CHAPTER-II

MONETARY AGGREGATION: A SURVEY OF MAJOR ISSUES AND EVIDENCES

Much ingenuity has been spent upon attempts to define the term money...All such attempts at definition seem to me to involve the logical blunder of supposing that we may, by settling the meaning of a single word, avoid all the complex differences and various conditions of many things, each requiring its own definition.

-----William Stanley Jevons
Money and the Mechanism of Exchange

2.0. INTRODUCTION

An attempt has been made in this chapter to trace the evolution of various approaches to money definition starting from the 1960s. The specific purpose of this chapter is to provide the necessary background to the present study, by way of highlighting the basic features of the theoretical and empirical approaches to money definition and bring together evidences drawn from the previous work. To facilitate the discussions, the chapter has been organised into seven sections. The first section reviews the theoretical approaches to money definition while section 2.2 reviews the approaches to empirical definition of money. The various approaches to weighted monetary aggregates are surveyed in section 2.3 followed by a critical evaluation of all the approaches in section 2.4. Section 2.5 presents a review of some major studies. Studies focusing on financial innovations and Divisia monetary aggregates are presented in section 2.6. Money definition in the Indian context is dealt with in the last section.
2.1 THEORETICAL APPROACH

The theoretical approach to money definition involves conceptualising money in terms of certain functions or characteristics and then identifying the real world economic entities which are consistent with the theoretical concept of money. Unfortunately, there is no single function of money. Emphasis on different functions produces different monetary aggregates. As a result, there is a considerable disagreement about how to define money. In the literature, the medium of exchange, "liquidity" and "temporary abode of purchasing power" functions have been emphasised while defining money.

Clower (1971), an advocate of the means of payment approach says that, in case of an organized market, the Walrasian auctioneer-coordinator being at the centre, there is no need for a specialized commodity to serve as a means of payment because all commodities are perfect substitutes. The absence of a Walrasian auctioneer-coordinator necessitates a specialized commodity which should routinely serve as a means of payment Clower calls this commodity as money. He favours trade credit as well as currency and demand deposits for inclusion in the broad connotation of money definition, for practical purposes in the United States and the United Kingdom. He suggests credit cards, overdraft facilities, travellers' cheques as well as book credits in trade credit for inclusion in money stock but rejects some substitutes like time deposits and other financial claims to qualify as money.

Emphasizing on the means-of-simultaneous payment function of money, Schacke (1971) defines money as "the total of all those payments which could be made without the payers receiving or counting on the payments to be made by others. Simultaneity must be insisted on here, lest we mix up quantity and velocity" (p.32). This definition of Schacke includes coins, notes, transaction deposits and time deposits at banks. Time deposits are included because the owner of the time deposit account could
write a cheque on his demand account (having zero balance) as per the provisions. This is nothing but the overdraft facility. Money, here, is defined as the means of making payments. Increasing trade credit on the other hand puts off the making of payments. Shackle therefore hesitates to consider trade credit as money. But he includes bank credit in the definition of money. This implies that Schackle has a narrow view of encompassing the goods market only. If the distinction between the goods market and the debt market is avoided then the transaction will not be complete until the bank overdraft is repaid and hence bank credit along with trade credit cannot be included in the stock of simultaneous means of payment.

Johnson (1971) defines money as that which can routinely be exchanged for goods without creating a debt and a repayment obligation. Money under this approach is a means of payment that does not create obligations against it. Similarly, Yeager (1968) advocates that for a commodity to be money, it must serve as a medium of exchange and must circulate routinely. This definition of money by Yeager assumes monetary theory as essentially a theory of exchange media. For example, non bank travellers' cheques working as exchange media are not identified as money because they do not circulate routinely.

The tangible medium of exchange approach originates from the writings of Black (1970) and Fama (1980). In their opinion, the entity functioning as a medium of exchange, if tangible could be called money. For example, they identify currency as the tangible money medium of exchange. Fama's definition of money is implicit in his model. In his model of unregulated banking, an accounting system of exchange operating through debits and credits acts as the method of paying for goods and services. There is no need for a physical medium of exchange in this case. The two features of an "ideal" system of payments as given by Fama are (i) an accounting system of transactions maintained by banks, and (ii) charging competitively determined fees for services and paying competitive
interest rates on deposit balances. This ideal system of payments does not need currency or any other physical medium of exchange and therefore accounting balances of the real world system are no money. Then currency alone is money. The question raised here is whether it is necessary for the medium of exchange to be tangible so as to qualify for money.

Tobin (1980) points out two distinctive features of money viz (i) it is an "outside" asset, not generated by the private economy itself as the counterpart of private debt, and (ii) that its nominal or own rate of interest is institutionally or legally fixed and is not determined in markets. To quote Tobin, "The story told by monetary theory would be quite different if 'money' were an inside asset, its nominal quantity and yield endogenous, or if people were induced to hold additional outside 'money' by an increase in a market clearing nominal interest rate on money itself" (p 319). Again quoting his words, "The nominal supply of money is something to which the economy must adapt, not a variable which adapts itself to the economy-unless the policy authorities want it to" (p 319).

According to the store of value function approach, what matters is the liquidity. That is to say in the presence of a whole range of liquid assets, cash may not be an obstacle in the path of household and business spending. Spending here is constrained by liquidity but not by cash alone, as payments can be made through the available alternative liquid assets. Variations in trade credits and debts created by nonbank financial intermediaries have a bearing upon the attempts of Central Banks to manipulate money supply for its desired effects on economic activity. Therefore monetary policy should take into account the whole range of liquid assets instead of focusing on money stock alone.

The above argument is in line with the view of Gurley and Shaw (1960) and Radcliffe Committee. Gurley and Shaw argue that the monetary system is free from
competition by other financial intermediaries only when money demand is limited to
transaction services and no other financial assets can be substituted for means of payment.
In reality, money faces competition as other financial assets are also held on demand.
Money supply is then indeterminate. The degree of substitutability between money
created by banks and financial assets created by other financial institutions therefore
matters to find out the quantum of money supply at a given point of time.

Friedman(1971) is the main advocate of the "temporary abode of purchasing
power" approach. He emphasized the "store of value" function of money. According to
him "the function of money as a temporary abode of purchasing power makes it seem
entirely appropriate to include also such stores of value as time deposits not transferable
by cheque" (p 9). In his words "The essential feature of a money economy is that it enables
the act of purchase to be separated from the act of sale. In order that the act of purchase
be separated from the act of sale, there must be something which everybody will accept in
exchange as general purchasing power. But also there must be something which can
serve as a temporary abode of purchasing power in the interim between sale and
purchase" (p 9). Friedman favours the M2 aggregate (currency + demand deposits + time
deposits of the public with commercial banks) as money that serves as a "temporary
abode." Though the definition is consistent with the concept of temporary abode of
purchasing power including only time deposits in it is not justified. Any component
assets serving as medium of exchange can serve as temporary abode, but not vice versa.

To sum up the functional or theoretical approach defines money through a priori
reasoning. Conceptualisation precedes measurement and identification follows
conceptualisation. That is, a theoretical concept of money is developed first on the basis
of certain specific functions performed by money and then a set of assets conforming to
the concept is identified. The collection of such assets is to be called as money.
The basic limitation of the theoretical approach lies in different functions of money being emphasised by different authors which results in multiplicity of definitions. As no single asset can capture all the functions of money at a time one gets confused as to what ought to be called as money. It is perhaps right here to conclude by quoting A.P. Andrew (1899), who says, "It is a singular and, indeed, a fact that, although money was the first economic subject to attract man's thoughtful attention, and has been the focal centre of economic investigation ever since, there is at the present day not even an approximate agreement as to what ought to be designated by the word. The business world makes use of the term in several senses, while among economists there are almost as many different conceptions as there are writers upon money" (p. 219)

2.2 EMPIRICAL APPROACHES

The ambiguities inherent in the theoretical approach and emergence of more money-like (near money) entities gave a different angle to the money definition debate. Monetary economists therefore started looking at the problem as an empirical matter. They endeavoured to identify and quantify money stock measure, considering a constellation of monetary assets based on certain policy criteria.

Basically, there are two ways of looking at the empirical approach to money definition. If the purpose is to have a well-defined money stock measure, then one has to select certain policy criteria and accordingly group the assets satisfying these criteria to call them as money. These criteria are preconceived and preselected. For example, that measure of money is the best which (a) has the highest correlation with national income, (b) has a stable demand function, (c) represents the best target for monetary policy, and (d) produces an adequate theory of demand for money. The other way of defining money
empirically basically involves aggregating different monetary assets available. The resulting monetary aggregate is the outcome of different permutations and combinations of the financial assets. The number of assets may be one or more.

The various approaches to an empirical definition of money may be classified into two broad groups viz., (a) simple sum approach and (b) weighted aggregation approach. Under the simple sum approach, (i) Friedman-Meiselman (F-M) dual criteria, (ii) stable money demand function approach, and (iii) extension of simple correlation analysis are well documented in the literature. The weighted aggregation approach may be subdivided into the following (iv) elasticity of substitution approach, (v) microeconomic monetary aggregation approach, (vi) some ad hoc (alternative) approaches. In the following subsections a brief note on the above mentioned approaches is made.

