

BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM  
DIVISION OF MONETARY AFFAIRS

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**From:** Don Kohn  
**Subject:** A Minor Redefinition of M2

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The attached paper discusses a minor redefinition of M2. The redefinition involves the removal of overnight wholesale RPs and overnight Eurodollars from M2. They will remain in M3, so that non-M2 M3 will contain total RPs and Eurodollars.

The overnight components were originally included in M2 because of substitution between them and other M2 components, as suggested by their negative correlation with demand deposits in the mid-1970s, when corporate sweep accounts were spreading rapidly. However, since that time, movements in these components have come to reflect arbitrage by banks across funding sources, rather than demands of depositors. They no longer have any correlation with changes in demand deposits, any other component of M2, or the rest of M2 as a whole, nor do they evince seasonal or other behavioral patterns that would suggest they are primarily surrogates for demand deposits. Moreover, in recent years, the week-to-week volatility of M2 has become increasingly attributable to the behavior of these two small components. As shown in the paper, removal of these components from M2 has no effect on the fit of money demand functions, nor on M2's macroeconomic indicator properties. Furthermore, obtaining separate data on the overnight components and their term

counterparts is problematic and imposes significant reporting burdens.

In sum, this minor redefinition of M2 will not affect the usefulness of the aggregate for policy and will reduce costs for the private sector and the Federal Reserve. We are planning to implement the change with the February 1996 benchmark and seasonal factor review.

A Minor Redefinition of M2

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A Minor Redefinition of M2

I. Overview

The analytical distinction between M2 and the non-M2 portions of M3 has been based partly on a split between retail and wholesale components and partly on a distinction between demand and supply influences. M2 has often been interpreted as a measure of broad money that reflects primarily the demand of the non-depository public for safe, relatively liquid financial assets. By contrast, M3 has been seen to reflect the overall funding needs of depositories, its quantity driven largely by the supply decisions of banks and thrifts rather than by the public's demand preferences.<sup>1</sup>

This paper describes a small modification in the definition of M2 that would make it more of a retail aggregate, and would also strengthen its adherence to a money demand concept. It recommends shifting the overnight components of Eurodollars (EDs) and wholesale repurchase agreements (RPs) from M2 to non-M2 M3. The term portions of EDs and RPs (that is, contracts with original maturities greater than one day) are already in non-M2 M3.

Overnight RPs and EDs are highly volatile wholesale sources of funding for depositories that represent a small fraction of M2. Eurodollars in the monetary aggregates are overseas dollar deposits of U.S. residents; this deposit funding becomes available to banks domestically when they borrow from their overseas offices. In recent years, banks have apparently become more active users of overnight RPs and borrowings from offshore offices to adjust funding imbalances. The degree to which they rely on these sources shifts dramatically

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1. To be completely supply-determined, the depository industry as a whole would have to face a perfectly elastic demand curve for its M3 liabilities.

from week to week with small changes in relative costs. In addition, retail money fund holdings of these instruments are netted out prior to their inclusion in M2, and fluctuations in money fund holdings contribute to volatility in the monetary components. Overnight RPs and EDs were included in M2 because they were once close substitutes for demand deposits, owing to their use in demand deposit sweeps. However, such substitutions have been little evident in recent years. Excluding these wholesale components from M2 has minimal effect on the behavior of this aggregate on a monthly- or quarterly-average basis, and entails no significant differences in either the macroeconomic indicator properties of M2 or the fit of standard money demand models.

In eliminating the distinction between overnight and term RPs and EDs, the redefinition would reduce reporting burdens on the depository sector by an estimated 8,600 hours of labor per year. Furthermore, by removing the imperfectly measured wholesale components from M2, it would permit an improvement in the overall quality of the data reported for that aggregate.

Technical redefinitions of M2 have been undertaken before. In 1982, an adjustment of a similar nature was made, when the volatile wholesale component of money market mutual funds was shifted from M2 to non-M2 M3. Also at that time, retail RPs--both overnight and term--were shifted from non-M2 M3 into M2. The small amount of remaining retail RPs, with properties similar to small time deposits, would be retained in M2 under the current redefinition.

II. Placement of RPs, EDs, and Money Funds in the Monetary Aggregates

The rationales for allocating money components to the aggregates are not without ambiguity. In general, M1 includes the monetary components most often used in transactions, while non-M1 M2 comprises those deposits and money fund shares that holders are likely to view as fairly close substitutes for M1 instruments.<sup>2</sup> Substitutability may arise because of liquidity, safety, or other attributes. Although small time deposits are illiquid in the sense that converting them to cash before their maturity date usually involves a material loss of value, they nevertheless have proved empirically to be close substitutes for liquid deposits, perhaps because they are also insured and offered by the same institutions. Incorporation of small time deposits in M2 gives the aggregate a more stable demand function. Money components in non-M2 M3 represent assets traded in wholesale markets--large time deposits and similar funding sources for depositories and institutional money funds.

As shown in table 1, RPs, EDs, and money market mutual funds were included in the monetary aggregates for the first time in 1980.<sup>3</sup> Overnight RPs and EDs were placed in M2 in order to internalize within that aggregate potential substitution effects between these components and business demand deposits. Bank sweep accounts may involve transfers between demand deposits and overnight bookings of the bank's own RPs or of ED deposits. However, because overnight RPs and EDs are largely wholesale sources of funding, they could have been included with other wholesale instruments in

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2. Household holdings of Treasury bills may also be close substitutes for money, but are not included in M1, M2, or M3 on the principle that they involve price risk. However, they are included in the broad measure of liquidity called L.

3. For a discussion of the major changes in the definitions of the monetary aggregates undertaken that year, see Simpson (1980).

