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Financial Innovation and Stability of Money Demand Function in Post–reform period in India

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Abstract

Innovation in financial sector, financial reforms and changes in the policy environment are the factors responsible for instability in the money demanded in an economy. The dawn of 1991 balance of payment crisis in India brought much needed reforms in the economy and financial sector and triggered financial innovation fueled with revolution in information technology world wide and in India. In this backdrop this paper attempts to take a meticulous look on stability of money demand in India with quarterly data for 1996–97:1–2009–10:3 period. Based on Gregory–Hansen (1996) method of co–integration estimation the analysis confirms that in contrast to most of the previous studies, money demand function in India is not stable in the post reform period.

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1. Introduction

The relationship between the demand for money and its key determinants is an important building block in macro-economic theories and is a crucial component in the conduct of monetary policy (Goldfeld, 1974). Even in the era of inflation targeting, a well-specified money demand function is of utmost importance for the effective implementation of monetary policy—especially to track both, the interest rates and the stock of money—in order to access the impact of monetary policy upon the economy.[1] As a result, the issue of long-run relationship among broad money, its determinants and also the stability of the demand for money has always been in the centre of research. It has stealed the interest of researchers during the period of 'Great Velocity Decline' of 1970's and subsequently research indicates that increased financial innovations, reforms in financial sector, shifts in exchange rate policy world-wide and increased financial integration appeared contributing factors in unstable money demand function. During and after 70's, a long list of empirical work has come up which analyzed and examined the stability of money demand function and its determinants in US and UK, in particular and in other countries, in general.

Goldfeld (1974) study on the stability of money demand in US is considered as pioneer work. After the Goldfeld's work, a good number of studies examined the issue to identify different factors that could contribute to an unstable demand for money function. Enzler, et al. (1976) attributed to financial innovation for instability in money demand in US. For Boughton (1981) it is the shift in exchange rate regime which is underneath the instability of demand for money. However, Arango and Nadiri (1981), argues that it is not only the change in exchange rate regime, but also closing down of the foreign exchange market in the wake of the Organization of the Petroleum Exporting Countries (OPEC) oil embargo which contributed to the instability of money demand. This point was even recognized by Gorden (1984). Further, Girton and Roper (1981) shows instability is also associated with currency substitution.

Since inception of the co-integration technique, the stability of the demand for money has received a renewed attention. Miller (1991) offer evidence supporting the use of M2 as guide to monetary policy implementation in US. On the same tone, Hoffman and Rasche (1991) provide evidence in favor of a stable money demand function in US. McNown and Wallace (1992) for US supports stable money demand function for M2 (but not M1) when effective exchange rate is added as explanatory variable in addition to other variables. For Adam (1991) it is the devaluation of currency which contributes to instability in UK money demand function. On a similar line, result of Melnick (1990) study indicates instability in money demand function for Argentina. Muscatelli and Papi (1990) modeled the demand for M2 in Italy by explicitly incorporating variables that proxy the various processes of financial innovation. Presence of cointegration among variables in estimating money demand function depicts the role of financial innovation in making demand for money unstable. For Japan, Bahmani–Oskooee and Shabsigh (1996) endorse the findings of some of the earlier study (like McNown and Wallace, 1992) that inclusion of exchange rate makes money demand function

[1] Laidler (1969) has pointed towards a stable money demand function as predictability of money demand holds paramount importance for smooth functioning of monetary policy as it bears a close relationship with targeted macroeconomic variable.

stable. Bahmani–Oskooee and Rhee (1994) analyzed the long run equilibrium relationship between M2 (M1) and its determinants, real income and the long-term interest rate, and found presence of long run relationship for M2 (but same does not hold true for M1) in Korea. Hafer and Kutan (1994) provide evidence in favor of using broad money supply (M2) as the preferred aggregate for estimating demand for money in China. Bahmani–Oskooee (1996) highlights the importance of black market exchange rate to formulate the demand for money in Iran (or country like Iran where there is black market for foreign currencies). Recently, Rao and Kumar (2007a, 2007b); Singh and Pandey (2009) examined the stability of demand for money using Gregory–Hansen (1996) approach for Fiji, Bangladesh and India respectively. Results of these studies argue in favour of a stable money demand function.

