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Determinants of Demand for Money (M_1) using Cointegration Approach

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Abstract

Estimating the demand for money in an economy and understanding its relationship with various macroeconomic variables is an essential element in the planning of the issue and distribution of currency (Nachane et al., 2013). The penetration of several innovative instruments in the financial sector has changed the behavior and relationship of demand for money. Understanding the significance of estimating money demand function in this evolving financial innovation era, this paper attempts to analyze the major determinants of demand for money via M_1 for India for the period 2005-06 to 2014-15. The demand for M_1 was estimated applying the Johansen's Cointegration Technique and the estimated results revealed that there existed long run relationship among the explanatory variables of the function, with specific reference to debit cards that form the major substitute for cash in the country. The findings suggests that the financial innovations in the banking sector have influenced the demand for money, specifically M_1, indicating that the transaction demand for money in India is influenced by the innovations.

***Keywords**: Demand for money, M_1, Cointegration technique, Transaction demand for money*

1. Introduction

Demand for money investigates what motivates people to hold money balances. Deducing from the estimations of money demand equations, the monetary authority can decide which monetary policies are better to implement under the current economic conditions. A stable demand function for money has long been perceived as a prerequisite for the use of monetary aggregates in the conduct of policy (Goldfeld and Sichel, 1990). The money demand functions can enhance our understanding of the behaviour of key monetary aggregates. The financial assets that can serve the medium of the payments role of money have changed over time, as has the elasticity of substitution of the monetary assets, which has led to the definition of money change over time.

2. Financial Innovations – The Buzzword

Financial Innovation is the key to financial inclusion, which is considered as the watch word of the 29th India Economic Summit of the World Economic Forum held at New Delhi

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during November 2014. The emergence of financial innovations has turned the phase of financial transactions across the world and India is no exception. Universal banking and globalization has led to the introduction and adoption of various innovations in the payment mechanism options across countries today. In India, the RBI is today walking on the roadmap of cashless economy with all its monetary and financial policies targeting the same. Technical innovations in the deposit and withdrawal mechanisms and practices for various types of assets like the introduction of ATM and telephonic and computer-based transfers of funds between accounts, debit cards and credit cards began in the late 1990s but in common usage in this century.

The general specification of money demand in most macroeconomic literature postulates money demand as a function of income and interest rates. With the changing structure of the monetary mechanism and the functioning of banks, it becomes vital to understand the impact of modern developments in the money and banking sectors on the demand for money in India. The potential of digital money to replace currency in the payment for retail goods and its ability to flow freely across international borders has alarmed central bankers, the media, and scholars (Tanaka 1996).

3. Literature Review

The demand for money studies using the cointegration approach to determine the long run determinants of demand for money function was found to be adequately supported in the literature with the studies for various economies by Dekle and Pradhan (1997), OyaCelasun and MangalGoswami (2002), Reilly and Sumner (2007) and Ajmi et al; (2015). Butkiewicz and McConnell (1995) estimated the demand for money using funds flow data for household and business sectors in USA during 1952 (3rd quarter) – 1990 (1st quarter). The study concluded that business and household sectors in USA were co-integrated with interest rates and incomes. It was also noted that instability in money demand can be attributed to deregulations and financial innovations in USA.

Subramanian Sriram (1999) analyzed the demand for money (M2) in Malaysia from 1973 to 1995 under both the closed and open economy framework. Based on the co-integration and weak-exogenity test results, the short run dynamic error correction models were specified and estimated. The results indicated that the demand for real M2 both in the long and short run were well specified and fairly stable. The long run income elasticity was close to one with the opportunity cost variables carrying the expected signs.

