhan 1997

and others) that has estimated linkages produced mixed results. While some have tested for effectiveness of monetary policy, others have tested for stability and report mixed results (Bahmani-Oskooee and Nasir 2004).

Empirical studies on the relationship between the demand for money and interest rates in various countries have taken two directions. Some suggest that there is a negative relationship between money demand and interest rates (Hossain and Younus 2007 and others). The other group of studies suggests that there is no relationship between the demand for money and interest rates (Friedman 1959, Mishkin 2007).

There is a dearth of studies on empirically examining explicit links between interest rates and monetary variables in Sri Lanka. A few studies on money demand relations have focused on effects of monetary policy and issues to be dealt with in monetary policy formulation (Wijewardena 1985, Silva 1977, Paudel 2007). These studies explain fiscal and monetary policy issues in the behaviour of interest rates rather than empirically testing the links between interest rates and monetary variables. Another set of recent studies in Sri Lanka has focused on the stability of the demand for money function in Sri Lanka. Jegatheesan (2009) argued that the demand for money is stable in the long run. By applying the error correction model, Jayasuriya (2010) found that the demand for money function in Sri Lanka is stable in the long run and weak in the short run. Dharmadasa and Nakanishi (2013) found that the demand for money function in Sri Lanka has been stable amid serious international financial crises in recent times. Though these studies shed light on the mechanisms of the effects of monetary policy, they do not test for the relationship between the demand for money and interest rates in Sri Lanka. All these studies use annual data to test short-run dynamics. However, annual data cannot fully capture short-run dynamics of highly volatile monetary variables. In order to capture the short-run dynamics of monetary policy, more disaggregated data is required.

Our study is justified on two grounds. First, though understanding the empirical relationship between interest rates and the demand for money in the short run and the long run is required for effective implementation of monetary policy, there are no recent studies on this issue pertaining to Sri Lanka. Second, no studies to date have examined the empirical relationship between money demand and interest rates using the Baumol-Tobin Model for Sri Lanka in any detail for quarterly data enabling capturing both short run and long run dynamics. This paper, therefore, employs the ARDL model to analyze short-run and long-run dynamic relations between interest rates and money demand in Sri Lanka for quarterly data.

## Theoretical Framework

This paper modifies the models developed by William Baumol and James Tobin to explain the relationship between the demand for money and interest rates by integrating the inventory theoretic model. Baumol and Tobin demonstrated that even money balances held for transaction purposes are sensitive to the level of interest rates. Money which earns zero interest is held only because it can be used to carry out transactions. Baumol and Tobin concluded that, as interest rates increase, the amount of cash held for transaction purposes will decline. It also means velocity will increase as interest rates increase. The transactions component of the demand for money is negatively related to the level of interest rates.

It is assumed that households earn an income which is automatically deposited at the beginning of each period in an interest-bearing savings account at a bank. Household income per month is denoted by *pq*. The household's consumption expenditure represents a constant flow during the month. The household must withdraw money from the savings account for consumption purposes. There is also a fixed cost when money is withdrawn from the saving account each time, which is *pb*, where *b* is real cost and *pb* is nominal cost. The household has M* in cash within the month which is the cash held by the household. The average money holding over the month is M*/2. The optimal level of the demand for money tends to depend on various costs. The cost of each trip to the bank is denoted by the cost of holding money *(pq)*. The cost of the number of trips during the month is *pq/M**. The total cost during the month of trips to the bank which is the cost of holding money is pb*(pq/M*)*. The opportunity cost of holding money is the interest rate forgone on the average money holdings which is *(M*/2)*. The total cost of holding money (TC) is:

$$TC = \text{pb}\left(\frac{pq}{M^*}\right) + \left(\frac{M^*}{2}\right) i \qquad (1)$$

Households must balance the costs of frequent trips to the banks against the forgone interest. The optimal choice of *M** is found by minimizing the total cost of holding money. We can also obtain an algebraic expression for the demand for money in the Baumol-Tobin model as:

$$\frac{\partial TC}{\partial M^*} = 0$$

$$\frac{\partial TC}{\partial M^*} = \frac{\partial\left[\text{pb}\left(\frac{pq}{M^*}\right) + \left(\frac{M^*}{2}\right) i\right]}{\partial M^*} = 0$$

$$\frac{M^*}{p} = \left(\frac{2bq}{i}\right)^{\frac{1}{2}} \qquad (2)$$

The demand for money is therefore given by;

$$\frac{Md}{p} = \frac{M_0^*}{2p} = \frac{1}{2}\left(\frac{2bq}{i}\right)^{\frac{1}{2}} \qquad (3)$$

Equation 2 represents the demand for money as a function of three key variables: income, interest rate and fixed cost. The following empirical equation is derived from this model:

$$\ell og\left(\frac{Md}{p}\right)_t = a_0 + a_1 \ell og\left(\frac{Md}{p}\right)_{t-1} + a_2 \ell og(Q)_t + a_3 \ell ogi_t + U_t \qquad (4)$$

where;

$\ell og\left(\frac{Md}{p}\right)_t$ = log of real money demand at time t

$\ell og\left(\frac{Md}{p}\right)_{t-1}$ = log of lagged real money demand at time t

$\ell og(Q)_t$ = log of real GDP at time t

$\ell ogi_t$ = log of nominal Interest Rates at time t

$U_t$ = disturbance term

By dropping the lagged term $(g\left[\frac{Md}{P}\right]_{t-1})$ and rebuilding equation 4 gives:

$$logrm1_t = \beta_0 + \beta_1 logrgdp_t + \beta_2 logint_t + u_t \qquad (5)$$

where,

$logrm1_t$ = Log value for real money demand at time t
$logrgdp_t$ = Log value for real gross domestic product at time t
$logint_t$ = Log value for nominal interest rates at time t

Where, interest rates in Sri Lanka are given below

*logBR* = Log value for banking rates
*logFDR3* = Log value for three months fixed deposits tares
*logFDR6* = Log value for six months fixed deposits tares
*logFDR12* = Log value for twelve months fixed deposits tares
*logIBCLR* = Log value for interbank call loan rates
*logSR* = Log value for saving deposits rates
*logTBPR* = Log value for treasury bill rates (primary market)
*logTBSR* = Log value for treasury bill rates (secondary market)
*logWLR* = Log value for loan rates- with security
*logWOLR* = Log value for loan rates- without security

According to this derivation, there are two estimates to analyze the relationship between the demand for money and interest rates. They are the relationship between the demand for money and deposits interest rates, and the relationship between the demand for money and lending interest rates. The relationship between demand for money and deposits interest rates is:

$$logRM1_t c + \alpha logRGDP_t + \beta logBR_t + \varnothing logFDR3_t + \partial logFDR6_t + \theta logFDR12_t + \delta logSR_t + \vartheta logTBPR_t + logTBSR_t + \varphi D_t + \epsilon_t \quad (6)$$

where $D_t$ is a dummy variable. The reason for this variable [The reason for including this dummy variable is to capture any structural breaks of the time series data arising from significant policy shifts in Sri Lanka]:

