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Determinants of money demand for India in presence of structural break: An empirical analysis

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This paper empirically analyses India's money demand function during the period 1996 to 2013 using quarterly data. Cointegration test suggests that money demand represented by M1 and Interest Rate have a unit root, whereas in the presence of structural break both of the variables are found to be stationary which implies that shocks are temporary in nature. It was found that there is no long term equilibrium relationship in the money demand function. Moreover, when the money demand function was estimated using dynamic OLS, it is concluded that GDP and short term interest rate has a positive impact on money demand (M1).

JEL Classifications: E41, E52

Keywords: Demand for money, monetary policy, cointegration

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Introduction

Money Demand Function has been subjected to extensive theoretical and empirical research because of its crucial importance as a fundamental building block in macroeconomic theory and as a critical component in the formulation of monetary policy. Money can play a useful role in the monetary policy process if some reliably exploitation relation exists between money and income or prices or any other variable that the monetary policy tends to influence. Monetary authority can alter the supply of money if changes in money supply help predict future fluctuations in income or interest rate and thereby achieve its desired goals. Consequently, a steady stream of theoretical and empirical research has been carried out worldwide over the past several decades. The interest rate has triggered primarily by the concern among central banks and researchers on the impact of the movement toward flexible exchange rate regime, globalization of capital markets, advancement in time series analysis and country specific issues.

This paper, therefore, uses quarterly data for the period of 1996 to 2013 to estimate India's money demand function, which is derived from real money balances, real interest rates and output and shed light on its characteristics.

The next section of this paper consists of a review of relevant prior research and a discussion of the unique contributions of this paper. In the third section, theoretical framework is presented followed by fourth section in which variables are defined, sources are provided and data characteristics are explained.

Moving into the fifth section, empirical results are observed and Dynamic OLS (DOLS) is used to examine the sign conditions and significance of output and interest rate coefficients. Lastly, analysis results are used to discuss the characteristics of India's money demand function and the implications for India's monetary policy.

Literature review

India's money demand function has been the subject of numerous quantitaive research efforts. Among these was the first study to explicitly consider the stationarity of and cointegration relationship among the variables of the money demand function. Moosa (1992) used three types of money supply - cash M1 and M2 to perform cointegration tests on real money balances, short term interest rate and industrial production over the period beginning with the first quarter of 1972 and extending the fourth quarter of 1990. Results indicated that for all three types of money supply, the money balance had a cointegration relationship with output and interest rates. However, greater numbers of cointegrating vectors were detected for cash and M1 than for M2 so Moosa (1992) states that narrower definitions of money supply are better for pursuing monetary policy.

Bhattacharya (1995), like Moosa (1992), considered three types of money supply - M1, M2, and M3 - and used annual data for the period of 1950 to 1980 to analyze India's money demand function. Bhattacharya (1995) performed cointegration tests for real money balances, real GNP, and long-term and short-term interest rates, detected a cointegrating relationship among variables only when money supply was defined as M1, and clearly showed that long-term interest rates are more sensitive to money demand than are short-term interest rates. In addition, Bhattacharya (1995), after estimating an error correction model based on cointegration test results, found that, in the case of M1, the error correction term is significant and negative, and held that monetary policy is stable over the long term when money supply is narrowly defined.

Bahmani-Oskooee and Rehman (2005) analyzed the money demand functions for India and six other Asian countries during the period beginning with the first quarter of 1972 and ending with the fourth quarter of 2000. Using the ARDL approach described in Pesaran et al. (2001), they performed cointegration tests on real money supplies, industrial production, inflation rates, and exchange rates (in terms of US dollar). For India, cointegrating relationships were detected when money supply was defined as M1, but not M2, so they concluded that M1 is the appropriate money supply definition to use in setting monetary policy. Contrasting with the above, there is also prior research that uses money supply defined broadly in holding that India's money demand function is stable. In one example, Pradhan and Subramanian (1997) employed cointegration tests, an error correction model, and annual data for the period of 1960 to 1994 to detect relationships among real money balances, real GDP, and nominal interest rates. They estimated an error correction model using M1 and M3 as money supply definitions and found the error correction term to be significant and negative. Their position, therefore, was that the money demand function is stable not only with M1 but also with M3.

Das and Mandal (2000) considered only the M3 money supply in stating that India's money demand function is stable. They used monthly data for the period of April 1981 to March 1998 to perform cointegration tests and detected cointegrating vectors among money balance, industrial production, short-term interest rates, wholesale prices, share prices, and real effective exchange rates. Their position, therefore, was that long-term money demand relevant to M3 is stable. Similarly, Ramachandran (2004), too, considered only the M3 money supply in using annual data for the period of 1951/52 to 2000/01 to perform cointegration tests on nominal money supply, output, and price levels. Because stable relationships were discovered among these three variables, Ramachandran (2004) states that, over the long term, it is possible to use an increase in M3 as a latent indicator of future price movements.

