

IS DEMAND FOR MONEY STABLE IN PAKISTAN?

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Abstract. The effectiveness of monetary policy for overcoming economic fluctuations is the main objective of the policy makers and it calls for clear knowledge regarding what factors affect the demand for money. The present study is an attempt to analyze the long-run relationship between demand for money, real income, inflation rate and exchange rate using ARDL approach. The results of the study reveal that M2 monetary aggregate is cointegrated with its determinants and its long-run relationship with its determinants appears to be stable. The study suggests that monetary authorities and policy makers should focus only on long-run stabilization policy in Pakistan.

Keywords: Stability, Cointegration, Demand for money

JEL classification: C62, C80, E41

I. INTRODUCTION

The demand for money is one of the key functions in formulating effective and appropriate monetary policy. For this purpose there is a need to have clear understanding regarding the monetary aggregates which need to be controlled by monetary authorities. The existing literature on demand for money reveals that not much attention has been given to analyze the

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relationship between money demand and its determinants in developing countries like Pakistan.

Some of the previous studies on money demand have neglected the role of foreign monetary developments. In open economies monetary developments like foreign interest rate and exchange rate influence the domestic demand for real cash balances under flexible exchange rate. Hence, it can make the domestic money demand functions unstable. Mundell (1963) first of all pointed out the existence of the relationship between demand for money and exchange rate. He was of opinion that in addition to the traditional variables the impact of exchange rate on demand for money cannot be ignored. The less restricted movement of capital and growing needs of foreign trade may make money demand functions unstable. McKinnon (1982) advocated specific channel of effects called currency substitution hypothesis which suggested that the countries with flexible exchange rates are subject to external monetary shocks transmitted through international financial markets.

During the past two decades the focus of researchers remained on the impact of monetary developments on money demand functions. (See, for example, Arango and Nadiri, 1981; Bahmani-Oskooee and Pourheydarian, 1990; Bahmani-Oskooee, 1991; Chowdhury, 1997; Khalid, 1999; Ibrahim, 2001; Bahmani-Oskooee and Rehman, 2005). There emerged two points of view regarding the impact of foreign monetary developments on the domestic demand for money which are:

1. Arango and Nadiri (1981) are of the opinion that depreciation of domestic currency (or appreciation of foreign currency) increases the domestic currency value of foreign assets which leads to an increase in the wealth of country leading to an increase in the demand for real cash balances. This indicates that exchange rate depreciation has positive impact on the demand for money.
2. Bahmani-Oskooee and Pourhedrian (1990) point out that depreciation of domestic currency and its expectation of further depreciation may result in holding less of domestic currency and more of foreign currency, leading to fall in demand for money. This reveals that exchange rate depreciation has a negative impact on the demand for domestic currency.

This study is an attempt to investigate the stability of the demand for money in Pakistan considering the movements of exchange rate as an important determinant of demand for money.

II. REVIEW OF LITERATURE

As a consequence of the Monetarist Revival and the Concomitant Keynesian-Monetarist debate, attention has been focused increasingly and extensively in monetary economics literature on the stability of demand for money. The empirical literature on the money demand function in less developed countries (LDCs) has provided little that is new in the way of approaches to the problem on estimation compared to work undertaken for developed countries. Such studies have yielded useful evidences on the role of the determinants of the money demand function and the influence and effect of varying monetary frameworks, varying degrees of monetization and financial innovations in these countries.

A lot studies are available in the existing literature which have analyzed the stability of the long run relationship between the demand for money and its determinants which is considered to be highly important in formulating effective monetary policy for achieving the desired results. Many studies have used cointegration technique for estimating the demand for money in developing countries like Pakistan. See, for example, Rao and Shalabh (1995) on India; Bahmani-Oskooee and Rhee (1994) on Korea; Choudhry (1995) on Argentina; Tan (1997) on Malaysia; Khan (1994) on Pakistan; Arize (1994) on Pakistan, Korea, and Singapore; and Chowdhury (1997) on Thailand. Obben (1998) on Bruni Weliwita and Ekanyake (1998) on Sri Lanka Semadram (1981), Ghaffar and Habibullah (1987), Habibullah (1989) on Malaysia and Bahmani-Oskooee and Rehman (2005) on Asian Developing Countries.

