An Estimation of Money Demand Function in Pakistan: Bound Testing Approach to Co-integration

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Abstract
Money demand function plays a vital role in monetary policy formulation. The present study is an attempt to estimate the factors which determine real money demand function in Pakistan. The study is based on a time series data analysis covering the period from 1972 to 2011. We have employed a bound testing approach to cointegration for estimating money demand function through an auto regressive distributed lag (ARDL) framework. Findings of the study reveal that variables like real GDP, financial innovation and total population have positive effects on real demand for money while factors like deposit and exchange rates are inversely related to real demand for money. Furthermore, it has been observed that error correction term is highly significant and shows high rate of convergence to the equilibrium. The study bears a policy implication for monetary authorities in Pakistan to adopt a liberal stance on monetary policy for boosting economic and business activities in the economy.

Keywords: Money Demand; Monetary Policy; ARDL Approach; Error Correction Model

I. Introduction
Money has assumed an indispensable and vital role both in private as well as business activities across the globe. Money started its journey as a commodity, evolved through a series of developments and variations and these days we are having plastic money. The scope of money is extended over consumption, production and distribution. Individuals and businesses tend to hold money partly in cash and partly in assets. Thus, demand for money stems from its functions of being a unit of account, medium of exchange and store of value.

Three major approaches to demand for money are those by Classical, Keynesians, and the post-Keynesians. The classical economists did not explicitly formulate a demand for money theory yet their views are inherent in the quantity theory of money presented by Fisher (1911). Fisher emphasized on transactions demand for money through its velocity of circulation. He asserts that the transactions demand for money is determined by full employment level of income. This is based on the notion of supply creates its own
demand, assuming full employment level of income. Thus, the demand for money in Fisher’s approach was a constant proportion to the level of transactions which in turn held a constant relationship with the level of national income. Furthermore, the demand for money is also connected to existing volume of trade in an economy at a given time period.

Keynes (1936) rejected the views upheld by the Classical and developed a theory of money demand that underscored the importance of interest rates. His theory of money demand, known as Liquidity Preference Theory raised the question as to why do individuals demand money? He postulated three motives behind the money demand: the transaction motive, the precautionary motive and speculative motive. As per Keynes, money demand for transaction and precautionary motives was a positive function of income while speculative demand for money was negatively associated with interest rates.

Baumol (1952) analyzed the interest elasticity of transactions demand for money on the basis of his innovative theoretical approach. He proclaimed that the relationship between transactions demand and income is neither linear nor proportional rather changes in income lead to less than proportionate changes in transactions demand for money. Tobin (1956) formulated a risk aversion theory of liquidity preference based on portfolio selection. This theory removed two major defects of the Keynesian theory of money demand. Firstly, Keynes’s liquidity preference function depended on the inelasticity of expectations of future interest rates and secondly, individuals tend to hold either money or bonds. His theory did not depend on the elasticity of expectations of future interest rates but was rested on the assumption that expected value of capital gain or loss from holding interest-bearing assets is always zero. Moreover, it also explained that an individual’s portfolio consisted of holding both money and bonds together rather than one of these at a time. Friedman (1956) added that people wanted to hold a certain amount of real money balances and his real money demand was a function of wealth (permanent income), expected return on money, bonds, equity and expected rate of inflation.

Having gone through the historical context, rest of the paper is organized as follows. Section that follows provides a review of literature on the subject while section 3 develops a model for household money demand and consumption. Data and methodological issues are discussed in section 4. Section 5 provides a discussion of results while the final part concludes.

II. Literature Review

The present study is intended to examine the determinants of money demand function based on broad and narrow money in Pakistan while a flood of literature is available in this area both nationally as well as internationally. Rehman and Afzal (2003) empirically studied the impact of black market exchange rate on demand for money in Pakistan where official and black market exchange rates operated side by side due to exchange controls. They analyzed time series data during the period of 1972-2000 by using autoregressive and distributed lag models for estimation. They concluded that real income, proxied by industrial production and black market exchange rates were increasingly affected by desired holdings of real money balances while inflation was negatively influenced by desired holdings of real money balances. They suggested that
M₂, as a monetary aggregate, was the right aggregate to be considered for an affective policy formulation.

