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# Revisions in the Monetary Services (Divisia) Indexes of the Monetary Aggregates

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The following paper, which was summarized in the *Bulletin* for December 1985, was prepared in the spring of 1985. The analyses and conclusions set forth are those of the authors and do not necessarily indicate concurrence by the Board of Governors, by the Federal Reserve Banks, or by the members of their staffs.

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*Page 6, column 1, line 2:*

*For* **within the overall index** *read* **within the subindex**

*Page 27, column 2, after "Comparisons" subhead, line 5:*

*For* **MSI1 grows less rapidly** *read* **MSI1 grows more rapidly**

Empirical work on what have come to be known as the Divisia monetary aggregates or indexes began as early as 1978.[1] In early 1981 the Federal Reserve began releasing monthly data on these aggregates through internal memoranda; later it began releasing the data for public distribution. From early 1981 to mid-1984, occasional changes in the underlying data were made and documented in the monthly releases.[2] To date, however, no one has made a comprehensive review of the data.

The staff of the Federal Reserve recently completed a major revision of the indexes. This paper explains the revision by cataloging both the data used to calculate the indexes and the changes made to those data; the theoretical bases of the original indexes have not been revised. We hope that these new indexes, computed with data that are more accurate and better documented, will aid future research.[3]

We have abandoned the name "Divisia monetary indexes" in favor of the term "monetary services indexes"; this change is the subject of the first section of the paper. The second section deals with the data: monetary asset stocks, own rates paid to holders of the stocks, and miscellaneous issues. The third section compares the properties of the revised indexes with those of the old indexes and with those of the conventional monetary aggregates. The fourth section is a brief summary.

## What's in a Name

Early work on the monetary indexes made use of the Törnquist–Theil discrete time approximation to the Divisia quantity index; the money indexes computed with this formula became known as the Divisia monetary aggregates. The Divisia monetary index can be written as follows:

$$(1) \qquad Q_t = Q_{t-1} \prod_{i=1}^{N} \left(\frac{m_{it}}{m_{i,t-1}}\right)^{(1/2)(s_{it}+s_{i,t-1})},$$

where $m_{it}$ is the quantity of the $i$th monetary asset at time $t$, $s_{it} = \pi_{it}m_{it}/\sum_{k=1}^{N}\pi_{kt}m_{kt}$ is the expenditure share of the $i$th asset at time $t$, and $\pi_{it}$ is the price or user cost of the $i$th asset at time $t$. The derivation of $\pi_{it}$ is based on the own rates of the assets and other factors.[4] The growth rate of the Divisia quantity, $Q$, can be computed as

$$(2) \quad \log Q_t - \log Q_{t-1} = \sum_{i=1}^{N} (1/2)(s_{it} + s_{i,t-1}) \times (\log m_{it} - \log m_{i,t-1}).$$

Expressed in this fashion, the growth rate of the aggregate is an expenditure-share-weighted average of the growth rates of the component assets, $m_{it}$. Barnett has said that the ease of interpreting this growth rate argues in favor of using the Divisia index instead of the Fisher ideal index, although the latter index, he

NOTE. We received help in this project from many sources. William Hampel of the Credit Union National Association provided invaluable assistance in developing appropriate own rate data for credit unions. Arthur Kennickell helped in unearthing possible theoretical underpinnings of some of the asset stock and own rate data used in index calculations. Michael Caffrey calculated "most commonly paid rate" data from surveys preceding November 1983. Gerhard Fries contributed substantially to the work underlying the section on autocorrelations and cross correlation with GNP. Peter Tinsley, Richard Porter, Patricia White, and Mary McLaughlin offered comments and suggestions. Sharon Sherbert typed many drafts of this paper and deserves thanks not only for the end product but for her great patience. Last but not least, Paul Spindt provided consultation throughout to ensure that revisions were consistent with the original concepts.

1. See William A. Barnett and Paul A. Spindt, *Divisia Monetary Aggregates: Compilation, Data, and Historical Behavior*, Staff Studies 116 (Board of Governors of the Federal Reserve System, 1982), note 1, for references to some of this work.

2. The original data are described in ibid. The last release of the old indexes was dated August 28, 1984, and contained data through July 1984; see Bruce Gilsen and Deborah Johnson, "Recent Behavior of the Divisia Monetary Aggregates" (Board of Governors of the Federal Reserve System, staff memorandum, August 28, 1984).

3. Monthly releases of the revised indexes are available from the Special Studies Section, Division of Research and Statistics, Board of Governors of the Federal Reserve System, Washington, D.C. 20551.

4. See William A. Barnett, "Economic Monetary Aggregates: An Application of Index Number and Aggregation Theory," *Journal of Econometrics: Annals of Applied Econometrics 1980-3*, supplement to *Journal of Econometrics*, vol. 14 (September 1980), pp. 11-48.

notes, has certain advantages over the former.[5]

Both the Divisia and Fisher ideal indexes are Diewart "superlative"[6] and normally move together so closely as to be empirically indistinguishable. However, problems arose with the Divisia formula because some of the asset stocks included in the monetary aggregates are new instruments; these instruments thus have zero values for that part of the sample period preceding their introduction. Because the Divisia index is not defined when any $m_{i,t-1}$ is equal to zero, more recent releases of the "Divisia" quantity indexes have used the Fisher ideal formula,

$$(3)\ Q_t = Q_{t-1}\left[\frac{\left(\sum_{i=1}^{N}\pi_{it}m_{it}\right)\left(\sum_{i=1}^{N}\pi_{i,t-1}m_{it}\right)}{\left(\sum_{i=1}^{N}\pi_{it}m_{i,t-1}\right)\left(\sum_{i=1}^{N}\pi_{i,t-1}m_{i,t-1}\right)}\right]^{1/2},$$

which is well defined for zero base values.[7]

It has been suggested that using the appellation "Divisia monetary indexes" is akin to calling the consumer price index the "Laspeyres index"; the name is largely uninformative. The last releases of the unrevised indexes were called Divisia indexes even though, as noted above, they were not calculated using the Divisia formula. Barnett has suggested, indirectly, a more appropriate name:

> Aggregation theory does not attach a name (such as 'moneyness' or 'liquidity') to the functional quantity index. However, our use of user costs does dictate that the quantity index is a quantity of services provided by the components of the aggregate.

Barnett calls these services "monetary services."[8] In this spirit, we have renamed the indexes the monetary services indexes, although the title of this paper retains the term "Divisia" for the sake of those familiar with the earlier naming convention. We will refer to the unrevised indexes interchangeably as the old, or Divisia, indexes and to the revised indexes as the new, or monetary services, indexes. The terms MSI1, MSI2, MSI3, and MSI4 refer to the monetary services indexes defined over the asset stocks included in (simple-sum) M1, M2, M3, and L, respectively.

## Quantifying the Indexes

This section describes the revisions to the data on asset stocks and on own rates.

### Asset Stocks

The asset stocks used in calculating the monetary services indexes (MSI) are basically the same as those used to compute the conventional simple-sum aggregates M1 through L, seasonally adjusted (see table 1).[9] The main difference lies in the treatment of demand deposits: for MSI computations, demand deposits are partitioned into deposits held by households (DDCON) and those held by others, predominantly businesses (DDBUS).[10]

Data on household demand deposits, as reported in the Demand Deposit Ownership Survey (DDOS),[11] are used to determine the proportion of demand deposits held by households (HHDDRAT). In the computer programs used to compute the old indexes, the

5. For example, the Fisher Ideal index satisfies Fisher's factor reversal test, whereas the Divisia index does not. See William A. Barnett, "Recent Monetary Policy and the Divisia Monetary Aggregates," *American Statistician*, vol. 38 (August 1984), p. 167.

6. See W.E. Diewart, "Aggregation Problems in the Measurement of Capital", in Dan Usher, ed., *The Measurement of Capital* (University of Chicago Press, 1980), pp. 433–528.

7. Having easily interpreted growth rates is far less important than having an index that is defined over the whole time span considered; moreover, arguments for easily interpreted growth rates are now moot. Since the indexes are typically compared to the behavior of the conventional simple-sum aggregates, and since official published growth rates of the aggregates are arithmetic (as opposed to logarithmic), the growth rates of the indexes are now computed as $(Q_t/Q_{t-1})-1$ for comparability with the reported growth rates of the conventional aggregates. Neither index has an easily interpreted growth rate under this formulation.

8. Barnett, "Economic Monetary Aggregates," note 42, p. 30.

9. Table 1 shows a mnemonic for each asset stock and a brief description of that stock. It also includes, for reference, the identities for the conventional monetary aggregates. Greater detail on the exact composition of each asset stock can be found in notes to Board of Governors of the Federal Reserve System, *Money Stock, Liquid Assets, and Debt Measures*, weekly statistical release H.6.

10. This allocation is necessary since it is assumed that households receive a zero rate of return on their demand deposit balances while other holders of demand deposits are assumed to receive an implicit, competitive, nonzero rate of return.

11. These data are reported quarterly and are not seasonally adjusted. The quarterly survey data are interpolated to obtain a monthly series, also not seasonally adjusted. The survey results can be found in selected issues of the *Federal Reserve Bulletin*.

## 1. Asset stocks used to calculate the monetary services indexes

| Asset stock mnemonic | Asset stock description |
|---|---|
| 1 CUR | Sum of seasonally adjusted currency and travelers checks |
| 2 DDCON | Seasonally adjusted household demand deposits |
| 3 DDBUS | Seasonally adjusted demand deposits held by others, predominantly business |
| 4 OCD | Other checkable deposits less Super NOW accounts, seasonally adjusted, when appropriate, by the implicit seasonal factor for other checkable deposits[1] |
| 5 SNOWC | Super NOW accounts at commercial banks, seasonally adjusted, when appropriate, by the implicit seasonal factor for other checkable deposits[1] |
| 6 SNOWT | Super NOW accounts at thrift institutions, seasonally adjusted, when appropriate, by the implicit seasonal factor for other checkable deposits[1,2] |
| MEMO: M1 identity | M1 ≡ sum of assets 1 through 6 |
| 7 ONRP | Net overnight repurchase agreements at commercial banks |
| 8 ONED | Net overnight Eurodollars |
| 9 MMF | Money market mutual fund shares |
| 10 MMDAC | Money market deposit accounts (MMDAs) at commercial banks |
| 11 MMDAT | MMDAs at thrift institutions and credit unions[2] |
| 12 SDCB | Savings deposits less MMDAs at commercial banks |
| 13 SDSL | Savings deposits less MMDAs at savings and loan associations |
| 14 SDSB | Savings deposits less MMDAs at savings banks |
| 15 SDCU | Savings deposits less MMDAs at credit unions |
| 16 STDCB | Small time deposits including retail repurchase agreements less Individual Retirement Accounts (IRAs) and Keogh accounts at commercial banks |
| 17 STDTH | Small time deposits including retail repurchase agreements less IRAs and Keogh accounts at thrift institutions[2] |
| 18 STDCU | Small time deposits less IRAs and Keogh accounts at credit unions |
| MEMO: M2 identity | M2 ≡ M1 + sum of asset stocks 7 through 18 less M2 consolidation component[3] |

1. Before 1979, OCD, SNOWC, and SNOWT, not seasonally adjusted, are added to separately seasonally adjusted currency, travelers checks, and demand deposits to derive seasonally adjusted M1. Thereafter they are combined with demand deposits not seasonally adjusted, and the sum (transactions deposits) is seasonally adjusted; this seasonally adjusted component is then added to separately seasonally adjusted currency and travelers checks to derive seasonally adjusted M1. In computing the monetary services indexes (MSI), these components are seasonally adjusted as appropriate to the definition of seasonally adjusted M1.

From 1979 on, transactions deposits and demand deposits are seasonally adjusted separately; the difference between the two is (implicitly) seasonally adjusted other checkable deposits (OCD + SNOWC + SNOWT). The ratio of not seasonally adjusted deposits to seasonally adjusted deposits is the implicit seasonal factor for other checkable deposits. For MSI calculations, it seemed appropriate to estimate seasonally adjusted DDCON and DDBUS based on seasonally adjusted demand deposits. Adjusting OCD, SNOWC, and SNOWT using the implicit seasonal factor for other checkable deposits then insures that the component asset stocks still add up to seasonally adjusted M1.

2. The term "thrift institutions" in this paper refers to savings and loan associations and savings banks. Credit unions are part of the thrift industry but have different characteristics and are often treated separately.

3. Seasonally adjusted M2 is defined as seasonally adjusted M1 plus the seasonally adjusted nontransactions component of M2 (M2 minus M1). The seasonal factor for the nontransactions component has been used to seasonally adjust each of the asset stocks 7 through 18 and the M2 consolidation component for use in the MSI calculations.

The M2 consolidation component has been broken into three subcomponents: (1) vault cash held at thrift institutions, (2) other checkable deposits held at corporate central offices, and (3) demand deposits of thrift institutions held at commercial banks. For MSI calculations at the M2 level and above, these are netted out of CUR, OCD, and DDBUS respectively.

1. Continued

| Asset stock mnemonic | Asset stock description |
|---|---|
| 19 LTDBC | Large time deposits at commercial banks |
| 20 LTDTH | Large time deposits at thrift institutions and credit unions[2] |
| 21 MMFI | Institution-only money market mutual funds |
| 22 TRP | Net term repurchase agreements at commercial banks plus term repurchase agreements at thrift institutions net of retail repurchase agreements[2] |
| 23 TED | Term Eurodollars |
| MEMO: M3 identity | M3 ≡ M2 + sum of asset stocks 19 through 23 less M3 consolidation components[4] |
| 24 SB | Savings bonds seasonally adjusted |
| 25 STTS | Short-term Treasury securities seasonally adjusted |
| 26 BA | Bankers acceptances seasonally adjusted |
| 27 CP | Commercial paper seasonally adjusted |
| MEMO: L identity | L ≡ M3 + sum of asset stocks 24–27 |

4. Seasonally adjusted M3 is defined as seasonally adjusted M2 plus the seasonally adjusted sum of non-M2 components of M3 (M3 minus M2). The seasonal factor for the non-M2 component has been used to seasonally adjust each of the asset stocks 19 through 23 and the M3 consolidation components.

The M3 consolidation components are institutional overnight repurchase agreements and institutional overnight Eurodollars. For MSI calculations at the M3 level and above, they are subtracted from ONRP and ONED, respectively.

allocation of demand deposits was handled as follows: Denote the monthly DDOS-based series on household demand deposits as DDM, seasonally adjusted demand deposits as DDSA, demand deposits not seasonally adjusted as DDNSA, and the demand deposit seasonal factor as SFDD. Then

$$(4) \qquad HHDDRAT = \frac{DDM}{DDSA},$$

$$(5) \qquad DDCON = (HHDDRAT)(DDSA),$$

$$(6) \qquad DDBUS = (1 - HHDDRAT)(DDSA).$$

Note that equation 4 is the ratio of not-seasonally-adjusted deposits (DDM) to seasonally adjusted deposits (DDSA). Given this inappropriate mixture of data, DDCON and DDBUS are incorrect and contain seasonality. This can be seen by substituting, from equation 4, for HHDDRAT in equations 5 and 6, which gives

$$(7) \qquad DDCON = \left(\frac{DDM}{DDSA}\right)(DDSA) = DDM$$

$$(8) \qquad DDBUS = \left(1 - \frac{DDM}{DDSA}\right)(DDSA) = DDSA - DDM.$$

Thus, in computing the old indexes, DDCON equalled the unadjusted DDM, and DDBUS was an unadjusted residual and contained a seasonal pattern exactly opposite to that of DDCON. To correct this problem, the following changes were made. The proportion of demand deposits held by households is defined as the ratio of two series that are not seasonally adjusted:

$$(9) \qquad HHDDRAT = \frac{DDM}{DDNSA}.$$

We then tried seasonally adjusting each component of the partitioned demand deposits:

$$(10) \qquad DDCON = \frac{DDM}{SFDD},$$

$$(11) \qquad DDBUS = \frac{DDNSA - DDM}{SFDD}.$$

However, the seasonal factor for total demand deposits is not necessarily appropriate for seasonal adjustment of the two subcomponents and, in fact, introduces seasonality into the index at the M1 level (MSI1), though not at higher index levels.

We explored three alternative methods of allocating demand deposits between the two components, DDCON and DDBUS: (1) seasonally adjust DDM, using the multiplicative version of the Census Bureau's X-11 seasonal adjustment program, to get seasonally adjusted DDCON, and define DDBUS as a residual (DDSA minus DDCON); (2) seasonally adjust the quantity (DDNSA minus DDM) to get seasonally adjusted DDBUS, and define DDCON as a residual (DDSA minus DDBUS); and (3) seasonally adjust HHDDRAT (the result being denoted RATSA) and define the seasonally adjusted components as

$$DDCON = (RATSA)(DDSA). \tag{12}$$

$$DDBUS = (1 - RATSA)(DDSA). \tag{13}$$

The results of methods 1 and 3 were the best (and equally good) in the sense of producing components—and MSI1—which had no seasonal. We have chosen method 3 because the components are then based on the official seasonally adjusted demand deposits, DDSA.

At the time of the annual seasonal review in January 1984, seasonally adjusted M2 and M3 were no longer defined as the sum of separately seasonally adjusted components (and some not-seasonally-adjusted components).[12] Further, M3 was redefined to include term Eurodollars, previously included only in L. None of these changes was incorporated in the computation of the asset stocks used to calculate the old indexes. This violated the principle that the asset stocks used to compute the indexes should be consistent with those used to compute the conventional aggregates; this principle had been a primary feature of the original design of the indexes. Thus, when one summed the asset stocks used for the old indexes and compared the sums to the relevant simple-sum aggregates, many enormous discrepancies appeared—for example, on the order of $90 billion for M3 (mainly because of the failure to include term Eurodollars among the M3-level asset stocks). The computation of all asset stocks has been corrected in computing the new indexes to restore the consistency with the components of the simple-sum aggregates.

## Own Rate Calculations

Revisions in the own rates of asset stocks used to compute the monetary services indexes arise from three sources: (1) correction of errors in the data, (2) correction of computational errors or inaccuracies, and (3) reassessments of the appropriate data to be used in the construction of own rates. Before turning to the discussion of the own rates for specific asset stocks, we describe two sets of calculations that are involved in deriving many of the own rates: the derivation of the appropriate own rate for composite asset stocks and the yield curve adjustment.

### *The Own Rate on Composite Asset Stocks*

Several of the asset stocks used in the MSI calculations are composite asset stocks; that is, they are not a single asset but the sum of several assets.[13] One obvious example is small time deposits at commercial banks. This asset stock is the sum of time deposits having a variety of maturities.[14] (In fact, we do not usually know the dollar volume of assets at each maturity and have no choice but to deal with the sum.) Each such composite asset may

12. At the time of the 1982 seasonal review, transactions deposits (demand deposits plus other checkable deposits) were seasonally adjusted as an aggregate and then added to currency and travelers checks, seasonally adjusted separately, to derive seasonally adjusted M1.