Demand for money has received a fair amount of attention from researchers in Pakistan. Some of the studies have used classical econometrics in estimating the demand for money, but their results produced faulty and misleading conclusions. Since the introduction of cointegration technique, many researchers in Pakistan have attempted to re-estimate the demand for money function. The use of cointegration technique has brought to light some controversies regarding the estimation of the money demand function. These controversies include the choice of satisfactory scale variable, opportunity cost measures of holding money, as well as, the appropriate functional form of the money demand equation. Although the importance of some measures of income in the money demand function has always been supported, there has been no consensus on the importance of the interest rate. Some studies found interest rate to be a significant variable while other failed to find its significance in the demand for money. Furthermore, some studies

have ignored the influence of foreign monetary development, which brings up the need for further empirical evidence on this issue.

Estimation of the money demand function gained popularity in Pakistan in the 1970s. Three main researches were conducted during the 1970s (see for example, Akhtar, 1974; Abe *et al.*, 1975; Mangla, 1979). These studies had employed classical regression technique and used small annual data. These studies failed to find any significant results. Khan (1980) used a larger sample over the period from 1959-60 to 1977-78 and found no significant difference in the result while using permanent or measured income alternatively. The author used the same data period and adopted a disaggregated approach to estimate the demand for various components of money and found similar result with the aggregate approach. With almost the same data period, Nasir and Naheed (1983) tried to estimate the money demand function for Pakistan using term structure interest rates. The authors reported the presence of diseconomies of scale in the use of money.

Khan (1992) estimated the determinants of money demand in Pakistan and India over the period from 1967 to 1987. The main purpose of his study was to measure the effects of the rate of interest, income, and price level on the demand for money in both countries. The author found that income and interest rate were significant variables in demand for money for M_2 in both countries, but the interest rate was insignificant in Pakistan for M_1 . The inflation rate had positive signs and was statistically significant in both countries.

All of these studies have used conventional regression analysis, but none of them has explored the time series characteristics, because the required econometrics techniques were not available at that time.

Hossain (1994) estimated the money demand function by employing Johansen cointegration test and annual data over 1951-91 period. The results of the study showed that there was a cointegrating relationship between real money balances and output from 1953-91. However, for the sub-sample 1972-91, the test results among real money balances, real output, and market call rate of interest indicated the presence of two cointegrating vectors. The study concluded that the narrow money demand function is more stable than the broad money demand function and suggested that narrow monetary aggregate should be used for monetary targeting in Pakistan.

Khan (1994) employed cointegration and error-correction model techniques on the money demand function using quarterly data from 1971Q₁ to 1993Q₂. The main purpose of his study was to examine the impact of

financial sector reforms on the demand for money in Pakistan. The study showed that the M_2 monetary aggregate was cointegrated with real income, real interest rates, nominal interest of medium-term maturity, and the inflation rate, but not with the interest rate of short-term maturity. On the other hand, M_1 was found to be cointegrated with real income, real interest rate and inflation rate but not with short-term and medium-term nominal interest rates. The study concluded that financial liberalization in the early 1990's did not have destabilizing effects in Pakistan.

Both Khan (1994) and Hossain (1994) documented the stability of the money demand function in Pakistan. Like many other studies both interpreted their finding of cointegration as a sign of stable long-run relation. However, Bahmani-Oskooee and Bohl (2000), who investigated the stability of German money demand, showed that cointegration does not necessarily imply a stable relationship between the variables.

Qayyum (2005) tried to estimate the dynamic demand for money function in Pakistan for the period 1960-1999. The results of the study showed that M_2 has long-run relationship with real income, rate of inflation, call money rate and government bond yield. The preferred money demand function showed that income and interest rate were important determinants in the short-run. The author concluded that being a stable model preferred money demand model could be used for policy analysis in Pakistan as it passes the stability test.

Bahmani-Oskooee and Rehman (2005) showed that in some Asian countries, even though real M_1 and M_2 monetary aggregates were cointegrated, the estimated parameters were unstable. They concluded that for formulating appropriate monetary policy both M_1 and M_2 aggregates should be considered particularly in developing countries.

Hussain *et al.* (2006) tried to analyze the demand for money function for Pakistan for the period of 1972-2005. The results of the study revealed that broad money (M_2) is more appropriate for Pakistan. Azim *et al.* (2010) analyzed the money demand function for Pakistan for the period 1973-2007 by using ARDL approach. They concluded that M_1 and M_2 both monetary aggregates should be considered in formulating monetary policy for Pakistan.