D1 = 1 = 1977:2-1980:4
2000:4-2001:4
0 = Otherwise

## Estimation Methods

Many past studies have used the Johansen co-integration technique to determine the long-term relationships between variables concerned. In fact, this remains a technique of choice for many researchers who argue that this is the most accurate method to apply for I (1) variables. Recently, however, a series of studies by Pesaran and Shin (1999), Pesaran and Pesaran (1997), Pesaran, Shin and Smith (1996) and Pesaran et al. (2001) have introduced an alternative co-integration technique known as the 'Autoregressive Distributed Lag (ARDL)' bound test. This technique has a number of advantages over the Johansen co-integration technique. First, the ARDL model is a more statistically significant approach to determining the co-integration relation in small samples (Ghatak and Siddiki 2001) while the Johansen co-integration technique requires large data samples for validity. Another advantage of the ARDL approach is that it can be applied whether the repressors are I (1) and/or I (0) while other co-integration techniques require all of the repressors to be integrated in the same order. This means that the ARDL approach avoids the pre-testing problems associated with standard co-integration (Pesaran et al, 2001). In addition, if we are not sure about the unit root properties of the data, applying the ARDL procedure is the most appropriate model for empirical work. As Bahmani-Oskooee and Nasir (2004:485) postulate the first step in any co-integration technique is to determine the degree of integration of each variable in the model but this depends on which unit root test one uses as different unit root tests could lead to contradictory results. For example, by applying conventional unit root tests such as the Augmented Dickey Fuller and the Phillips-Perron tests, one may incorrectly conclude that a unit root is present in a series that is actually stationary around a one-time structural break (Perron 1989, 1997). The ARDL approach is useful as it avoids these problems. Further, the Johansen co-integration technique requires a large number of choices to be made including decisions such as the number of endogenous and exogenous variables (if any) to be included, the treatment of deterministic elements as well as the order of VAR and the optimal number of lags to be used. The estimation procedure is very sensitive to the method used to make these choices and decisions (Pesaran and Smith 1996). Finally, the ARDL approach allows different variables to have a different optimal number of lags, which is not permitted in the Johansen-type models (Pesaran and Pesaran (1997).

The conditional VECM of the relationship between money demand and deposits interest rates can be specified as:

$$\Delta logRM1_t = c_0 + \delta_1 logRM1_{t-1} + \delta_2 logRGDP_{t-1} + \delta_3 logBR_{t-1} + \delta_4 logFDR3_{t-1}$$
$$+\delta_5 logFDR6_{t-1} + \delta_6 logFDR12_{t-1} + \delta_7 logSR_{t-1} + \delta_8 logTBPR_{t-1}$$
$$+\delta_9 \log TBSR_t + \sum_{i=1}^{p} \varnothing_i \Delta logRM1_{t-i} + \sum_{j=1}^{q} \omega_j \Delta logRGDP_{t-j} + \sum_{l=1}^{q} \varphi_l \Delta logBR_{t-l}$$
$$+\sum_{m=1}^{q} \gamma_m \Delta logFDR3_{t-m} + \sum_{P=1}^{q} \vartheta_p \Delta logFDR6_{t-p} + \sum_{R=1}^{q} \rho_R \Delta logFDR12_{t-R}$$
$$+\sum_{W=1}^{Q} \tau_W \Delta logSR_{t-W} + \sum_{U=1}^{Q} \sigma_U \Delta logTBPR_{t-U} + \sum_{K=1}^{Q} \theta_K \Delta logTBSR_{t-K} + \varphi D_1 + \epsilon_t \qquad (7)$$

Where,$\delta_t$ are the long run multipliers, $c_o$is the drift and $\epsilon_t$ are white noise errors.

The first step in the ARDL bounds testing approach to co-integration is to estimate equation (7) by ordinary least squares (OLS) in order to test for the existence of a long-run relationship among the variables. This is done by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables, i.e.,

$$H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = \delta_9 = 0$$

$$H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq \delta_7 \neq \delta_8 \neq \delta_9 \neq 0.$$

We denote the test which normalizes on logRM1 by

$$F_{logRM1}(logRM1 logRGDP, logBR, logFDR3, logFDR6, logFDR12, logSR, \log TBPR, logTBSR)$$

According to the ARDL approach, two variables are co-integrated when the independent variables are I (d) (where 0≤d≥1): a lower value assuming the regressors are I (0) and an upper value assuming purely I (1) regressors. If the F-statistic is above the upper critical value, the null hypothesis of no long-run relationship can be rejected irrespective of the orders of integration for the time series. Conversely, if the test statistic falls below the lower critical value, the null hypothesis cannot be rejected. Finally, if the statistic falls between the lower and the upper critical values, the result is inconclusive. The approximate critical values for the F-test are given in Pesaran and Pesaran (1997).In the second step, once co-integration is established, the conditional ARDL *($p_1$,$q_1$,$q_2$,$q_3$,$q_4$,$q_5$,$q_6$,$q_7$,$q_8$)* long-run model for *t logRM1* can be estimated as follows:

$$logRM1_t = c_0 + \sum_{i=1}^{p_1}\delta_1 logRM1_{t-i} + + \sum_{i=0}^{q_1}\delta_1 logRGDP_{t-i} + \sum_{i=0}^{q_2}\delta_3 logBR_{t-i}$$
$$+ \sum_{i=0}^{q_3}\delta_4 logFDR3_{t-i} + \sum_{i=0}^{q_4}\delta_5 logFDR6_{t-i} + \sum_{i=0}^{q_5}\delta_6 logFDR12_{t-i}$$
$$+ \sum_{i=0}^{q_6}\delta_7 \Delta logSR_{t-i} + \sum_{i=0}^{q_7}\delta_8 logTBPR_{t-i} + \sum_{i=0}^{q_8}\delta_9 logTBSR_{t-K} + \varphi D_1 + \epsilon_t \quad (8)$$

Where, ∅,ω,φ,γ,β,ρ,τ,σ,θ are short run dynamic coefficients.

This involves selecting the orders of the ARDL $(p_1,q_1,q_2,q_3,q_4,q_5,q_6,q_7,q_8)$ model in the five variables using Akaike information criteria (AIC).In the third and final step, this paper obtains the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. This is specified as follows:

$$\Delta logRM1_t = \mu + \sum_{i=1}^{p}\varnothing_i \Delta logRM1_{t-i} + \sum_{j=1}^{q}\omega_j \Delta logRGDP_{t-j} + \sum_{l=1}^{q}\varphi_l \Delta logBR_{t-l}$$
$$+ \sum_{m=1}^{q}\gamma_m \Delta logFDR3_{t-m} + \sum_{P=1}^{q}\beta_p \Delta logFDR6_{t-p} + \sum_{R=1}^{q}\rho_R \Delta logFDR12_{t-R}$$
$$+ \sum_{W=1}^{Q}\tau_W \Delta logSR_{t-W} + \sum_{U=1}^{Q}\sigma_U \Delta logTBPR_{t-U} + \sum_{K=1}^{Q}\theta_K \Delta logTBSR_{t-K} \quad (9)$$
$$+ \vartheta ecm_{t-1} + \epsilon_t$$

where, ∅,ω,φ,γ,β,ρ,τ,σ,θare short run dynamic coefficients of the model's convergence to equilibrium and ϑ is the speed of adjustment.

The linkages between the demand for money and lending interest rates are specified as follows:

$$logRM1_t = \delta + \vartheta logRGDP_t + \alpha logTBCLR_t + \gamma logWLR_t + \partial logWOLR_t + \varphi D_t + \epsilon_t \quad (10)$$

where, $D_t$ is a dummy variable.

The reason for including this variable is to address the fluctuations of time series data for the demand for money and lending interest rates in Sri Lanka.