Beginning in 1984, a similar approach was adopted for M2 and M3. The sum of the nontransactions components of M2 (M2 minus M1) was seasonally adjusted as an aggregate and added to seasonally adjusted M1 to derive seasonally adjusted M2. Similarly, the sum of the non-M2 components of M3 (M3 minus M2) was seasonally adjusted as an aggregate and added to seasonally adjusted M2 to derive seasonally adjusted M3. (While many components of M2 and M3 are still seasonally adjusted separately, they are not used in this form in deriving the seasonally adjusted aggregates.) Seasonally adjusted L became the sum of the redefined seasonally adjusted M3 and the non-M3 components of L, which were seasonally adjusted separately.

13. We are indebted to Arthur Kennickell for most of the following discussion.

14. Other composite asset stocks are STDTH, STDCU, LTDCB, LTDTH, TRP, TED, STTS, BA, and CP (see table 1 for definitions).

be regarded as a subindex of the overall index; within the ~~overall~~ index, assets are assumed to be nearly perfect substitutes and thus may be summed.

The user cost of each composite asset stock is the dual price index to this quantity index. Given perfect substitutability among the assets in the quantity index, all unconstrained agents in the submarket for these assets will be at a corner solution, "purchasing" the asset with the lowest user cost (or equivalently, the highest own rate).[15] This user cost is taken as the price index of the composite asset. The associated own rate is calculated as the maximum of the yield-curve-adjusted rates on components of different maturities within the composite asset. For ease of exposition we will denote the own rate of a composite asset as the MYCAC—the Maximum Yield-Curve Adjusted rate for the Composite asset.[16]

In equilibrium, prices of all other assets in the subindex set will change explicitly or implicitly so that all assets are held. To the extent that the change is only implicit, as in the case of a nontraded asset such as a time deposit, the quantity index is misspecified because we are using the book value of assets rather than the (implicit) market value. Perhaps future research can show the degree of the misspecification involved.

### *Yield Curve Adjustment*

As shown above, the appropriate own rate for a composite asset stock is the maximum of the own rates paid on its components. However, the own rates being considered are rates on assets having a variety of maturities. Given typical yield curve relationships, liquidity premiums keep rates on long-maturity assets higher than those on short-maturity assets. Thus, before the rates can be compared, they must be put on some common basis—the liquidity premiums must be extracted. To do this, the rates are converted to a common-maturity basis using an adjustment derived from the Treasury yield curve (hereafter called the yield curve adjustment). The length of the common maturity is not important so long as all rates are on a comparable basis. We have chosen a one-month maturity for consistency with all other own rates used in the MSI calculations.[17]

To illustrate the yield curve adjustment of an interest rate, let $RX_m$ be the rate on some security $X$ of maturity $m$, where $m$ is expressed in months. Then the yield-curve-adjusted rate on the security, $RX_m^{YCA}$, is defined as

$$RX_m^{YCA} = RX_m - (y_m - y_1), \qquad (14)$$

where $y_m$ is the $m$-month yield on the Treasury yield curve and $y_1$ is the one-month yield. Where $m$ is not equal to one, three, six, twelve, or thirty-six, which are the maturities used to define the Treasury yield curve, $y_m$ is interpolated by cubic splines.

For all empirical work on the monetary services indexes, the yield curve is defined by yields on one-month, three-month, six-month, one-year, and three-year Treasury securities. The bill rates are converted from the quoted discount basis to an annualized yield. Until now, the following formula had been used to convert all three bill rates: given a discount-basis rate, $d$, the one-period yield, $y$, can be stated as

$$y = \frac{\frac{d}{100}}{1 - \frac{d}{100}} \times 100, \qquad (15)$$

where all rates are stated as percentages, for example, 9.0. There are two problems associated with using this formula:

(1) The formula is maturity-independent in that the length of the period involved has no associated time unit such as day, month, or year. Nonetheless, this formula had been used to convert discount-basis rates of three differ-

15. Since the user cost in period $t$ is essentially defined as the difference between a given "benchmark rate" in period $t$ and the own rate in the same period, the highest own rate gives the lowest user cost. See, for example, Barnett and Spindt, *Divisia Monetary Aggregates*, p. 9, for a discussion of the concept of the benchmark rate.

16. Rates calculated in this manner have previously been referred to as "Fitzgerald rates." This uninformative and somewhat inaccurate nomenclature has been dropped.

17. To the extent possible, all own rates are annualized one-month investment yields on a bond interest basis. Bond interest is quoted on the basis of a 12-month year in which each month has 365/12 days. Bank interest is quoted on the basis of a 360-day year.

ent, time-specific maturities. The result was that all three yields calculated using equation 15 overstated the correct yields, with the overstatement the greatest at high rates and short maturities.[18]

(2) The formula produces a 360-day rate (bank basis) rather than a 365-day rate (bond basis) because discount-basis rates are quoted on a 360-day basis.

The simplistic conversion formula shown in equation 15 has been replaced by a conventional formula that accounts for the maturity of the rate being converted and gives a yield on a 365-day basis:

$$(16) \qquad y = \frac{\frac{365d}{100}}{360 - \frac{nd}{100}} \times 100,$$

where $y$ and $d$ are defined as above and $n$ is the number of days to maturity (approximated by 30 days per month).[19]

The effects of this revision on the estimated yield curves are illustrated in chart 1. The top panel of the chart plots the rate on one-year Treasury notes. This serves as a reference point for evaluating the differences in the yield curves implied at high versus low interest rates when equation 16 (new method) is used in place of equation 15 (old method) to convert discount-basis rates to annualized yields. The next three panels of the chart show the spreads between the three-month and one-month yields, the six-month and three-month yields, and the one-year and six-month yields; each of these three panels shows the spread calculated using the old and new methods.

Among other things, the chart indicates that, at high interest rates, equation 15 produces inversions of the yield curve (short-maturity rates exceeding long-maturity rates) that did not occur, or it exaggerates those that did occur. Further, larger errors are associated with longer maturities and higher rates. In summary, it is clear that the revisions represented by equation 16 produce different yield curves, particularly at high rates of interest, on which to base the yield curve adjustment of other interest rates. Thus, in computing the MSI, the relative weights applied to all asset stocks, and particularly to those whose own rates depend on yield-curve-adjusted rates, have been considerably altered.

## The Own Rates in Detail

We turn to the construction of specific own rates. All rates will be reviewed, but only those that differ in some way from the rate previously used for a given asset will be discussed at length. Table 2 refers to own rates by the mnemonic, shown in table 1, of the associated asset stock; it gives the basic rates used in the construction of own rates, the basis on which the basic rates are quoted (discount, annual percentage rate, and so on), the interest basis (bank or bond), the formulas used in calculating the final own rate, and the old own rate.

### *Currency, Household Demand Deposits*

The own rates for currency (CUR) and household demand deposits (DDCON) are still assumed to be zero.

### *Non-household Demand Deposits*

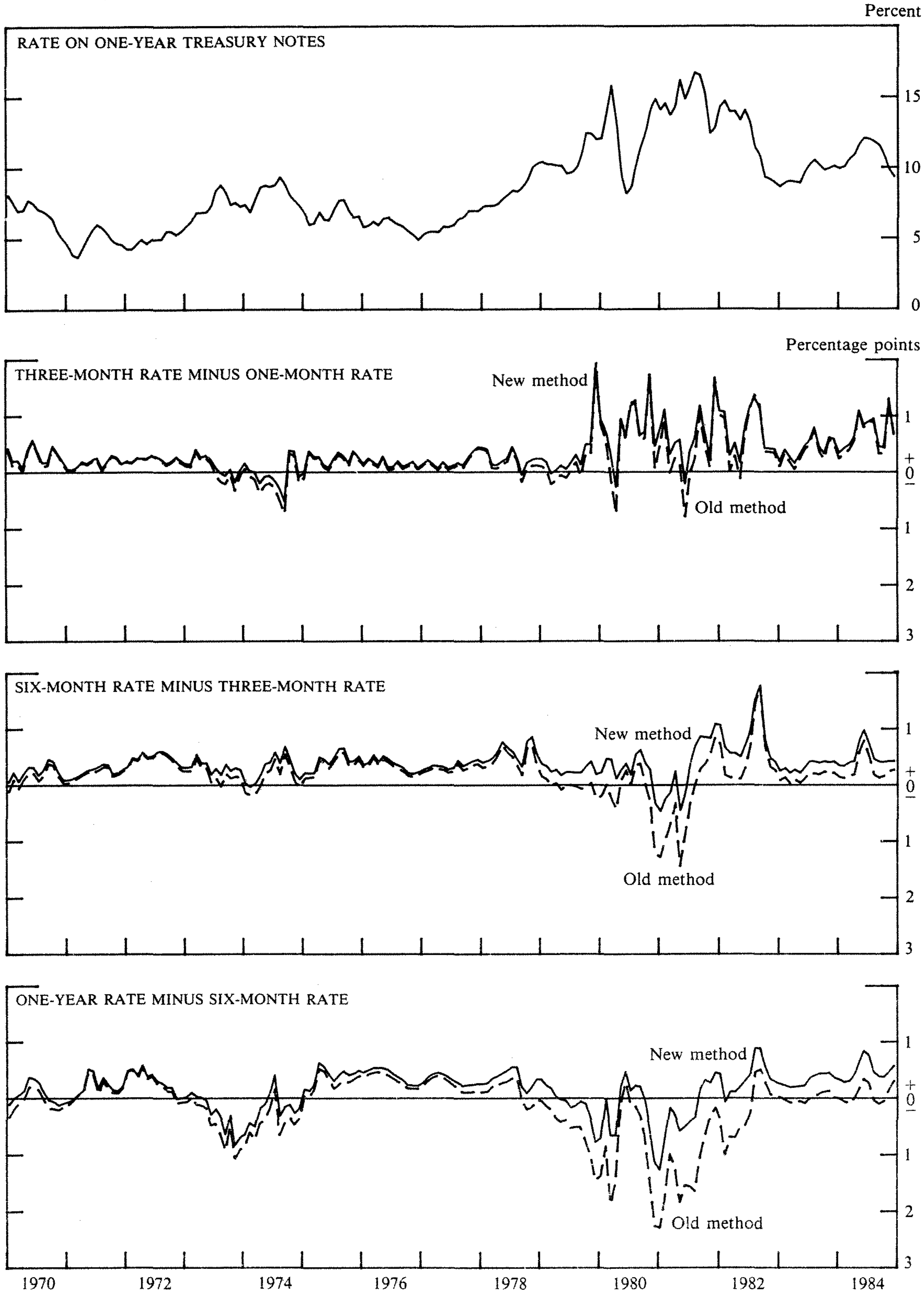
The rate on demand deposits other than those held by households (DDBUS) has changed as a result of the correction of errors in the data for maximum marginal reserve requirements for member banks and of errors in the computation of the commercial paper rate to be used in the calculations.[20] The data on reserve

18. From 1970 through 1984, the mean and maximum overstatements of the correct rates were 0.58 and 2.68 for the one-month maturity, 0.49 and 2.25 for the three-month maturity, and 0.31 and 1.31 for the six-month maturity. In fact, if the discount-basis rates had not been adjusted at all, smaller errors would have been made; in this case the correct rates would have been *understated* with mean and maximum errors of 0.16 and 0.45, 0.29 and 0.93, and 0.50 and 1.54, respectively.

19. Equation 16 is valid only for maturities of six months or less. See, for example, Marcia Stigum, in collaboration with John Mann, *Money Market Calculations: Yields, Break-Evens, and Arbitrage* (Dow Jones-Irwin, 1981).

20. The commercial paper rate used here had been described (in Barnett and Spindt, *Divisia Monetary Aggregates*, p. 9) as a one- to two-month rate on finance company paper. The rate is actually the one-month rate on directly placed finance company commercial paper.

1. Spread between rates on the Treasury yield curve as estimated under the new and old methods of converting discount-basis rates to yields and, for reference, the rate on one-year Treasury notes[1]




1. The old method is equation 15 in the text; the new method is equation 16. The rates used to calculate the three spreads are those on one-month, three-month, and six-month Treasury bills and one-year Treasury notes.

requirements contained two kinds of errors: (1) the computation was incorrect for months in which the maximum requirement changed, and (2) the series had not been updated to reflect the changes in reserve requirements that were instituted under the Monetary Control Act of 1980.

The commercial paper rate is quoted on a discount basis for a 360-day year. Before the implicit rate on DDBUS can be computed, the paper rate must be converted to a yield for a 365-day year for comparability with other rates used.

The net effect of the changes made in computing this own rate is to raise the rate (lower the user cost), particularly since the effective date of the Monetary Control Act. Since that time, the maximum marginal reserve requirement at member banks (MMRR) has fallen from 16.5 percent to 12 percent. For a paper rate quoted at 10 percent, the conversion to a 365-day yield raises the rate about 25 basis points. Given an interest rate, $r$, of 10 percent, the result of the calculation

$$r' = (1 - MMRR)r$$

is an $r'$ that is about 50 basis points higher when MMRR is 12 percent than when it is 16.5 percent. (The two effects are not additive; in this example, the net result is an own rate about 65 basis points higher.)

### *Other Checkable Deposits Net of Super NOWs*

The Regulation Q ceiling for NOW accounts is still used as the own rate for other checkable deposits net of Super NOWs (OCD).

### *Super NOWs, Money Market Deposit Accounts*

We continue to use rate data from Federal Reserve surveys as the source for own rates for Super NOW and money market deposit accounts at commercial banks (SNOWC and MMDAC).[21] Survey data for a given month are often revised at the time that the data for the next month are published. The inclusion of these revisions in the historical MSI database has caused minor changes in the own rates. Own rates for Super NOWs and money market deposit accounts at thrift institutions (SNOWT and MMDAT) are now derived from Federal Home Loan Bank Board surveys of FSLIC-insured institutions instead of Federal Reserve surveys of savings banks.[22]

Apparently no common convention exists for quoting rates on deposits at banks and thrift institutions. When Regulation Q ceilings were in effect, the Federal Reserve granted a varying amount of leeway in how a ceiling rate could be converted to an annual effective yield (for example, allowing the ceiling rate to be treated as a 360-day rate, or allowing compounding, or both). The frequency of compounding (daily, monthly, and so on) varies among institutions and across time; we do not have the information, except as noted in the discussion of small time deposits at commercial banks, necessary to convert these rates to annualized one-month yields. Therefore, we have assumed that the quoted rates are annualized one-month rates.

In the case of the survey data, it is hard to say whether this assumption produces a systematic bias in the own rates. Where Regulation Q ceiling rates have been used as own rates or in deriving own rates (SDCB, SDSL, SDSB, SDCU, STDCB, STDTH, and STDCU), the bias is almost certainly in the direction of understating the true own rates (overstating the asset user cost), especially in periods when the spreads between market interest rates and Regulation Q ceiling rates increased.

### *Overnight Repurchase Agreements, Eurodollars*

Data on basic rates for overnight repurchase agreements (ONRP) and overnight Eurodollars (ONED) are overnight rates quoted on a bank-interest basis. For comparability with other own rates, two conversions are necessary: (1) conversion to a one-month basis and

21. "Monthly Survey of Selected Deposits and Other Accounts," special supplementary table in Board of Governors, *Money Stock*.

22. "Deposit Account Structure: Estimated Balances and Offering Rates in Selected Accounts," in Federal Home Loan Bank Board, *Thrift Institution Activity*, monthly statistical release.

(2) annualization to a bond interest basis (see table 2). Previously, these rates were annualized to a bank interest basis. Revising the annualization factor results in own rates that are about 12 basis points higher, on average; the maximum increase in these rates is about 25 basis points.

A far more substantial revision has been made in the rate data for ONRP for 1970 and 1971. Data on ONRP stocks exist for the whole time span (1970 to date) over which the present MSI are computed. However, rate data do not exist for periods preceding 1972. Thus, the user cost of ONRP had been overstated for periods before 1972 because this asset was erroneously assigned an own rate of zero. Comparing rate data on ONRP (where these data exist) with the appropriately adjusted federal funds rate showed that, on average, the funds rate was about five basis points higher than the RP rate. Thus, for the period without explicit ONRP rate data, the own rate has been set equal to the adjusted funds rate minus five basis points.[23]

23. The need for adjustment and the appropriate method of adjustment of the funds rate are discussed below in connection with term RPs.

2. Derivation of own rates used in the calculation of monetary services indexes

| Asset mnemonic | Basic rate | Basis on which quoted |
|---|---|---|
| CUR | 0 | . . . |
| DDCON | 0 | . . . |
| DDBUS | One-month commercial paper rate (RCP) | Discount |
| OCD | Regulation Q ceiling | Annual percentage rate |
| SNOWC | FRB survey, average rate paid | Annual percentage rate |
| SNOWT | FHLBB survey, average rate paid | Annual percentage rate |
| ONRP | Rate on overnight RPs (*RONRP*) | Add-on yield[1] |
| ONED | Rate on overnight Eurodollars (*RONED*) | Add-on yield[1] |
| MMF | *Donoghue's Money Fund Report* average one-month rate (*RMMF*) | Annualized monthly yield |
| MMDAC | FRB survey, average rate paid | Annual percentage rate |
| MMDAT | FHLBB survey, average rate paid | Annual percentage rate |
| SDCB | Regulation Q ceiling | Annual percentage rate |
| SDSL | Regulation Q ceiling | Annual percentage rate |
| SDSB | Regulation Q ceiling | Annual percentage rate |
| SDCU | CUNA survey, average rate paid, 1970–84<br>RMMF, 1985<br>FRB survey, average rate paid, 1986 on | Annual percentage rate<br>Annualized monthly yield<br>Annual percentage rate |
| STDCB | MYCAC rate for commercial banks (*MYCACB*) | "Instantaneous" yield |
| STDTH | MYCAC rate for thrift institutions (*MYCACT*) | "Instantaneous" yield |
| STDCU | Rate for STDTH, 1970–May 1978<br>MMC Rate at thrift institutions, July 1978–Sept. 1983<br>Rate for STDTH, Oct. 1983 on | "Instantaneous" yield<br>Annual percentage rate<br>"Instantaneous" yield |

### *Money Market Mutual Funds*

Previously, the own rate on money market mutual funds (MMF) was the annualized average one-month yield on money market funds reported in *Donoghue's Money Fund Report*. However, these rate data are not available until June 1974, whereas asset data begin in 1973. Thus, for the period representing approximately the first one and one-half years of their existence, the user cost of MMFs was greatly overstated since MMFs carried an own rate of zero.

The problem is exactly analogous to that of ONRPs, just discussed, and has been corrected in a similar fashion. For the period over which we do not have explicit MMF rate data, the own rate has been set equal to a rate on secondary certificates of deposit (see the discussion below of the own rate on large time deposits at commercial banks) less 70 basis points, the average spread between the two rates over subsequent periods.

