AGGREGATING THE MONETARY AGGREGATES:
CONCEPTS AND ISSUES

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In early 1970 the Federal Reserve System modified some of the operating procedures it employs in conducting monetary policy. Specifically, the Federal Open Market Committee (FOMC), which is the System's principal policymaking body, began to place somewhat greater emphasis on what have since come to be known collectively as "the monetary aggregates" as operating variables in formulating and implementing monetary policy.[1] The monetary aggregates are various measures of the nation's stock of money. During the 1950's and 1960's, in contrast, the FOMC had focused primarily on conditions in the money markets, as indexed by member bank reserve positions and certain key short-term interest rates. This shift in procedural emphasis has generated a great deal of interest among and comment from monetary economists, financial market participants, and other observers of System policy. Monetary economists found the change interesting because it suggested that monetarist doctrine, which had achieved considerable prominence in academic circles in the 1960's, had finally attained at least a degree of acceptance in the halls of the nation's principal monetary authority. Market participants, on the other hand, regarded the shift as important from the standpoint of evaluating past and present System policy and making judgments about the likely future course of policy.

The extent to which the Federal Reserve has *in fact* altered its operating strategy since 1970 is the subject of a spirited and sometimes heated debate among economists. Some monetarists claim that although the FOMC now gives lip service to the monetary aggregates in its policy pronouncements, it continues to focus mainly on financial market conditions in practice, thereby relinquishing potentially useful control over the aggregates. Conversely, some nonmonetarists believe the FOMC has paid too much attention to the aggregates to the detriment of the credit markets and, consequently, the general economy. For their part, System officials have made it plain in a number of public statements and articles that as far as the System is concerned, the change that occurred in 1970 represented a shift of emphasis among alternative operating variables rather than any official recognition of a change in economic doctrine. The monetary aggregates, while not emphasized, were by no means ignored prior to 1970.[2] Nor have financial market conditions and interest rates been ignored since 1970.

Whatever the merits of these arguments, it is clear that the monetary aggregates presently play a more important role than earlier, both in the formulation and execution of monetary policy and in public discussions of policy. Perhaps the strongest indication of the increasing prominence of the aggregates is their central position in the Congressional resolution concerning monetary policy passed on March 24, 1975. This resolution calls on the FOMC to maintain longer-run growth in the monetary aggregates at rates consistent with the longer-run potential for growth of the nation's productive capacity. The resolution also requests the Federal Reserve to inform the House and Senate Banking Committees periodically of its targets for growth of the aggregates over the following twelve months. The first such hearings took place on May 1, 1975. At the hearings Chairman Arthur F. Burns of the Federal Reserve announced the System's targets for certain aggregates for the period March 1975-March 1976.[3] The hearings received considerable national attention.

The greater emphasis on the aggregates raises some immediate questions. First, precisely what are the monetary aggregates? As the term implies, they are essentially aggregations or summations of the

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[1] More specifically still, the FOMC began to express its operating objectives more frequently in terms of the desired behavior of the monetary aggregates in its instructions to the Manager of the System Open Market Account at the Federal Reserve Bank of New York. Acting as the FOMC's agent, the Manager supervises the System's day-to-day purchases and sales of securities, or open market operations. These operations constitute the FOMC's principal tool for implementing monetary policy. The FOMC normally meets once each month. At the conclusion of each meeting it issues a "Directive" to the Manager containing its operating instructions covering the period until the following meeting.

[2] In 1966 the FOMC began supplementing its instructions in the Directive regarding desired money market conditions with explicit references to the desired behavior of certain monetary aggregates. For an interesting discussion of the Committee's attention to the aggregates during the 1950's, see Elmus R. Wicker, "Open Market Money Supply Strategy," *Quarterly Journal of Economics*, 88 (February 1974), 170-9.

[3] See the Statement by Arthur F. Burns, Chairman, Board of Governors of the Federal Reserve System, before the Committee on Banking, Housing and Urban Affairs, U. S. Senate, May 1, 1975, reprinted in *Federal Reserve Bulletin*, May 1975, pp. 282-8.

public's holdings of various financial assets that appear to function as "money" in household and business portfolios. But this description raises more basic questions. What is money? What are its distinguishing functional characteristics? Exactly which financial assets possess these characteristics?

Unfortunately, economists have not arrived at definitive answers to these questions. As a result, universally agreed definitions of money and the money stock do not exist. In the absence of such definitions, the Federal Reserve has found it necessary to take an eclectic approach in the practical implementation of policy. Accordingly, it has defined several monetary aggregates deemed relevant to policy analysis. Each such aggregate is designated by the letter M and a numerical subscript, higher subscripts indicating more inclusive aggregates.