$D_2$ 1= 1978:1-1980:1
0= Otherwise

Equation for ARDL bounds test is:

$$\Delta logRM1_t = \delta_0 + \beta_1 logRM1_{t-1} + \beta_2 logRGDP_{t-1} + \beta_3 logTBCLR_{t-1}$$
$$+\beta_4 logWLR_{t-1} + \beta_5 logWOLR_{t-1} + \sum_{i=1}^{p} \vartheta_i \Delta logRM1_{t-i} + \sum_{j=1}^{q} \gamma_j \Delta logRGDP_{t-j}$$
$$+\sum_{l=1}^{q} \varphi_l \Delta logTBCLR_{t-l} + \sum_{m=1}^{q} \gamma_m \Delta logWLR_{t-m} + \sum_{P=1}^{q} \vartheta_p \Delta logWOLR_{t-p}$$
$$+\varphi D_2 + \epsilon_t \qquad (11)$$

To estimate the long-run relationship among the variables using ARDL approach requires:

$$logRM1_t = c_0 + \sum_{i=1}^{p_1} \delta_i logRM1_{t-i} + \sum_{i=0}^{q_1} \delta_2 logRGDP_{t-i} + \sum_{i=0}^{q_2} \delta_3 logTBCLR_{t-i}$$
$$+\sum_{i=0}^{q_3} \delta_4 logWLR_{t-i} + \sum_{i=0}^{q_3} \delta_5 logWOLR_{t-i} + \varphi D_2 + \epsilon_t \qquad (12)$$

The ARDL error correction representation is:

$$\Delta logRM1_t = \mu + \sum_{i=1}^{p} \vartheta_i \Delta logRM1_{t-i} + \sum_{j=1}^{q} \gamma_j \Delta logRGDP_{t-j} + \sum_{l=1}^{q} \varphi_l \Delta logTBCLR_{t-l}$$
$$+\sum_{m=1}^{q} \gamma_m \Delta logWLR_{t-m} + \sum_{P=1}^{q} \vartheta_p \Delta logWOLR_{t-p} + \vartheta ecm_{t-1} + \epsilon_t \qquad (13)$$

The Boumal-Tobin model of the demand for money and deposits interest rates behaviour illustrates that increases in deposits interest rates help decrease the demand for money. This model also suggested that the relationship between money demand and interest rates is negative and the coefficient of the relationship is approximately 0.5.

**Table 1: Definition of Variables for Empirical Tests**

| | |
|---|---|
| GDP | GDP is the Gross Domestic Product. As published data for quarterly GDP is not available, annual time series was transformed into quarterly series using relevant disaggregate techniques. |
| GDP Deflator | The GDP deflator is calculated using the GDP at constant factor prices (1996) and GDP current factor prices series published by the Central Bank on an annual basis which were then transformed into quarterly series. |
| RGDP | Nominal Gross Domestic Product deflated by the GDP deflator to obtain the Real Gross Domestic Product. |
| GRRGDP | Calculated Growth Rate of Real Gross Domestic Product using Real Gross Domestic Product |
| RM1 | Real Money Demand: Real narrow money was obtained by dividing nominal narrow money by the GDP deflator. |
| BR | Banking Rates: The Central Bank interest rates imposed on loans to commercial banks. |
| FDR3 | Fixed deposits interest rate given by commercial banks for the three-month time period. |
| FDR6 | Fixed deposits interest rates for the six-month time period. |
| FDR12 | Fixed deposits interest rates for the twelve-month time period. |
| IBCLR | Inter-bank call loan rates: Credit transactions which are inter banks and financial institutions during less than one-week time period. |
| SR | Saving Rates: The interest rates given for money deposited in commercial and savings banks. |
| TB(P) | The interest rate given for government treasury bills for the primary market |
| TB(S) | The interest rate given for government treasury bills for the secondary market |
| WLR | The loan recovery interest rate with security given by commercial and savings banks |
| WOLR | The interest rate that is recovery of loans without security given by commercial and savings banks |

The annual data for all the variables was taken from annual reports and published statistical appendices of the Central bank of Sri Lanka for different years. The annual data was transformed into quarterly data so that quarterly data is available from 1977: 1$^{st}$ quarter to 2007: 4th quarter. Data was then converted into a natural log form to standardize empirical analysis. The time series data was used in empirical analysis using econometric methods to reach the conclusion of study.

## Empirical Analysis

To identify the nature of the variables, unit roots tests were conducted. A co-integration test using the ARDL approach was conducted to test the relationship between the demand for money and interest rates. Dicky- Fuller (DF), ADF (Augmented Dicky

fuller) and Phillips-Perron (PP) tests were conducted. The test results would be more realistic and easily declared as I (0) or I (1). In the second step, co-integration tests by using the ARDL approach were conducted to identify the relationship between the demand for money, deposits interest rates and lending interest rates.

A stationary time series means having independent means and variances of time. It is determined by evaluating the mean and the variance of a series, i.e., if the mean and the variance of a time series changes over time, it is non-stationary and is said to have a unit root. In this case, it needs to be converted into stationary time series by differencing. If a time series becomes stationary after differencing by one time, then such a time series is known as integration of order one, normally denoted by I(1). If it needs differencing by two times, it is known as order two, denoted by I (2). Similarly, if it needs to be differenced by d times and denoted by I *(d)* is denoted by I (0).

**Table 2: Results of Unit Root Tests**

| Variables | Unit Root Tests on Levels | | | | Unit Root Tests on 1st Difference | | | |
|---|---|---|---|---|---|---|---|---|
| | Test with a constant | | Test with a constant and a trend | | Test with a constant | | Test with a constant and a trend | |
| | ADF | PP | | ADF | PP | ADF | PP | ADF |
| LRM1 | -1.229 | 3.67** | -3.601* | 9.686** | 7.393** | 25.468** | 7.360** | 25.051** |
| LRGDP | 0.155 | -0.996 | -2.457 | -3.102 | -3.420* | -3.940** | -3.606* | -3.885* |
| LSR | -2.053 | -2.132 | -2.063 | -2.333 | -3.581** | -9.302** | -3.581* | -9.302** |
| $LFDR_3$ | -2.645 | -2.755 | -2.811 | -2.962 | -3.895** | -11.280** | -3.839* | -11.255** |
| $LFDR_6$ | -2.210 | -2.894* | -2.926 | -3767 | -4.877** | -12.201** | -4.841** | -12.203** |
| LFDR12 | -2.121 | -2.669 | -2.614 | -4.173** | -3.821** | -10.653** | -3.757* | -10.676** |
| LTBPR | -2.834 | -3.806** | -2.908 | -3.869* | -4.616** | -9.852** | -4.486** | -9.906** |
| LTBSR | -2.484 | -2.610 | -2.765 | -2.768 | -4.913** | -9.688** | -4.893** | -9.638** |
| LIBCLR | -3.628** | -5.571** | -3.646* | -5.545** | | | | |
| LWLR | -3.292* | -4.762** | -3.163 | -4.522** | -5.612** | -11.625** | -5.692** | -11.770** |
| LWOLR | -2.684 | -5.227** | -2.893 | -5.303** | -5.428** | -12.275** | -5.403** | -12.447** |
| critical **1%**** | **-3.486** | **-3.484** | **-4.037** | **-4.035** | **-3.486** | **-3.487** | **-4.038** | **-4.035** |
| value **5%*** | **-2.886** | **-2.885** | **-3.448** | **-3.447** | **-2.886** | **-2.885** | **-3.448** | **-3.447** |

The unit root test is the preliminary step in empirical analysis in the co-integration test. The DF test, ADF test, and PP test are normally common to the unit root test adopted by many scholars (Perron 1989, Nwaobi 2002, Hossain & Younus 2007, Ghatak & Siddiki 2001). Results are achieved assuming the presence of unit root (non-stationary variables) in the null hypotheses ($H_0$) and no unit root (stationary

variables) in the alternative hypothesis ($H_1$). In this regard, a decision is made based on the calculated statistics and McKinnon's critical value. The results of ADF and PP tests for level variables are summarized in Table 2.

