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An Extended Series of Divisia Monetary Aggregates

THE CONVENTION IN monetary economics has been to create monetary aggregates by simply adding together the dollar amounts of the various financial assets included in them. This is the simple-sum method of aggregation. This procedure has been criticized because such monetary aggregates are essentially indexes that weight each component financial asset equally, a practice that is economically meaningful only under special circumstances.

A number of alternative indexes of monetary aggregates have been developed recently. The most well known are the Divisia monetary aggregates developed by Barnett (1980). This article reviews the theoretical basis for monetary aggregation and presents series of Divisia monetary aggregates for an extended sample period. The behavior of the simple-sum aggregates and their Divisia counterparts are compared over this period.

THE THEORETICAL BASIS FOR MONETARY AGGREGATION[1]

Simple-sum aggregation stemmed directly from the classical economists' notion that the essential function of money is to facilitate transactions, that is, to serve as a medium of exchange. Assets that served as media of exchange were considered money and those that did not, were not. By this definition only two assets, currency and demand deposits, were considered money. Both assets were non-interest bearing, and individuals

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[1]The discussion in this section is based on consumer demand theory. This may not be a serious limitation. For example, Feenstra (1986) has shown that money in the utility function is equivalent to other approaches. These approaches assume, however, that all of the costs and benefits of money are internalized, and it is commonly believed that there are externalities to the use of money in exchange (see Laidler [1990]).

were free to alter the composition of their money holdings between currency and demand deposits at a fixed one-to-one ratio. Consequently the monetary value of transactions was exactly equal to the sum of the two monies.[2] Simple-sum aggregation was a natural extension of both restricting the definition of money to non-interest-bearing medium-of-exchange assets and of the fixed unitary exchange rate between the two alternative monies.[3]

In consumer demand theory, simple-sum aggregation is tantamount to treating currency and demand deposits as if they are perfect substitutes. Currency and demand deposits, however, are not equally useful for all transactions, so this assumption was clearly inappropriate. But, simple-sum aggregation of those two monetary assets was still appropriate because the assets were non-interest bearing and exchanged at a fixed one-to-one ratio. Consequently individuals would allocate their portfolio of money between the two assets until they equalized the marginal utilities of the last dollar held of each. Under these conditions, simple-sum aggregation is appropriate if it is also assumed that each agent is holding his equilibrium portfolio.

The recognition that non-interest-bearing demand deposits may have paid an implicit interest weakened the theoretical justification for simple-sum aggregation. A more serious blow to simple-sum aggregation, however, was dealt by a shift in monetary theory to emphasizing the store-of-value function of money.[4] That an asset could not be used directly to facilitate transactions was no longer a sufficient condition for excluding it from the definition of money. Instead, the asset approach to money emphasized money's role as a temporary abode of purchasing power that bridges the gap between the sale of one item and the purchase of another. Currency and checking accounts are money because they are both media of exchange and temporary abodes of purchasing power. Non-medium of exchange assets are superior to currency and non-interest-bearing checking accounts as stores of value because they earn explicit interest. This superiority typically increases with the length of time between the sale of one item and subsequent purchase of another because the cost of getting into and out of such assets and the medium of exchange assets is thought to be small and *not* proportional to the size of the transaction.

This shift in emphasis in monetary theory dramatically expanded the number of assets that were considered money and the number of alternative monetary aggregates proliferated.[5] Nonetheless, the method of aggregation remained the same—simple-sum aggregation.

As more financial assets came to be considered money, it became increasingly clear that it was inappropriate to treat these assets as perfect substitutes. Some financial assets have more "moneyness" than others, and hence they should receive larger weights. In what appears to be the first attempt at constructing a theoretically

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[2]This need not be true for the economy as a whole when measured over a sufficiently long time interval. In this case the amount of each form of money multiplied by its turnover velocity will equal total expenditures. This is the basis for the velocity of the demand for money. Fisher (1911) explicitly recognized that turnover velocities of currency and checkable deposits would likely be different. He circumvented this problem by assuming that there was an optimal currency-to-deposit ratio that would be a function of economic variables. Given these variables, the demand for the two alternative monetary assets was taken to be strictly proportional. Moreover, because individuals were free to adjust their money holdings between currency and checkable deposits quickly and at low cost, Fisher argued that the actual ratio would deviate from the desired ratio for only short periods. For some recent evidence that the actual currency-to-deposit ratio might be determined by the policy actions of the Federal Reserve, see Garfinkel and Thornton (1991). The possibility that currency and checkable deposits have different turnover velocities is the basis for Spindt's (1985) weighted monetary aggregate, MQ.

[3]There is an issue of whether the fixed ratio was endogenous, from either the perspective of supply or demand, or the result of arbitrary legal restrictions. From the demand side, this would require that these assets be perfect substitutes for all transactions. From the supply side, Pesek and Saving

(1967) argued that the one-to-one exchange rate was a natural outcome of competitive pressures in the banking industry. Whether the fixed one-to-one ratio is the endogenous outcome of a free market economy or is simply due to legal restrictions remains controversial.

Of course today some checkable deposits earn explicit interest. Consequently such deposits are a better store of wealth than currency. They are also a preferable medium of exchange for some, but not all, transactions.

[4]There has been a difference of opinion about the degree of emphasis that should be placed on the asset and transactions motives for holding money. Indeed, Laidler (1990, pp. 105–6) has noted that "...the most extraordinary development in monetary theory over the past fifty years is the way in which money's means-of-exchange and unit-of-account roles have vanished from what is widely regarded as the mainstream of monetary theory."

Broaching the medium-of-exchange line of demarcation between money and non-money assets also gave rise to an extensive literature on the empirical definition of money. For a critique of this literature and the idea of distinguishing between monetary and non-monetary assets based on the concept of the temporary abode of purchasing power, see Mason (1976).

[5]At one point the Federal Reserve published data on five alternative monetary aggregates.

preferable alternative to the simple-sum monetary aggregate, Chetty (1969) added various savings-type deposits, weighted by estimates of the degree of substitution between them and the pure medium of exchange assets, to currency and demand deposits. Larger weights were given to assets with a higher estimated degree of substitution.[6]

Divisia aggregation, which also relies on consumer demand theory and the theory of economic aggregation, treats monetary assets as consumer durables such as cars, televisions and houses. They are held for the flow of utility-generating monetary services they provide. In theory, the service flow is given by the utility level. Consequently the marginal service flow of a monetary asset is its marginal utility. In equilibrium, the marginal service flow of a monetary asset is proportional to its rental rate, so the change in the value of a monetary asset's service flow per dollar of the asset held can be approximated by its user cost. The marginal monetary services of the components of Divisia aggregates are likewise proxied by the user costs of the component assets. The user cost of each component is proportional to the interest income foregone by holding it rather than a pure store-of-wealth asset—an asset that yields a high rate of return but provides no monetary services. Currency and non-interest-bearing demand deposits have the highest user cost because they earn no explicit interest income. Consequently they get the largest weights in the Divisia measure. On the other hand, pure store-of-wealth assets get zero weights.[7]

The object of a Divisia measure is to construct an index of the flow of monetary services from a group of monetary assets, where the monetary service flow per dollar of the asset held can vary from asset to asset.[8] Applying an appropriate index number to a group of assets is not sufficient, however, to get a correct measure of the flow of monetary services. The index must also be constructed from a set of assets that can be aggregated under conditions set by consumer demand theory. The objective of economic aggregation is to identify a group of goods that behave as if they were a single commodity. A necessary condition for this is block-wise weak separability. Block-wise weak separability requires that consumers' decisions about goods that are outside the group do not influence their preferences over the goods in the group whatsoever.[9] If this condition is satisfied, consumers behave just as though they were allocating their incomes over a single aggregate measure of monetary services and all other commodities to maximize their utility. Their total expenditure on monetary services is subsequently allocated over the various financial assets that provide such services.