2.2.0. F-M Dual Criteria

Friedman-Meiselman (1963) developed a dual criteria in order to arrive at an appropriate money definition. According to them, an aggregate to be called as money should satisfy the following two criteria: (i) It must bear the highest correlation with income and (ii) money income must be more highly correlated with the aggregate than with individual components of the aggregate.

The dual criteria was applied to three components of money stock viz., currency, demand deposits and time deposits by Friedman-Meiselman, to check whether the inclusion of time liabilities in money satisfies the criteria. The empirical results showed a higher correlation between the aggregate and income when the aggregate included time deposits rather than excluding it.
The dual criteria was further extended by Kaufman (1959), Hullet (1971) and Schadrack (1974) to check for alternative definitions of money. Kaufman (1969) extended the dual criteria to alternative monetary aggregates observed in time lags up to four quarters and lead of one and two quarters with income. Only a limited number of definitions satisfied the dual criteria.

A distributed lag model of the following form

\[ Y_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i X_{t-i} + \epsilon_t \]

where \( Y_t \) and \( X_t \) represent income and monetary assets respectively and \( \epsilon_t \) is white noise error, was introduced by Hullet (1971) in order to test the long run impacts of the money supply changes on money income. The conclusion was in line with that of Kaufman's.

But the estimated regression coefficients changed significantly across the sample periods, unlike Kaufman's study where the results were not even sensitive to alternative sample periods. Hullet attributed his results to changes in the transaction technology in the financial market which resulted in changes in the degree of moneyness for various financial assets during the sample period 1953-68.

Schadrack (1974) evaluated alternative monetary aggregates using three different criteria viz., (i) strength of the relation between changes in money and income, (ii) stability of this relationship over time, and (iii) ability of the relationship to predict changes in income outside the sample periods. The results were in favour of M2 comprising of currency outside the treasury Federal Reserve Banks and commercial bank vaults, demand deposits at commercial banks, foreign demand balances at Federal Reserve Banks and United States Government demand deposits at member banks, as it satisfied all the criteria for the period 1953 I through 1968 II and for different sub periods. Hence, Schadrack advocated M2 as the most appropriate definition of money.
2.2.1 Stable Money Demand Function Approach

This criterion selects a set of assets by identifying its most stable demand function with respect to a few theoretically appropriate explanatory variables. The logic behind this criterion is that if the demand for a monetary aggregate is a stable function of a few theoretically important economic variables such as income, interest, then changes in the aggregate are sufficiently predictable in terms of changes in these variables. Alternatively, changes in money stocks may be manipulated to exert influence on economic activity via changes in income and rate of interest. Thus a stable money demand function creates a conducive atmosphere for an efficient conduct of monetary policy.

The major studies under this approach include those of Brunner and Meltzer (1963, 1968), Rose (1985), and Roley (1985). The earlier studies identify the narrow money (M1) as generally stable. The latter studies indicate that short-run money demand models are generally unstable because of coefficient instability, lag adjustment problems, single equation format etc. But Rose (1985) attributed the poor performance of the earlier money demand equations to problems like employing traditional partial adjustment models, insufficient diagnostic testing etc. Otherwise M1 is a stable reliable empirical monetary aggregate from the policy viewpoint.

Friedman and Schwartz (1970) while analyzing the US data observed drastic changes in the conditions of money supply with stable demand conditions and therefore laid emphasis on demand conditions. Then they proposed the stable money demand criterion to select a particular collection of monetary assets from among a bunch of alternative allocations which will have the most stable demand function. Meltzer (1963) opined that money should be defined in such a way that the stable demand function can be
shown to have existed under alternative institutional arrangements and under changing social, political and economic conditions.

Until the mid 70's the demand for money function was generally accepted to be stable and robust, irrespective of money definitions. Therefore, application of the stable demand criterion to define money by identifying a group of assets had no meaning. The question "what is money? " still remained unanswered.

Laidler (1969) differed at this point whose suggestions changed the direction from stability to controllability. To quote him, "the authority must be able to control the volume of that set of assets that most closely corresponds to the money stock of standard macro economics, at the same time the demand function for these stock of assets must be stable enough for the consequences of changing its volume to be predictable with a high degree of reliability"(p 509)

The inherent contradiction in the stable money demand approach was rightly pointed out by Osborne(1992). To quote him, "Belief in this proposition has led some monetarists to define money as that(set of liquid assets) which has a stable demand function. This definition is rarely stated in so many words, but it is implicit in some of the best work on money demand, such as Laidler(1969 509-15 1977 149-52) Whether implicit or explicit, the definition puts the cart before the horse. We have to define and identify money before we can test the stability of its demand. This stability(if it exists) is to be demonstrated empirically, not deemed true axiomatically."
2.2.2 Extension of Simple Correlation Analysis

This approach basically aims at measuring moneyness of the near money assets. Advocates of this approach, Timberlake and Fortson (1967), employed a regression model of the following form.

\[ \Delta Y_t = \alpha_0 + \alpha_1 \Delta M_{1t} + \alpha_2 \Delta T_t + \epsilon_t \]

where \( Y \) is nominal income, \( M_1 \) is currency plus demand deposits, \( T \) is time deposits, \( \Delta \) is difference operator and \( \alpha \)'s are coefficients. By computing the regression coefficients \( \alpha_1 \) and \( \alpha_2 \) they tried to find out the degree to which near moneys were near to money. The three conditions listed by them were

(a) if \( 0 < \alpha_2/\alpha_1 < 1 \), then \( T \) would have some degree of moneyness

(b) if \( \alpha_2/\alpha_1 = 1 \) then \( M \) and \( T \) are homogeneous assets

(c) if \( \alpha_2/\alpha_1 < 0 \), then it indicates that people reduce their transaction balances and buy time deposits

The estimated results yielded \( \hat{\alpha_1}/\hat{\alpha_2} = 7.997 \) for the period 1933-38. Hence, the aggregate comprising of time deposits seemed to be a better predictor of change in money income than the narrow money stock. During the 1950s, the quantity \( \hat{\alpha_2}/\hat{\alpha_1} \) was positive but there was no significant difference even after inclusion of time deposits.

2.3 APPROACHES TO WEIGHTED MONETARY AGGREGATES

The weighted monetary aggregates basically aim at weighing different financial assets according to their degree of contribution to the monetary service flow of the economy. The advocates of this approach raised their voice against the practice of simple
sum scheme while constructing monetary aggregates. The simple sum scheme has been criticized by them on the following grounds: First, the simple sum scheme assumes perfect substitutability among different components of a monetary aggregate and accordingly assigns equal weights to them. But in reality the component monetary assets are found to be imperfect substitutes differing in their degree of moneyness, which has been supported by voluminous empirical evidences. Secondly, the simple sum aggregates measure the accounting stock, which is not an economic variable in any economy's structure. Thirdly, the sum aggregates are incapable of capturing the flow of monetary services provided by the component assets. At low levels of aggregation, the simple sum(narrow) aggregates entirely overlook the contribution of monetary substitutes to the flow of monetary services. On the other hand, at higher levels aggregation, the sum(broader) aggregates do not change in response to one-for-one transfers between component assets and hence do not capture the interest elasticity of velocity of monetary services. Regarding the simple sum (arithmetic average) index, Irving Fisher wrote over a half century ago that "the simple arithmetic average produces one of the very worst of index numbers, and if this book has no other effect than to lead to the total abandonment of the simple arithmetic type of index number, it will have served a useful purpose." The simple arithmetic [index] should not be used under any circumstances" (p 36)

Thus the simple sum measures may bring in distortions in monetary aggregates. The conventional monetary aggregates add up to accounting stocks only and therefore, are not suitable for meaningful economic analysis. Friedman and Schwartz (1970) observed, "This (simple summation) procedure is a very special case of the more general approach. In brief, the general approach consists of defining the quantity of money as the weighted sum of the aggregated value of all assets, the weights for individual assets varying from zero to unity with a weight of unity assigned to that asset or assets regarded as having the largest quantity of moneyness." The more general approach has been
suggested frequently but experimented with only occasionally. We conjecture that this approach deserves and will get much more attention that it has so far received" (p 151)

Hence, the advocates of these approaches argued for weighted monetary aggregates as an alternative to the existing sum aggregates, apprehending the use of the latter for monetary policy

Approaches towards construction of weighted monetary aggregates can broadly be grouped into three viz.,

(i) Substitution approach
(ii) Micro economic monetary aggregation approach
(iii) Some ad hoc approaches such as

(a) The preference independence transformation approach
(b) The Roper and Turnovsky approach
(c) Turnover rate weighting approach

2.3.0 Substitution Approach

The main architect of this approach is Chetty (1969) who put forth the argument that each monetary asset has a certain degree of moneyness in it. The problem here is not the selection of assets to be included in the measure of money stock but how much of each monetary asset is to be included. Intuitively therefore monetary aggregates have to be constructed covering all assets being properly weighed in accordance with their degree of moneyness. The weighting scheme employed by Chetty is dependent on the elasticity of substitution between different component assets. The degree of moneyness associated with any financial asset is determined by elasticity of substitution between that asset and a reference asset which is considered to be the most liquid asset. Under this approach, Chetty (1969) for the first time explicitly utilized the neo-classical utility maximization
framework to estimate elasticities of substitution between liquid assets. The decision problem formulated by Chetty is of the form

\[ \text{Max } U(m_1, m_2, ..., m_n) \]

Subject to

\[ \sum_i m_i / (1 + r_i) = W \]

where \( U() \) is a CES utility function, \( m_i \) is the money value of the \( i \)th liquid asset held at the beginning of the next period, \( r_i \) is the interest rate on liquid asset \( i \), and \( W \) is the discounted value of current period's financial wealth. Then the exact quantity aggregate is \( u(m) \) where \( m = (m_1, m_2, ..., m_n) \). From the above discussion, it becomes clear that the substitution approach recognizes the direct relevance of microeconomic aggregation theory to monetary aggregation.