Sarwar *et al.* (2011) estimated both Allen and Morishima elasticities of substitution. The authors concluded that elasticity substitution in non-linear asymptotically ideal model (AIM) varies considerably. The study suggested that monetary authorities should target the board money aggregates and the

transition from simple sum to divisia aggregation may be helpful for Pakistan in checking the problem of inflation.

Arize and Nam (2012) tried to analyze the impact of exchange rate changes on money demand of seven countries for the period 1973-2009. The results revealed that exchange rate and domestic interest rates have positive and negative impact respectively on money demand in all the countries. The study concluded that broad money needed to be emphasized by the monetary authorities in all the countries for achieving desired objectives.

III. ISSUES ON EMPIRICAL ANALYSIS

THEORETICAL ASPECT

An understanding of the determinants of the demand for money is important because it bears on monetary theory and policy, and it throws light on how changes in money supply and related variables such as interest rates are transmitted to the economy and on how they affect the level of economic activity. Since the 1930's, economists have developed theories underlying the demand for money along several lines while diverse theories often posit similar variables to explain the demand for money. They frequently differ on the specific role assigned to each other.

ISSUES ON EMPIRICAL ANALYSIS

The demand for money is a well-explored field of monetary econometrics. The main objective of this theoretical and empirical work is to find a stable money demand function, which is considered to be a prerequisite for an effective monetary policy. Stability of demand for money may facilitate an assessment of the path to be attained. To this end, various forms of the money demand functions have been estimated by including various variables in the money demand functions. Researchers have employed various econometric techniques in estimating the money demand functions. It is widely accepted that conventional models explain the demand for money to be determined by a scale variable represented by the rate of interest and/or inflation rate (see Khan, 1994; Pradhan and Subramanian, 1997; James Obben, 1998; Bahmani-Oskooee and Bohl, 2000; Bahmani-Oskooee, 2001; Bahmani and Rehman, 2005). In addition, several attempts have been made to incorporate foreign opportunity cost variables such as exchange rate, foreign interest rate or interest rate differentials (see Bahmani-Oskooee, 1991; 1996; Tan, 1997; Chowdhury, 1997; Khalid, 1999; Bahmani-Oskooee and Rehman, 2005).

Choice of Variables

The choice of variables is one of the most important tasks for the researchers to begin with. A simple theoretical money demand relationship relates the demand for real money balances to a measure of transactions or scale variable and opportunity cost of holding money. The definition of money employed in empirical work differs from study to study. For example, the transaction theories view money function as a medium of exchange, and money is held as an inventory for transaction purposes. The asset theories of the demand for money lay emphasis on the role of money as a store of value. The transaction theories lay emphasis on M_2 while the asset theories emphasize M_1 . The transaction theories include income while the asset theories employ wealth; and on the opportunity cost of holding money, the transaction theories lay emphasis on short-term interest rates such as yield on the treasury bills, whereas the asset theories favour yields on longer-term financial assets. For each of these variables, there is a wide range of choices employed in the empirical research as discussed below.

Money Stock Definition

The first problem in the empirical estimation of the money demand function is the selection of an explicit measure. Monetary aggregates employed in the empirical analysis vary from study to study. They are selected on the basis of the objective of the studies and on other variables being considered in the estimation. Money stocks are classified into two categories — narrow and broad money. Narrow money (M_1) consists of those assets readily available and transferable in everyday transactions, which provide the means-of-exchange function. The broad money (M_2) consists of M_1 , time deposits at the commercial banks, savings deposits, money market deposit accounts, money market mutual fund balances, and overnight repurchase agreements. Several empirical studies exclusively estimated the demand for M_1 , as M_2 was considered to be incapable of bringing out the full effects of rate of interest. A number of studies in developing countries also considered M_1 better than those employing M_2 because of the under-developed financial sector and weak banking systems (see Moosa, 1992; Hossain, 1994).

Scale Variables

The scale variable in the money demand function is used as a measure of transactions relating to economic activity. Recent research has also focused on the disaggregation of GNP into several scale variables, reflecting the notion that not all transactions are equally money intensive. For example, Bomberger and Makinen (1980) and Mankiw and Summers (1986) provide

theoretical arguments as well as empirical evidence to establish the superiority of expenditure-based proxies. They further argue that in the context of an open economy, the impact of foreign trade on total domestic transactions is reflected more accurately in an expenditure-based aggregate. However, there is no firm evidence that disaggregation of GNP improves the performance of the money demand functions.

