5.1 INTRODUCTION

The relevance of Monetary Approach to the Balance of Payments has been an extensively explored theme of discussion among economists throughout the world particularly due to high rate of inflation and growing balance of trade and balance of payments deficits in the developing countries. The essence of the argument of the monetary approach to the balance of payments is that the balance of payments is essentially a monetary phenomenon. The core of the analysis of monetary approach is based on Walras Law according to which the excess demand of goods and service, bonds and securities and money, considered together, equals zero. In an open economy, macroeconomic framework excess demand for money can be eliminated by net sales of domestic goods and services or by sale of securities in the foreign market resulting in reserve inflow. Similarly, excess supply of money can be eliminated through purchases of foreign goods and services or by investment abroad resulting in reserve outflow. The balance of payments is in equilibrium when the sum of reserve inflow and outflow is zero. The deficit/surplus of balance of payments is, therefore, self-correcting provided that the monetary authorities do not replace the outflowing funds by a policy of creating new domestic credit. According to monetary approach the depreciation of "deficit nation's currency" under a freely flexible exchange rate system increases the nation's demand for money and absorbs the excess supply of money (which was the cause of deficit) without any outflow of money or reserves.
from the nation. Contrary to this the appreciation of a "surplus nation's currency" automatically eliminates the excess demand for money in the nation without any inflow of money or reserves. Whereas under a managed exchange rate system balance of payments disequilibria are partly corrected by exchange rate changes (which affect the demand for money in the deficit and surplus nations) and are partly corrected by international money flows (which change the supply of money in the deficit and surplus nations). There is paucity of studies undertaken to test the validity of monetary approach to the balance of payments in the Indian case. S.L. Bhatia (1980) studies the period 1951-1973 and emphasises the validity of monetary approach for India. M. Sohrab Uddin (1985) covers the period 1960 - 1980 and stresses that this approach is not an appropriate model for explaining international reserve movement in India. Sundararajan (1986) investigates the period 1952-1977 and says nothing about the causal relations between domestic credit and foreign exchange reserves. R. Kannan (1989) deals with the period 1968 - 1985 and supports the validity of monetary approach. V.S. Raghavan and M.K. Saggar (1989) covers the period 1960-61 to 1985-86 and shows that the monetary approach to the balance of payments theory is not an appropriate model for explaining movements in net foreign assets in the Indian case. Against this background, the objective of this Chapter is to empirically test the relevance of the monetary approach to the understanding of balance of payments situation, in India during 1960-61 to 1985-86.

The organisational structure of this chapter is as follows:

For the purpose of background reference the theories related to the Monetary Approach to the Balance of Payments are briefly
examined in chronological order in Section 5.2. In Section 5.3 methodology adopted, for testing validity of the 'monetary approach' in Indian case, is presented. In Section 5.4 estimated results of the demand for money, reserve flow equation and sterilisation equation are analysed. The last section contains conclusions of the study.

5.2 HISTORICAL PERSPECTIVE OF THE MONETARY APPROACH

The monetary approach to the balance of payments theory has a long academically overwhelmingly reputable history. For the purpose of background reference to monetary approach the theories in the chronological order are:

(i) The classical price-specie-flow mechanism and purchasing power parity theory.

(ii) The elasticities approach.

(iii) The Keynesian multiplier approach

(iv) The absorption approach

(v) The economic policy approach

(vi) The monetary approach

(i) The classical price-specie-flow mechanism and purchasing power parity theory

David Hume's (1752) 'price-specie-flow mechanism' in the 18th century, the interest in the monetary approach to the balance of payments which were seen as providing a mechanism for automatically correcting payments imbalances. David Hume argued that there was an automatic self-correcting 'price-specie-flow mechanism' at work which guaranteed balance
of payments equilibrium. His explanation was that gold flows tended to produce price-level changes which in turn tended to restore equilibrium in the balance of payments and eventually check the flow of gold. After the First World War, almost all the countries of the world abandoned the gold standard and adopted inconvertible paper currency standard in its place. It leads to the problem of fixing the rate of exchange between two countries currencies under inconvertible paper currency standard. In order to remove this difficulty Gaustav Cassel articulated his purchasing power parity theory. According to his theory the rate of exchange between two countries currencies under inconvertible paper currency standard is determined by the purchasing power parity of their currencies. Gaustav Cassel maintained it as “the rate of exchange between two currencies must stand essentially on the quotient of the internal purchasing powers of these currencies”. However, the purchasing power parity theory has been severely criticised by many economists.