Table I defines the aggregates M_0 - M_7. Economists have traditionally focused on M_1, M_2 and, to a lesser degree, M_3 as the most useful definitions of the money supply. Among these, M_1 is the definition most frequently referred to in public discussions of money and monetary policy. The specification of the higher numbered aggregates shown in the table is a recent development reflecting the growing belief in some quarters that advanced cash management techniques, the introduction of new financial instruments such as large-denomination negotiable certificates of deposit, and other financial market innovations have broadened the spectrum of assets that serve as money.[4] For this reason, some students of monetary policy believe that explicit consideration of these broader aggregates might increase the effectiveness of monetary policy.[5] Others doubt this contention on the grounds that the Federal Reserve would find it difficult to control these aggregates and that their behavior, in any event, bears a predictable relationship over time to the behavior of the narrower concepts such as M_1.

Whatever the outcome of this relatively technical debate, it seems rather paradoxical that in a policy environment where the money supply is such a central concept, there is no professional consensus as to precisely what the money supply is. This article will not attempt to answer this question. Its purpose, rather, is to indicate to nonprofessional readers—many of whom probably take the existence of an

[4] Money supply statistics are published in the monthly *Federal Reserve Bulletin*. Series for M_1, M_2, and M_3 have been carried in these tables for some time. M_4 and M_5 were added to the tables in April 1975.

[5] For a concise official statement of this attitude, see the Statement by Arthur F. Burns, Chairman, Board of Governors of the Federal Reserve System, before the Committee on Banking, Currency and Housing, House of Representatives, July 24, 1975, reprinted in *Federal Reserve Bulletin*, August 1975, pp. 491-7.

Table I

EIGHT MONETARY AGGREGATES*

M_0 = currency

M_1 = M_0 + demand deposits at commercial banks

M_2 = M_1 + time deposits at commercial banks other than large negotiable certificates of deposit

M_3 = M_2 + mutual savings bank deposits, savings and loan association shares, and credit union shares

M_4 = M_2 + large negotiable certificates of deposit

M_5 = M_3 + large negotiable certificates of deposit

M_6 = M_5 + short-term marketable U. S. Government securities and savings bonds

M_7 = M_6 + short-term commercial paper

* For more precise definitions the reader should consult the footnotes to the table titled "Measures of the Money Stock" in the statistical section of any recent **Federal Reserve Bulletin**.

agreed money definition for granted—the difficulties inherent in arriving at an unambiguous answer. The article will also describe recent research aimed at developing new money supply concepts superior to those listed in Table I. It is hoped that this material will assist the nonprofessional in critically evaluating commentary in the financial press and elsewhere on the use of a growing list of monetary aggregates in the conduct of monetary policy.

The article contains four sections. The first section reviews the earlier controversy among economists over the proper definition of money. The second section describes a general and highly flexible procedure for developing so-called weighted monetary aggregates. Such weighted aggregates are refinements of the conventionally-derived aggregates listed in Table I and, in the view of at least some economists, potentially better measures of the money supply. The third section reviews some preliminary empirical efforts to estimate the weights that should be attached to particular categories of financial assets in developing operational weighted monetary aggregates.

I. THE POSTWAR DEBATE OVER THE DEFINITION OF MONEY

When it comes to definitions, money is a little bit like sex appeal: everyone has a fairly clear intuitive idea of what it is, but defining it in precise language is difficult. Economists have been arguing about the best way to define money for centuries.[6] Despite

[6] An excellent survey of the historical dialog is contained in Milton Friedman and Anna J. Schwartz, *Monetary Statistics of the United States: Estimates, Sources, Methods*, New York: National Bureau of Economic Research, 1970, pp. 89-198.

their inability to achieve a consensus, the question cannot be abandoned either as a theoretical matter or as a practical matter. Clearly, the concept of money lies at the core of both monetary theory and monetary policy.

The effort to define money has been approached from two directions during the postwar period. One segment of the relevant literature has taken a theoretical approach and has sought to settle the issue on the basis of general principles. Analysts in this camp have commonly begun by specifying their respective views regarding the purpose that money serves from the standpoint of the economic units—households and business firms—that hold money. With these purposes delineated, the analyst has then defined money to include the various categories of deposits and other financial assets that appear to serve the indicated functions. The other approach has been more heavily empirical. Here, the choice among alternative definitions has been made on the basis of such criteria as the stability of the relationship between income and various candidate measures of money as revealed by detailed statistical analysis.

Theoretical Approaches As indicated above, those who have taken a theoretical approach to defining money have often begun by asking what money is used for, or, equivalently, why it is demanded. One obvious response to this question is that money is used to facilitate purchases: that is, money is a means of payment. Money should therefore be defined to include those assets used directly in making purchases and to exclude other assets. On the basis of this criterion, some economists have defined money as the sum of currency in the hands of the public and demand (checking) deposits at commercial banks, or M_1. The appeal of this apparently straightforward logic is so great that M_1 has become the most widely accepted definition of money in the eyes of the general public.[7]

A more thoughtful examination of these points, however, suggests that neither the means of payment criterion nor the M_1 definition is necessarily preferable. From the standpoint of both economic analysis and policy, money is interesting primarily because changes in the stock of money held by the public are

likely to affect aggregate spending and hence broader economic conditions respecting such things as the level of output, employment, and prices. There is no reason to believe that the stock of assets relevant to spending decisions is limited to those assets that can be used directly as payments media in the act of exchange itself. For this reason, many economists now regard the essential function of money as extending beyond its service as a means of payment to include its use as a "temporary abode of purchasing power," that is, as a repository bridging the gap between the receipt and disbursement of payments.[8]