The Divisia index generates such a monetary aggregate. Moreover, in continuous time it has been shown to be consistent with any unknown utility function implied by the data. In discrete time the Divisia index is in the class of superlative index numbers. Simple-sum indexes, on the other hand, do not have this desirable property. Thus they have no basis in either consumer demand theory or aggregation theory.[10]

In principle, all financial assets other than pure store-of-wealth assets provide some monetary services. Which assets can be combined into a meaningful monetary aggregate is an empirical

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[6]Chetty's work was motivated by the Gurley/Shaw hypothesis and the general lack of agreement in the empirical findings of Feige (1964) and others about the degree of substitutability between money and near-money assets. Gurley and Shaw (1960) suggested that the effectiveness of monetary policy was limited because of the high degree of substitutability between money (currency and demand deposits) and near-money (various bank and nonbank savings-type accounts) assets. Subsequent research has tended to support Feige's finding of a relatively low degree of substitutability between transactions media and liquid, non-medium-of-exchange assets. See Fisher (1989) for a survey of much of this literature.

[7]There does not appear to be agreement about what constitutes the best proxy measure for the theoretical pure store-of-wealth asset. Barnett, Fisher and Serletis (1992, p. 2,093) state the following, "The benchmark asset is specifically assumed to provide no liquidity or other monetary services and is held solely to transfer wealth intertemporally. In theory, R (the benchmark rate) is the maximum expected holding period yield in the economy. It is usually defined in practice in such a way that the user costs for the monetary

assets are (always) positive." Parentheses added. The Baa bond rate, or the highest rate paid on any of the component assets when the yield curve becomes inverted, has frequently been used to construct Divisia aggregates.

[8]See Barnett, Fisher and Serletis (1992) and Yue (1991a and b) for more detailed analyses of issues in monetary aggregation.

[9]Technically the marginal rates of substitution between any two goods inside the group must be independent of the quantities of the goods consumed that are outside of the group.

[10]Fisher (1922) was especially critical of the simple-sum index in his extensive analysis of index numbers. In particular, Fisher argued that simple-sum aggregates cannot internalize pure substitution effects associated with relative price changes. Thus changes in utility, which should occur only as a result of the income effect associated with relative price changes, occur in simple-sum aggregates because of both income and substitution effects.

issue because economic theory does not tell us which group of assets satisfies the condition of block-wise weak separability. Unfortunately, the most widely used test for weak separability is not powerful.[11] Consequently, it has been common simply to create Divisia indexes under the maintained hypothesis that the assets that compose the aggregate satisfy this condition. Thus the issues of the appropriate method of aggregation and the appropriate aggregate have been treated separately.[12]

SIMPLE-SUM AND DIVISIA MONETARY INDEXES

A simple-sum monetary aggregate is a measure of the *stock* of financial assets that compose it, whereas a Divisia monetary aggregate is a measure of the *flow* of monetary services from the *stocks* of financial assets that compose it.[13] For this reason alone, the methods of measurement are quite different. Simple-sum aggregates are obtained by simply adding the dollar amounts of the component assets. On the other hand, Divisia monetary aggregates are obtained by multiplying each component asset's growth rate by its share weights and adding the products. A component's share weight depends on the user costs and the quantities of all component assets.[14] Specifically, the share weight given to the jth component asset at time t is its share of total expenditures on monetary services; that is,

$$S_{jt} = u_{jt} \, q_{jt} / \left(\sum_{j=1}^{n} u_{jt} \, q_{jt} \right),$$

where q_j denotes the nominal quantity of the jth component asset, u_j denotes the jth component's

user cost and n denotes the number of component financial assets. The user cost is equal to $(R-r_j)p/(1+R)$, where R is the benchmark rate (that is, the rate on the pure store-of-wealth asset), r_j is the own rate on the jth component, and p is the true cost-of-living price index that cancels out of the numerator and denominator of the shares. The growth rate of the ith Divisia monetary aggregate, GDM_i, is given by

$$GDM_i = \sum_{j=1}^{n} [(S_{jt} + S_{jt-1})/2] \, g_{jt},$$

where g_{jt} is the growth rate of q_{jt}.[15]

A Comparison of Simple-Sum and Divisia Monetary Aggregates

Because the Divisia aggregates are an alternative to the conventional simple-sum aggregates, it is instructive to compare them. When constructing data in this section, the authors used an extension of the Farr and Johnson (1985) method. The Appendix presents details of the construction of the Divisia monetary aggregates used here.

A Divisia monetary index is an approximation to a nonlinear utility function. Because it is an index, the level of utility is an arbitrary unit of measure; the level of the index has no particular meaning.[16] Nevertheless, because they are alternative measures of money, the Divisia and simple-sum aggregates are frequently compared to see how any analysis of the effects of monetary policy or other issues might be affected by the method of aggregation. The comparison of the levels of

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[11]The most widely used test, developed by Varian (1982, 1983), is not statistical. The null hypothesis of weak separability is rejected if a single violation of the so-called regularity conditions is found. Because tests for weak separability lack power, Barnett, Fisher and Serletis (1992, p. 2,095) argue that "existing methods of conducting such tests are not...very effective tools of analysis." See Barnett and Choi (1989) for evidence indicating that available tests of block-wise weak separability are not very dependable. For results of tests for weak separability, see Belongia and Chalfant (1989) and Swofford and Whitney (1986, 1987).

[12]A common practice both in the United States and abroad is to construct Divisia monetary aggregates for collections of assets that are reported by the country's central bank. For example, see Yue and Fluri (1991), Belongia and Chrystal (1991) and Ishida (1984).

[13]It should be noted that the accounting stock, that is, the sum of the dollar amounts of all assets that are considered money, is not necessrily equal to the capital stock of money. The accounting stock is the present value of both service flow of money and the interest income (the service as a store of value). The economic capital stock of money

comprises only the present value of the flow of monetary services. See Barnett (1991) for the formula for the economic capital stock of money.

[14]For the Divisia monetary aggregates, the share weight of each component's growth rate is its expenditure share of total expenditures on monetary services. Theoretically the share weights for the Divisia monetary aggregates are not a function of prices or user costs, but of quantities. The observable user costs are substituted for the unobservable marginal utilities under the implicit assumption of market-clearing equilibrium, where each consumer holds an optimal portfolio of monetary and nonmonetary assets. For the simple-sum monetary aggregates, the share weights are the components' share of the aggregate.

[15]$GDM_i = \ln DI_t - \ln DI_{t-1}$, where DI denotes the Divisia index. The index is initialized at 100, that is, $DI_0 = 100$. See Farr and Johnson (1985) for more details.

[16]Rotemberg (1991) derives a weighted monetary aggregate stock under conditions of risk neutrality and stationarity expectations; however, Barnett (1991) shows that this measure is the discounted value of future Divisia monetary service flows.