In Table 2, the unit root test results of all eleven variables as defined in previous section (3) are presented. The maximum lag length proceeds down the appropriate lag by examining the Schwarz Criterion (SBC) and Akaike Information Criterion (AIC). ADF and PP tests are conducted with four lags. The results show that only the variable LIBCLR is stationary in level form, and is known as the I(0) variable in this study. LWLR is another significant variable with a constant and a trend in all tests assuming that this variable includes a time trend and is assumed as I (0). The remaining variables were processed to test the unit root in the 1st difference with the results also presented in Table 2.

Results for the 1st difference show that LRMI, LRGDP, LSR, LFDR3, LFDR6, LFDR12, LTBPR, LTBSR, LWLR and LWOLR are significant and I (1) with all three test methods. Among the variable selected, both I (0) and I (1) are found, the ARDL approach to co-integration was used to test the relationship between the variables over the long term.

In the first step of the ARDL analysis, this paper tested for the presence of long-run relationships. It used an AIC to select a maximum lag order of 3 for the conditional ARDL and VECM. Following the procedure in Pesaran and Pesaran (1997), this paper first estimated an OLS regression for the first differences and then tested for the joint significance of the parameters of the lagged level variables when added to the first regression. According to Pesaran and Pesaran (1997), "this OLS regression in first differences are of no direct interest" to the bounds co-integration test. The Fstatistic tests the joint null hypothesis that the coefficients of the lagged level variables are zero (i.e., no long-run relationship exists between them). Table 3 reports the relationship between the demand for money and deposit interest rates, and the results of the calculated F-statistics when each variable is considered as a dependent variable (normalized) in the ARDL-OLS regressions.

**Table 3: Results of bound Tests on Equation 7**

| Model | Dependent Variable | Independant Variables | AIC lags | F-statistics | Probability | Results |
|---|---|---|---|---|---|---|
| $f_{LOGFM1}$ | LOGFM1 | LOGRGDP, LOGSR, LOGBR, LOGFDR3, LOGFDR6, LOGFDR12, LOGTBPR, LOGTBSR | 3 | 4.056 | 0.0000 | Integrated |
| $f_{LOGRGDP}$ | LOGRGDP | LOGRM1,LOGSR,LOGBR,LOGFDR3, LOGFDR6,LOGFDR12, LOGTBPR, LOGTBSR | 3 | 67.25 | 0.0000 | Integrated |
| $f_{LOGSR}$ | LOGSR | LOGRGDP,LOGRM1,LOGBR,LOGFDR3, LOGFDR6,LOGFDR12, LOGTBPR, LOGTBSR | 3 | 1.60 | 0.0000 | No Integrated |
| $f_{LOGBR}$ | LOGBR | LOGRGDP,LOGSR,,LOGRM1,LOGFDR3, LOGFDR6,LOGFDR12, LOGTBPR, LOGTBSR | 3 | 0.832 | 0.07 | No Integrated |
| $f_{LOGFDR3}$ | LOGFDR3 | LOGRGDP,LOGSR,LOGBR,LOGRM1, LOGFDR6,LOGFDR12,LOGTBPR, LOGTBSR | 3 | 5.219 | 0.710 | Integrated |
| $f_{LOGFDR6}$ | LOGFDR6 | LOGRGDP,LOGSR,LOGBR,LOGFDR3, LOGFDR6,LOGRM1,LOGTBPR, LOGTBSR | 3 | 2.69 | 0.0000 | No Integrated |
| $f_{LOGFDR12}$ | LOGFDR12 | LOGRGP,LOGSR,LOGBR,LOGFDR3, LOGFDR6,LOGFDR12, LOGRM1, LOGTBSR | 3 | 2.012 | 0.0174 | No Integrated |
| $f_{LOGTBPR}$ | LOGTBPR | LOGRGP, LOGSR, LOGBR, LOGFDR3, LOGFDR6, LOGFDR12, LOGRM1, LOGTBSR | 3 | 3.133 | 0.0003 | No Integrated |
| $f_{LOGTBSR}$ | LOGTBSR | LOGRGDP,LOGSR,LOGBR,LOGFDR3, LOGFDR6,LOGFDR12, LOGTBPR, LOGRM1 | 3 | 1.898 | 0.0263 | No Integrated |

*Note:* Asymptotic critical value bound are obtained from Table F in Appendix C 'unrestricted intercept and trend', k=9(Pesaran and Pesaran, 1997.p.478), lower bound I (0) =2.67 and upper bound I (1) =3.60 at 1% significance level.

The calculated F-statistics $f_{LOGFM1}$(LOGRM1/LOGRGDP, LOGSR, LOGBR, LOGFDR3, LOGFDR6, LOGFDR12, LOGTBPR, LOGTBSR) is 4.056 which are higher than the upper-bound critical value 3.60 at the 1% level. If the F-statistics test based on the F table (Pesaran and Pesaran 1997) is significant, a long- term relationship does exist. Methods for testing hypotheses are to compare the F-statistics with the upper and lower bound of critical value with a 1% level of significance. If it exceeds the upper bound then the case is significant and a null hypothesis is rejected by saying there is a long-term relationship between the variables. If the F statistic is beneath the lower bound of the critical value it is insignificant, and the null hypothesis cannot be rejected by saying there is no long-term relationship. According to this study, the calculated F statistic is 4.056 and F Table critical value for 1% level of significance is given as 2.65 to 3.60. Since the F statistics exceed the upper bounds of critical value, the null hypothesis is rejected. This clearly shows that LOGRM1 has a long-term relationship with LOGRGDP, LOGSR, LOGBR, LOGFDR3, LOGFDR6, LOGFDR12, LOGTBPR and LOGTBSR and that they move together. Also, $f_{LOGRGDP}$(LOGRGDP/ LOGRM1, LOGSR, LOGBR, LOGFDR3, LOGFDR12, LOGTBPR, LOGTBSR)=67.25 and $f_{LOGFDR3}$ (LOGFDR3/LOGRGDP, LOGSR, LOGBR, LOGRM1, LOGFDR6, LOGFDR12, LOGTBPR, LOGTBSR)=5.219 both are higher than the upper bound critical value 3.60. Thus, the null hypothesis of no co-integration relationships

amongst the variables when the regressions are normalized on LOGRM1, LOGRGDP and $LOGFDR_3$ variables (Table 3).

According to these bound test results, we conclude that there is a joint long-run co-integration relationship among the variables of money demand and deposits interest rates in Sri Lanka. Furthermore, this paper finds that there is a relationship between money demand and deposits interest rates as predicted in the Boumal -Tobin model. The results obtained by normalizing on real money demand (LOGRM1) in the long-run are reported in Table 4.