Table 1Placement of RPs, EDs, and Money Funds in the Monetary Aggregates

<u>DATES</u>	<u>ACTION</u>
Prior to March 1980	RPs, EDs, and money funds were not included in the monetary aggregates.
March 1980	Overnight EDs, overnight wholesale bank RPs, and all money funds began to be included in non-M1 M2. Thrift RPs and term wholesale bank RPs began to be included in non-M2 M3. All taxable money market mutual funds began to be included in non-M1 M2.
Oct. 1981	Retail RPs began to be included in non-M2 M3.
March 1982	Retail RPs were shifted from non-M2 M3 to small time deposits (in M2). Institutional money funds were shifted from M2 to non-M2 M3.
March 1983	Tax-exempt money funds were included in non-M1 M2.
March 1984	Term EDs began to be included in non-M2 M3.
March 1990	Overnight thrift RPs were shifted from non-M2 M3 to M2.

non-M2 M3. Including them in non-M1 M2 put an emphasis on the liquidity concept at the expense of the retail/wholesale criterion, and empirical work at the time showed that such an emphasis was justified.<sup>4</sup>

Also in 1980, all money market mutual funds began to be included in M2. To avoid double-counting, overnight RPs and EDs had to be reported net of money fund holdings of these instruments. In early 1982, institutional money funds were shifted from M2 into non-M2 M3, and the netting became more complicated.<sup>5</sup> The investments of retail money funds continued to be netted out of the overnight RP and ED components of M2 as before. However, such investments by institutional money funds had to be netted out only at the non-M2 M3 level, where the double-counting would otherwise occur.<sup>6</sup>

Beginning in 1981, data on retail RPs (those issued in denominations of less than \$100,000) began to be collected and were initially added to non-M2 M3--both the overnight and term components. However, because retail RPs were household investments similar to small time deposits, they were relocated within that M2 component beginning in 1982. Retail RPs were important for a time in the early 1980s, because they allowed banks to offer interest rates that exceeded then prevailing ceilings under Regulation Q.

In 1984, as new data became available, term EDs began to be included in non-M2 M3. While all thrift RPs had been included at the

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4. See Tinsley, Garrett, and Friar (1978), Farr, Porter, and Pruitt (1978), and Porter, Simpson, and Mauskopf (1979).

5. Retail money market mutual funds are sometimes called "general purpose and broker/dealer" money funds. Institutional money funds are those for whom the minimum size initial shareholding is at least \$50,000.

6. Because term RPs and term EDs are non-M2 M3 components, the netting of money fund holdings of these items can be accomplished without distinguishing between retail and institutional funds.



M3 level beginning in 1980, the small amount of overnight RPs issued by thrifts were shifted into M2 in 1990.

Table 2 below gives a quantitative breakdown of the RP and ED money stock components as of June 1995 (the latest date for which complete data are available).

### III. Data Issues

#### Data on Gross RPs and EDs

As is evident from table 3, considerable efforts have been made over the years to distinguish overnight from term components of RPs and EDs; however, such distinctions remain a source of estimation errors for the monetary aggregates. In 1964, banks began providing data to the Federal Reserve on RP liabilities. Forty-six large banks reported weekly on their borrowings (including RPs) from securities dealers. Special surveys were undertaken in 1974 and 1977 to estimate the breakdown of such borrowings into overnight and term components. In 1980, when RP data began to be included in the money stock, the weekly report was expanded to 122 banks and revised to distinguish between overnight and term RPs. Call reports provided data on the sum of RP and federal funds financing beginning in December 1965. A Call report supplement for 500 large banks, implemented between 1978 and 1983, distinguished RPs from federal funds and gave a maturity breakdown for RPs.

Table 2: Selected Money Components as of June 1995  
 (\$ billion, not seasonally adjusted)

<u>Gross Overnight RPs</u>	<u>97.5</u>	
Banks	95.3*	
Thrifts	2.2	
Less: Held by retail money funds	<u>(9.8)</u>	
Net Overnight RPs (a component of M2)	<u>87.7</u>	
<u>Memo:</u>		
Bank retail RPs (included in small time deposits)		1.2
M3 money fund 1-day RPs (subtracted from non-M2 M3)		12.5
<u>Gross Term RPs</u>	<u>120.6</u>	
Banks	77.7#	
Thrifts	42.9	
Less: Held by money funds	<u>(0.8)</u>	
Net Term RPs (a component of M3)	<u>119.8</u>	
<u>Gross Bank Overnight EDs</u>	32.4	
Less: Held by retail money funds	<u>(2.8)</u>	
Net Overnight EDs (a component of M2)	<u>29.6</u>	
<u>Memo:</u>		
M3 money fund 1-day EDs (subtracted from non-M2 M3)		1.8
<u>Gross Bank Term EDs</u>	73.4**	
Less: Held by money funds	<u>(11.0)</u>	
Net Term EDs (a component of M3)	<u>62.4</u>	
<u>Memo:</u>		
M2		3698.2
M3		4459.4

\* Of this amount, \$60 billion were liabilities of weekly reporters, of which \$21 billion were held by security dealers.

# Of this amount, \$57 billion were liabilities of weekly reporters, of which \$38 billion were held by dealers.

\*\* Of this amount, \$26 billion reported from London and Canada with no maturity breakdown likely includes some overnights.

Table 3

Sources of Data on Gross RPs and EDs

SOURCES OF DATA ON GROSS RPs

<u>Dates</u>	<u>Report and Description</u>
...	Call reports, no distinction between federal funds and RPs, no maturity breakdown
8/64 - 2/80	FR 716, 46 large banks, weekly, no maturity breakdown
1974, 1977	Special surveys of FR 716 panel to distinguish overnight from term RPs
12/78 - 12/83	Supplement to Call report for 500 large banks, distinguished RPs from federal funds and showed maturity breakdown
2/80 - now	FR 2415, successor to FR 716, expanded panel, provided maturity breakdown of RPs
1/82	Special RP survey of 14,000 respondents
9/84 - now	FR 2090 q & a, quarterly and annual RP reports
6/86 - now	FR 2415t, weekly RP report for large thrifts

SOURCES OF DATA ON GROSS EDs

<u>Dates</u>	<u>Report and Description</u>
10/69 - 4/78	FR 502 monthly, ED liabilities of large domestic banks, including--without distinguishing--interbank deposits
5/78 - 3/94	FR 2502 monthly, successor to FR 502, indicated ED liabilities of large domestic banks to U.S. nonbanks
12/79 - 3/94	FR 2050 weekly, overnight EDs of large domestic banks
9/83 - 3/94	FR 2077 weekly, term EDs of large domestic banks
9/83 - now	Bank of Canada monthly reports on ED deposits of U.S. and non-U.S. banks, no maturity breakdown
9/83 - now	Bank of England quarterly reports of ED deposits of U.S. and non-U.S. banks, no maturity breakdown
6/93 - now	FFIEC 002s, branches and agencies of foreign banks reports on offshore ED liabilities managed in U.S.
4/94 - now	FR 2502 shifted to quarterly frequency
4/94 - now	FR 2050 weekly, changed to include data on both overnight and term EDs, separate FR 2077 dropped

A special one-week survey of 14,000 depositories, undertaken in early 1982, provided improved estimates of RPs at thrifts and a better breakdown of RPs at smaller banks into overnight and term components. In July 1984, the Federal Reserve's quarterly and annual reports of RPs were instituted, providing a distinction between overnight and term components for thrifts and smaller banks. After June 1986, large thrifts began reporting RPs weekly.

