Long run demand for money in India: A co-integration approach

I, Sahadudheen

Pondicherry University

2012

LONG RUN DEMAND FOR MONEY IN INDIA: A COINTEGRATION APPROACH (1970 TO 2010)

Sahadudheen I

M.Phil scholar

Department of Economics

Pondicherry University, India

Shd4frnds@gmail.com

+919042458737

ABSTRACT

Demand for money plays a pivotal role in determining the welfare implications of monetary policy actions in an economy. This study estimated the demand for money in India and investigated various determinants of demand for money for the period 1970 to 2009. The study utilized Johansen-juselius cointegration analysis to test for the existence of a long run relationship between the variables and an Error Correction method is then used. The study concluded that the income and price has a positive effect on the demand for money. On the other hand, interest rate and exchange rate has a negative. The income elasticity is 1.98 and showing significant, implying that in India, a one percent economic growth requires around 1.98 percent increase in the nation's money supply.

KEYWORDS: Demand for money, India, unit root, cointegration, ECM

JEL: E41

INTRODUCTION

Demand for money is an important concept in the history of economic thought and can be defined as the desired holdings of money balances in the form of cash or bank. According to Mankiw "the demand for money reflects the degree of willingness to possess money by economic entities". It plays a pivotal role in determining the welfare implications of monetary policy actions in an economy. Since the early 1970s a sizable chunk of empirical literature in monetary economics has been concerned with the demand for money, because money demand is considered as an important indicator of growth of a particular economy. The demand for money function creates a background to review the effectiveness of monetary policies, as an important issue in terms of the overall macroeconomic stability. Money demand is an important indicator of growth of a particular economy. The increasing money demand mostly indicates a country's improved economic situation, as opposed to the falling demand which is normally a sign of deteriorating economic climate.

LITERATURE OF THE STUDY

It is essential to review the literature in the relevant field both theory and practice as to arrive at reasonable and meaningful conclusion. With this background on mind some of the earlier studies on demand for money in national and international level are reviewed.

THEORETICAL LITERATURE REVIEW

There are diverse spectrums of money demand theories which address a broad range of hypotheses. These theories bring forward the relationship between the quantity of money demanded and a set of economic variables.

Classical Theory

Money demand theories date back to the quantity theory of money. Fisher (1911) provided the famous classical equation in his classical work "*the purchasing power of money*". He examined the link between the quantity of money (M) and the total amount of spending on final goods and services, aggregate nominal income /total spending (PxY). If the velocity of money (average number of times per year that a dollar is spend) is

$V=PxY/M$, Multiply both sides of the equation by M

$VxM/_1=PxY/_1 \text{ x } M/_1$

$MV=PY$

Where, M= quantity of money, V=Velocity, P= Price level, Y= aggregate output or income

Cambridge Approach

The Cambridge approach is associated with the neo-classical economists, Pigou (1917) and Marshall (1923). The Cambridge approach stressed the demand for money as public demand for money holdings, especially the demand for real balances, which was an important factor in determining the equilibrium price level consistent with a given quantity of money.

Divide both side of the exchange equation (MV=PY) by V

$MxV/V=PxY/V$

$M=PY/V$, It can be written as,

$M=1/V \text{ x}PY$, Here we can replace 1/V in the equation by 'k'

$M=k \text{ x}PY$ where, k is a constant

Keynesian Demand for Money

Keynes (1936) built on the Cambridge approach to provide a more rigorous analysis of money demand, focusing on the motives of holding money. Keynes's liquidity preference theory emphasizes the role of interest rates in the demand for money. He distinguished three motives for holding money: the transactions motive, the precautionary motive and the speculative motive. All the three motives influence a particular person's holdings of money. Keynes argued that the demand for money for transactions and precautionary motives depends on the level of income, while speculative demand for money depends on interest rates. From Keynes perspective, the demand for real money balances (Md) is a positive function of real income (Y) and a negative function of interest rate (r) as depicted by the "liquidity preference function'' given in equation.

$$Md= f(Y,r);\ fy>0\ ,fr<0$$

Inventory Theory of Boumol

Baumol (1952) and Tobin (1956) independently developed similar demand for money models, which demonstrated that even money balances held for transactions purposes are sensitive to the level of interest rates. The Baumol - Tobin model analyses the costs and benefits of holding money for transactions purposes. The benefit is convenience and the cost of this convenience is the interest forgone. A person can thus hold a portfolio of monetary assets and non-monetary assets .If 'r' is the difference in the return between monetary and non-monetary assets and 'b' as the cost of transferring non-monetary assets into monetary assets, such as a brokerage fee, then a person minimizes the sum of brokerage costs and interest income forgone. This leads to a well-known "square-root formula'' given in equation below.

$$Md=\sqrt{(bY/2r)}$$

This states that the demand for real money balances m is directly proportional to transactions costs b and real income Y, and inversely proportional to the interest rate r. In the ideal world of the Baumol-Tobin model, the elasticity of money demand in response to income and interest rate must be 0.5 and -0.5 respectively.