According to Harry Johnson, ‘the classical approach to international monetary theory contained no analysis of currency devaluation, except in the indirect form of the theory purchasing power parity offering some guidance on the problem of determining the level of a fixed rate of exchange to which a country temporarily on a floating exchange rate could safely return’.

(ii) The Elasticities Approach

The essence of the elasticities approach argument is that, under certain assumptions depreciation will improve the balance of payments of a country. Appreciation will worsen it
if the sum of the price elasticities of demand for a country's exports and of the price elasticities of demand for a country's imports are greater than one.

The concept of 'elasticities' approach to balance of payments is based on the Marshallian partial equilibrium analysis which was developed by John Robinson in his essay "The Foreign Exchanges" (In Essay in Theory of Employment, London, Macmillan, 1937).

The core of the analysis of traditional approach to the effect of devaluation on trade balance is contained in the Marshall-Lerner conditions stating that the sum of the elasticities of home demand for imports and foreign demand for exports must be greater than unity for a devaluation to have a positive effect on a country's trade balance. Marshall-Lerner conditions can be set out in the following formula:

\[ dB = KXp (ef + eh -1) \]

Where \( dB \) is the change in trade balance, \( K \) the devaluation in percentage, \( X \) is exports, \( p \) the home price of exports, \( ef \) the elasticity of foreign demand for exports and \( eh \) the elasticity of home demand for imports.

The above equation suggests the following rules for effectiveness of devaluation:

(a) if \( ef + eh \) is greater than one, devaluation would improve trade balance

(b) if \( ef + eh \) is equal to one, devaluation would leave the trade balance unchanged
(c) if $ef + eh$ is less than one, devaluation would result in worsening trade balance.

The shortcomings of this approach can be summed up briefly by saying that it is a partial equilibrium analysis. The approach supply conditions and cost changes as a result of devaluation and it tends to neglect the income and expenditure effects of exchange rate changes.

(iii) Keynesian Multiplier Approach

The Keynesian multiplier Approach was developed by Harberger (1950), Laursen and Metzler (1950) and Meade (1951). Harry Johnson\(^3\) pointed out that while the 'Keynesian Multiplier Approach' is a vast theoretical improvement on the 'elasticities approach' it shares with it three basic defects as an analysis of devaluation. First, it assumes a condition of mass unemployment and a rigid money wage. It therefore fails to provide any guidance for the analysis of devaluation under full employment or inflationary conditions. Second, it makes the same monetary-theoretical error of treating a demand for increased money balances as an equilibrium flow demand (matched by an equilibrium excess of income over expenditure) rather than as one facet of a transient stock-flow adjustment process which must end with actual money stocks equal to desired, expenditure equal to income, and the balance of payments in balance. Third, the analysis ignores the fact that whether an increased domestic demand for money is met by international reserve inflow or domestic credit creation and hence whether devaluation improves the balance of payments or it depends crucially on the conduct of domestic monetary policy.
(iv) The Absorption Approach

The absorption approach was originally developed by Sidney Alexander (1952) and subsequently elaborated by Harry Johnson (1958). Alexander explained that devaluation affects domestic economic variables such as consumption, investment and national income and this has to be taken into account in predicting the results of devaluation on the balance of payments situation of a country. Symbolically, the absorption approach can be expressed as:

\[ Y = C + I + G + (X - M) \]

where \( Y \) is national income, \( C \) is consumption expenditure, \( I \) is investment expenditure, \( G \) is government expenditure, \( X \) is exports of goods and services. Letting \( X-M = B \), and \( C + I + G = A \), the relation becomes \( Y = A + B \) and then \( B = Y - A \), where \( A \) is 'aggregate absorption' or domestic expenditure and \( B \) is the balance of trade. The equation suggests that devaluation can improve trade balance only if it increases national income more than absorption.

The main theme of the absorption approach can be summed up by saying that the trade balance is the outcome of a difference between aggregate domestic income and aggregate domestic expenditure. The trade deficit occurs when domestic absorption exceeds domestic production and a surplus occurs when absorption is less than the output or income. The trade deficit will be reduced by devaluation if it cause output to rise more than any rise in absorption or fall by less than absorption.