2.3.1. Micro Economic Monetary Aggregation Approach

The substitution approach as a weighing scheme to arrive at an appropriate monetary aggregate has some deficiencies. They include (i) econometric specification of parameterised functional form, (ii) estimation of its parameters, (iii) sensitiveness of the results to model specifications, use of data, estimation procedures. These limitations have been overcome by proposing some innovative and novel approaches. A new strand of research in the literature viewed the problem of monetary aggregation as preparation of a good monetary statistical index which is known as the user cost approach or the Divisia approach or the micro-economic theory of monetary aggregation approach. This approach has been made popular by Barnett and his collaborators in the 1980's.
Barnett's (1980) pioneering effort integrated economic aggregation theory, index number theory and monetary theory. However, the groundwork for Barnett's whole exercise of integration was done by Hulten(1973), Diewert(1976) and Barnett(1978) himself.

In economic aggregation theory, an aggregator function is either a utility function or a production function. An economic price aggregate \( P \) is solely a function of the component prices, i.e., \( P = f(p) \), \( p = (p_1, \ldots, p_n) \) where \( f \) is called the aggregator function. Similarly, an economic quantity aggregate, \( Q \) is solely a function of the component quantities, i.e., \( Q = g(q) \), \( q = (q_1, \ldots, q_n) \), where \( g \) is called the aggregator function. The product of \( P \) times \( Q \) must equal total expenditure on the components. Therefore, knowledge of \( P \) helps in finding out \( Q \) and vice versa.

The economic aggregation theory requires two important conditions to be satisfied. They are (i) The proposed aggregate to bear a stable definition, the components of the aggregate must be weakly separable and (ii) The aggregator function must be linear homogeneous in its arguments. The first condition is a necessary condition which may otherwise be called as the existence condition as it ensures the existence of an economic aggregate. The second condition is a sufficient condition which ensures consistency between growth rate of the aggregate and growth rate of its components. These two conditions when satisfied enable the economic aggregate to act as a variable in the economy's structure. That is to say, the economy's structure can then be written as a composite function of the quantity aggregator function \( Q \).

In reality, it is difficult to find out an exact economic price or quantity aggregate, since the aggregator function is not known. Even though the aggregator function can be specified and estimated, the aggregates produced may not be acceptable to the monetary authorities for publication due to the aggregates' dependence on estimated parameters.
This is where the theory of statistical index numbers comes to the rescue and helps in overcoming the conventional parametric problems as they do not contain any unknown functions. These index numbers are constructed so as to provide a close approximation to the economic aggregate at every instant of time.

Dievert (1976) succeeded in unifying the economic aggregation theory with index number theory. He derived a new class of index numbers called superlative index numbers. These index numbers possess good theoretical properties and provide high quality approximations to the unknown exact aggregates of economic theory. A superlative index number is defined as "an index number consistent with (or exact for) a flexible aggregator function", where a flexible aggregator function is an aggregator function, capable of providing a second order approximation to an arbitrary twice differentiable linearly homogeneous function. The Fisher's ideal index and the Divisia index fall in this category. Hulten (1973) showed that in continuous time the Divisia index is always exact for any consistent aggregator function which is block wise homothetically weakly separable. Tomqvst-Theil index is found suitable as it provides a discrete time approximation to the continuous time Divisia index and falls within the class of superlative index numbers.

The established linkage between aggregation theory and index number theory paved the way for monetary aggregation. Monetary aggregates now can be expressed as monetary statistical indices. But again the problem arose due to non-availability of prices of monetary components since the index number contains both prices and quantities as its arguments. Barnett's (1978) derivation of user cost of money helped in subduing this difficulty.

Barnett applied the concept of user cost of a durable good to the monetary components and derived an appropriate formula. The user cost of a durable good is the
cost during one period of acquiring, using and disposing of the asset, i.e., the user cost of any real durable good is nothing but its imputed one-period holding cost. Then the user-cost of the durable good is calculated by subtracting the discounted expected resale value of the depreciated good in the next period from the purchase price of the durable good in the current period. In simple terms, the user cost of a monetary asset can be written as \((R - r_i)\) where \(r_i\) is the own rate of return on the monetary asset \(i\) and \(R\) is the maximum available yield in the economy on any monetary asset. The difference \(R - r_i\) represents the opportunity cost of holding monetary asset \(i\) during that period. Thus \(R - r_i\) is the price paid in return for receipt of the services of the \(ith\) asset.

Barnett's derivation of the current period user cost\(^1\) \(\pi_{it}\) of \(m_{it}\) reduced to

\[
\pi_{it} = P_t^* (R_t - r_{it}) / (1 + R_t)
\]

where \(P_t^*\) is the current true cost of living index.

The corresponding real user cost is given by,

\[
\pi_{it}^* = x_{it} / P_t^*
\]

The task becomes easier after obtaining the user cost of different monetary assets.

Supposing that \(x_1, x_2, \ldots, x_n\) are the user costs for the monetary assets with balances \(M_1, M_2, \ldots, M_n\) the moneyness associated with the \(ith\) asset is the corresponding user cost evaluated value share in the total. Thus moneyness of \(ith\) asset is given by.

\(^1\)The formula may be corrected for taxation which is as follows \(x_{it} = P_t^* (R_t - r_{it}) (1 - t) V (1 + R_t (1 - t))\) where \(t\) is marginal income tax rate, \(r_{it}\) is the own current period holding yield on component \(i\), \(R_t\) is the maximum available expected holding period yield in the economy.
\[ S_i = \pi_i M_i / \sum_{i=1}^{n} \pi_i M_i \]

\( S_i \) is therefore the weight assigned to the asset in accordance with the contribution of the assets towards the economy's monetary service flow. Statistical index number theory is then used to construct the weighted aggregates. Using Divisia Index (Tornqvst-Theil Index) the discrete time approximation to the continuous time Divisia index becomes

\[ Q_t^* = Q_{t-1}^* \Pi j \left[ m_{jt} / m_{j,t-1} \right]^{1/2} \left( s_{jt} + s_{jt-1} \right) \]

where \( S_{jt} = \pi_{jt} M_{jt} / \sum_k (\pi_k + M_{kt}) \) is the expenditure share on component \( j \) during period \( t \), and \( \Pi \) is the product symbol.

Taking logarithms on both sides

\[ \ln Q_t^* - \ln Q_{t-1}^* = \sum_j S_{jt}^* \left( \ln m_{jt} - \ln m_{j,t-1} \right) \]

where \( S_{jt}^* = 1/2 \left( S_{jt} + S_{jt-1} \right) \)

The growth rate of the Divisia monetary aggregate is a weighted average of the growth rates of the individual component assets. The Divisia monetary aggregate could properly weigh the contribution of all segments of the money market to the monetary service flow of the economy. Thus the fundamental problem of estimation of unknown parameters could be circumvented with the application of index numbers to the aggregation process. Parameter free estimates could be obtained to closely approximate the economic aggregate. The Divisia index was employed in most of the empirical exercises as it was the most informative one which aggregated over as much of the money market as possible.
Following Barnett (1980a, 1987), the ideas underlying microeconomic monetary aggregation theory may be crystallised as follows. In aggregation theory demanders of monetary assets are treated as maximizing intertemporal utility subject to a sequence of budget constraints expressed as an intertemporal transformation function. The utility function contains real monetary asset balances as arguments. Beginning with neoclassical consumer demand theory, one assumes that the utility function of each economic agent is blockwise weakly separable in the current period portfolio of monetary assets.

Proofs in Barnett (1987) show that economic agent (for example a consumer) solves a simple conditional current period decision problem, since the first and second order conditions for solving that problem are included among the necessary condition for solving the economic agent’s full intertemporal joint optimization problem. The current period conditional decision is of the form

\[
\text{Maximize } u(m_t) \tag{2.1} \\
\text{Subject to } m_t^* \pi_t y_t \text{ where } m_t^* = (m_{1t}^*, \ldots, m_{nt}^*). \text{ is the economic agent’s current period real balances of the } n \text{ monetary assets, } \pi_t = (\pi_{1t}, \ldots, \pi_{nt}) \text{ is the vector of real user cost prices of those prices of those assets, and } y_t \text{ is current period real expenditure on the services of monetary assets. The function } u \text{ is the weakly separable subfunction (category subutility function) that is nested within the full intertemporal transformation function or utility function. The function } u \text{ is monotonically increasing and strictly quasi concave.}
\]

In the general case, the exact economic quantity aggregate produced by decision (2.1) is the distance function, treated as a function of \( m_t \) at fixed reference level \( u_0 \). The distance function \( d(u_0, m_t) \) is defined in implicit form by,

\[
u(m_t d(u_0, m_t)) = u_0 \tag{2.2}\]
The geometric interpretation of equation (2.2) is that \( d(u_0, m_t) \) is the factor by which \( m_t \) must be deflated to reduce (or increase) the level of \( u \) to the fixed reference level \( u_0 \).