Opportunity Cost of Holding Money

For a given definition of money, the opportunity cost of holding money is the difference between the rate of return in assets alternative to money and the own rate on money. A uniformly good performance irrespective of which of the interest rates is included in the regression, is an indication that the various interest rates are related, moving up and down in a consistent pattern, so that it is immaterial which interest rate is included.¹ However, while the relevant interest rates are closely related, they do not move so closely together that any one of them will do equally well in estimation, so that usually one or two of them to be chosen on empirical grounds for inclusion as regressors on the wider question of whether the demand for money depends on interest rates or not, there is substantial evidence that the demand for money does depend negatively upon the rate of interest in financially developed economies. This is also the finding of many studies on the developing countries.

However, some studies on the developing countries do not find significant interest rate elasticities for a variety of reasons, including regulatory limits on the interest rates in the economy, and inadequate access to banking and other financial institutions. In these cases, very often the rate of inflation rather than published data on interest rates yields better empirical results. This occurs because the regulated interest rates usually do not accurately reflect the expected rate of inflation. So the land, inventories, and other real assets, whose prices better reflect the rate of inflation, become more attractive alternatives to holding cash than bonds. Due to the highly repressed financial system in most of the Asian developing countries, it is considered to be more appropriate to use inflation in place of rates of interest.

Due to the open nature of the economy, it is vital to analyze whether foreign opportunity costs significantly affect cash holdings in developing

¹One theory that points towards such consistency patterns is the expectations hypothesis on the term structure of interest rates, *i.e.* on the yields on assets differing in maturity.

countries. The exchange rate has a bearing on the demand for money in developing countries. The importance of the real exchange rate in the money demand function is highlighted by Bahmani-Oskooee (1991) for the United Kingdom; Bahmani-Oskooee and Pourhedrian (1990) for the US and Canada; Bhamani and Rehman (2005) for Asian Developing countries.

IV. METHODOLOGY AND MODEL SPECIFICATION

The Data

The study uses yearly series for the period 1975-2009. Annual data for RGDP is expressed in million rupees at constant price (2000 price). GDP deflator is used for finding the inflation rate which is defined as

$$\frac{\text{GDP Deflator} - \text{GDP Deflator}(-1)}{\text{GDP Deflator}(-1)}$$

where GDP deflators base year is 2000.

M_1 is the money supply consisting of currency in circulation plus demand deposits. M_2 is M_1 plus Quasi money. EX is exchange rate that is defined as number of units of domestic currency per US dollar. This indicates that an increase reflects a depreciation of domestic currency. All the data except exchange rate has been taken from *Handbook of Statistics* on Pakistan economy published by State Bank of Pakistan and exchange rate is taken from *World Development Indicators* of World Bank. All the variables except inflation rate are transformed into natural log.

Non-Stationary Regressors and Cointegration Technique

The money demand variables (and most of the economic and financial time series in general) are non-stationary, and the basic statistical issue is the appropriate representation of the nature of non-stationarity.² In literature, it has been established that most of the economic time series variable are non-stationary and the use of non-stationary time series leads to spurious regression which cannot be used for precise decision. As a first step of empirical analysis, the order of integration of the variables included in the model is determined by using standard tests like ADF and PP.

²Granger and Newbold (1974) found that when the regression involves non-stationary variables, the OLS regression can be spurious. They concluded that such a regression equation leads to incorrect rejection of the null hypothesis of no relationship when, in fact, there might be none. They also found high R^2 and low Durbin-Watson (DW) statistics, which tend to cause the conventional formula to underestimate standard errors and thus overstate t values.

The common practice of making non-stationary series that would render the series stationary is taking its first difference. However, regressions with even the first differences eliminate the relationship between the levels of the variables, so that the regressions do not provide estimates of the long-run relationship between the dependent and independent variables in estimating the equation. Therefore, the use of differenced data is not a proper strategy for finding this relationship. In the context of the money demand function, the underlying theory implies an equilibrium relationship between the levels of the variables, so that using differenced data will not provide an estimate of this function.

Specification of the Money Demand Functions

A stable money demand function is one of the important issues for policy makers in both developed and developing countries. Various factors are considered as determinants of the money demand function. Variable selection and framework chosen are considered to be highly important to modeling and estimating the demand for money. Proper specification of opportunity cost variable happens to be the most important factor in obtaining meaningful results. In literature, it has been accepted that interest rate is not a suitable opportunity cost variable of holding money. This is because of the fact that in developing countries money markets are relatively thin and controlled by the monetary authorities.