Banks first began reporting ED liabilities to the Federal Reserve in 1969; large domestic banks provided month-end data. In the late 1970s, the Federal Reserve instituted a weekly survey of overnight EDs. Also, banks began providing a breakdown between bank and non-bank sources of ED funding, an important distinction since interbank ED deposits are not included in the monetary aggregates. In late 1983, weekly reports on the term EDs of domestic banks were initiated, and data on the ED deposits of U.S. residents at non-U.S. banks began to be provided monthly by the Bank of Canada and quarterly by the Bank of England. The foreign bank data include an unknown amount of overnight maturities.<sup>7</sup> Data on ED deposits held by U.S. residents in offshore offices of foreign banks that are managed from the United States became available quarterly beginning in 1994. They have not as yet been included in the monetary aggregates.<sup>8</sup>

Available data on RPs and EDs do not include information on the remaining maturities of the term components. Although the liquidity of an overnight instrument is the same as the liquidity of a

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7. EDs of U.S. addresses held at non-U.S. banks reported by the Bank of Canada and the Bank of England currently amount to about \$26 billion. If significant amounts of these EDs are actually overnight maturities, they could have a major effect on the reported net overnight EDs of about \$30 billion.

8. Prior to inclusion in the aggregates, Board staff intend to complete a review of the quality of these data, the appropriate frequency of reporting, and adjustments needed for missing historical values.

term instrument with only one day left to maturity, no attempt is made to adjust the monetary aggregates to account for this. As a result, term RPs and term EDs are in principle overestimated and the overnight components are underestimated by the portion of the term instruments that are about to mature.

A number of other problems affect the quality of data reported for RPs and EDs. For example, holidays often result in increased difficulty in separating the overnight from the term portions of RPs and EDs. Contracts maturing on the next business day (excluding weekends or holidays) are overnight maturities. However, a two-day contract is supposed to be reported as an overnight maturity if it spans a partial holiday and at least one of the parties is closed that day. Considerable ambiguity occurs on partial holidays, which include Good Friday, Patriots' Day, and other days when the securities markets or some banks are closed but many banks remain open. At such times, many banks misreport in term components contracts that should be reported as overnights.

#### Data on Money Fund Netting Items

Data to obtain netting items are available from reports of the mutual fund industry to their trade association, the Investment Company Institute (ICI). Money funds have experienced difficulties in making accurate assessments of their holdings of bank RPs and EDs, and revisions of such data have resulted in large benchmark adjustments in the level of M2.

In practice, money funds have limited staff resources to devote to preparing voluntary reports for ICI. Furthermore, ICI itself has limited staff available to track down and resolve all discrepancies that may arise in edits of the raw data submitted by money funds. In light of this, the Federal Reserve in 1994 began

asking banks themselves to net money fund holdings out of their reported ED liabilities. The Federal Reserve has provided banks with lists that distinguish institutional from retail money funds, a distinction needed because of the differences in netting overnight versus term EDs. Similarly, Board staff intend to request that depositories begin reporting their overnight and term RPs net of the holdings of money funds. The recommended change in the definition of M2 would thus likely save RP as well as ED reporters the burden of maintaining up-to-date lists that distinguish institutional from retail money funds for the purpose of computing netting items.

Another complication in constructing netting items arises from ambiguity in the allocation of money fund asset components to either retail or institutional investors. Some money funds have different classes of shares, including both institutional and retail customers in the same fund. Aggregations of the shareholdings themselves into these two classes have been generally reliable, but allocations of the RP and ED assets of money funds to retail and institutional shareholders has been more problematic. Differences in methods employed by ICI in making these allocations have contributed to large benchmark adjustments to the monetary aggregates. Under the new definition of M2, such allocations would be no longer necessary.

#### Revisions in Published Data and Reporting Burdens

Summary statistics suggestive of differences in the quality of data between the overnight components and the rest of M2 are shown in table 4 below. In deriving the numbers in the table, the initial step was to compute monthly growth rates using first published data, and then to subtract them from growth rates calculated using data currently in our files. The differences, called the growth rate errors, reflect benchmarks and other report corrections, often

necessitated by misreporting. The absolute average of such errors over the period 1988-94 was then computed, separately for M2 and revised M2. As shown, the absolute average growth rate error for M2 was 64 basis points, while that for revised M2 was substantially less--42 basis points. The root mean square growth rate error was also less for revised M2--56 basis points versus 80 for M2. These results highlight the fact that the RP and ED components of M2 have suffered proportionately far more reporting revisions and corrections than other components of the aggregate.

Table 4: Growth Rate Errors in First Published Data

(1988-1994, monthly NSA data, percentage points, annualized)

	<u>M2</u>	<u>Revised M2</u>
Average absolute error	.64	.42
Root mean square error	.80	.56
Memo: Average growth rate	3.08	3.11

The reporting problems in RPs and EDs arise in part because of the difficulty of separating the overnight and term components, both in gross data, and in money fund netting items. Combining all EDs and wholesale RPs in non-M2 M3 would avoid making a distinction that is difficult to estimate accurately with available data.

Revising the definition of M2 would also permit a reduction in reporting burdens for the banking sector. Excluding the overnight components from M2 would eliminate the need for banks to report a breakdown of maturities on RPs and EDs. In addition, depositories would no longer need to maintain an updated partition of money funds into retail and institutional categories, in order to report separate netting items for M2 and non-M2 M3. These simplifications in

reporting requirements by depositories would save an estimated 8,600 hours of labor per year.<sup>9</sup>

The RP and ED reports are voluntary. Some depositories find that the burdens involved in completing such reports are too great, and refuse to provide them to the Federal Reserve. When this occurs, the quality of the published data on the monetary aggregates suffers, as a larger portion of the aggregates must be estimated. By reducing reporting burdens, the proposed revision in the monetary aggregates could help the Federal Reserve to maintain a larger panel of banks providing such reports, thereby contributing to the accuracy of the published data.