**Table 4: ARDL Model Long-run Coefficients on Equation 8**

| Regressor | Coefficient | Standard error | t value | P value |
|---|---|---|---|---|
| $logRM1_{t-1}$ | 0.3579 | 0.1274 | 2.8073*** | 0.0072 |
| $logRM1_{t-2}$ | -0.0717 | 0.1210 | -0.5920 | 0.5563 |
| $logRGDP_t$ | 0.3493 | 0.0916 | 3.8115*** | 0.0004 |
| $logSR_t$ | -0.2600 | 0.1066 | -2.4370** | 0.0186 |
| $logSR_{t-1}$ | 0.0022 | 0.1130 | 0.0198 | 0.9840 |
| $logSR_{t-2}$ | 0.0649 | 0.1124 | 0.5775 | 0.5664 |
| $logSR_{t-3}$ | 0.2483 | 0.1114 | 2.2287** | 0.0306 |
| $logSR_{t-4}$ | -0.0839 | 0.0980 | -0.8560 | 0.3963 |
| $logSR_{t-5}$ | 0.1341 | 0.0669 | 2.0030** | 0.0510 |
| $logSR_{t-6}$ | 0.1420 | 0.0436 | 3.2514*** | 0.0021 |
| $logSR_{t-7}$ | 0.1388 | 0.0590 | 2.3420** | 0.0234 |
| $logBR_i$ | -0.0178 | 0.0811 | -0.2201 | 0.8267 |
| $logBR_{t-1}$ | 0.1229 | 0.1189 | 1.0328 | 0.3070 |
| $logBR_{t-2}$ | 0.2255 | 0.1358 | 1.6600 | 0.1030 |
| $logBR_{t-3}$ | -0.2063 | 0.1180 | -1.7480* | 0.0869 |
| $logFDR3_t$ | 0.1409 | 0.0831 | 1.6954* | 0.0900 |
| $logFDR6_t$ | 0.0061 | 0.0700 | 0.0860 | 0.9310 |
| $logFDR6_{t-1}$ | -0.0372 | 0.0720 | -0.5110 | 0.6110 |
| $logFDR6_{t-2}$ | -0.1097 | 0.0640 | -1.7070* | 0.0944 |
| $logFDR6_{t-3}$ | -0.2274 | 0.0715 | -3.1779*** | 0.0026 |
| $logFDR6_{t-4}$ | -0.0157 | 0.0770 | -0.2014 | 0.8412 |
| $logFDR6_{t-5}$ | 0.0358 | 0.0733 | 0.4884 | 0.6275 |
| $logFDR6_{t-6}$ | -0.0917 | 0.0600 | -1.5065 | 0.1386 |
| $logFDR6_{t-7}$ | -0.0806 | 0.0586 | -1.3754 | 0.1755 |
| **$logFDR12_t$** | **-0.2238** | **0.0881** | **-2.5390**** | **0.0145** |
| $logTBPR_t$ | -0.0390 | 0.0718 | -0.5420 | 0.5898 |
| $logTBPR_{t-1}$ | 0.1560 | 0.0625 | 2.4968** | 0.0161 |
| $logTBPR_{t-2}$ | 0.0910 | 0.0673 | 1.3521 | 0.1828 |
| $logTBPR_{t-3}$ | 0.1654 | 0.0632 | 2.6181** | 0.0119 |
| $logTBSR_t$ | 0.0710 | 0.0634 | 1.1176 | 0.2694 |
| $D_1$ | -0.0081 | 0.0300 | -0.2723 | 0.7865 |
| C | 0.8386 | 0.7368 | 1.1381 | 0.2608 |

*(critical value ***-1% , **-5% ,*- 10%*
$\bar{R}^2 = 0.9753$ *SER= 0.034 AIC= -3.6147 SBC= -2.6548 DW= 2.0586 F=100.50(prob 0.0000)* $\sigma^2$ *=05*

ARDL long-run coefficients are presented in Table 4. The maximum lag length proceeds down the appropriate lag by examining the Akaike Information Criterion (AIC). The test statistics in this Table show that the coefficient sign of $LOGRGDP_{t,}$ $LOGSR_{t,}$ $LOGFDR_{6,t-3,}$ $LOGFDR_{12,t}$ and $LOGTBPR_{t-1}$ are consistent with expectations and have recorded a 1% level of significance. This proves the long-term impact of $LOGRGDP_{t,}$ $LOGSR_{t,}$ $LOGFDR_{6,\ t-3,}$ $LOGFDR_{12,\ t}$ and $LOGTBPR_{t-1}$ on $LOGRM_{1t.}$ The estimated coefficient of the long-run relationship shows that saving interest rates have a very high impact on real money demand. A 1% increase in saving interest rates at time t leads to approximately a 0.26 decrease in real money demand at time t, all things being equal. These results indicate that there is a negative relationship between real money demand and saving interest rates.

The real GDP variable is positive and very significant at the 1% level. It indicates that there is a relationship between LOGRM1 and LRGDP. Further, Table 5 shows that there is a positive relationship between LRM1 and LRGDP. The relationship between LRGDP and LRM1 is positive showing that a 1% increase in LRGDP leads to approximately a 0.35% increase in LRM1. This result indicates that there is a positive relationship between real money demand and real GDP in the long run.

The impact of fixed deposits interest rates on real money demand is significant at the 1% level. Only the six-month LFDR at time period t-3 has the expected negative impact on real money demand. A 1% increase in six-month fixed deposit rates at time t-3 leads to a 0.227% decrease in real money demand. There is a negative relationship between six-month fixed deposit rates at time t-3 and real money demand.

This analysis also found that the coefficient of twelve-month fixed deposit rates at time t has a negative impact on real money demand and is significant at 1%level. A 1% increase in twelve- month fixed deposit rate leads to a 0.18 decrease in real money demand. The Treasury Bill rates, which are traded in the primary market, are positive and significant at the 5% level. A 1% increase in Treasury Bill rates at time t-1 leads to approximately a 0.16% increase in real money demand.

According to these results, there is a negative relationship among the saving deposit rates, fixed deposit rates and real money demand. But, there is a positive relationship among the real GDP, TB(P) and real money demand in the long run in Sri Lanka. The results of this analysis satisfy the implications of the Boumol-Tobin model.