When the study does not find consensus in their results on stability of money demand function, against this backdrop, present study intends to investigate the issue of stability of money demand using quarterly data of the post-reform period (1996:1–2009:3) for India with a suspect of unstable money demand function due to increased financial innovation in the economy. The contribution of the paper is relevant on three grounds. First, the clarity on the issue of stability of money demand is relevant from immediate policy point of view because Reserve Bank of India (RBI), India's central bank, recently hints at tightening monetary policy to overcome double digit generalized inflation, resulted due to increased risk of food price inflation with a stronger recovery in the country after recent financial crisis (RBI, 2010).[2] Second, as most of the earlier studies on the issue uses yearly data with a few observations of post-reform period, casting serious doubts on the results of these studies which favors a stable demand for money in India.

And finally, methodologically, while time variant co-integrating relation should be allowed—especially in examining the stability of money demand function in the Indian economy where reforms are under way and due to possible exposure of financial system to financial crisis (through financial integration)—whereas, most of the studies have formulated their conclusions based on co-integration technique in which co-integrating relation is time invariant.[3] Though the study of Singh and Pandey (2009) employs Gregory–Hansen methodology, but we suspect that use of yearly data with limited observation of post reforms period could not capture true effect of increased financial innovation on stability of money demand function. Our analysis confirms the unstable money demand function in India during the post reform and crisis period. The structure of the rest of the paper is as follows: section 2 presents some stylized facts about India macroeconomic, financial and institutional structures and section 3 deals with the data and the model used for the analysis. Empirical results are discussed in section 4. The paper ends with section 5, where concluding remarks of the study on India's monetary policy, stability of financial, banking system and macroeconomic are briefly discussed.

[2] Ramchandran (2004) argues that stability of money demand function continue to play an important role even in the multiple indicator approach regime of monetary policy in India.
[3] See Singh and Pandey (2009) for review of these studies.

2. Some stylized facts about India macroeconomic, financial and institutional structures

Like many other countries, the macroeconomic, financial and institutional structure of India can be studied in two parts: pre-reform period (pre-1991) and post-reform period (post-1991). Leaving instances of political uncertainty, wars (with Pakistan in 1965 and 1971 and with China in 1962) and famine pre-reforms period has not witnessed any major structural change in the macroeconomic financial and institutional environment.[4] The first wave of reform majors started during the prime ministerial regime of late Rajiv Gandhi (1984–89). But some of the economists argue that truly and systematically economic and financial reforms in India started after 1991 balance of payment (BOP) crisis. In context of monetary policy in India the first major policy shift happened in 1980s, with financial deregulation followed by RBI moving to monetary targeting regime as recommended by the Chakravarty Committee in 1985. In April 1992, RBI permitted commercial banks to freely set term deposit and lending rates for loans above Rs.2 lakhs, (except for bank savings deposits, non-resident deposits, loans for less than 200,000 rupees, and export credit) which was earlier regulated by RBI.

RBI got some muscle in 1994, to exercise monetary policy independently when it entered in agreement with government of India to bear fiscal burden only through issuance of 91 days ad-hoc Treasury bills. These bills were used to finance fiscal deficits, and RBI eventually eliminated these securities altogether in April 1997, greatly reining in the central bank's automatic monetization of fiscal deficits. Again in 1998, RBI moved to multiple indicator approach for the conduct of monetary policy from a regime of monetary targeting approach (RBI; 1998). A Liquidity Adjustment Facility (LAF) has been introduced since June 2000 to precisely modulate short-term liquidity and signal short-term interest rates. In essence the thrust of monetary policy in recent years has been to develop an array of instruments so as to transmit monetary policy signals in a more flexible and bi-directional manner (for detailed study on Indian monetary policy and financial market see Reddy, 2001a; 2001b).

3. Data and the Model

What emerges from the previous section is that Indian economy after the BOP crisis of 1991–92 has undergone a series of reform measures with a large push in financial sector translating into increased financial innovations. Inspired with this the objective of the study is to examine the stability of money demand function in a period which is marked by list of reform, measures taken and drastic surge in financial innovation in Indian economy. Study uses quarterly data for the period of 1996:1–2009:3 to investigate the stability of money demand function in India during the post reforms period. Use of 1996:1 as the starting point of the data series is partly due to data availability and partly due to belief that reforms must have had its effect only after few years of 1991. The source of data is Handbook of Statistics on Indian Economy (2009) published by RBI. Y is GDP at constant prices of 1999–2000, $M3$ is the broad money supply deflated by WPI to get the real money supply ($RM3$). WPI is whole sale price index used as measures of price (P). For short term nominal interest rate we have used bank rate data (r). Rupee–Dollar exchange rate (ex) is taken as variable for exchange rate