### *Savings Deposits at Commercial Banks*

The own rate on savings deposits at commercial banks (SDCB) had been the most commonly paid, deposit-weighted average rate reported for one month each quarter in the

2. Continued

| Interest basis | Conversion formula/rate formula | Old rate |
|---|---|---|
| . . . | | Same |
| . . . | | Same |
| Bank | *Rate* = (1 – *maximum marginal reserve requirement*) *{365*(*RCP*/100)/[360 – (*RCP*/100)*30]}*100 | See text |
| Bond | | Same |
| Bond | | Same except for minor data errors; also see text |
| Bond | | FRB survey for savings banks; also see text |
| Bank | To Dec. 1971: *Rate* = {[(1 + *RFF*/36,000)**30] – 1}*(36,500/30) – .05<br>Jan. 1972 on: *Rate* = {[(1 + *RONRP*/36,000)**30] – 1}*(36,500/30) | See text |
| Bank | *Rate* = {[(1 + *RONED*/36,000)**30] – 1}*(36,500/30) | Same except for incorrect annualization |
| Bond | To May 1974: *Rate* = (*LTDCB rate*) – .7<br>June 1974 on: *Rate* = *RMMF* | Missing rate data before June 1974; otherwise same |
| Bond | | Same except for minor data errors; also see text |
| Bond | | FRB survey for savings banks; also see text |
| Bond | | Survey of Time and Savings Deposits (STSD) rate |
| Bond | | Same |
| Bond | | Same |
| Bond | 1985: *Rate* = *RMMF* – 1.5 | Ceiling rate; see text. |
| Bond | *Rate* = {[(1 + *MYCACB*/36,500)**30] – 1}*(36,500/30) | See text |
| Bond | *Rate* = {[(1 + *MYCACT*/36,500)**30] – 1}*(36,500/30) | See text |
| Bond | To May 1978: *Rate* = {[(1 + *MYCACT*/36,500)**30] – 1}*(36,500/30)<br>Oct. 1983 on: *Rate* = {[(1 + *MYCACT*/36,500)**30] – 1}*(36,500/30) | See text |

2. Continued

| Asset mnemonic | Basic rate | Basis on which quoted |
|---|---|---|
| LTDCB[2] | One-month, three-month, and six-month secondary CD rates ($RCD_1$, $RCD_3$, $RCD_6$) | Add-on yield[1] |
| LTDTH | See rates for LTDCB | Add-on yield[1] |
| MMFI | *Donoghue's Money Fund Report* average one-month rate (RMMF) | Annualized monthly yield |
| TRP | See rates for ONRP, TED, ONED | Add-on yield[1] |
| TED[2] | One-month, three-month, and six-month term Eurodollar rates ($RTED_1$, $RTED_3$, $RTED_6$) | Add-on yield[1] |
| SB | Maximum rate (*RSB*), 1970–Oct. 1982<br>Current six-month-average rate ($RSB_{6A}$) | Add-on yield[1]<br>Annual percentage rate |
| STTS | One-month Treasury bill rate (*RTB*) | Discount |
| BA | Rate on bankers acceptances maturing in 0–90 days (*RBA*) | Discount |
| CP | One-month commercial paper rate (*RCP*) | Discount |

1. An add-on yield is the yield on a short-term coupon security that pays interest only at maturity. Longer-term coupon securities typically pay interest periodically over the term of the security. See Stigum, *Money Market Calculations*, especially chap. 6, for a discussion of these securities.

Federal Reserve's quarterly Survey of Time and Savings Deposits (STSD). The reported monthly data were interpolated to obtain data for the intervening months. The last quarterly survey was conducted in January 1982, and in the absence of further survey data, the final survey rate had been used ever since. Because the quarterly survey is no longer in existence and because the own rates on other savings deposit components of the MSI are ceiling rates, we decided to use the Regulation Q ceiling rate instead of the survey rate. The effects of this revision are minor since the survey data indicated that rates paid on SDCB were typically within a few basis points of the ceiling rates.

### *Savings Deposits at Savings and Loans and Savings Banks*

Regulation Q ceiling rates continue to be used as own rates for savings deposits at savings and loan associations (SDSL) and at savings banks (SDSB).

### *Savings Deposits and Small Time Deposits at Credit Unions*

We encountered some problems common to the own rates on savings deposits and on small time deposits at credit unions (SDCU and STDCU, respectively). After discussing these problems, we will turn to the specific own rates.

The own rate on savings was supposed to be the ceiling rate, and the own rate on small time deposits was supposed to be a yield-curve-adjusted ceiling rate. However, we could find no documentation on the savings ceiling (particularly on its jump, as reflected in the old historical data base, from 7 percent to 12 percent in October 1981). The documentation on the small time deposit ceiling is limited to the period between June 1978 and June 1980.[24]

24. See Barnett and Spindt, *Divisia Monetary Aggregates*, p. 8. We have been unable to locate the source of this ceiling information. Further, the ceiling rates implied seem to be inconsistent with our information on small time deposits at credit unions (discussed below).

2. Continued

| Interest basis | Conversion formula/rate formula | Old rate |
|---|---|---|
| Bank | $Rate = Maximum\ of\ (RCD_1, RCD_3^{YCA}, RCD_6^{YCA})$<br>$RCD_3^{YCA} = RCD_3 - (y_3 - y_1)$<br>$RCD_6^{YCA} = RCD_6 - (y_6 - y_1)$ | Same except for differing conversions of discount-basis rates |
| Bank | $Rate = (LTDCB\ rate) + .3$ | See text |
| Bond | To May 1974: $Rate = (LTDCB\ rate) - .7$<br>June 1974 on: $Rate = RMMF$ | Missing rate data before June 1974; otherwise same |
| Bank | $Rate = (ONRP\ rate) + (TED\ rate - ONED\ rate)$ | Federal funds rate + .25; see text |
| Bank | For 1970: $Rate = RTED_3^{YCA}$<br>1971 on: $Rate = Maximum\ of\ (RTED_1, RTED_3^{YCA}, RTED_6^{YCA})$<br>$RTED_3^{YCA} = RTED_3 - (y_3 - y_1)$<br>$RTED_6^{YCA} = RTED_6 - (y_6 - y_1)$ | Same except for differing conversions of discount-basis rates |
| Bank | To Oct. 1982: $Rate = RSB*(365/360)$<br>Nov. 1982 on: $Rate = RSB_{6A}*(365/360)$ | Same except for some errors in data; see text and appendix B |
| Bank | $Rate = \{365*(RTB/100)/[360 - (RTB/100)*30]\}*100$ | Same except for differing conversions of discount-basis rates |
| Bank | $Rate = \{365*(RBA/100)/[360 - (RBA/100)*30]\}*100$ | See text |
| Bank | $Rate = \{365*(RCP/100)/[360 - (RCP/100)*30]\}*100$ | Maximum of seven commercial paper rates converted to yield basis and yield curve adjusted. Differing conversion of discount-basis rates. |

2. See text for description of yield-curve-adjusted rates used in the rate formula. Any basic rates entering these calculations that are quoted on a bank-interest basis are first converted to a bond-interest basis by multiplying by 365/360.

Apparently, the formula for the June 1980 ceiling had been used ever since in computing the own rate for STDCU. Because interest rates on all credit union accounts were deregulated in April 1982, updates and revisions were clearly needed.

To find better and more current rate information, we contacted both the National Credit Union Association, which is the regulatory agency for credit unions, and the Credit Union National Association (CUNA), their trade association. Neither association was able to supply historical information on rate ceilings on small time deposits. Fortunately, however, CUNA provided valuable information on rates paid, where such data are available; it also had information on deposit characteristics, which helped in choosing a proxy for the own rate when actual rate data were not available.

In general, data on rates paid by credit unions do not exist, and most of the rates we now use are proxies. Because the volume of deposits represented by credit union deposits is very small, even fairly substantial alterations in the own rates attributed to these deposits would have only small impacts on the calculated growth rates of the relevant indexes.[25]

*Savings Deposits at Credit Unions.* Discussions with CUNA confirm that there were ceilings on share account rates from 1970 to the time of deregulation. The initial ceiling was 6 percent and was raised to 7 percent in September 1973. We could find no evidence of a 12 percent ceiling. However, annual survey data supplied by CUNA for rates actually paid indicate that credit unions typically paid about 1 percentage point less than the prevailing ceiling. Therefore, we have chosen to use the sur-

25. In fact, we experimented by changing these own rates by hundreds of basis points and observing the effects on the growth rates of the resulting indexes. Changes as large as 400 basis points in either own rate were required before the annualized growth rate, that is, the growth rate multiplied by 12, of *any* MSI2 (the index at the M2 level) changed by as much as one percentage point. On average, the absolute annualized changes were less than 0.7 percent.

vey rate data rather than the ceiling rates for these deposits.[26]

Using a rate from an annual survey to represent monthly own rates in no way worsens the degree of approximation of the "true" monthly rates over this period because the ceiling rate changed only once between 1970 and deregulation. In fact, the approximation is considerably improved because it is based on rates actually paid, which changed several times.

We have adopted the suggestion of the staff at CUNA, which was based on their own research and experience, that we use the rate on money market funds (RMMF) less 150 basis points as a proxy for the own rate on savings deposits at credit unions over 1985 and early 1986.[27] Rates paid on savings deposits at thrift institutions and commercial banks will be deregulated as of March 31, 1986. Thereafter, the staff at CUNA believe that the own rate on savings deposits at thrift institutions will be a suitable proxy for credit unions. These choices leave us with the period between deregulation of credit unions (April 1982) and the end of 1984, for which we have only the data from the annual survey. Using such data to represent monthly rates implies a constancy that is probably not realistic in a deregulated environment. However, even under these circumstances we are undoubtedly much closer to the true rate with the survey data than we were with the previously used constant rate of 12 percent.

The net effect of these revisions is fairly small, lowering the own rate about 150 basis points on average. The largest revisions occur from October 1981 to the time of the revision, an interval in which the own rate was previously computed as 12 percent. The own rate for this period has been reduced about 475 basis points; while the revision is enormous, the effect of changes in this own rate on the MSI is small.

*Small Time Deposits at Credit Unions.* Small time deposits were not officially authorized at credit unions until November 1978.[28] Before then, some credit unions issued "certificates of indebtedness," unsecured promissory notes designed to compete with small time deposits at thrift institutions. On June 1, 1978, banks and thrift institutions were authorized to issue money market certificates with a ceiling rate tied to the six-month Treasury bill rate. At that time, credit unions patterned their certificates of indebtedness and the offering rates to match the money market certificates of thrift institutions. In November 1978, when the National Credit Union Administration put its stamp of approval on such deposits, the credit union certificates were restructured.

Given the nature of small time deposits at credit unions, the own rate on this asset stock (STDCU) has been revised as follows:

(1) For the period before June 1978, the proxy for the own rate is the rate on small time deposits at thrift institutions (see discussion below).

(2) For the period from June 1978 through September 1983, the proxy for the own rate is the ceiling rate on money market certificates at thrift institutions.

(3) For the period from October 1983 (when the rates on small time deposits at thrift institutions were fully deregulated) to the present, the proxy for the own rate is again the own rate on small time deposits at thrift institutions.

The most significant effect of these revisions is on the own rate for the period from 1970 to 1978. Before these revisions were made, we had data on STDCU from 1970 but the rate data did not begin until 1978. Thus, for eight years the own rate was set at zero; the revisions reduce the user cost of this asset stock about 625 basis points, on average, over this period.

From 1978 to the present, the revisions increase the own rate (reduce the user cost) about 50 basis points, although there are some months for which the revised own rate is lowered. Revisions range from a maximum increase of 308 basis points to a maximum decrease of 241 basis points. Because of the relatively small size of the asset stock involved, neither set of revisions is likely to have a significant effect on the calculated indexes.

26. This is not at variance with the decision to use ceiling rates instead of survey data for the own rate on SDCB. These survey data indicate that, for all practical purposes, banks paid the ceiling rates.

27. Use of the RMMF proxy is subject to the caveat that it would no longer be appropriate should RMMF exceed 10 percent; in that event, we would contact CUNA again.

28. Most of the information in this section was obtained from CUNA.

*Small Time Deposits at Commercial Banks*

We have made fairly substantial revisions in the method of computing the own rate for small time deposits at commercial banks (STDCB), although we still use the maximum of the yield-curve-adjusted rates on components of the composite asset (the MYCAC). In line with the decision to use ceiling rates rather than rates based on data from the Federal Reserve's Survey of Time and Savings Deposits, the MYCAC is based in part on ceiling rates on different maturities of small time deposits.[29] As before, upon the introduction of new small time deposits bearing a market-related rate of interest, such as money market certificates or small saver certificates, the ceiling that is tied to the market rate replaces the Regulation Q ceiling for other small time deposits of the same maturity in computing the MYCAC.[30]

As of October 1, 1983, ceiling rates were lifted for all small time deposits. Since that time, data on the "average rate paid" are available from the survey conducted by the Federal Reserve (see note 21) for a variety of maturities. These data replace the ceiling rates underlying the MYCAC.[31] Rate data for deposits with original maturities of 7 to 31 days and 32 to 91 days are deposit-weighted averages of annual percentage rates. Rate data for deposits with longer maturities are deposit-weighted averages of annual compound rates.

The computation of the compound rates is based on the reported frequency with which surveyed institutions compound rates on various deposit categories. Because the frequency of compounding is known for these rates, whereas it is unknown for earlier time periods and certain other deposit categories, it was decided that the rates with known compounding frequencies should enter the MYCAC calculation as compound annual yields. If information were to become available on the compounding frequency for earlier periods and other deposit categories, all rates could be converted to annualized one-month yields.[32]

We also changed and corrected the method of computing the MYCAC based on the rate data described above. Previously, an estimate of the yield curve was based on rates at different maturities along the yield curve. However, the short rates quoted on a discount basis were not converted to a yield basis. Therefore, "true" short rates were consistently understated. Furthermore, weighted moving averages of the rates were used, introducing an inappropriate lag into the yield curve and, thus, into the MYCAC. The estimation of the yield curve for any given month is now based on appropriately adjusted rates at different maturities along that curve for the current month only.[33] Finally, the MYCAC we derived was adjusted for the period during which the all savers certificate was available (October 1981 through December 1982); see appendix A for a discussion of this adjustment.

The resulting MYCAC is an "instantaneous" rate of return on the basis of a 365-day year.

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29. See the discussion, above, of the rate on savings deposits at commercial banks.

30. When money market certificates were introduced (June 1, 1978), the rate paid could be compounded. However, as of March 15, 1979, compounding of interest on these certificates was prohibited. This change ended the strict comparability of ceiling rates on money market certificates with other ceiling rates, which could be compounded.

31. Before October 1983, ceiling rates were removed for selected deposit maturities (four years or more in August 1981, three and one-half years or more in May 1982, and two and one-half years or more in April 1983). Rate data are not available for these ceiling-free deposits for periods before December 1982. Thereafter, the data are used where relevant.

32. When ceiling rates were well below market rates, banks took one or both of two steps to lessen the impact of the binding ceilings: (1) increase the frequency of compounding or (2) compound a rate as though the ceiling were a 360-day rate. An example of the latter, for daily compounding, is represented by

$$y = \left[\left(1 + \frac{r}{36{,}000}\right)^{365} - 1\right] \times 100$$

where $y$ is the compound annual yield and $r$ is a simple annual yield (or ceiling rate).

33. The yield curve used in the MYCAC rate calculations is still defined somewhat differently from that discussed in the section above on the yield curve adjustment. It is defined by fitting a second degree polynomial to the rates on three-month, five-year, and ten-year Treasury securities. If this is done correctly, the process of yield curve adjustment of rates on various maturities of time deposits is essentially the same as that described above; the only difference is that rates on "missing maturities" do not have to be interpolated by cubic splines because a continuous yield curve is defined.

A comparison of the MYCAC rates derived from this yield curve and rates derived using a yield curve defined in the manner described earlier showed that, in general, the differences between the two sets of MYCAC rates were only a few basis points. However, there were some periods when rates based on the latter yield curve were unrealistically discontinuous, even when the curve was augmented with five- and ten-year rates. Thus, we have chosen to stay with the "continuous yield curve" for these calculations.

The final difference between this own rate as currently computed and the rate used previously is that the MYCAC is converted to a one-month basis.

### Small Time Deposits at Thrift Institutions

The own rate on small time deposits at thrift institutions (STDTH) previously was set equal to the own rate on corresponding deposits at commercial banks plus 25 basis points. In the days when no small time deposits had market-determined ceilings on interest rates, this was a fairly reasonable approximation because most ceiling rates for thrift institutions were 25 basis points higher than those for commercial banks. However, depending on the shape of the yield curve, the approximation might not be reasonable because some ceilings for thrift institutions were 50 basis points higher than those for commercial banks. With the introduction of market-determined ceilings on interest rates, it became imperative to calculate a MYCAC specifically for thrift institutions; this is because the differential accorded to such entitites varied considerably at times depending on the then-current or recently prevailing levels of the market interest rate upon which a given ceiling was based. Such a MYCAC is now being used for the MSI. For the period from October 1983 on, survey rate data for FSLIC-insured institutions are used in calculating the MYCAC for thrift institutions.[34] The method of computing the own rate for thrift institutions is identical to the method of computing the own rate for commercial banks.

The net result of these changes is surprisingly small revisions of the own rates for thrift institutions and commercial banks. The mean differences are about 15 basis points and the mean absolute differences about 45 basis points, with maximum and minimum differences of about 250 and −150 basis points, respectively.

34. See note 22. For deposit maturities deregulated before October 1983, the same procedure is used for thrift institutions as for commercial banks (note 31). Because the data from the Federal Home Loan Bank Board do not exist for the period before October 1983, survey data for savings banks (note 21) were used for that period.

### Large Time Deposits at Commercial Banks

The new own rate on large time deposits at commercial banks (LTDCB), like the previous own rate, is the maximum of yield-curve-adjusted secondary market rates on large certificates of deposit (a MYCAC). However, it differs from the previous rate because of the improvement in the method of converting Treasury bill rates from a discount basis to a yield basis (see the earlier discussion of yield curve adjustments). The effects of revisions to this rate are relatively small, with a maximum absolute difference of 68 basis points.

### Large Time Deposits at Thrift Institutions

The own rate on large time deposits at thrift institutions (LTDTH) was once set equal to the rate on large time deposits at commercial banks plus 25 basis points. The differential was later reduced to 10 basis points. (The source of these differentials was not documented.) Thrift institutions pay a premium to sell new-issue certificates of deposit; the premium varies over time and has apparently gone as high as 200 basis points, although this was an unusual event. Since 1983, the premium appears to have varied between 20 and 60 basis points with the modal value being about 30 basis points. In the absence of further information, the own rate on LTDTH now equals the own rate on large time deposits at commercial banks plus 30 basis points. The appropriateness of this differential will be reviewed periodically.

### Institution-Only Money Market Mutual Funds

Because we lack data on rates paid by institution-only money market funds (MMFI), the estimate of this own rate continues to be the annualized average one-month yield on money market funds given in *Donoghue's Money Fund Report*. The *Donoghue's* data are augmented for missing observations, as discussed above.

### Term Repurchase Agreements

The own rate on term repurchase agreements (TRP) has been revised in several ways. Previously, the rate had been set equal to the federal funds rate less 25 basis points. Since the funds rate is a daily rate, it should have been converted to a one-month, 365-day-year basis for consistency with other rates used as own rates. Furthermore, in looking for rate data to approximate the own rate on overnight RPs (see the discussion above in the section on overnight RPs), it was found that the spread between the adjusted funds rate and the rate on overnight RPs was approximately 5 basis points, on average. Thus, setting the rate on term RPs 25 basis points below the funds rate tended to produce a rate that was frequently lower than the overnight rate.