Deflated by its value in a base period, the distance function becomes the malmquist quantity index, which is dual to the famous Konus true cost of living index. Thus it is clear from the above elaboration that the exact monetary quantity index for a consumer can be estimated by estimating the function \( u \). If \( u \) is linearly homogeneous then \( u \) itself is the quantity aggregator function. If \( u \) is not linearly homogeneous then the distance function, which is derivable from \( u \), is the exact quantity aggregator function. Estimation of \( u \) however, produces an aggregate dependent on empirical specification of \( u \) and estimated parameters. Government data producing agencies usually hesitate to use such kind of a method. Instead they prefer using index numbers which are parameter and specification free.

The solution to this practical problem therefore lies clearly in statistical index number theory which is nonparametric in nature. Recent results from index number theory have proved the Divisia index to be the best available index as the Divisia index tracks the exact aggregator function without error. In discrete time, the Tornqvist approximation to the Divisia index tracks the exact economic aggregator function with very low error, regardless of whether \( u \) is homogeneous.\(^2\)

2.3.2. The Ad hoc Approaches to Monetary Aggregation

The monetary services of a liquid asset are the services valued by the asset holder other than the interest rate yielded by the asset. However, for specific purposes one may

\(^2\)An excellent survey of microeconomic monetary aggregation theory is found in Anderson et al., (1997)
need to evaluate the quantity of a single service such as liquidity rendered by an asset. But it is rarely possible to measure directly the quantity of one service produced by a multiservice asset. Theil's preference independence transformation enables one to untangle the jointness in service production. Barnett et al. (1981) directly applied this approach. One of the assumptions in Lancaster's (1966) consumer demand theory is that goods produce characteristics or services. And utility is a function of these characteristics or services rather than goods themselves. The preference independence transformation reveals the quantities of those services as functions of the quantities of the goods or assets.

The Roper and Turnovsky approach uses a simple IS-LM Keynesian macroeconomic model to produce the control theoretic solution to the optimum policy that maximizes a particular policy objective function. Roper and Turnovsky (1980) solve for the monetary aggregate that will produce that optimum policy if the aggregates growth rate is stabilized in terms of a constant growth rate rule. Hence, the optimum monetary aggregate equates maximization of the policy objective function with stabilization of the growth rate of the aggregate.

For example the optimal monetary aggregate may be that which minimizes the forecast variance in nominal income. Thus,

\[ M(RT) = \sum_{i=1}^{n} \phi_{it} M_{it} \]

where RT refers to Roper and Turnovsky, \( M_{it} \) is the \( i \)th monetary asset during time \( t \), and \( \phi_{it} \) is the optimal weight for \( (i \)th) asset during time \( t \). The optimal weights may be derived by minimizing the forecast variance in nominal income using a Vector Autoregressive (VAR) System.
In the Turnover Rate weighting approach, turnover rates are functions derived from the demand function for a monetary asset. In this approach, a monetary aggregate is produced using a Fisher Ideal index in monetary quantities and turnover rate which is just an arbitrary combination of component quantities and turnover rates. Spindt (1985) made use of this approach.

2.4. A CRITICAL EVALUATION OF APPROACHES

The approaches discussed above have some limitations. In this section, an attempt is made to present a critical evaluation of the approaches.

2.4.0. Substitution Approach

The substitution approach propounded by Chetty has been criticized on following grounds. First, Chetty's model is appropriate only in a two period world, as Chetty's prices do not measure the opportunity cost of acquiring a unit of the service flow and hence are not user costs. The model may have only limited applicability to a multiperiod world, because in a multiperiod world the user costs measure the price of a unit of the services of an asset. Secondly, the assumption of strong separability and theoretical inadequacy of CES form might have considerably biased Chetty's elasticity estimates upwards. Thirdly, this approach is sensitive to the specification of the model, sample size etc. and produces estimates which are not parameter free. Lastly in the Indian context as observed by Jadhav, Chetty's model when applied to Indian data for the period 1945 to 1966 yielded unduly large elasticities of substitution. The elasticity of substitution as between narrow money (M1) and time deposits turned out to be as high as 34.7, which meant that the two were very good substitutes of each other. Or in other words the "moneyness" associated with currency or demanded deposits was as high as the moneyness of time deposits.
In the later periods, the substitution approach of Chetty and the model employed by him along with the underlying assumptions were criticized by Donovan, (1978) Boughton (1981) and Husted-Rush (1984), who suggested certain modifications such as the use of rental price of assets in lieu of interest rates, real values instead of nominal values of financial assets, an implicit rate of return for narrow money stock. They showed interesting results by incorporating these changes in the original model.

2.4.1. Micro Economic Monetary Aggregation Approach

This approach has also been subjected to criticism. For instance Cockerline and Murray (1981) argued that the rates posted on savings deposits and other monetary assets may exaggerate the effective rate economic agents expect on their investments. They also argued that the minimum balance requirements in certain accounts, early encashment penalties on some fixed term assets might tend to reduce the measured own rates of return on monetary assets. Calculating user costs would be complicated if one wants to aggregate across assets with different maturity dates.

Jadhav (1989) has raised certain questions which reflect his skepticism insofar as the applicability of this approach to construct weighted monetary aggregates is concerned. First under the user cost approach, "money" is regarded as a capital aggregate similar to Friedman's conception presented in his "Restatement of the quantity theory of money" (1956). Then, the demand for money by wealth holders is treated as a problem in capital theory. In this sense, analytically, there is no distinction between a money good and any other capital good. To quote Spindt (1985), "this conception of money is insufficiently narrow for the analytical and empirical purposes of some monetary economists who emphasize the primary significance of money's distinctive role as means of
payment" (p. 77). But, the user cost approach having a wide coverage of services besides general acceptability of money as a means of payment i.e., liquidity, divisibility, surety of nominal value etc., is subjected to conceptual imprecision.

Secondly, the construction of monetary aggregates is highly dependent on measurement of user cost (formula) of the relevant monetary assets. It is to be noted that the user cost is proxied by the formula $R - r_i$ where $R$ is the expected maximum available yield on the chosen benchmark asset during time $t'$, $r_i$ is own rate of return on the $i$th asset during time $t'$. As Judd and Scadding (1982) have pointed out, this method of computing user costs is useful for a world in which interest rates on monetary assets are unregulated. But in countries like India where the interest rate is administered, the use of this formula may be problematic. Thus the use of this approach may bring in more problems though it is considered to be an improvement over the previous approaches to arrive at an appropriate money stock measure.

Thirdly, Barnett’s user cost formula for monetary assets has been criticized by McCann and Divid (1989) on the ground that it did not take into account the capital gain or loss due to changes in price level occurring at the beginning of a period as the budget constraint was expressed in nominal terms. Therefore, they suggested an inflation adjusted user cost formula as an alternative to that of Barnett’s. But the results of the exercise did not improve upon Barnett’s previous results.

Lastly, as McCulloch (1990) pointed out, certain aspects were not touched upon by Barnett in his aggregation theoretic developments. For instance, the sensitivity of Divisia indices to monetary disequilibrium is not addressed by Barnett. McCulloch cited the study by Davidson and Ireland (1990) in which the plausible inventory models of money demand predicted that most often most money holders were equally content with a broad range of money holdings. This implies a certain long-run average level of money
demand but at any moment the money holders feel themselves under no compulsion to be on their demand schedule. How can the index number theory be applied here when money is not in the utility function?

Fisher, Hudson and Pradhan(1993) pointed out that weights on component monetary assets were very sensitive to interest rate changes. A rise in interest rate increases the user cost of currency and therefore lead instantaneously to a higher weight. Again as the higher interest rate causes investors to hold less cash in their portfolio, the weight for currency will fall over time. Current weights are not optimal due to this lag unless investors adjust their portfolio instantaneously with corresponding changes in interest rates. In the short run in a situation in which the amount of currency held by economic agents grows more rapidly than the amount of interest bearing assets, an increase in interest rates will instantaneously increase the weight for currency and reduce that on interest bearing assets, thereby leading to an increase in the superlative index growth rate. Based on this reasoning Fisher et al concluded that the superlative index could be misleading indicator of the monetary policy stance.

2.4.2. The Ad hoc Approaches

Among the ad hoc approaches, the Preference Independence Transformation is not free from parameters. It requires specification of a utility function and estimation of its parameters.