The absorption approach marked a significant improvement over the 'elasticity' and 'Keynesian multiplier' approach. But according to D.J. Coppock (1978) it is instructive to look at
Harry’s criticisms of the “absorption approach” as set out in his two papers (1977a, 1977b). These are:

(i) It confuses the trade balance with the total balance. Actually, Alexander referred to the current account balance and deliberately abstracted from capital flows in the interest of simplicity. But Harry’s 1958 paper extended the argument to capital flows.

(ii) It assumes that any improvement in the balance of payments from devaluation will be nontransitory. But Alexander recognised explicitly that many of what he called “direct absorption effects” might be transitory (1952, p.274).

(iii) It treats devaluation as a single policy. This is a valid point though one might argue that, with flexible wages and prices the Monetary Approach to Balance of Payments treats devaluation as a single (monetary) policy.

(iv) It fails to elucidate the monetary policy role of devaluation under non-Keynesian conditions. But Alexander refers to the possibility that the cash balance effect may be removed by any domestic credit creation that comes in response to devaluation (1952, p.274). Although his references to the point are brief, there is a clear recognition of the central monetary approach to the balance of payments proposition that domestic credit expansion and balance of payments surpluses are alternative ways of satisfying any excess demand for cash balances. The argument was underlined by Machlup (1955, pp.273-5) in terms that permit no misunderstanding and the monetary implications of the “general absorption” approach were clearly set out in Harry’s 1958 paper (pp.49-51) together with the general inference that balance of payments problems were essentially a monetary phenomenon, implying dishoarding by
residents and/or credit creation by the authorities. The theoretical linkage between devaluation, the real balance effect and monetary policy was set out in 1960 in a brief but perceptive note by Michaely.

(v) The Economic Policy Approach

The essence of the economic policy approach, which is developed by Meade (1951) and Tinbergen (1952) "can be conveyed in the central finding that if, in a two-country world system, it is desired to achieve a balance of payments surplus/deficit equilibrium consistently with the maintenance of full employment in both countries, one country must deflate and the other inflate domestic expenditure by the amount of the desired surplus; that if the sum of the marginal propensities to import is less than unity, the deflation/inflation would create an excess supply of the intending surplus country's exports and an excess demand for the intending deficit country's exports at an unchanged relative price ratio; and that if the exchange market is stable (the 'stability' or 'elasticity condition' is fulfilled) the excess demand/excess supply can be cleared by an appropriate devaluation of the intending surplus country's exchange rate".

According to Harry Johnson this approach has two theoretical errors. First, insofar as it envisages an equilibrium balance of payments surplus or deficit, it wrongly treats international money flows as equilibrium repetitive flows rather than transient symptoms of stock disequilibrium and mechanism of adjustment of actual to desired stocks. Second, by identifying demands for additional money with a demand for accretions of international reserves it disregards the role of domestic monetary policy in determining both whether a devaluation is
"necessary" to correct a balance of payments deficit, or whether it will be successful in doing so.

(vi) The Monetary Approach

The essence of the argument of the monetary approach to the balance of payments is that balance of payments disequilibrium must be considered as the outcome of stock disequilibrium between the supply of and demand for money. Balance of payments difficulties are a monetary phenomenon which can be corrected by monetary adjustment. The relevance of the monetary approach to the balance of payments has been extensively explored themes of discussion both in the developed and the developing countries particularly with reference to a rapidly rising price level and gradually deteriorating conditions of balance of payments.

There has been a renewal of interest in the classical theory of the balance of payments in the period following World War II. The monetary approach to the balance of payments represents a revival of the price-specie-flow theory originally advanced by D. Hume (1752) and later developed by Harry Johnson (1958, 1972) and Robert Mundell (1968, 1971). The pioneering work of Harry Johnson and Robert Mundell is followed by a number of economists. The monetary approach to the balance of payments in its original version states that real variables effect the balance of payments and exchange rates. The real variables operate through monetary channels not only under a fixed and flexible exchange rate system but also under controlled exchange rate system because the money market in this model is assumed to be stable in the sense that if there is a disequilibrium in the money market it will initiate an automatic adjustment process and finally result in the
attainment of equilibrium at least in the long-run. Thus major feature of this approach is that it takes into consideration the stock of money supply endogenous as the stock of money supply is linked with the balance of payments of the country. According to Harry Johnson "balance of payments deficits and difficulties are essentially monetary phenomenon, traceable to either of two causes: too low a ratio of international reserves relative to the domestic money supply, so that the economic policy authorities cannot rely on the natural self-correcting process; or the pursuit of governmental policies by credit creation. In both cases, the problem is associated fundamentally with the power of national banking systems to create money which has no internationally acceptable backing"

5.3 METHODOLOGY OF THE STUDY

This study closely follows the model and methodology adopted by Harry Johnson (1958, 1972), Mohd. Sohrabuddin (1985), Kannan (1989) and Raghavan and Saggar (1989) with some slight alteration in the method and regressing the model by employing the stepwise inclusion of explanatory variables.