The yield curve in the RP market, as in other markets, typically slopes upward. However, at very short maturities in the RP market, the yield curve frequently inverts, and the overnight RP rate is often a few basis points higher than the rate on a one- or two-week RP. However, a sizable volume of term RPs are transacted at maturities longer than two weeks. Thus, the typical term RP rate is undoubtedly higher than the overnight rate.

Unfortunately, historical data on term RP rates and on the typical maturity of a term RP are extremely scarce. As explained below, the own rate chosen for term RPs is the overnight RP rate plus the difference between the rate used for term Eurodollars and that used for overnight Eurodollars.[35]

Daily data, available from Data Resources, Inc. (DRI), established that the "term premium" for different maturities of RPs was extremely close to the same term premium for Eurodollars. The term premium is the rate differential that is due largely to differences in liquidity between shorter and longer term assets. In general, the size of the premiums differed by only a few basis points (although the premiums varied over time), and the premiums between comparable maturities were also highly correlated. (Advantages of using Eurodollar rates include the existence of both overnight and term markets and the availability of historical rate data for a variety of maturities.)

The effect of these revisions to the own rate for term RPs is to increase the rate by about 60 basis points on average, although rates for some months are now lower.

35. Data on overnight Eurodollar rates do not exist for periods before 1971. We approximate the 1970 spreads between term and overnight Eurodollar rates by the 1971 spreads.

### *Term Eurodollars, Short-term Treasury Securities*

The own rate for term Eurodollars (TED) is a yield-curve-adjusted rate and that on short-term Treasury securities (STTS) is a discount-basis rate converted to an annualized yield. Because the method of converting rates from a discount basis to a yield basis has been improved, and because this affects the computed values for any yield-curve-adjusted rate, both own rates have been revised, though the underlying concepts remain the same.

The revisions barely change the own rate data for TED. (Although there is one change of −225 basis points, this appears to be due to an error in the old data.) The revised own rate on STTS is uniformly lower than the old rate. The average difference is about 50 basis points, but there are some fairly substantial differences as large as 268 basis points.

### *Savings Bonds*

Before the introduction of the Series EE bonds that have variable, market-rate-determined rates of interest, the own rate on savings bonds (SB) is the maximum rate paid, converted to a 365-day basis. With the introduction of the Series EE bonds with market-based yields, it is not as obvious what one should use as an own rate. It was decided to continue using the 6-month-average rate in effect for the current month, converted to a 365-day basis. Thus, this rate has not been changed, except to correct some errors in the historical data. See appendix B for a detailed discussion of how yields are determined on the new Series EE bonds and the rationale for continuing to compute the own rate as before.

### *Bankers Acceptances*

Previously, the own rate on bankers acceptances (BA) had been converted from a discount basis and then yield curve adjusted to a one-month rate. The second step is inconsistent with the treatment of all other own rates for which only one basic rate enters the calculation of the own rate. These other rates, admittedly all with maturities of one month or less, are converted to a one-month yield basis and then annualized. The same procedure should have been used for the own rate on BA, and it has been adopted in the course of these revisions. Because the basic rate used in the calculation of the BA rate is assumed to be a forty-five-day rate, the process of conversion to a one-month rate is presented here in some detail:

(1) Convert the discount-basis rate to a simple yield, $y$ (not annualized), denoted by $y_{45}$.

(2) Using the standard assumption that bond interest accrues in a straight-line fashion, calculate accrued interest for one month (approximated by thirty days) as

$$y_{30} = \frac{30}{45} y_{45}. \tag{17}$$

(3) Use the following formula to obtain $y_{30}$ annualized to a bond-interest basis, $y_{30A}$:

$$y_{30A} = \frac{365}{30} y_{30}. \tag{18}$$

Substituting from equation 17 for $y_{30}$ in equation 18 yields

$$y_{30A} = \frac{365}{30} \times \frac{30}{45} y_{45} = \frac{365}{45} y_{45}. \tag{19}$$

In other words, the appropriate formulation of the own rate for BA is the annualized simple yield; this is equivalent to converting the discount-basis rate to an annualized yield using equation 16.[36]

The improved conversion of a discount-basis rate to a yield and the correct conversion of a forty-five-day yield to an annualized one-month yield produces an own rate for BA which is uniformly lower than the old one. The average reduction is about 70 basis points, with some changes as large as 318 basis points.

### *Commercial Paper*

Previously, the own rate used for commercial paper (CP) was the maximum of seven different rates on finance company commercial paper converted from a discount basis to a yield basis and then yield curve adjusted (a MYCAC). Markets for many maturities of commercial paper are extremely thin because most commercial paper has an initial maturity of thirty days or less. Therefore, we now use only the one-month paper rate, converted from a discount basis using the improved formula.

### Other Revisions

When a new instrument is introduced, one must decide what user cost should be associated with that instrument in the month preceding its introduction ($\pi_{i,\,t-1}$ in equation 1 or 3). Drawing upon work by Diewert, we have "estimated" $\pi_{i,\,t-1}$ to be equal to the $\pi_{i,\,t-1}$ of an asset that is a close substitute.[37] Specifically, in the case of money market deposit accounts, $\pi_{i,\,t-1}$ is set equal to the previous month's user cost on money market funds, and in the case of Super NOW accounts, $\pi_{i,\,t-1}$ is set equal to the previous month's user cost on NOW accounts. (The treatment of $\pi_{i,\,t-1}$ for money market funds is a somewhat special case and was discussed earlier.) These lagged user costs previously were set equal to zero.

## Comparison of the Monetary Services Indexes with the Divisia Indexes

The previous section discussed many differences between the data used to compute the Divisia indexes—the old indexes—and those used to compute the monetary services indexes (MSI)—the new indexes. This section broadly describes the effects of the data revisions and contrasts the new indexes with the old. It also presents some comparisons of the behavior of the MSI and of the conventional monetary aggregates.

The comparisons use data from the next-to-last Divisia run (a full data history was not

36. The combined operations of converting a discount-basis rate to a simple yield and then annualizing to a bond-interest-basis are illustrated in equation 16.

37. See Diewert, "Aggregation Problems."

available for the release mentioned in note 3) and from an MSI run using asset stocks based on the monetary aggregates as of December 1984, that is, before the 1985 seasonal and benchmark revisions.[38] The original span of the Divisia data is from January 1969 through June 1984; the span of the MSI data is January 1970 through December 1984. To facilitate comparison, the two sets of data have been truncated to fit within a time span common to both, January 1970 through June 1984, and the Divisia indexes have been renormalized so that the index levels equal 100 in January 1970. Finally, growth rates for the Divisia indexes have been recomputed as arithmetic (as opposed to logarithmic) growth rates for comparability with the format for reporting growth rates of the MSI and conventional (simple-sum) monetary aggregates.

In general, the revised data on own rates are higher than those used previously, especially over subperiods in which own rates had been set to zero.[39] In many cases, the revisions are greater at higher rates of interest than at lower ones. Higher own rates imply lower user costs (see note 15), and the user costs are the weights applied to the asset stocks in computing the indexes; therefore we would expect that, other things unchanged, MSI levels would be below Divisia levels. However, no simple characterization of the asset stock revisions is apparent; thus, the net effects of all revisions can be seen only by examining the resulting indexes.

## A Visual Review

Chart 2 plots the differences between the levels of the new and old indexes and, for reference, the rate on three-year Treasury notes. The differences between the new and old indexes (particularly for higher-level indexes, which include longer-term, less-liquid, and higher-yielding assets) mirror to a remarkable degree the movements in the interest rate. In fact, correlations between the interest rate and the differences between the new and old indexes are −0.39, −0.86, −0.83, and −0.83 at the M1, M2, M3, and L levels of aggregation, respectively.[40] Thus, it appears that much of the revision in the indexes is due to changes in the calculations of own rates, particularly to the revisions in the procedure for yield curve estimation.

Not surprisingly, the M1-level index is least affected because the own rate on only one of its components (DDBUS) is significantly altered. The main cause of the differences that do exist at the M1 level is probably the change in the method of allocating demand deposits between those held by households (DDCON) and those held by others, predominantly businesses (DDBUS). In fact, differences between the new and old indexes at the M1 level are highly correlated (0.77) with differences between the new and old DDCON series. Because DDCON has an own rate of zero, it gets the maximum possible weight (user cost) in computing the indexes and is therefore strongly reflected in the resulting index. The impact of the changes in DDCON can also be seen, though to a lesser degree, in the higher-level indexes as well, especially when interest rates are low.

Chart 3 plots the growth rates of nominal GNP against the growth rates of quarterly averages of MSI1 through MSI4. None of the index growth rates appears to be closely related to contemporaneous growth in GNP. Over the whole period, growth in quarterly average MSI4 is the most highly correlated with GNP growth, but the correlation is only 0.10 (MSI2 has the lowest correlation, 0.03). Dividing the time span into 1970–78 and 1979–84, correlations are generally higher over the first subperiod but are still low; MSI4 has the highest correlation, 0.23, and MSI2 the lowest, 0.06. Over the second subperiod only MSI1 is positively correlated, 0.07; MSI2 has the most negative correlation, −0.19.

We now turn to examining the autocorrelation and cross-correlation properties of the new and old indexes.

## Monthly Autocorrelations

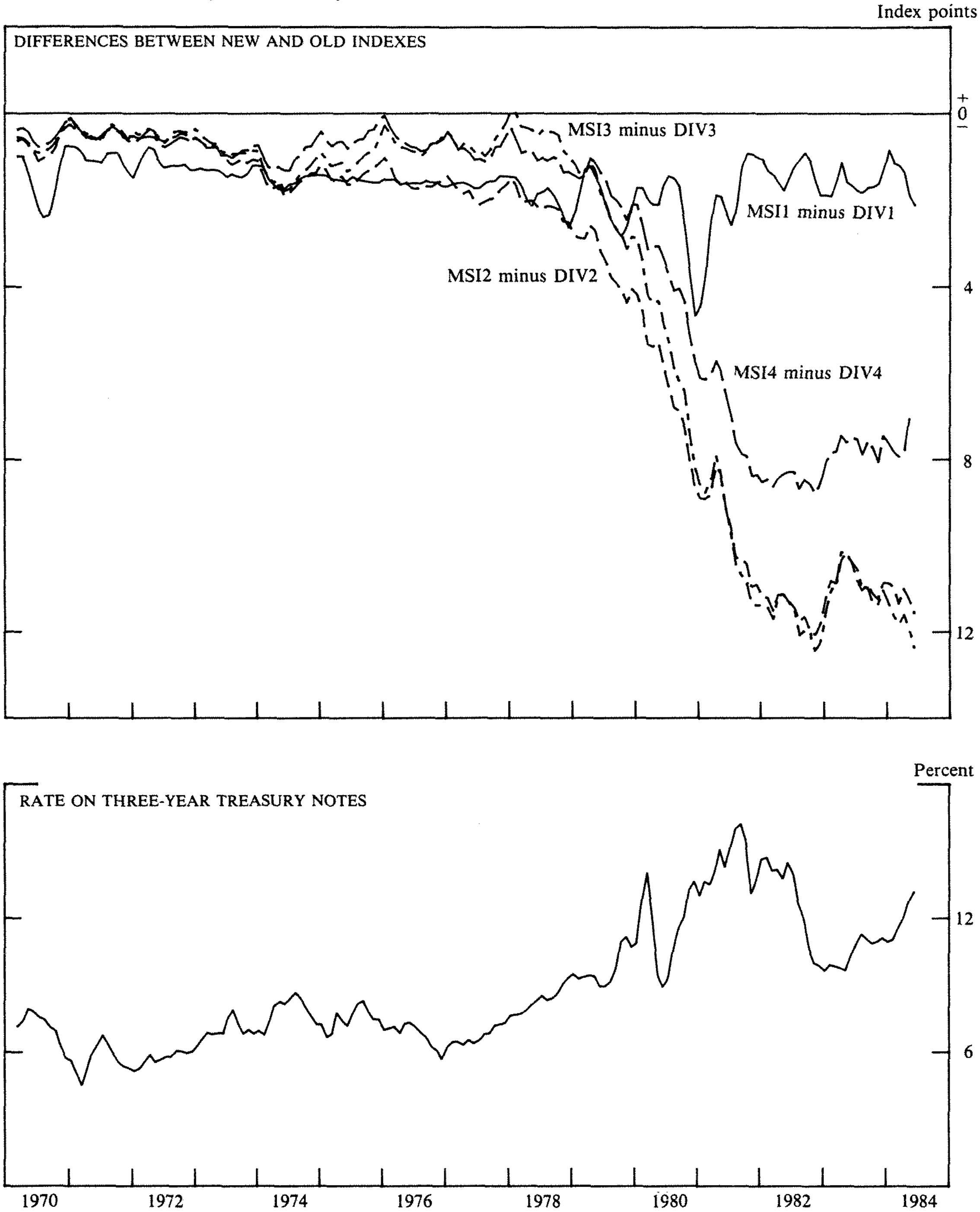
Table 3 indicates that, for the full monthly sample period, the MSI exhibit autocorrelation structures very similar to the Divisia indexes,

38. The MSI data presented in appendix C are based on the most recently published data on the conventional monetary aggregates and include the 1985 revisions.

39. Exceptions are own rates for SDCU, STTS, BA, and CP. The last three of these rates enter the indexes at the L level. The remaining L-level own rate, that for SB, is essentially unchanged.

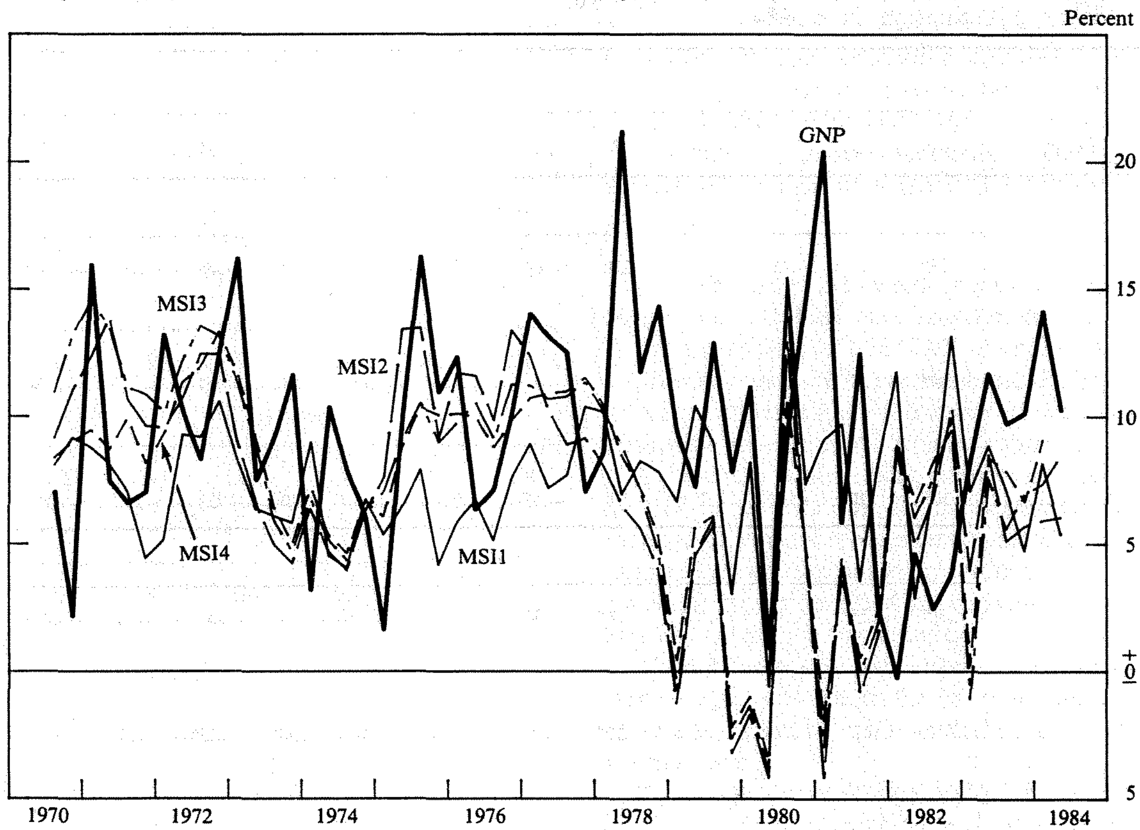
40. Correlations with the one-year Treasury yield are −0.48, −0.76, −0.72, and −0.73, respectively.

2. Differences between the new and old indexes of the monetary aggregates and, for reference, the rate on three-year Treasury notes[1]




1. The old indexes are denoted DIV1 through DIV4.

3. Quarterly growth rates of GNP and the monetary services indexes




although they are more highly autocorrelated.[41] MSI1 and the M1-level Divisia index (DIV1) are perhaps the most dissimilar and exhibit the fewest significant autocorrelations. (The estimated autocorrelation at lag $k$ is denoted by $r_k$.) For MSI1, $r_1$, $r_3$, $r_4$, and $r_8$ are significant, while only $r_1$ and $r_4$ are significant for DIV1.

The conventional (simple-sum) monetary aggregates, M1, M2, M3, and L, are all less autocorrelated than their index counterparts. It is interesting to note the significant twelve-month autocorrelation for M1 ($r_{12} = -0.19$). Also, note the reduction in the one-month autocorrelations, $r_1$, as one moves from M2 through L. This change in the autocorrelation structure of the aggregates as the level of aggregation increases is not apparent in either set of indexes.

Tables 4 and 5 show the corresponding autocorrelations for the subperiods 1970–78 and 1979–84, respectively. The autocorrelation properties of the earlier subperiod, shown in table 4, are similar to those for the complete sample reported in table 3. For the earlier subperiod, however, MSI1 and DIV1 have nearly identical autocorrelation structures, except for the significant twelve-month autocorrelation for MSI1, $r_{12} = -0.22$. Over this subperiod, the conventional monetary aggregates, except for M1, also show autocorrelation properties similar to their corresponding indexes. This is not true for the later subperiod nor for the entire sample period.

Table 5, containing results for the later subperiod, shows autocorrelation structures for MSI1 and DIV1 strikingly similar to those for the entire sample (table 3) and, thus, different from those for the earlier subperiod (table 4). The higher-level indexes show autocorrelation patterns dramatically different from those shown in either table 3 or table 4. It can be shown that these indexes have changed from an autoregressive structure to a moving-average format.[42] This is also true for conventional M2; however, it is difficult to tell

41. All series used in the autocorrelation analysis are annualized one-month growth rates.

42. See George E.P. Box and Gwilym M. Jenkins, *Time Series Analysis: Forecasting and Control* (Holden-Day, 1970), especially chap. 3.