Following Bahmani-Oskooee (1996), the money demand is assumed to take the following form:

$$\log M_t = a_0 + a_1 \log Y_t + a_2 \pi_t + a_3 \log EX + \varepsilon_t \quad (1)$$

where

$$M_t = \text{desired holding of real money balances (M}_1 \text{ or M}_2\text{)}^3$$

$$\pi = \frac{\text{GDP Deflator} - \text{GDP Deflator}(-1)}{\text{GDP Deflator}(-1)}$$

where GDP Deflator (2000 = 100)

$$Y_t = \text{Annual data for RGDP (in million rupees) at constant price (2000 = 100)}$$

³M₁ consists of currency outside the banks and demand deposits at scheduled banks divided by GDP Deflator. M₂ consists of M₁ plus Quasi money divided by GDP Deflator.

EX = official exchange rate is measured by the number of domestic currencies per US dollars

ε_t = stochastic disturbance term

Following macroeconomic theory, the sign of a_1 is expected to be positive and the expected sign a_2 will be negative. a_3 is expected to be positive or negative.

The error correction version of Autoregressive Distributed Lag (ARDL) model pertaining to variables in equation (2) is as follows:

$$\begin{aligned} \Delta \log M_t = & a_0 + \sum_{i=1}^n a_{1i} \Delta \log M_{t-i} + \sum_{i=0}^n a_{2i} \Delta \log Y_{t-i} + \\ & \sum_{i=0}^n a_{3j} \Delta \pi_{t-i} + \sum_{i=0}^n a_{4i} \Delta \log EX_{t-i} + \delta_1 \log M_{t-1} \\ & + \delta_2 \log Y_{t-1} + \delta_3 \pi_{t-1} + \delta_4 \log EX_{t-1} + \varepsilon_t \end{aligned} \quad (2)$$

The ARDL approach is very suitable to our formulation of the demand for money because we may have a stationary variable such as inflation rate along with non-stationary variables such as money or income.

In this set up, the null of no cointegration defined by $H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$ is tested against the alternative of $H_1: \delta_1 \neq 0, \delta_2 \neq 0, \delta_3 \neq 0, \delta_4 \neq 0$ by means of familiar Wald-test (F statistic).

Once cointegration is established, shifting back to equation (2) and the entire model is estimated using an appropriate lag selection criterion such as Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). From this second stage, not only estimates of long-run elasticities ($\delta_2 - \delta_4$) are obtained, but also the CUSUM and CUSUMSQ tests are applied to the residuals of equation (2) to test for stability of long-run elasticities by taking into account the short-run dynamics.

V. RESULTS AND INTERPRETATION

The first practice in applying any cointegration technique is to determine the degree of integration of each variable. For this reason ADF and PP tests are employed.

The test results of ADF and TP are presented in Table 1.

TABLE 1
ADF and PP Test Statistic Results 1975-2010

Variables	ADF test (t-stat)		PP test statistic (Adjusted t-stat)	
	c	c,t	c	c,t
Variables at levels				
LM ₂	-1.51	-2.93	-2.09	-2.57
LM ₁	0.04	-3.05	-0.04	-1.40
LRGDP	0.26	-2.64	0.63	-2.64
LEX	0.36	-2.47	0.26	-2.65
INF	-4.42*	-4.43*	-4.44*	-4.42
Variables at first differences				
ΔLM ₂	-2.99*	-4.48*	-4.20*	-4.44*
ΔLM ₁	-4.77*	-4.46*	-4.69*	-4.66*
ΔLRGDP	-6.19*	-6.11*	-6.56*	-6.66*
ΔLEX	-4.75*	-4.66*	-4.75*	-4.66*
ΔINF	-7.91*	-6.16*	-8.69*	-8.62*

Note: * shows significance of the variable

The results show that the variables are I(0) and I(1). This provides a justification of using ARDL for analyzing the stability of money demand function in Pakistan. There is no need to classify variables into I(0) or I(1) in ARDL approach.

TABLE 2
Lag Length Criteria (M1)

Lag	LogL	LR	FPE	AIC	HQ
0	-63.19753	NA	0.000897	4.335324	4.395640
1	79.90563	240.0440	2.49e-07	-3.864879	-3.563302
2	107.3575	38.96401*	1.26e-07*	-4.603712*	-4.060874*

* indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

The next step in ARDL is to find the lag length. The results of table 2 indicate that by using different criteria the lag length for M_1 is determined as 2.