To estimate the equations we have used time series data for the period 1960-61 -1985-86 and derived ordinary least square (OLS) estimates. Significance of the estimates is tested at 5 per cent level. Problem like the presence of auto-correlation is duly considered. Standard Error (SE), $R^2$ and F values are provided with each estimated equation. These values justify the 'goodness of fit' of the estimated equations. Data on all the variables was collected from the various issues of the Reserve Bank of India publication like the RBI Bulletins Annual Reports and Reports on Currency and Finance and the International Financial Statistics Yearbook published by the International Monetary Fund.
5.4 EMPIRICAL RESULTS

As reported earlier, the purpose of this chapter is to empirically test the validity of the propositions of monetary approach by analysing the time series data for the period 1960-61 – 1985-86 using ordinary least squares (OLS) method. We have estimated various equations with numerous explanatory variables in different combinations. But here we report only 'best-fitting' regression equations.

DEMAND FOR MONEY

The demand for real balances is assumed to have the function of real national income (Y1), the price level (P) and the 12 month time deposit rate of commercial banks (R12). Specifically, the demand for real money balances is assumed to be of the following form:

\[ \ln \frac{M}{P} = \beta_0 + \beta_1 \ln Y_1 + \beta_2 \ln P + \beta_3 R_{12} + \epsilon_t \]

Since the above equation is specified in logarithms, \( \beta_1 \) and \( \beta_2 \) are the income and price elasticities respectively. In general, the coefficient of income (\( \beta_1 \)) is expected to be positive, whereas the coefficient of price (\( \beta_2 \)) is expected to be negative to reflect the opportunity cost of holding money balances relative to real goods and the coefficient of interest rate (\( \beta_3 \)) would be negative. \( \epsilon_t \) is the error term which is assumed to be independent and normally distributed with zero mean and constant variance.

Estimation of log linear equation, by employing the stepwise inclusion of variables, for demand for real balances for the period 1960-61 to 1985-86 yield the following results with t-values given in parentheses:

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(1) \[ \ln M/P = -4.551 + 0.862 \ln Y_l \]
\[ t\text{-statistic}=(-6.876) \ (14.820) \]
\[ R^2 = 0.897, \ SE = 0.077, F(1,24) = 219.634 \]

(2) \[ \ln M/P = -8.936 + 1.317 \ln Y_l - 0.200 \ln P \]
\[ t\text{-statistic}=(-2.629) \ (3.752) \ (-1.314) \]
\[ R^2 = 0.900, \ SE = 0.076, \ F(2,23) = 114.011, \ DW = 1.828 \]

(3) \[ \ln M/P = -10.114 + 1.444 \ln Y_l - 0.293 \ln P + 0.018 \ln R_{12} \]
\[ t\text{-statistic}=(-2.538) \ (3.473) \ (-1.327) \ (0.590) \]
\[ R^2 = 0.898, \ SE = 0.077, \ F(3,22) = 73.967, \ DW = 1.80 \]

(4) \[ \ln M/P = -9.968 + 1.421 \ln Y_l - 0.279 \ln P + 0.093 \ln R_{12} \]
\[ t\text{-statistic}=(-2.613) \ (3.624) \ (-1.403) \ (0.629) \]
\[ R^2 = 0.898, \ SE = 0.077, \ F(3,22) = 74.144, \ DW = 1.815 \]

It is evident from equation (1) that the coefficient of the variable real national income \( Y_l \) is found to be statistically significant at 5 per cent level with proper sign. The variable explains 89.7 per cent of the variation in the demand for real money balances. There is a slight increase in the explanatory power of equation (2) to 90 per cent, when variable \( P \) is considered along with variable \( Y_l \), while the coefficient of the variable \( P \) possesses expected sign but it is not significant. In comparison to equation (2) there is a slight decrease in the explanatory power of equation (3) to 89.8 per cent when the variable 12 month time deposit rate of commercial banks \( R_{12} \) is added to the variable \( Y_l \) and \( P \). The coefficients of the variables \( P \) and \( R_{12} \) are not significant at 5 per cent level whereas coefficient of \( Y_l \) is highly significant. Apart from using \( R_{12} \) we have also used \( \ln R_{12} \). The results which are presented in equation (4) prove to be somewhat similar. It
can be observed that all the four equations have high degree of explanatory power with no serial correlation but equation (1) is superior in terms of F value.