Analysis

This paper uses quarterly data for empirical analysis. For quarterly data, we use data over the period of 1996 to 2013. The data source is Handbook of Statistics on Indian Economy (RBI). M1 is obtained from RBI bulletin. We deflate these monetary aggregates by WPI index. Real Short term deposit rate has been incorporated in the model after being deflated by WPI index. GDP at constant prices with base 2004-05 has been captured. Logarithm values are used for M1, GDP and real interest rates.

TABLE 1. TEST FOR THE ORDER OF INTEGRATION

Variable	Level (with Trend and Intercept)		First Difference (with Trend and Intercept)		Second Difference (with Trend and Intercept)	
	ADF	PP	ADF	PP	ADF	PP
LGDP	-1.75	-7.33***	-3.15	-15.65***	-27.85***	-19.173***
LIR	-1.37	-1.20	-3.71**	-8.64***	-13.90***	-31.67***
LM1	-2.34	-1.59	-2.09	-6.98***	-12.99***	-21.11***

Source: data from RBI, handbook of Statistics on Indian Economy.

Note: ** 5% level of significance, *** 1% level of significance. Null Hypothesis is Presence of Unit Root.

Table 1 shows the results of Augmented Dickey-Fuller Tests (1979) and Phillips Perron Tests (1988) for the logs of GDP, Real Interest Rate and Real Money Balances. As a result, the level of LGDP was found to be stationary -I(0), whereas the level for LIR and LM1 was found to have a unit root and the first difference of them was found not to have a unit root. So LIR and LM1 are I(1) variable.

Unit root test against a single-break stationary alternative was proposed by Zivot and Andrews (1992). It was extended to a two-break stationary alternative by Lumsdaine and Papell (1997) and up to five-break stationary alternative, with an a priori unknown number of breaks, by Kapetianos (2005). However, as pointed out by Bec and Bassil (2009), these tests maintain the linearity assumption under the unit root null hypothesis. If a break exists under the null of unit root, they will exhibit size distortions such that not only over-rejects the null hypothesis of unit root, but also will tend to estimate the break point incorrectly. To overcome this problem, Lee and Strazicich (2003, 2004) have developed an alternative (at most two) endogenous break unit root test that uses the Lagrange Multiplier (LM) test statistics, and allows for breaks both under the null and the alternative hypothesis. Thus, any conclusion on the rejection of unit root null based on this LM test provides quite strong evidence of stationarity.

TABLE 2. LEE AND STRAZICICH'S (2003) UNIT ROOT TESTS WITH TWO STRUCTURAL BREAKS

Series	Model	Break Point 1	Break Point 2	Lag	T-Statistic	Result
LGDP	Break (Intercept and Trend)	2003 Q1	2008 Q1	2	-17.19	Reject Null Hypothesis of Unit Root at 5% level
LIR	Break (Intercept and Trend)	2001 Q3	2005 Q1	2	-4.52	Reject Null Hypothesis of Unit Root at 5% level
LM1	Break (Intercept and Trend)	2004 Q3	2008 Q4	2	-4.93	Reject null hypothesis of unit root at 5% level

Source: Own calculations based on data from the RBI.

Table 2 shows the Unit Root in the presence of structural break in the model. After incorporating structural break LIR and LM1 which were integrated of Order 1 are now found to have no Unit Root. It means the shocks are temporary. Hence all the three variables are stationary in the presence of structural break. This is the major contribution of this paper as most of the earlier studies have not incorporated Structural Break in their analysis. We determine the accurate sequence of such break dates and run Dynamic OLS Regression to see the impact of Breaks in our model and will check its significance level.

TABLE 3. DYNAMIC OLS MODEL

VARIABLE	COEFFICIENT	PROBABILITY
C	2.499	0.000
D1	0.412	0.000
LGDP	0.169	0.08
LIR	0.402	0.000
T	0.008	0.000
D1T	-0.007	0.000

Source: Own calculations based on data from the RBI.

In Table 3, Dynamic OLS is run where D1 is 0 for 2008 Q1 and 1 otherwise and T is trend. All variables are significant, Sign of LGDP is validating the theory whereas sign of LIR is not validating the theory. Reason for the positive coefficient of LIR is increase in short term interest rate will lead to increase in demand for deposits and hence for M1, since M1 comprises demand deposits.

$$M/P = L(Y, R) \quad LY>0, LR<0 \tag{1}$$

$$Ln\,(M/P) = c + b1\,Ln\,(GDP) + b2\,Ln\,(R) + Error \tag{2}$$

Where, M/P - Money Supply; Y - Output; R - interest rate; Ln represents log transformation of the variables; Error - Residuals

$$Ln\,(M/P) = c + b1D1 + b2\,Ln\,(GDP) + b3\,Ln\,(R) + b4T + b5D1T + Error \tag{3}$$

Where, T is Trend; Di are dummy variables.

Conclusion

If an equilibrium relationship is observed in the money demand function, financial authorities can employ appropriate money supply controls to maintain a reasonable inflation rate. This paper empirically analyzed India's money demand function over the period of 1996 to 2013 using quarterly data. Results suggests that increase in GDP and Short term Interest Rate has a positive impact on the demand for Money (M1). The empirical results of this paper will help RBI to more appropriately control price levels and in managing monetary policy.

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