Oskooee and Karacal (2006) investigated the demand for money in Turkey by taking into account the currency substitution in the form of exchange rate in addition to income, interest rate and inflation rate. Using monthly data over the period 1987:1–2004:6 the research was an attempt to study the cointegrating properties of real M1 and M2 money demand in Turkey using the bounds testing approach to cointegration incorporating the

CUSUM and CUSUMSQ tests to estimate the demand for money function. The results showed that in Turkey, while both M1 and M2 are cointegrated with their determinants and both are more or less stable, the two important determinants, i.e. income and interest rate do not belong to the cointegrating space in M2 formulation.

Haghighat (2011) empirically investigated the long-run money demand function and its stability in Iran. The Johansen-Juselius co-integration test was employed to see the determinants of money demand like real income, inflation rate and exchange rate. The results showed that money demand function has been stable and financial reforms were yet to have any significant effect. The negative sign of inflation supports the theory, i.e. people prefer to substitute physical assets for money balances. The positive sign of the exchange rate implies that as the currency of Iran depreciate, the demand for M2 increases, possibly supporting the wealth argument in literature.

In the Indian context, the money demand function has been a subject to several empirical investigations with pertinent studies in the last decade of Samarjit Das and Kumarjit Mandal (2000), Bhattacharya and Joshi (2001), Purna Chandra Padhan (2005), Rao and Singh (2006), Inoue and Hamori (2008), Prakash Singh and Pandey (2009), Bharadwaj and Pandit (2010), Dasgupta and Gupta (2011), and JyotiKumari and Jitendra (2012) found stable money demand function for India.

4. Objectives of the Study

The Indian literature in the past two decades has basically focused on the stability of demand for money and factors affecting it. The recent financial innovations in the payment mechanism of the banking industry have been a boost to form the substitute for currency based transactions. This has led to the scope for the present study to capture and analyze the impact of adoption of financial innovations in the payment mechanism on the demand for money in India, with specific reference to M_1, considering the policy implications on the money supply arena by the Reserve Bank of India. Hence the present study is confined to estimate the demand for money using the monetary aggregate M_1 for India and its long term determinants.

The study was carried out with the following objectives

1. To study the growth and trend of the financial innovations that form substitutes for cash transactions in India during the study period 2005-06 to 2014-15.
2. To verify the existence of long run relationship between M_1 and its determinants for the study period 2005-06 to 2014-15.

5. Data and Methodology

The current study is set on the background of the Baumol model of transaction demand for cash adopted by economic systems. Following Hamori (2008) and Bahmani-Oskooee (1996) and Rauf and Khan (2012) the functional form of the model for demand for money M1 in India was specified using a log linear specification as follows:

$$\log M_{1t} = \beta_0 + \beta_1 \log Y_t + \beta_2 \log P_t + + \beta_3 \log R_t + \beta_4 \log RTGS_t + \beta_5 \log DC_t + \beta_6 \log CC_t + \beta_7 \log ETF_t + \varepsilon_t \ldots\ldots\ldots \mathbf{1}$$

where the dependent and explanatory variables are

- M_{1t} is the demand for narrow money to be estimated;
- Y_t is the Index of Industrial Production measured as a proxy for national income (GDP);
- $P_t$is the price level measuring inflation through Consumer Price Index;
- R_t is the interest rate measured by term deposit rate of commercial banks in India
- $RTGS_t$ denotes the value of (Real Time Gross Settlement) RTGS transactions recorded
- DC_t denotes the value of transactions using debit cards
- CD_t denotes the value of transactions using credit cards
- ETF_t denotes the value of (National Electronic Funds Transfer) NEFT transactions
- ε_t refers to the error term

The data for the above variables were obtained from the Reserve Bank of India's database drawn from the statistical reports 'Statistics of the Indian Economy' and 'Time Series Publication of Statistical Tables Relating to Banks in India' and 'Payment System Indicators' for the period 2005-06 to 2014-15.The data recorded consisted of 120 monthly observations collected from the RBI data base on Payment System Indicators, for the period 2005 to 2015.

