

STABILITY OF MONEY DEMAND FUNCTION IN PAKISTAN

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ABSTRACT: *The role, which money demand function plays in monetary policy formulation has attracted a lot of research studies to analyze this macroeconomic phenomenon. In the wake of current global and local economic and political upheavals, it is imperative to revisit the stability of money demand function. The study used the time series data and applied latest econometric techniques to find out the long run and short run money demand relationship. Moreover, all the three official monetary aggregates were used for finding out the most stable monetary demand relationship, which could provide correct signals for monetary policy formulation. The study found that broader monetary aggregate (M_2) was the proper aggregate, which provided stable money demand function for Pakistan. The real GDP was positively related to the demand for real balances, while opportunity cost of money was negatively related. The study found that the role of financial innovation, in explaining the demand for money warrants attention in formulating monetary policy.*

Keywords: *Stability, monetary aggregates, financial innovation*

JEL Classification: G01, E4, E5

1. INTRODUCTION:

The study and the estimation of demand for money has gained popularity in the econometric and economic literature overtime. The Money demand reflected an important relationship for formulating appropriate monetary policy and targeting related variables. The structural adjustments, entailing financial deregulations and innovations in many countries and Pakistan is no exception, it seems imperative to establish whether the underlying assumptions and the properties of the money demand function still hold (Malnick, 1995).

The financial markets were under pressure worldwide due to the devastating effects of global financial crisis. This global financial crisis not only endangered the giant financial institutions world wide, but also shed doubts on the established economic relations.

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One of the main reasons for this global turmoil was the liquidity mismanagement in the financial sector. Pakistan as an open economy was not able to safeguard it from the external effects, and the recent global financial crisis coupled with political upheavals and law and order situation further exacerbated the situation. During 2001-2007, the economy showed promising growth of more than 6 percent, gross official reserves rose to \$14.3 billion and inflation remained nearly 7 percent (IMF country report, 2008). After mid 2008, the economic situation deteriorated rapidly, foreign exchange reserves melt down quickly, liquidity position aggravated and inflation rose to unprecedented levels. This situation compelled the authorities to sign Stand-by Arrangement (SBA) of \$7.6 billion with IMF for 23 months (IMF Survey, 2008). The thorough analysis of these ups and downs of Pakistan economy's recent history depicted that once again liquidity mismanagement and monetary policy flaws were among the main culprits. The boundless consumer financing and leasing at one point of time and severe liquidity crunch later on was the simple evidence of monetary mismanagement. This study explored the root cause of these monetary problems of Pakistan through estimating the stable money demand function and tracing out the true monetary aggregate, which provides support to a sound monetary policy.

One of the important issues confronting the monetary policy was to discover a steady money demand function (Friedman (1959); Friedman and Schwartz (1982); Laidler (1977); Laidler (1982)). Thus, a stable money demand function was a necessary pre-requisite in establishing a one to one relationship between the appropriate monetary aggregates and nominal income. The study and estimation of a stable money demand function enable the monetary authorities and policy makers to stabilize prices. Nevertheless, the empirical evidence for a stable money demand was necessary but not a sufficient condition to uphold the monetarist argument that the money supply was causal in the process of inflation (Kaldor, 1982).

The question for stable and predictable demand function stemmed from results that traditional models for money demand function in many industrialized countries showed instability over time in the 1970s. The empirical findings in developing countries faced similar problems in the traditional specification. The problems included but not limited to serial correlation, over prediction or missing money syndromes, misspecification, wrong signs and insignificant coefficients of the important parameters. Friedman, (1956) revealed that money demand function assumed that there was a stationary long-run equilibrium relationship between real money balances, real income, and the opportunity cost of holding real balances. Several studies for Pakistan reported different aggregates as the stable aggregates for different time periods. The rapidly changing global and local financial scenario calls for revisiting the stability of money demand function. The current study aims at testing all the three official monetary aggregates, and to choose a stable money demand relationship which could serve as a base for sound monetary policy.

Initial studies on the topic were confined to identifying the determinants of demand for money, coupled with the choice of model specification and estimation procedure. Few

studies confined their estimations only to M_1 due to the fact that the broader aggregates might grubby the interest rate effects. Many such studies conducted in developed economies did not perform well, but several studies in the developing economies pointed out that M_1 performed well as compared with broader aggregates. This finding was mainly due to the weak banking and financial sector of the less developed countries (Moosa (1992), Hossain (1994) Hafer and Jansen (1991)). On the other hand, Ericsson and Sharma (1996) showed that narrowly defined aggregates were not really relevant to the policy issues and broader aggregates have better predictive power. This directed many studies to estimate demand for money using M_2 exclusively. However, it is not uncommon to find studies that evaluate the demand for money using both the narrow and broad money aggregates. Judd and Scadding (1982), Goldfeld and Sichel (1990), Boughton (1992), Laidler (1993) Sriram (1999) and Serletis (2001) have surveyed these studies.