#### IV. Volatility Issues

Despite the fact that overnight RPs and EDs combined represent only about 3 percent of M2, they are significant contributors to its variance at weekly frequencies.

#### Volatility of the Overnight Components

The overnight components have become increasingly volatile in recent years. As shown in the first row of table 5, over the last fifteen years, the variance of weekly changes in the sum of overnight RPs and EDs amounted to \$10 billion.<sup>10</sup> Over the last two and a half years, this variance increased to \$15.5 billion.<sup>11</sup> Overnight RPs

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9. Because of the larger panel for RP reports, their aggregate reporting burdens would be reduced by an estimated 5,900 hours per year, while those for the ED reports would decline by an estimated 2,700 hours.

10. The data are not seasonally adjusted, as there is no apparent seasonal in RPs and EDs. Before 1980, the quality of data available on these components is considerably less reliable.

11. An alternative measure of volatility is given in the third row of the table. It again uses a first differenced series, computes the mean change, then takes absolute values of deviations from that mean change, and finally uses the mean of those absolute deviations. For example, the mean weekly change in the sum of overnight RPs and EDs

(Footnote continues on next page)



and EDs are somewhat less volatile when using month-average data. The variance in monthly changes was a bit less than \$7 billion over both the last fifteen years and the more recent thirty months.<sup>12</sup>

Table 5

Volatility of Changes in the Sum of Overnight RPs and EDs

	<u>Dec. 1980 - June 1995</u>	<u>Dec. 1992 - June 1995</u>
	- - - - - \$ billion - - - - -	
<u>Weekly (NSA data)</u>		
Variance of changes	10.0	15.5
Standard deviation	3.2	3.9
Mean absolute deviation from mean change	2.4	3.0
<u>Monthly (NSA data)</u>		
Variance of changes	6.8	6.6
Standard deviation	2.6	2.6
Mean absolute deviation from mean change	2.1	1.9
<u>Memo: (percentage points)</u>		
Standard deviation of annualized growth rates	45.5	30.0

Substitution Effects with Other M2 Components

Volatility in overnight RPs and EDs is not undesirable if it reflects shifts of funds among the components of M2. Demand deposits seem the most likely candidate for substitutions with the wholesale

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was only \$140 million since 1980. On average, however, actual weekly changes differed from that mean by \$2.4 billion. This measure also indicates an increase in volatility in recent years, as the mean absolute deviation rose to \$3.0 billion.

12. Another monthly measure is the standard deviation of the annualized growth rates, which was 45 basis points over 1980 to mid-1995 and about 30 basis points over the last two years, the drop reflecting the presence of a regular core element in the higher average level of the components in recent years.

components, and correlations are shown in table 6. A search for a period of strong negative correlation between demand deposits and overnight net bank RPs turned up the mid-1970s, shown in the table. That was the time of missing M1 money--when the innovation of corporate demand deposit sweep accounts first became widespread. However, outside of that period, there is no evident correlation between overnight RPs and demand deposits. Indeed, as indicated in the last column of table 6, in the period since 1980, when data on EDs and money funds have also been available, demand deposits show a stronger negative correlation with institutional money funds (in non-M2 M3) than with either of the overnight components in M2.

Table 6: Correlations with Demand Deposits

(All variables in first differences, weekly NSA data)

<u>Component</u>	<u>Dec. 1969- June 1995</u>	<u>Dec. 1974- Dec. 1978</u>	<u>Dec. 1980- June 1995</u>
Bank Overnight RPs	-.05	-.63	-.01
Bank Term RPs	-.21	-.64	-.18
Overnight EDs	n.a.	n.a.	-.18
Term EDs	n.a.	n.a.	-.03
Institutional Money Funds	n.a.	n.a.	-.29

Sweeps from demand deposits, perhaps under longstanding programs, do still account for some RP activity at banks. However, in recent years, changes in overnight RPs appear to have become increasingly dominated by banks arbitraging across alternative sources of funding. For instance, 23 percent of the large banks in a December 1994 Senior Financial Officers' Survey reported that the spread between the federal funds rate and the RP rate was "very important" in

explaining day-to-day movements in their overnight RPs. Bank RPs that are purchased by securities dealers are especially correlated with the funds/RP rate spread, suggesting trades initiated by banks, and the share of overnight bank RPs held by dealers has risen to nearly 40 percent of weekly reporters' overnight RPs in recent years (versus less than 10 percent in early 1980).

Aside from demand deposits, other M2 components also show little correlation with overnight RPs and EDs. Overall, the monthly correlation of changes in the overnight components with changes in the rest of M2 is close to zero both since 1980 (actually  $-.05$ ) and over the last thirty months ( $.02$ ). With weekly data, the correlations are also low ( $-.12$  since 1980 and  $-.06$  more recently).<sup>13</sup> In sum, the observed patterns of correlations do not support identification of overnight RPs and EDs as M2 items in contra-distinction to the other wholesale funding sources in M3.

Part of the reason for the weak correlations between the wholesale components and other elements of M2 owes to substitutions by investors between those components and money market instruments outside of M2. Such market instruments could include non-bank RPs, commercial paper, institutional money fund shares, bankers' acceptances, short-dated Treasury bills, and the term components of RPs and EDS. For instance, substantial substitution between overnight and term RPs, either by banks or investors, are suggested by their significant negative correlations ( $-.49$  since 1969, and  $-.58$  since 1980).

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13. With no apparent seasonality in the overnight components, the correlations in this paragraph were obtained using not seasonally adjusted data. There was little difference in the results when using seasonally adjusted data for other M2 components.

Anecdotal reports from banks also suggest more active management of offshore purchases of dollars, including arbitrage between ED and federal funds markets. While the monetary aggregates include only a portion of bank offshore dollar liabilities, examination of daily data suggest a very elastic demand curve that allows banks to adjust their ED liabilities dramatically with small changes in offering rates--the level of EDs reported by individual banks may jump or drop by more than 50 percent from one day to the next.