This extension of the concept of money's function in the economy might seem at first glance to be a minor refinement. Actually, it constitutes a fundamental break with the narrower view of money as a means of payment. For although only a limited number of assets can be used directly in effecting payments, a wide variety of assets can be used as temporary reservoirs of purchasing power in anticipation of payments. It certainly seems reasonable to suppose that a sizeable portion of household balances in commercial bank time and savings deposits, in mutual savings bank deposits, and in credit union and savings and loan association shares are held in anticipation of specific payments. On these grounds, the view of money as a temporary store of purchasing power suggests that M_2 or M_3, or at least some portion of these aggregates, might properly be regarded as money.[9] Shifting the focus from households to business firms produces further possibilities. It is well known that in the current business environment a major goal of corporate management is to minimize noninterest-bearing cash balances. Using highly sophisticated cash management techniques, large corporations are able to maintain a sizeable fraction of what are effectively transactions balances in various money market instruments such as large-denomination certificates of deposit, short-term commercial paper, and short-term U. S. Government securities. It is on this basis that some analysts would suggest that under present conditions at least a portion of an aggregate as broadly inclusive as M_5

[7] The most comprehensive effort to establish M_1 as the proper definition of money on theoretical grounds is found in the work of Pesek and Saving. See Boris P. Pesek and Thomas R. Saving. *Money, Wealth, and Economic Theory*, New York: The Macmillan Company, 1967, pp. 39-254. For a critique of this analysis see Milton Friedman and Anna J. Schwartz, "The Definition of Money: Net Wealth and Neutrality as Criteria," *Journal of Money, Credit and Banking*, 1 (February 1969), 1-14.

[8] Friedman and Schwartz, *Monetary Statistics*, pp. 106-7.

[9] Several recent innovations in the financial sector related to the payments services provided by financial institutions to their customers further support this view. For example, so-called NOW (for negotiable order of withdrawal) accounts offered by thrift institutions and banks in New Hampshire and Massachusetts permit depositors to write what are essentially checks on interest-bearing deposits. Also, Federal regulatory authorities recently adopted new regulations allowing banks and thrift institutions to offer preauthorized bill-paying services to savings depositors.

might reasonably be considered money. Nor does the story necessarily end here. For example, bank loan commitments to business firms are sources if not abodes of purchasing power. None of the aggregates listed in Table I captures this additional source.

Although the view of money as a temporary abode of purchasing power has considerably broader implications than the more restrictive means of payment concept, both tend to focus attention on the relationship between money and current transactions. A somewhat different position regarding the basic function of money has been evident in part of the postwar literature. Taking their cue from Keynesian monetary theory, analysts in this group have emphasized the role of money as a store of liquid wealth held to meet unanticipated contingencies necessitating payments as well as expected transactions and to balance illiquid assets such as long-term securities and non-financial assets in household and business portfolios.[10] According to this view, "money" is synonymous with "liquidity," although the latter term has never been specified rigorously. Much of the analysis along these lines was published in the late 1950's and 1960's. Writers in this vein argued that the transactions approach to defining money had tended to restrict attention too narrowly to commercial bank deposits, obscuring the significance of the postwar shift of liquid balances from commercial banks to other financial intermediaries such as savings and loan associations and credit unions. Unless money were viewed more broadly as liquidity, and the liabilities of nonbank intermediaries considered part of the money stock, monetary policy would be rendered ineffective.

The more recent extension of the transactions approach described above, which recognizes the possibility that transactions balances may well be held not only in bank and nonbank deposits but also in a variety of money market instruments, has blurred some of the issues that were central to the earlier debate and broadened the scope of the dialog. At this point, many economists would probably acknowledge that *as a purely formal matter* money might be defined more broadly than M_1, or perhaps more broadly than M_2 or M_3. Beyond that, interest in defining money on purely theoretical grounds appears to have waned.

Empirical Approaches Since the theoretical approach to defining money has failed to produce any definitive agreement, it is not surprising that economists have attempted to settle the issue empirically. Indeed, Milton Friedman and Anna J. Schwartz, two prominent participants in the discussion, have suggested that the question of the correct definition of money cannot be separated from the question of the practical uses to which such a definition would be put by policymakers or others:

> We conclude that the definition of money is to be sought for not on grounds of principle but on grounds of usefulness in organizing our knowledge of economic relationships. 'Money' is that to which we choose to assign a number by specified operations; it is not something in existence to be discovered like the American continent; it is a tentative scientific construct to be invented, like 'length' or 'temperature' or 'force' in physics.[11]

As suggested above, money is interesting to economists and policymakers primarily insofar as changes in its stock affect basic economic variables such as income, employment, and prices. From this standpoint, the best definition of money might be the definition producing the closest statistical correlation between money so defined and, say, national income. A large number of statistical tests have in fact attempted to determine which money definition yields the closest correlation. Taken as a group, these studies have shown a close relationship between income and several of the narrower money aggregates such as M_1, M_2, M_3, and variants of these measures. But they have been contradictory and inconclusive regarding exactly which concept produces the best fit.[12] In general, the results of these various tests have been quite sensitive to the time period considered and the exact form of the estimating equations used, especially their respective lag structures.