TABLE 3
ARDL Bound Test estimates for (M_1)

Dependent Variable	F-Statistics	
LM_1	Lag (2, 2, 2, 2)	
	6.042009*	
Critical Value	Pesaran <i>et al.</i> (2001) ^a	
	Lower Bound Value	Upper Bound Value
1%	3.43	4.60
5%	2.86	3.99
10%	2.57	3.66

ARDL bound test results show that F value of M_1 is higher than the upper bound value. This is an indication of the presence of cointegration among the variables included in the model. Considering that real monetary (M_1), Income, inflation rate and exchange rate are cointegrated so error correction model equation (2) is estimated. The main aim here is to capture the short run dynamics.

The results are reported in table 4.

TABLE 4
ARDL Short run Coefficients Estimates (1, 0, 0, 2)
Dependent Variable DLM_1

Variables	Coefficients	Standard Errors	T-Statistics	Probability
Constant	-6.8583	1.4352	-4.7785	0.000
DLRGDP	1.1489	0.26627	4.3147	0.000
DLEX	-6.7428	0.14623	-4.6111	0.000
DINF	-0.0099748	0.004985	-2.0008	0.055
DINF(-1)	-0.015271	0.004480	-3.4088	0.002
R Squared = 0.60766; Adjusted R Squared = 0.52047; F Statistics = 8.3634; DW Statistic = 2.0303				

Table 4 reports the coefficient estimates of all lagged first differenced variables in ARDL model (short run coefficient estimates). Not much interpretation could be attached to the short run coefficients. All they show is the dynamic adjustment of all the variables.

In Table 5, the long run coefficients are reported.

TABLE 5
ARDL Long run Coefficient Estimates (1, 0, 0, 2)
Dependent Variable LM_1

Variables	Coefficients	Standard Errors	T-Statistics	Probability
Constant	-24.8412	8.4822	-2.9286	0.007
LRGDP	4.1614	1.1450	3.6343	0.001
LEX	-2.4423	0.86114	-2.8361	0.009
INF	-0.000252	0.022833	-0.011056	0.991
EC_{t-1}	-0.27608	0.12123	-2.2774	0.031

These are the coefficients of $\delta_1 - \delta_4$ from the ARDL model. Following the literature the long run elasticities on M_1 are normalized by dividing them by $-\delta_1$. This yields an income elasticity of 4.1614 which is significant. The inflation rate elasticity is negative (-0.000252) and is insignificant. It supports our theoretical expectation that as inflation rate raises the demand for money falls. This indicates that people prefer to substitute physical assets for money balances. The exchange rate coefficient is negative and significant (-2.4423). The negative sign of the exchange rate elasticity supports the Bahmani Oskaoee and Pourhedrian (1990) argument.

The estimates of $\delta_1 - \delta_4$ is used to form a lagged error correction term. The results of Table 5 report that $EC_{t-1} = \delta_1 \log M_{t-1} + \delta_2 \log Y_{t-1} + \delta_3 \pi_{t-1} + \delta_4 \log EX$. After replacing the linear combination of the lagged level of variables in the ARDL model by EC_{t-1} , we re-estimate the model by imposing the same lag structure selected by the AIC criterion, and look for the significance of EC_{t-1} . A negative and significant coefficient of EC_{t-1} will be an indication of cointegration. The EC_{t-1} carries an expected negative sign, which is highly significant, indicating that in Pakistan, real M_1 , income, inflation rate, and exchange rate are cointegrated.

In order to observe the stability of M_1 money demand function in Pakistan CUSUM and CUSUMSQ test proposed by Brown, Durbin and Evans (1975) are applied.

FIGURE 1

M_1 Real Monetary Aggregates (1975-2010)
CUSUM Test to the Residuals of Equation (2) for Pakistan