The time-series econometric analysis has a pivotal role in the contemporary empirical research on money demand. Initial estimations using these techniques were primarily confined to the industrially developed countries especially United Kingdom, United States and Canada. Later on, this technique was used for both developed and developing countries alike. For example Muscatelli & Papi (1990) for Italy, Ericsson & Sharma (1998) for Greece, Mehra (1993) for United States; and for developing countries Hafer and Kutan (1994), and Lee and Chien (2008) for China, Moosa (1992) for India, Bahmani (1996) for Iran, Arize (1994) for Korea, Ariez (1994), Hossain (1994), Qayyum (1998, 2001, 2005) and Zakir, *et al.* (2006) for Pakistan, Reilly and Sumner (2008) for Sri Lanka were few of the long list of literature that used Cointegration technique and Error correction Model for money demand analysis.

In Pakistan most empirical studies found standard economic relationships to hold. The estimates of money demand functions mostly found money demand to be determined by measures of opportunity costs and activity (Modood et al, 1997). Likewise, inflation was influenced by changes in money supply, interest rates, measures of aggregate demand or output, and import prices (e.g., Ahmad and Ali, 1999).

The current study tried to analyze all the three official monetary aggregates of Pakistan, to choose the most efficient and stable aggregate, which could perform well in the midst of global and national financial crisis. Rest study is balanced as, part two discusses about data sources, part three presents the methodology, part four explains the results and last part concludes the study.

2. DATA SOURCES:

In order to estimate the stability of money demand function, annual data for Pakistan economy was used comprising the time period of 1972-2007. Main data sources were Hand Book of Statistics on Pakistan Economy (2005) by State Bank of Pakistan (SBP), various Statistical Bulletins of State Bank of Pakistan and CD-Rom of International Monetary Fund (IMF). State Bank of Pakistan collects these statistics from different fi-

financial and statistical institutions, as well as different surveys are conducted for data collection exercise.

The main thrust of the study was on finding out the stable money demand function based on the official monetary aggregates namely: Reserve Money (M_0), Narrow Money (M_1) and Broad Money (M_2). For the estimation of money demand function for all three official aggregates, rest of the required variables were Gross Domestic Product (GDP) as a proxy for income, opportunity cost of money, and financial Innovation (FI). The proxy variables used for opportunity cost of money and financial innovation were interest rate (I) and ratio of $M_2 - CC/GDP$ respectively. GDP deflator was used for obtaining real gross domestic product (RGDP). For capturing the effect of financial sector development, in literature a lot of proxies were in use, but this study used the ratio of difference of M_2 and Currency in Circulation (CC) to GDP. By subtracting the Currency in Circulation from the broadest aggregate, one can get the money with in the banking system, and the ratio of this difference to GDP gave the efficiency of banking system. An increase in ratio indicated increase in efficiency of banking system and vice versa.

The component assets of these Simple sum official aggregates were:

M_0 = Currency in circulation (CC) + Other deposits with SBP (DothSBP) + Currency in tills of scheduled Banks (Ctills) + Bank's deposit with SBP (Dbanks)

M_1 = M_0 + Current Deposits (CD) + Call Deposits (D_{call}) + Other Deposits (D_{oth}) + Saving Deposits (SD)

M_2 = M_1 + Time Deposits + Residents Foreign Currency Deposits (RFCD)

3. METHODOLOGY:

The conventional economic models, which were considered stable for decades, could not sustain the shock and broke down. Granger and Newbold (1974) identified that these models were based on non-stationary data and were 'spurious'. The prime cause of this phenomenon was non-stationary data, so the handling of any time-series data calls for a stationarity check.

3.1 Stationarity Check

Any kind of empirical analysis on time-series data requires that it should individually be tested for stationarity. For stationarity of any stochastic process Y_t , it is necessary that, it should be:

- 1) $E(Y_t) = \text{constant}$ for all time period t ;
- 2) $\text{Var}(Y_t) = \text{constant}$ for all time period t ;
- 3) $\text{Cov}(Y_t, Y_{t-m}) = \text{constant}$ for all $t \neq m$.