[4] It is believed that element of uncertainty introduced by war and other factors reduces the efficiency of the financial system.

measure. All the variables used in the estimation are in their logarithmic form, except bank rate. The primary model is specified as follows:

$$RM3_t = \beta_1 Y_t + \beta_2 r_t + \beta_3 P_t + \beta_4 ex_t + \varepsilon_t \quad (1)$$

where $RM3_t$, Y_t, r_t, P_t and ex_t, respectively, are the real broad money supply; real GDP, nominal interest rate, price index and exchange rate whereas, ε_t is the stochastic error term and t is the time.

4. Empirical Investigation and Result Discussions

Results of Phillip Perron unit root test suggest that variables under consideration contain unit root in their level but are stationary at first difference.[5] As the variables follow same order of integration, i.e., I(1), we now test for the presence of co-integration to examine the long run equilibrium relationship among these variables. Most of the study which examined the stability of money demand function based on cointegration framework bank on use of Johansen co-integration, but the potential limitation of Johansen type co-integration test in estimating co-integrating parameter is that it does not allow parameter to be time variant. It is important to mention here that there are many reasons to believe that the co-integrating relation among the underlying variables might change (shifts in the co-integrating vector can occur) or they are time dependent. These could occur due to host of reasons (economic crises, technological shocks, changes in the economic factors' preferences and behavior accordingly, policy and regime changes, and organizational or institutional evolution). As an alternative to Johansen, Hansen (1992) test of co-integration allows us to test the presence of co-integration while allowing the co-integration parameter to be time dependent. Hansen (1992) cointegration technique also has drawback as it fails to locate point of break in the co-integrating relation (i.e. whether the break is in constant or in trend or in regime of the co-integration relation) to circumvent this problem we employ Gregory–Hansen (1996) (GH henceforth) co-integration technique.[6] GH test results documented in Table I reject the null of no co-integration for all the three GH break specification at 1 per cent level of significance.[7] This confirms presence of co-integrating relation among real money, real income, the nominal interest rate, prices and exchange rate, irrespective of the functional form of structural breaks.

[Table I about here]

It is hard to decide which of the three models of GH test best explains the money demand function for India as all the three models of GH test rejects null of no co-integration. We now estimate the co-integrating equations for all the three models with the Engle–Granger (1987) method to distinguish which GH specification best explain the money demand behavior for

[5] For the sake of brevity, we do not present the results of unit root test here. However, results can be obtained from authors on request.

[6] GH methodology of testing co–integration has one added advantage over Hansen (1992) that it specifies three different null as compared to single in Hansen technique and thus makes results more comparable.

[7] We also test the null of no co–integration using seasonally adjusted series as Singh and Kumar (2007) suggest seasonal adjustment for near unit income elastic estimate of money demand function. Results with seasonally adjusted series were not good, so we dropped the idea of estimation using seasonally adjusted series.

Indian during reform period. The first stage Ordinary Least Square (OLS) estimation results are presented in Table II.

[Table II about here]

As the estimated equation show similar coefficient for income elasticity, interest elasticity and other variables in long run, we can now proceed with GH–I for estimation of error correction model (ECM). In the second stage of the estimation, we make use of residual from estimated long-run GH–I equation for estimation of short run dynamic equation for the demand for money with the ECM. At this stage, we adopt LSE–Hendry's general to specific modeling (GETS) approach. Thus, estimation involves the use of lag terms of the differenced series of $RM3, Y, P$, r and ex along with lagged error term from GH–I co-integrating equation. Given the fact that our analysis is based on quarterly data, we have employed lags up to 4. After estimating the equation following LSE–Hendry's GETS approach, we finally arrived at the following parsimonious equation using variable deletion method.[8]

$$\Delta RM3 = \underset{(2.21^*)}{-0.88}ECM_{t-1} + \underset{(2.28^*)}{0.01}\Delta RM3_{t-1} - \underset{(7.29^*)}{.48}\Delta Y_{t-1} + \underset{(1.69)}{0.01}\Delta r_t - \underset{(-7.72^*)}{0.58}\Delta P_t - \underset{(-1.12)}{0.01}\Delta ex_t \qquad (2)$$

After estimating the ECM equation, it is very much required to test the adequacy of the estimated equation for any possible presence of serial correlation, non normality and ARCH effects. For this we perform the Breusch–Godfrey Serial Correlation test, Jarque–Bera test for normalcy check and LM test for ARCH effect. Test results indicate that none of these test statistics is significant at 5% level of significance (see Table III). This suggests that there is no serial correlation and ARCH effect in the residual series and therefore, imply robust model.