#### Comparative Volatility of M2 and Revised M2

Since overnight RPs and EDs are virtually independent of other components of M2, their volatility tends to be transmitted to M2 as a whole. This is evident in table 7, which compares M2 as currently defined and revised M2 (excluding overnight RPs and EDs).

The first row of the table reveals that variance in the weekly changes in M2 has amounted to \$16.4 billion over the last fifteen years, while that for revised M2 amounted to \$13.4 billion. This implies that the wholesale components have accounted for nearly one-fifth of the variance in weekly changes in M2  $[(16.4-13.4)/16.4]$ . In recent years, that variance has risen noticeably, and its rise owes almost entirely to RPs and EDs; the wholesale components have accounted for 37 percent of the variance in M2's weekly changes over the last two and a half years.<sup>14</sup>

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14. The gap between the variances of changes in M2 and changes in revised M2 equals two terms; the first is the variance of changes in the overnight components (implicitly seasonally adjusted), while the second term is twice the covariance between changes in overnight components and changes in revised M2. The two terms amount to 8.6 and -5.6 respectively over the entire period and 10.2 and -1.8 over the last two and a half years (in billions of dollars). These results underscore the reduced correlation between the overnight components and the rest of M2 in recent years.

Table 7

Volatility of Changes in M2 and Revised M2

	<u>Dec. 1980 - June 1995</u>		<u>Dec. 1992 - June 1995</u>	
	<u>M2</u>	<u>Revised M2</u>	<u>M2</u>	<u>Revised M2</u>
	- - - - - \$ billion - - - - -			
<u>Weekly (SA data)<sup>15</sup></u>				
Variance of changes	16.4	13.4	22.8	14.4
Standard deviation	4.0	3.7	4.8	3.8
Mean absolute deviation from mean change	3.1	2.6	3.8	2.9
<u>Monthly (SA data)</u>				
Variance of changes	77.6	72.6	80.3	82.8
Standard deviation	8.8	8.5	9.0	9.1
Mean absolute deviation from mean change	6.7	6.5	6.6	6.1
<u>Memo: (percentage points)</u>				
Standard deviation of annualized growth rates	4.7	4.6	3.0	3.1

Quarterly Volatilities

	<u>Variance of Changes</u> (\$ billion)	<u>Standard Deviation</u> <u>of Growth Rates</u> (percentage points)
<u>1980:Q4- 1995:Q2</u>		
M2	385.9	4.7
Revised M2	380.4	4.6
<u>1992:Q4- 1995:Q2</u>		
M2	175.7	1.5
Revised M2	176.4	1.6

15. Although no clear seasonality is evident in overnight RPs and EDs, volatility in these components may be implicitly smoothed away in M2, because non-M1 M2 is seasonally adjusted as a whole. Volatility in the seasonally adjusted aggregate is what matters. For this reason, the table compares M2 with revised M2 on a seasonally adjusted basis.

At the monthly or quarterly level, this high frequency noise largely washes out, and there is little effect of the wholesale components on M2. The close correspondence of monthly growth rates of M2 and revised M2 is clearly shown in charts 1 and 2.<sup>16</sup> The correlation of monthly changes in the two series is .97, versus .71 for the weekly changes. Important differences in the behavior of M2 and revised M2 at weekly frequencies are apparent in chart 3.

#### V. Money Demand

The high frequency volatility in M2 owing to the inclusion of the wholesale components might be acceptable if the components contributed to the monetary aggregate's ability to reveal the behavior of nominal income or spending. To assess this issue, comparisons of M2 with revised M2 were undertaken using the staff's standard money demand model. The model was originally specified to explain the behavior of M2, so any better performance using revised M2 would be the more impressive. It is an error-correction model, with a long-run log-levels relationship between money, nominal GDP, and opportunity costs, and short run dynamics that depend on the growth of nominal personal consumption expenditures and changes in the log of opportunity costs. Opportunity costs are defined as the difference between the three-month Treasury bill rate and the weighted-average own rate on M2. The only specification change when using revised M2 was adjusting the own rate to account for the absence of RPs and EDs. Quarterly and monthly versions of the model were reestimated over two periods, each ending in mid-1995; the first period begins in 1969, when data first became available on the overnight components, and the second begins in

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<sup>16</sup>. The spike in M2 growth in early 1983 reflected the introduction of MMDA accounts.