Figure 1
Year-Over-Year Growth of SSM1a and DIVM1a, and Levels of SSM1a and DIVM1a
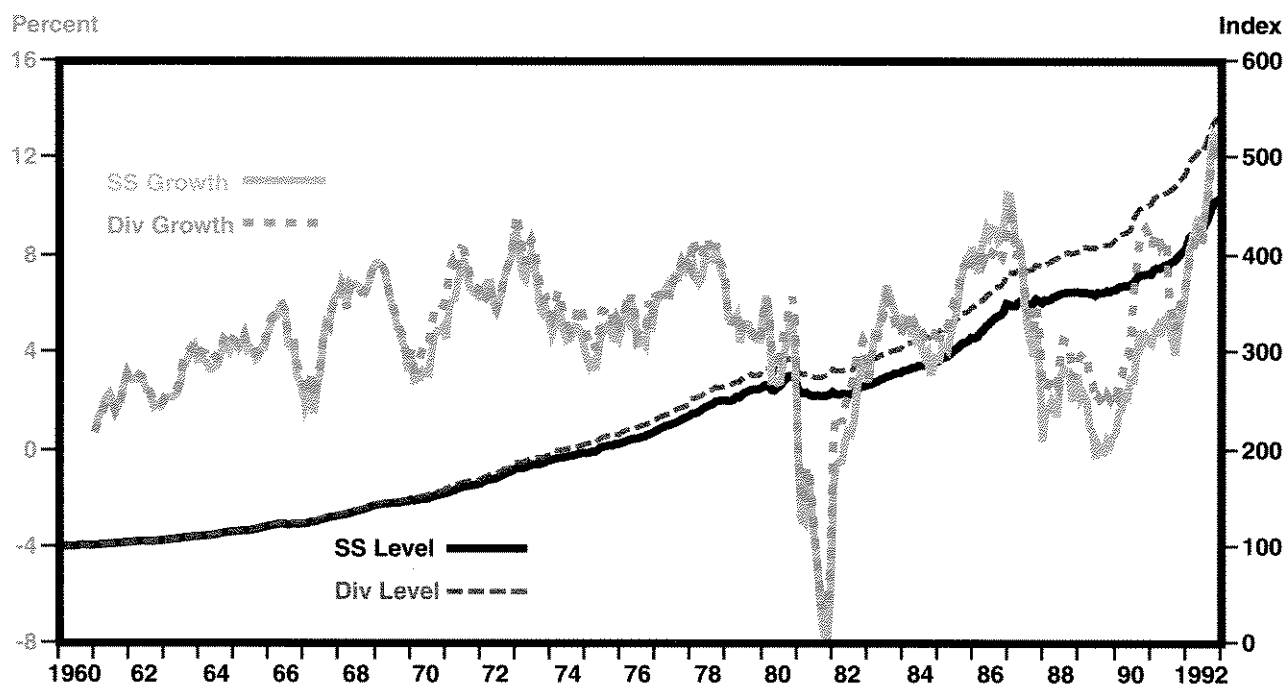
the simple-sum and Divisia measures is made by normalizing both measures so that they equal 100 at some point in the series, usually the first observation.[17] Comparisons of the levels and growth rates of the Divisia and simple-sum measures are presented in figures 1–5 for four monetary aggregates, M1A, M1, M2 and M3, and for total liquid assets, L.[18] The figures have two scales. The left-hand scale indicates the growth rate, and the right-hand scale indicates the level of the series. Both indexes equal 100 in January 1960.

M1A

M1A comprises currency and non-interest-bearing demand deposits held by households and businesses. Although neither household nor business demand deposits earn explicit interest, business demand deposits are assumed to earn an implicit own rate of return proportional to the rate paid on one-month commercial paper.[19] Consequently, additional units of business demand deposits are assumed to yield a smaller

[17]An alternative justification for comparing the Divisia and simple-sum aggregates might come from noting that the appropriate Divisia monetary aggregate would be the simple-sum aggregate if all of the component assets had identical own rates. Such a comparison is tenuous, however, because the actual level of the simple-sum aggregate might have been different from the observed level had the user costs actually been equal.

It is common to compare the levels and growth rates of simple-sum and Divisia monetary aggregates. For example, see Barnett, Fisher and Serletis (1992). Because Divisia indexes involve logarithms, the growth rate of a component asset is plus or minus infinity, respectively, when a component is introduced or eliminated. To circumvent this problem, the Divisia index is replaced by Fisher's ideal index at these times and the user cost is measured by its reservation price during the period that precedes the introduction or follows the elimination of the asset. See Farr

and Johnson (1985) for a discussion of this procedure.

[18]Note that the simple-sum aggregates presented here are not identical to the official published series. The official series are obtained by adding the non-seasonally adjusted components and seasonally adjusting the aggregate as a whole or by adding large subgroups of component assets that have been seasonally adjusted as a whole. The simple-sum aggregates presented here are obtained by adding the components after each component (that has a distinctive seasonal) has been seasonally adjusted. See the Appendix for details. A comparison of the series used here and the official series shows that the differences are small.

[19]Alternatively, estimates of the own rate on household demand deposits could also be used. However, such a series was not available for the entire sample period. Moreover, the desire was to follow the procedure used by Farr and Johnson (1985) as closely as possible.

Figure 2

Year-Over-Year Growth of SSM1 and DIVM1, and Levels of SSM1 and DIVM1
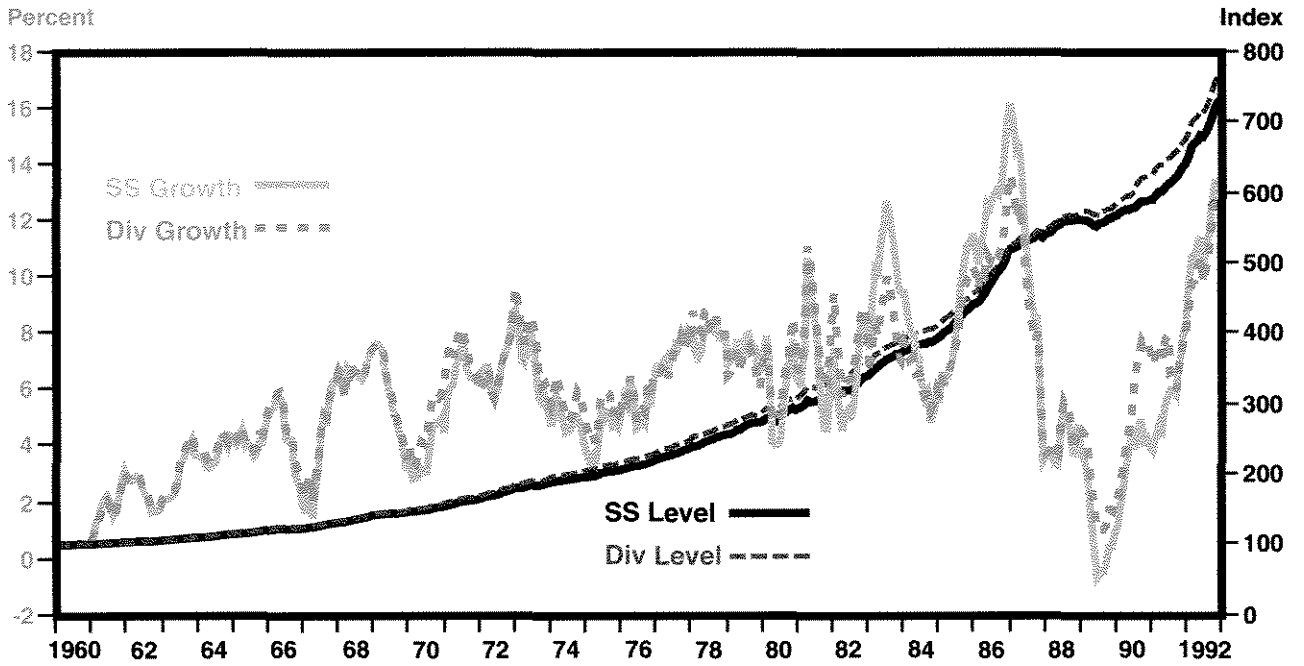
Figure 3

