DETERMINANTS OF DEMAND FOR MONEY IN INDIA --
AN EMPIRICAL ANALYSIS

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This study is essentially exploratory in nature. In this study, the results of the regression analysis are presented and analysed. Before doing that, alternative measures of each variable used in the regression analysis are discussed.

Extent of Variability in the Variables Included in the Analysis

Before the presentation and the interpretation of regression results, the extent of variability in the variables included in the regression analysis is examined. Table 1 gives the coefficient of variation of each of the variables included in the study. The variability in M_1 (narrow definition of money supply) considerably less than the variability in M_3 (broader definition of money supply). While the former is 64.12 per cent, the latter is 80.27 per cent. Interestingly the variability in respect of real quantity of money is significantly less than that of nominal quantity of money. The variability in real quantities is about one-half of the variability in nominal quantities as can be seen from Table 1.

This difference in variability is observed in the case of nominal and real income variables also. The extent of variation in nominal income variables Y_2, Y_3 and Y_5 is higher than that of real income variables Y_2, Y_4 and Y_6 as can be seen from Table 1. Interestingly the variability in respect of wholesale price index and consumer price index is almost the same. The variability in inflation rate is much higher than the variability in respect of the price indices. The inflation rate based on wholesale price index showed greater variation (co-efficient of variation is 83.64 per cent) than the variation in respect of inflation rate based on consumer price index (coefficient of variation is 62.82 per cent). As can be expected the interest rates vary less than the other variables such as money supply and income. Further, as can be expected the long-term rate showed lesser variation than the short-term and call money rates as can be seen from Table 1.

1.   Demand for Nominal Cash Balances

Against this background, we look into the results of the regression analysis. Table 2 gives estimated log-linear regression equations. As the equations are linear in logarithms the regression coefficients stand for elasticities also. Equation (1) in Table 2 allows us to draw the inference that income (NNP at factor cost at current prices) elasticity of demand for money is 1.0092, not significantly different from one. The coefficient is statistically significant at the 1 per cent level. When we used NNP at factor cost at constant (1980-81) prices instead of NNP at factor cost at current prices as income variable, the elasticity estimate increased to 3.0617 and is statistically significant at the 1 per cent level. When Y_1 is regressed on M_1 the regression coefficient fell significantly, although still being statistically significant. Although equations (1) to (4) do not provide

Table 1

Coefficient of Variation-Selected Variables

S.No.	Variable	Mean	S.D.	Coefficient of variation $\frac{S.D.}{Mean} \times 100$
1.	M_1	23912.67	15332.40	64.12
2.	M_3	58056.11	46599.20	80.27
3.	$m_{11}(M_1/P_1)$	9491.17	2153.08	22.69
4.	$m_{12}(M_1/P_2)$	5995.83	1364.93	22.76
5.	$m_{31}(M_3/P_1)$	21411.68	9200.85	42.97
6.	$m_{32}(M_3/P_2)$	13567.44	5823.97	42.93
7.	Y_1	133638.72	69189.50	51.77
8.	Y_2	109507.39	22519.10	20.56
9.	Y_3	127258.56	79463.10	62.44
10.	Y_4	122003.78	26328.40	21.58
11.	Y_5	126664.83	78819.30	62.23
12.	Y_6	121285.22	25994.40	21.43
13.	P_1	233.16	97.35	41.75
14.	P_2	367.33	152.54	41.53
15.	$\bar{P}_1$	8.80	7.36	83.64
16.	$\bar{P}_2$	8.23	5.17	62.82
17.	i_1	11.76	2.23	18.96
18.	i_2	13.69	3.38	24.69
19.	i_3	8.79	2.26	25.71

M_1 = money supply (narrow definition); M_3 = money supply (broad or Chicago School definition); m_{11} (M_1/P_1) = narrow money supply in real terms based on WPI; $m_{12}(M_1/P_1)$=narrow money supply in real terms based on CPI; $m_{31}(M_3/P_1)$ = broad money supply in real terms based on WPI, $m_{32}(m_3/P_3)$=broad money supply in real terms based on CPI; Y_1=NNP at factor cost at current prices; Y_3=NNP at factor cost at constant (1980-'81) prices; Y_3=GDP at factor cost at current prices; Y_4=GDP at factor cost at constant (1980-'81) prices; Y_2=GNP at factor cost at current prices; Y_6=GNP at factor cost at constant (1980-'81) prices; i_1=long-term interest rate (IDBI primary lending rate); i_2=short-term interest rate (SBI prime lending rate); i_3=major commercial banks call money rate (Madras); P_1=wholesale price index (WPI) (1970-'71=100); P_2=consumer
price index (CPI) for urban non-manual employees (1960=100); $\bar{P}_1$=inflation rate based on WPI; $\bar{P}_2$=inflation rate based on CPI.

any firm basis for inferring about causation, the size of the regression coefficients indicate that the causation runs from income to money demand. Further, the income elasticity of demand for money is higher when real income measure is used than when nominal income measure is used as can be seen from equations (1) and (2) in Table 2.