Qayyum (2005) estimated the dynamic demand for money function in Pakistan that could be used for policy analysis. The study used a time series data for the period of 1960 to 1999 following Johansen’s technique of Cointegration. The analysis concluded that inflation rate was negatively inducing a long run money demand function while long-run income was positively associated with demand for money.

Khan and Sajjid (2005) investigated both the long-run and short-run relationships across real money balances, real income, inflation rate, foreign investment rate and real effective exchange rate. They utilized time series data during the period of 1982 to 2002 following an autoregressive distributed lag approach to estimation. The study concluded that real GDP had positive effects on nominal money balances while interest and inflation rates were negatively related to the latter. They suggested rebalancing effect resulting from variations in the real exchange rate that played a key role in Pakistan’s money demand behavior.

Valadkhani (2008) analyzed both the long and short run determinants of the demand for money in Asian-Pacific countries. The study was based on collected panel data covering the time period of 27 years from 1975 to 2002. He discovered that money demand balances was positively associated with real income but negatively linked to interest rate spread, inflation, real effective exchange rate and the US real interest rate. He further estimated that the long run income elasticity exceeded unity.

Arshad (2008) attempted to reformulate and estimate the Monetary Approach to Balance of Payments (MABP) for Pakistan. He made use of time series data during the years 1962 to 2005 using a fully-modified ordinary least square method and Johansen’s cointegration technique for estimation. The author concluded that real income and real exchange rate were positively associated with money demand function in real terms while interest rate was negatively related to the same. He suggested an inverse relationship between foreign reserves and domestic credit with an implication to restrict borrowings from the Central Bank of Pakistan.

Hye et al. (2009) explored the association across exchange rates, stock prices and money demand function in Pakistan. They made use of time-series data during the years 1971 to 2006 following Johansen’s cointegration estimation technique. The authors concluded that economic activity; inflation and stock prices were positively influencing money demand and exchange rates while interest rate had negative affect on money demand. Their analysis recommended an increase in stock prices while dictating an easier monetary policy stance to prevent a given nominal income or inflation target being undershot.

Omer (2010) contributed to the ongoing debate; should central bank of Pakistan adopt the inflation-targeting or continue with the monetary-targeting as a strategy to monetary policy? His analysis concluded that real permanent income per capita; real interest and expected inflation were directly affecting income velocity of money while transitory income was negatively affecting the latter. He suggested monetary authorities in Pakistan to use M₀ and M₂ as nominal anchors for operational and intermediate targets.
Rutayisire (2010) explored the factors that influence the function of demand for money both in short run as well as in long run for the economy of Rwanda. He made a time series analysis by using the Johansen’s cointegration estimation technique for the period of 1980-2005. The study concluded that log of real income was inducing $M_2$. Central bank financing rate, the London Inter-Bank Offer Rate (LIBOR) and the anticipated fluctuation of Rwanda’s exchange rate, representing money depreciation, were negatively influencing the log of $M_2$. He suggested a non-significant role of interest rates in the demand for money in Rwanda. The study concluded that the refinancing rate and National Bank of Rwanda’s key interest rate had no effect on the composition of people’s portfolio.

Sarwar et al. (2010) evaluated the money demand function that played a key role in monetary policy formulation. They utilized time series data following auto regressive and distributed lag models of estimation. The study concluded that log of real GDP and log of financial innovation were directly related to reserve money while prices had a negative impact on reserve money.

Suliman and Dafaalla (2011) attempted to test for the existence of stable money demand function in Sudan. Their study concluded that real income was affecting demand for real money balances directly while inflation and exchange rates were negatively affecting the demand for real money balances. They recommended the use of narrow money aggregates as targets of monetary policy in Sudan.