Friedman Theory

In 1956, Friedman developed the modern quantity theory of money. He applied the theory of portfolio choice and postulated that the demand for money must be influenced by the same factors that influence the demand for any asset. Thus according to Friedman, the demand for money function is given by equation below.

$$(m/p)^d = f(Y^p; r^b - r^m; r^e - r^m; \pi^e - r^m)$$

where $(M/P)^d$ is the demand for real money balances, Y^p is a measure of wealth or permanent income, r^m is the expected return on money, r^b is the expected return on bonds, r^e is the expected return on equity, and π^e is the expected inflation rate.

EMPIRICAL LITERATURE REVIEW

The empirical literature on demand for money is extensively available. The empirical investigation may shed some light on which specification is more likely to be better.

A number of researchers have been estimated India's money demand function. Among these the first study was conducted by Moosa in 1992. His study explicitly considers the stationarity of, and cointegration relationships among, the variables of the money demand function. He used three types of money supply, cash, M1, and M2 to perform cointegration tests on real money balances, short-term interest rates, and industrial production over the period 1972Q1 to 1990Q4. Results indicated that for all three types of money supply, the money balance had a cointegrating relationship with output and interest rates.

Bahmani-Oskooee and Rehman (2005) analyzed the money demand functions for India and six other Asian countries during the period of 1972Q1-2000Q4. Using the ARDL approach 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, so they concluded that M1 is the appropriate money supply definition to use in setting monetary policy.

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.

Parvez Azim, Nisar Ahmed,Sami Ullah,Bedi-uz-Zaman.Muhammad Zakaria (2010) estimated the demand for money in Pakistan for the period 1973 to 2007 using Autoregressive Distributed Lag (ARDL) approach to cointegration analysis. The empirical results shows that there is a unique cointegrated long-run relationship among M2 monetary aggregate, income, inflation and exchange rate. The income elasticity and inflation coefficients are positive while the exchange rate elasticity is negative. The results show that income and inflation variables are positively associated with money demand while exchange rate negatively affects money demand.

AL-Abdulrazag Bashier and Abdullah Dahlan (2011) made an attempt to examine the money demand function and its stability in Jordan over the period 1975-2009 by using Johansen-Juselius Cointegration test and VAR. Their empirical findings stress the existence of a positive relationship between money aggregates and the level of income while the relationship is negative for exchange rate.

DATA AND METHODOLOGY

In order to estimate the demand for money in India, the following data are used. The data used in this study are cumulated from various secondary sources. The variable such as Broad money (M3), nominal Gross domestic product, wholesale price index (WPI), call money rate, ₹-$ bilateral exchange rate are collected from various Reserve Bank of India bulletin. The data collected over a period of 1970-71 to 2009-10. The WPI is collected on the basis of 1993-94 constant prices, whereas nominal GDP is on 2004-05 constant prices. To investigate the above issue the study uses the 40 observations. In order to estimate the demand for money function in India, we considered five variables, namely M3 (Nominal money), nominal GDP, WPI, call money rate and bilateral exchange rate between rupee and dollar. The statistical and time series properties of each and every variable are examined using the conventional unit root test and employed cointegration and error correction method.

ECONOMETRIC MODEL

There is a diverse spectrum of money demand theories emphasizing the transactions, speculative, precautionary considerations. All the theories share common important variable. The general agreement in the literature is that a money demand equation should contain a scale variable to the level of transactions in the economy and a variable representing the opportunity cost of holding money. In the context of an open economy, a variable such as exchange rate can be included in the money demand equation to reflect the impact of currency depreciation on money demand.

Specification of the Model

The general specification begins with the following functional relationship for the demand for money:

$$M = f(s, oc, x)$$

The demand for nominal balances M is a function of the chosen scale variable(S) to represent the economic activity and the opportunity cost of holding money (OC) and exchange rate. Although there are several functional forms of specifying money demand function, there is general consensus that the log linear version is the most appropriate functional form because it performs better than the other forms because the log linear form allows for interpretation of coefficients of variables in logarithms as elasticities.