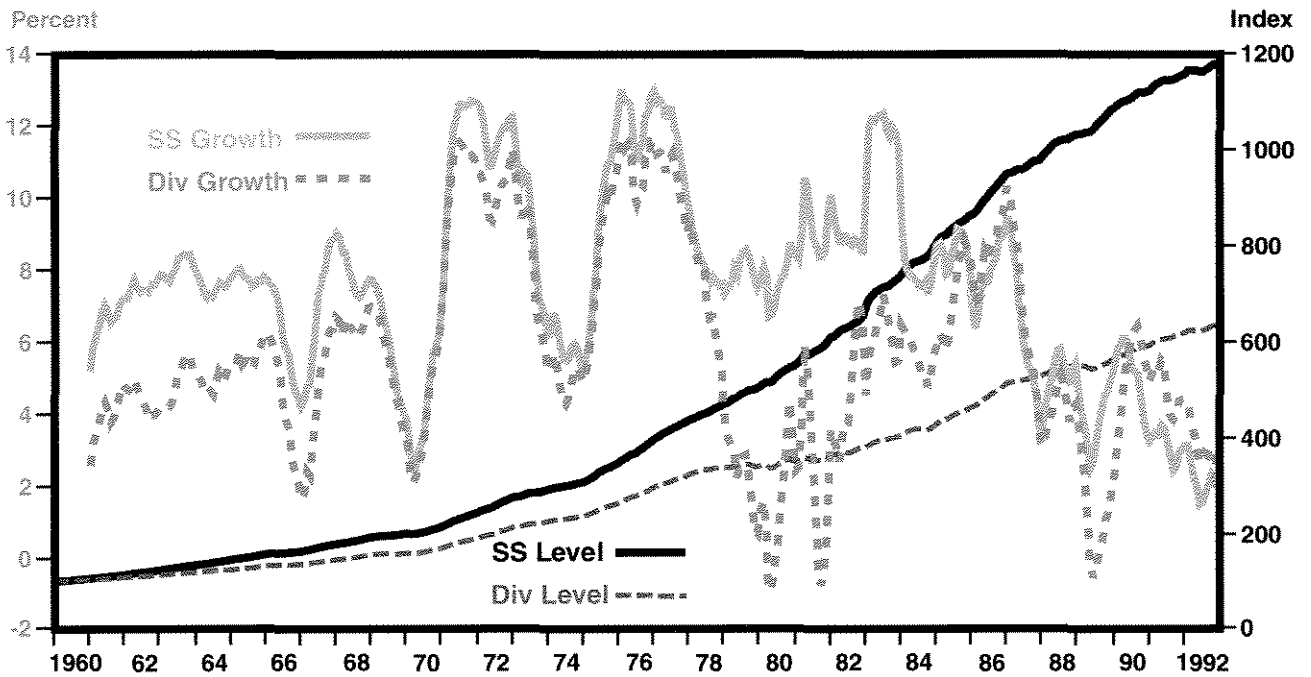**Year-Over-Year Growth of SSM2 and DIVM2, and Levels of SSM2 and DIVM2**

Figure 4
Year-Over-Year Growth of SSM3 and DIVM3, and Levels of SSM3 and DIVM3

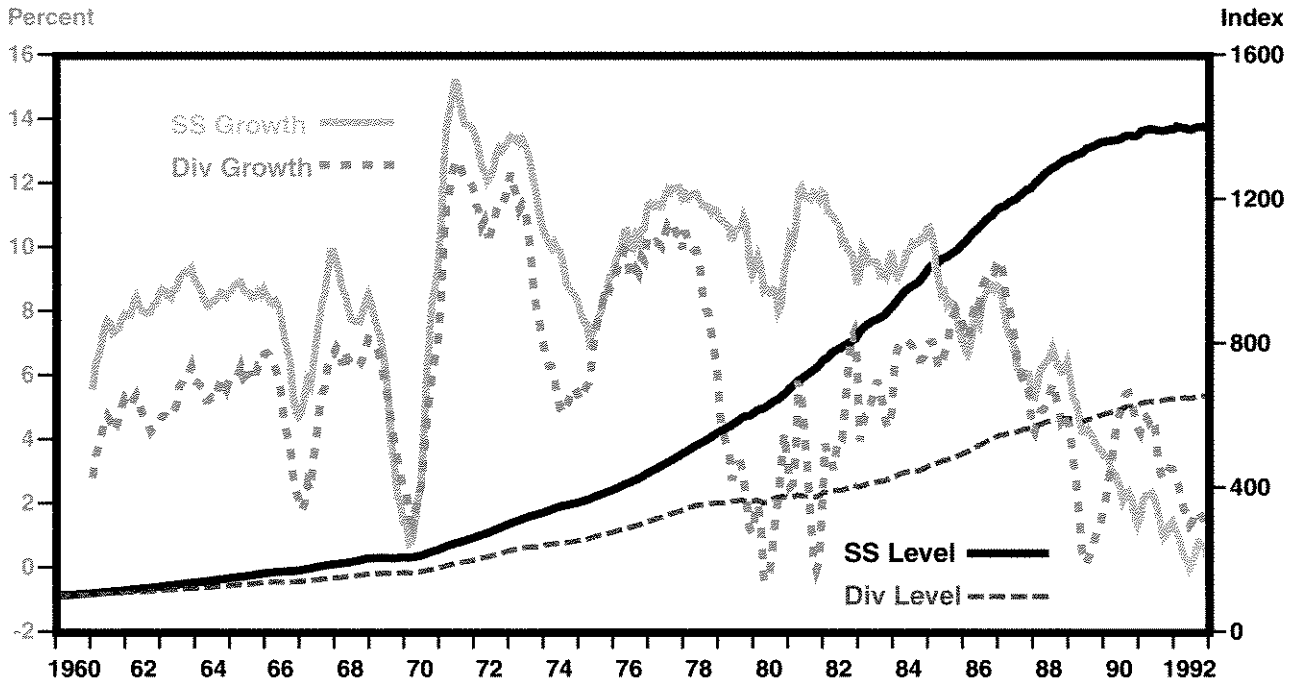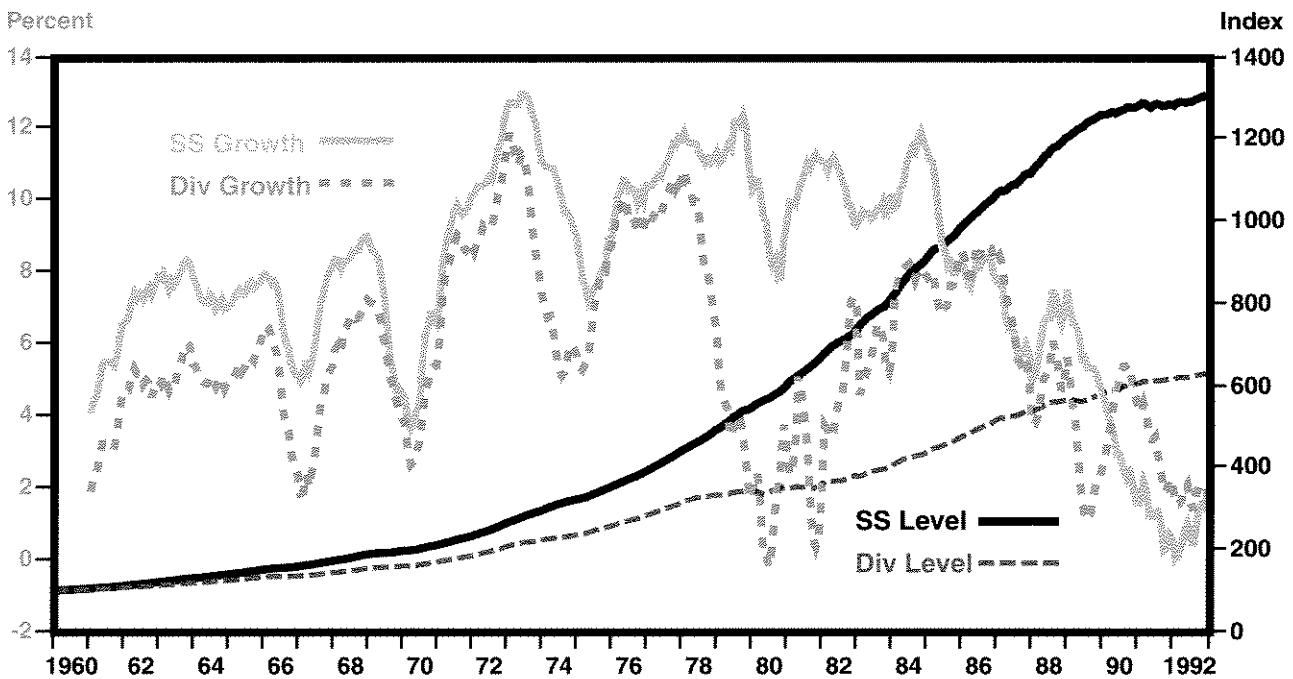Percent   Index

