The Determinants and Stability of Money Demand in India

Pawan Kumar
Research scholar, University of Delhi, India

Abstract

A sound knowledge of determinants of money demand is prerequisites for the effective monetary policy to attain the desired goal of price stability and economic growth. This study is an attempt to analyze the short-run and long-run determinants, and stability of money demand in India. Monthly data from April 2005 to February 2014, for narrow and broad monetary aggregates, income, inflation rate, exchange rates are used in this study. This paper employed Johansen co-integration and Error Correction Model to find out long run and short run determinants of Money demand. In this study the CUMSUM and CUSUMSQ test suggests that while the long run real broad money demand function is stable but real narrow money demand is unstable .Therefore long run real broad money demand seems to be relatively more significant to explain short run and long run fluctuations in money demand.

KEYWORDS: co-integration, India, money demand, stability

Introduction

The study and estimation of money demand function are very important because stability of money demand function is the precondition to operate an effective monetary policy. The demand function for money helps to ascertain the liquidity needs of the economy (Handa, 2009). Therefore, it is essential for the policy makers to figure out the factors that determine this function and existence of the stable long run relationship among these factors and monetary aggregates. Due to this key role of money demand function in the economy numerous empirical researches have generated in the money demand function with its long and short run stability. Despite this fact, the rapidly changing global and domestic financial conditions motivate for revisiting to the stability of the demand function.

The Econometrics time series analysis has a key role in the empirical research on the stability of demand for money. Initially these time series techniques were restricted to the developed countries but later on were used for developing countries as well. 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) forSri Lanka were few among long list of literature that used co-integration and ECM for money demand analysis.

Some of the previous literatures on money demand function for India had ignored the role of foreign monetary development. In an open economy with flexible exchange rate, monetary development like exchange rate may significant factor to influence the domestic demand for money with less restricted inflow and outflow of capital among

countries and growing role of foreign trade may lead unstable money demand. Mundell(1963) first of all pointed out the existence of a relationship between exchange rate and demand for money and suggest that apart from traditional variables the influence of exchange rate should be included in the money demand function. Mckinnon(1982) advocated specific channel of effects called currency substitution hypothesis which suggest that the countries with flexible exchange rates are subject to external monetary shocks transmitted through international financial market. Therefore the focus of researchers have shift to impact of monetary development on money demand function from past two decades (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). Two points of view come in light regarding the influence of monetary development on domestic money demand. These are summarized below:

(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. Taking these facts into consideration; this study tries to explore the stability of demand for money in India considering the fluctuation of exchange rate as a key factor of demand for money.

Review of Literature

Ramacha ndran (2004) found that "barring the instability noticed during 1978–1980, the real demand for money is fairly stable. The co-integration test produced evidence in favor of the long run equilibrium relationship between money demand, income and prices, confirming the existence of causal link among these variables. There exists a proportional relationship between money and real income and money and prices. However, the relationship among these variables as endorsed by the traditional quantity theory is not found, indicating that there is feedback and dynamic relationship among these variables. The results derived from the speed of adjustment parameters showed that short run disequilibrium among these variables is adjusted through the dynamics of output and money supply, but not by the prices."

Marashdeh(1997) estimated the demand for money in Malaysia over 1980:1 – 1994:10 period using co-integration and Error correction methodology and found that money balance, income, exchange rate, price and interest rate are co-integrated. The explanatory variables that are found statistically significant to influence demand for money in short run were income, expected inflation rate, six month money deposit rate, expected rate of

change in exchange rate, seasonal dummies, and the error correction from the long run demand for money.

K Humavindu(2007) employed ARDL model using co-integration and an unrestricted ECM framework to analysis the stability of broad money in the South African economy. The study found a stable relationship between broad money and its determinants, namely, real GDP, real interest rate and inflation rate, using the CUSUMS and CUSUMS of squares test.