There are different variants available for unit root tests. One of the simplest tests is the Dickey – Fuller test proposed in Dickey and Fuller (1979). Many other tests in this regard

are Augmented Dickey Fuller test, Phillips-Perron test (1988), Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, multivariate Johansen's unit root test etc.

The study used Augmented Dickey Fuller (ADF) test, which has three models. The main difference between the three models was concerning to the presence of deterministic elements b_0 and b_2t .

- 1 – For testing if Y_t is a pure Random Walk.
- 2 – For testing if Y_t is a Random Walk with Drift.
- 3 – For testing if Y_t is a Random walk with Drift and Deterministic Trend.

The test which is the most frequently used is Augmented Dickey Fuller (ADF) test. This study used ADF test, due to the fact that it includes lagged dependent variables to capture autocorrelated omitted variables that would in case of DF, enter the error term. The general form of ADF model was:

$$\Delta Y_t = \alpha + (\rho - 1)Y_{t-1} + \Delta Y_{t-1} + \Delta Y_{t-2} + \dots + \Delta Y_{t-p} + e_t$$

This model was used for testing the hypothesis:

$$H_0: \rho - 1 = 0$$

$$H_1: \rho - 1 < 0$$

t-values obtained were compared with the critical values of Mackinnon (1996). All the series were tested using the ADF test.

3.2 Stability of Money Demand Function:

In this study the long-run real money demand relationship was investigated by the following models:

$$M_0 = f(Y, P, I, FI) \quad (1)$$

$$M_1 = f(Y, P, I, FI) \quad (2)$$

$$M_2 = f(Y, P, I, FI) \quad (3)$$

Where:

M_0 , M_1 , & M_2 : the real money demand dependent variables found by dividing nominal money balances to GDP deflator;

Y = Real Gross Domestic Product;

P = the inflation rate;

I = Interest rate on Time deposit as an opportunity cost of holding money; and

FI = Financial Innovation (Ratio of $M2 - CC/GDP$)

In case of model selection, general to specific approach (GETS) was adopted. In which one starts with more variables and then keep on dropping the irrelevant variables depending upon their statistical and economic insignificance.

Before going for the stability tests of the above given money demand models, the test for Cointegration was carried out, in order to check, if there exists a long run relationship among the variables.

Johansen and Juselius approach successfully tackles most of the shortcomings of Engle Granger approach, that is why this study followed Johansen and Juselius (JJ) approach. The JJ procedure is based on maximum likelihood estimates and provides trace value test and maximum Eigenvalue statistic for detecting number of cointegrating vectors. This procedure provides framework for Cointegration test in context of Vector Autoregressive models (VAR).

In Johansen's approach, a vector \mathbf{z}_t of n potential endogenous variables is defined as an unrestricted vector autoregression (VAR) involving up to k lags of \mathbf{z}_t

$$\mathbf{z}_t = \mathbf{A}_1 \mathbf{z}_{t-1} + \mathbf{A}_k \mathbf{z}_{t-k} + \mathbf{u}_t \quad (4)$$

Where \mathbf{z}_t is $(n \times 1)$, and each of \mathbf{A}_i is an $(n \times n)$ matrix of parameters. This type of model is also advocated by Sims (1980) because it estimates dynamic relationships among jointly endogenous variables with out imposing many restrictions. This model can be reformulated into a Vector Error Correction Model (VECM) as:

$$\Delta \mathbf{z}_t = \Gamma_1 \Delta \mathbf{z}_{t-1} + \Gamma_{k-1} \Delta \mathbf{z}_{t-k+1} + \Pi \mathbf{z}_{t-k} + \mathbf{u}_t \quad (5)$$

where $\Gamma_i = -(I - A_1 - \dots - A_i)$ ($i = 1, \dots, k-1$) and $\Pi = -(I - A_1 - \dots - A_k)$. If Π has full rank i.e. $r = n$, then the variables in \mathbf{z}_t are $I(0)$ and if Π has zero rank then there is no cointegrating vector. If Π has reduced ranks i.e. $r < (n-1)$, cointegrating relationships are present. Usually two tests are commonly used for finding out the number of cointegrating vectors, namely; Trace test and Maximal Eigenvalue test. Both the tests have different set of hypotheses. Trace statistics test the hypothesis of $r=q$ (where $q = 0, 1, 2, \dots, n-1$) against the alternative of $r = n$, while the maximal Eigenvalue statistic tests hypothesis of $r = 0$, against alternative hypothesis of $r = 1$.