Figure 5
Year-Over-Year Growth of SSL and DIVL, and Levels of SSL and DIVL

Percent   Index

flow of monetary services than are additional units of household demand deposits. On the other hand, the simple-sum measure implicitly assumes that each unit of each component provides the same flow of monetary services. Hence the Divisia aggregate gives more weight to the growth rates of currency and household demand deposits than does the simple-sum aggregate.[20]

The average differences in the growth rates of the simple-sum and Divisia measures of M1A for the entire sample period, January 1960 to December 1992, and for selected sub-periods are presented in table 1. Because currency generally grew more rapidly than demand deposits over the sample period, the growth rate of Divisia M1A averaged about half a percentage point higher than the growth rate of simple-sum M1A over the entire period.[21] Much of this difference occurs during the latter part of the 1980s, when the growth rate of demand deposits generally slowed relative to the growth rate of currency.[22] This more rapid growth of the Divisia measure is reflected in a generally widening gap between the levels of the indexes.

M1

The behavior of simple-sum and Divisia M1 is similar to that of M1A. Indeed, the growth rates of simple-sum and Divisia M1 were similar until the late 1970s, when the growth of interest-bearing NOW accounts began to accelerate. The sharp rise in NOW accounts after their nationwide introduction on January 1, 1981, tended to increase the growth rate of the simple-sum measure relative to the Divisia measure because the growth rate of NOW accounts gets a smaller weight in the Divisia measure. As a result, the Divisia measure grew more slowly on average

than the simple-sum measure from the late 1970s until the mid-1980s, after growing more rapidly previously. However, in neither period is the average difference in the growth rate of the alternative measures large.[23]

After the late 1980s the Divisia measure grew more rapidly than the simple-sum measure, reflecting the rise in the growth rate of currency relative to the growth rate of checkable deposits. Of course, the smaller average difference in the growth rates of the alternative M1 aggregates compared with M1A is reflected in a smaller difference in the levels of the two indexes as well.

M2, M3 and L

Not surprisingly, larger differences arise when the monetary measures are broadened to include savings-type deposits because their explicit own rates of return are higher than those of trans-actions deposits. The higher own rate reduces the share weights of these component assets relative to the weights they receive in the simple-sum measures. During the sample period the growth rates of the broader simple-sum aggregates tend to be substantially larger than those of the corresponding Divisia measures. For the broader measures, the average growth rates of the simple-sum measures are about 2 percentage points greater than the corresponding Divisia measures over the entire sample period.

Much of this difference arises from the late 1970s to the mid-1980s and is likely due to financial innovation and deregulation in the period. The late 1970s witnessed a marked acceleration in the growth of money market mutual funds. These accounts paid relatively high interest rates and had limited transactions capabilities. A number of new deposit instruments that paid higher market interest rates were

[20]In both cases, the sum of the weights must equal unity.

[21]Currency grew at an annual rate of 7 percent during the entire period, whereas household and business demand deposits both grew at a 3.2 percent annual rate.

[22]This is a period of very slow reserve growth. Because reserves and checkable deposits are tied closely together under the present system of reserve requirements, it is not surprising that this is also a period of slow growth in check-able deposits, including household and business demand deposits. See Garfinkel and Thornton (1991) for a discussion of the relationship between reserves and checkable deposits under the present system of reserve requirements.

[23]We have refrained from using the phrase "statistically significant" because these observations are clearly dis-tributed identically and independently, so the "t-statistics" reported in table 1 are biased and neither the direction nor extent of the bias is known. These statistics are presented

to give the reader a rough approximation of the magnitude of the differences in the growth rates. Correlegrams of the difference in the growth rates of simple-sum and Divisia M1A and M1 show some lower level persistence through the sample period and some large spikes at seasonal frequencies after 1969. Correlegrams for the difference in the growth rates of the broader monetary aggregates reveal some higher level persistence. In any event, differences that are small in absolute value tend to be small relative to the estimated standard errors, and differences that are large in absolute value tend to be large in relative terms.

Another measure of the distance between the growth rates is the square root of the sum of the squared differ-ences in the growth rates. These measures for the entire sample period are 58.5, 52.1, 69.6, 81.4 and 77.6 for M1A, M1, M2, M3 and L, respectively. These data are broadly comparable with those presented in table 1.

Table 1

Average Percentage Point Difference in the Annual Growth Rate of Simple-Sum and Divisia Aggregates

Period	Aggregate	Mean[1]	Standard Deviation	t-statistic
1960.01–1992.07				
	M1A	−0.514	3.16	3.24*
	M1	−0.153	2.83	1.07
	M2	1.889	3.49	10.75*
	M3	2.317	3.88	11.88*
	L	2.223	3.66	12.07*
1960.01–1977.12				
	M1A	−0.285	2.04	2.05*
	M1	−0.253	2.03	1.82
	M2	1.660	1.54	15.81*
	M3	2.134	2.08	15.02*
	L	1.897	1.73	16.10*
1978.01–1986.12				
	M1A	−0.324	3.83	0.88
	M1	0.420	3.65	1.20
	M2	3.526	5.59	6.55*
	M3	4.334	5.75	7.84*
	L	4.303	5.50	8.12*
1987.01–1992.12				
	M1A	−1.485	4.41	2.85*
	M1	−0.714	3.32	1.82
	M2	0.116	2.45	0.40
	M3	−0.163	2.82	0.49
	L	0.076	2.84	0.23

[1]The growth rate of the simple-sum aggregate less the growth rate of the Divisia aggregate.

*Indicates a t-statistic greater than 2. See footnote 23.

introduced in the early 1980s and Regulation Q interest rate ceilings were being phased out.[24] Moreover, short-term interest rates reached very high levels in the early 1980s. With share weights sensitive to the spread between an asset's own rate of return and the return on the benchmark asset, it is not surprising that the Divisia measures grew markedly slower than the corresponding simple-sum measures during this period. Nevertheless, the signi-

ficantly slower growth of the broader Divisia measures during this period is more consistent with the disinflation of the period than is the growth of the simple-sum aggregates, whose growth remained fairly rapid. Although the growth rates of the broader Divisia and simple-sum aggregates have been essentially the same, on average, since about the mid-1980s, the pattern of growth of these alternative measures is somewhat different.

[24]For a discussion of the financial innovations of this period see Gilbert (1986) and Stone and Thornton (1991).