Chart 1  
Monthly Growth Rates of M2 and Revised M2

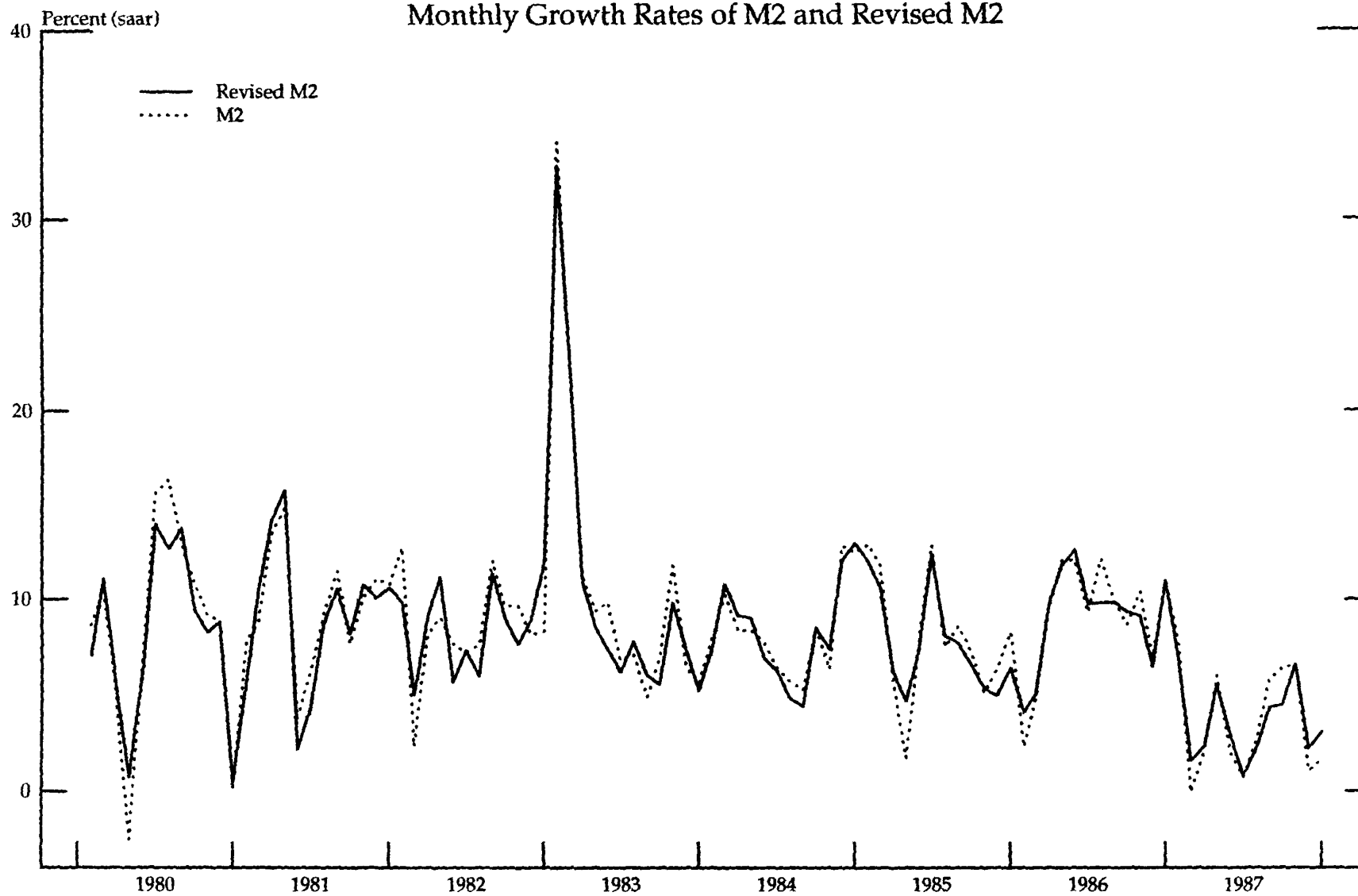


Chart 2  
Monthly Growth Rates of M2 and Revised M2

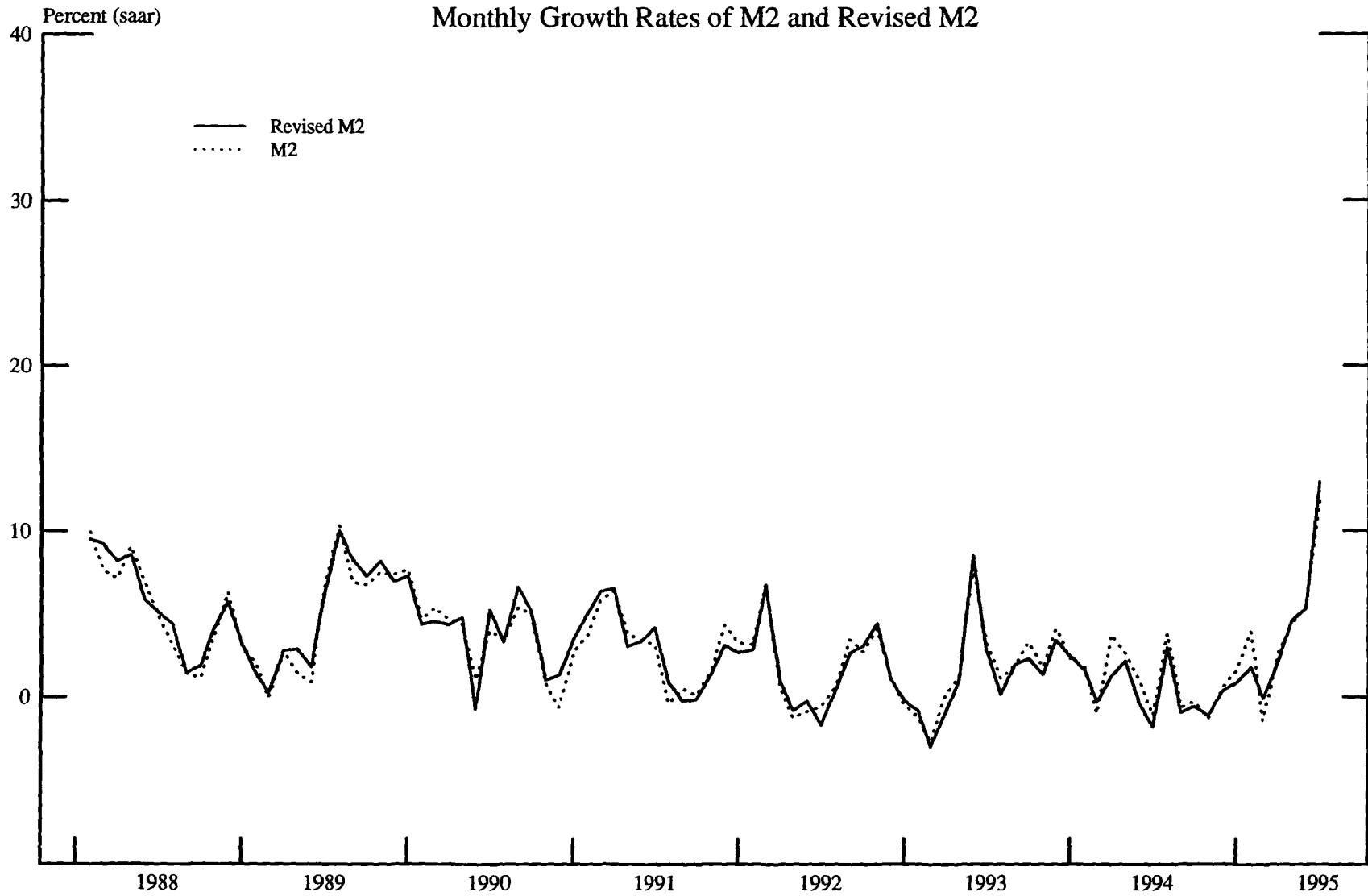
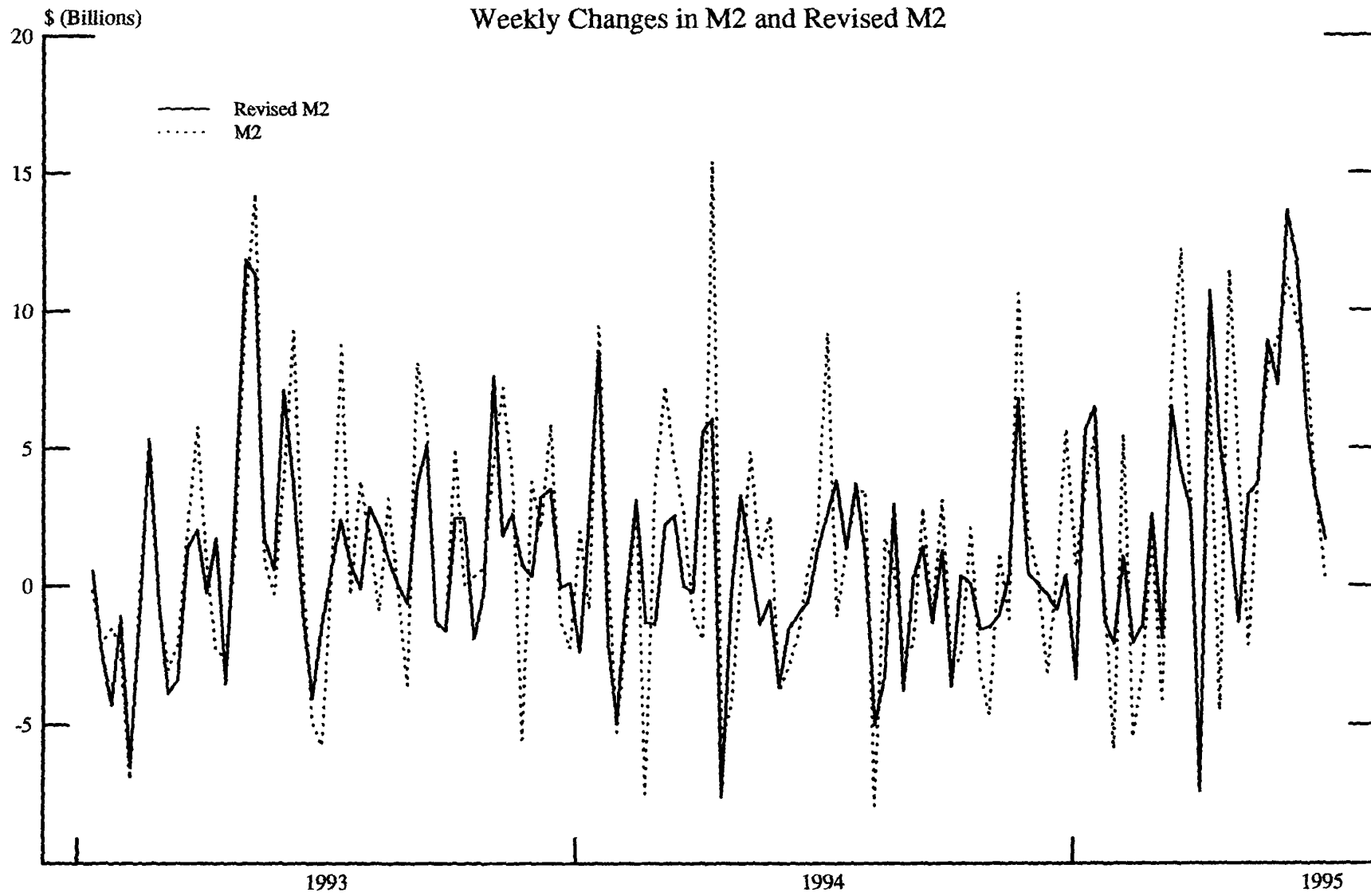