### III. A Household Money Demand and Consumption Model

Considering that a person’s money demand behaviors is as under,

$$\frac{M_t}{P_t} = l(Y_t, R_t)$$  

Where;

- $M_t$ = Money supply
- $P_t$ = Price level
- $M_t/P_t - m_t$, showing the real money holdings
- $l_t$ = leisure
- $Y_t$ = income and
- $R_t$ = Rate of interest

$t_t$ represents the time period

A hypothetical household at time period ‘t’ intends to make best use of multi-period utility function ($u$);

$$u(c_t, l_t) + \beta u(c_{t+1}, l_{t+1}) + \beta^2 u(c_{t+2}, l_{t+2}) + .................$$  

Here $c_t$ and $l_t$ represent domestic intake of goods and leisureliness at time period ‘t’. The household is only concerned for the consumption of his goods and availing his leisure in future time. We may notice that both the derivatives of $\mu_1$ and $\mu_2$ are positive. Being the partial derivatives, these represent marginal utilities where both 1 and 2 are less than zero in $u_1$ and $u_2$ respectively. The $\beta$ in equation (2) is a discount factor which is positive but less than unity signaling the fact that the household has to spend his money within his given budget constraint. Thus, utility achieved by the household for the period $c_t$ and $l_t$ is higher than that of the future planned periods of $C_t+1$ and $L_t+1$. 
For simplicity, it is considered that the household receives his real income “Y” in each time period. He is also having the options of borrowing and lending his wealth. Let us assume that the household can borrow and lend at a rate \( R_t \) for time period ‘t’. Suppose \( B_t \) is the nominal quantity of loans made (bonds purchased) by the household in time period ‘t’ (which expires in \( t+1 \)). The household budget constraint can be written on the basis following assumptions:

\[
P_t \cdot y + M_{t-1} + (1 + R_{t-1})B_{t-1} = P_t c_t + M_t + B_t
\]

Left hand side (LHS) of the equation, represents the total resources of the household from his current income and also the amount of bonds purchased in the past. Equation on the right hand side (RHS) shows the total expenditures made on consumption and bonds during the period ‘t’. The constraints exist in each time period, e.g. the constraint for period \( t+1 \) can be written as,

\[
B_t = \frac{P_{t+1} (c_{t+1} - y) + M_{t+1} - M_t + B_{t+1}}{1 + R_t}
\]

Now, equation (4) can be used to eliminate \( B_t \) from equation (3). This brings in \( B_{t+1} \), but similar steps can be used to eliminate \( B_{t+1} \) and so on. By successive eliminations of this type, we can finally arrive at the following equation;

\[
(1 + R_{t-1})B_{t-1} = [P_t (c_t - y) + (M_t - M_{t-1})] +
\]

\[
(1 + R_t)^{-1} [P_{t+1} (c_{t+1} - y) + (M_{t+1} - M_t)] +
\]

\[
(1 + R_t)^{-1} (1 + R_{t+1})^{-1} [P_{t+2} (c_{t+2} - y) + (M_{t+2} - M_{t+1})] + \ldots 
\]

Equation (4) represents household’s inter-temporal budget constraint that is for each single period. Introducing the role of money, we assume that it is used for purchasing various commodities. To purchase various commodities, it is essential for the family to exert energy and spend time for shopping purposes. The quantity of energy used and time spent have a positive effect on capacity of consumption. However, for some assumed capacity; it recedes by extra money possessions.

As greater energy and time are consumed for spending, it reduces the energy and time available for leisuriness. Thus, equation (5) reflects that the relationship of leisure \( (l) \) in time period ‘t’ will be positive to actual money holdings and negative to consumption. Assuming that this relationship can be expressed in terms of a function \( \Psi \), and can be written as;

\[
l_t = \Psi(c_t, m_t)
\]