The Roper and Turnovsky aggregate originates from the policy objective function and it is not an outcome of the economy's structure. Micro economic aggregation theory produces aggregates that exist and can be factored out of the economy's structure. Thus the economy's structure is a composite function of the aggregates. In this sense the Roper-Turnovsky aggregate does not exist, as it is not an outcome of any structural
function which is blockwise separable. Therefore, this aggregate does not measure monetary services, liquidity or "money" in any meaningful sense. As Jadhav (1989) observed, this approach attempts to measure money without prior conceptualisation. Moreover, with respect to different policy criteria, different money stock measures can be derived under this approach so that no single measure could be able to claim its superiority over others. To quote Jadhav, "It has been pointed out that there is no generally agreed criterion as a standard for making judgement. Roper-Turnovsky's criterion is only one of the several possible candidates" (p. 52-53). Even after identifying a globally optimal criterion, monetary aggregates may differ across countries, time periods, functional forms and models. The superior forecasting ability of the resulting monetary aggregates however, should not be surprising as it is very much embedded in their very construction.

The aggregate constructed by Spinett (1985) from the turnover-rate weighting is entirely arbitrary, as an infinite number of function of monetary quantities and turnover rates can be found out which will produce arbitrary growth rates for the aggregate from the same component data.

2.5. REVIEW OF MAJOR STUDIES

After discussing the basic tenets of the various approaches to money definition it would be of interest to survey the available empirical evidences under those approaches.

Pointing out certain fundamental problems in Chetty's formulation of the utility maximization problem and his estimation procedures, Donovan (1978) derived a system of aggregate liquid asset demand equations from a household model of utility maximizing behaviour. The improvements in his model were the application of the concept of the rental price of a durable good to the case of money and use of frontier developments in
duality theory. Using the annual Canadian household data for 1952-74, the study showed substitutability of a lower order magnitude among monetary assets.

Reestimating Chetty's model using an extended data sample Boughton(1981) He modified Chetty's model in several respects. He used real values of financial assets instead of nominal values and introduced implicit yield on demand deposits. He also differenced the data by applying a consistent two stage estimator. Relaxing the strong separability condition but retaining the homotheticity assumption, it was concluded that there was only a weak substitution between money (narrowly defined) and such assets as savings and time accounts at banks and thrift institutions.

Certain theoretical and empirical flaws were pointed out by Husted-Rush(1984) in the Chetty-Boughton specification of the model. They questioned Boughton's use of the implicit yield on demand deposits as an inappropriate measure of yield on narrowly defined money, since only a part of M1 consisted of demand deposits. They formulated a consumer problem which involved allocation of current period savings and inherited wealth of the consumer between holds of money (M) and balances of a near money asset (T). The model was estimated by using both two stage and three stage least square techniques. The interest rate used by the authors is measured by \( R_j \) \( m \) \( (d-i_j) \) \( d \), where \( d \) is the discount rate proxied by the yield on long term BAA corporate bonds, \( j \) are time deposits, mutual savings bank deposits, savings and loan shares, \( m \) is money and \( i \) is rate on \( n \)th asset. The results of the study indicated still lower elasticities of substitution. Thus the authors concluded that money was a unique asset having no close substitutes.

Employing duality theory and a flexible functional form Subrahmanyan(1980, 1993) presented a model for an empirical definition of money for the US household sector. The study estimated Allen partial elasticities of substitution and cross-interest elasticities for seven financial and physical assets. The elasticity results suggested the ranking of
assets to be US Govt short term marketables (US), Savings and loan shares + mutual savings bank deposits (SM) and Time + Savings accounts at commercial banks (TS) and the empirical monetary aggregate to be M₄ = M₁ + US + SM + TS

An interesting paper by Subrahmanyan (1996) reexamined the substitutability among demand deposits and time deposits, using Indian annual data from 1951 to 1985. Incorporating the influence of bank branch expansion as a factor in a CES model, he estimated the elasticities of substitution which were found to be lower. Ignorance of the branch expansion factor in a Chetty (1969) kind of model would have yielded higher elasticities of substitution.

Application of information theory was made by Barnett and Spindt (1979, 1980) to compare the performance of Divisia index with that of the simple sum index. They found the Divisia monetary aggregate performed better than the simple sum aggregate in terms of their information content for each of their choices of components for the monetary aggregate and for each of their choices of targets for policy.

Barnett (1980) gave a comparative account of monetary aggregates constructed using two different approaches viz., (i) functional approach and (ii) index number approach. In the functional approach, Chetty's CES specification of the model for the utility function was used and the elasticity of substitution between savings accounts across institutions was examined. The functional quantity aggregator provided better approximation than the sum aggregates. As the functional aggregator depends on the model specification and estimation of unknown parameters, the study employed Divisia index to construct parameter free approximations to monetary aggregates. Barnett advocated the use of Divisia index as it performed better than the sum aggregates.
Offenbacher (1980) estimating a linear logarithmic expenditure system for currency, demand deposits and time deposits less large Certificate of deposits (CDs) at commercial banks with US quarterly data for the sample period 1952-76, found a lower degree of substitution between means of payment assets and non means of payment assets. He made a case against simple sum aggregates. Barnett et al (1981) considered an aggregate having transaction balances, pass book savings at the three institution types and at credit unions, small time deposits at the three institution types and negotiable and non negotiable large CDs at commercial banks as the components. The velocity of the simple sum aggregate in this study was found to be declining while that of the Divisia aggregate was rising. This was due to erroneous and inadequate weighting done by the sum aggregate for the transaction balances. With the use of Divisia index the interest elasticity of money demand yielded the expected sign. Incorporation of the elements of the unregulated money market satisfactorily stabilized the velocity of the Divisia aggregate. Thus study therefore advocated the use of Divisia index (Tornquist-Theil) to compute monetary aggregates.

Cockerline and Murray (1981) used Canadian data for the first time to evaluate the empirical properties of Divisia monetary aggregates. They compared Divisia aggregates versus sum aggregates in terms of their informational content, money-income causality, and stability of money demand functions. The overall performance of the Divisia aggregates was unclear though the Divisia aggregates followed smoother time paths than the summation aggregates. For instance Divisia aggregates were found to be more stable in money demand equations but performed poorly in causality tests and information content tests.

Barnett (1982b) laid down certain conditions to obtain an optimal monetary aggregate. The conditions were (i) existence condition (defining the condition under which an economic aggregate exists in aggregation theory), (ii) consistency condition, and
(iii) recursiveness condition. The steps suggested by him were to select an asset group satisfying the above conditions and choosing a proper index number formula. The last step involves selection of the optimal one from among the hierarchy of aggregates produced.

In the first stage, a theoretically admissible set of component assets is selected over which the monetary aggregates can be constructed. The first condition in this stage is the existence condition which states that the component group should be weakly separable. For example, let \( M \) be the set of assets available in the economy and let \( C \) be a subset of \( M \). \( C \) is said to be a separable component group if and only if the marginal rate of substitution between any two assets in \( C \) is independent of the quantity of any good or asset not in \( C \). All the separable subsets like \( C \) have to be obtained from \( M \) to get the admissible groupings. The consistency condition, (second in the first stage) says that an admissible component group \( C \) is a consistent component group, if the elasticity of substitution between any component asset in the group and any good or asset not in the group is independent of the good or asset that is not in the group. Every consistent component group is separable, but not every separable group is consistent.

Imposition of the restriction of linear homogeneity on the economic aggregate ensures consistency. The third condition is the recursiveness condition which stipulates that the components of each aggregate should be monetary assets only and not any other goods or assets. Though monetary assets as such is not defined in aggregation theory, assets have to be selected by intuition. After obtaining the admissible grouping one switches over to the second stage where a proper index number formula is chosen and user costs of monetary assets are calculated. Finally, the monetary statistical indices are computed. In the third stage, the aggregates obtained from the second stage are put to specific tests depending upon the application in which the aggregate has to be used. That
aggregate which empirically works best is selected as the optimal monetary aggregate from a hierarchy of the nested aggregates.

Mills (1983) developed a framework for providing an empirical assessment of alternative monetary aggregates in terms of their ability to predict future movements in nominal income and price level. He argued that considerable information is lost through aggregation but the conventionally defined monetary aggregates do provide a significant amount of information for predicting future values of the goal variables.

Barnett (1984) compared the growth rates of the new Divisia monetary aggregates with those of the corresponding officially targeted sum aggregates for the period 79 11-82 8. The average growth rates of simple sum M2 and M3 were 9.3% and 10.0% respectively whereas the average growth rates of the Divisia M2 and M3 were 4.5% and 4.8% respectively. The rate of inflation was 10.4 - 12.8%. Hence, monetary policy was found to be tighter when measured by official sum aggregates. On the other hand, measured by the Divisia aggregates the monetary policy was found to be more volatile and tighter than the sum aggregates.

Barnett et al (1984) again made a comparison between the performance of the Divisia monetary aggregates and the simple sum aggregates and emphasised the relevance of the Divisia scheme. Certain policy relevant criteria were chosen and the aggregates were put to different tests like Haugh-Pierce causality test, Sims test, approximate likelihood ratio test in the bivariate VAR etc. The results could not suggest a uniformly best aggregate. Divisia M3 and Divisia L (Federal reserve's highest level official aggregate which contains most of the national debt of short and intermediate maturity) acquired the most stable demand for money function. The velocity function for Divisia M3 was found to be stable. In the reduced form comparison, sum M1 performed better than Divisia M1, but at a higher level of aggregation, Divisia aggregates outperformed the sum aggregates.
Using Japanese quarterly data from 1971 to 1982, Ishida (1984) computed Divisia monetary aggregates and compared velocities of money and the money demand functions using these aggregates with those derived from the simple sum aggregates. The main findings of the study were (i) there was a more stable relation between Divisia monetary aggregates and GNP than those between ordinary simple sum aggregates and GNP, (ii) the results from money demand estimations using Divisia aggregates also supported the fact that relations between Divisia monetary aggregates and GNP were stable. In view of the ensuing financial innovations in Japan, the results on the whole were suggestive of use of Divisia monetary aggregates especially at the higher levels of aggregation.