**Table 5: ARDL Model ECM Results on Equation 9**

| Regressor | Coefficient | Standard error | t value | P value |
|---|---|---|---|---|
| $dlogRM1_{t-1}$ | 0.2574 | 0.1396 | 1.843* | 0.0717 |
| $dlogRM1_{t-2}$ | -0.1453 | 0.1002 | -1.449 | 0.1541 |
| $dlogRGDP_{t}$ | 0.1897 | 0.7648 | 0.248 | 0.8050 |
| $dlogSR_{t}$ | -0.2433 | 0.0804 | -3.024*** | 0.0041 |
| $dlogSR_{t-1}$ | 0.0530 | 0.0869 | 0.609 | 0.5451 |
| $dlogSR_{t-2}$ | 0.0948 | 0.0839 | 1.130 | 0.2642 |
| $dlogSR_{t-3}$ | 0.2138 | 0.0831 | 2.572** | 0.0134 |
| $dlogSR_{t-4}$ | -0.0287 | 0.0790 | -0.360 | 0.7198 |
| $dlogSR_{t-5}$ | 0.0762 | 0.0624 | 1.220 | 0.2286 |
| $dlogSR_{t-6}$ | 0.1628 | 0.0548 | 2.968*** | 0.0047 |
| $dlogSR_{t-7}$ | 0.2160 | 0.0560 | 2.855*** | 0.0004 |
| $dlogBR_{i}$ | 0.0326 | 0.0663 | 0.492 | 0.6247 |
| $dlogBR_{t-1}$ | 0.1079 | 0.1072 | 1.006 | 0.3190 |
| $dlogBR_{t-2}$ | 0.0983 | 0.1070 | 0.919 | 0.3630 |
| $dlogBR_{t-3}$ | -0.2229 | 0.0953 | -2.339** | 0.0237 |
| $dlogFDR3_{t}$ | 0.0476 | 0.0619 | 0.769 | 0.4454 |
| $dlogFDR6_{t}$ | 0.0286 | 0.0535 | 0.534 | 0.5960 |
| $dlogFDR6_{t-1}$ | -0.0413 | 0.0588 | -0.701 | 0.4870 |
| $dlogFDR6_{t-2}$ | -0.1028 | 0.0596 | -1.718* | 0.0924 |
| $dlogFDR6_{t-3}$ | -0.1854 | 0.0616 | -3.008*** | 0.0042 |
| $dlogFDR6_{t-4}$ | -0.0129 | 0.0615 | -0.209 | 0.8352 |
| $dlogFDR6_{t-5}$ | 0.0473 | 0.0590 | 0.802 | 0.4268 |
| $dlogFDR6_{t-6}$ | -0.1156 | 0.0482 | -2.394** | 0.0208 |
| $dlogFDR6_{t-7}$ | -0.1275 | 0.0531 | -2.401** | 0.0204 |
| $dlogFDR12_{t}$ | -0.1790 | 0.0748 | -2.394** | 0.0208 |
| $dlogTBPR_{t}$ | -0.0402 | 0.0566 | -0.711 | 0.4808 |
| $dlogTBPR_{t-1}$ | 0.1436 | 0.0433 | 3.313*** | 0.0018 |
| $dlogTBPR_{t-2}$ | 0.0787 | 0.0476 | 1.652 | 0.1050 |
| $dlogTBPR_{t-3}$ | 0.0954 | 0.0536 | 1.652* | 0.0820 |
| $dlogTBSR_{t}$ | 0.0451 | 0.0508 | 1.777 | 0.3793 |
| $ecm_{t-1}$ | -0.9463 | 0.1991 | 4.888*** | 0.0000 |
| C | 0.0050 | 0.0115 | 0.4416 | 0.6600 |

(critical value ***-1% , **-5% ,*- 10%
$\bar{R}^2$ =0.4638 SER= 0.0319 AIC= -3.755 SBC= -2.7882 DW= 2.011 F=3.1487 (prob 0.0002)
$\sigma^2$=0.04

The results of the short-run dynamic coefficients associated with the long-run relationships obtained from the ECM are given in Table 5. The signs of the short-run dynamic impacts are maintained to the long run. However, $SR_{t}$, $BR_{t-3}$, FDR6, $_{t-3}$, FDR12, $_{t}$ and TBPR are significant at the 5% level, but the RGDP variable

is not significant even at the 10% level. The coefficients of these $SR_t$, $BR_{t-3}$, FDR6, $_{t-3}$, FDR12, $_t$ and TBPR are statistically significant showing that they have a significant impact on real money demand in the short term, albeit with different signs.

The estimated equilibrium correction coefficient, -0.946 (0.000), is highly significant which has the correct sign and implies a fairly high speed of adjustment to equilibrium after a shock. Approximately 94% of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year.

The calculated F statistics $f_{LOGFM1}$(LOGRM1/LOGRGDP, LOGIBCLR LOGWLR, LOGWOLR,) is 4.707, which is higher than the upper bound critical value of 4.68 at the 1% level. Also, $f_{LOGRGDP}$(LOGRGDP, LOGRM1, LOGIBCLR, LOGWLRR, LOGWOLRR) is 172.30, which is higher than the upper bound critical value 4.68 at the 1% level. Thus, the null hypothesis of no co-integration is rejected, implying long-run co-integration relationships amongst the variables when the regressions are normalized on both LOGRM1 and LOGRGDP variables (Table 6). However, based on the Boumol-Tobin theory, the paper used LOGRM1 as the dependent variable. The results show a long-term relationship between the variables. LIBCLR and LWLR are I (0) and the remaining variables are I (1). A dependent variable is the log of real money demand (LOGRM1). The independent variables are the real gross domestic product (LOGRGDP, LOGIBCLR, LOGWLR, and LOGWOLR).

**Table 6: Results of Bounds Tests on Equation 11**

| Model | Dependent Variable | Independant Variables | AIC lags | F-statistics | Probability | Results |
|---|---|---|---|---|---|---|
| *f*LOGFM1 | LOGFM1 | LOGRGDP,LOGIBCLR,LOGWLR, LOGWOLR | 4 | 4.707 | 0.0000 | Co-integration |
| *f*LOGRGDP | LOGRGDP | LOGRM1,LOGIBCLR,LOGWLRR, LOGWOLR | 4 | 172.30 | 0.0000 | Co-integration |
| *f*LOGIBCLRR | LOGIBCLR | LOGRGDP,LOGRM1 LOGWLR,LOGWOLR | 4 | 3.384 | 0.0000 | No Co-integration |
| *f*LOGWLR | LOGWLR | LOGRGDP,LOGIBCLR, LOGRM1,LOGWOLR | 4 | 2.893 | 0.0000 | No Co-integration |
| *f*LOGWOLR | LOGWOLR | LOGWOLR LOGRGDP,LOGIBCLR, LOGWLR | 4 | 2.689 | 0.0002 | No Co-integration |

Table 7 presents the long-term results of the ARDL (4 0 1 0 8) model showing that only LOGRGDPt, LOGWLRt and LOGWOLRt-8 are statistically significant at the 5% level. The signs of the variables LOGWLR, LOGIBCLR and LOGWOLR meet our expectation that LOGWLR and LOGWOLR have a negative and highly significant relationship. LOGRGDP has a positive and highly significant relationship and only LOGIBCLR has a negative and insignificant relationship with real money demand.

The estimated coefficient of the long-run relationship shows that real GDP has a positive relationship and a very high significant impact on real money demand. A 1% increase in real GDP leads to approximately a 0.64% increase in real money demand, all things being equal. The sign of LOGGDP exceeds the expected results and supports our hypothesis. But, the estimated coefficient, 0.64, does not support the Boumal-Tobin hypothesis. This estimated coefficient, however, exceeds the value obtained from the Baumol-Tobin results.

**Table 7: ARDL Model Long-run Coefficient on Equation 12**

| Regressor | Coefficient | Standard error | t value | P value |
|---|---|---|---|---|
| $logRM1_{t-1}$ | -0.2004 | 0.0971 | -2.062** | 0.0419 |
| $logRM1_{t-2}$ | -0.2809 | 0.0978 | -2.872*** | 0.0050 |
| $logRM1_{t-3}$ | 0.1912 | 0.0981 | 1.984* | 0.0543 |
| $logRM1_{t-4}$ | 0.2391 | 0.09616 | 2.487** | 0.0146 |
| $logRGDP_{t}$ | 0.6421 | 0.1352 | 4.747*** | 0.0000 |
| $logIBCLR_{t}$ | -0.0339 | 0.05859 | -0.579 | 0.5635 |
| $logIBCLR_{t-1}$ | 0.0114 | 0.0636 | 0.179 | 0.8582 |
| $logWLR_{t}$ | -0.5995 | 0.2148 | -2.791*** | 0.0063 |
| $logWOLR_{t}$ | 0.6208 | 0.3400 | 1.822* | 0.0710 |
| $logWOLR_{t-1}$ | 0.0703 | 0.4120 | 0.171 | 0.8648 |
| $logWOLR_{t-2}$ | -0.3740 | 0.3936 | -0.950 | 0.3444 |
| $logWOLR_{t-3}$ | 0.1249 | 0.3742 | 0.333 | 0.7390 |
| $logWOLR_{t-4}$ | -0.0717 | 0.3786 | -0.189 | 0.8501 |
| $logWOLR_{t-5}$ | -0.0887 | 0.3767 | -0.235 | 0.8143 |
| $logWOLR_{t-6}$ | 0.5258 | 0.3508 | 1.499 | 0.1372 |
| $logWOLR_{t-7}$ | 0.0093 | 0.2995 | 0.031 | 0.9750 |
| $logWOLR_{t-8}$ | -0.7082 | 0.2500 | -2.830*** | 0.0056 |
| D_2 | -0.8532 | 0.1440 | 5.922*** | 0.0000 |
| C | 2.8018 | 1.0707 | 2.616** | 0.0103 |