Equation (6) only represents the dependency of \( l_t \) on \( c_t \) and \( m_t \). The derivatives of; \( \psi_1 \) as \( < 0 \) and \( \psi_2 \) as \( > 0 \); are most familiar. The second partial derivatives of equation (6) are \( \psi_{11} > 0 \) and \( \psi_{22} < 0 \) and represent the diminishing marginal effects. In order to fulfill the maximizing objective of the household, \( c_t, M_t \) and \( B_t \) values, subject to the constraint (6) are chosen. Thus, the following equation is derived as below:

\[
u \left[ c_t, \Psi \left( c_t, \frac{M_t}{P_t} \right) \right] + \beta u \left[ c_{t+1}, \Psi \left( c_{t+1}, \frac{M_{t+1}}{P_{t+1}} \right) \right] + \ldots \]

\[
\]
By substituting (6) into (2) by considering the maximization problem, suppose consider Lagrangian expression $l_t$ which can be written as follows,

$$
l_t = u \left[ c_t, \psi \left( c_t, \frac{M_t}{P_t} \right) \right] + \beta u \left[ c_{l+1}, \psi \left( c_{l+1}, \frac{M_{l+1}}{P_{l+1}} \right) \right] + \sum_{i=1}^{\infty} \left[ (1 + R_{l+1}) - \left[ P_t (c_t - y) + (M_t - M_{l+1}) \right] - \lambda_t \right]
$$

We impose constraint (5) through the first order condition $\partial L_t / \partial \lambda_t = 0$, by maximizing with respect to $\lambda_t$. Thus, we compute the partial derivatives $\partial L_t / \partial c_{l+j}$ and $\partial L_t / \partial M_{l+j}$ for $j = 0, 1, 2 \ldots$ as well as $\partial L_t / \partial \lambda_t$. To set all of these equal to zero, we get,

$$
\frac{\partial l_t}{\partial c_t} = u_1 [c_t, \psi(c_t, m_t)] + u_2 [c_t, \psi(c_t, m_t)] \psi(c_t, m_t) - \lambda_t P_t = 0
$$

and

$$
\frac{\partial l_t}{\partial M_t} = u_2 [c_t, \psi(c_t, m_t)] \psi_2 (c_t, m_t) - \lambda_t + \lambda_t (1 + R_t)^{-1} = 0
$$

Eliminating $\lambda_t P_t$ from the above two equations generates the following equation:

$$
\psi_2 (c_t, m_t) = \left[ 1 - (1 + R_t)^{-1} \right] [u_1 [c_t, \psi(c_t, m_t)] + u_2 [c_t, \psi(c_t, m_t)] \psi_1 (c_t, m_t)]
$$

After a careful analysis, it can be noticed that the variables: $m_t$, $c_t$, and $R_t$ are exceptionally answered by $m_t = M_t / P_t$. Thus, equation (11) can be written as:

$$
\frac{M_t}{P_t} = l(c_t, R_t)
$$

The result in equation (12) is just similar to that of the equation (1); the household money demand function. The difference is obvious as in the present model $c_t$ is the transaction variable which is similar to $y_t$ in equation (1).

The general demand function, explaining consumer behavior regarding real money demand function, may be interpreted in Cobb-Douglas real money demand function as below.

$$
RM = \frac{M_t}{P_t} = A_t Y^{\beta_1} R^{\beta_2}
$$

Where:

$M_t/P_t$ denotes the real demand for money, $Y$ stands for income level, $R$ is the real rate of interest; and $A_t$ denotes other factors that influence real demand for money. The $A_t$ can be expressed as under:

$$
A_t = f \left( FINO, ER, TPOP, \alpha \right)
$$

Or

$$
A_t = FINO^{\beta_3} ER^{\beta_4} TPOP^{\beta_5}, \alpha
$$
Where;
FINO= financial innovation
ER= Exchange rate
TPOP= total population and α indicates others exogenous factors.
Combining equations (13) and (14), we get;

$$RM = \frac{Mi}{P_i} = \alpha Y_t^{\beta_1} R_t^{\beta_2} FINO_t^{\beta_3} ER_t^{\beta_4} TPOP_t^{\beta_5} \epsilon_t$$  \hspace{1cm} (15)

Where, $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$ are constant elasticity coefficients of real money demand function with respect to the $Y_t$, $R_t$, $FINO_t$, $ER_t$, and $TPOP$. Having taken the natural log on both sides of the equation (15), the specified model for estimation is given as follows;

$$\ln(RM) = \ln(\frac{Mi}{P_i}) = \ln\alpha + \beta_1 \ln Y + \beta_2 \ln R + \beta_3 \ln(FINO) + \beta_4 \ln(ER) + \beta_5 \ln(TPOP) + U_t$$  \hspace{1cm} (16)