Figure 6
Levels of Divisia M2, M3, and L

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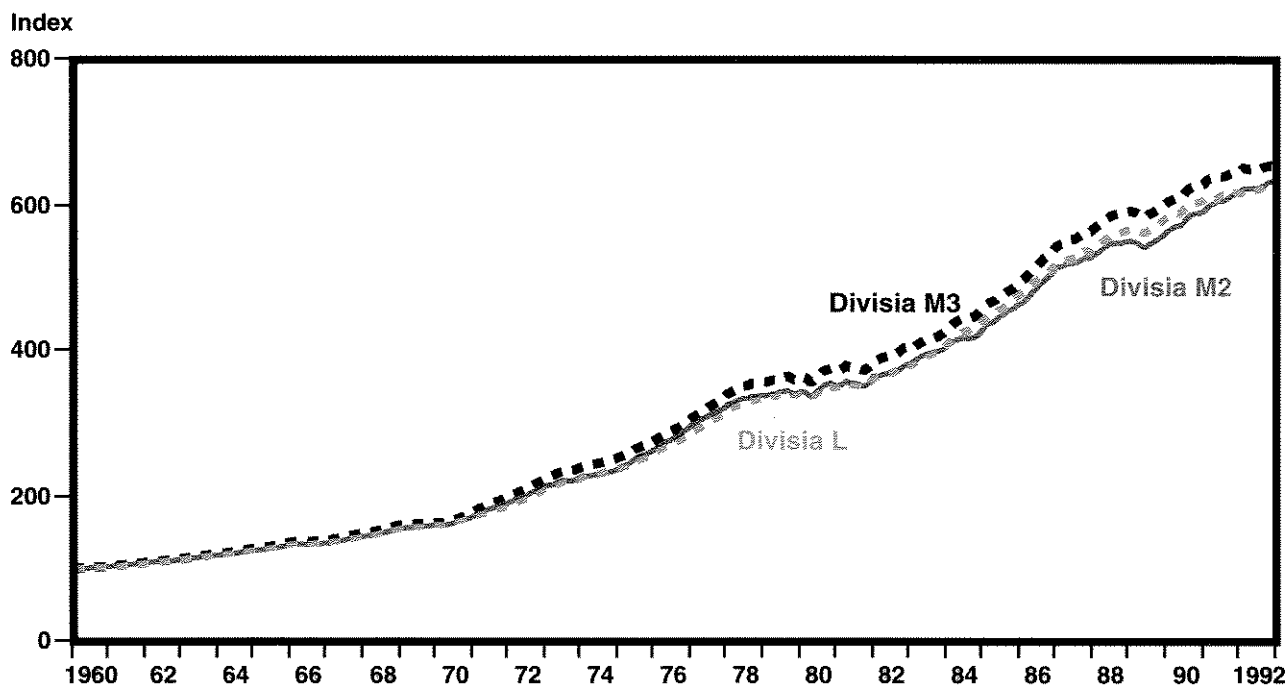
A Comparison of Broader Divisia Aggregates

That Divisia aggregation gives relatively small weight to less liquid assets that yield high rates of return suggests that differences in the growth rates of successively broader Divisia monetary aggregates will tend to get smaller.[25] The levels of Divisia M2, M3 and L presented in figure 6 and simple correlations of the compounded annual growth rates of these Divisia aggregates presented in table 2 confirm this. The growth rates of Divisia M3 and L differ little from the growth rate of Divisia M2. This implies that adding successively less liquid assets to those in M2 adds little to the flow of monetary services.[26] That the average difference in the growth rates of Divisia M2 and L is nearly zero over the entire sample period is reflected by the levels of the two Divisia aggregates, which are essentially equal by the end of the sample. Divisia M3, however, has grown more rapidly than the other measures, so the spread between its level and the levels of Divisia M2 and L has widened over the sample period.

CONCLUDING REMARKS

Despite their theoretical advantage, Divisia and other weighted monetary aggregates have garnered relatively little attention outside of academe, and the official U.S. monetary aggregates remain simple-sum aggregates. The official reliance on simple-sum aggregates will probably continue unless the Divisia aggregates or other alternative weighted aggregates are shown to be superior in economic and policy analysis.

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[25]Of course this tendency also exists for the simple-sum aggregates. For the simple-sum aggregate, the growth rate of each component is weighted by the component's share of the total asset. Hence the growth rates of successively broader monetary aggregates could diverge if the marginal components were successively larger. For example, this is what happens from M1 to M2. The growth rates tend to converge, however, because the marginal components are smaller. This tendency is exacerbated in the Divisia measures because of smaller weights associated with higher own rates of return on successively less liquid assets.

[26]The average differences in the growth rates of Divisia M2, M3 and L over the sample period are small (less than 0.12 percentage points in absolute value). The absolute values of the average differences in the growth rates of simple-sum M2, M3 and L are larger than those of the corresponding Divisia measures; the standard errors are also much larger.

Table 2

Correlations of the Annual Growth Rates of the Divisia Monetary Aggregates

Aggregate	M1A	M1	M2	M3
M1	.7920			
M2	.6540	.6914		
M3	.6015	.6346	.9568	
L	.5754	.6126	.8863	.9216

Although nothing definitive can be said about this issue from the simple analysis of the data presented here, a few observations are offered.

First, that the growth rates of the narrow simple-sum and Divisia monetary aggregates are quite similar suggests that the method of aggregation may not be important at low levels of aggregation.[27] For example, it does not appear that conclusions about the long-run effects of money growth on inflation would be much different using either simple-sum or Divisia M1 or M1A. The average difference in the growth rates of narrow simple-sum and Divisia monetary aggregates is small. This observation is consistent with the empirical work of Barnett, Offenbacher and Spindt (1984) who, using a broad array of criteria, found that the difference in the performance of simple-sum and Divisia monetary aggregates was small at low levels of aggregation.

Second, the method of aggregation is likely to be more important for broader monetary aggregates. Beyond some point, however, a further broadening of the monetary aggregate makes little difference. For the United States, the differences in the average growth rates of Divisia M2, M3 and L are small. Consequently, long-run analysis using the growth rates of any of these Divisia aggregates is likely to produce similar results. Monthly growth rates of these Divisia aggregates are also highly correlated. Hence it would not be too surprising to find that the broader Divisia aggregates perform similarly to one another in many short-run analyses as well.

These observations point to the critical need for more work to determine which financial

assets should be included in the appropriate monetary aggregate. In consumer demand theory, these assets must satisfy the condition of weak separability. If analysis suggests a relatively narrow monetary aggregate such as M1, policymakers may be reluctant to adopt the theoretically superior index measure because, as a practical matter, the method of aggregation may not be empirically important.

If such tests point to an aggregate that includes a much broader array of financial assets, the practical case for the weighted aggregates will be enhanced. Even casual analysis of simple-sum and Divisia monetary aggregate data show differences in both the levels and growth rates of these aggregates that are large, suggesting that the method of aggregation is important. Consequently, the method of aggregation should also be a concern for those who favor broader monetary aggregates on other grounds. The objective of the present article in publishing Divisia monetary statistics is to stimulate further empirical research both on the importance of monetary aggregation and on the role of money in the economy.

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Appendix
Constructing Divisia Monetary Aggregates: 1960-1992[1]

The assets used to calculate Divisia monetary aggregates are the same as those used by the Board of Governors to calculate the official simple-sum aggregates M1A through L. The only major difference is that demand deposits are broken into household demand deposits (HDD) and business demand deposits (BDD). We assume that households receive a zero rate of return on demand deposits and that businesses receive an implicit, nonzero rate of return. HDD and BDD are computed using seasonally adjusted monthly data for total demand deposits and non-seasonally adjusted quarterly data for consumer, foreign, financial, nonfinancial and other demand deposits. These can be found in Table 1.31 of the *Federal Reserve Bulletin*. Using the non-seasonally adjusted quarterly data, we calculate two ratios and use them to par-

tition the seasonally adjusted monthly data. The ratio for BDD is the sum of financial and nonfinancial demand deposits divided by the sum of all five non-seasonally adjusted series, whereas the ratio for HDD is one minus the BDD ratio. The non-seasonally adjusted series go back only to 1970.01 and are discontinued after 1990.06. For data before 1970.01 and after 1990.06, the means of the respective ratio series over the available sample were used. The means used were 62.33 percent for BDD and 37.67 percent for HDD. To get the final HDD and BDD series, these quarterly ratios were multiplied by the seasonally adjusted monthly data for total demand deposits. Each quarterly observation was multiplied by the three months of data for that particular quarter. All assets are seasonally adjusted and in millions of dollars.