We start with a standard money demand function in which nominal money balances are expressed as a function of nominal income, price level, interest rate and exchange rate. We expect the estimate of income is expected to be positive; an estimate of price level, interest rate and exchange rate are expected to be negative.

For estimation purposes, we use the logarithmic transformation of annual data for the period 1970:71 – 2009:10. We specify the following money demand equation, where all variables are expressed in logarithmic forms, U is a random error term, and t is a annual time index.

$$\ln (M)_t = \alpha + \beta_0 \ln Y_t + \beta_1 \ln P_t + \beta_2 \ln r_t + \beta_3 \ln X_t + u_t \quad (1)$$

M= Nominal money

Y= Nominal gross domestic product (2004-05 base year prices)

P= wholesale price index (1993-94 base year prices)

r= (1+Call money rate)

X= rupee- dollar bilateral exchange rate

U= error term

ECONOMETRIC METHODOLOGY AND EMPIRICAL RESULTS

Unit Root Test

The first step of the strategy of our empirical analysis involves determining the order of integration. Most time series are trended and therefore in most cases are nonstationary. The problem with nonstationary or trended data is that the standard OLS regression procedure can easily lead to incorrect conclusion. A series of Augmented Dickey-Fuller unit root test is performed to determine the order of integration of the variables.

Table (1) shows the ADF test results for both at the level and the first difference on intercept and intercept and trend.

Table (1)

	Intercept only		Intercept and trend	
Variables	Level	First difference	Level	First difference
	Prob: value	Prob: value	Prob: value	Prob: value
ln M	0.9793(0)	0.0000(0)	0.3236 (0)	0.0002(0)
ln Y	1.0000(0)	0.0000(0)	0.8523(0)	0.0000(0)
ln P	0.1861(0)	0.0013(0)	0.3805(0)	0.0023(0)
ln r	0.1484(0)	0.0000(0)	0.2763(0)	0.0000(0)
Ln x	0.9206(0)	0.0046(0)	0.7813(0)	0.0239(0)

(Numbers in parenthesis are the number of lags)

The reported result in table (1) reveals that the hypothesis of a unit root can’t be rejected in all variables in levels. However, the hypothesis of a unit root is rejected in first differences at 0.05 level of significant which indicates that all variables are integrated of degree one, I(1). That means all the variables achieve stationarity only after first difference.

The estimation of the equation by direct OLS gives the following integration equation.

$$M = -11.95514 + 1.357y_t + 1.3280p_t - 0.0632r_t - 0.144x_t \quad (2)$$

(-8.574708) (11.64363) (14.49066) (-1.355412) (-2.3448)

(0.000) (0.000) (0.000) (0.1840) (0.0248)

Adj R^2= 0.998553 F= 6730.536 DW=0.881464

The estimated parameters of equation are in accordance with economic theory. Interest rate and exchange rate have negative parameters while nominal income and price level has positive elasticity. All coefficients are statistically significant at 0.05 % level except interest rate. Here we have high R^2 and t-values, but U_t is not white noise. Often it is identified with R^2 > D-W statistic. All the variables give the expected result, but the nonstationarity of variable biased the previous estimation, and the low value of DW compared to R^2 can be interpreted as sign of spurious regression.

Selection of Lag Length

The criterion for selecting the lag length consist an important step. There are different tests that would indicate the optimal number of lags. The study utilizes the SC criterion to ensure sufficient power of the Johansen procedure.

Table (2)

Lag	AIC	SC
0	-2.485340	-2.267649
1	-15.16707	-13.86092*
2	15.92078*	-13.52617
3	15.90297	-12.41991

(VAR lag order selection criteria included observation 37)

Cointegration

The next step in our empirical analysis is to test for cointegration. Since the variables are considered to be I(1), the cointegration method is appropriate to estimate the long run demand for money. The concept of cointegration is that non-stationary time series are cointegrated if a linear combination of these variables is stationary. The cointegration requires the error term in the long-run relation to be stationary. Suppose there are two variable Y_t ad X_t and both Y_t and X_t follows I (1) process, Still the linear combination $U_t = Y_t - \alpha X_t$ is I (0). If so, both Y_t and X_t are said to be cointegrated and *a* is the cointegrating parameter. The maximum likelihood approach to test for cointegration is based on the following system of equations

$$\Delta x_t = \pi x_{t-1} + \sum_{i=1}^{p-1} \pi_i \Delta x_{t-i} + \varepsilon_t$$

The number of independent cointegrating vector is equal to the rank of matrix *π*, If rank of *π* = 0; then *π* is a null matrix and equation turns out to be a VAR model, whereas If rank of *π* =1, there is one cointegrating vector and $\pi\ x_{t-1}$ is an error correction term. Johansen suggests that it can be done by testing the significance of characterizes roots of π.