6. Empirical Findings

Growth and Trend of the variables of study

The financial innovations data adopted in the banking industry, which are considered in the study, are the predominant electronic payment mechanism innovations via; RTGS, NEFT, debit cards and credit cards and ATMs in the banking sector and form gateway of financial transactions in the country. These form close substitutes to the currency in transaction in India during the study period. Table 1 shows the growth in the major financial innovations in the payment mechanisms adopted in India from 2004-05 to 2014-15. From the table it can be inferred that the volume of RTGS has increased from 1.77 million to 83.11 million in 2014-15. The value of transactions using RTGS has increased from 115408.36 billion in2005-06 to 1026350.05 in 2012-13 and thereof showed a decline to 822620.81 billion in 2014-15.This can be attributed to increased innovative instruments in the banking sector like IMPS, which enables instant transfers of money and also the fact that there is no threshold limits to transferable amounts in NEFT like RTGS.

The volume of EFT/NEFT increased from 3.07 million in 2005-06 to a record of 821.54 million in 2014-15 and the value of EFT/NEFT transactions also showed a positive trend with increase from 612.86 billion in 2005-06 to 52711.50 billion in 2014-15, which clearly depicted the large scale popularity of NEFT among the Indian banking population for transfer of funds online.

Table 1 Growth of Financial Innovations in Payment Mechanism in India 2005-06 to 2014-15

Year	RTGS		EFT/NEFT		Credit Cards		Debit Cards		Number of ATMs
	Volume	Value	Volume	Value	Volume	Value	Volume	Value	(in actuals)
2005-06	1.77	115408.36	3.07	612.86	156.09	338.86	45.69	58.97	54791
2006-07	3.88	246191.83	93.65	6460.17	169.55	413.62	182.74	295.74	57042
2007-08	5.86	482945.59	73.26	6263.14	228.21	579.85	155.49	240.80	61129
2008-09	13.38	611399.12	32.17	2519.56	259.63	653.54	127.65	185.47	64608
2009-10	33.27	1011699.3	66.34	4095.09	234.25	618.23	170.17	264.18	60153
2010-11	49.28	941039.33	132.33	9391.49	265.16	755.16	237.06	386.91	74505
2011-12	55.05	1079790.6	226.1	17903.49	322.16	978.72	5409.45	14532.04	95686
2012-13	68.52	1026350.05	394.13	29022.42	399.23	1244.268	5775.25	17426.39	114014
2013-14	81.11	904968.04	661.01	43785.52	512.03	1556.72	6707.10	20602.86	160055
2014-15	83.11	822620.81	821.54	52711.50	562.06	1741.29	7103.85	21396.31	1198008
CAGR**		31.44		51.51		19.01		72.37	32.61

*Source: RBI, Payment System Indicators 2014-15, Volume in Million and Value in Rs. Billion, **Compound Annual Growth Rate Estimates based on data from above table*

With regard to the credit cards, it can be observed that the volume of credit cards issued in India has increased from 156.09 million in 2005-06 to 562.06 million in 2014-15, and the value of the transactions using credit cards also showed remarkable increase from 338.86 billion in 2005-06 to 1741.29 billion in 2014-15.

The debit cards volume increased from 45.69 million in 2005-06 to 7103.85 million in 2014-15, which showed the spectacular growth of debit cards issued by banks in India during this period. The volume of transactions using debit cards increased from 58.97 billion in 2005-06 to the highest levels of 21396.31 billion in 2014-15, which clearly is the positive response of the efficient and easy usage of debit cards as the instrument which makes banks move towards cashless society. Debit cards usage at point of sale (POS) and permission to withdraw cash at POS using debit cards introduced in 2010 have boosted the growth of volume and value of debit cards as the widely accepted innovation and substitute for cash. Number of ATMs in the country has grown from 54791 in 2005-06 to 1198008 in 2014-15. Much of the ATMS opened since 2011 have been in the rural areas of India, thus enabling innovations to become inclusive and efficient. ATMS enable customers to have ease of access to banking operations and make banking an anywhere anytime service to them. ATMs are used mainly for cash withdrawals and balance enquiries. Savings bank customers can use a different bank's ATM free of charge for the first five transactions (of any type, financial or non-financial) in a month, with subsequent transactions being charged (the charge not to exceed INR 20). Customers pay no charges for using the ATMs of their own bank.