Money Components

CUR	— Sum of seasonally adjusted currency and traveler's checks.
DEMDPS	— Total demand deposits.
HDD	— Demand deposits for households as described in the preceding section.
BDD	— Demand deposits for businesses as described in the preceding section.
OCD	— Other checkable deposits less super NOW account balances. OCD includes ATS and NOW balances, credit union share draft balances and demand deposits at thrift institutions.
SNOWC	— Super NOW accounts at commercial banks. SNOWC data begin in 1983.01 and end in 1986.03. After 1986.03 there is no distinction between NOWs and super NOWs.
SNOWT	— Super NOW accounts at thrifts. SNOWT begin in 1983.01 and end in 1986.03. After 1986.03 there is no distinction between NOWs and super NOWs.
ONRP	— Overnight repurchase agreements. ONRP includes overnight and continuing contract repurchase agreements issued by commercial banks to organizations other than depository institutions and money market mutual funds (MMMFs) (general purpose and broker/dealer organizations).
ONED	— Overnight eurodollars. ONEDs are issued by foreign (principally Caribbean and London) branches of U.S. banks to U.S. residents and organizations other than depository institutions and money market mutual funds.
MMMF	— Money market mutual funds. MMMF is general purpose and broker/dealer money market mutual fund balances including taxable and tax-exempt funds and excluding IRA/KEOGH accounts at money funds.
MMDAC	— Money market deposit accounts at commercial banks. MMDAC initially had a minimum balance requirement of $2,500 until December 31, 1984, and a $1,000 minimum balance requirement until December 31, 1985, when the requirement was removed. MMDACs were no longer reported after 1991.08.
MMDAT	— Money market deposit accounts at thrifts. MMDAT initially had a minimum balance requirement of $2,500 until December 31, 1984, and a $1,000 minimum balance requirement until December 31, 1985, when the minimum requirement was removed. MMDATs were no longer reported after 1991.08.
SDCB	— Savings deposits at commercial banks less money market deposit accounts at commercial banks. MMDACs are included after 1991.08.
SDSL	— Savings deposits at thrifts less money market deposit accounts at thrifts. MMDATs are included after 1991.08.
STDCB	— Small time deposits (less than $100,000) at thrifts including retail repurchase agreements less IRA/KEOGH accounts.
STDTH	— Small time deposits (less than $100,000) at thrifts including retail repurchase agreements less IRA/KEOGH accounts.
LTDCB	— Large time deposits (more than $100,000) at commercial banks excluding international banking facilities (IBFs).
LTDTH	— Large time deposits (more than $100,000) at thrifts excluding IBFS.
MMMFI	— Institution only money market mutual funds. MMMFI includes taxable and tax-exempt funds and excludes IRA/KEOGH accounts at money funds.
TRP	— Term repurchase agreements. TRP consists of RPs with original maturities greater than one day, excluding continuing contracts and retail RPs.

TED — Term eurodollars with original maturities greater than one day. TED includes those eurodollars issued to U.S. residents by foreign branches of U.S. banks and by all banking offices in the United Kingdom and Canada. Eurodollars held by depository institutions and MMMFs are not included.

SB — Savings bonds.

STTS — Short-term Treasury securities. STTS comprises U.S. Treasury bills and coupons with remaining maturities of less than 12 months not held by depository institutions, Federal Reserve Banks, MMMFs or foreign entities.

BA — Bankers acceptances. BA is the net of bankers acceptances held by accepting banks, Federal Reserve Banks, foreign official institutions, federal home loan banks and MMMFs.

CP — Total commercial paper less commercial paper held by MMMFs.

The interest rate data are more complicated than the asset data. The major concern with the interest rate data is the variety of forms in which they are reported. Before including different rates in an aggregate, the characteristics of all the rates should be as similar as possible. To this end, two problems need to be addressed. First, for composite asset stocks where the total asset is the sum of deposits with different maturities, such as small and large time deposits, the own rate is the maximum rate paid across the deposit categories at each point.

Because there are a variety of maturity lengths among the rates of a given composite asset stock, an adjustment is needed to transform each rate to a common maturity before the final rate is computed. Given rates with differing maturities and a typical upward-sloping yield curve, liquidity premiums keep rates on assets with longer maturities higher than rates on those with shorter maturities. To adjust these rates to a common maturity, this liquidity premium must be removed using a yield curve adjustment as described in Farr and Johnson (1985). As Farr and Johnson did, all rates that are yield curve adjusted are adjusted to a one-month maturity:

$R^{\cdot} = R - (TB_M - TB_1)$, where

R = the original rate on a bond basis (that is, a 365-day basis) basis

$R^{\cdot}$ = the yield curve adjusted rate

TB_M = the M-month Treasury bill rate

TB_1 = the one-month Treasury bill rate

A second adjustment is needed to convert all the rates to the same yield basis. Interest rates are quoted in various forms, including discount basis and annual percentage rate basis, and have various interest bases, including bond (365 day) and bank (360 day). To the extent possible, the rates were transformed into annualized one-month investment yields on a bond-interest basis. For rates quoted on a discount basis for a 360-day year, the following formula can be used to convert them to an annualized yield for a 365-day year (see Farr and Johnson [1985]):

$R = \left([(365*D)/100] / \{360 - [(N*D)/100]\} \right) * 100$,

where R = the annualized rate
D = a discount basis rate (360-day year)
N = the number of days to maturity

Including the variable N ensures that the formula is maturity independent.

Interest Rate Series for the Monetary Components

RZER — Rate on currency and traveler's checks. RZER is zero by definition.

RDD1 — Rate on household demand deposits. RDD1 is zero by definition.

RDD2 — Rate on business demand deposits. The basic formula for computing is as follows:

RDD2 = (1-MRR)*RCP

where MRR = maximum reserve requirement on demand deposits
RCP = one-month financial paper rate

Before applying this formula, adjust RCP, which is quoted on a discount basis for a 360-day year, to an annualized one-month yield for a 365-day year. This is done by using the formula described in the preceding text.

$$RCP^{\cdot} = \big([(365*RCP)/100]/\{360-[(30*RCP)/100]\}\big)*100$$

Then $RDD2 = (1-MRR)*RCP^{\cdot}$

For MRR and all ceiling rates used in the following text, we use the same convention as Farr and Johnson and assume that rates are quoted as annualized one-month yields.

ROCD — Rate on other checkable deposits.

1960.01–1974.11 — Regulation Q ceiling rate on passbook savings accounts at commercial banks. From 1962.01–1964.12 the ceiling rate on savings deposits of less than 12 months is used.

1974.12–1986.03 — Regulation Q ceiling rate on NOW accounts.

1986.04–present — Weighted average interest rate on NOWs and super NOWs.

RSNOWC — Rate on super NOWs at commercial banks. RSNOWC is the average rate paid on super NOW accounts at insured commercial banks and is quoted on an effective annual yield in the monthly Survey of Selected Deposits, a special supplementary table in the weekly *Federal Reserve Statistical Release* H.6.

RSNOWT — Rate on super NOWs at thrift institutions. RSNOWT is the average rate paid on super NOW accounts at FDIC-insured savings banks (both mutual and federal savings banks) and is quoted on an effective annual yield in the monthly Survey of Selected Deposits, a special supplementary table in the weekly *Federal Reserve Statistical Release* H.6.

RONRP — Rate on overnight dealer financing in the repurchase market. Because RONRP is an overnight rate quoted on a bank-interest basis, it must be transformed into an annualized one-month yield on a bond-interest basis using the following formula:

$$RONRP^* = \{[1+(RONRP/36000)]^{30}-1\}*(36500/30)$$

Data for RONRP goes back only to 1972.01, whereas asset data goes back to 1969.11. Farr and Johnson argue that the rate on overnight RPs has historically been five basis points below the federal funds rate, so we use the following formula to compute a rate before 1972:

$$RONRP^* = \big(\{[1+(RFF/36000)]^{30}-1\}*(36500/30)\big)-.05$$

Like RONRP, the fed funds rate is an overnight rate quoted on a discount basis and must be transformed into an annualized one-month yield on a bond-interest basis.