We have also estimated the demand for real balance equation for the period 1970-71--1985-86 which yield the following results:

(5) \[ \ln M/P = -8.937 + 1.338 \ln Y_1 - 0.253 \ln P \]
\[ t\text{-statistic } = (-1.887) (2.749) (-1.193) \]
\[ R^2 = 0.708, SE = 0.089, F(2,13) = 19.183, DW = 1.887 \]

(6) \[ \ln M/P = -6.940 + 1.14 \ln Y_1 - 0.171 \ln P - 0.01 R_{12} \]
\[ t\text{-statistic } = (-1.261) (2.275) (-0.707) (-0.749) \]
\[ R^2 = 0.698, SE = 0.090, F(3,12) = 12.544, DW = 2.059 \]

(7) \[ \ln M/P = -9.81 + 1.421 \ln Y_1 - 0.306 \ln P - 0.073 \ln R_{12} \]
\[ t\text{-statistic } = (-1.526) (2.214) (-0.910) (-0.211) \]
\[ R^2 = 0.685, SE = 0.092, F(3,12) = 11.863, DW = 1.840 \]

Of the above three equations (5), (6) and (7), equation (5) is clearly superior in terms of $R^2$ and F values. In all the equations the signs of coefficients are as per expectations but all the coefficients are insignificant at 5 per cent confidence level except the coefficient of $Y_1$, which is significant.

From equations (2), (3), (4), (5), (6) and (7) we observed that the coefficients of $P$ and $R_{12}$ are not significant at 5 per cent level whereas the coefficient of $Y_1$ is significant. Therefore, we conclude that the changes in $P$ and $R_{12}$ do not explain the variation in demand for real balances, while the change in $Y_1$ does affect to demand for real balances. It is also evident from the equations (2), (3), (4), (5), (6), and
that the income elasticity of real demand for money is more than unity, indicating that the real demand for money rises more than proportionally as income rises.

**RESERVE FLOW EQUATION**

We have estimated the following assumed form of Reserve Flow Equation:

\[
\frac{R}{H} \Delta \ln R = \beta_0 + \beta_1 \Delta \ln Y_1 + \beta_2 \Delta \ln i + \beta_3 \Delta \ln P + \beta_4 \Delta \ln m + \beta_5 \frac{D}{H} \Delta \ln D + e_t
\]

Where \( R \) = Net Foreign Exchange Assets of RBI;

\( H \) = Reserve Money;

\( D \) = Domestic Component of Reserve Money (\( D = H-R \));

\( Y_1 \) = Net National Product at Factor Cost at 1980-81 prices;

\( i \) = Bank Rate;

\( P \) = wholesale Price Index (Base 1980-81 = 100);

\( m \) = Money Multiplier of Narrow Money (M1);

\( e \) = Error Term;

\( \Delta \) = Represents Change;

\( \ln \) = Natural Log.

\( \beta_1, \beta_2, \beta_3, \beta_4 \) and \( \beta_5 \) are the coefficients to be estimated. In general, it is expected that \( \beta_1 > 0, \beta_2 < 0, \beta_3 > 0 \), and \( \beta_4 < 0, \beta_5 \) known as "offset coefficient" shows the degree to which changes
in the domestic component of the reserve money are offset by changes in the international reserves. It is expected that the value of the offset coefficient ($\beta_5$) is -1 and the changes in the domestic component of the reserve money (D) will cause opposite and equal change in the international reserve (R) i.e., the direction of causation is always from $\Delta \ln D$ to $\Delta \ln R$ and not otherwise.