Table 2

Regression Results - Log-Linear Equations

S.No.	Dependent variable	Constant term	Independent Variables					R^2	$\bar{R}^2$	D.W. statistic	D.W. test result
			M_1	Y_1	Y_2	i_1	i_2				
1.	M_1	-1.6732		+1.0092* (40.6108)				0.99	0.99	1.8211	No autocorrelation
2.	M_1	-25.5733			+3.0617* (22.6716)			0.97	0.97	1.6843	No autocorrelation
3.	Y_1	+1.7522	+0.9814* (40.6108)					0.99	0.99	1.8138	No autocorrelation
4.	Y_2	+8.4502	+0.3168* (22.6716)					0.97	0.97	1.6999	No autocorrelation
5.	M_3	-37.6504			+4.1690* (27.2134)			0.98	0.98	1.5131	No autocorrelation
6.	M_1	-2.6191		+1.1277* (15.9904)		-0.0351** (1.7812)		0.99	0.99	2.2532	No autocorrelation
7.	M_1	-2.0198		+1.0493* (18.6656)			-0.0083 (0.7982)	0.99	0.99	2.0879	No autocorrelation
8.	M_3	-31.0439			+3.5352* (9.4889)	+0.0626** (1.8421)		0.98	0.98	1.8223	No autocorrelation
9.	M_3	-30.8309			+3.5277* (13.7951)		+0.0445* (2.8879)	0.99	0.98	1.5547	No autocorrelation

M_1 = money supply (narrow definition); M_3 = money supply (broad or Chicago School definition), Y_1 = NNP at factor cost at current prices, Y_2 = NNP at factor cost at constant (1980-'81) prices, i_1 = long-term interest rate (IDBI primary lending rate), i_2 = short-term interest rate (SBI prime lending rate).
* Significant at 1% level; ** Significant at 5% level.

When instead of narrow money stock measure, the broader money stock measure is used as dependent variable, the size of the income elasticity showed substantial rise and is significantly larger than one [equation (5), Table 2]. The results so far do not allow us to discriminate between the two money stock measures on the basis of the coefficient of determination. Because in both the cases the coefficient of determination was more than 95 per cent.

When both income and interest rate variables are used as independent variables, with M_1 as the dependent variable, the regression coefficients of both income and interest rate variables have appropriate signs [equations (6) and (7)]. The short-term interest rate has statistically significant coefficient [equation (6)] while the coefficient of long-term interest rate has the appropriate sign but is not statistically significant. Instead of M_1 when M_3 is used [equations (8) and (9)] as dependent variable income elasticity increased substantially with both interest rate coefficients turning out to be with inappropriate sign. Short-term interest rate and income thus appear to be important determinants of the demand for nominal cash balances.

## 2.	Demand of Real Cash Balances

We estimated regressions using the real stock of money measures as dependent variables. We used four real money stock measures in our regression analysis:

(a)	Narrow money supply in real terms based on wholesale price index (m_{11}).

(b)	Narrow money supply in real terms based on consumer price index (m_{12}).

(c)	Broad money stock in real terms based on wholesale price index (m_{31}) and

(d)	Broad money stock in real terms based on consumer price index (m_{32}).

The log-linear regression results are given in Table 3.

When real income (Y_2) is used as the independent variable, the income elasticity is found to be 0.9532 and 82 per cent of the variation in demand for real cash balances is explained by the variation in real income. The results did not vary much when cash balances are deflated by the consumer price index [equations (2) and (3)].