Chart 3  
Weekly Changes in M2 and Revised M2



1980, when more complete data were available. Summary statistics are given in table 8.

There is virtually no difference between the quarterly models for either estimation period. For the monthly models, the standard error is only trivially lower when using revised M2 than when using M2 itself in these regressions. Thus, removing overnight RPs and EDs will not fix up problems associated with errors in forecasting the demand for M2. However, including them in M2 adds nothing to a money demand regression. The implication is that there is no information in these components that would improve one's understanding of the relationship of money to aggregate spending, interest rates, and opportunity costs, as indicated in a money demand framework.

#### VI. Reduced Form Results

Other empirical comparisons of M2 and revised M2 were undertaken to assess the ability of each aggregate to predict future values of nominal income, real economic activity, and inflation. The results are presented in table 9. Any of these reduced form regressions could be subject to criticisms of omitted variables biases or other problems. The point of the exercises was not to establish the robustness of monetary indicator properties, but rather to investigate whether there were any obvious and important differences in the performance of M2 and revised M2 in simple tests of their roles as macroeconomic indicators. Because the monthly growth rates of these two monetary variables are so highly correlated, and the quarterly growth rates are even less distinguishable, little difference in their performance as macroeconomic indicator variables was to be expected; the data confirm this supposition.

Table 8: Comparison of Money Demand Models

Dependent variable: change in log of monetary aggregate

	<u>Quarterly Model</u>			
	<u>1969:Q4 to 1995:Q2</u>		<u>1980:Q1 to 1995:Q2</u>	
	<u>M2</u>	<u>Revised M2</u>	<u>M2</u>	<u>Revised M2</u>
R-Square	.79	.79	.85	.85
Adjusted R-Square	.77	.77	.82	.82
Std. error of regression (as annual growth rate)	1.93	1.94	1.62	1.63
Durbin H statistic	.16	.62	.55	.91
F Statistic	35.6	34.4	29.5	28.3

	<u>Monthly Model</u>			
	<u>1969:11 to 1995:6</u>		<u>1980:3 to 1995:6</u>	
	<u>M2</u>	<u>Revised M2</u>	<u>M2</u>	<u>Revised M2</u>
R-Square	.69	.71	.69	.72
Adjusted R-Square	.68	.70	.67	.70
Std. error of regression (as annual growth rate)	2.72	2.57	2.73	2.53
Durbin H statistic	-.77	.35	-.61	.96
F Statistic	55.0	60.9	32.3	36.6