Where, all other coefficients and variables are defined but $U_t$, indicates the stochastic disturbances term. The expected signs of the coefficients are as below:
$\beta_1 > 0, \ \beta_2 < 0, \ \beta_3 > 0, \ \beta_4 < 0$ and $\beta_5 > 0$

IV. Data and Methodological Issues
Considering the equation (16), $RM$ is defined as real demand for money; $Y_t$ is the real Gross domestic product; $R$ shows the deposit rate; $FINO$ as abbreviated as financial innovation and measured as the ratio of broad money to narrow money; $ER$ is the exchange rate and $TPOP$ is measured as volume of total population. The current study has utilized time series annual data for the time period from 1972 to 2011. The main data sources used for the study were; The Handbook of Statistics on Pakistan Economy (2010), Economic Survey of Pakistan (2010–11) and Statistical Year Book (2010).

Model Specification
The main approach used in present study is bound testing approach to cointegration. This approach is used within an autoregressive distributive lag (ARDL) frame work. The ARDL approach has some major advantages over other approaches of cointegration. Firstly, it is most suitable approach when the order of integration of variables is $I(0)$ or $I(1)$. Secondly, the approach is even useful when the size of sample is small. Thirdly, the approach is feasible to the different variables with different lags; which is not possible in case of cointegration VAR Models (Pesaran et al., 2001). Following Pesaran et al. (2001) as comprehended in Choong et al. (2005), we pertain the bounds test procedure by modelling the long-run equation (5) as a general Vector Autoregressive (VAR) model of order $\theta$, in $z$

$$z_t = c_0 + \alpha t + \sum_{i=1}^{\theta} \rho_i \Delta z_{t-i} + \epsilon_t, \ t = 1, 2, 3, \ldots, T$$  

Where $(k+1)$ is a vector of intercept with drift as indicated by $C_0$ while trend coefficients of a $(k+1)$ vector are indicated by $\alpha$. Related to above equation, a vector equilibrium correction model is formulated [see, Pesaran et al., 2001].

$$z_t = c_0 + \alpha t + \Omega z_{t-1} + \sum_{i=1}^{\theta} \lambda_i \Delta z_{t-i} + \epsilon_t, \ t = 1, 2, 3, \ldots, T$$
Here, \( y_t \) is a dependant variable of integration order \( I(1) \) defined as \( LRM_1 \) and \( X_t \) is a vector matrix of independent variables defined as; \([X_t = LRGDP, LDR, LFINO, LER, LTPOP]\) possess explanatory variables of mixed order of \( I(0) \) and \( I(1) \). Considering the existence of long run relationship among variables defined above, the conditional VECM model is formulated as below:

\[
\Delta y_t = c_0 + \alpha \Delta + \rho_{0-1-1} + \Delta X_{t-1} + \sum_{i=0}^{\rho_{0-1-1}} \Delta y_{t-i} + \sum_{i=0}^{\rho_{0-1-1}} \alpha \Delta X_{t-i} + \epsilon_{it} \quad t = 1, 2, 3, ..., T
\]

After general formulation of the long run relationship, the conditional VECM model of our interest is specified as under:

\[
\Delta LRM_i = c_0 + \sum_{\rho_{0-1-1}} \psi_i \Delta (LRGDP)_{i,\rho} + \sum_{\rho_{0-1-1}} \xi_i \Delta (LDR)_{i,\rho} + \sum_{\rho_{0-1-1}} \xi_i \Delta (LRFINO)_{i,\rho} + \sum_{\rho_{0-1-1}} \theta_i \Delta (LER)_{i,\rho} + \sum_{\rho_{0-1-1}} \pi_i \Delta (LTRPOP)_{i,\rho}
\]

Where, \( C_0 = Drift, \psi = multiplier \) of long run variables, and \( \epsilon_i = White \) noise error.