A related but nonetheless distinct empirical approach has focused on the degree of substitutability among various categories of assets considered candi-

[10] This strain of analysis began with the work of John G. Gurley and Edward S. Shaw in the 1950's. See John G. Gurley and Edward S. Shaw, "Financial Intermediaries and the Saving-Investment Process," *Journal of Finance*, 11 (March 1956), 257-76, and Gurley and Shaw, *Money in a Theory of Finance*, Washington, D. C.: The Brookings Institution, 1960. Similar views were put forward in the Radcliffe Committee report on the British monetary system published in 1959.

[11] Friedman and Schwartz, *Monetary Statistics*, p. 137.

[12] Representative examples are Milton Friedman and David Meiselman, "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958," in Commission on Money and Credit, *Stabilization Policies*, Englewood Cliffs, N. J.: Prentice-Hall, 1963, pp. 165-268; George G. Kaufman, "More on an Empirical Definition of Money," *American Economic Review*, 59 (March 1969), 78-87; Frederick C. Schadrack, "An Empirical Approach to the Definition of Money," in *Monetary Aggregates and Monetary Policy*, New York: Federal Reserve Bank of New York, 1974, pp. 28-34; and Jack L. Rutner, "A Time Series Analysis of Income and Several Definitions of Money," *Monthly Review*, Federal Reserve Bank of Kansas City, November 1974, pp. 9-16. The Friedman-Meiselman and Schadrack studies concluded that M_2 is the preferable definition of money. Kaufman's results suggested that a somewhat broader definition along the lines of M_3 is slightly better than either M_1 or M_2 on the basis of certain evaluative criteria. Rutner's work suggested that the correlation between income and alternative money concepts is itself a function of the time frame of the statistical analysis, broader aggregates performing relatively better over longer time horizons.

dates for inclusion in the definition of money. It is generally agreed that demand deposits should be included in any definition of money. A high degree of substitutability between demand deposits and, say, time deposits would suggest that time deposits can satisfy at least partly the purposes for which demand deposits are held and should therefore be considered money. Statistically, the degree of substitutability has commonly been measured by the sensitivity (in technical language the "cross-elasticity") of the demand for agreed money assets, such as demand deposits, to variations in the interest rates paid on candidate categories, such as commercial bank time deposits and the liabilities of nonbank intermediaries. Unfortunately, these substitutability studies, like the money-income correlation studies discussed above, have not produced conclusive results. Some studies have found relatively low cross-elasticities and have concluded that M_1 is the appropriate definition. Others have found higher elasticities, suggesting that M_2 or M_3 might be preferable.[13]

To summarize, neither theoretical nor empirical analysis has produced a concensus among economists as to precisely what collection of financial assets constitutes "money." On reflection, this lack of agreement is not very surprising. For one thing, a given financial asset can serve its holder in more than one fashion. For example, while a savings deposit provides its holder with a store of purchasing power, it also produces income in the form of explicit interest payments. Therefore, savings deposits as a class might be partly money and partly something else. There is no particular reason for insisting that the definition of money either include or exclude the *entire* stock of savings deposits outstanding. More basically, money is fundamentally a social phenomenon, and, like all social phenomena, is subject to continuous change. What appears to be needed is not some final, exclusive catalog of assets labeled money, but a flexible framework aimed at helping analysts and policymakers determine to what extent specific asset classes are functioning as money at particular points in time. The next section describes such a framework.

[13] Two of the most widely discussed of these studies are Edgar L. Feige, *The Demand for Liquid Assets: A Temporal Cross Section Analysis*, Englewood Cliffs, N. J.: Prentice-Hall, 1964, and Tong Hun Lee, "Substitutability of Non-Bank Intermediary Liabilities for Money: The Empirical Evidence," *Journal of Finance*, 21 (September 1966), 441-57. Feige's study indicated that demand deposits and bank time deposits are weak substitutes, suggesting the superiority of a narrow money definition. Lee found significant substitutability between thrift deposits and bank demand and time deposits, indicating that a broader definition such as M_3 might be preferable. See also Franklin R. Edwards, "More on Substitutability between Money and Near-Monies," *Journal of Money, Credit and Banking*, 4 (August 1972), 551-71. A fourth important study dealing with substitutability, by Chetty, will be discussed later in a somewhat different context.