Inoue and hamori(2008) finds that a long run equilibrium relationship in money demand prevails, only when money supply represented by M1 and M2 but not for M3. Moreover**, Inoue and Hamori**(2008)Claim that when money demand function estimated by using dynamic OLS, the sign conditions of the coefficients of output and interest rates were found consistent with theoretical rationale and statistical significant was confirmed when the money supply was represented by either M1 and M2. Further they suggest that it is appropriate for RBI to focus on M1 and M2, rather than M3, managing monetary policy.

Narayan, S and Mishral(2009) used panel data estimation methods to estimate a money demand function for the five South Asian countries including India. The study showed that the money demand and its determinants, namely real income, real exchange rate and short term domestic and foreign interest rate are co-integrated both for individual countries as well as for the panel, and panel long run elasticity provides robust evidence of statistically significant relationship between money demand and its determinants. The study found that except for Nepal money demand function are stable.

Valadkhani(2009) examine the long and short run determinants of the demand among six Asian-Pacific countries during 1975-2002.The results showed that in the long run demand for money has a positive relationship with real income and inversely related to the interest rate spread, inflation, the real effective exchange rate, and the US real interest rate with more than unity income elasticity. However, in the short run error correction model showed that only income, inflation and nominal interest rate have statistically significant effect (with consistent sign) on M2 express that currency substitution and capital mobility are reliable only in long run.

Padhan(2009) estimated stability of demand for money in India by employing co-integration and Error Correction Model technique, using quarterly data since 1962:2 – 2009:2. The money demand function formed by including interest rate, income, stock prices and exchange rate. The result showed that except exchange rate all variables are statistically significant to influence demand for money with stability of all the liquidity aggregates.

Anwar and Asghar(2012) employed Autoregressive Distributed lag(ARDL) model using Annual time series data for the period 1975-2009 to examine the long run relationship between money demand, exchange rate, inflation and real GDP for Pakistan. The results of the study showed that the M2 monetary aggregate was co-integrated with income, exchange rate and inflation rate with stable long run relationship.

Jammeh(2012) examines the long and short run determinants of demand for money and its stability in the Gambia using quarterly time series data from 1993:1 to 2008:4. The study found co-integration among money demand, income, interest rate, inflation rate and exchange rate. However the short run dynamic model did not approve any relationship among Variables. Furthermore, transactional, precautionary and speculative motives for money demand hold only in the long run. Moreover, the assets substitution phenomenon also holds only in the long run while the currency substitution phenomenon did not exist in Gambia during the sample period.

S Arwar S and Waqas(2013) used annual time series data for Pakistan comprising the time period of 1972-2007 and applied co-integration and ECM techniques to find out the long run and short run money demand relationship. The study found that a stable relationship between broad money and its determinants, namely real GDP, inflation rate, interest rate on time deposit and financial innovations.

Kjosevski(2013) examine the long and short run determinants and stability of money demand defined as M1 for the Republic of Macedonia using monthly data from January 2005 to October 2012 by employing Johansen co-integration and Error correction model technique to find the long-run and short term dynamic relationship in the money demand model. The finding of the study showed that the exchange rate and one month interest rate on Denar is highly significant to influence the money demand in the long run. Further, estimated long run demand for money function showed a very slow speed of adjustment of removing the disequilibrium.

Bhatta(2011) employed ARDL modeling approach to analyze the stability issue money demand for Nepal using annual data set of 1975-2009.The study found that there exists long run equilibrium relationship between demand for real money balances, real income and interest rate for both narrow and broad monetary aggregates. Further, The study suggests that demand for real money balance is stable and predictable function of the few variables that includes real income, inflation rate and interest rate and central bank can focus on monetary aggregates to achieve the broad economic goals.

Theoretical Model

In most of the Macroeconomics literatures, the general framing of money demand as a function income and interest rate. However, usual money demand function is expended by including exchange rate to consider the currency substitution hypothesis and inflation rate to consider the assets substitution hypothesis. As Mundell (1963) suggested that the exchange rate to be included in the standard money demand function to take account of currency substitution phenomenon. 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. Therefore in this paper demand for money considered as the function of income, exchange rate and inflation rate.