Cointegration analysis described the long run relationship among the variables of the model. In order to find out the short run behavior of the variables and to measure their displacement from the equilibrium in the short run, Error Correction Mechanism (ECM) was used. If two variables Y_t and X_t are cointegrated, then according to the definition of Cointegration, the associated error term should be integrated of order zero (i.e. Stationary). Thus, the relationship of these two variables can be expressed in ECM framework as:

$$\Delta Y_t = a_0 + b_1 \Delta X_t + \pi \hat{e}_{t-1} + u_t \quad 6$$

This model now carried both long run and short run effects, b_1 captured the short run effects and was termed as 'impact multiplier', while π was the adjustment or feedback effect and captured the effect of any adjustments which took place due to disequilibrium

in the previous period. In equation (6) $\hat{e}_{t-1} = Y_t - \beta_1 - \beta_2 X_t$ and here β_1 carried the long run effect. This ECM specification had many advantages and was adopted for this study, because the model was convenient for measuring the displacement from the disequilibrium, as well as the correction of the disequilibrium. This ECM specification could easily fit into the general-to-specific approach, which was being carried out in this study.

4. RESULTS & DISCUSSION:

4.1 Stationarity Check

The results showed that all six series were non-stationary at levels in both models, but at first difference all the series were stationary with both models. In second model LRM_1 was marginally non-stationary, but as it was stationary in first model so that was not of much significance.

Table 1: *Augmented Dickey-Fuller Test for Unit root*

| Variables | Levels | | First Difference | |
|-----------|-----------------------------|--------------------------|-----------------------------|--------------------------|
| | With Intercept but no trend | With Intercept and trend | With Intercept but no trend | With Intercept and trend |
| LRMo | -2.2843 | -2.2382 | -5.0365* | -5.2289* |
| LRM1 | 0.27832 | -1.1794 | -2.9750* | -2.6942 |
| LRM2 | -1.5082 | -2.3244 | -3.9582* | -3.8661* |
| LRGDP | -1.1565 | -1.7489 | -5.4492* | -5.9439* |
| LFI | -2.1172 | -2.7777 | -4.2963* | -4.1886* |
| Int | -0.77261 | -1.7650 | -5.0047* | -5.0199* |

* The coefficient is significantly different from zero at 0.05 probability level

The ADF statistic are -2.9591 and -3.5615 for models 'with Intercept but no Trend', and 'with Intercept & Trend' respectively at 0.05 probability level.

After testing for stationarity, the next step was to analyze the long run relationship of the model variables. In this study, as the results reported above indicate, all the series were integrated of order one (i.e. I(1)) hence Johansen and Juselius (1990) approach was used for three models of demand for money.

4.2 Money Demand Model Based on Reserve Money:

The first money demand model estimates were based on real reserve money (RM_t). The equation of the model was:

$$LRM_{0t} = C + LRGDP_t + Int_t + LFI_t + u_t \quad (7)$$

The results in table 2 indicated cointegration analysis based on Maximal Eigenvalue and Trace value statistics. The results showed that there was single cointegrating relationship

in the model, because under ME statistics, one tests the hypothesis of ‘no cointegration’ against having ‘one cointegration’. The value of statistic was greater than the critical value at 0.05 probability level, so the null was not accepted. The non acceptance of null hypothesis indicated the presence of one cointegrating relationship. The similar result was shown by Trace value statistic.

Table 2: *Results of Cointegration Test for Reserve Money(LRMo)*
Model: ‘Unrestricted intercepts and no trends’

| Based on Maximal Eigenvalue Statistic | | | | | Based on Trace value statistic | | | | |
|---------------------------------------|-------|--------------------|----------------------|----------------------|--------------------------------|--------|-----------|----------------------|----------------------|
| Null | H1 | Eigen Statistic | 95%Critical Value | 90%Critical Value | Null | H1 | Statistic | 95%Critical Value | 90%Critical Value |
| r = 0 | r = 1 | 34.817* | 27.420 | 24.990 | r = 0 | r >= 1 | 55.097* | 48.880 | 45.700 |
| r <= 1 | r = 2 | 15.159 | 21.120 | 19.020 | r <= 1 | r >= 2 | 20.279 | 31.540 | 28.780 |
| r <= 2 | r = 3 | 5.120 | 14.880 | 12.980 | r <= 2 | r >= 3 | 5.121 | 17.860 | 15.750 |
| r <= 3 | r = 4 | 0.008 | 8.070 | 6.500 | r <= 3 | r >= 4 | 0.008 | 8.070 | 6.500 |