3. Autocorrelations of the conventional monetary aggregates and the new and old indexes, March 1970 through June 1984[1]

| Series | Lag, *k* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | $\sigma = .08$ | | | | | | | | | | | |
| M1 | .28* | −.07 | −.09 | −.15 | .01 | .01 | −.02 | .14 | .09 | −.06 | −.08 | −.19* |
| MSI1 | .29* | −.05 | −.22* | −.33* | −.11 | .01 | .14 | .28* | .05 | −.09 | −.16* | −.17* |
| DIVI | .30* | .01 | −.10 | −.27* | −.11 | −.06 | −.02 | .14 | .00 | −.08 | −.07 | −.09 |
| | $\sigma = .08$ | | | | | | | | | | | |
| M2 | .58* | .23* | .17* | .18* | .17* | .07 | .03 | .13 | .13 | −.01 | −.11 | −.12 |
| MSI2 | .71* | .42* | .26* | .15 | .20* | .24* | .26* | .34* | .34* | .25* | .17* | .09 |
| DIV2 | .68* | .37* | .21* | .11 | .13 | .15 | .17* | .26* | .26* | .19* | .16* | .12 |
| | $\sigma = .08$ | | | | | | | | | | | |
| M3 | .49* | .24* | .25* | .25* | .33* | .20* | .11 | .15 | .16* | .15 | .05 | −.02 |
| MSI3 | .70* | .44* | .30* | .20* | .25* | .30* | .30* | .36* | .34* | .25* | .19* | .12 |
| DIV3 | .66* | .38* | .24* | .13 | .15 | .18* | .19* | .26* | .24* | .18* | .17* | .14 |
| | $\sigma = .08$ | | | | | | | | | | | |
| L | .37* | .16* | .31* | .11 | .18* | .19* | .01 | .10 | .05 | −.00 | .05 | −.15 |
| MSI4 | .70* | .47* | .31* | .15 | .22* | .29* | .29* | .36* | .34* | .22* | .16* | .09 |
| DIV4 | .66* | .41* | .24* | .11 | .14 | .18* | .20* | .28* | .26* | .15 | .14 | .09 |

1. The conventional aggregates are M1, M2, M3, and L. For the Monetary Services indexes, the index counterparts of the conventional aggregates are MSI1 through MSI4; for the Divisia indexes, the counterparts are DIV1 through DIV4. Series are annualized one-month growth rates. The L-level series end in May 1984. Asterisks indicate significant autocorrelations ($|r_k| \geq 2\sigma$ for $\alpha = 0.05$).

3. Continued

| Lag, *k* | | | | | |
|---|---|---|---|---|---|
| 13 | 14 | 15 | 16 | 17 | 18 |
| σ = .09 | | | | | |
| −.06 | .17 | .05 | .06 | .11 | .06 |
| σ = .10 | | | | | |
| −.16 | .08 | .09 | .14 | .11 | .03 |
| σ = .09 | | | | | |
| −.10 | .08 | .07 | .14 | .11 | .01 |
| σ = .11 | | | | | |
| −.01 | .05 | .04 | .01 | .05 | −.02 |
| σ = .14 | | | | | |
| .15 | .27 | .29* | .26 | .22 | .14 |
| σ = .13 | | | | | |
| .15 | .24 | .26* | .25 | .20 | .10 |
| σ = .12 | | | | | |
| .09 | .11 | .07 | .02 | .08 | .05 |
| σ = .15 | | | | | |
| .18 | .26 | .28 | .25 | .23 | .17 |
| σ = .13 | | | | | |
| .16 | .21 | .24 | .24 | .19 | .09 |
| σ = .10 | | | | | |
| −.11 | −.02 | −.10 | −.04 | .11 | −.06 |
| σ = .15 | | | | | |
| .15 | .22 | .26 | .25 | .23 | .14 |
| σ = .13 | | | | | |
| .13 | .16 | .21 | .24 | .16 | .06 |

whether there has been a structural change for M1, M3, or L. Note that the decrease in the one-month autocorrelations as one moves from M2 through L, evident over the whole sample period, is also evident over both subperiods.

In summary, autocorrelations of one-month annualized growth rates exhibit the following properties:

(1) Over the entire sample period and both subperiods, the MSI have autocorrelation structures similar to their DIV counterparts.

(2) MSI1 and DIV1 are the most dissimilar of all the index pairs, with much of the dissimilarity appearing in the later subperiod.

(3) There is a decreasing pattern in one-month autocorrelations for conventional M2 through L in all three periods, indicating a change in autocorrelation structure as one moves to higher levels of aggregation, a property not exhibited by the indexes.

(4) For the earlier subperiod, the conventional aggregates except for M1 show autocorrelation patterns quite similar to their index counterparts.

(5) Except for MSI1 and DIV1, the indexes exhibit a structural shift from an autoregressive format over the earlier subperiod to a moving average format over the later subperiod, a shift also apparent for conventional M2.

## Quarterly Autocorrelations and Cross Correlations with GNP

The left-hand part of table 6 is the analogue to table 3 for annualized quarterly average growth rates and includes nominal gross national product for a closer examination of the relationships shown in chart 3. The following four results are consistent with those shown in table 3:

(1) The MSI show autocorrelation structures similar to the DIV indexes.

(2) The conventional aggregates M2, M3, and L are less autocorrelated than their index counterparts.

4. Autocorrelations of the conventional monetary aggregates and the new and old indexes, March 1970 through December 1978[1]

| Series | Lag, $k$ 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\sigma = .10$ | | | | | | | | | | | |
| M1 | .16 | −.09 | .05 | −.10 | .08 | .14 | −.13 | .19 | .16 | −.00 | .16 | −.16 |
| MSI1 | .32* | .09 | .09 | −.11 | .01 | .09 | −.08 | .19 | .11 | −.05 | .02 | −.22* |
| DIV1 | .33* | .11 | .09 | −.16 | −.06 | .02 | −.11 | .17 | .14 | .01 | .10 | −.10 |
| | $\sigma = .10$ | | | | | | | | | | | |
| M2 | .70* | .46* | .38* | .30* | .26* | .23* | .17 | .18 | .11 | .07 | .02 | −.13 |
| MSI2 | .71* | .47* | .40* | .33* | .31* | .27* | .20* | .21* | .13 | .07 | .03 | −.09 |
| DIV2 | .67* | .41* | .32* | .24* | .21* | .19 | .17 | .22* | .15 | .06 | .05 | −.05 |
| | $\sigma = .10$ | | | | | | | | | | | |
| M3 | .62* | .50* | .39* | .29* | .30* | .27* | .28* | .24* | .15 | .14 | .12 | .08 |
| MSI3 | .72* | .57* | .49* | .43* | .40* | .32* | .26* | .22* | .14 | .08 | .03 | −.03 |
| DIV3 | .63* | .45* | .41* | .35* | .31* | .23* | .22* | .27* | .18 | .09 | .03 | .05 |
| | $\sigma = .10$ | | | | | | | | | | | |
| L | .57* | .47* | .39* | .24* | .27* | .27* | .18 | .19 | .10 | .01 | .08 | .01 |
| MSI4 | .69* | .51* | .41* | .33* | .34* | .30* | .21* | .20* | .11 | −.02 | −.06 | .14 |
| DIV4 | .61* | .43* | .35* | .25* | .21* | .20* | .18 | .22* | .17 | .03 | .01 | −.06 |

1. See note to table 3.

4. Continued

| Lag, *k* | | | | | |
|---|---|---|---|---|---|
| 13 | 14 | 15 | 16 | 17 | 18 |
| $\sigma = .12$ | | | | | |
| −.18 | .03 | .06 | .09 | .25* | .03 |
| $\sigma = .12$ | | | | | |
| −.12 | .06 | .02 | .04 | .14 | −.00 |
| $\sigma = .12$ | | | | | |
| −.05 | .08 | .02 | .01 | .10 | −.07 |
| $\sigma = .18$ | | | | | |
| −.17 | −.06 | .02 | .02 | .04 | −.07 |
| $\sigma = .18$ | | | | | |
| −.12 | −.02 | .01 | −.02 | −.00 | −.09 |
| $\sigma = .17$ | | | | | |
| −.09 | −.01 | .03 | .02 | .00 | −.11 |
| $\sigma = .18$ | | | | | |
| .12 | .13 | .13 | .10 | .19 | .09 |
| $\sigma = .20$ | | | | | |
| −.02 | −.00 | .00 | −.03 | .02 | −.03 |
| $\sigma = .18$ | | | | | |
| .03 | .04 | .05 | .03 | .03 | −.04 |
| $\sigma = .17$ | | | | | |
| .02 | −.02 | −.01 | −.01 | .09 | −.02 |
| $\sigma = .19$ | | | | | |
| −.13 | −.15 | −.17 | −.18 | −.12 | −.18 |
| $\sigma = .16$ | | | | | |
| −.06 | −.09 | −.10 | −.10 | −.14 | −.14 |

(3) MSI1 and DIV1 are the most dissimilar index pair and have the least significant autocorrelations.

(4) Although not decreasing as it did for monthly data, the one-quarter autocorrelation, $r_1$, changes significantly from M2 to M3, indicating a changing structure ($r_1$ for L is nearly identical to $r_1$ for M3). This property is not exhibited by the indexes.

Note that MSI1 has a significant four-quarter autocorrelation, $r_4 = -0.26$, while GNP, M1, and DIV1 have no significant autocorrelations. The latter three series can be modeled simply as a constant mean plus a random disturbance.

ARIMA (autoregressive integrated moving average) models estimated for the quarterly series are shown in table 7 along with the model standard errors, $\sigma_a$. Note the similarity of the model standard errors for the index pairs.

The right-hand part of table 6 displays the estimated cross correlations at lag $k$, $c_k$, of GNP innovations with the innovations of the indexes and conventional aggregates; these data also indicate similarities between the MSI and their DIV counterparts.[43] The cross correlations of GNP with the MSI are all very similar to those with the DIV indexes.[44] GNP innovations are related to past values (lag 2) and, except for MSI1 and DIV1, future values (lead 3) of innovations of each index. Lead 1 is also significant for MSI2, DIV2, and

43. See Box and Jenkins, *Time Series Analysis.* The innovations are the model residuals, $a_t$, from the relevant equations presented above.

44. The relationship of innovation correlations to the original growth rate series is illustrated for MSI1 ($m_t$) and GNP ($y_t$) as follows: It can be shown that the MSI1 and GNP growth rates are related by

$$y_t = \beta(m_{t-2} + 0.27m_{t-6}) + a_t,$$

where $\beta$ depends on the standard deviations of the MSI1 and GNP innovations and the lagged two-quarter cross correlation, $c_{-2} = 0.33$. A one-quarter spurt in MSI1 growth is reflected in an increase in GNP growth two quarters later and a smaller increase six quarters later.

5. Autocorrelations of the conventional monetary aggregates and the new and old indexes, January 1979 through June 1984[1]

| Series | Lag, *k* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | $\sigma = .12$ | | | | | | | | | | | |
| M1 | .32* | −.07 | −.17 | −.19 | −.03 | −.06 | −.00 | .13 | .06 | −.10 | −.21 | −.23 |
| MSI1 | .27* | −.10 | −.32* | −.40* | −.15 | −.01 | .21 | .31* | .02 | −.12 | −.22 | −.15 |
| DIVI | .28* | −.03 | −.17 | −.31* | −.13 | −.10 | .00 | .12 | −.06 | −.11 | −.14 | −.07 |
| | $\sigma = .12$ | | | | | | | | | | | |
| M2 | .44* | −.04 | −.09 | .04 | .07 | −.13 | −.17 | .05 | .12 | −.13 | −.29* | −.16 |
| MSI2 | .58* | .13 | −.11 | −.25* | −.15 | −.06 | .01 | .17 | .18 | .04 | −.10 | −.16 |
| DIV2 | .56* | .10 | −.14 | −.25* | −.20 | −.17 | −.09 | .04 | .06 | .−02 | −.07 | −.08 |
| | $\sigma = .12$ | | | | | | | | | | | |
| M3 | .24* | −.23 | −.02 | .10 | .31* | .04 | −.26* | −.08 | .09 | .09 | −.11 | −.16 |
| MSI3 | .55* | .11 | −.11 | −.25* | −.14 | −.02 | .02 | .15 | .15 | .01 | −.09 | −.16 |
| DIV3 | .54* | .11 | −.11 | −.26* | −.22 | −.13 | −.09 | .02 | .01 | −.05 | −.04 | −.08 |
| | $\sigma = .12$ | | | | | | | | | | | |
| L | .17 | −.14 | .21 | −.07 | .05 | .02 | −.25* | −.02 | −.04 | −.04 | .08 | −.21 |
| MSI4 | .59* | .24* | .01 | −.20 | −.09 | .02 | .06 | .20 | .18 | .03 | −.07 | −.13 |
| DIV4 | .57* | .19 | −.07 | −.23 | −.17 | −.10 | −.03 | .09 | .08 | −.03 | −.04 | −.09 |

1. See note to table 3.

5. Continued

| Lag, $k$ | | | | | |
|---|---|---|---|---|---|
| 13 | 14 | 15 | 16 | 17 | 18 |
| $\sigma = .16$ | | | | | |
| −.03 | .21 | .03 | .06 | .93 | .04 |
| $\sigma = .18$ | | | | | |
| −.16 | .10 | .11 | .16 | .06 | .00 |
| $\sigma = .15$ | | | | | |
| −.10 | .09 | .10 | .20 | .11 | .02 |
| $\sigma = .17$ | | | | | |
| .14 | .16 | .03 | −.05 | .00 | .00 |
| $\sigma = .18$ | | | | | |
| .02 | .19 | .19 | .15 | .08 | .06 |
| $\sigma = .17$ | | | | | |
| .04 | .15 | .17 | .15 | .08 | .03 |
| $\sigma = .16$ | | | | | |
| .06 | .08 | −.03 | −.07 | −.07 | .03 |
| $\sigma = .17$ | | | | | |
| −.01 | .14 | .17 | .15 | .10 | .10 |
| $\sigma = .17$ | | | | | |
| −.02 | .09 | .14 | .14 | .09 | .03 |
| $\sigma = .15$ | | | | | |
| −.19 | −.00 | −.14 | −.01 | .09 | −.08 |
| $\sigma = .18$ | | | | | |
| .01 | .15 | .22 | .22 | .18 | .12 |
| $\sigma = .17$ | | | | | |
| −.00 | .10 | .20 | .26 | .19 | .05 |

MSI4.[45] As in earlier tables, the indexes exhibit properties different from those of the conventional aggregates. Note particularly the significant zero-lag cross correlation of L with GNP, $c_0 = 0.40$, indicating a contemporaneous relationship.

The predominant conclusion of these analyses is that the revised MSI have autocorrelations and cross correlations with GNP similar to those of their old DIV index counterparts.

## Comparisons of the Conventional (Simple-Sum) Monetary Aggregates and the MSI

The annualized monthly growth rates of the conventional aggregates and of their MSI counterparts are plotted in chart 4; chart 5 shows the differences between the growth rates.[46] In general, MSI1 grows ~~less~~ more rapidly than conventional M1; the increasing differences between growth rates are coincident with the sharp rise in interest rates that began in late 1978 and continued into 1981. Barnett and Spindt found almost no difference between these two sets of growth rates.[47] Although the level of the revised index is lower than the old index (see chart 2), the net effect of the revisions is clearly to raise the weights on the more rapidly growing monetary assets in the index and to give relatively greater weight to these components in computing the index than in computing simple-sum M1.

The higher-level indexes tend to grow less rapidly than their conventional, simple-sum counterparts, a result also obtained by Barnett and Spindt. However, their study found that this difference consistently increased as the level of aggregation increased. Our results show that the differences between M3 and

45. Note that a relationship between current innovations of GNP and lagged innovations of the indexes means that the indexes *lead* GNP. A relationship with future innovations of an index indicates that the index also *lags* GNP.

46. The comparisons in this section are based on the conventional aggregates and the MSI incorporating the 1985 seasonal and benchmark revisions.

47. See Barnett and Spindt, *Divisia Monetary Aggregates*, chart 5 and table 3.

MSI3 growth rates and between L and MSI4 growth rates are often virtually indistinguishable. This is undoubtedly because the revised own rates used in computing MSI3 are higher than the old own rates and the own rates on the asset stocks included only in MSI4 (and L) have been revised downward.

The greatest differences between the growth rates of the conventional aggregates and the MSI occur in January 1983, a month in which there were significant deposit innovations. Super NOW accounts were introduced in January 1983, and conventional M1 grew at 8.9 percent. However, since Super NOWs pay higher rates of interest than ordinary NOW accounts (or demand deposits), shifts out of the latter deposit categories into Super NOWs caused the rate of growth in the supply of monetary services (MSI1) to slow to 2.4 percent. This is a reasonable result because using Super NOW balances for transactions is more costly, in terms of interest foregone, than using a NOW account or a demand deposit. In other words, the strong growth in Super NOWs did not contribute much to the growth of monetary services.

Money market deposit accounts were authorized in mid-December 1982. Many institutions initially offered these accounts at rates considerably higher than prevailing market interest rates. As a result, conventional M2, which includes money market deposit accounts, grew sharply at 33.4 percent in January 1983, while MSI2 actually declined 2.4 percent. Again, the result is sensible in view of the low user cost, or marginal contribution to monetary services, of money market deposit accounts. (The decline in measured monetary services is even more evident in MSI3 and MSI4, where monetary assets with the highest marginal contributions to monetary services, such as currency and demand deposits, get relatively smaller weights than they do in MSI2.)

Chart 6 plots quarterly GNP velocities of the conventional monetary aggregates and their MSI counterparts.[48] All the MSI velocities tend to trend upward, particularly from late 1978 through 1981 for the higher-level MSI, while velocities for the higher-level conventional aggregates are relatively flat or trending downward. This period of rising MSI velocities coincides with the period of rapidly rising interest rates noted earlier. Own rates on the

6. Autocorrelations and cross correlations, GNP, aggregates, and indexes[1]

| Series | Autocorrelations of GNP, conventional monetary aggregates, and the new and old indexes[2] | | | | | |
|---|---|---|---|---|---|---|
| | Lag, $k$ | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| GNP .. | .18 | .07 | −.06 | −.03 | −.07 | −.05 |
| M1 .... | .05 | −.01 | .07 | −.18 | .15 | .11 |
| MSI1 .. | −.18 | .01 | .08 | −.26* | .13 | .17 |
| DIV1 .. | −.03 | −.14 | −.03 | −.15 | .16 | .09 |
| M2 .... | .44* | .18 | .07 | −.08 | .03 | −.08 |
| MSI2 .. | .52* | .37* | .41* | .26* | .35* | .21 |
| DIV2 .. | .46* | .27* | .33* | .25 | .34* | .17 |
| M3 .... | .58* | .39* | .21 | .12 | .13 | .02 |
| MSI3 .. | .54* | .42* | .41* | .28* | .35* | .24 |
| DIV3 .. | .47* | .30* | .32* | .26* | .33* | .17 |
| L...... | .55* | .32* | .06 | −.08 | −.11 | −.05 |
| MSI4 .. | .53* | .40* | .40* | .23 | .34* | .20 |
| DIV4 .. | .48* | .32* | .33* | .22 | .31* | .12 |

1. The conventional aggregates are M1, M2, M3, and L. For the monetary services indexes, the index counterparts of the conventional aggregates are MSI1 through MSI4; for the Divisia indexes, the counterparts are DIV1 through DIV4. The L-level series end in the first quarter of 1984. Asterisks indicate significant autocorrelations ($|r_k| \geq 2\sigma$ for $\alpha = 0.05$) and cross correlations ($|c_k| \geq 2\sigma$ for $\alpha = 0.05$). For all $r_k$ and $c_k$, $\sigma = 0.13$.
2. Series are annualized quarterly average growth rates.