II. A GENERAL AGGREGATION TECHNIQUE

As we have seen, the monetary aggregates presently monitored by policymakers (see Table I) are simple summations of the total stocks of various financial assets. The characteristic feature of this aggregation technique is that the stocks of all assets included in a given aggregate carry equal and unchanging weights, namely unity. This is a convenient procedure, of course, but it raises some rather pressing questions regarding the analytical usefulness of these aggregates when they are expressed quantitatively. Suppose, for example, that an analyst wished to use M_5 as a measure of the money supply. This aggregate includes such diverse assets as currency, savings and loan shares, and large-denomination certificates of deposit. The weighting procedure employed in deriving M_5 would imply that each dollar of each asset class serves as money to the same degree. This implicit assumption would probably be invalid, whatever the analyst's criterion for defining money might be. Therefore, any uncritical use of M_5 as a measure of the money supply would almost certainly be analytically misleading.

This aggregation procedure is obviously a special instance of a more general technique where the weights attached to each asset category are permitted to vary both among categories and over time. For example, if the goal is an improved measure of the money supply, an analyst might want to attach a higher weight to demand deposits and a lower weight to certificates of deposit in compiling M_5. Edward J. Kane has developed a general framework for the weighted aggregation of monetary variables along these lines, and it will be useful to recapitulate briefly the main features of Kane's technique here.[14] It should be noted at the outset that Kane's technique requires that an analyst using it specify precisely his criterion for determining the relative moneyness of asset classes. Kane's own criterion is the extent to which assets are actually used, that is, liquidated, to support expenditures. It is this particular choice among alternative criteria that gives Kane's analysis its substantive content and raises it above the level of a purely mechanical exercise. The following description of the framework employs elementary algebraic notation for generality and simplicity. No high-powered mathematics is involved.

Kane begins by defining the money balance held by the jth individual economic unit (perhaps a household or a business firm) as:

[14] Edward J. Kane, "Money as a Weighted Aggregate," *Zeitschrift fur Nationalokonomie*, September 1964, pp. 222-7.

$$(1) \quad m_j = \sum_{i=1}^{N} w_{ij}a_{ij}, \qquad i = 1, \ldots, N;$$
$$j = 1, \ldots, P;$$

where a_{ij} is the dollar amount of the ith asset (one of N available assets) held by the jth unit (one of P units in the economy) and w_{ij} is the weight. The w_{ij} take on values between zero and unity. Any particular w_{ij} may be interpreted as the proportion of the ith asset regarded by the jth unit as serving a money function. We will adopt Kane's money criterion and regard the w_{ij} as signifying the proportion of the ith asset actually used by the jth unit to support transactions during the time period in question. Any number of alternative interpretations of the weights would be consistent with the framework.

The aggregate money stock, M, can be obtained from (1) by summing over the P economic units in the economy:

$$(2) \quad M = \sum_{j=1}^{P} m_j = \sum_{j=1}^{P} \sum_{j=1}^{N} w_{ij}a_{ij}.$$

This expression can be written equivalently as:

$$(3) \quad M = \sum_{i}^{N} \left[\frac{\sum\limits_{j}^{P} w_{ij}a_{ij}}{A_i} \right] A_i,$$

where A_i is the total dollar amount of the ith asset outstanding in the economy. The weighted aggregate is then:

$$(4) \quad M = \sum_{i}^{N} W_i A_i,$$

where:

$$(5) \quad W_i = \frac{\sum\limits_{j}^{P} w_{ij}a_{ij}}{A_i}.$$

Expressions (4) and (5) appear quite simple on the surface, but they point out with great clarity the fundamental problem facing analysts in monetary aggregation. That problem is to specify the determinants of the individual unit weights (the w_{ij}) and, from these, the determinants of the aggregate weights (the W_i). In the absence of empirical evidence, one can only speculate as to what these determinants might

be. Such things as interest rates and the price level and expectations of future changes in interest rates and the price level, however, are likely candidates. Further, since both current and expected interest rates and prices change over time, it seems reasonable to suppose that the weights might change in some systematic and therefore predictable manner over time.

Some simple examples might serve to illustrate the potential analytical usefulness of the weighted aggregate concept. Suppose that some technological innovation or perhaps a regulatory change reduced the cost and inconvenience to households of shifting funds from savings accounts to demand deposits. Under these circumstances, households would have an incentive to hold a greater portion of their transactions balances in savings accounts. Abstracting from any other factors affecting the total volume of savings deposits held by households, the weight attached to savings deposits in calculating the effective money supply would rise.[15]

The preceding example suggests the kinds of factors that might alter the weights over the longer run. A second example will indicate some of the factors that might cause the weights to vary systematically over the business cycle. Suppose that during an expansionary period a general increase in short-term interest rates occurred. Corporations would then have a stronger incentive than during a period of low rates to hold their transactions balances in the form of money market instruments such as Treasury bills or certificates of deposit. Under these circumstances, the monetary weights attached to these instruments would rise.

In view of these examples, it would appear that weighted monetary aggregation of the sort suggested by Kane's framework might be useful in developing improved measures of the money supply. At the same time, it is evident that efforts to apply the technique in practice will confront difficult statistical roadblocks. Nonetheless, the approach has been sufficiently appealing to motivate several preliminary empirical studies. The next section summarizes the results of these studies.