*Critical value ***-1% , **-5% ,*- 10%*
*$\bar{R}^2$=0.7569 SER= 0.170 AIC= -0.553 SBC= -0.1028 DW= 1.810 F=20.895 (prob 0.0000)*

The lending interest rates show negative signs and are very significant at the 1% level. The impact of WOLR and WLR on real money demand is significant at 1% which has the expected negative impact on money demand. A 1% increase in WOLR and $WLR_{t-8}$ leads to approximately a -0.71 and -0.599 decreases in real money demand, respectively. The sign and coefficients of WLR show expected results and supports the Boumol-Tobin hypothesis.

The results of the short-run dynamic coefficients associated with the long-run relationships obtained from the ECM equation are given in Table 8. It shows that the ECM (-1) is statistically significant with a correct sign, although the coefficient of -0.708 suggests that 70% of the disequilibria of the previous year's shock is adjusted back to the estimated equilibrium correction coefficient by -0.708(0.000) which is highly significant and tends to have the correct sign. This implies a high speed of adjustment to equilibrium after a shock. Approximately 71% of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year. The coefficient of dLOGRGDP, dLOGIBCLR, dLOGWLR and dLOGWOLR is statistically not significant at least the 10% level.

**Table 8: ARDL Model ECM Results on Equation 13**

| Regressor | Coefficient | Standard error | t value | P value |
|---|---|---|---|---|
| $dlogRM1_{t-1}$ | -0.3621 | 0.1236 | -2.929*** | 0.0042 |
| $dlogRM1_{t-2}$ | -0.3472 | 0.1189 | -2.920*** | 0.0044 |
| $dlogRM1_{t-3}$ | -0.2049 | 0.1146 | -1.788* | 0.0770 |
| $dlogRM1_{t-4}$ | -0.0394 | 0.0893 | -0.442 | 0.6594 |
| $dlogRGDP_{t}$ | 3.0490 | 2.4596 | 1.239 | 0.2180 |
| $dlogIBCLR_{t}$ | 0.0194 | 0.0503 | 0.386 | 0.7001 |
| $dlogIBCLR_{t-1}$ | 0.0683 | 0.0504 | 1.354 | 0.1787 |
| $dlogWLR_{t}$ | -0.1164 | 0.2828 | -0.411 | 0.6817 |
| $dlogWOLR_{t}$ | 0.3608 | 0.3165 | 1.140 | 0.2511 |
| $dlogWOLR_{t-1}$ | 0.3345 | 0.2976 | 1.124 | 0.2638 |
| $dlogWOLR_{t-2}$ | 0.0626 | 0.2968 | 0.211 | 0.8334 |
| $dlogWOLR_{t-3}$ | 0.1747 | 0.2714 | 0.643 | 0.5214 |
| $dlogWOLR_{t-4}$ | -0.0861 | 0.2723 | -0.316 | 0.7528 |
| $dlogWOLR_{t-5}$ | -0.1920 | 0.2715 | -0.707 | 0.4810 |
| $dlogWOLR_{t-6}$ | 0.0394 | 0.2712 | 0.145 | 0.8848 |
| $dlogWOLR_{t-7}$ | -0.1895 | 0.206 9 | -0.916 | 0.3619 |
| $dlogWOLR_{t-8}$ | -0.6184 | 0.2057 | -7.868*** | 0.0000 |
| $ecm_{t-1}$ | -0.7083 | 0.1573 | -4.503*** | 0.0000 |
| C | -0.0174 | 0.0349 | -0.497 | 0.6202 |

*(***-1% , **-5% ,*- 10%)*

*$\bar{R}^2$ =0.6210 SER= 0.1563 AIC= -0.72458 SBC= -0.27108 DW= 1.9426 F=11.3796(prob 0.0000)*

**Table 9: Summary of the Results**

| **Results** | **Deposits Interest Rates** | | **Lending Interest rates** | |
|---|---|---|---|---|
| Bound Test Results | Co-integration | | Co-integration | |
| ARDL Coefficient Estimates | ARDL (2 0 7 3 0 7 0 3 0 ) | | ARDL (4 0 1 0 8) | |
| | Dependent variable : LOGRM1 | | Dependent variable : LOGRM1 | |
| | $logRGDP_t$ | 0.3493*** | $logRGDP_t$ | 0.6421*** |
| | $logSR_t$ | -0.2600** | $logWLR_t$ | -0.5995*** |
| | $logFDR12_t$ | -0.2238** | | |
| ECM Results | ARDL(2 0 7 3 0 7 0 3 0 ) | | ARDL(4 0 1 0 8) | |
| | Dependent variable : LOGRM1 | | Dependent variable : LOGRM1 | |
| | $dlogSR_t$ | -0.2433*** | $dlogWOLR_{t-8}$ | -0.6184*** |
| | $dlogBR_{t-3}$ | -0.2229** | | |
| | $dlogFDR6_{t-3}$ | -0.1854*** | | |
| | $dlogFDR12_t$ | -0.1790** | | |
| | $dlogTBPR_{t-1}$ | 0.1436*** | | |
| $ecm_{t-1}$ | -0.9463*** | | -0.7083*** | |

The results are consistent with various country studies done previously (Dekle and Pradhan 1997, Wijewardena 1985, Nwaobi 2002). The results are also consistent with studies that have tested this hypothesis using recent developments in panel unit root and panel co-integration testing procedures in other countries (Mark and Sul 2003) that have estimated money demand functions using panel data. However, though this result supports the findings of the Keynesian tradition, they do not support the supply side and monetarists' arguments (Husain and Younus 2007, Friedman 1959, Mishkin 2007).

The commercial banks tend to balance different lending interest rates and deposit interest rates. They tend to increase the deposit interest rates related to the movement of lending interest rates. Therefore, there is a tendency for decreasing money demand due to the increases in holding money in hand with regard to opportunity cost. The other finding is that there is a long-term mutual relationship between real Gross Domestic Product and money demand. Increasing Gross Domestic Product will increase the income level of the people. They, in turn, try to uplift the money demand with the transaction motive and the precautionary motive.

## Conclusion and Practical Implication

This study employed the bounds testing (ARDL) approach to co-integration together with the Error Correction Model to examine the long-run and short-run relationships between money demand, deposits interest rates, and lending interest rates in Sri Lanka. The bounds test suggested that both variables of interest rates and the demand for money are bound together in the long-run. Furthermore, there is a co-integration relationship between both money demand and deposit interest rates and money demand and lending interest rates in the long run. In both estimations, the associated equilibrium correction coefficient was also significant confirming the existence of long-run relationships. The equilibrium correction is fairly fast and is restored by the first quarter of the year. The estimated result of the log run ARDL parameter also indicates that there is a negative relationship between money demand and deposit interest rates as well as money demand and lending interest rates. Therefore, both estimations suggested that there is a positive relationship between money demand and real output in the long run in Sri Lanka. The results of this study support the Boumol-Tobin hypothesis and findings. Keynesian interpretations of the money demand and interest rate relationship appears to hold ground in the empirical sphere.