48. For this exercise, each index was multiplied by the January 1970 level of the corresponding conventional monetary aggregate so that velocity levels would be of familiar magnitudes. Thus, the levels of the corresponding conventional aggregates and indexes are equal in January 1970.

Barnett and Spindt appeared to show far greater divergences between the velocities of the higher level aggregates (M2 through L) and their index counterparts than is evident in chart 6 (see Barnett and Spindt, *Divisia Monetary Aggregates*, charts 10 through 12). At least two nonsubstantive factors contribute to this result: (1) Barnett and Spindt chose to normalize the velocities to equal 1 in the first quarter of 1969. If the velocities plotted in chart 6 are normalized to equal 1 in the first quarter of 1970, divergences between conventional aggregate and index velocities appear to be greater. (2) The scales of the panels in chart 6 that plot the velocities of the higher-level aggregates are constrained to be the same so that visual comparisons among these panels are not distorted; the scales of the charts in Barnett and Spindt differ from aggregate to aggregate so that visual comparisons among charts are misleading. It appears that the revised indexes show less divergence between the velocities of L and MSI4 than the old indexes; this is probably due to the nature of the own rate revisions, discussed above in connection with growth rate differences.

## 6. Continued

Cross correlations ($c_k$) of innovations of GNP with the innovations of conventional monetary aggregates and of the new and old indexes[3]

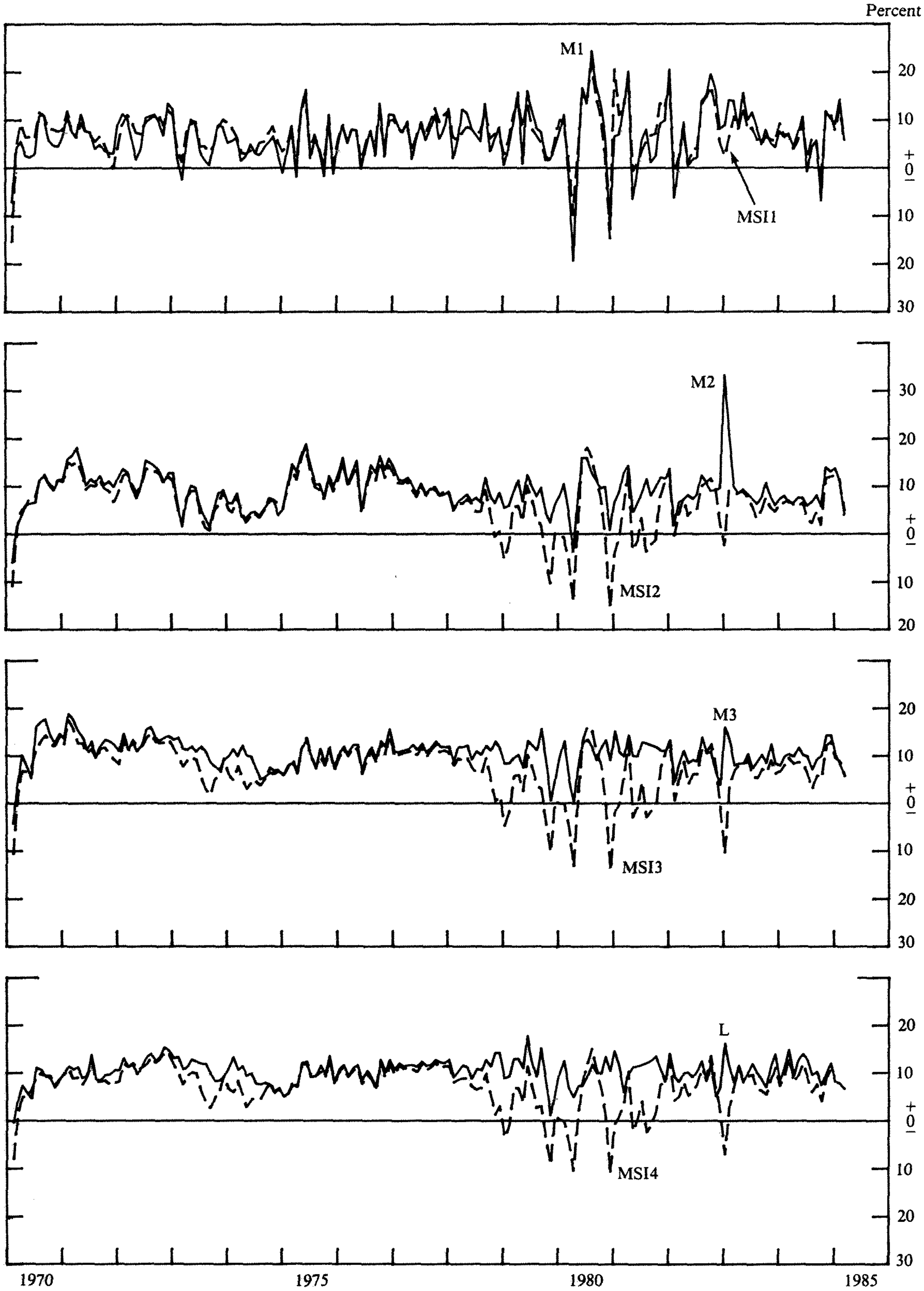
| Past values of money | | | | | | | Future values of money | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| −6 | −5 | −4 | −3 | −2 | −1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| .09 | −.08 | .06 | −.14 | .24 | .31* | .20 | −.18 | −.12 | −.30* | .02 | −.04 | −.23 |
| .01 | −.18 | −.10 | −.24 | .33* | .15 | .04 | −.15 | .14 | −.18 | .21 | .06 | −.24 |
| .04 | −.15 | −.14 | −.14 | .32* | .20 | .14 | −.14 | .02 | −.22 | .16 | .16 | −.21 |
| .14 | −.03 | .09 | −.10 | .25 | .21 | −.02 | −.26* | −.16 | −.12 | −.12 | −.16 | −.01 |
| .14 | .06 | .09 | −.09 | .32* | .16 | −.13 | −.42* | −.07 | −.28* | −.09 | .01 | −.09 |
| .13 | .04 | .09 | −.04 | .33* | .17 | −.08 | −.34* | −.01 | −.28* | −.01 | −.02 | −.16 |
| .06 | −.02 | −.12 | −.30* | .31* | .17 | .18 | −.16 | .04 | .01 | −.01 | .03 | −.06 |
| .12 | .08 | .07 | −.05 | .34* | .13 | −.13 | −.23 | .03 | −.31* | .04 | .04 | −.25 |
| .07 | .05 | .05 | −.04 | .36* | .14 | −.05 | −.23 | .05 | −.31* | .05 | .02 | −.22 |
| .15 | −.11 | −.21 | −.20 | .18 | .15 | .40* | −.03 | .18 | −.01 | .12 | −.10 | −.09 |
| .17 | .10 | .07 | −.03 | .33* | .11 | −.07 | −.30* | .03 | −.33* | .13 | −.03 | −.20 |
| .12 | .05 | .04 | −.00 | .37* | .13 | .01 | −.22 | .07 | −.34* | .07 | −.05 | −.28* |

3. Data are innovations of the relevant series (see text).

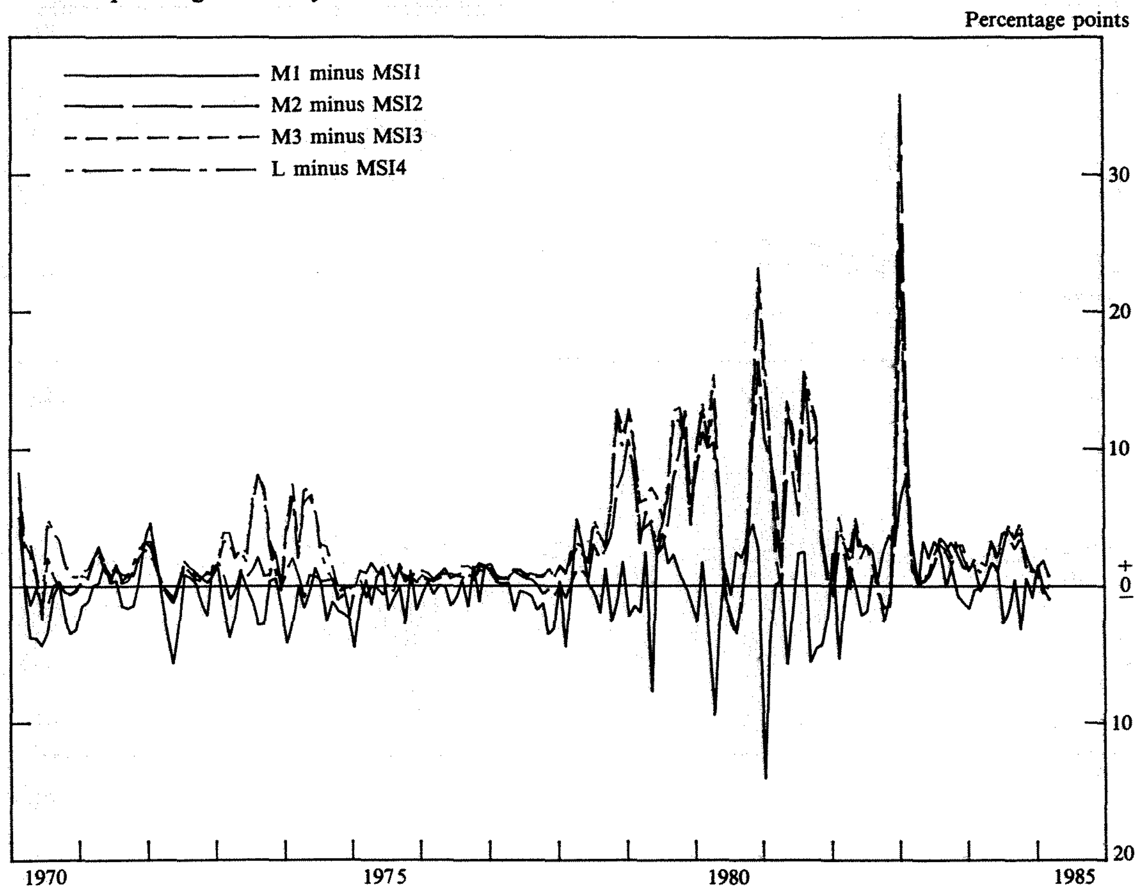
## 7. ARIMA models and their standard errors

| Model | Standard error, $\sigma_a$ |
|---|---|
| $GNP_t = 9.41 + a_t$ | 4.56 |
| $M1_t = 6.79 + a_t$ | 3.24 |
| $MSI1_t = -0.27\ MSI1_{t-4} + 9.34 + a_t$ | 2.54 |
| $DIV1_t = 7.34 + a_t$ | 2.68 |
| $M2_t = 0.45\ M2_{t-1} + 5.29 + a_t$ | 2.95 |
| $MSI2_t = 0.45\ MSI2_{t-1} + 3.87 + a_t + 0.28\ a_{t-3} + 0.35\ a_{t-5}$ | 3.63 |
| $DIV2_t = 0.40\ DIV2_{t-1} + 4.34 + a_t + 0.37\ a_{t-5}$ | 3.66 |
| $M3_t = 0.59\ M3_{t-1} + 4.49 + a_t$ | 1.80 |
| $MSI3_t = 0.48\ MSI3_{t-1} + 3.83 + a_t + 0.42\ a_{t-5}$ | 3.60 |
| $DIV3_t = 0.43\ DIV3_{t-1} + a_t + 0.51\ a_{t-5}$ | 3.43 |
| $L_t = 0.55\ L_{t-1} + 4.64 + a_t$ | 1.48 |
| $MSI4_t = 0.47\ MSI4_{t-1} + 3.76 + a_t + 0.20\ a_{t-3} + 0.40\ a_{t-5}$ | 3.60 |
| $DIV4_t = 0.45\ DIV4_{t-1} + 3.97 + a_t + 0.45\ a_{t-5}$ | 3.00 |

4. Growth rates of the conventional monetary aggregates and the monetary services indexes



5. Differences between the growth rates of the conventional monetary aggregates and their corresponding monetary services indexes




asset stocks used in computing the MSI would rise with market rates, except for asset stocks with an own rate that was zero or ceiling bound; in that case, the growth in the supply of monetary services as measured by the MSI would slow. The following table lists the correlations of the quarterly MSI and simple-sum velocities with the quarterly average level of the interest rate on three-year Treasury notes for the period 1970:1 through 1985:1. It shows that the MSI velocities (VMSI) are highly correlated with the level of interest rates as represented by the rate on three-year Treasury notes. In contrast, only the velocity of simple-sum M1 (VM1)—virtually identical to VMSI1—is highly correlated with the interest rate level. The correlation of the velocities of other simple-sum aggregates declines steadily, and M3 and L velocities (VM3 and VL) are actually negatively correlated with the level of interest rates.

The comparisons of the conventional aggregates and the MSI in charts 4 through 6

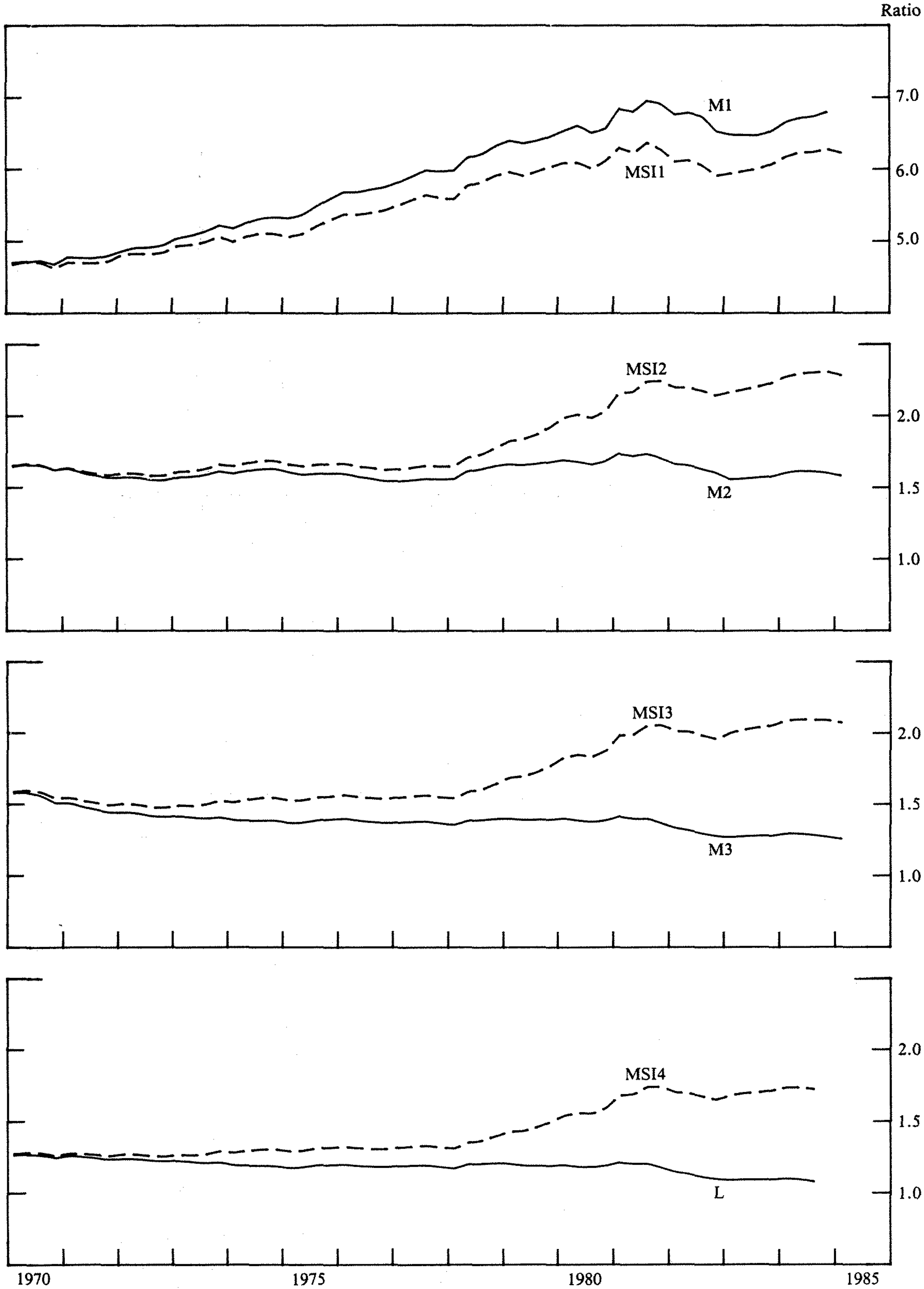
| MSI velocity and correlation | | Simple-sum velocity and correlation | |
|---|---|---|---|
| VMSI1 | 0.85 | VM1 | 0.85 |
| VMSI1 | 0.90 | VM2 | 0.67 |
| VMSI3 | 0.98 | VM3 | −0.48 |
| VMSI4 | 0.91* | VL | −0.55* |

*Data were available only through 1984:4.

serve to highlight some of the differences between simple-sum aggregates and the indexes when both are defined over the same set of asset stocks. They also provide some further information on the properties of the revised indexes and the Divisia indexes presented in the Barnett and Spindt study.