The enormity of the criteria considered in the study perhaps posed a problem in inferring something concrete as no uniformly best aggregate could be suggested. However, a favourable trend was set for the Divisia aggregates. At higher levels of aggregation, the performance of the Divisia aggregates was better than the simple sum aggregates due to the increasing divergence between the time paths of the Divisia and simple sum aggregates.

Serletis and Robb (1986) employed a quasi homothetic translog utility framework on Canadian data (1968 to 1982) and estimated the degree of substitutability between the services of money and checkable savings and time deposits. The results further strengthened the evidence supporting the Divisia scheme. Serletis (1987) systematically examined the appropriateness of the weak separability conditions using a flexible functional form interpretation of the quasi homothetic translog functional form and with the help of the approximation analysis developed by Denny and Fuss (1977). The different tests of separability hypothesis were not conclusive, however. On the whole, they suggested a narrow definition of money.
Barnett (1987) developed models of monetary asset demand by consumers and firms individually. He also developed a model of monetary asset supply by financial intermediaries. All these models were based on the usual neoclassical tenets. The models established that a unique correct monetary price aggregator (or a quantity aggregator) exists for each of the three economic agents—the consumer, the manufacturing firm and the financial intermediary, when the aggregator function is linearly homogeneous. Aggregation theoretic results were also established under the conditions of homotheticity and non homogeneity. These theoretical results yielded rigorous microeconomic foundations for both monetary and macro economics.

Another Canadian study by Hostland, Poloz and Storer (1988) measured the information content of Fisher Ideal monetary aggregates. The results showed the Fisher aggregates to contain less information than the summation aggregates. The study found M1 to be the most informative aggregate for both nominal and real GDP.

Barnett and Chen (1988) applied tests of mathematical chaos to four Divisia demand monetary aggregates, four Divisia supply monetary aggregates and their respective simple sum counterparts. The aggregates corresponded to four standard official US money stock measures namely M1, M2, M3 and L. The results showed Divisia demand monetary aggregates possessing the characteristics of mathematical chaos very clearly. The Divisia demand monetary aggregate L, simple sum supply aggregate M2 and Divisia supply monetary aggregate M2 were found to possess characteristics of mathematical chaos rather well, but with more noise. These results were consistent with the relevant aggregation theory.


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3Poterba and Rotemberg (1987) have demonstrated that estimation of theoretical economic monetary aggregator function is presently possible under risk aversion.
updated approach of Barnett's involves four stages viz., admissibility, approximation, monitoring and application. The details are as follows:

Step 1(Admissibility):

The first step seeks to identify theoretically admissible groups on the basis of blockwise weak separability tests. Models with intertemporal expected utility maximization should be used for conducting separability tests. Moreover, inference regarding separability should be deduced from within the Euler equations for which the literature is yet to develop and apply the same to monetary data.

Step 2(Approximation)

After identifying separable monetary asset blocks, one should apply the best available statistical index number to aggregate over those components. The aggregate thus constructed should be made available to the public. Index numbers presently in use are from Diewert's superlative class. However, assumption of perfect certainty or risk neutrality is inherent in these index numbers. The index number literature therefore need to be extended to allow for risk aversion.

Step 3(Monitoring)

On a continuous basis, the quality of these monetary services indices should be compared with estimated economic aggregator functions which are parametric in nature. Parametric estimations should also use the best available functional specification and econometric methodology.

Step 4(Application)
For the benefit of policy makers these aggregation theoretic aggregates should be introduced in demand for money functions and macroeconometric models. Instead of using linear Goldfeld type of demand for money functions, demand for money should be modelled by estimating Euler equations under the assumption of risk aversion.

Barnett, Hinich and Yue (1989) carried out steps 2 and 3 of the above mentioned four step procedure using monthly component data from Fayyad (1986). They estimated economic aggregator functions using generalized methods of estimation (GMM) and obtained an exact theoretical rational expectations monetary aggregate. This aggregate was then used to adjudge the tracking capabilities of two statistical index numbers - the simple sum and the Divisia, both in time domain and frequency domain. The authors found Divisia monetary aggregates tracking the estimated theoretical aggregate well, while the simple sum aggregate did not. To sum up, this study advocated extensive use of available theoretical results from aggregation and index number theory by the government data producing agencies for constructing monetary data and emphasized the need for continuously monitoring them.

Considering the Australian monetary data for the period 1969 IV to 1987 III Horne and Martin (1989) examined the performance of weighted aggregates using the weights of Chetty, Roper-Turnovsky and Barnett. The empirical results favoured Divisia aggregates over their simple sum counterparts.

Belongia and Chalfant (1989) constructed Divisia and simple sum aggregates over some weakly separable blocks of monetary assets for United States obtained from Vanarn's nonparametric tests. The performance tests in terms of controllability criterion and St. Louis equation indicated the superiority of Divisia aggregates over simple sum aggregates. Further, Belongia and Chalfant (1990) trying to solve the 1980's "velocity
problem prevalent in the United States, identified money stock mismeasurement as the cause for the breakdown of the historical relationships between the growth rates of M1 and both the price level and nominal income. They reviewed the monetary aggregation approach to money definition and discussed the properties of two measures namely Divisia and money metric index (MMI). Divisia M1 velocity was consistent with a stable long-run relationship with the aggregate price level while MMI velocity did not appear to be so. The M2 velocity was found to be stable whereas M1 velocity was not.

In the Swiss context, Yue and Fluri (1991), employing monthly data from 1976:6 to 1989:12 made a case for Divisia monetary indexes as monetary targets. The study examined the potential usefulness of Swiss M1 and M2 monetary aggregates compared to their Divisia counterparts. M1 and Divisia M1 possessed the same characteristics in relation to the Swiss inflation. Growth rates of both these aggregates were potentially controllable by the Swiss National Bank. M2 and Divisia M2, however, differed remarkably in their empirical behaviour in relation to inflation and monetary base.

Serletis and King (1993) examined the empirical relationships between Divisia and summation aggregates, income and prices in Canada. No monetary aggregate was found to be cointegrated with the price level or nominal income. H wiener the Granger causality tests found the growth rate of summation M2* to be the best leading indicator of inflation. For real output sum M1 and Divisia M1 were the best indicators of real output.

Belongia and Chrysal (1991) evaluated the performance of a monetary aggregate constructed from principles of economic and index number theory. Varsans (1982) non-parametric demand analysis was sought for in the study to test for the weak separability of alternative asset groupings. They examined the performance of the aggregates using cointegration technique and an aggregate spending equation. The cointegration technique
tested for the long-run relationship between the aggregate and both national income and price level. The results strongly favoured the use of Divisia scheme.

With the advent of financial innovations and introduction of more and more new financial assets, the debate has veered around inclusion or exclusion of certain assets in the monetary aggregate. Some recent studies have taken up the issue. Collin and Edwards (1994) considered the case of an alternative monetary aggregate to M2 for the Federal Reserve Bank of St Louis, in including household holdings of bond and equity mutual funds.

Subsequently, Barnett et al (1994) reacting to the question raised by Orphanides et al (1994) regarding the inclusion of stock and bond funds, suggested to untangle the two discounted present values viz., discounted present value of monetary service flow and discounted present value of investment yield of stock and bond assets. In fact a growing collection of assets creates confusion. The new assets certainly contribute to the economy’s monetary service flow though not fully. At the same time, the investment yield of these assets can not be considered as monetary services. Ignorance of these assets undervalue the economy’s monetary service flow and inclusion of them endangers contamination of aggregates with non-monetary services.

Pennacchi (1994) criticized the practice of expressing multigood demand relations as a function of a linear combination of those goods in monetary economics whereas the other areas of economics have abandoned this practice. He appreciated the “model based” approach of Barnett (1980) to construct monetary aggregates. The current situation, therefore, warrants such a practice as the traditional measures of monetary policy are obscured by the continuous financial innovations.

Chrysal and Macdonald (1994) compared the relative performance of simple sum and Divisia aggregates, taking seven countries viz. the United States, the United Kingdom,
Australia, Switzerland, Canada, Germany and Japan. The results from the St.Louis equations favoured Divisia aggregates against their broad simple sum counterparts. The overall results gave a clear edge to Divisia aggregates over the simple ones. The study suggested production of official Divisia index numbers for exhaustive test of their performance as indicators.

The performance of some Canadian weighted monetary aggregates was conducted by Longworth and Atta-Mensah (1995) mainly with Fisher Ideal aggregates for the period 1971-1989 using quarterly observations. Tests such as information content, forecasting performance of the aggregates in terms of prices, real output and nominal spending, stability of money demand relations etc., yielded results in favour of summation aggregates. Broad simple sum aggregates were found to predict inflation best whereas real M1 emerged as the best predictor of real output. These evidences were in line with the earlier Canadian studies where weighted aggregates rarely performed better than the simple sum aggregates.