[Table III about here]

In the above ECM equation, r and ex are though not significant but Wald test statistics for variable deletion (together and separately) is rejected meaning these variables can not be dropped from the ECM estimation. Further, estimated ECM equation after dropping r and ex leads to problem of serial correlation and ARCH effect. Finally, after establishing adequacy of the estimated money demand equation, we turn next to employ traditional test of stability (CUSUM test, CUSUM of Square test and recursive residual plot test) to see whether the estimated coefficients are stable or not.

[Figure 1 about here]

[Figure 2 about here]

Results of the traditional test provide evidence for presence of instability in the demand for money function as only for CUSUM test the plot of test statistics remain between the lower and upper bound through out the period of the study (see Figure 1) but for CUSUM of Square test and Recursive Residual the test plot breaches the boundary (see Figure 2 & 3). Thus, we

[8] Values in () parenthesis reports t-statistics and * represents significance at 1% level of significance.

conclude that demand for money in India in the era of reforms and financial crisis has not been stable.

[Figure 3 about here]

5. Concluding remarks

Since the onset of the reforms process (in India), the monetary management in terms of framework and instruments has undergone significant changes, reflecting broadly the transition of the economy from a regulated to a liberalized and deregulated one (Reddy, 2002). Though, the use of broad money as an intermediate target has been de-emphasized once RBI switched to multiple indicator approach, but the growth in broad money (M3) continues to be used as an important indicator of monetary policy. In terms of major policy shift in monetary policy after deregulation of interest rate in 1992, central banks agreement with government of India to bear fiscal burden only through issuance of 91 days ad-hoc Treasury bills in the year 1994 was major break through. Again in 1998, RBI shifted to multiple indicator approach for the conduct of monetary policy from a regime of monetary targeting approach (RBI; 1998).[9] Such a shift was gradual and a logical outcome of measures taken over the reform period since early nineties. In this context, this paper estimates demand for money function using quarterly data for 1996:1–2009:3 period; in an environment where recent empirical studies provides support to the maintained hypothesis of stable demand for money in India.

Study uses Gregory–Hansen (1996) method of co-integration estimation, since the Gregory–Hansen (1996) method of co-integration estimation allows estimation of the co-integration equation with three different null of breaks in the co-integrating relation. Results of the co-integration test identify existence of co-integration among the variable and thus presence of long run relationship. Engel–Granger (1987) method is then used to estimate the long run co-integrating equation. Further, the study also estimates ECM model. Finally, CUSUM, CUSUM of Square and Recursive residual test are employed on the estimated ECM model to test the stability of the money demand function. In sum, findings based on different tests corroborate towards an instable money demand function in India—in the post reforms and crisis hit era.

If our analysis has any validity, it has far more implications for the Indian monetary policy—especially when RBI is confused about tightening the current monetary policy. In addition to this, it will have its implication on the stability of financial and banking system as even if RBI focus on set of intermediate instrument for monetary policy conduct but still it uses M3 as one of the instrument. Seeing the huge capital inflow and its monetary base effect, forecasting demand for money with precision is necessary for strong macroeconomic fundamentals and stable financial and banking system as any error, if left uncorrected could trigger to crisis. Finally, the paper recommends that for more reliable outcomes, further research using multiple break option in the co-integrating relation or with non linear specification is imperative.

[9] The RBI, formally adopted a multiple indicator approach in April 1998 whereby interest rates or rates of return in different financial markets along with data on currency, credit, trade, capital flows, fiscal position, inflation, exchange rate, etc., are juxtaposed with the output data for drawing policy perspectives.