III. EMPIRICAL ANALYSIS USING WEIGHTED AGGREGATION

To date, only a handful of studies have attempted to measure statistically the weights that should be

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[15] This example, it should be noted, is more than hypothetical, since the Federal Reserve recently lifted its 39-year-old prohibition of the use of the telephone for transferring funds between savings and demand deposits.

attached to individual asset categories in developing monetary aggregates. The results of these analyses can only be considered preliminary. The studies are interesting, nonetheless, with respect not only to the specific numerical estimates of various weights but also to the methodologies employed.

This section summarizes four such studies published during the 1960's. No attempt will be made to evaluate the studies critically. The purpose of the summary is simply to convey the flavor of their results. For brevity, the following notation is used:

CBDD = demand deposits at commercial banks

CBTD = time and savings deposits at commercial banks

MSD = mutual savings bank deposits

PSD = Postal Savings System deposits

SLS = savings and loan association shares

Several preliminary remarks are in order. First, all of these studies appear to have been stimulated by the debate during the 1960's over whether various categories of consumer-type time deposits should or should not be included along with M_1 in the money supply.[16] They therefore focused on assets included in the M_2 and M_3 aggregates of Table I. No effort has yet been made to measure the weights that might be assigned to other assets included in the more broadly defined aggregates such as M_4 and M_5.

Second, the studies employed different assumptions and statistical procedures, and none adopted Kane's detailed framework and definitional criteria as a starting point. Therefore, differences among the estimated weights for particular assets across the four studies reflect conceptual dissimilarities as well as differences in the data and statistical models used. Still, the underlying concepts are sufficiently alike to permit comparison of the estimates.

The earliest of the four studies was a doctoral dissertation completed by Roy Elliott at the University of Chicago in 1964.[17] The purpose of this study was to investigate whether a money aggregate with nonuniform weights displayed a more stable relationship with income than conventional, uniformly

weighted aggregates. To this end, Elliott employed a cross-sectional analysis using per capita deposit and income data by states to estimate the weight for a composite group of assets consisting of CBTD, MSD, and PSD. Three separate cross-sectional estimates were derived for three separate years. The estimated weights were .26 for 1929, .35 for 1937, and .65 for 1954. Each of these estimates was significantly different, statistically, from both zero and unity. A separate time series analysis using aggregate national data for the years 1897-1957 produced an estimated weight of .37. This estimate was also significantly different from zero or unity, and its magnitude was consistent with those obtained from the cross-sectional tests.

Elliott's regression model was of the form:

$$(6) \quad Ln[CBDD + w(CBTD + MSD + PSD)] = a + b[Ln(y)],$$

where y is permanent income, and w, a, and b are the parameters to be estimated, with w the desired weight coefficient.[18] Several interpretations of w are consistent with this model. One such interpretation is that w measures the proportion of (CBTD + MSD + PSD) held to support current expenditures. If this interpretation is adopted, Elliott's three cross-sectional results tentatively suggest that the moneyness, in this sense, of time and savings deposits was increasing secularly over the time period considered.

Elliott's results can be compared with the results of two other studies employing roughly similar methodologies by (1) Richard H. Timberlake, Jr. and James Fortson and (2) Gurcharan S. Laumas.[19] Both of these time series studies used the following regression model:

$$(7) \quad \Delta Y = a + b(\Delta M_1) + c(\Delta T),$$

where Δ indicates first differences in the variables, Y is current aggregate income, M_1 is as defined in Table I, and T is time and savings deposits measured in various ways as indicated below. Equation (7) can be rearranged in the following manner:

$$(8) \quad \Delta Y = a + b(\Delta M_1 + c/b \, \Delta T).$$

[16] This debate grew out of Milton Friedman's inclusion of consumer time and savings deposits at commercial banks in his definition of the money supply. Virtually all empirical studies of the money supply, including the four discussed here, include M_1 balances at their full face value. That is, M_1 balances carry a weight of unity.

[17] Roy Elliott, "Savings Deposits as Money" (unpublished Ph.D. dissertation, University of Chicago, 1964).

[18] For statistical convenience, the equation Elliott actually estimated was an approximation of (6) that was linear in the weight coefficient w. All variables in his tests were expressed in real per capita terms.

[19] Richard H. Timberlake and James Fortson, "Time Deposits in the Definition of Money," American Economic Review, 57 (March 1967), 190-4; Gurcharan S. Laumas, "The Degree of Moneyness of Savings Deposits," American Economic Review, 58 (June 1968), 501-3.

The ratio c/b is then the collective weight for the assets included in T in any given test. Since the Timberlake-Fortson-Laumas tests, like Elliott's test, were based on the correlation of the monetary variable with an income variable, the interpretation suggested above for Elliott's w might also be applied to c/b.[20]

Although the Timberlake-Fortson and Laumas studies, respectively, were based on the same model, they produced very different results. Using *annual* data, Timberlake and Fortson estimated the weight for various subperiods between 1897 and 1960 with T defined, as in Elliott's study, as (CBTD + MSD + PSD). Among the pre-World War II subperiods, the estimated weight was positive only for the years 1933-1938. On these grounds the authors concluded that time and savings deposits did not serve a money function during most of the prewar period. The 1933-1938 result was interpreted as implying that the public associated a greater degree of risk with demand than with time deposits during these years in reaction to the rash of bank failures in the early 1930's. Hence, money balances were held in the form of time deposits during this period. In the postwar era, the weight was estimated at a relatively low .15 for the 1953-1965 subperiod.