When real cash balances are regressed on nominal income and long-term interest rate, the regression coefficients have appropriate signs and they are statistically significant [equation (4)]. 89 per cent of the variation in demand for real cash balances is explained by the income and interest rate variables. Comparing equations (4) and (5) the demand for real cash balances appear to be more responsive to long-term interest rate than to short-term interest rate. When we used real cash balances variables derived from the consumer price index [equations (6) and (7)] both long-term and short-term interest rate variables have coefficients with appropriate sign but are not statistically significant. When broad real stock of money measure (based on wholesale price index) is used [equation (8)] elasticity of demand for money with respect to income at constant prices is 2.0605 and is statistically significant. From the above analysis of the regression results, one can infer

Table 3

Regression Results - Log-Linear Equations

S.No.	Dependent variable	Constant term	Independent variables				R^2 statistic	$\bar{R}^2$	D.W. statistic	D.W. test result
			Y_1	Y_2	i_1	i_2				
1.	m_{11}	-1.9061		+0.9532* (8.9337)			0.83	0.82	1.2704	No autocorrelation
2.	m_{12}	+4.8473	+0.3340* (11.4732)				0.89	0.88	1.6434	No autocorrelation
3.	m_{12}	-3.1681		+1.0224* (11.3139)			0.89	0.88	1.8173	No autocorrelation
4.	m_{11}	+4.6464	+0.6117* (7.4169)		-1.0303* (3.9637)		0.90	0.89	2.2339	No autocorrelation
5.	m_{11}	+4.8733	+0.4621* (6.6392)			-0.4003** (2.5833)	0.86	0.84	1.8766	No autocorrelation
6.	m_{12}	-5.2158		+1.2538* (5.4812)	-0.2587 (1.0999)		0.90	0.88	1.9865	No autocorrelation
7.	m_{12}	-3.9808		+1.1090* (6.2677)		-0.0737 (0.5737)	0.89	0.88	1.9654	No autocorrelation
8.	m_{31}	-13.9831		+2.0605* (20.1023)			0.96	0.96	1.2775	No autocorrelation

M_{11} (M_1/P_1) = narrow money supply in real terms based on WPI; m_{12} (M_1/P_2) = narrow money supply in real terms based on CPI; m_{31} (M_3/P_1) = broad money supply in real terms based on WPI; Y_1 = NNP at factor cost at current prices; Y_2 = NNP at factor cost at constant (1980-'81) prices; i_1 = long-term interest rate (IDBI primary lending rate); i_2 = short-term interest rate (SBI prime lending rate).
* Significant at 1% level; ** Significant at 5% level.

that income and long-term interest rate are the major determinants of demand for real cash balances. The income elasticity is significantly greater than one when real income measure is used and is significantly less than one when nominal income is used.

Till now we formulated the demand for money function in terms of the income (scale) variable and the opportunity cost variable measured by either long-term or short-term interest rate. If the opportunity cost of holding money is viewed in terms of the return foregone on services from durable commodities or the yield on equities (variable dividend from securities) then it is equal to the sum of the real rate of interest and the expected rate of inflation. If this cost is viewed as the return foregone on bonds, then it is equal to the nominal rate of interest. When we used nominal interest rate measure as independent variable along with income variable, long-term interest rate is found to be having statistically significant coefficient.

3.   Price Level as a Determinant of Demand for Real Cash Balance

Suraj B. Gupta [1] found in his study that the demand for real cash balances is a decreasing function of the level of prices. Thus, the commonly made hypothesis that the demand for real cash balances is homogenous of degree zero in general price level is refuted by the results of the empirical analysis made by Gupta. We examine this issue afresh. Table 4 gives the relevant log-linear regression results.

When narrow definition of money supply M_1 in real terms is used (m_{11} based on wholesale price index) the price variable has come up with negative coefficient [equations (1), (2) and (3), Table 4] and all the coefficients are statistically significant. In all the three equations nominal income variable has statistically significant coefficient no significantly greater than one. Only long-term interest rate coefficient is found to be with

1.   Suraj B. Gupta, "Planning Neutral Money for India", <u>The Indian Economic Journal</u>, Vol. 23, No. 2, September-December 1975, p. 174.

Table 4

Regression Results -- Log-Linear Equations

| S. No. | Dependent variable | Constant term | Independent Variables | | | | | | $\bar{R}_2$ | R^2 | D.W. statistic | D.W. test result |
			P_1	Y_1	Y_2	i_1	i_2	i_3				
1.	m_{11}	+2.5780	-0.9644* (2.6745)	+1.1219* (5.5258)		-0.4615*** (1.5119)			0.93	0.92	2.3848	No autocorrelation
2.	m_{11}	+2.0745	-1.2909* (3.4422)	+1.2277* (5.3694)			-0.0338 (0.2126)		0.92	0.91	2.0729	No autocorrelation
3.	m_{11}	+2.2771	-1.2426* (3.7790)	+1.1875* (5.2396)				-0.0411 (0.5681)	0.92	0.91	1.9651	No autocorrelation
4.	m_{11}	-6.3300	+0.1479 (0.6607)		+1.4599* (4.4034)	-0.9149* (2.8173)			0.91	0.89	2.2923	No autocorrelation
5.	m_{11}	-6.5792	-0.0903 (0.3879)		+1.4581 (3.6793)		-0.2677*** (1.4911)		0.88	0.86	2.1483	No autocorrelation
6.	m_{11}	-5.9500	-0.1922 (0.9456)		+1.4121* (3.3524)			-0.1130 (1.2910)	0.88	0.85	1.6105	No autocorrelation