The Compound Annual Growth Rate (CAGR) estimates clearly indicated that debit cards as an alternative payment mechanism is on the rise with 72 percent growth rate during 2005-06 to 2014-15 in India followed by EFT//NEFT transactions with 51 percent growth rate. This depicted the fact that the adoption of financial innovations in payment mechanism has increased. The number of ATMs also showed a CAGR of 32 percent

followed by RTGS electronic transactions with 31.44 percent growth rate, indicating the inclination towards more electronic operations than real time banking operations in India.

Long run relationship between M1 and its determinants using cointegration analysis

The ADF Unit Root Test of Stationarity

The key concept underlying time series process is that of stationarity. The present study has performed the series of Augmented Dickey-Fuller unit root test to determine the degree of integration of the variables and to establish the order of stationarity of the databased on "Intercept" and "Trend and Intercept". The null hypothesis of the test is that the variable contains a unit root. Table 2 shows the ADF statistics based on "Intercept".

Using the "Intercept" criteria the results indicate that the null hypothesis of unit root could not be rejected for majority of the variables of the study. RTGS and WPI were the variables that were found to be level stationary and the variables ETF, DECARD, CRCARD, IIP, IR and M1 were found to be stationary only in their first differences, with their P values significant at five percent levels. The study also performed the ADF test based on "Trend and Intercept" and the results are given in table 3. The results of the unit root with "Trend and Intercept" indicated clearly that the null hypothesis of a unit root cannot be rejected at the "level" for all the variables used in the study. However, the hypothesis of unit root was rejected in the first difference at 5 percent level of significance, implying that the variables were found to be stationary at their first differences.

Table 2 Unit Root Test Results based on ADF Statistic using Intercept

Variable	ADF t-statistic	Critical values (5% level)	p-value	Conclusion	Order of Integration
LNRTGS					
Level	-3.0649	-2.8861	0.0320	Reject	I(0)
LNETF					
Level	-1.4897	-2.8859	0.5355	Accept	I(1)
First difference	-12.3489	-2.8861	**0.0000****	Reject	
LNCRCARD					
Level	-0.0942	-2.8861	0.9641	Accept	I(1)

First difference	-13.0159	-2.8862	**0.0000****	Reject	
LNDECARD					
Level	-0.8553	-2.8859	0.7791	Accept	I(1)
First difference	-10.7159	-2.8861	**0.0000****	Reject	
LNWPI					
Level	-6.6584	-2.8861	**0.0000****	Reject	I(0)
LNIIP					
Level	-2.0003	-2.8861	0.2864	Accept	I(1)
First difference	-12.1964	-2.8861	**0.0000****	Reject	
LNIR					
Level	-2.4452	-2.8859	0.1318	Accept	I(1)
First difference	-10.8242	-2.8861	**0.0000****	Reject	
LNM1					
Level	-1.2513	-2.8861	0.6503	Accept	I(1)
First difference	-12.3195	-2.8863	**0.0000****	Reject	

Source: Estimates based on secondary data

Table 3 Unit Root Test Results based on ADF Statistic using Trend and Intercept

Variable	ADF t-statistic	Critical values (5% level)	p-value	Decision	Order of Integration
LNRTGS					
Level	-2.5422	-3.4483	0.3077	Accept	I(1)
First difference	-13.5569	-3.4487	**0.0000****	Reject	
LNETF					
Level	-3.1882	-3.4480	0.0918	Accept	I(1)
First difference	-12.2961	-3.4483	**0.0000****	Reject	