An interesting study by Belongia (1996a) identified the flawed measurement of the money stock as one of the important reasons of the unresolved monetary puzzles of the 1980s. Reiterating the long recognised weaknesses of the traditional simple sum measures, he replicated the following five studies by replacing the sum measures with Divisia aggregates:

(i) Rotemberg's estimates of money innovations
(ii) Cover's study of symmetric monetary influences
(iii) Kydland-Prescott evidence against monetary effects on output
(iv) Robustness of results across sample periods
(v) Stock-Watson and Friedman-Kuttner results on Money Income causality
The empirical findings of the study implied that many of the monetary puzzles of the 1980s could have been resolved if the use of the flawed simple sum measures had been abandoned. The study concluded by saying that the basic inferences about the direction, magnitude and significance of money growth could crucially depend on the chosen money stock measure and the choice of simple sum money measures might prove hazardous for the policy makers. Belongia (1996b) also presented a collection of country specific studies covering eleven countries including the core European Monetary union, where the procedure for creation of Divisia series and their analysis for the respective countries have been attempted.

Belongia (1996b) also provided a collection of eleven country specific studies on the utility of Divisia monetary aggregates covering the European Monetary Union area.

2.6. FINANCIAL INNOVATIONS AND DIVISIA MONETARY AGGREGATES

The accuracy of Divisia monetary aggregates was questioned by Koenig and Fomby (1990) in the wake of changes in payments technology in the 1970s and 1980s which were attributed to introduction of new types of transaction accounts like other checkable deposits (OCDs) in the United States. Innovations like automated teller machines, money market mutual funds accounts and money market deposit accounts were also referred to which might have distorted the pattern of growth of transaction balances in the late 1970s and early 1980s. Assuming a specific functional form for the payments technology the authors explored an alternative aggregation procedure and obtained what they called a CES aggregate. The CES aggregate was favoured in terms of the empirical results found. This aggregate was much less sensitive to movements in OCD balances than was either the simple sum or the Divisia measure of household M1 balances.
Ford *et al.*, (1992) raised a question viz., "Do the Divisia monetary aggregates adequately capture the effects of all financial innovations such as introduction of new financial instruments and progress in transactions technology?" It is to be noted that if innovation in the financial industry is neutral in nature, the Divisia index can successfully measure the technological progress. But most financial innovations in reality are non-neutral in terms of their effects on the liquidity and productivity of different financial assets. Proceeding in line with Koenig and Fomby (1990), the authors demonstrated through a model how Divisia monetary aggregates fail to adjust for the effects of financial innovations related to technological progress and introduction of new monetary assets. Three kinds of modified Divisia measures therefore were constructed by the authors employing two innovation variables in the construction of the Divisia indices, using a learning curve adjustment of the retail sight deposit interest rate and third by combining the above two to capture effects of innovations. The results favoured modified Divisia aggregates as these modified aggregates outperformed their corresponding innovation neutral Divisia indexes as indicators of the level of economic activity.

An excellent collection of seven country specific experiments with Divisia monetary aggregates was presented by Mullineux's (1996). The studies in general searched for plausibility of empirical implementation of the newly constructed Divisia monetary indices as intermediate targets. However, the collection of studies differed from the earlier works in respect of introducing novel ideas such as financial innovation, emergence of new financial instruments and changes in the payments habits due to electronification in the payments system. The question raised in the wake of these innovations was "Do the Divisia indices instantaneously adjust for these changes?" which most of the studies tried to answer in this volume.

The study of the United Kingdom by James Ford and Andrew Mullineux focused on the impact of financial innovation and technological progress such as introduction of
automated teller machines (ATMs) and electronic funds transfer at point of scale (EFTPOS) on measurement of Divisia monetary aggregates. Slightly modifying the procedure developed in Ford et al (1992), the authors tried to incorporate electronification effects into the the Divisia monetary aggregates. Five different aggregates namely, simple sum, ordinary Divisia, a Divisia with technological progress, a Divisia with allowance for implicit interest on retail sight deposits and a Divisia incorporating both technological progress and the payment of implicit interest were constructed using components of Bank of England's M4 definition of money. An assessment of these aggregates was made through cointegration tests and error correction modeling, the results of which seemed to have favoured Divisia M4 as it explained variations in output and price level better than the sum M4.

Employing vector autoregressions and Engle-Granger cointegration tests, Eugenio Gaiotti found that financial innovation had a smaller effect on the substitutability among different kinds of bank liabilities in Italy. The study concluded that the simple sum M2 and its aggregation theoretic Divisia counterpart differed only marginally. This conclusion is interesting especially when several current studies have come out with evidences against the traditional aggregates.

Presenting the case of Switzerland, Genberg and Nefci focussed on the stability of demand and supply relationships for money. The use of recent nonparametric tests suggested by Darkhosku and Brodskiy check for the presence of structural shifts made the study different from the previous ones. Divisia monetary aggregates were found to have more stable money supply multipliers whereas the difference was negligible with respect to structural stability of money demand relationships between simple sum and Divisia aggregates.
The Japanese case of Divisia monetary aggregates with special reference to financial deregulation was examined by Hiriyama and Kasuya. Applying Stock-Watson dynamic OLS estimation procedure, the authors tested for cointegration between Divisia aggregates and a vector of real macro variables. Tests of structural stability had not been conclusive, however.

Belongia provided a descriptive account of the rapid financial innovation taking place in the United States and analysed its likely impact on the society at large. Maintaining that the Federal Reserves lost its grasp over the behavior of money stock due to different reporting requirements and introduction of deposit accounts with varying degrees of checking privileges, Belongia felt that there was a need to change both the reporting requirements of financial institutions and the approach to measurement of money.

Analysing the demand for Divisia and Simple sum M3, Gaab pointed out some shortcomings of computed Divisia monetary aggregates in practice in the context of Germany, 1960-93. The study analysed M3 (used by the Bundesbank both as an indicator and an official intermediate target of monetary policy) and a Divisia index over the same components as of M3. Both the demand functions for Divisia and simple sum M3 showed remarkably robust behaviour in the face of financial innovation and deregulation in recent decades. The Divisia aggregate were shown to be stable over the simple sum M3 during the sample period under study i.e. 1960-1993. The simple sum M3 shows some instability in the 1990s. It was inferred that the Divisia aggregate could cope up better with financial innovation.

Presenting a survey of empirical evidences relating to France, Lecarpentier found that the Divisia monetary aggregates though found to be satisfactory could not outperform simple sum monetary aggregates.
On the whole, the above empirical studies threw light on the variety of experiences of countries in the area of new monetary aggregates under differing institutional and regulatory environments. Though the evidences in general supported the superiority of aggregation theoretic Divisia monetary aggregates, they could outperform their simple sum counterparts, giving a clear message that it is difficult to do away with the practice of traditional monetary aggregates by the central banks. One of the conditions laid down by the microeconomic theory of monetary aggregation is to choose an array of weakly separable monetary assets. The above studies have missed out covering empirical works dealing with separability tests, parametric or otherwise.

A recent study by Feldstein and Stock (1996) suggested two methods viz., (i) a time varying parameter model and (ii) a switching regression model to automatically adjust compositional changes due to financial innovations while constructing monetary aggregates. Experimenting with M2+stocks or bond mutual funds the authors found the new aggregates performing better only during the period 1992-93.

### 2.7 Empirical Definition of Money in India

The developments in monetary aggregation theory in the international arena have also influenced the Indian studies to a great extent. The success of Divisia aggregates in countries like the US, UK, Japan etc., have motived research in India. While a few studies have exposed the limitations of the RBI money stock measures, a few others have examined the case for operationalisation of the weighted aggregates.

The First Working Group of RBI (1961) emphasised the role of money as a liquid asset as well as a medium of exchange while going for a proper measure of money. The
group defined money comprising of currency with public, net demand deposits with banks and other deposits with RBI.

The Second Working Group (1977) favoured a wide range of assets and suggested four aggregates viz., M1, M2, M3 and M4 which are in the descending order of liquidity defined as:

M1 = Currency notes and coins with the nonbank public + demand deposits
(excluding interbank deposits) of all commercial and cooperative banks +
other deposits with the RBI which are in the nature of demand deposits

M2 = M1 + Saving Deposits with Post Office Savings Banks

M3 = M1 + Time Deposits of all commercial and cooperative banks (excluding
inter bank time deposits)

M4 = M3 + Total Deposits of the post office Savings Organisation (excluding
National Savings Certificates)

The Second Working Group recognised the need "to all w f r sufficient
disaggregation so as to permit different combinations of assets to be employed for analysis
depending on the end-use to which the data are likely to be put"(p 5) The group further
felt that "the hard core of the monetary aggregates should continue to be basically those
assets possessing the quality of 'superior liquidity' arising from the concept of money
as a medium of exchange"(p 7)

The liabilities of the non-bank financial institutions like life insurance corporation,
general insurance corporation, development banks, investment companies, trust companies
and the Unit Trust of India are not included in the above measures of money stock. The
reason as given by the Group is that there is qualitative difference between the operations
of these institutions and those of the monetary institutions. There is a clear demarcation
implied by the above definitions between the money using sectors and the money
producing sectors. The money using sector is the non-bank public. The money producing sector comprises of the Government and the banking system including RBI.