Methodology

Model Specification and Description of Variables

This paper form money demand function for an open Indian economy for both narrow and broad monetary aggregates. Following Bahmani-Oskooee (1996), the money demand is assumed to take the following form:

$$Log(M_t) = F[Log(y), Log(EX), Log(\pi)] \quad (1)$$

Where

M_t = Real money balance (deflated with whole sale price index)

Y = Level of GDP as a proxy to capture transactions and precautionary demand for money.

EX= Real effective exchange rate (reert) trade based (36 –country weights)as a proxy to capture the currency-substitution phenomenon.

π = Whole sale price index as a proxy to capture the assets-substitution hypothesis.

The theoretical model can be econometrically presented as-

$$Log(M_t) = \beta_0 + \beta_1 Log(Y_t) + \beta_2 Log(EX_t) + \beta_3 Log(\pi_t) + U_t \quad (2)$$

Theoretically, demand for money is positively related to GDP and negatively related with the inflation rate. But the sign of the exchange rate is uncertain. So the coefficient of GDP (β_1) should be positive and coefficients of inflation rate (β_3) should be negative. But sign of the coefficient of exchange rate (β_2) is uncertain. It motivates us for the empirical estimation of demand for money functions and tests its stability.

To form the model for money demand function for both narrow and broad monetary aggregates, equation (2) can written as in two different equations-

Model 1 (Narrow money aggregates):

$$Log(M_{1t}) = \beta_0 + \beta_1 Log(Y_t) + \beta_2 Log(EX_t) + \beta_3 Log(\pi_t) + U_t \quad (3)$$

Model2 (Broad money aggregate):

$$Log(M_{2t}) = \beta_0 + \beta_1 Log(Y_t) + \beta_2 Log(EX_t) + \beta_3 Log(\pi_t) + U_t \quad (4)$$

Dataset and its Source

The data set used in this paper got from Reserve Bank of India (RBI) website. The empirical analysis is carried out applying monthly data from April 2004 to February 2014.This period has been chosen based on availability of monthly data. Since monthly data on GDP is not available therefore Index of Industrial Production is used as a proxy of GDP.

Unit Roots and Co-integration Tests

An analysis of the time series properties of variables used in the macroeconomic research is particularly important when examining the casual relationship between variables that exhibit a common trend (Clive W.J. Granger 1986; Robert Engle and Clive granger 1987; Soren Johansen (1991). Our initial step would be to check the order of variables used in this study by conducting stationarity or unit root test. The Phillips –perron test is employed for this purpose. Unit root test is the first step in this study because it is prerequisite for cointegration test.

In order to have a valid money demand function, there must be at least one cointegrating equation in the system. Co-integration test is used to find if there exist stable long run relationship between monetary aggregates and their determinants, and therefore predictable over long period. For this we employ the (johansen, 1991, 1995) multivariate cointegration technique. The johansen cointegration a VAR based test and can be presented as-

$$\Delta Y_t = \Pi Y_{t-1} \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-1} + \mu + \Theta t + \varepsilon_t$$

Y_t Isa $(n \times 1)$ vector of endogenous variables and ε_t is also a $(n \times 1)$ vector of white noise error term where n is the number of variables used in this study. The rank of the matrix coefficient $\prod$ shows the long run relationship among variables. Full rank $r = n$ means that the variables are cointegrated. Rank $r = 0$ means that the variables are not cointegrated and reduced rank where r lies between zero and n means that there are r cointegrating vector among the variables. According to (Bashier and Dahlan, 2011) this technique is preferred to the two-step Engle-Granger procedure because it can test for multiple cointegrating vectors. Johansen developed two test statistics – trace eigen value statistics and maximum eigen value statistics. In the trace test, the null hypothesis is that there are r cointegrating vectors and the alternative hypothesis is there are n cointegrating vectors. On the other hand, the maximum eigenvalue test tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of r +1 cointegrating vectors.