LNCRCARD					
Level	-2.5312	-3.4483	0.3128	Accept	I(1)
First difference	-10.6654	-3.4483	**0.0000****	Reject	
LNDECARD					
Level	-2.1915	-3.4480	0.4876	Accept	I(1)
First difference	-10.6654	-3.4483	**0.0000****	Reject	
LNWPI					
Level	-1.5208	-3.4483	0.8171	Accept	I(1)
First difference	-6.7474	-3.4483	**0.0000****	Reject	
LNIIP					
Level	-3.0909	-3.4483	0.1133	Accept	I(1)
First difference	-12.2340	-3.4487	**0.0000****	Reject	
LNIR					
Level	-2.3864	-3.4480	0.3847	Accept	I(1)
First difference	-10.8584	-3.4483	**0.0000****	Reject	
LNM1					
Level	-3.0794	-3.4483	0.1161	Accept	I(1)
First difference	-12.3840	-3.4487	**0.0000****	Reject	

Source: Estimates based on secondary data

Johansen Co-integration Test for M1 and IIP, WPI, IR, RTGS, EFT, DECARD, CRCARD

When the variables of the study are found to have the same order of integration, the next step is to identify the presence of long run relationship among the variables. The Johansen and Juselius (1990) maximum likelihood test that employs a VAR based methodology of analyzing the presence of cointegration among the variables has been employed in the present study. The two likelihood ratios (LR) test statistics of the Johansen methodology, the trace statistic and the Max-Eigen value are used to test for the presence of the cointegrating relationship and to determine the cointegration rank (r) of the model. The Johansen method is proved to give robust results than many other tests of cointegration when there are more than two variables. The Akaike Information criterion (AIC) was used as a criterion based on the preliminary VAR estimates to decide the lag length and the study used thelag of 4 as per the criterion for the testing of the cointegration. The model of the demand for Narrow money (M1) in India is tested for presence of cointegration among the variables using the following hypothesis.

Hypothesis for the test of cointegration

Null Hypothesis (H0): There is no cointegration among the variables of the study. Alternate Hypothesis (Ha): There is at least one co-integrating equation. The table 4 gives the estimates of the Trace statistic for the demand for narrow money M1 and the dependent variables IIP, WPI, IR, RTGS, EFT, DECARD and CRCARD. The trace statistic was found to be greater than the critical value for "None" and "At most 1" number of cointegrating equations.

Table 4
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.408444	**192.6245**	**159.5297**	**0.0002**
At most 1 *	0.342492	**132.2495**	**125.6154**	**0.0185**
At most 2	0.238102	84.03021	95.75366	0.2430
At most 3	0.171879	52.75676	69.81889	0.5159
At most 4	0.129401	31.06826	47.85613	0.6628
At most 5	0.066858	15.13230	29.79707	0.7714
At most 6	0.050045	7.174574	15.49471	0.5575
At most 7	0.010986	1.270353	3.841466	0.2597

*Source: Estimates based on Secondary data, * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values*

Hence we reject the null hypothesis that there is no cointegration among the variables of the study and conclude that the variables of the model during the study period revealed the presence of atleast two cointegrating equations. This indicated that the variables of the model have a long run equilibrium relationship.

Table 5 Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.408444	**60.37496**	**52.36261**	**0.0062**
At most 1 *	0.342492	**48.21932**	**46.23142**	**0.0303**
At most 2	0.238102	31.27345	40.07757	0.3443
At most 3	0.171879	21.68850	33.87687	0.6317
At most 4	0.129401	15.93596	27.58434	0.6713
At most 5	0.066858	7.957722	21.13162	0.9062
At most 6	0.050045	5.904221	14.26460	0.6255
At most 7	0.010986	1.270353	3.841466	0.2597

*Source: Estimates based on Secondary data, * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values*

The statistic Maximum Eigen value estimated using the Johansen procedure for the variables of the study presented in table 5 revealed that the Eigen statistic values were found to be greater than the critical values at "None" and "At most 1" number of cointegrating equations. This leads to the rejection of the null hypothesis that there is no cointegration among the variables of the model and it can be concluded that there is presence of atleast two cointegrating equations.