Estimation of the reserve flow equation, by using the stepwise inclusion of explanatory variables, for the period 1960-61—1985-86 yield the following results:

(8) $\frac{R}{H}$lnR = 0.098 - 0.739* $\frac{D}{H}$lnD

\[ R^2 = 0.492, \text{SE} = 0.057, F(1,24) = 25.25, \]

(9) $\frac{R}{H}$lnR = 0.099 - 0.512*lnm - 0.769* $\frac{D}{H}$lnD

\[ t\text{-statistic} = (5.591) (-5.025) \]
\[ R^2 = 0.492, \text{SE} = 0.057, F(1,24) = 25.25, \]

(10) $\frac{R}{H}$lnR = 0.107 - 0.196(lnP - 0.533*lnm

\[ t\text{-statistic} = (6.627) (-1.117) (-3.451) \]
\[ -0.697* \frac{D}{H} \Delta \ln D \]
\[ (-5.012) \]
\[ R^2 = 0.646, \text{SE} = 0.048, \]
\[ F(3,22) = 16.195, DW = 0.971 \]

(11) $\frac{R}{H}$lnR = 0.102 + 0.126*lnY1 + 0.005 $\Delta \ln i$

\[ t\text{-statistic} = (5.103) (0.445) (0.034) \]
\[ -0.208 \ln P - 0.524*\Delta \ln \eta - 0.697* \frac{D}{H} \Delta \ln D \]
\[ (-1.094) (-3.216) \]
\[ R^2 = 0.614, \text{SE} = 0.050, F(5,20) = 8.967, DW = 1.015 \]
From the estimated equations (8), (9), (10) and (11) we can observe that the coefficients of the price and interest rate variables are of the unexpected signs while the estimated coefficients of the rest of the variables are of expected signs. It is also evident from the equations that all the coefficients are insignificant at 5 per cent level except the coefficient of the rate of growth of money multiplier and the value of the offset coefficient which are statistically significant.

Estimation of the reserve flow equation for the period 1970-71 - 1985-86 yield the following results:

(12) \[ \frac{R}{H} \Delta \ln R = 0.153 - 0.304 \Delta \ln i - 0.400* \Delta \ln m \]
    \[ t\text{-statistic} = (9.232) (-1.961) (-3.204) \]
    \[ -0.924 \Delta \ln D \]
    \[ (-8.696) \]
    \[ R^2 = 0.856, SE = 0.038, F(3,12) = 30.836 \]
    \[ DW = 2.774 \]

(13) \[ \frac{R}{H} \Delta \ln R = 0.165 - 0.173 \Delta \ln Y1 - 0.204 \Delta \ln i \]
    \[ t\text{-statistic} = (7.682) (-0.645) (-1.030) \]
    \[ -0.185 \Delta \ln P - 0.441* \Delta \ln m - 0.883* \Delta \ln D \]
    \[ (-0.916) (-3.312) (-6.777) \]
    \[ R^2 = 0.848, SE = 0.039, F(5,10) = 17.788 \]
    \[ DW = 2.380 \]

Equations (12) and (13) give slightly better results as both the equations have higher degree of explanatory power. The DW
statistic indicates the absence of first order serial correlation in both the equations.

The above results are obtained by considering the change in the logarithmic values of the variables. Now only specifying the variables in logarithmic form and replacing $Y_1$ with gross domestic Product at factor cost at 1980-81 Prices ($Y_2$), the estimation of the reserve flow equation for the period 1970-71 - 1985-86 yield the following results.

(14) $R/H\ln R = 6.833 - 0.717*D/H\ln D$
    t-statistic = (9.185)(-7.372)
    $\bar{R}^2 = 0.781$, $SE = 0.563$, $F(1,14) = 54.348$

(15) $D/H\ln R = -28.623 + 3.142\ln Y_2 - 0.870*D/H\ln D$
    t-statistic =(-14.551) (18.079) (-40.499)
    $\bar{R}^2 = 0.991$, $SE = 0.114$, $F(2,13) = 823.068$

(16) $R/H\ln R = -22.132 + 2.607\ln Y_2 - 0.834*\ln m$
    t-statistic = (-6.841) (9.588) (2.355)
    - 0.861*D/H\ln D
    (-45.814)
    $\bar{R}^2 = 0.993$, $SE = 0.098$, $F(3,12) = 742.379$

(17) $R/H\ln R = -10.59 + 1.412*\ln Y_2 + 0.561*\ln P$
    t-statistic = (-2.329) (3.167) (3.035)
    -0.858*ln m - 0.869*D/H\ln D
    (-3.142) (-59.041)
    $\bar{R}^2 = 0.996$, $SE = 0.076$, $F(4,11) = 940.094$
    $DW = 1.853$
\[ (18) \quad R/H \ln R = -9.989 + 1.341 \ln Y^2 - 0.156 \ln i \]
\[ t\text{-statistic} = (-1.952) (2.578) (-0.313) \]
\[ +0.695 \ln P - 0.783 \ln m - 0.876^* D/H \ln D \]
\[ (1.478) (-2.101) (-32.104) \]
\[ \bar{R}^2 = 0.996, \text{SE} = 0.079, F(5,10) = 690.436 \]
\[ DW = 1.831 \]

It is evident from equation (14), (15), (16) and (17) that all the explanatory variables are important as shown by the significance of the "t statistic". All the equations have high degree of explanatory power and the signs of coefficients are as per expectations.