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Table and Figures

Table I: Result of Gregory–Hanson Co-integration Test

Model	GH test statistic	critical value at 1%
GH–I	–9.93*	–6.05
GH–II	–8.55*	–6.36
GH–III	–8.92*	–6.92

Note: * represents significant at 1 percent level of significance

Table II: Result of Co-integrating Equation

Variables	GH–I	GH–II	GH–III
Intercept/constant	1.66	1.54	1.67
Trend	-	–0.05	-
Break date dummy	–0.01*	–0.04**	–0.02
Log of GDP	0.41*	0.44*	0.48*
Break date dummy* Log of GDP	-	-	–0.04**
Nominal interest rate	–0.05*	–0.03*	–0.08*
Break date dummy* Nominal interest rate	-	-	0.04***
Log of WPI	–0.63*	–0.62*	0.68*
Break date dummy*LWPI	-	-	0.08*
Log of exchange rate	–0.03	–0.08	–0.01
Break date dummy* Log of exchange rate	-	-	0.01

Note: *, ** and *** represents significant at 1, 5 and 10 percent level of significance, respectively.

Table III: Result of Residual Analysis of ECM equation

Residual Analysis test	F–statistic/test value	Probability
Breusch–Godfrey LM Test	1.59	0.25
Jarque Bara Value	1.35	0.51
ARCH Test	0.48	0.49

Figure 1: Plot of CUSUM test

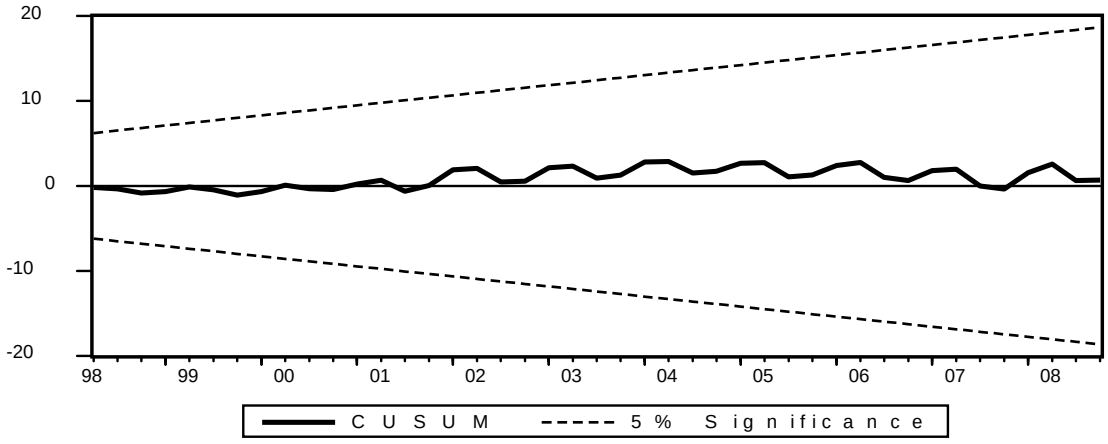

Figure 2: Plot of CUSUM of Squares

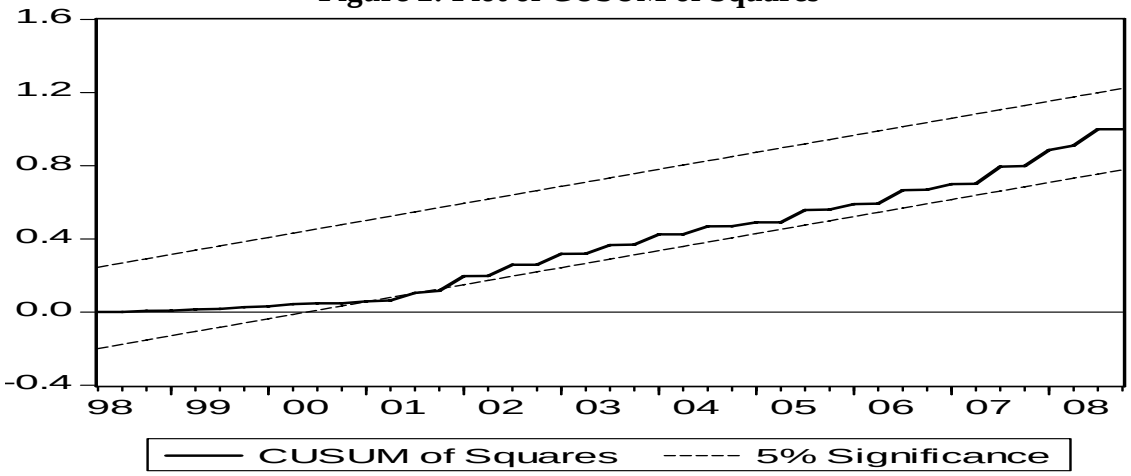

Figure 3: Plot of Recursive Residual