From the results of the Johansen cointegration test using the trace statistic and the Max-Eigen value statistic, it can be concluded that the variables of the model exhibited a common trend and move together in the long run. The results of the presence of long run relationship among the variables of the model are in accordance with economic theory and empirical research works on estimating demand for money in India by Moosa (1992), Nag and Upadhyay (1993), Joshi and Saggar (1995), Apte (1997) and Bharadhwaj and Pandit (2010). The literature also reveals the presence of cointegration among the variables that determine demand for money in the presence of financial innovations for similar economies like India by Theresa and Franklin (2004), Suliman and Halla (2011), Sriram (2000), Siddiki (2000), Rauf and Khan (2010), Safdar and Khan (2014) and Naseer (2013).

Estimation of long run money demand function (M1) using the Normalized Cointegrating Coefficients

The presence of long run relationship among the variables of the model necessitates understanding the nature of relationship among them and hence the normalized cointegrating coefficients of the independent variables of the model for M1 derived from the Johansen cointegration procedure are given in table 6.

Table 6 Normalized Cointegrating Coefficients from the Cointegration equation

Variable	Coefficients	Standard Errors
LNRTGS	**-0.131347**	(0.03494)
LNETF	0.052264	(0.01459)
LNCRCARD	**-0.218082**	(0.07716)
LNDECARD	0.027932	(0.01056)
LNWPI	**-1.634645**	(0.24470)
LNIIP	-0.097653	(0.27437)
LNIR	**0.464913**	(0.14057)

Source: Estimates obtained from secondary data.

The normalized cointegration coefficients of the cointegrating equation give the long run money demand as a function of the determinants. The coefficients obtained revealed that RTGS, credit cards (CRCARD), IIP and WPI have negative impact on the demand for M1 in India during the study period. It denotes that an increase in the values of the above variables will lead to decline in M1. ETF, debit cards (DECARD) and interest rates have a positive effect on demand for M1. The coefficient of IR is highest with 0.46, implying that a one percent increase in the interest rate leads to 46 percent increase in demand for M1. Similarly credit cards have higher negative coefficient -0.21 implying that a one percent increase in credit cards will lead to 21 percent decline in demand for M1. The coefficients obtained from the cointegration equation clearly suffices the fact that demand for M1 during the study period for India is impacted by both macro economic variables like WPI and interest rate and financial innovations RTGS and credit cards. On the macro economic variables WPI has a negative impact with coefficient being -1.63 and interest rate IR has a positive impact on M1 with coefficient being 0.46 respectively. With regard to the financial innovations, RTGS and credit cards have showed greater impact on demand for M1 and the interesting result is both the variables have a negative impact on demand for M1 with their coefficients being – 0.13 and – 0.21 respectively.

7. Conclusion

The present study examined the determinants of demand for M1 using the robust cointegration technique. The study in addition to the conventional macro economic variables has analyzed the impact of the financial innovations that form substitutes to cash on the demand for M1. The findings of the study indicated that the null hypothesis of a unit root cannot be rejected at the 'level' for all the variables used in the study. However, the hypothesis of unit root was rejected in the first difference at 5 percent level of significance, implying that the variables were found to be stationary at their first differences. From the results of the Johansen cointegration test using the trace statistic and the Max-Eigen value statistic, it was found that the variables of the model exhibited a trend and moved together in the long run. The presence of long run relationship among the variables of the model was in accordance with economic theory and empirical research works. The normalized cointegration coefficients of the cointegrating equation revealed that RTGS, CD, IIP and WPI had negative impact on the demand for M_1 in India

during the study period. ETF, DC and interest rates had positive effect on demand for M_1. The coefficient of R was highest with 0.46, implying that a one percent increase in the interest rate leads to 46 percent increase in demand for M_1.

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