Table 9: Macroeconomic Prediction Results

(Estimation period: January 1980-June 1995)  
 (Growth Rate Regressions including "Error Correction" Level Terms)<sup>17</sup>

Quarterly Data

	<u>M2</u>	<u>Revised M2</u>
<u>Nominal GDP</u> (one lag on growth rates)		
R-square	.24	.23
Standard error	3.24	3.26
t-statistic on error correction	- .48	- .48
P-value on money growth	.02	.04
<u>Real GDP</u> (one lag on growth rates)		
R-square	.26	.26
Standard error	2.98	2.99
t-statistic on error correction	-2.48	-2.47
P-value on money growth	.56	.65
<u>CPI excluding food and energy</u> (three lags on inflation, one on money)		
R-square	.83	.83
Standard error	.78	.78
t-statistic on error correction	-1.25	-1.33
P-value on money growth	.77	.60

Monthly Data

	<u>M2</u>	<u>Revised M2</u>
<u>Nominal Personal Income</u> (one lag on growth rates)		
R-square	.09	.08
Standard error	8.21	8.30
t-statistic on error correction	- .44	- .51
P-value on lagged money growth	.24	.61
<u>Industrial Production</u> (two lags of IP and one money growth lag)		
R-square	.13	.13
Standard error	8.09	8.08
t-statistic on error correction	-2.45	-2.55
P-value on lagged money growth	.95	.53
<u>CPI excluding food and energy</u> (7 inflation lags, lags 2 & 3 on money)		
R-square	.60	.61
Standard error	1.42	1.41
t-statistic on error correction	-1.28	-1.34
P-value on lagged money growth	.21	.08

17. Lag-lengths are based on Akaike or Schwarz criteria. Alternate trials with longer lags and alternate specifications without error correction terms generally indicated similar results, although a lack of robustness of levels of significance was also suggested.

Each reduced form included a two-step "error correction" procedure; first, the level of a macroeconomic variable was regressed on the contemporaneous level of money, in an attempt to uncover a long-run relationship. In the second stage, the growth rate of the macroeconomic variable was regressed on its own lags, on lags of money growth, and on errors from the levels regression. Growth rate terms reflect short-run dynamic interactions, while a significant coefficient on the levels error term indicates that the dependent variable would tend to adjust gradually, or "error correct" over time, to the long-run levels relationship with money. The estimation period was 1980-1995.

In the nominal GDP regression, lagged money growth, using either of the two versions of M2, was found to have predictive power at the 5 percent significance level. However, the error correction term, which indicates adjustment to a long-run relationship, was insignificant.<sup>18</sup> In regressions for real GDP, lagged money growth was insignificant, but a long-run levels relationship seemed evident. Neither monetary variable appeared able to predict the quarterly-average core CPI. In each of the quarterly regressions, there was little difference between the two versions of M2.

Neither aggregate tended to have significant predictive power when using monthly data. The monthly regressions were run for nominal personal income, industrial production, and the core CPI. In sum, there was evidence of error correction for each aggregate in the industrial production regression, and significance at the 10 percent level for revised M2 growth in the inflation regression. Alternate

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18. The absence of a significant long-run relationship between these monetary variables and nominal GDP appears to reflect the divergence of M2 from its historical patterns of behavior in the early 1990s.

trials were run with monthly data that made adjustments to each version of M2 for the effects of the introduction of Money Market Deposit Accounts in early 1983 and that varied the estimation period and lag length specifications. These results showed that, for both M2 and revised M2, the significant relationships reported on the table were quite sensitive to the specification used.

The key point of the above findings is that, when using either quarterly or monthly data, there were no persistent or reliable differences between the observed macroeconomic indicator properties of M2 and revised M2.

Other recent research has found little value in inclusion of overnight RPs and EDs in an alternative M2-type concept. Hess and Morris (1995) developed a monetary aggregate they call M\*, which has time-varying weights on the components of M2. The weights were estimated to optimize the ability of the resulting aggregate to predict the long-run price level. They found that overnight RPs and EDs added nothing to the indicator properties of their aggregate.

#### VII. Conclusion

This paper recommends revising M2 by excluding from it overnight EDs and overnight wholesale RPs. Implementing the revision would result in improved data quality, elimination of high frequency noise in M2, and reduced reporting burdens for the depository sector. The need to make such a revision has become more obvious in recent years because of heightened volatility in the overnight RP and ED components, and because of the accumulation of evidence that there is no longer any correlation between these components and other components in M2.

The breakdown of RPs and EDs into overnight and term maturities is poorly estimated in the monetary aggregates, because of

limitations in source data. Published data on overnight EDs are downward biased because, in the absence of maturity data, overnight and term EDs held by U.S. residents in non-U.S. banks in Canada and the United Kingdom are both lumped together in the term component, and because of an absence of data on the ED deposits of U.S. residents in other locations. Furthermore, term RPs and term EDs with one day of remaining maturity are not included in the overnight components. Finally, the netting items related to money fund holdings of RPs and EDs are subject to mis-estimation because of the need to distinguish between overnight and term components of RPs and EDs. Excluding overnight RPs and EDs from M2 would eliminate a source of reporting errors for both M2 and non-M2 M3.

As reported, overnight RPs and EDs are quite volatile on a weekly basis, and the volatility has risen in recent years as banks have apparently become more willing to adjust such wholesale instruments based on changing funding needs and relative returns. Although a significant negative correlation between RPs and demand deposits was evident briefly in the mid-1970s, little correlation of either RPs or EDs with demand deposits is apparent since then; as a result, the short-run volatility in these components has been increasingly transmitted to M2. The levels of the overnight components seem predominantly determined by the supply decisions of banks, and are certainly more supply-determined than investments in institutional money funds.

Empirical investigations have shown that excluding overnight RPs and EDs from M2 does not affect the goodness of fit of a standard money demand model, which is specified for quarterly data. Furthermore, little difference between the performances of M2 and revised M2 is evident in predicting the future behavior of key

macroeconomic variables. The conclusion is that overnight RPs and EDs merely make M2 a more noisy series at high frequencies. Exclusion of these components might make it easier to spot emerging trends in redefined M2, and perhaps, as a result, enhance the potential usefulness of this aggregate as a macroeconomic indicator.



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