RONED — Rate on overnight eurodollars from London. The original series is weekly, and thus the monthly series is a simple average of the weekly observations for a particular month. Like RONRP, RONED is an overnight rate quoted on a bank-interest basis and must be converted to an annualized one-month yield on a bond-interest basis using the following formula:

$$RONED^* = \{[1+(RONED/36000)]^{30}-1\}*(36500/30)$$

RMMMF — Average yield of money market mutual funds. RMMMF comes from the Board, which in turn gets it from *Donoghue's Money Fund Report*. Data for RMMMF is available only back to 1974.06. RMMMF data from before this date are set to the rate on large time deposits at commercial banks (RLTDCB) less 70 basis points (see Farr and Johnson [1985]).

RMMDAC — Rate on money market deposit accounts at commercial banks. Before 1989.06 RMMDAC is the average rate paid at insured commercial banks. After 1989.07 it is the average of the rates paid at insured commercial banks for personal and nonpersonal MMDAs, which are quoted as effective annual yields in the monthly Survey of Selected Deposits, a special supplementary table in the weekly *Federal Reserve Statistical Release* H.6.

RMMDAT   — Rate on money market deposit accounts at thrift institutions. Before 1989.06 RMMDAT is the average rate paid at FDIC-insured savings banks. After 1989.07 it is the average of the rates paid at FDIC-insured savings banks (including both mutual and federal savings banks) for personal and nonpersonal MMDAs, which are quoted as effective annual yields in the monthly Survey of Selected Deposits, a special supplementary table in the weekly *Federal Reserve Statistical Release* H.6.

RSDCB   — Rate on savings deposits at commercial banks less money market deposit accounts at commercial banks. RSDCB comes from the Board and is quoted as an effective annual yield.

RSDSL   — Rate on savings deposits at FDIC-insured savings banks (the thrift rate).

1966.10–1986.03 — The ceiling rate on NOW accounts at thrifts.

1986.04–present — The rate on savings deposits at thrifts published in the Board's H.6 release.

There are two problems with data before 1966.10: 1) interest rates on savings deposits at thrifts were not regulated and 2) different states paid different rates on these accounts. One of the few series published for this period is the average dividend paid on savings deposits at thrifts, which is what we use here. This is an annual rate and includes passbook savings accounts and fixed-term certificates.

FITSTCB   — Rate on small time deposits and retail repurchase agreements at commercial banks. FITSTCB is the Fitzgerald-adjusted small time deposit rate that is calculated at the Board and quoted as an effective annual yield.

RSTTH   — Rate on small time deposits and retail repurchase agreements at thrifts. RSTTH is the Fitzgerald-adjusted small time rate that is calculated at the Board and quoted as an effective annual yield.

RLTDCB   — Rate on large time deposits at commercial banks. RLTDCB is a yield-curve-adjusted rate that is calculated using the one-, three- and six-month secondary CD rates (of deposits greater than $100,000) and the one-, three- and six-month Treasury bill rates.

1) The first step is to convert the Treasury bill rates, which are quoted on a discount basis for a 360-day year, to annualized yields for a 365-day year as follows:

$$Y* = \left([(365*Y)/100]/\{360-[(N*Y)/100]\} \right) *100$$

where Y = one-, three- and six-month Treasury bill rates on a discount basis
N = number of days to maturity

2) Second, calculate the yield-curve-adjusted three- and six-month CD rates using the following formula:

RCD3YCA = RCD3 − (Y3 − Y1)
RCD6YCA = RCD6 − (Y6 − Y1)
  where RCD3 = three-month CD rate
        RCD6 = six-month CD rate
          Y1 = one-month Treasury bill rate
          Y3 = three-month Treasury bill rate

3) Finally, the interest rate for large time deposits at commercial banks is given as follows:

RLTDCB   — MAX (RCD1, RCD3YCA, RCD6YCA).

1) Data on CD rates were not available before 1964.06 so RLTDCB was set to the ceiling rate on savings deposits of less than one year as set by Regulation Q.

2) Before entering any calculations, the CD rates were multiplied by (365/360) to convert them to a bond, or 365-day, basis.

RLTDTH — Rate on large time deposits at thrifts. RLTDTH is simply the rate on large time deposits at commercial banks (RLTDCB) plus 30 basis points based on Farr and Johnson's result that the rate on large time deposits at thrifts has been about 30 basis points above that on large time deposits at commercial banks.

RMMMFI — Rate on institution-only mutual fund shares. RMMMFI is simply the rate on general purpose and dealer/broker mutual fund shares (RMMMF).

RTRP — Rate on term repurchase agreements. RTRP is equal to the rate on overnight RPs plus the difference of the rates on term eurodollars and overnight eurodollars (RONRP + [RTED-RONED]). Asset data for term RPs is available back to 1969.10, whereas data for RONED is available only back to 1971.01. From 1969.10 to 1970.12 the spread (RTED-RONED) is estimated as the average difference between the two rates for 1971.

RTED — Rate on term eurodollars. RTED is a yield-curve-adjusted rate computed from the one,- three- and six-month term eurodollar rates. It is calculated in the same way as the rate on large time deposits (RLTDCB).

1) First, use annualized rates on one-, three- and six-month Treasury bill rates to calculate the yield-curve-adjusted three- and six-month term eurodollar rates (see the formulas from RLTDCB).

2) The RTED rate will then be the maximum of the one-month term eurodollar rate and the three- and six-month yield-curve-adjusted term eurodollar rates.

NOTES: 1) Only data for the three-month eurodollar rate is available back to 1960.01, so RTED is just equal to that yield-curve-adjusted rate until 1963.05.

2) Before entering any calculations, the eurodollar rates were first multiplied by (365/360) to convert them to a bond-interest, or 365-day, basis.

RSB — Rate on savings bonds. RSB is a six-month average rate for the current month converted to a bond-interest basis by multiplying by (365/360).

RSTTS — Rate on short-term Treasury securities. RSTTS is simply the rate on the one-month Treasury bill. Data for the one-month Treasury bill rate is available only back to 1968.01, so data before 1968.01 is set at the three-month rate less the average difference between the one- and three-month rates for 1968.01 to 1990.12. Because this rate is quoted as a discount rate for a 360-day year, it is converted to an annualized one-month yield using the following formula:

$$RSTTS = \left([(365*TB1)/100]/\{360 - [(30*TB1)/100]\}\right)*100$$

RBA — Three-month bankers acceptances rate. Although this rate has a three-month maturity, it is not yield curve adjusted as RLTDCB and RTED were because only one rate is used in the calculation (compared with three used for each of the others). Instead, it is converted from a discount basis for a 360-day year to an annualized yield for a 365-day year using the following formula (see Farr and Johnson [1985]):

$$RBA^{\cdot} = \left([(365*RBA)/100]/\{360 - [(90*RBA)/100]\}\right)*100$$

RCPL — Rate on commercial paper. RCPL is the rate on one-month financial paper, which is converted from a discount rate for a 360-day year to an annualized one-month yield for a 365-day year using the following formula:

$$RCPL^{\cdot} = \left([(365*RCPL)/100]/\{360 - [(30*RCPL)/100]\}\right)*100$$

RBAA — Rate on Moody's Baa corporate bonds. RBAA is taken directly from the Board's G.13 release and is used only in the computation of the benchmark interest rate. It was yield-curve adjusted to a one-month annualized yield on a bond basis.

BENCH   — BENCH is the highest yielding rate for the period among all 24 interest rate series and the Baa bond rate; that is,

$$\text{BENCH} = \text{MAX} [\text{RBAA}, (R_{it}, i = 1, ..., 24)].$$

Simple-sum and Divisia monetary aggregates presented in this article can be downloaded from the FRED electronic bulletin board with a personal computer and a modem. The monetary aggregates are in a file called "DIVISIA." To access FRED, dial 314-621-1824. Parameters for communication software should be set to no parity, word length = 8 bits, one stop bit, full duplex and the fastest baud rate your modem supports, up to 9,600 bps. For more information, telephone Tom Pollmann at 314-444-8562.