Laumas employed Timberlake and Fortson's technique, but he restricted his study to the postwar era (his tests covered the years 1947-1966), and he used quarterly data and several specifications of T. His results were as follows. Using the Elliott-Timberlake-Fortson specification of T, (CBTD + MSD + PSD), the estimated weight was .48. It is worth noting that this estimate falls about midway between Elliott's cross-sectional estimates for 1937 (.35) and 1954 (.65). Therefore Laumas' results tend to substantiate Elliott's. With T more narrowly defined as CBTD alone, the estimate increased to .58. Defining T more broadly as (CBTD + MSD + PDS + SLS) reduced the estimate to .32. These results imply that the moneyness of CBTD exceeds that of MSD and, in turn, the moneyness of MSD exceeds that of SLS.

The final study, by V. Karuppan Chetty, took a somewhat different approach.[21] Specifically, Chetty

measured the weights for individual time and savings deposit categories (CBTD, MSD, and SLS, respectively) on the basis of prior estimates of their substitutability in demand for M_1 balances.

Chetty's conceptual procedure is illustrated in a simplified manner by Figure 1. This diagram depicts the public's allocation of its liquid balances between M_1-type assets, measured on the vertical axis, and time deposits, measured on the horizontal axis. The sloping line in the figure is what economists refer to as an indifference curve. The curve specifies various combinations of M_1 balances and time deposit balances that are equally satisfactory to the public. It also indicates the rate at which the public is willing to substitute balances in one of the categories for balances in the other.[22]

Let us suppose that the shape and position of the indifference curve are known and that the public is observed to be at point A on the curve. At this point it holds OM dollars of M_1 balances and OT dollars of time deposit balances. The curve indicates that the public would be equally satisfied at point P, where it would hold OP dollars of M_1 balances and no time deposit balances. This implies that the public considers a combination of OM dollars of M_1 balances and OT dollars of time deposit balances to be

[22] Indifference curves are explained in most elementary economics textbooks. See for example, Paul A. Samuelson, *Economics*, 8th ed., New York: McGraw-Hill Book Company, 1970, pp. 421-6.
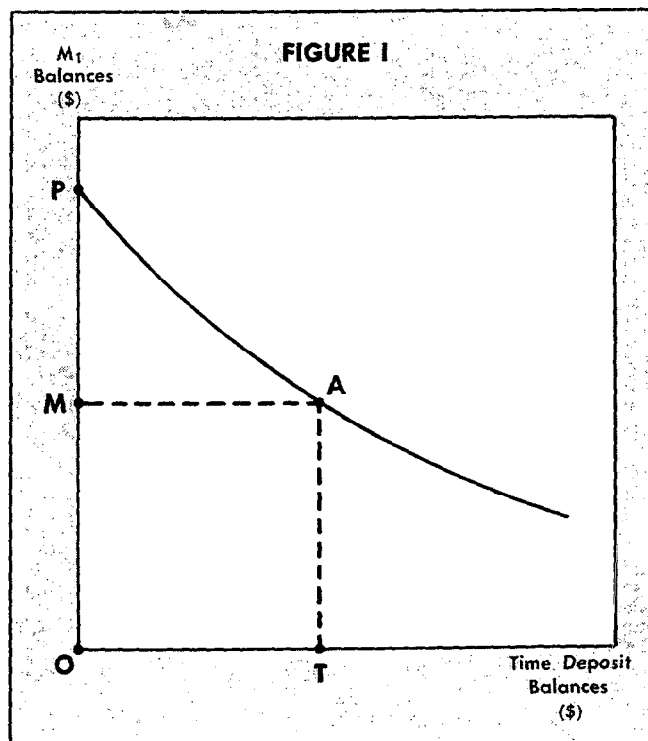
[20] While the concepts are similar, the statistical procedures and data employed in the two sets of studies were vastly different. The present writer believes that Elliott's procedures, as detailed on pages 35-40 of his study, were sounder and that his estimates are therefore more reliable.

[21] V. Karuppan Chetty. "On Measuring the Nearness of Near-Moneys," *American Economic Review*, 59 (June 1969), 270-81.

FIGURE I

equivalent in moneyness to OP dollars of M_1 balances. That is:

(9) Moneyness of ($OM + $OT) = Moneyness of $OP.

To complete the analysis, a measure of moneyness is needed. Let us arbitrarily assume that one dollar of M_1 balances contains exactly one unit of moneyness. Under this rubric the quantity of moneyness in any combination of M_1 and time deposit balances is measured by the dollar value of the M_1 balance to which the combination is equivalent. In the present example, equation (9) then indicates that the combination of OM dollars of M_1 balances and OT dollars of time deposit balances contains OP dollars of moneyness. That is:

(10) Moneyness of ($OM + $OT) = $OP.