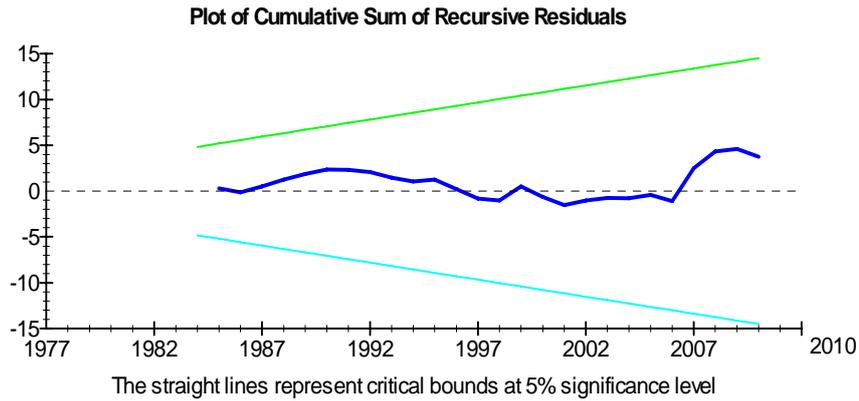
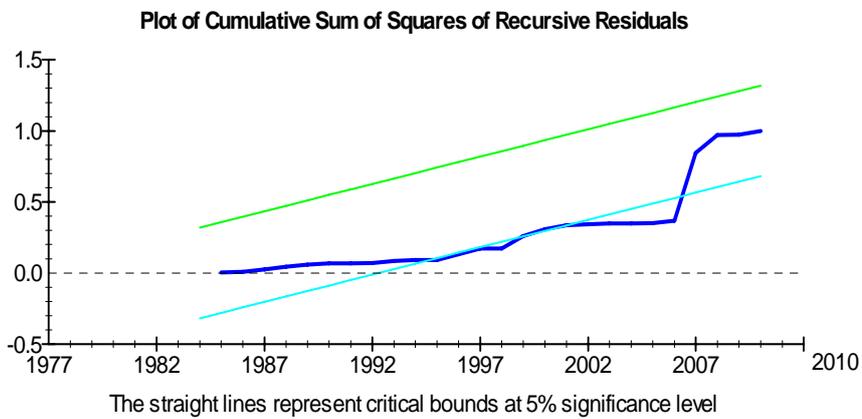


FIGURE 2

M_1 Real Monetary Aggregates (1975-2010)
CUSUMSQ Test to the Residuals of Equation (2) for Pakistan



As can be seen the plot of CUSUMSQ crosses the critical value line indicating instability in M_1 money demand in Pakistan.

TABLE 6
Lag Length Criteria (M_2)

Lag	LogL	LR	FPE	AIC	HQ
0	-37.63269	NA	0.000172	2.685980	2.746296
1	108.5443	245.2001	3.93e-08	-5.712535	-5.410958
2	129.3493	29.52967*	3.05e-08*	-6.022535*	-5.479697*

* indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; HQ: Hannan-Quinn information criterion

The results of Table 6 indicate that by using different criteria the lag length for M_2 is determined as 2.

TABLE 7
ARDL Bound Test Estimates for (M_2)

Dependent Variable	F-Statistics	
LM2	Lag (2, 2, 2, 2)	
	13.24539*	
Critical Value	Pesaran <i>et al.</i> (2001) ^a	
	Lower Bound Value	Upper Bound Value
1%	3.43	4.60
5%	2.86	3.99
10%	2.57	3.66

The ARDL bound test results show that F value of M_2 is higher than upper bound value. This is an indication of the existence of the cointegration among the variables.

The coefficient estimates of all lagged first differenced variables in the ARDL (short run coefficient estimates) are reported in Table 8.

TABLE 8
ARDL Short run Coefficient Estimates (2, 2, 0, 0)
Dependent Variable DLM_2

Variables	Coefficients	Standard Errors	T-Statistic	Probability
Constant	-0.81374	0.47797	-1.7025	0.100
$DLM_2(-1)$	0.30470	0.13025	2.3393	0.027
DLRGDP	0.12468	0.19281	0.64665	0.523
DLRGDP(-1)	-0.43716	0.18472	-2.366	0.025
DLEX	-0.062784	0.052208	-1.2026	0.240
DINF	-0.0076408	0.0019098	-4.0007	0.000
R Squared = 0.64081; Adjusted R Squared = 0.54410 F-Statistic = 7.7308; DW Statistic = 1.9973				

Not much interpretation could be attached to the short run coefficients. All they show is the dynamic adjustment of all the variables.