* The coefficient is significantly different from zero at 0.05 probability level

The long run relationship specified by cointegration analysis depicted demand for money function as obtained in equation no 8:

$$LRM_{0t} = 0.001 + 0.6742 LRGDP_t - 0.0182 Int_t + 0.4876 LFI_t \quad (8)$$

(2.1032) (3.3409) (-1.5102) (3.9018)

The above equation revealed that long run money demand was determined by log of real GDP, interest rate and log of financial innovations. The results showed that real GDP and financial innovations showed significant positive impact on money demand, while interest rate has negative relation with money demand, which was not significantly robust. The analysis depicted that one percent increase in real GDP resulted in a 0.67 percent increase in real money (M_0), while one percent increase in financial innovations showed a 0.48 percent increase in demand for money. These results of positive relationship of money demand and financial innovation were in line with the recent studies of Odularu and Okunriboye (2009) and Columba (2009).

In order to study the short run behavior of the variables and to measure their deviation from the equilibrium in the short run, Error Correction Mechanism (ECM) was used. The results of ECM for Money demand model of Reserve money were given in the table 3:

Table 3: *ECM for variable LRMo estimated by OLS based on Cointegrating VAR (2)*

| Regressor | Coefficient | Std Error | T-Ratio | Prob. | |
|-----------|-------------|-----------|----------|-------|------------------|
| Intercept | -0.0551 | 0.01811 | -0.30422 | 0.763 | R-Square: 0.6153 |
| Dint | -0.01248 | 0.00921 | -1.3550 | 0.186 | DW: 2.1222 |
| DLRGDP | 1.0304 | 0.31249 | 3.2974 | 0.003 | F-Stat: 11.996 |
| DLFI | 0.53168 | 0.09814 | 5.4175 | 0.000 | |
| ECM (-1) | -0.35205 | 0.12184 | -2.8894 | 0.007 | |

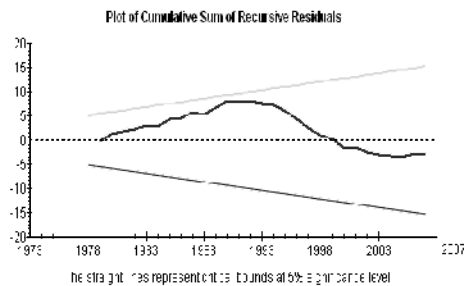
$$\text{DLRMO}_t = -0.0551 - 0.0125\text{Dint}_t + 1.0304\text{DLRGDP}_t + 0.5317\text{DLFI}_t - 0.3521\text{ecm}_{t-1} \quad (9)$$

(-0.3042) (-1.3550)
(3.2974)
(5.4175)
(-2.8894)

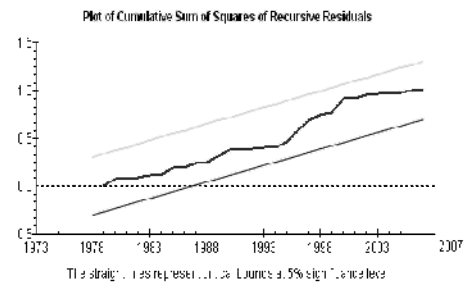
The estimated ECM has many desirable statistical properties. Durban Watson Statistic, F-test and R-square indicated good fit of the model. Moreover, the model was interpretable for short run dynamics and the signs were also consistent with the economic theory. The estimated intercept term had negative sign, indicating the decline in unconditional growth in money demand, but most of the studies pointed out that intercept term did not have strong direct implications.

Although, the magnitude of parameter was low, yet the negative sign of error correction term was consistent with the economic theory. The low value of error correction parameter indicated slow speed of adjustment towards equilibrium. The possible cause for this slow adjustment was perhaps the cost involved in the adjustment of money holdings. Moreover, Thornton (1983) also pointed out that national and international disasters like oil price shocks, earthquakes and natural calamities could also assist long run disequilibrium to prevail. Another reason for slow speed of adjustment was also due to the low saving rate in Pakistan.