Estimation Techniques: Error Correction Mechanism (ECM)

An ECM estimation technique has been use one of the most dominant estimation technique to estimate money demand function in previous literatures. So, we applied ECM to estimate money demand and examine its stability in India. An ECM model is effective tool to study the short run dynamic in money demand function. After testing co integration between money demand and its determinants by using johansen cointegration test, the ECM allows us to reunite the short run and long run behavior of money demand. The ECM model can be specified as-

$$\Delta \ln m_t = \beta_0 + \beta_1 \Delta \ln y_{t-i} + \beta_2 \Delta \ln EX_{t-i} + \beta_3 \Delta \ln \pi_{t-i} + \beta_4 \Delta \ln m_{t-i} + \beta_5 \bigcup_{t-i} + \varepsilon_t$$

$$\bigcup_{t-i} = \ln m_t - \alpha_0 - \alpha_1 \ln y_t - \alpha_2 \ln EX - \alpha_3 \ln \pi$$

Where $\beta_5 \bigcup_{t-i}$ is error correction term. β_5 is error correction coefficient and β_i are the estimated short run coefficients. The functioning of error correction coefficient is that it push the short run disequilibrium in money demand function towards its long run equilibrium and shows the speed of this adjustment.

Next we examine the structural stability of the error correction model of money demand. Stability test is used to examine if the money demand and its determinants in India were stable during the sample period. High inflation rate, rapid innovations in financial sector, sharp depreciation of rupee, recession in 2008 or combination of these factors may cause money demand instable. We use cumulative sum (CUMSUM) and cumulative sum of squares (CUSUMQ) of recursive test (Brown et al; 1975).

Results & Discussion:
Stationary Check

In this paper we perform the *phillips perrorn* on all variables of the series. The analysis of unit

root shown in table 1.

Table 1 Phillips- perron test results for unit

	At Level		First Difference	
Variables	With intercept but no trend	With intercept and trend	With intercept but no trend	With intercept and trend
LogM1	-2.13(p=0.23)	-2.084(P=0.55)	-10.488^{*} (p=0.00)	-11.78^{*} (p=0.00)
LogM2	-1.62 (p=0.46)	-1.26(p=0.89)	-9.25^{*} (p=0.00)	-9.39^{*} (p=0.00)
LogY	-2.39 (p=0.14)	-4.046^{*} (p=.0011)	-26.39^{*} (p=0.001)	-31.18^{*} (p=0.0001)
LogEX	0.216(p=0.97)	-1.97(p=0.61)	-8.55^{*} (p=0.00)	-8.55^{*} (p=0.00)
			-	
π	-0.06(p=0.95)	-2.74(0.21)	-7.17^{*} (p=0.00)	-7.13^{*} (p=0.00)

Note: - * shows the coefficient is significantly different from zero at 0.05 probability level
The Phillips perrorn statistic are -2.888932 and -3.452764 for models 'with Intercept but no Trend', and 'with Intercept &Trend' respectively at 0.05 probability level.

The Phillips perrorn unit root test results showed that all five series were non-stationary at levels for both models except logY which is nonstationary with intercept and no trend, but stationary with intercept and trend. After first difference all the series were stationary with both models.

Money demand model based on narrow money:
First we estimate the money demand model for Narrow money (M1). The equation for the model was:-

$$Log(M_{1t}) = \beta_0 + \beta_1 Log(Y_t) + \beta_2 Log(EX_t) + \beta_3 Log(\pi_t) + U_t$$

Given that all the variables are non stationary at their level but stationary at their first difference, we proceeds to examine whether there exist any long run equilibrium relationship among these variables. The trace statistics reveals that there exist one co-integration vector between M1 and its determinants. The results shows in table 2.

Table 2: *Results of Cointegration Test for narrow Money.*

Based on Maximal Eigen value Statistic				Based on Trace value statistic			
Null	Eigen Statistic	95% critical value	90% critical value	Trace statistic	95% critical value	90% critical value	
None	26.01410	28.588	26.121	60.56441*	54.079	50.525	
At most one	17.26129	22.299	20.050	34.55031	35.192	32.268	
At most two	11.33330	15.892	13.905	17.28902	20.261	17.980	
At most three	5.955720	9.164	7.556	5.955720	9.164	7.556	

*Indicates that the coefficient is significantly different from zero at 0.05 probability level.