**Bounds Testing Procedure**

Wald test or F-statistic is employed for the joint significance of coefficients of variables that are in lagged level, to test for the existence of cointegration and the existence of a long-run relationship among the variables. For that purpose, we formulate a Null Hypothesis (\( H_0 \)) of non-existence of cointegration as below:

\[ H_0: \psi_1 = \psi_2 = \psi_3 = \psi_4 = \psi_5 = 0 \]

While the alternate hypothesis (\( H_1 \)) for the existence of cointegration takes the following form:

\[ H_1: \psi_1 \neq \psi_2 \neq \psi_3 \neq \psi_4 \neq \psi_5 \neq 0 \]

The test shown by:

\[ f_{LRM} (LRM / LRGDP, LDR, LFINO, LER, LTPOP) \]

In Wald test for the cointegration, a lower and an upper value is presumed that processes the regressors of integration order \( I(0) \) and \( I(1) \) when the explanatory variables are in the range of \( 0 \leq d \leq 1 \).

Conditional ARDL model \((j, k1, k2, k3, k4, k5)\) for \( LRM_1 \) is defined as:

\[
LRM_i = c_0 + \sum_{\rho_{0-1-1}} \psi_i (LRM1)_{i,\rho} + \sum_{\rho_{0-1-1}} \psi_i (LRGDP)_{i,\rho} + \sum_{\rho_{0-1-1}} \psi_i (LDR)_{i,\rho} + \sum_{\rho_{0-1-1}} \psi_i (LRFINO)_{i,\rho}
\]

\[
+ \sum_{\rho_{0-1-1}} \psi_i (LER)_{i,\rho} + \sum_{\rho_{0-1-1}} \psi_i (LTRPOP)_{i,\rho} + \epsilon_i
\]
Where, all of the variables are as defined earlier. Schwarz criterion is used in selecting order of ARDL for the six variables. Finally, the association of the short run variables is achieved by specifying an Error correction Model (ECM). This involves selection of the orders of the ARDL \((a, b, c, d, e, f)\).

\[
\Delta LRM_t = \mu + \sum_{i=0}^{a} \phi_i \Delta(LRGDP)_{t-i} + \sum_{m=0}^{b} \xi_m \Delta(LDR)_{t-m} + \sum_{n=0}^{c} \phi_n \Delta(LFINO)_{t-n} + \sum_{p=0}^{d} \phi_p \Delta(LER)_{t-p}
\]

\[
+ \sum_{q=0}^{e} \pi_q \Delta(LTOPP)_{t-q} + \sum_{r=4}^{f} \beta_r \Delta(LRM1)_{t-r} + \eta \Delta m_{t-1} + \epsilon_t
\]

Here, \(\phi_i, \xi_m, \phi_n, \pi_q, \beta_r, \eta\) and \(\epsilon_t\) are coefficients of the short-run dynamic and \(\eta\) shows the speed of adjustment of short run variables to attain equilibrium in the long run.

V. Results and discussion

Before proceeding to estimation process, the data was tested for stationarity. In case the series are non-stationary, (i.e. their mean, variance and auto-covariance are not independent of time), the regression analysis can be spurious. Augmented Dickey-Fuller (ADF) test has been used to test for the stationarity of all the variables. Thus, to address the potential problems of cointegration, the data is first-differenced (Table 1). The results of the ADF test indicate that the variables selected for the analysis are either stationary at level or at first difference. This implies that Johnson’s cointegration technique is not appropriate for the estimation. Thus, considering time series properties of the data, the Bound testing approach is suggested instead.

**Table 1: Results of Augmented Dickey-Fuller test**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>1st Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Trend</td>
<td>With Trend</td>
</tr>
<tr>
<td>LRGDP</td>
<td>-0.72</td>
<td>-2.66</td>
</tr>
<tr>
<td>LDR</td>
<td>-2.85</td>
<td>-3.55</td>
</tr>
<tr>
<td>LFINO</td>
<td>-2.33</td>
<td>-4.06</td>
</tr>
<tr>
<td>LER</td>
<td>0.09</td>
<td>-2.34</td>
</tr>
<tr>
<td>LTOPP</td>
<td>-2.84</td>
<td>-2.26</td>
</tr>
<tr>
<td>LRM1</td>
<td>-0.04</td>
<td>-2.09</td>
</tr>
</tbody>
</table>

Note: MacKinnon critical values for rejection of hypothesis of a unit root at 5% level value.