A stable money demand function is termed as a valuable tool for monetary policy formulation. In order to find out the parameter constancy, the study applied Cumulative sum (CUSUM) and Cumulative sum of squares (CUSUMSQ) tests of structural stability proposed by Brown *et al.* (1975). The CUSUM test was basically used for detecting systematic changes in the regression coefficients while CUSUMSQ test captured any parameter's departure from constancy. The graphs of both CUSUM and CUSUMSQ for the above equation were shown in graph1 below:



Graph 1: CUSUM plot of LRMO Model



Graph 2: CUSUMSQ plot of LRMO Model

The graphs indicated that the residuals were within the 5 percent critical bounds for both the graphs, which further indicated that model was stable for the entire sample, and the defined money demand model was stable. This was also a proof of constancy of the regression coefficients in case of any haphazard and sudden shocks.

4.3 Money Demand Model Based on Narrow Money:

In order to find out the most appropriate money demand function, the study estimated the model as discussed in the previous section with log of real Narrow money (LRM_t) as the dependent variable. The model was:

$$LRM_{it} = C + LR GDP_t + Int_t + LFI_t + u_t \quad (10)$$

The Maximal Eigenvalue indicated two cointegrating vectors at 5 percent level of significance as well as Trace statistic also indicated two cointegrating vectors at 5 percent level of significance.

Table 4: *Results of Cointegration Test for Narrow Money(LRM_t)*
Model: 'Unrestricted intercepts and no trends'

| Based on Maximal Eigenvalue Statistic | | | | | Based on Trace value statistic | | | | |
|---------------------------------------|---------|--------------------|----------------------|----------------------|--------------------------------|------------|-----------|----------------------|----------------------|
| Null | H1 | Eigen Statistic | 95%Critical Value | 90%Critical Value | Null | H1 | Statistic | 95%Critical Value | 90%Critical Value |
| $r = 0$ | $r = 1$ | 40.697* | 27.420 | 24.990 | $r = 0$ | $r \geq 1$ | 73.713* | 48.880 | 45.700 |
| $r \leq 1$ | $r = 2$ | 24.508* | 21.120 | 19.020 | $r \leq 1$ | $r \geq 2$ | 33.585* | 31.540 | 28.780 |
| $r \leq 2$ | $r = 3$ | 7.964 | 14.880 | 12.980 | $r \leq 2$ | $r \geq 3$ | 9.077 | 17.860 | 15.750 |
| $r \leq 3$ | $r = 4$ | 1.112 | 8.070 | 6.500 | $r \leq 3$ | $r \geq 4$ | 1.112 | 8.070 | 6.500 |

* The coefficient is significantly different from zero at 0.05 probability level

In case of results of cointegration analysis showing more than one cointegrating relationships, it becomes bit difficult to explain the results. Handa (2000) showed that if there were more than one cointegrating vectors in a model, the econometric technique, by itself did not show that which relationship depicted the long run money demand relationship. Qayyum (2005) argued that in such cases, more often the first vector was interpreted as money demand function after normalization. The present study estimated the long run money demand model by normalizing the first cointegrating relationship.

$$LRM_{it} = -16.9696 + 0.0048int_t + 2.4699LR GDP_t + 0.7636LFI_t \quad (11)$$

(-2.1452) (0.2684) (3.8513) (2.8036)

The long run money demand model based on narrow money had few issues that needed little explanation. The signs of real income and financial innovation were according to the theory, but interest rate parameter had positive sign, which was not consistent with the economic theory. The interest rate was also statistically insignificant; however, magnitude of the parameter was very small. The estimated model results revealed long run demand for money was being determined by the income of the people and the availability of ease in financial transactions and interest rate was not playing any significant role in the decision of a representative person in terms of his money holdings.

In order to analyze the adjustment of the disequilibrium, the study applied ECM methodology on the narrow money demand function.

Table 5: ECM for variable LRM_t estimated by OLS based on Cointegrating VAR (2)

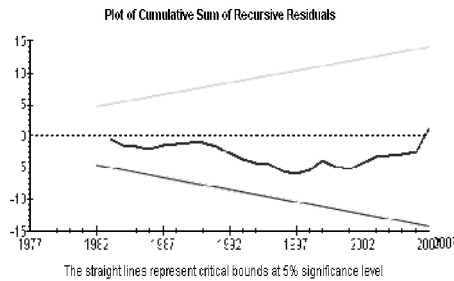
| Regressor | Coefficient | Std Error | T-Ratio | Prob. | |
|-----------|-------------|-----------|---------|-------|------------------|
| Intercept | -0.046 | 0.041 | -1.139 | 0.265 | R-Square: 0.5129 |
| Dint | 0.009 | 0.018 | 0.482 | 0.634 | DW: 1.4774 |
| DLRGDP | 2.147 | 0.689 | 3.112 | 0.004 | F-Stat: 6.8435 |
| DIFI | 0.649 | 0.248 | 2.614 | 0.015 | |
| ECM (-1) | 0.283 | 0.288 | 0.983 | 0.335 | |