The long run-relationship identified by Johansen co-integration technique depicted money demand function as obtained in equation no 5:

$$Log(M_{1t}) = 16.984 + 2.779Log(Y) - 1.737Log(EX) - 3.560Log(\pi)$$
$$\qquad\qquad (23.40) \quad (2.390) \qquad (3.315) \qquad (3.665)$$

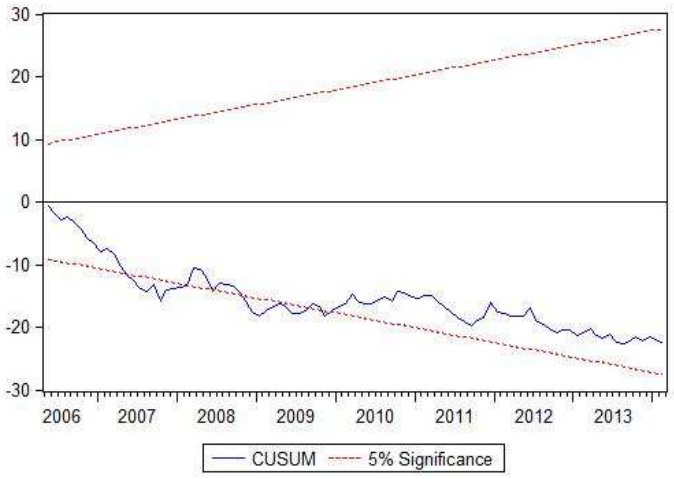
The above estimated model of money demand reveals that all the coefficients are consistent with a prior expectation regarding signs. The analysis shows that one percentage increase in income resulted in 2.779 percent increase in real money demand in long run. Since the income coefficient is greater than one so income is consider as luxury in India. The negative sign of coefficient of exchange rate support the Bahmani-oskawee and pourhedrian(1990) argument. The coefficient of inflation is negative which indicates the presence of assets substitution in long run i.e. inflation leads to shift from money holding to physical assets holding.

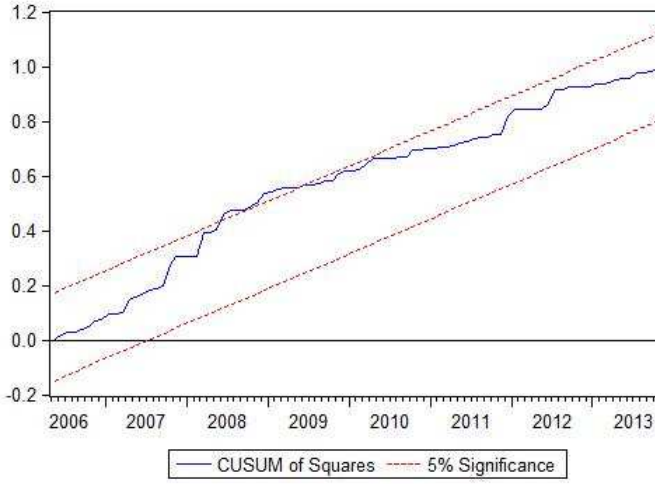
In order to examine the short run effect of the variables and to check their deviation from the short run equilibrium, ECM is to be used. The results of the error correction mechanism for money demand model of narrow money is given in appendix.

The results from ECM show that inflation is the most important factor to influence demand for money in short run. The short term adjustment coefficient has a negative sign (-0.070252) as expected but not statistically significant. The absolute value of adjustment coefficient of error correction term shows that around 7 percent of disequilibrium adjusted in demand for money function by short run adjustment within a month. The coefficient (7.02%) shows that speed of adjustment in demand for money function in low in India.

Stability Test

In order to examine the stability of demand function for narrow money in India during the period under study CUMSUM and CUSUMSQ test proposed by Brown, Durbin and Evan(1975) are applied.





Graph(1) for CUMSUM plot for Log(M1) Graph(2) for CUSUMSQ plot for LOG(M1)

The graph 1 and 2 clearly shows that the demand for narrow money function is not stable. If all the coefficient of ECM were stable , the CUSUM and CUSUMSQ plots will be under 5 percent critical bounds, but as graphs shown, the plot of both CUSUM and CUSUMSQ crossed the bounds and therefore indicates the instability of the model.