Suppose that π is a 3x3 matrix and the ordered characteristics roots are $\lambda_1 > \lambda_2 > \lambda_3$

If rank of π = 0 then $\lambda_i = 0$; hence, $\ln(1-\lambda_i) = 0$ whereas, If rank of π = unity then $0 < \lambda_1 < 1$ and $\ln(1-\lambda_1)$ will be negative and the rest $\ln(1-\lambda_2) = \ln(1-\lambda_3) = 0$

Johansen suggests two test statistics to test the null hypothesis that numbers of characteristics roots are insignificantly different from unity.

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i)$$

$$\lambda_{\max}(r, r+1) = -T \ln(1-\hat{\lambda}_{r+1})$$

λ_i = estimated characteristic roots or Eigen values

T = the number of usable observations

λ_{trace} test the null hypothesis

$r = 0$ against the alternative of $r > 0$

λ_{max} test the null hypothesis

$r = 0$ against the alternative of $r = 1$

The theory asserts that there exists a linear combination of this non-stationary that is stationary. Solving for the error term, we can rewrite the relation as

$$e_t = \alpha - \beta_0 \ln Y_t - \beta_1 \ln P_t - \beta_2 \ln r_t - \beta_3 \ln X_t \quad (3)$$

Since $\{e_t\}$ must be stationary, it follows that the linear combination of integrated variables given by the right hand side of must also be stationary.

Johannsen Cointegration Result

Table (3)

Sample adjusted 1973-2009				
Unrestricted cointegration Rank test (Trace)				
Null hypothesis	Eigen Value	Trace statistics	5 percent critical value	Porb.**
r=0*	0.755347	102.8782	69.81889	0.0000
r≤1*	0.446328	50.78548	47.85613	0.0259
r≤2	0.386113	28.91171	29.79707	0.0630
r≤3	0.210302	10.85775	15.49471	0.2204
r≤4	0.055735	2.121876	3.841466	0.1452
Unrestricted cointegration Rank test (Maximum Eigenvalue)				
Null hypothesis)	Eigen Value	Max-Eigenvalue statistics	5 percent critical value	Porb.**
r=0*	0.755347	52.09276	33.87687	0.0001
r≤1	0.446328	21.87377	27.58434	0.2269
r≤2	0.386113	18.05395	21.13162	0.1278
r≤3	0.210302	8.735877	14.26460	0.3088
r≤4	0.055735	2.121876	3.841466	0.1452

(denotes the rejection of the hypothesis at the 0.05 level. And ****** are Mackinnon-Hauge-Michelis (1999) p-values.)*

The above table shows that the null hypothesis of no cointegration is rejected at the conventional level (0.05) and the study conclude that there exists a relationship among the proposed variables in the long run. Trace test indicates that there are two cointegrationg vector is there, whereas Eigen value test indicates that there is at least one linear combination in the long run.

Table (4)

Normalized cointegration coefficients				
lnM	lnY	lnP	lnr	lnx
1.0000	1.985757 (0.15342)	1.282433 (0.10896)	-0.42314 (0.075)	-0.4782 (0.060)

The cointegration equation is depicted in above table which reveals that the income and price has a positive effect on the demand for money. On the other hand, interest rate and exchange rate has a negative. The income elasticity is 1.98 and showing significant, implying that in India, a one percent economic growth requires around 1.98 percent increase in the nation's money supply. Interest rate and exchange rate carries expected negative and significant coefficient.

The Dynamic Short Run Relationship (VECM)

By specifying the long run demand for money in an error correction model, the short run as well as the long run effects of all right hand side variables in equation are estimated in one step, which is a major advantage that error correction modeling has in comparison to other estimation.

The dynamic relationship includes the lagged value of the residual from the cointegrating regression (ε_{t-1}) in addition to the first difference of variables which appear in the right hand side of the long run relationship (y, p, r and x). The inclusion of the variables from the long run relationship would capture short run dynamics.

To start, we define the error correction term by

$$e_t=\alpha-\beta_0 \ln Y_t-\beta_1 \ln P_t-\beta_2 \ln r_t-\beta_3 \ln X_t \qquad (4)$$

β_0, β_1,β_2 and β_3 are cointegrating coefficient $e_{t=}$ the error from a regression of M on y_t, p_t, r_t and x_t.