The ECM equation in the light of above results was:

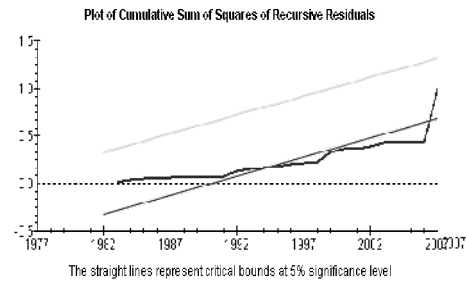
$$DLRM_{it} = -0.0458 + 0.0088Dint_t + 2.1469DLRGDP_t + 0.6487DIFI_t + 0.2829ecm_{t-1} \quad (12)$$

(-1.1395) (0.4812) (3.1115) (2.6144) (0.9827)

These results of short run divergence of equilibrium were also corroborating the wrong sign and insignificant relationship of interest in the long run model. Moreover, the tests of stability of parameters also confirmed the non-stable nature of the model as shown in the graphs 3 and 4



Graph 3: CUSUM Plot of LRM1 Model



Graph 4: CUSUMSQ plot of LRM1 Model

The graphs 3 and 4 clearly showed that the function was not stable. If all the coefficients in the error correction model were stable, the CUSUM and CUSUMSQ plots would remain within 5 percent critical bounds, but as was evident from the graphs, the plot of cumulative sum of square of recursive residuals crossed the bounds and indicated the instability of the model.

4.4 Money Demand Model Based on Broad Money:

M_2 is the broader aggregate and most of the studies suggested that M_2 the stable demand for money function. In the present study along with narrow and reserve money, broad money function was also estimated. The model used in this regard was given by equation 13:

$$LRM_{zt} = C + LRGDP_t + Int_t + LFI_t + u_t \quad (13)$$

Where:

LRM_2 = log of real M_2 and was the dependent variable.

In the cointegration analysis with order of VAR 2, Maximal Eigenvalue statistic reported two cointegrating vectors, while Trace value statistic indicated one cointegrating relationship as shown by the results in table 6 below:

Table 6: *Results of Cointegration Test for Broad Money(LRM_2)*
Model: 'unrestricted intercepts and no trends'

| Based on Maximal Eigenvalue Statistic | | | | | Based on Trace value statistic | | | | |
|---------------------------------------|---------|--------------------|----------------------|----------------------|--------------------------------|------------|-----------|----------------------|----------------------|
| Null | H1 | Eigen Statistic | 95%Critical Value | 90%Critical Value | Null | H1 | Statistic | 95%Critical Value | 90%Critical Value |
| $r = 0$ | $r = 1$ | 40.697* | 27.420 | 24.990 | $r = 0$ | $r \geq 1$ | 73.713* | 48.880 | 45.700 |
| $r \leq 1$ | $r = 2$ | 24.508* | 21.120 | 19.020 | $r \leq 1$ | $r \geq 2$ | 33.585* | 31.540 | 28.780 |
| $r \leq 2$ | $r = 3$ | 7.964 | 14.880 | 12.980 | $r \leq 2$ | $r \geq 3$ | 9.077 | 17.860 | 15.750 |
| $r \leq 3$ | $r = 4$ | 1.112 | 8.070 | 6.500 | $r \leq 3$ | $r \geq 4$ | 1.112 | 8.070 | 6.500 |

* The coefficient is significantly different from zero at 0.05 probability level

In case of conflict between Maximal Eigenvalue and Trace statistic, several studies gave preference to the Trace statistic due to the fact that Trace statistic takes into account all of the smallest Eigenvalue. Moreover, Trace statistic has more power as compared with maximal Eigenvalue statistic (Asteriou and Hall, 2007), as well as Johansen and Juselius (1990) also favored the Trace statistic in case of conflict. The long run money demand relationship specified by the cointegration analysis was:

$$LRM_{2t} = 0.2738 - 0.0048int_t + 0.9717LRGDP_t + 0.7701LFI \quad (14)$$

(0.6099) (-0.1062) (23.6325) (13.5210)

The long run money demand function indicated that real broad money demand had strong and highly significant relationship with real income and financial innovations, while it had a very weak and insignificant relationship with the interest rate in the short run. The results depicted that one percent change in log of real income brought 0.97 percent change in demand for money, and one percent change in financial sector development brought 0.77 percent change in demand for money. As the broad aggregate M_2 included savings accounts of different denominations and saving rates in Pakistan were low in the period under study, so the insignificant relationship of M_2 and rate of interest was not unexpected. On the other hand, highly significant relationship of LRGDP and LFI with money demand was consistent with the economic theory.