In order to trace out the long-run relationship among variables, the conditional error correction (EC) version of ARDL model for money demand function is estimated. As purposed by Pesaran & Shin (1999) and Narayan (2004), we have chosen the maximum order of two lags in the ARDL approach since our sample consists of annual series for the period of 1972 to 2011.
Table 2: F-Statistic of Testing Cointegration Relationship

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>Lag</th>
<th>Significance level</th>
<th>Bound critical Values (Restricted intercept and no trend)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>4.493</td>
<td>1</td>
<td>1%</td>
<td>3.57 4.84</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5%</td>
<td>2.78 3.94</td>
</tr>
</tbody>
</table>

Note: Results are based on authors’ calculations using Microfit 4.1.

Once it is determined that there is no evidence of serial correlation, the study uses Schwarz-Bayesian Criterion (SBC) for determining the optimal number of lags as pointed out by Pesaran et al. (2001). The selected lag length is one that minimizes SBC in the present study. We have reported the value of F-statistic in Table-2 for the cointegration test along with the critical values as suggested by Pesaran and Shin (1999). The estimated value of F-statistic in our model is (4.493) which is greater than the upper bound value at 5 percent level of significance 3.94 considering restricted intercept and no trend case. It is concluded that we reject the Null hypothesis of no cointegration at 5 percent and there exists long-run relationship among the variables.

Table-3 describes empirical findings of the long-run model, obtained by normalizing the money demand function. The estimated coefficients of the model indicate long-run elasticities. The coefficient of the real gross domestic product is positive and highly significant at one percent level of significance. Income elasticity demand for money is highly elastic in the long run. The findings suggest that a one percent increase in income proxied by RGDP raises the money demand by more than one percent (1.409). Our results support the Keynesian notion of transaction demand for money and corroborate with the findings by Omer (2010), Yu. Hsing (2007) and Azim et al. (2010).

As expected, we have found that rate of interest, proxied by deposit rate, has negatively significant impact on real demand for money. It is observed that interest elasticity of demand of money is less elastic. Real demand for money falls about at 0.37 percent due to a percentage increase in the rate of interest. Both results favor the demand for money theories and conclude that the demand for money function is stable in the long run. Our results are consistent with those by Hilade (2005) and Khan & Sajjid (2005).

It can be observed that financial innovation has discernible effects on money demand function. Economic and business activities are augmented by higher degree of financial innovation. The coefficient of LFINO is not only positive but also highly significant. The long run demand for money with respect to financial innovation is also highly elastic. One percent increases in financial innovation raises the demand for money by 2.27 percent. Our result supports the findings by Sewar et al. (2010).
Table 3: Estimated long run coefficients of ARDL (1, 0, 0, 0, 0, 0) Approach
Dependant variable= LRM

<table>
<thead>
<tr>
<th>Regressors</th>
<th>Coefficients</th>
<th>Standard Errors</th>
<th>t-Ratios</th>
<th>t-Probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-22.29</td>
<td>8.54</td>
<td>-2.61</td>
<td>0.014</td>
</tr>
<tr>
<td>LRGDP</td>
<td>1.41</td>
<td>0.546</td>
<td>2.58</td>
<td>0.015</td>
</tr>
<tr>
<td>LDR</td>
<td>-0.375</td>
<td>0.074</td>
<td>-5.09</td>
<td>0.000</td>
</tr>
<tr>
<td>LFINO</td>
<td>2.272</td>
<td>0.435</td>
<td>5.22</td>
<td>0.000</td>
</tr>
<tr>
<td>LER</td>
<td>-0.55</td>
<td>0.203</td>
<td>-2.71</td>
<td>0.011</td>
</tr>
<tr>
<td>LTPop</td>
<td>0.65</td>
<td>1.005</td>
<td>0.651</td>
<td>0.520</td>
</tr>
</tbody>
</table>