m_{11} = narrow money supply in real terms based on WPI, P_1 = wholesale price index (1970-'71 = 100), Y_1 = NNP at factor cost at current prices, Y_2 = NNP at factor cost at constant (1980-'81) prices, i_1 = long-term interest rate (IDBI primary lending rate), i_2 = short-term interest rate (SBI prime lending rate), i_3 = major commercial banks call money rate (Madras).
* Significant at 1% level; *** Significant at 10% level.

appropriate sign and statistically significant at 10 per cent level of significance. When real income variable is used instead of nominal income variable along with interest rate and price variables as independent variables [equations (5) and (6), Table 4], price variable has negative sign but is not statistically significant. The income elasticity of demand for money turns out to be significantly larger than one. Only short-run interest elasticity is statistically significant.

4.   Inflation Rate as Opportunity Cost Variable

Shyam J. Kamath[2] in his study of demand for money in India has put forward the following hypothesis:

> "Physical assets served as substitutes for money in developing countries rather than financial assets since there are few alternative financial assets available for wealth holders due to the under developed financial markets".

On the basis of this hypothesis it is argued that the appropriate opportunity cost variable for India is the inflation rate/expected rate of inflation which emphasises the role of money as a store of value. First we incorporate the current inflation rate along with the income variable in the regression equation. Two inflation rates, one based on the wholesale price index (P_1) and other based on consumer price index (P_2) are used in the regression analysis. Table 5 gives the log-linear regression results. In both the equations [equations (5) and (6), Table 5] which have nominal income and inflation rate as independent variables, income elasticity of demand for money is about 0.6 significantly less than one. Equation (5) tells us that a 1 per cent increase in the inflation rate will reduce the demand for money in real terms by 0.07 per cent.

In equation (6) the inflation rate coefficient has the appropriate sign but is not statistically significant. The regression results in Table 5 tell us that inflation rate based on wholesale price index impinges negatively and significantly on the demand for money. The results also tell us that 95 per cent of the variation in the demand for money is explained by the income and inflation rate variables.

In the empirical literature on demand for money several alternative measures of expected inflation rate are used. In our analysis we proceed on the assumption that this year's inflation rate would be the basis for price expectations in the subsequent year. Thus, we used inflation rate with one year lag along with income variable as independent variables. The log-linear regression results are given in Table 6. We used narrow money stock and broad money stock in real terms as dependent variables. We begin with the results for narrow money stock measure in real terms.

[2.]   Shyam J. Kamath, "The Demand for Money in India 1951-76 Theoretical Aspects and Empirical Evidence", Indian Journal of Economics, Vol. LXV, No. 257, October 1984, p. 132.

Table 5

Regression Results -- Log-Linear Equations

S.No.	Dependent variable	Constant term	Independent variables			R^2	$\bar{R}^2$	D.W. statistic	D.W. test result
			Y_1	$\bar{P}_1$	$\bar{P}_2$				
1.	m_{31}	+10.6470		-0.3118[**] (1.7916)		0.21	0.15	0.4186	Autocorrelation
2.	m_{31}	+10.3687			-0.1851 (0.6685)	0.04	-0.04	0.0950	Autocorrelation
3.	m_{32}	+10.1337		-0.2832[***] (1.5553)		0.17	0.10	0.3825	Autocorrelation
4.	m_{32}	+9.7789			-0.1209 (0.4243)	0.01	-0.07	0.1004	Autocorrelation
5.	m_{31}	+2.7602	+0.6359[*] (13.6814)	-0.0739[***] (1.5983)		0.96	0.94	1.5029	No autocorrelation
6.	m_{32}	+1.8465	+0.6682[*] (14.8759)	-0.0332 (0.7434)		0.96	0.95	1.4852	No autocorrelation

M_{03} = broad money supply in real terms based on WPI, m_{32} = broad money supply in real terms based on CPI; Y_1 = NNP at factor cost at current prices, $\bar{P}_1$ = inflation rate based on WPI, $\bar{P}$ = inflation rate based on CPI.