The overall results of the estimated equations (from 8 to 18) suggest that the Indian reserve flow experience over the period under the study has been broadly in conformity with the monetary approach to the balance of payments. As it can be seen from all the equations that the value of offset coefficient is approaching -1 and it is statistically highly significant. This confirms the proposition of the monetary approach to the balance of payments i.e., for a given amount of money multiplier changes in the domestic component of the reserve money (D) will cause opposite and equal change in the international reserves (R).

STERILIZATION EQUATION

The sterilisation equation, which is considered as a policy reaction function of the monetary authorities, is expected to explain change in the domestic component of the reserve money (D) in response to change in the foreign assets (R) and other variables which are considered in the reserve flow equation.
Specifically, the sterilisation equation is assumed to be of the following form:

\[ \frac{D}{H} \Delta \ln D = \beta_0 + \beta_1 \Delta \ln Y_1 + \beta_2 \Delta \ln i + \beta_3 \Delta \ln P \\
+ \beta_4 \Delta \ln m + \beta_5 \frac{R}{H} \Delta \ln R + \varepsilon_t \]

where \( \beta_5 \) is known as "Sterilisation coefficient". Other notations are the same as explained in reserve flow equation. Here Sterilisation Coefficient measures the use of monetary policy to sterilise the impact of reserve flows on the reserve money. In the monetary approach to the balance of payments it is assumed that the monetary authorities do not adopt any sterilisation policy. In other words the monetary authorities do not replace the outflowing funds by creating new domestic credit (which is known as sterilisation). If the monetary authorities do not adopt any sterilisation policy then the value of sterilisation coefficient is expected to be zero. But under complete sterilisation the value of coefficient would be -1.

The estimation of sterilisation equation for the period 1960-61 – 1985-86 yield the results shown in the following equations:

(19) \[ \frac{D}{H} \Delta \ln D = 0.113 - 0.694 \times \frac{R}{H} \Delta \ln R \]
\[ t\text{-statistic} = (9.662) (-5.025) \]
\[ R^2 = 0.492, \text{SE} = 0.056, F(1,24) = 25.25 \]

(20) \[ \frac{D}{H} \Delta \ln D = 0.115 - 0.452 \times \Delta \ln m - 0.815 \times \frac{R}{H} \Delta \ln R \]
\[ t\text{-statistic} = (11.016)(-2.684) (-6.216) \]
\[ R^2 = 0.597, \text{SE} = 0.0496, F(2,23) = 19.49 \]
(21) \[ \frac{D}{H} \Delta \ln D = 0.106 - 0.079 \Delta \ln Y_1 + 0.004 \Delta \ln i + 0.131 \Delta \ln P \]
\[ t\text{-statistic} = (5.009) (-0.264) (0.027) (0.642) \]
\[ - 0.413 \ln m - 0.755 \frac{\Delta \ln R}{\Delta \ln R} \]
\[ (-2.181) (-4.620) \]
\[ R^2 = 0.547, SE = 0.053, F(5,20) = 7.040, \]
\[ DW = 1.083 \]

Above results reveal that the fit of equation measured by \( R^2 \) is not very high. The coefficients of all the explanatory variables are insignificant at 5 per cent level except the coefficients of money multiplier and net foreign assets which are significant at 5 per cent level. The values of sterilization coefficients in equations (19), (20) and (21) are \(-0.694\), \(-0.815\) and \(-0.755\) respectively, while the monetary approach suggests a value of zero for this coefficient as the causation is from \( \Delta \ln D \) to \( \Delta \ln R \) and not otherwise.