Money Demand Model Based on Broad Money

M2 is the broader monetary aggregate and in most of the studies found that M2 the stable demand for money function. In the present study along with narrow money, broad money function is also estimated. The model is

$$Log(M_{2t}) = \beta_0 + \beta_1 Log(Y_t) + \beta_2 Log(EX_t) + \beta_3 Log(\pi_t) + U_t$$

In the co-integration analysis with order of VAR 2, Maximal Eigen value statistic and Trace statistic shows one co-integration as shown in Table:

Based on Maximal Eigen value Statistic				Based on Trace value statistic			
NULL	Eigen Statistic	95%Critical	90% critical value	Trace statistic	95% critical value	90% critical value	
None	56.057*	28.588	26.121	85.560*	54.079	50.525	
Atmost 1	16.269	22.299	20.050	29.502	35.192	32.268	

Atmost 2	8.094	15.892	13.905	13.23	20.26	17.980	
Atmost 3	5.138	9.164	7.556	5.138	9.144	7.556	

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

The estimated long run money demand function obtained by co-integration analysis as-

$$Log(M_{3t}) = 8.227 + 2.086Log(Y_t) - 1.1501Log(EX_t) - 1.438Log(p_t)$$

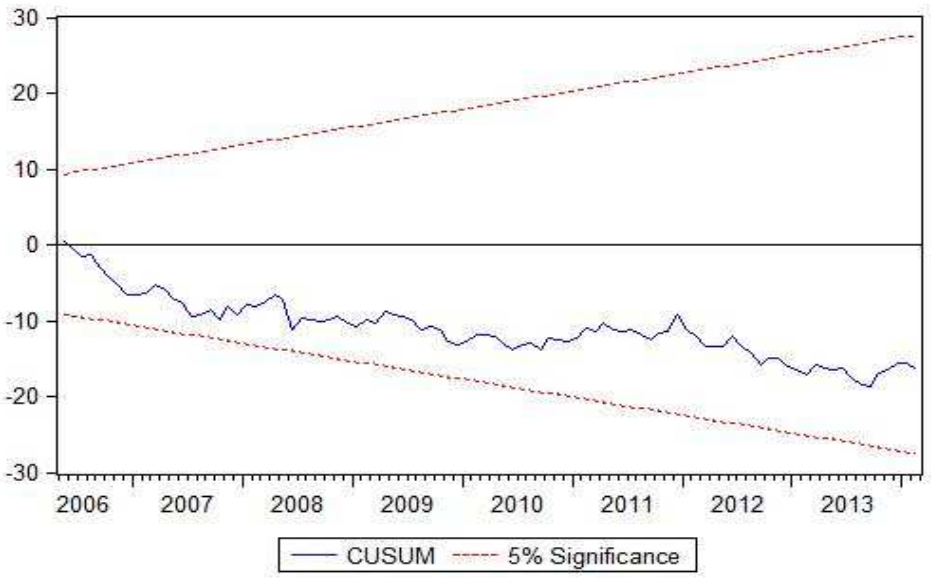
(4.54) (0.478) (0.64223) (0.727)

The above long run demand function shows that broad money has highly significant relationship with all its determinants namely, income,exchange rate and inflation rate. As the magnitude of income coefficient is greater than one so income is termed as luxury in India.The coefficient of inflation is negative and significant which supports the existence of assets substitution in long run.The coefficient of exchange rate is negative and statistically significant supports the Bahmani Oskawee and pourhedrian(1990) argument.For examine the disequilibrium adjustment process in the short run, ECM are shown in Appendix.