These results imply that the purchasing power of money tends to increase beyond the level it would otherwise have reached, which means that the general level of money prices tends to decrease. Inversely, when the demand for money diminishes, the purchasing power of money tends to fall below the level it would otherwise have reached, or, which is the same thing, the general level of money prices will tend to increase. That means increases in interest rates will lead to increases in price levels. The demand for money is of crucial importance in the conduct of monetary policy in Sri Lanka. The interest elasticity of the demand for money is of important magnitude for consideration in an effective anti-inflationary monetary policy. Second, on the other hand, increased interest rates will help reduce the growth of aggregate demand in the economy. The slower growth will lead to lower inflation. Higher interest rates tend to reduce consumer spending. Third, increased interest rates increase the cost of borrowing, discouraging consumers from borrowing and spending. Then money demand will decrease. Fourth, increased interest rates make it more attractive to save money. Finally, increased interest rates will lead to a decrease in money demand and reduce the disposable income of those with mortgages. These implications suggest that decreased lending interest rates are better for increased GDP through investments.

The results of this study imply a number of important policy implications as they suggest that as interest rates increase, the demand for money tends to decrease. The lessons learned from this are useful in formulating and implementing monetary policy in Sri Lanka. The Central Bank of Sri Lanka may formulate sound monetary policies that will ensure a stable demand for money function, thereby encouraging economic growth in the country. A policy of attracting more participants (non-government) and private sector funds to the money market is necessary as this will deepen the market and make the market more dynamic and amenable to monetary policy. Our results indicate that financial innovations have not affected the demand for money and thus there is still a basis for monetary policy. It is something we cannot run away from and as such, CBSL should be prepared for it as and when it comes. It appears that investment behaviour is greatly influenced by monetary policy, specifically policy interest rates, as the relationship between demand for money and nominal interest rates is clear.

This paper takes a step forward from the current literature on monetary policy dynamics by examining the dynamic short-run and long-run linkages between demand for money and interest rates in Sri Lanka. The methods applied in the paper are advanced and complete in capturing monetary dynamics in the short and long run. However, this study is limited to only one area of monetary policy dynamics in Sri Lanka. In order to fully understand monetary policy dynamics, one needs to empirically examine in the Sri Lankan context the linkages between money supply and interest rates, and the nature and development of the monetary transmission mechanism in highly globalized international financial markets. We leave these two areas for further research.

## Reference

Abeysinghe, T., & Lee, C. (1998).Best Linear Unbiased Disaggregate of Annual GDP to Quarterly Figures: The Case of Malaysia. *Journal of Forecasting, 17,* 527-537.

Abeysinghe, T., & Rajaguru, G. (2004). Quarterly Real GDP Estimates for China and ASEAN 4 with a Forecast Evaluation. *Journal of Forecasting, 23,* 431-447.

Bahmani-Oskooee, M. & Nasir, A. (2004). ARDL Approach to test the Productivity Bias Hypothesis. *Review of Development Economics, 8*(3), 483-488.

Baumol, W. (1952). The Transaction Demand for Cash: An Inventory Theoretic Approach. *Quarterly Journal of Economics, 67,* 545-556.

De Silva, K. E. A. (1977). Money Supply, Inflation and the Balance of Payments in Sri Lanka. *Journal of Development Studies, 13*(2), 27-36.

Dekle, R., & Pradhan, M. (1997). Financial Liberalization and Money Demand in ASEAN Countries: Implications for Monetary Policy. IMF Working Paper 97/36, International Monetary Fund.

Dharmadasa C., & Makoto N. (2013). Demand for Money in Sri Lanka: ARDL Approach to Co-integration. Proceedings of the 3rd International Conference on Humanities, Geography and Economics held in Indonesia.

Fisher, I. (1896).Appreciation and Interest. *American Economic Review.11*, 331-442.

Friedman, Milton. (1959). The Demand for Money: Some Theoretical and Empirical Results. *Journal of Political Economy, 67*(4), 327-351.

Ghatak, S., & Siddiki, J. (2001).The use of ARDL Approach in Estimating Virtual Exchange Rates in India. *Journal of applied statistics, 11,* 573-583

Hossain, A., & Younus, S. (2007). Interest Rates and the Demand for Money in Bangladesh; an Empirical Investigation with Quarterly Data 1997Q4-2006Q4. Retrieved from http:// www.bb.org.bd/pub/research/policynote/pn0803.pdf

Jayasuriya, S. P. (2010). Dynamic Modeling of Stability of Money Demand and Minimum Wages. *Journal of Economics and International Finance. 2*(10), pp 221-230.

Jegatheesan, S. (2009). *An Examination of Stability of Demand for Money in Sri Lanka: Implications for Monetary Policy*. Proceedings of International Conference on Business Management, Faculty of Management and Commerce, University of Sri Jayewardenepura.

Keynes, J. M. (1936). *General Theory of Employment, Investment and Money*. UK: Macmillan Cambridge University Press.

Mark, N. C., & Donggyu, S. (2003). Co-integration Vector Estimation by Panel DOLS and Long-run Money Demand. *Oxford Bulletin of Economics and Statistics, 65*(5), New York: University of Oxford, 655-680.

Mishkin, F. (1984). Are Real Interest Rates Equal Across countries? An Empirical Investigation of International Parity Conditions. *Journal of Finance, 39,* 1345–1357.

Mishkin, F. S. (2007). *The Economics of Money, Banking and Financial Markets*. Addison-Wesley, New York.

Nwaobi, G. C. (2002). A Vector Error Correction and Non-nested Modeling of Money Demand Function in Nigeria. *Economics Bulletin, 3*(4), 1-8.

Paudel, C. R. (2007). *Liberalization in Sri Lanka: An Econometric Analysis*. Australian Digital Thesis Program. Australia: University of Wollongong.

Perron, P. (1989). The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Econometrica, 57,* 1361-1401.

Perron, P. (1997). Further Evidence on Breaking Trend Functions in Macroeconomic Variables. *Journal of Econometrics, 80,* 355-385.

Pesaran, M. H., & Pesaran, B. (1997). *Working with Microfit 4.0: Interactive Econometric Analysis*. Oxford: Oxford University Press.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001).Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics,16,* 289-326.

Pesaran, M. H., & Shin, Y. (1999). An Autoregressive Distributed Lag Modeling Approach to Co-integration Analysis in Strom S (ed.).Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium,Cambridge: Cambridge University Press.

Pesaran, M. H., Shin Y., & Smith R. J. (1996). Testing for the Existence of a Long-Run Relationship.DAE Working Paper. (No. 9622). Retrieved from. http://ideas.repec.org/p/cam/camdae/9622.html

Pesaran, S., & Smith, A. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics, 16,* 289–326.

Rajapaksa, R. P. C. R. (2004). The Money Demand Function for Sri Lanka for the Period 1960-2002. *Social System Studies, 8,* 51-75.

Ranaweera, T. W. Y. (1971). The Demand for Money in Ceylon (1950-1969). Staff Studies. *Central Bank of Sri Lanka, 1*(2), 100-123.

Tobin, J. (1956). The Interest Elasticity of Transaction Demand for Cash. *The Review of Economics and Statistics. 38*(3), 241-247.

Wijewardena, W. A. (1985). Interest Elasticity of Money Supply in Sri Lanka. Staff Studies. *Central Bank of Sri Lanka, 15*(1&2x), 43-57.