The estimated equations for the period 1970-71 – 1985-86 are presented below:

(22) \[ \frac{D}{H} \Delta \ln D = 0.145 - 0.791 \frac{\Delta \ln R}{\Delta \ln R} \]
\[ t\text{-statistic} = (10.975) (-6.233) \]
\[ R^2 = 0.716, SE = 0.049, F(1,14) = 38.847, \]

(23) \[ \frac{D}{H} \Delta \ln D = 0.144 - 0.382 \Delta \ln m - 0.888 \frac{\Delta \ln R}{\Delta \ln R} \]
\[ t\text{-statistic} = (13.108) (-2.713) (-7.990) \]
\[ R^2 = 0.805, SE = 0.040, F(2,13) = 31.93, DW = 2.191 \]
\[(24) \quad D/H \triangle \ln D = 0.158 - 0.273 \triangle \ln i - 0.377 \triangle \ln m \]
\[\text{t-statistic} = (12.039)(-1.694) (-2.862)\]
\[-0.934 R/H \triangle \ln R\]
\[(-8.696)\]
\[\bar{R}^2 = 0.829, SE = 0.038, F(3,12) = 25.308, DW = 2.836\]

\[(25) \quad D/H \triangle \ln D = 0.168 - 0.254 \triangle \ln Y_1 - 0.255 \triangle \ln i - 0.032 \triangle \ln P\]
\[\text{t-statistic} = (7.482)(-0.943) (-1.301) (-0.151)\]
\[-0.396 \triangle \ln m - 0.930 R/H \triangle \ln R\]
\[(-2.581) (-6.771)\]
\[\bar{R}^2 = 0.813, SE = 0.0396 F(5,10) = 14.008, DW = 2.741\]

It is evident from the above equations that period 1970-71 to 1985-86 yields better fit for the sterilisation equation in terms of explanatory power. But in all the equations values of sterilisation coefficients are approaching to -1.

Without taking any change in the logarithmic values of the variables in sterilisation equation and replacing \(Y_1\) by Gross Domestic product at factor cost at 1980-81 prices \((Y_2)\), the estimation of the equation for the period 1970-71 - 1985-86 yield the following results:

\[(26) \quad D/H \ln D = 9.114 - 1.108 R/H \ln R\]
\[\text{t-statistic} = (32.641)(-7.372)\]
\[\bar{R}^2 = 0.795, SE = 0.70, F(1,14) = 54.348\]

\[(27) \quad D/H \ln D = -32.907 + 3.612 \ln Y_2 - 1.142 R/H \ln R\]
\[\text{t-statistic} = (-15.396)(19.666) (-40.499)\]
\[\bar{R}^2 = 0.992, SE = 0.131, F(2,13) = 969.311,\]
Out of above five equations, (29) is best fitted in terms of $R^2$ and F values. In general, all the individual equations have very high degree of explanatory powers. Except the equation (30) the coefficient of all the explanatory variables in all the equations are statistically significant at 5 per cent level. Values of the estimated sterilisation coefficients in equations (26), (27), (28), (29) and (30) are -1.108, -1.142, -1.134, -1.147 and -1.131 respectively, and all are significant at 5 per cent level, while the monetary approach to the balance of payments postulates a zero value for the sterilization coefficient. The monetary approach to the balance of payments proposition that it is the domestic credit
which causes changes in international reserves and not vice-versa is not confirmed by our results.

5.5 CONCLUDING REMARKS

In summary we can say that in India the real demand for money rises proportionally more than income. Growth in output and the price level are associated with balance of payments surpluses. The growth in money supply (M1) tends to be associated with deficits and reserve outflows whereas effects of the interest rate on reserve flows tend to be weak. All our results taken together suggest that India’s reserve flow experience over the period of the study has been broadly in conformity with the monetary approach to the balance of payments but the sterilisation equation does not give guidance in this direction.

In view of the above results it becomes evident that the monetary approach to the balance of payments needs to be probed from a different angle as well. This will have to be done by separating the reserves inflow on account of Non-Resident Indian’s (NRI) remittances from the totally independent of growth of real output and changes in price level within India. The second manner in which our results could be improved would be by taking instead of domestic price level if we take into account a ratio of domestic price to some kind of an average of world prices on as its proxy the ratio of prices of Indian exports and imports.
REFERENCES

1. For a collection of essays on this topic see Jacob Frenkel and Harry Johnson (eds.) The Monetary Approach to the Balance of Payments, Allen and Unwin, 1976.

2. Under the rules of the gold standard, the gold-losing (gold-gaining) country is required to allow its money supply to decrease (increase). These money supply changes supposedly set into motion David Hume's Price-Specie-Flow mechanism which restored balance of payments equilibrium.