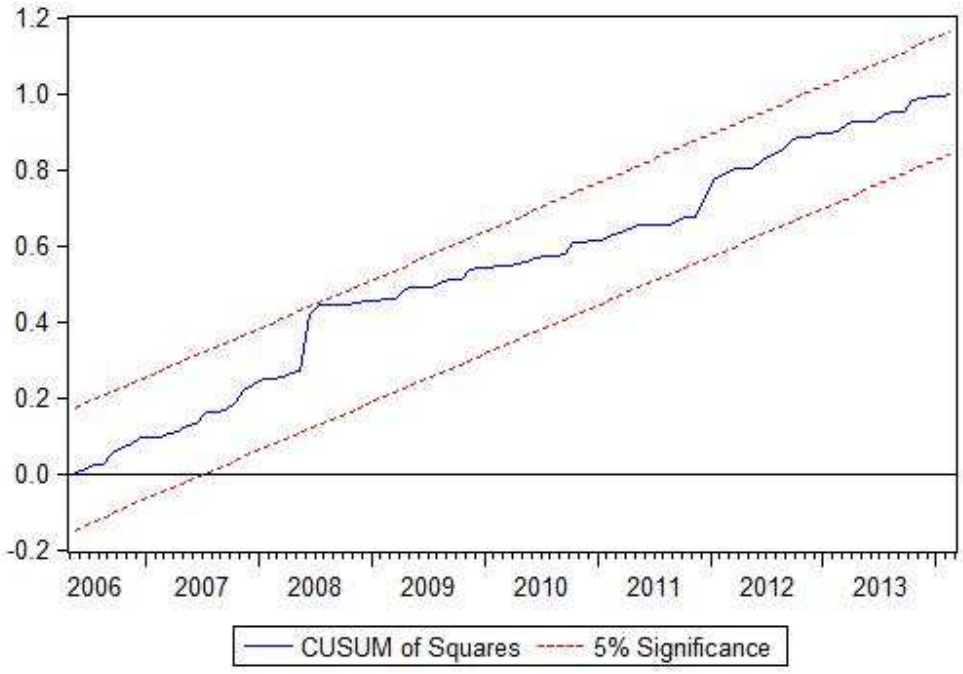
The estimated ECM shows that the short term adjustment coeficient has a negative sign and statistically significant.The absolute value of adjustment coefficient of error correction term shows that around 5.38 percent of disequilibrium adjusted within a month .The coefficient shows that rate of adjustment of demand for broad money function is low in India.Moreover, D-statistic, F-test and R^2 shows fairly good fit of the model.The results from ECM also shows that income and inflation rate is the most important factor to the money demand in short run.

Stability Test

In order to examine the stability of demand function for broad money in India during the period under study CUMSUM and CUSUMSQ test proposed by Brown, Durbin and Evan(1975) are applied.



Graph(3) for CUMSUM plot for Log(M3)



Graph(2) for CUSUMSQ plot for LOG(M3)

As both the CUSUM and CUSUMSQ statistics stay within critical bounds at 5 percent level of significance, so it is the indication of stability of the long run estimates of the model i.e. broad money demand function is stable during the sample period.

Conclusion

The money demand function must be correctly specified in order to formulate and conducts the monetary policy by the central bank. The stability of money demand is essential to bring the predictable effects on output, rate of interest, and prices through the transmission mechanism of monetary policy. This paper study the long run and short run determinants of money demand and its stability India using monthly time series data from April 2005 to February 2014. The Phillips perron test clearly showed that all the variables in money demand function are stationary at first difference. The johansen cointegration test indicated that there is a long run equilibrium relationship between real money demand (for both narrow and broad) and their dereminants. the estimated long run money demand function indicates that money demand (for both narrow and broad money) in the long run have positive relationship with income and negative relationship with exchange rate and inflation rate. Though statisticl properties of broad money demand function is stonger relative to narrow money demand function statisticl properties, indicates that broad money demand function would me more reliabe to perform monetary policy by the central bank. The estimated long run income elasticity of money demand is greater than one which shows that income is considered a luxury in India. The negative sign of coefficient of exchange rate support the Bahmoni-oskawee and pourhedrian(1990) argument. The coefficient of inflation is negative which indicates the presence of assets sucstitution in the long run. Moreover,ECM shows that inflation is the most important factor to influence the demand for money in short run.

In this study the CUMSUM and CUSUMSQ test suggest that while the long run real broad money demand function is stable but real narrow money demand is unstable .Therefore long run real broad money demand seems to be relatively more significant to explain short run and long run fluctuations in money demand.

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