* Significant at 1% level; ** Significant at 5% level, *** Significant at 10% level.

Table 6

Regression Results - Log-Linear Equations

S.No.	Dependent variable	Constant term	Independent variables				R^2	$\bar{R}^2$	D.W. statistic	D.W. test result
			Y_1	Y_2	$(\bar{P})_{1\text{-}1}$	$(\bar{P})_{2\text{-}1}$				
1.	m_{11}	+5.4985	+0.3477* (10.3628)			-0.1661* (3.7619)	0.92	0.91	1.6369	No autocorrelation
2.	m_{11}	-1.0676		+0.8970* (7.3649)	-0.0853** (2.2457)		0.90	0.88	1.6756	No autocorrelation
3.	M_{12}	+5.1335	+0.3208* (9.1750)		-0.0617** (1.9462)		0.92	0.91	1.6531	No autocorrelation
4.	M_{12}	-2.2850		+0.9551* (9.1413)	-0.0445 (1.3664)		0.92	0.91	1.5930	No autocorrelation
5.	m_{31}	+2.5644	+0.6595* (13.7287)		-0.1171** (2.6874)		0.96	0.96	1.6681	No autocorrelation
6.	m_{31}	+2.0700	+0.7169* (21.0504)			-0.1976* (4.4106)	0.98	0.97	1.9867	No autocorrelation
7.	m_{31}	-12.9277		+1.9837* (17.5376)	-0.0790** (2.2408)		0.98	0.97	1.7530	No autocorrelation

M_{11} = narrow money supply in real terms based on WPI, m_{12} = narrow money supply in real terms based on CPI, m_{31} = broad money supply in real terms based on WPI, Y_1 = NNP at factor cost at current prices, Y_2 = NNP at factor cost at constant (1980-'81) prices, $(P_1)\text{-}1$ = inflation rate with one year lag based on WPI; $(P_2)_{\text{-}1})$ = inflation rate with one year lag based on CPI.
* Significant at 1% level; ** Significant at 5% level.

When m_{11} (M_1 deflated by wholesale price index) is used as the dependent variable and income and inflation rate with one year lag are used as the independent variables [equations (1) and (2), Table 6] the inflation rate variable has coefficients with appropriate sign and are statistically significant. Inflation rate based on consumer price index (CPI) has numerically higher coefficient than that of inflation rate based on wholesale price index (WPI). A 1 per cent increase in inflation rate based on consumer price index (CPI) will result in 0.17 per cent reduction in demand for money, while a 1 per cent increase in inflation rate based on wholesale price index (WPI) will result in 0.08 per cent reduction in demand for money [equations (1) and (2), Table 6]. The equation with inflation rate based on CPI [equation (1), Table 6] has marginally higher R^2 (0.91) than the equation having inflation rate based on WPI (0.86).

When we used real money stock measures based on narrow money supply definition and consumer price index, we find the coefficients of both current income and lagged inflation rate (based on WPI) have coefficients with appropriate signs and are statistically significant (equation (3), Table 6). The income elasticity of demand for money is 0.3208 and a 1 per cent rise in inflation rate in the previous year will result in about 0.06 per cent fall in the quantity of cash balances in the current year.

When real quantity of money (narrow money stock measure deflated by consumer price index) is regressed on real income and inflation rate with one year lag, the income elasticity of demand for money is 0.96 and the coefficient of the lagged inflation rate is --0.0445. Thus, all the results based on narrow money supply as the dependent variable show that 88 per cent or more than 88 per cent variation in the demand for money is explained by the income and lagged inflation rate variables. When lagged inflation rate is used along with income variable, the nominal income elasticity of demand for money is found to be less than 0.5 and the real income elasticity of demand is found to be less than one. The results show that the appropriate opportunity cost variable in the demand for money function in the Indian context is inflation rate with one year lag.

When broader money stock measure in real terms is used instead of the narrow money stock measure, similar results are obtained as can be seen from equations (5) to (7) in Table 6. But the coefficients of determination indicate slightly higher explanatory power of the income and lagged inflation rate variables when broader money stock measure is used. Income elasticity of demand for money is found to be significantly greater than one [equation (7), Table 6]. This result shows that the real income elasticity of demand for money is in the neighbourhood of two, supporting the monetarist hypothesis that money holding is a luxury.

The regression results, so far considered, reveal that the following are the major determinants of demand for money in the Indian context:

1.   Nominal and real national income
2.   Long-term interest rate
3.   Current inflation rate and inflation rate with one year lag.