In order to study the disequilibrium adjustment process in the short run and also to complement cointegration analysis, the Error Correction Mechanism was applied. The results of the ECM were reported in the Table10

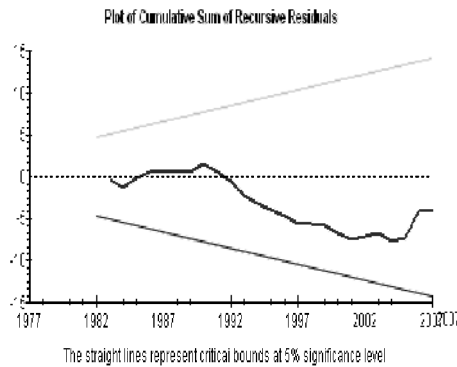
Table 7: ECM for variable LRM2 estimated by OLS based on Cointegrating VAR (2)

| Regressor | Coefficient | Std Error | T-Ratio | Prob. | |
|-----------|-------------|-----------|---------|-------|------------------|
| Intercept | 0.015 | 0.008 | 1.081 | 0.082 | R-Square: 0.9277 |
| Dint | 0.002 | 0.004 | 0.043 | 0.966 | DW: 1.6557 |
| DLRGDP | 0.768 | 0.142 | 5.182 | 0.000 | F-Stat: 83.4268 |
| DLFI | 0.785 | 0.047 | 16.813 | 0.000 | |
| ECM (-1) | -0.244 | 0.238 | -1.025 | 0.315 | |

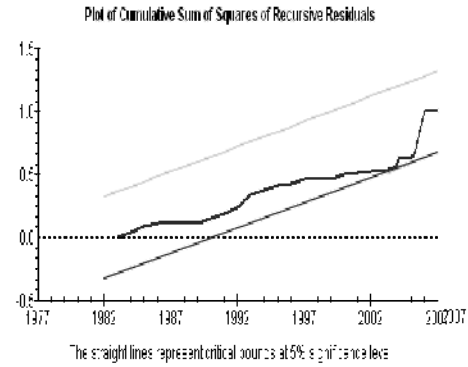
$$DLRM_{2t} = 0.0145 + 0.0015Dint_t + 0.7678DLRGDP_t + 0.7851DLFI_t - 0.2442ecm_{t-1} \quad (15)$$

(1.0812) (0.0432) (5.1817) (16.8133) (-1.0250)

The estimated ECM equation 15 depicted that there was short run disequilibrium in the model. The estimates further pointed out that equilibrium error term was negative, which was in accordance with the expectations of economic theory. The coefficient of error correction term indicated that the discrepancy (disequilibrium) of 0.24 units in the previous period was eliminated in this period. The results also illustrated that the income elasticity of real M_2 was also very high and highly significant. Moreover, financial innovations also had strong power of explaining the variation in short run real money demand.



Graph 5: CUSUM Plot of LRM2 Model



Graph 6: CUSUMSQ Plot of LRM2 Model

As both the CUSUM and CUSUMSQ statistics stay within critical bounds at 5 percent level of significance, so it was the indication of stability of the long run estimates of the model.

V- Conclusion:

In the nutshell, after analyzing all the simple sum official monetary aggregates (M_0 , M_1 , and M_2) it was easily concluded that the money demand function based on real narrow money (RM_1) was not stable money demand relation, while reserve money and broad monetary aggregates provided stable money demand functions. The comparison of the results for these two functions illustrated that the broad money aggregate was relatively better in statistical properties. Moreover, as per economic theory and also by definition,

M_2 inclusive of M_0 was the proper aggregate for monetary policy formulation. The stability of money demand relationship further implied that instead of interest rate targeting which has devastating impacts on the Pakistan economy in the current scenario, State Bank of Pakistan should control money supply. But this policy shift could be fruitful, after the formulation of true monetary aggregates.

Moreover, financial development also played a significant role in the demand for monetary assets of the individuals; hence the policy makers should take this factor under consideration while formulating the monetary policy.

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