Since an M_1 dollar contains one unit of moneyness, we know that:

(11) Moneyness of $OM = $OM.

It then follows that:

(12) $OM + Moneyness of $OT = $OP.

Equation (12) can be rewritten equivalently as:

(13) $OM + m($OT) = $OP,

where m is the proportion of moneyness in a nominal dollar of time deposits. In other words, m is the weight that would be attached to time deposit balances in monetary aggregation.

It is obvious from equation (13) that the dollar values of the balances OM, OT, and OP are sufficient to determine m. Chetty used actual observations of OM and OT (along with interest rate data) for the years 1945-1966 to determine, in effect, the shape and position of the indifference curve in Figure 1. This procedure fixed the point P and established the value of the hypothetical balance OP from which the weight m was then derived.[23]

By deposit classes, the estimated weights were 1.00 for CBTD, .88 for MSD, and .62 for SLS. For the reader's convenience, Chetty's results are shown in Table II along with the postwar period results of

the three other studies discussed above. Chetty's weights were generally higher than those found in the other studies. In particular, Chetty's estimate of the weight for CBTD was unity, implying that these deposits should be included along with M_1 balances at their full dollar value in measuring the aggregate money stock. Apart from this, it is worth noting that Chetty's estimates for the respective asset categories were ordered identically to Laumas' estimates.

As previously stated, the results of these empirical studies are tentative at best. As is common in statistical estimation of this sort, the numerical results are quite sensitive to the methods and data used.[24] Nonetheless the similarities among some of the results shown in Table II are at least mildly encouraging. Moreover, the estimates fall generally within a range that is intuitively plausible. In short, the results of these studies suggest that weighted monetary aggregation might be empirically feasible. In addition, they appear to justify further analysis aimed at developing preliminary estimates of the weights of some of the assets included in the broader aggregates of Table I.

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[24] As an example of this sensitivity, Franklin R. Edwards found much less substitutability between M_1 balances and other assets when he applied Chetty's model to cross-sectional metropolitan area data. See Franklin R. Edwards, "More on Substitutability Between Money and Near-Monies," *Journal of Money, Credit and Banking, 4* (August 1972), 564-6.

Table II

ESTIMATES OF WEIGHTS FOR VARIOUS ASSETS AND COMBINATIONS OF ASSETS DURING THE POSTWAR PERIOD*

Study	Data	Assets	Weight
Elliott	Cross-sectional (state data), 1954	CBTD + MSD + PSD	.65
Timberlake-Fortson	Annual time series, 1953-1965	CBTD + MSD + PSD	.15
Laumas	Quarterly time series, 1947-1966	CBTD	.58
		CBTD + MSD + PSD	.48
		CBTD + MSD + PSD + SLS	.32
Chetty	Annual time series, 1945-1966	CBTD	1.00
		MSD	.88
		SLS	.62

Notation

CBTD — time and savings deposits at commercial banks

MSD — mutual savings bank deposits

PSD — Postal Savings System deposits

SLS — savings and loan association shares

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* All estimates assume a weight of unity for currency and demand deposits.

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[23] The foregoing description of Chetty's technique is not precise, but it is a close enough approximation for the purposes of the present survey. In technical language, Chetty measured the weights using a regression model derived by maximizing a CES utility function having M_1, CBTD, MSD, and SLS as arguments. For the detailed derivation, see Chetty, "Near-Moneys," pp. 272-8.

IV. SUMMARY AND CONCLUSION

This article has attempted to provide an overview of some of the major conceptual issues associated with the process of monetary aggregation and, as a consequence, with the use of monetary aggregates as they are presently defined in the conduct of monetary policy. The article reviewed the main features of the debate among economists over the proper definition of money. It then described a general framework for weighted aggregation and suggested some of the factors that might influence the weights and their behavior over both the short and long runs. The third section reviewed preliminary efforts to estimate the weights of a limited number of assets statistically.

A major aim of this discussion has been to suggest that despite all of the current public comment about the money supply, there is no firm agreement as to precisely what it is or how it should be measured. As we have seen, this state of affairs reflects the fact that money is simply not as concrete and unambiguous a concept as is commonly believed. Moreover, what serves as money can change over time with longer-run changes in financial technology, financial

regulations, and underlying social behavior, and possibly with variations in economic activity and financial conditions over the business cycle.

Do these observations imply that the use of the various monetary aggregates shown in Table I is analytically unsound? Not necessarily. They *do* suggest, however, that the combined behavior of these aggregates as a group may provide a more accurate indication of the effect of monetary policy actions than the behavior of any one of them.

This last comment is not intended to imply that simply monitoring a larger constellation of aggregates is an ideal procedure. Refinements are clearly possible. This is where research along the lines described in Sections II and III is relevant. True, the complexity of weighted aggregation and the measurement difficulties associated with the technique will almost certainly preclude employing any such aggregate as an operational variable in the day-to-day conduct of monetary policy. Nonetheless, this research shows promise of producing new insights that might substantively improve the ability of policymakers to interpret the behavior of the conventional aggregates.