TABLE 9
ARDL Long run Coefficient Estimates (2, 2, 0, 0)
Dependent Variable LM_2

Variables	Coefficients	Standard Errors	T-Statistic	Probability
Constant	-3.0002	1.7945	-1.6708	0.107
LRGDP	1.3429	0.25716	5.2221	0.000
LEX	-0.23148	0.21271	-1.0882	0.286
INF	-0.028171	0.013406	-2.1014	0.045
EC_{t-1}	-0.27123	0.094052	-2.8838	0.008

The results for real monetary aggregates M_2 for Pakistan are presented in Table 9. The results show that the income elasticity carries an expected positive and significant sign. The inflation rate coefficient is negative and significant supporting our theoretical expectation. The exchange rate

elasticity is negative and insignificant. Since the lagged error term EC_{t-1} carries a significant negative sign, it can be concluded that real M_2 aggregate is cointegrated with its determinants.

FIGURE 3

M₂ Real Monetary Aggregates (1975-2010)
CUSUM Test to the Residuals of Equation (2) for Pakistan

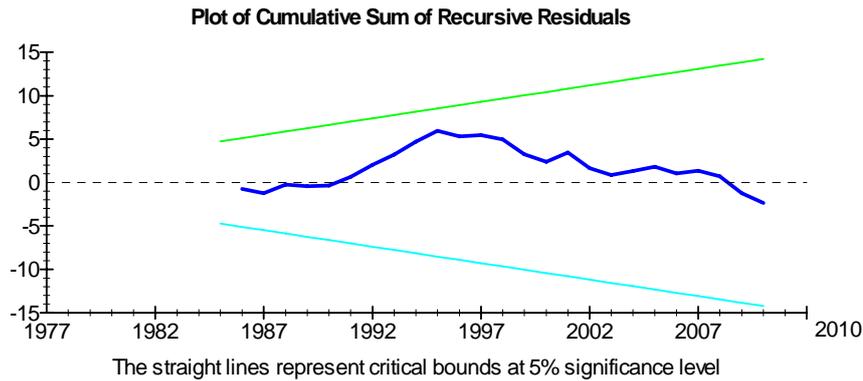
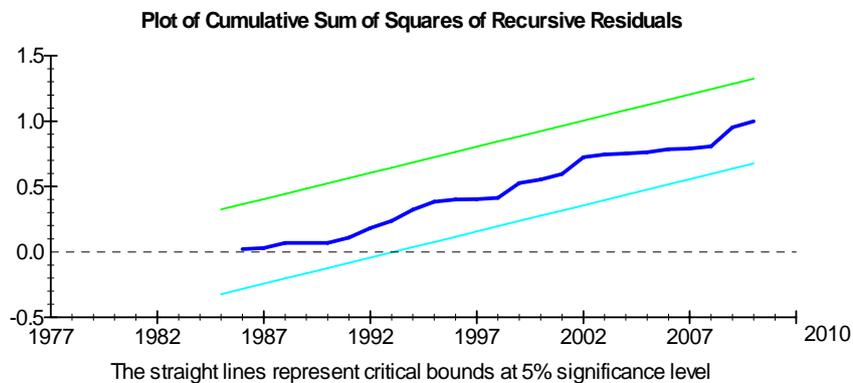


FIGURE 4

M₂ real monetary aggregates (1975-2010)
CUSUMSQ test to the residuals of equation 2 for Pakistan



Graphical presentations of CUSUM and CUSUMSQ tests are provided in figure 3 and 4. It can be seen, the plots of these two tests do not cross the critical value line, indicating a stable long relationship between real M_2 ,

income, inflation rate and exchange rate. So it can be concluded that M_2 is a better monetary aggregate in terms of formulating monetary policy.

VI. CONCLUSION

The results of the study show that M_1 monetary aggregate is cointegrated with its determinants in Pakistan but the estimated elasticities are not stable over time. In case of M_2 the error correction term carries expected significant sign which is an indication that the real monetary aggregate M_2 is cointegrated with its determinants. CUSUM and CUSUMSQ tests provide the evidence of stable long run relationship for real M_2 balances. Furthermore, the coefficient estimates of all lagged first differenced variables in the ARDL model show the dynamic adjustment of all variables in the short-run. They may not have potentially important implication on the formulation and implementation of monetary policy in Pakistan. Reacting to all shocks through various short run stabilization policies may be harmful to the economy. Still, if the short run stabilization is called for, the usefulness of M_2 real monetary aggregate target in the conduct of monetary policy depends crucially on the extent to which policy makers can detect the structural break in the money demand functions and how long it takes for them to realize that there exists a behavioural change in the money demand function. The inability to anticipate a structural break and longer time to realize that the break has occurred raise doubt over the use of real monetary aggregates target for short run stabilization. So it is suggested that monetary authorities should focus only on the long run stabilization policy.

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