The ECM simply defined as

$$\begin{aligned}
\Delta m_t &= \lambda_m(m_{t-1}-a-\beta_1 y_{t-1}-\beta_2 p_{t-1}-\beta_3 r_{t-1}-\beta_4 X_{t-1})+\varepsilon_{mt}\\
\Delta y_t &= \lambda_y(m_{t-1}-a-\beta_1 y_{t-1}-\beta_2 p_{t-1}-\beta_3 r_{t-1}-\beta_4 X_{t-1})+\varepsilon_{yt}\\
\Delta p_t &= \lambda_p(m_{t-1}-a-\beta_1 y_{t-1}-\beta_2 p_{t-1}-\beta_3 r_{t-1}-\beta_4 X_{t-1})+\varepsilon_{pt}\\
\Delta r_t &= \lambda_r(m_{t-1}-a-\beta_1 y_{t-1}-\beta_2 p_{t-1}-\beta_3 r_{t-1}-\beta_4 X_{t-1})+\varepsilon_{rt}\\
\Delta X_t &= \lambda_X(m_{t-1}-a-\beta_1 y_{t-1}-\beta_2 p_{t-1}-\beta_3 r_{t-1}-\beta_4 X_{t-1})+\varepsilon_{Xt}
\end{aligned}$$

Where, the elements of ε_t s are white noise errors and λ_s are speed of adjustment parameters and α and β are short run parameters. All the variable in the ECM are stationary, and therefore, the ECM has no problem of spurious regression.

Table (5)

Error correction	D(M)	D(Y)	D(P)	D(r)	D(X)
Coint Eq1	-0.048794	-0.090687	0.216132	1.930285	-0.355205
Standard error	(0.05300)	(0.06177)	(0.09236)	(0.42757)	(0.12612)
t statistics	[-0.92068]	[-1.46805]	[2.33998]	[4.51450]	[-2.81651]

The above table shows the speed of adjustment coefficients, which reveals that only three variables are adjusting. The adjustment coefficient on cointegration equation 1 for the price is positive, but quite rapid 9% per year. The adjustment coefficient for interest rate is showing negative, as it should not be, but both adjusting coefficient are showing significant. Similarly adjustment coefficient for exchange rate is showing negative, as it should be. But the estimated error correction model enjoys a very low goodness of fit (R^2=0.345262, adj R^2 =0.057177). The empirical study is performed by using PC version of Eviews 6.0.

CONCLUSION

The study used five variables extracting 40 annual observations from 1970 to 2009. Since all the variables have unit root at levels the study utilizes Johansen-juselius cointegration analysis to test for the existence of a long run relationship between the variables. The cointegrating regression so far considers only the long-run property of the model, and does not deal with the short-run dynamics explicitly. For this, the error correction from the long rum money demand is then used as a dynamic model to estimate the demand money demand. The trace test indicates that there are two cointegrationg vector is there, whereas Eigen value test indicates that there is at least one linear combination in the long run. The study concluded that the income and price has a positive effect on the demand for money. On the other hand, interest rate and exchange rate has a negative. The income elasticity is 1.98 and showing significant, implying that in India, a one percent economic growth requires around 1.98 percent increase in the nation's money supply. Interest rate and exchange rate carries expected negative and significant coefficient.

REFERENCES

1. Al-Abdulrazag Basheer and Abdullah Dahlan(2011), The Money Demand Function for Jordan: An Empirical Investigation, International Journal of Business and Social Science March 5, 2011, Vol. 2
2. Bahmani-Oskooee, M and Rehman Hafez (2005) Stability of the Money Demand Function in Asian Developing Countries, Applied Economics, 37, 773-792
3. Damodar N Gujarathi, Basic Econometrics, fourth edition
4. Das, S and K Mandal (2000) "Modeling Money Demand in India: Testing Weak, Strong & Super Erogeneity". Indian Economic Review, 35, 1-19.
5. Dimitorios Asteriou, Applied Econometrics, A Modern Approach Using Eviews And Microfit, Palgrave Macmillan Publication, 2006
6. Juan J. Dolado a, Jesús Gonzalo and Francesc Marmol "Cointegration", February, 1999
7. Liang Xueping , Analysis of money demand
8. Moosa, I. A. (1992). The Demand for Money in India: A Cointegration Approach, The Indian Economic Journal 40(1): 101-115.
9. Parvez Azim, Nisar Ahmed,Sami Ullah,Bedi-uz-Zaman.Muhammad Zakaria Demand for Money in Pakistan: an Ardle approach, Global Journal of Management and Business Research Page 76 Vol. 10 Issue 9 ,December 2010