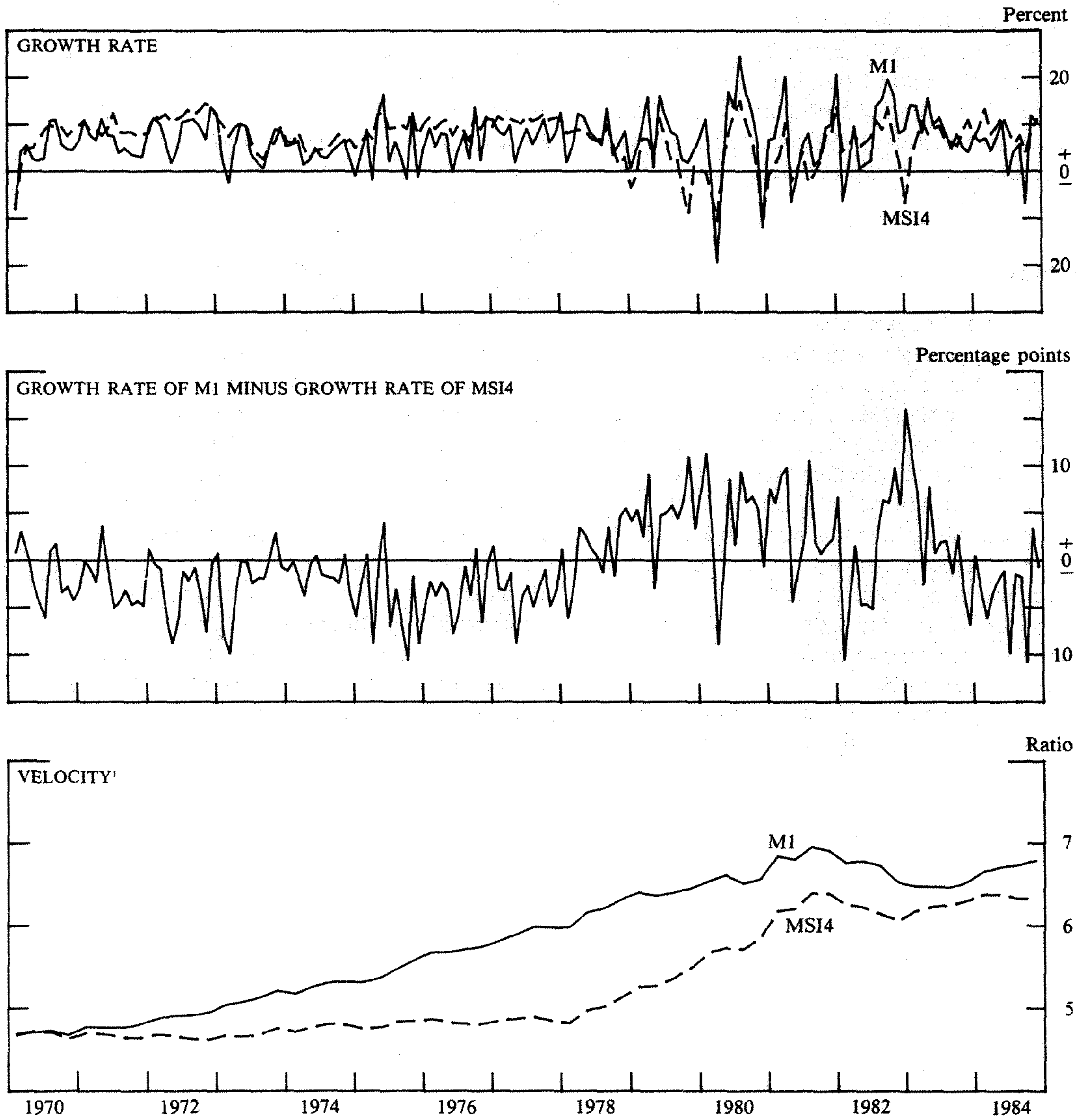
Perhaps a more interesting comparison is between what might be considered a conventional definition of money, M1, with our most inclusive definition of available monetary services, MSI4. The top panel of chart 7 plots the annualized monthly growth rates of M1 and

6. Velocities of the conventional monetary aggregates and the monetary services indexes[1]




1. In order to compare the velocities of the aggregates and the indexes, each MSI was multiplied by the January 1970 level of its corresponding conventional monetary aggregate so that the units of each pair would be comparable.

7. Comparisons between M1 and MSI4




1. The M1 velocity is the same as that plotted in the top panel of chart 6. In order to compare the velocities, MSI4 was multiplied by the January 1970 level of M1 so that the units of M1 and MSI4 would be comparable.

MSI4, and the middle panel plots the differences between the growth rates of the two series. For periods before 1979, the growth rates of MSI4 follow the general pattern of M1 growth rates, although they are noticeably less volatile and generally higher. After 1979, MSI4 growth rates continue to follow the general pattern of M1 growth rates, although the volatility of both series increases, and MSI4 growth rates are, in general, lower than M1 growth rates. The greatest difference between the two series occurs in January 1983 and can be largely accounted for, as noted above, by the introduction of Super NOWs and money market deposit accounts. The correlation between the two growth-rate series is 0.66 before 1979 and 0.86 from 1979 through 1984.

The bottom panel of chart 7 plots quarterly GNP velocities. As seen earlier in chart 6, M1 velocity trends upward fairly steadily over the whole time span (1970:1 through 1984:4) with the notable exception of a sizable decline at the end of 1982. In contrast, MSI4 velocity is relatively flat until the second quarter of 1978, when it begins to rise, steadily approaching the level of M1 velocity. From mid-1980 on, the two velocities behave quite similarly, except that the MSI4 velocity rebounds earlier from the drop at the end of 1982. Over the whole time span, the two velocity series have a correlation of 0.88.

## Summary

The data used to compute the indexes of the monetary aggregates were revised to restore the consistency of the data with the original concepts and principles underlying the indexes. Data on both monetary asset stocks and own rates were affected. Further, changes were made in computational methodology: the Fisher ideal index formula was substituted for the Divisia index formula, and the conversion of discount-basis interest rates to yields was improved. Finally, the indexes were given the new, more informative name of monetary services indexes (MSI).

In keeping with the primary purpose of the paper—to serve as a basic reference for the MSI data—we conducted only a limited analysis of the properties of the new (monetary services) and the old (Divisia) indexes. The analysis (1) highlighted the sources of the differences between the two sets of indexes, (2) showed through autocorrelation and cross correlation analyses that there are similarities in the properties of the new and old indexes, and (3) compared some of the properties of the conventional monetary aggregates with those of the new indexes. The comparison of conventional aggregates and new indexes proved to be similar to, though somewhat different from, the comparison of the aggregates with the old indexes as presented in the original staff study, by Barnett and Spindt. The comparisons between a conventional definition of money, M1, and our broadest index of monetary services, MSI4, showed some differences between these alternative measures of money, but also broad similarities as reflected in high correlations of growth rates and of velocities. More detailed anlayses will be needed to draw further inferences about the effects of the revisions in the indexes and the properties of alternative measures of money.

## Appendix A

### Adjusting MYCACs on small time deposits at banks and thrift institutions for the presence of all savers certificates

Between October 1981 and December 1982, banks and thrifts were authorized to issue all savers certificates (ASC). Interest on these certificates of up to $1,000 per owner was tax exempt. The certificates had a maturity of one year and an annual investment yield equal to 70 percent of the average investment yield for 52-week Treasury bills as determined by the auction immediately preceding the calendar week in which the ASC was issued.

With the introduction of ASCs, it was felt that some adjustment to the MYCACs on small time deposits was needed to reflect the after-tax yield on these certificates.[49] Because much important information relating to these instruments was unavailable, we had to make several assumptions and approximations.

By definition, the investment yield to which the ASC yield was tied lies on the Treasury yield curve. The ASC yield was 70 percent of the yield on 52-week Treasury bills ($y_{52}$); if all taxpayers were in the 30 percent marginal tax bracket, the MYCAC for small time deposits would be the same whether or not the ASC rate were explicitly considered. That is,

$$y_{52} = 0.7\left(\frac{y_{52}}{1 - 0.3}\right).$$

However, not all taxpayers are in the 30 percent marginal tax bracket. It did not pay those in lower marginal tax brackets to hold ASCs; further, the after-tax investment yield on an ASC for those in higher marginal tax brackets was higher than the rate lying on the Treasury yield curve:

$$0.7\left(\frac{y_{52}}{1 - \beta}\right) > y_{52} \text{ for } \beta > 0.3.$$

Thus, an estimate is needed of the percentage, $\alpha$, of taxpayers falling into marginal tax brackets of 30 percent or higher and of the average marginal tax rate, $\beta$, of those taxpayers. An initial approximation for the MYCAC, *RMYCAC*, adjusted for the existence of ASCs, $RMYCAC^A$, is as follows:

$$\text{(A.1)} \quad RMYCAC^A = (1 - \alpha)RMYCAC + \frac{0.7\alpha RMYCAC}{1 - \beta}.$$

That is, $(1 - \alpha)$ percent could earn *RMYCAC* while $\alpha$ percent could earn a higher after-tax yield. Note that if $\beta$ is 0.3, at which marginal tax rate one is indifferent between holding and not holding an ASC, then $RMYCAC^A$ equals *RMYCAC*. Rough estimates using the latest data available at the time from the Treasury Department's Statistics of Income put $\alpha$ at 0.55 and $\beta$ at 0.44.

We assumed that all the taxpayers who could benefit from holding an ASC, $\alpha$ percent, bought one. Since *RMYCAC* is a measure of the return available on new flows of time deposits, the above adjustment would have been made only for October 1981 if all $\alpha$ percent had bought a certificate that month. However, although a large percentage of total ASCs issued were issued in the first few months that they were available, purchases were distributed over time.

We also assumed that all purchases of ASCs were made during the first year in which they were offered.[50] Thus, ignoring possible early redemptions and interest crediting that may have been included in the data (because we could not extract these), the outstanding stock at the end of September 1982 represented 100 percent of all certificates issued. To adjust the commercial bank *RMYCAC*, commercial bank data on outstanding ASCs were used; for the thrift institution rate, data for FSLIC-insured institutions were used.[51]

49. MYCAC is the acronym for the maximum yield-curve-adjusted rate for a composite asset. See main text for a description.

50. Because ASCs were offered for a total of fifteen months, those who bought one during the first three months might have bought a new one at the end of a year if they had not already earned their tax-exempt $1,000. The data on the outstanding stock of ASCs at commercial banks and at savings banks, published in special supplementary tables to various releases of Board of Governors, *Money Stock*, included interest crediting as well as new issues. It was decided that the "new issues" implied by the data for October through December 1982 were more likely interest crediting.

51. These data are available in the monthly statistical release of the Federal Home Loan Bank Board, *Thrift Institution Activity*.

Finally, we assumed that the month-to-month changes in the outstanding stock of ASCs represented purchases of new certificates. This again ignores the possible effects of early redemption and interest crediting.

Using data on the "final" stock of ASCs, we obtained an estimate of the volume of ASCs issued in each month, $t$, as a percentage of the total volume of ASCs issued. Assuming that this percentage was purchased by $\delta_t$ percent of the relevant $\alpha$ percent of taxpayers, then, in month $t+1$, the ASC rate was available to only $(\alpha - \delta_t\alpha)$ percent of the population.[52] Thus, equation A.1 was modified as follows:

At the beginning of October 1981 all $\alpha$ percent of the population could potentially receive the ASC rate. Thus, $RMYCAC^A$ for October was computed using equation A.1 as it stands.

At the beginning of November the ASC rate was available to $(\alpha - \delta_1\alpha)$ percent. Thus, the relevant equation for November was:

52. This also assumes that each purchaser of an ASC bought one that yielded the full $1,000 of tax-exempt interest.

$$\text{(A.2)}\quad RMYCAC^A = [1 - (\alpha - \delta_1\alpha)]RMYCAC + \frac{0.7(\alpha - \delta_1\alpha)RMYCAC}{1-\beta}.$$

Similarly, in December 1981 the ASC rate was available to the remaining $(\alpha - \delta_1\alpha - \delta_2\alpha)$ percent of potential holders, and the relevant equation for December was:

$$\text{(A.3)}\quad RMYCAC^A = [1 - (\alpha - \delta_1\alpha - \delta_2\alpha)]RMYCAC + \frac{0.7(\alpha - \delta_1\alpha - \delta_2\alpha)RMYCAC}{1-\beta}.$$

Thus, the general equation $(1 \leq i \leq 11)$ is

$$\text{(A.4)}\quad RMYCAC^A_{t+i} = [1 - (\alpha - \sum_{j=0}^{i-1}\delta_{t+j}\alpha)]RMYCAC_{t+i} + \frac{0.7(\alpha - \sum_{j=0}^{i-1}\delta_{t+j}\alpha)RMYCAC_{t+i}}{1-\beta}.$$

## Appendix B

### Determination of the Yield on Series EE Savings Bonds

In November 1982 the Treasury Department issued the first Series EE Bonds to pay a market-based variable rate of interest. The yield on these bonds is based on an average of ten six-month-average rates that is compounded semiannually. The six-month-average rates are, in turn, based on rates on Treasury securities. The calculation is made as follows.

(1) Each day, an average is computed of the rates for all Treasury securities (if any) that have exactly five years remaining to maturity. (The time remaining to maturity is the relevant measure, not the original maturity.) If there is no rate for a given day, the average rate for the closest day is used.

(2) Six-month periods are defined as either November 1 through April 30 or May 1 through October 31. An average of all daily averages is computed for each six-month period. The rate so determined is then in effect for the *next* six months.

(3) The first six-month-average rate used to compute the eventual yield on a savings bond is that determined over the most recently completed six-month period. For example, if the bond is issued January 1, 1984, the most recently completed six-month period is May 1, 1983, through October 31, 1983. The six-month-average rate computed for this period is, therefore, the first of the ten six-month-average rates that will be used to calculate the yield at maturity.

(4) At the end of the tenth period, the ten six-month-averages are averaged. This new "global" average is multiplied by 85 percent, rounded to the nearest 1/4 percent and compounded semiannually. This is the yield if a bond is retired after five years.

(5) If the bond is held longer than five years, the number of six-month periods averaged to derive the interest rate is twice the number of years the bond is held. Again the global average is multiplied by 85 percent, rounded to the nearest 1/4 percent and compounded semiannually.

(6) If the final interest rate (before compounding but after rounding to the nearest 1/4 percent) is less than 7.5 percent, the bond will pay 7.5 percent compounded semiannually.

Because the yield on a currently purchased savings bond is determined by the future course of interest rates, the most any purchaser knows at the time of purchase is the current six-month-average rate—the first of ten (or more) average rates that will eventually determine the return on the bond.

For purposes of MSI computations, we use only the current six-month-average rate as an estimate of the unknown yield on savings bonds rather than develop an estimate of expected future rates such as the schedule of expected forward rates implicit in the term structure.

## Appendix C
Historical data for the monetary services indexes[1]

| Year and month | Level | | | | Annualized growth rate | | | |
|---|---|---|---|---|---|---|---|---|
| | MSI1 | MSI2 | MSI3 | MSI4 | MSI1 | MSI2 | MSI3 | MSI4 |
| *1970* | | | | | | | | |
| January | 100.0 | 100.0 | 100.0 | 100.0 | ... | ... | ... | ... |
| February | 98.7 | 99.1 | 99.1 | 99.3 | -15.3 | -10.8 | -10.6 | -8.0 |
| March | 99.1 | 99.2 | 99.3 | 99.4 | 4.7 | 1.1 | 1.8 | 1.3 |
| April | 99.9 | 99.6 | 99.8 | 99.9 | 9.4 | 5.0 | 6.8 | 4.9 |
| May | 100.4 | 100.1 | 100.4 | 100.3 | 6.4 | 6.2 | 6.6 | 5.0 |
| June | 101.0 | 100.8 | 101.0 | 100.8 | 6.6 | 7.9 | 7.6 | 6.6 |
| July | 101.5 | 101.4 | 101.9 | 101.6 | 6.3 | 7.8 | 11.1 | 9.0 |
| August | 102.5 | 102.4 | 103.1 | 102.4 | 11.6 | 11.2 | 13.2 | 9.9 |
| September | 103.4 | 103.4 | 104.3 | 103.2 | 10.9 | 12.2 | 14.4 | 9.3 |
| October | 104.1 | 104.4 | 105.4 | 104.0 | 8.2 | 10.7 | 12.8 | 9.4 |
| November | 104.8 | 105.2 | 106.5 | 104.7 | 8.2 | 9.7 | 11.9 | 7.5 |
| December | 105.5 | 106.2 | 107.7 | 105.4 | 7.6 | 11.4 | 14.0 | 8.7 |
| *1971* | | | | | | | | |
| January | 106.2 | 107.2 | 108.8 | 106.3 | 7.9 | 10.9 | 12.5 | 9.5 |
| February | 107.2 | 108.5 | 110.4 | 107.2 | 11.9 | 15.0 | 17.6 | 10.9 |
| March | 107.9 | 109.8 | 111.9 | 108.0 | 7.6 | 14.4 | 15.8 | 8.8 |
| April | 108.5 | 111.2 | 113.1 | 108.8 | 6.3 | 15.3 | 12.6 | 9.0 |
| May | 109.3 | 112.4 | 114.2 | 109.5 | 9.5 | 13.0 | 12.6 | 7.6 |
| June | 110.0 | 113.3 | 115.2 | 110.3 | 7.5 | 9.4 | 10.4 | 9.1 |
| July | 110.7 | 114.3 | 116.3 | 111.5 | 7.0 | 10.3 | 11.4 | 12.5 |
| August | 111.2 | 115.2 | 117.2 | 112.3 | 5.5 | 9.9 | 9.3 | 8.4 |
| September | 111.8 | 116.3 | 118.3 | 113.0 | 6.5 | 11.4 | 11.5 | 8.1 |
| October | 112.3 | 117.2 | 119.5 | 113.8 | 5.2 | 9.6 | 11.8 | 8.4 |
| November | 112.5 | 118.1 | 120.5 | 114.5 | 2.9 | 9.1 | 10.3 | 7.5 |
| December | 112.5 | 118.8 | 121.5 | 115.3 | -.2 | 6.7 | 9.1 | 7.9 |
| *1972* | | | | | | | | |
| January | 113.0 | 119.6 | 122.3 | 116.0 | 4.7 | 8.6 | 8.1 | 8.1 |
| February | 113.8 | 120.8 | 123.6 | 117.2 | 9.2 | 12.2 | 13.1 | 11.8 |
| March | 114.9 | 122.1 | 124.7 | 118.3 | 11.1 | 12.7 | 11.0 | 11.2 |
| April | 115.8 | 123.2 | 126.1 | 119.5 | 9.8 | 10.5 | 13.4 | 12.1 |
| May | 116.5 | 124.1 | 127.4 | 120.5 | 7.4 | 8.7 | 11.8 | 10.6 |
| June | 117.2 | 125.1 | 128.6 | 121.6 | 7.1 | 10.1 | 12.0 | 11.1 |
| July | 118.2 | 126.6 | 130.1 | 122.8 | 9.6 | 13.6 | 13.8 | 11.7 |
| August | 119.2 | 128.0 | 131.7 | 124.2 | 10.3 | 13.5 | 14.6 | 13.1 |
| September | 120.3 | 129.4 | 133.1 | 125.4 | 11.0 | 13.1 | 12.9 | 12.0 |
| October | 121.4 | 130.7 | 134.5 | 126.8 | 10.7 | 12.6 | 12.6 | 12.9 |
| November | 122.3 | 131.9 | 136.0 | 128.3 | 9.0 | 10.7 | 12.8 | 14.4 |
| December | 123.5 | 133.2 | 137.5 | 129.8 | 12.1 | 12.1 | 13.2 | 13.9 |
| *1973* | | | | | | | | |
| January | 124.6 | 134.5 | 138.8 | 131.0 | 11.0 | 11.1 | 11.4 | 11.5 |
| February | 125.0 | 135.0 | 139.9 | 132.1 | 3.8 | 5.2 | 9.9 | 10.0 |
| March | 125.2 | 135.3 | 140.8 | 132.9 | 1.3 | 2.4 | 7.6 | 7.4 |
| April | 125.9 | 136.2 | 141.9 | 133.9 | 7.4 | 7.5 | 8.9 | 9.2 |
| May | 126.9 | 137.2 | 143.0 | 135.1 | 9.1 | 9.1 | 9.6 | 10.1 |
| June | 127.9 | 138.2 | 144.1 | 136.2 | 9.7 | 9.0 | 9.2 | 9.8 |
| July | 128.4 | 138.7 | 144.8 | 136.8 | 4.5 | 4.4 | 5.6 | 5.9 |
| August | 128.9 | 138.9 | 145.1 | 137.2 | 4.6 | 1.4 | 2.8 | 3.6 |
| September | 129.2 | 139.0 | 145.3 | 137.5 | 3.3 | .7 | 1.7 | 2.5 |
| October | 129.7 | 139.5 | 145.9 | 138.1 | 4.7 | 4.6 | 4.9 | 4.8 |
| November | 130.6 | 140.2 | 146.6 | 138.8 | 8.5 | 6.0 | 5.8 | 6.2 |
| December | 131.8 | 141.3 | 147.8 | 139.9 | 10.2 | 9.3 | 9.5 | 9.3 |

1. Revisions and more recent data are available in monthly reports released since March 1985. To obtain these reports, see text note 3.