M1 is the narrow money usually referred in the monetary economics literature. In M2, even though the non-chequable portion of post office savings ought to be included, owing to non-availability of data, all post office savings have been included in it. The time liability portion of saving deposits should have also been included in M2. But it is impracticable. The savings and time deposits of post offices could have been considered for possible inclusion in M3, but it is not done due to the following reasons: (i) postal savings organisation does not come under the conventionally defined banking system, (ii) it is very difficult to collect information on a weekly basis from post offices, (iii) the deposits in the post offices are of different maturity periods in which case it becomes a daunting task to produce consolidated figures by aggregating them through weighted aggregation.

The saving deposit balances with the commercial banks have two components: demand liabilities and time liabilities. According to the RBI rules, the portion of savings deposits balances which is allowed to be withdrawn without notice, has been classified as demand deposit. The rest of the balances is time deposit. In March 1975, the demand and time deposit portions of savings balance were 85.8% and 14.2% respectively. The time deposit portion of the saving balances which can be withdrawn is around 14% of total savings account balances. There has been significant changes in these figures of time and demand liability portions in recent years. However, the Second Working Group has recommended for a quinquennial survey in this regard to watch the changing proportions of time and demand liabilities.

The RBI had instituted Non-Resident (External) Rupee Accounts which accept deposits in any type of deposit accounts in March 1970 for the benefit of the non-resident
Indians. In November 1975, the RBI again started a novel scheme, the FCNR (Foreign Currency Non-Resident Accounts) in pound sterling, U.S dollar, German mark, Dutch guilder and Japanese yen. The second working Group treats these deposit balances as time deposits for most purposes.

Government deposits and float are not considered as candidates to qualify for any of the four monetary aggregates. Because, inclusion of float may lead to double counting. Exclusion of government deposits with the RBI would help in drawing a line between the ultimate money producer from the ultimate money users. The amount of unutilised credit limits, trade credit etc., have also been excluded due to data limitations and on empirical grounds.

The Indian quest for a better monetary aggregate started with Shergill (1980) who considered six alternative money stock measures including those suggested by the Second Working Group. His findings confirmed that M1 did not satisfy the Friedman-Menselman dual criteria. This study with Indian data from 1951 to 1973, could not suggest any uniformly best measure of the money stock. However, the M4 aggregate (currency + demand deposits + other deposits with RBI + time deposits + total postal saving deposits) was preferred to the conventional M1 aggregate.

Kamaiah and Bhole (1982) using factor analytic technique with four assets viz., currency with the public (CU), demand deposits with the banking sector (DD), time deposits with the banking sector (TD) and post office saving deposits (SD) for the sample period 1957 to 1977, concluded that narrow money should be considered in modelling the demand for money and monetary policy in the Indian context.

Kamaiah and Subrahmanyan (1983) conducted canonical correlation analysis for two sets of variables. One set was currency with the public (CU), demand deposits with
the banking sector (DD), time deposits with the banking sector (TD) and post office and saving deposits (SD). The other set consisted of real income, expected real income, inflationary expectations, rate of inflation, variability of inflation rate, bazaar bill rate and private debenture yield rate. The empirical exercise for the period 1958 to 1978 and two of its sub periods viz, 1951-71 and 1958-78 resulted in varying definition of money due to qualitative changes in the composition of money holdings and changes in banking habits.

Bhole (1987) suggested a single analytically or conceptually sound measure of money instead of having multiple measures of money. His argument was for a measure of money M including currency, current deposits with banks, saving deposits with banks, saving deposits with post office saving banks and other deposits with the RBI. He advocated to revive the old practice of designating other financial assets as near-money assets which could be grouped into one or more aggregates to be called near money aggregates (NMAs) on the basis of their liquidity, maturity, marketability, risk etc. Two aggregates viz, NMA1 and NMA2 for India were tentatively suggested by him, NMA1 including fixed deposits with banks and time deposits with post offices and NMA2 including NMA1 and other deposits with post offices.

Bhole suggested the following assets as potential candidates for money and made a case for their inclusion in the broad connotation of money. The assets are (1) currency (CU), (2) other deposits with RBI (ODR), (3) current deposits with banks (CDB), (4) saving deposits with banks (SDB), (5) saving deposits with post office saving banks, (6) fixed deposits with post offices (FDB), (7) time deposits with post offices (TDPO), (8) other deposits with post offices (ODPO), (9) national saving certificates (NSCS), (10) other certificates with post offices (OCPO), (11) treasury bills (TB), (12) commercial bills (CB), (13) government bonds (GB), (14) industrial bonds (IB), (15) fixed deposits with non-banking companies (FDCOS), (16) trade credit (TC), (17) unutilised credit limits (UCL), (18) industrial shares (IS).
Rao (1983) suggested that SDB (saving deposits with banks) in rural and semi-urban areas should be treated as time deposits because they represent savings. On the other hand, SDB in metropolitan and urban areas should be treated as demand deposits as there is every possibility of these deposits being used as transaction balances. Bhole suggested to consider SDB as money without going for any division based on any criterion. Similarly, Bhole examined the cases with the rest of the assets.

Kamaiah and Ramachandran (1991) carried out an exercise using the F-M dual criteria and factor analysis. Regulatory changes and financial innovations introduced in the money market which had possibly led to qualitative changes in financial assets, were identified to be the main causes for the varying definition.

Kannan (1989) made a comparison of different weighted monetary aggregates obtained by him by using the methods of Chetty, Barnett, and Roper-Turnovsky, on the grounds of stability, predictability and causality tests with respect to the target variable. He concluded that the best weighting method for constructing monetary aggregates was the Roper-Turnovsky method.

Jadhav (1989) skeptically looked at the situation in India to operationalise weighted monetary aggregates. He pointed out the discrepancies among the available alternative approaches to construct monetary aggregates. His contention is that the empirical attempts in India have not come out with monetary aggregates which would decisively outperform the simple sum aggregates.

Jadhav criticized Kannan's (1989) study on the following grounds. First, Kannan has not taken into account the major shifts in the long-term time series of demand and time deposits in 1978. As in India, there are two characteristics of saving deposits viz.,
transaction characteristics (ii) saving characteristics The transaction balances should be merged with demand deposits and the residual with time deposits The Second Working Group (1977) recommended to lump that part of saving deposits which could be withdrawn without notice with demand deposits. As a result, around 85% of saving deposits (from 1961 to 1977) got merged with demand deposits.

After 1st March 1978, with the changed accounting procedure the portion of saving deposits on which interest is paid was treated as time deposits and the residue as demand deposits Then the earlier break-up got reversed and around 85% of saving deposits was then treated as time deposits But the study by Kannan did not consider these problems and therefore the data series for demand deposits and time deposits as well as the estimated results are put to question Secondly, the study used the GDP deflator for the public administration sector as a proxy for interest rate on demand deposits, instead of computing "implicit" rate of return on demand deposits. Lastly, the study does not specify the reference rate of interest rate used for discounting while computing the user costs which has a definite impact on the final results.

Experimenting with Indian data for the period 1951 to 1984-85, Subrahmanyam and Swami (1991) compared the quantitative performance of three superlative monetary aggregates viz Divisia, Diewert and Fisher Ideal, with two non-superlative ones viz, geometric and simple sum. Surprisingly, the results supported simple sum aggregates which were highly informative about the goal variable.

In a recent attempt, Kamal and Ramachandran (2004) using annual time series data for the period 1950-51 to 1989-90 discovered theoretically admissible groups of monetary assets using Denny-Fuss approximation analysis. The results of the study showed that only the components of M3-money formed a weakly separable block out of the four measures (M1, M2, M3, M4) suggested by the Second Working Group of RBI.
The study found demand deposits as a distant substitute for rest of the components in M1. The study also recommended certain alternative separable groups for construction of monetary aggregates. The study seems to have violated Barnett's (1982) recursiveness condition while hypothesizing different utility structures for separability test.

Subrahmanyam and Swami (1994) verified the theoretical consistency of M1, M2 and M3 as optimal groupings of their respective constituent assets for the period 1960-61 to 1988-89. The flexible translog dual cost function approach was employed with user costs of assets. They concluded that M2 and M3 did not confirm to the theoretical requirements of optimal grouping and therefore M1 remained as the residual aggregate with a very high elasticity of substitution between currency and demand deposits (including other deposits).

It is clear from the above discussion that results of individual research efforts towards an appropriate money definition in the Indian context have been at gross odds with each other. Earlier studies focusing on simple sum aggregates did not come out with any concrete suggestions. Preliminary evidences on Divisia aggregates also could not establish the superiority of these aggregates.

2.8. CONCLUDING REMARKS

The above discussion on basic ideas underlying different approaches to money definition and associated evidences suggest that the issue is still riddled with several conceptual and empirical problems. However, the macroeconomic monetary aggregation school emerges as the only convincing approach to a proper money definition due to its theoretical rigour. The accumulated empirical evidences across countries seem in support of it.