Note: Results based on Authors calculations using Microfit 4.1

The study suggests a negative relationship between exchange rate and demand for money. The coefficient of exchange rate (LER) is highly significant at 1 percent level of significance but less elastic. The real demand for money drops by 0.55 percent as the exchange rate rises by one percent. This might be due to the fact that a rise in exchange rate makes the foreign goods more expensive and demand for imports drops that resulting in a fall in real demand for money. Our findings on this relationship are similar to those by Hye et al. (2009), Suliman & Dafaalla (2001) and Valadbhani (2008). Population elasticity for demand of money is positively inelastic but statistically insignificant. A one percent rise in population leads to an increase in money demand by 0.65 percent. This is due to the fact as number of the people increase; more money is needed to accommodate an increase in their transaction demand.

The results of the ECM for real money demand function are presented in the table-4. Almost all of the coefficients in the ECM are highly significant except for the total population. The short-run results are compatible with those of the long-run estimates indicating that demand for money function is stable. The value of adjusted $R^2$ shows explanatory power of the model that is about 63 percent. Overall, significance of the model is judged by F-statistic which is highly significant. The value of the Durbin-Watson statistics is 2.07 which is an indicator of no autocorrelation in the ECM.

Table 4: Error Correction Model for Money Demand Function
Dependant variable= Δ LRM

<table>
<thead>
<tr>
<th>Regressors</th>
<th>Coefficients</th>
<th>Standard Errors</th>
<th>t-Ratios</th>
<th>t-Probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔC</td>
<td>-11.98</td>
<td>4.737</td>
<td>-2.61</td>
<td>0.017</td>
</tr>
<tr>
<td>ΔLRGDP</td>
<td>0.757</td>
<td>0.2904</td>
<td>2.61</td>
<td>0.014</td>
</tr>
<tr>
<td>ΔLDR</td>
<td>-0.201</td>
<td>-0.045</td>
<td>-4.48</td>
<td>0.000</td>
</tr>
<tr>
<td>ΔLFINO</td>
<td>1.22</td>
<td>0.207</td>
<td>5.89</td>
<td>0.000</td>
</tr>
<tr>
<td>ΔLER</td>
<td>-0.296</td>
<td>0.102</td>
<td>-2.89</td>
<td>0.007</td>
</tr>
<tr>
<td>ΔLTPop</td>
<td>0.352</td>
<td>0.548</td>
<td>0.64</td>
<td>0.526</td>
</tr>
<tr>
<td>ECM (-1)</td>
<td>-0.538</td>
<td>0.084</td>
<td>-6.39</td>
<td>0.000</td>
</tr>
</tbody>
</table>

R Square 0.69 R
DW Statistic 2.07
N= 39
R-Bar Square(6,32) = 0.63
F-Statistic(6,32)= 11.72
Note: Results are based on authors’ calculations using Microfit 4.1
The error correction term ECM (-1) is highly significant at one percent level. The estimated coefficient of ECM (-1) is -0.535 with correct sign. The value of the coefficient of ECM (-1) shows the high rate of convergence to equilibrium. The short-run speed of adjustment towards long-run equilibrium is almost 54 percent per year.

VI. Conclusion

The main objective of the study is to investigate factors that determine money demand function in Pakistan. The specified model is constructed based on household money demand and consumption model. We have employed bound testing approach to cointegration by using the time series data of variables that surface as important in context of the extant literature on the subject. Findings of the study reveal that income elasticity is positive while interest elasticity is negative. Furthermore, the study shows that variables like financial innovation and population influence money demand function positively while exchange rate affects the real demand for money as negatively. The analysis also alludes to the point that short-run elasticities are less elastic as compared to long-run elasticities.

Based on results of the study, it is suggested that extended economic activities hoist the demand for money implying that the real sector need to grow at a faster rate. Monetary authorities need to adopt a liberal stance on monetary policy. Rates of interest need to be reduced to develop the investment opportunities in real sector of the economy. Financial innovation turns out to be the most significant factor in determining the money demand function. This leads to the implication that a higher degree of financial innovation needs to be launched in order to promote business and economic activities in the economy.

References


Muhammad Zahir Faridi, Mohammad Hanif Akhtar