Historical data for the monetary services indexes—continued

| Year and month | Level | | | | Annualized growth rate | | | |
|---|---|---|---|---|---|---|---|---|
| | MSI1 | MSI2 | MSI3 | MSI4 | MSI1 | MSI2 | MSI3 | MSI4 |
| *1974* | | | | | | | | |
| January | 132.8 | 141.9 | 148.5 | 140.6 | 9.5 | 5.3 | 5.9 | 6.5 |
| February | 133.7 | 142.4 | 149.1 | 141.3 | 8.4 | 4.5 | 4.9 | 5.8 |
| March | 134.5 | 143.4 | 150.1 | 142.3 | 6.5 | 7.8 | 7.8 | 8.2 |
| April | 134.8 | 143.9 | 150.7 | 142.9 | 3.1 | 4.6 | 5.2 | 5.3 |
| May | 135.1 | 144.2 | 151.1 | 143.2 | 2.9 | 2.3 | 2.9 | 2.8 |
| June | 135.6 | 144.6 | 151.7 | 143.8 | 3.7 | 3.8 | 4.4 | 4.5 |
| July | 135.9 | 145.2 | 152.3 | 144.3 | 3.0 | 4.4 | 4.8 | 4.7 |
| August | 136.5 | 145.6 | 152.7 | 144.9 | 5.3 | 3.4 | 3.7 | 4.6 |
| September | 137.1 | 146.2 | 153.4 | 145.6 | 5.6 | 5.0 | 5.1 | 6.3 |
| October | 137.9 | 147.1 | 154.3 | 146.6 | 7.2 | 7.5 | 7.5 | 7.9 |
| November | 139.0 | 148.0 | 155.2 | 147.3 | 8.8 | 7.1 | 6.7 | 6.0 |
| December | 139.6 | 148.7 | 156.1 | 148.2 | 5.4 | 6.2 | 7.1 | 6.8 |
| *1975* | | | | | | | | |
| January | 140.0 | 149.4 | 156.9 | 148.8 | 3.5 | 5.4 | 5.8 | 5.0 |
| February | 140.5 | 150.5 | 157.9 | 149.5 | 4.6 | 9.1 | 7.6 | 5.7 |
| March | 141.5 | 152.3 | 159.1 | 150.5 | 8.5 | 13.8 | 9.3 | 8.3 |
| April | 141.5 | 153.7 | 159.9 | 151.4 | −.5 | 11.3 | 6.2 | 6.9 |
| May | 142.8 | 155.7 | 161.5 | 152.9 | 11.2 | 15.6 | 11.6 | 12.0 |
| June | 144.6 | 158.0 | 163.3 | 154.5 | 15.0 | 18.0 | 13.8 | 12.4 |
| July | 145.0 | 159.8 | 164.6 | 155.6 | 3.8 | 13.2 | 9.8 | 9.1 |
| August | 145.9 | 161.1 | 165.7 | 156.8 | 7.0 | 9.8 | 7.7 | 9.3 |
| September | 146.3 | 162.3 | 167.1 | 158.2 | 3.6 | 9.2 | 9.8 | 10.1 |
| October | 146.4 | 163.3 | 168.1 | 159.3 | 1.0 | 7.2 | 7.8 | 8.9 |
| November | 147.7 | 164.9 | 169.7 | 161.0 | 10.1 | 11.5 | 11.2 | 12.9 |
| December | 147.7 | 166.1 | 170.7 | 162.1 | .5 | 8.8 | 7.0 | 7.6 |
| *1976* | | | | | | | | |
| January | 148.5 | 167.7 | 172.1 | 163.4 | 6.0 | 11.7 | 9.6 | 10.2 |
| February | 149.5 | 169.8 | 173.7 | 165.0 | 8.8 | 15.1 | 11.6 | 11.4 |
| March | 150.3 | 171.2 | 175.2 | 166.2 | 5.9 | 10.0 | 9.8 | 9.0 |
| April | 151.3 | 172.9 | 176.8 | 167.7 | 8.1 | 12.2 | 11.5 | 10.4 |
| May | 152.3 | 175.0 | 178.5 | 169.2 | 7.8 | 14.2 | 11.4 | 10.9 |
| June | 152.4 | 175.6 | 179.4 | 170.3 | 1.3 | 4.2 | 6.0 | 7.5 |
| July | 153.1 | 177.0 | 180.8 | 171.6 | 5.4 | 9.4 | 9.3 | 9.7 |
| August | 154.1 | 178.9 | 182.4 | 172.9 | 7.4 | 13.1 | 10.8 | 8.6 |
| September | 154.6 | 180.6 | 183.7 | 173.8 | 4.1 | 11.3 | 8.5 | 6.3 |
| October | 156.2 | 182.9 | 185.7 | 175.6 | 12.1 | 15.2 | 12.5 | 12.3 |
| November | 156.6 | 184.7 | 187.3 | 176.9 | 3.5 | 11.7 | 10.4 | 8.9 |
| December | 157.9 | 186.9 | 189.5 | 178.6 | 9.7 | 14.4 | 14.3 | 11.6 |
| *1977* | | | | | | | | |
| January | 159.2 | 188.8 | 191.0 | 180.0 | 10.1 | 12.3 | 9.7 | 9.6 |
| February | 160.3 | 190.5 | 192.7 | 181.7 | 8.4 | 10.8 | 10.2 | 11.7 |
| March | 161.3 | 192.2 | 194.3 | 183.4 | 7.4 | 10.6 | 10.5 | 10.8 |
| April | 162.6 | 194.0 | 196.1 | 185.1 | 9.6 | 11.2 | 10.7 | 11.1 |
| May | 163.1 | 195.5 | 197.9 | 186.7 | 3.7 | 9.4 | 11.1 | 10.6 |
| June | 164.0 | 196.7 | 199.6 | 188.3 | 6.6 | 7.7 | 10.0 | 10.1 |
| July | 165.3 | 198.4 | 201.5 | 190.1 | 9.6 | 10.1 | 11.8 | 11.8 |
| August | 166.2 | 199.7 | 203.1 | 191.8 | 6.6 | 8.0 | 9.8 | 10.6 |
| September | 167.6 | 201.3 | 205.0 | 193.6 | 9.9 | 9.5 | 11.1 | 11.1 |
| October | 169.3 | 202.9 | 207.1 | 195.6 | 12.4 | 9.9 | 12.4 | 12.2 |
| November | 170.7 | 204.3 | 209.0 | 197.3 | 9.6 | 8.2 | 10.6 | 11.0 |
| December | 172.2 | 205.8 | 210.9 | 199.2 | 11.0 | 8.9 | 11.1 | 11.3 |

Historical data for the monetary services indexes—continued

| Year and month | Level | | | | Annualized growth rate | | | |
|---|---|---|---|---|---|---|---|---|
| | MSI1 | MSI2 | MSI3 | MSI4 | MSI1 | MSI2 | MSI3 | MSI4 |
| *1978* | | | | | | | | |
| January | 174.0 | 207.4 | 212.8 | 201.1 | 12.1 | 8.8 | 10.6 | 11.2 |
| February | 174.9 | 208.3 | 214.1 | 202.4 | 6.4 | 5.7 | 7.8 | 8.0 |
| March | 175.7 | 209.5 | 215.8 | 203.9 | 5.7 | 6.5 | 9.5 | 8.5 |
| April | 176.8 | 210.6 | 217.4 | 205.3 | 7.4 | 6.4 | 8.8 | 8.8 |
| May | 178.1 | 211.9 | 219.1 | 206.8 | 8.6 | 7.3 | 9.4 | 8.8 |
| June | 179.3 | 213.0 | 220.5 | 208.1 | 8.2 | 6.4 | 7.4 | 7.0 |
| July | 180.4 | 213.8 | 221.6 | 209.2 | 7.4 | 4.6 | 6.3 | 6.4 |
| August | 181.5 | 214.6 | 222.8 | 210.4 | 7.5 | 4.6 | 6.3 | 6.8 |
| September | 183.4 | 216.3 | 224.6 | 212.1 | 12.2 | 9.2 | 9.5 | 9.9 |
| October | 184.3 | 217.1 | 225.5 | 213.0 | 6.1 | 4.4 | 4.9 | 5.2 |
| November | 185.4 | 217.0 | 225.6 | 213.2 | 7.1 | -.6 | .4 | 1.3 |
| December | 186.5 | 217.1 | 225.8 | 213.8 | 6.8 | .6 | 1.4 | 3.0 |
| *1979* | | | | | | | | |
| January | 186.9 | 216.1 | 224.9 | 213.1 | 2.9 | -5.2 | -4.7 | -3.6 |
| February | 187.8 | 215.7 | 224.6 | 213.0 | 5.9 | -2.3 | -2.0 | -1.0 |
| March | 189.6 | 216.7 | 225.7 | 214.2 | 11.3 | 5.6 | 5.8 | 6.9 |
| April | 191.7 | 217.8 | 226.8 | 215.4 | 13.4 | 5.9 | 5.9 | 6.7 |
| May | 193.1 | 218.2 | 227.3 | 216.1 | 8.5 | 2.5 | 2.7 | 3.7 |
| June | 195.3 | 220.1 | 229.2 | 218.1 | 13.9 | 10.2 | 10.1 | 11.4 |
| July | 196.6 | 221.4 | 230.6 | 219.4 | 8.2 | 7.2 | 7.3 | 7.0 |
| August | 197.7 | 222.0 | 231.3 | 219.8 | 6.7 | 3.2 | 3.7 | 2.5 |
| September | 198.6 | 222.3 | 231.9 | 220.4 | 5.2 | 1.8 | 2.9 | 3.1 |
| October | 198.8 | 221.4 | 231.1 | 219.7 | 1.5 | -5.1 | -4.2 | -3.7 |
| November | 199.1 | 219.5 | 229.1 | 218.0 | 1.7 | -10.4 | -10.3 | -9.2 |
| December | 200.1 | 219.5 | 229.2 | 218.2 | 5.7 | .1 | .4 | 1.1 |
| *1980* | | | | | | | | |
| January | 201.7 | 219.4 | 229.1 | 218.3 | 10.0 | -.6 | -.2 | .1 |
| February | 203.3 | 219.3 | 229.1 | 218.2 | 9.4 | -.7 | -.2 | -.2 |
| March | 203.6 | 218.3 | 228.2 | 217.4 | 1.5 | -5.4 | -4.9 | -4.3 |
| April | 201.9 | 215.7 | 225.6 | 215.5 | -10.0 | -14.2 | -13.4 | -10.5 |
| May | 202.5 | 215.9 | 225.9 | 215.8 | 3.4 | 1.2 | 1.5 | 1.3 |
| June | 205.1 | 218.8 | 228.4 | 217.2 | 15.6 | 16.3 | 13.4 | 8.2 |
| July | 207.5 | 222.2 | 231.5 | 219.4 | 14.2 | 18.2 | 16.1 | 11.8 |
| August | 211.3 | 225.1 | 234.4 | 222.1 | 22.0 | 16.1 | 15.1 | 15.1 |
| September | 213.9 | 227.4 | 236.5 | 224.1 | 14.8 | 11.8 | 10.4 | 10.7 |
| October | 215.8 | 228.8 | 238.0 | 225.4 | 10.4 | 7.5 | 8.1 | 6.8 |
| November | 216.1 | 228.7 | 238.0 | 225.6 | 2.0 | -.4 | .1 | 1.0 |
| December | 213.5 | 225.7 | 235.2 | 223.5 | -14.7 | -15.5 | -14.1 | -11.2 |
| *1981* | | | | | | | | |
| January | 217.2 | 225.0 | 234.9 | 223.3 | 20.7 | -4.0 | -1.9 | -.9 |
| February | 219.2 | 224.8 | 234.9 | 223.5 | 11.0 | -.9 | -.1 | .9 |
| March | 221.4 | 225.8 | 235.9 | 224.1 | 12.5 | 5.5 | 5.4 | 3.5 |
| April | 225.1 | 228.3 | 238.4 | 226.1 | 19.8 | 13.0 | 12.7 | 10.4 |
| May | 224.9 | 227.6 | 237.8 | 225.7 | -.8 | -3.4 | -3.0 | -2.2 |
| June | 225.1 | 227.3 | 237.7 | 225.7 | .9 | -1.7 | -.7 | .2 |
| July | 225.8 | 228.0 | 238.6 | 226.5 | 3.7 | 3.4 | 4.4 | 4.1 |
| August | 226.9 | 227.3 | 238.0 | 226.0 | 5.6 | -3.7 | -3.0 | -2.5 |
| September | 228.1 | 226.8 | 237.6 | 225.9 | 6.7 | -2.3 | -1.6 | -.7 |
| October | 229.5 | 226.6 | 237.6 | 226.2 | 7.1 | -1.2 | -.3 | 1.8 |
| November | 232.1 | 228.0 | 239.1 | 227.6 | 13.5 | 7.7 | 7.6 | 7.6 |
| December | 234.4 | 230.1 | 241.2 | 229.1 | 12.3 | 10.9 | 10.6 | 7.8 |

Historical data for the monetary services indexes—continued

| Year and month | Level MSI1 | Level MSI2 | Level MSI3 | Level MSI4 | Annualized growth rate MSI1 | Annualized growth rate MSI2 | Annualized growth rate MSI3 | Annualized growth rate MSI4 |
|---|---|---|---|---|---|---|---|---|
| *1982* | | | | | | | | |
| January | 238.0 | 232.7 | 243.9 | 231.8 | 18.3 | 13.7 | 13.5 | 14.0 |
| February | 237.8 | 232.7 | 244.0 | 232.6 | −1.0 | −.5 | .5 | 4.2 |
| March | 238.2 | 233.4 | 245.0 | 233.6 | 2.0 | 4.1 | 5.1 | 5.0 |
| April | 239.8 | 234.9 | 246.8 | 235.1 | 8.1 | 7.4 | 8.6 | 8.1 |
| May | 239.9 | 235.6 | 247.6 | 236.1 | .5 | 3.7 | 3.9 | 5.1 |
| June | 240.7 | 236.6 | 248.8 | 237.4 | 3.8 | 5.2 | 6.2 | 6.2 |
| July | 241.5 | 237.7 | 250.1 | 238.8 | 4.1 | 5.3 | 6.1 | 7.4 |
| August | 244.2 | 239.6 | 252.5 | 241.0 | 13.3 | 9.8 | 11.4 | 10.9 |
| September | 247.2 | 241.8 | 254.7 | 242.8 | 14.7 | 10.9 | 10.7 | 8.9 |
| October | 250.7 | 244.1 | 257.4 | 245.6 | 17.0 | 11.6 | 12.4 | 13.6 |
| November | 253.4 | 246.2 | 259.0 | 246.9 | 12.8 | 9.9 | 7.7 | 6.7 |
| December | 254.4 | 246.6 | 258.8 | 247.4 | 5.1 | 2.2 | −1.1 | 2.1 |
| *1983* | | | | | | | | |
| January | 254.9 | 246.1 | 256.5 | 245.9 | 2.4 | −2.4 | −10.6 | −7.1 |
| February | 256.3 | 248.0 | 257.3 | 246.5 | 6.4 | 9.1 | 3.9 | 3.0 |
| March | 258.6 | 249.7 | 258.8 | 248.0 | 10.8 | 8.4 | 6.9 | 7.1 |
| April | 260.4 | 251.5 | 260.5 | 250.2 | 8.2 | 8.4 | 7.9 | 10.8 |
| May | 263.1 | 253.3 | 262.3 | 251.8 | 12.5 | 8.9 | 8.1 | 7.9 |
| June | 264.8 | 254.9 | 264.3 | 253.8 | 7.9 | 7.5 | 9.1 | 9.1 |
| July | 266.6 | 256.1 | 265.5 | 255.8 | 8.3 | 5.7 | 5.7 | 9.6 |
| August | 268.0 | 256.8 | 266.7 | 257.2 | 6.0 | 3.3 | 5.2 | 6.5 |
| September | 269.1 | 257.9 | 268.2 | 258.5 | 4.9 | 5.0 | 7.2 | 6.2 |
| October | 270.5 | 259.5 | 269.7 | 259.7 | 6.5 | 7.6 | 6.3 | 5.3 |
| November | 271.9 | 260.7 | 271.7 | 261.5 | 5.9 | 5.3 | 9.0 | 8.6 |
| December | 273.1 | 261.7 | 273.1 | 263.9 | 5.4 | 4.5 | 6.2 | 11.0 |
| *1984* | | | | | | | | |
| January | 275.2 | 263.0 | 274.6 | 265.5 | 9.3 | 6.2 | 6.7 | 7.1 |
| February | 276.7 | 264.4 | 276.5 | 267.6 | 6.7 | 6.6 | 8.0 | 9.4 |
| March | 278.4 | 266.0 | 278.6 | 270.5 | 7.1 | 7.0 | 9.5 | 13.2 |
| April | 279.3 | 267.3 | 280.5 | 272.3 | 3.9 | 6.1 | 8.2 | 7.9 |
| May | 280.5 | 268.6 | 282.5 | 274.4 | 5.6 | 5.8 | 8.6 | 9.4 |
| June | 282.7 | 270.1 | 284.5 | 277.1 | 9.4 | 6.6 | 8.3 | 11.9 |
| July | 283.2 | 270.8 | 285.9 | 279.2 | 1.9 | 3.2 | 5.9 | 9.0 |
| August | 284.6 | 271.3 | 286.6 | 280.6 | 6.0 | 2.2 | 3.0 | 5.8 |
| September | 285.9 | 272.4 | 288.0 | 282.3 | 5.3 | 4.7 | 5.8 | 7.6 |
| October | 285.0 | 272.8 | 289.3 | 283.3 | −3.8 | 1.8 | 5.3 | 3.9 |
| November | 287.7 | 275.4 | 292.2 | 285.3 | 11.3 | 11.6 | 12.1 | 8.5 |
| December | 290.3 | 278.2 | 295.4 | 287.9 | 11.1 | 12.0 | 13.0 | 11.0 |
| *1985* | | | | | | | | |
| January | 292.2 | 281.0 | 297.7 | n.a. | 7.8 | 12.2 | 9.4 | n.a. |
| February | 295.2 | 283.6 | 299.9 | n.a. | 12.4 | 11.2 | 8.8 | n.a. |
| March | 296.5 | 284.8 | 301.3 | n.a. | 5.1 | 5.0 | 5.7 | n.a. |

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