THE 1983 M1 SEASONAL FACTOR REVISIONS:
AN ILLUSTRATION OF PROBLEMS THAT MAY ARISE IN USING SEASONALLY ADJUSTED DATA FOR POLICY PURPOSES

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I.

INTRODUCTION

Early each year the Federal Reserve uses the past year's data to revise the seasonal factors used to seasonally adjust the money stock. As shown in Table I, the 1984 revisions in the seasonal factors caused unusually large revisions in the seasonally adjusted 1983 monthly M1 growth rates for the second year in a row.[1,2] In addition, the revisions shifted some of the growth in M1 in 1983 from the first to the second half of the year. Table I also shows that, with one exception, the effect of the 1984 revisions on the 1983 monthly growth rates was in the opposite direction from the effect of the 1983 revisions on the 1982 monthly growth rates.

The revisions in the 1983 seasonally adjusted M1 growth rates were of unusual interest because they influenced expectations regarding Federal Reserve behavior and the economy. In July 1983 the Fed had reset (or "rebased") the 1983 target range for M1 to run from the second quarter to the fourth quarter of the year. Originally the weak growth of M1 in late 1983 had caused it to fall to the lower end of the range, which contributed to expectations in some quarters that the Fed would "ease" policy. The revisions lifted M1 to the midpoint of its range and altered expectations that such a policy move was imminent.[3,4]

[1] The measure of the money stock discussed in this paper is the narrowly-defined M1, which includes currency, demand deposits, other checkable deposits, and nonbank travelers checks. There were also revisions in the broader measures of the money stock, M2 and M3. The formal position of the Federal Reserve in 1983 was that it was placing greater weight on M2 and M3 than on M1 for policy purposes. The focus on M1 in this article is not meant to imply anything about the weight placed on M1 versus the other monetary aggregates for policy purposes in 1983. Rather it reflects three other factors: (1) the revision in the level of M1 was by far the greatest relative to its target range and generated the most public interest; (2) the possible seasonal adjustment problems with M1 were a major concern in policy discussions at the Federal Reserve Bank of Richmond in the latter months of 1983; and (3) this paper evolved from those discussions.

[2] All growth rates referred to in the paper are on an annualized basis.

[3] The range for M1 from the second quarter to the fourth quarter was 5 to 9 percent. The money stock revisions raised the growth rate of M1 over this period from 5.5 to 7.2 percent. Most of the revision in the monthly growth rates of M1 was due to revisions in the seasonal factors. However, a portion (20 percent) was due to benchmark revisions in the unadjusted data.

*For example, "The money supply's faster growth reduces any incentive for the Fed to ease credit conditions, several analysts said" ("Interest Rates Rise as Analysts Worry that Fed Won't Be Loosening Reins Soon," Wall Street Journal, February 4, 1984, p. 45).

Table I

END-OF-YEAR REVISIONS OF SEASONALLY ADJUSTED M1 GROWTH RATES DUE TO SEASONAL FACTOR REVISIONS

(percentage points)

	Revisions in Monthly Growth Rates		Average Revisions in Monthly Growth Rates	
	1982	1983		
January	−1.3	4.1	1973	0.1
February	4.0	−7.8	1974	0.8
March	−1.1	−2.9	1975	2.3
April	−8.7	4.6	1976	0.4
May	10.9	−5.8	1977	2.3
June	4.1	−1.4	1978	1.3
July	3.0	−0.4	1979	2.2
August	−0.1	3.0	1980	1.7
September	−1.7	2.0	1981	2.0
October	−5.8	2.7	1982	3.9
November	−3.8	2.3	1983	3.1
December	1.8	−0.2		

The seasonal factor revisions also influenced expectations concerning the near-term future course of the economy. Many economists place a high weight on changes in the growth rate of the money stock as a determinant of short-run economic activity. The M1 growth rate originally dropped from 14.1 percent over the six months ending May 1983 to 3.4 percent over the six months ending January 1984, causing fears of a recession in the first half of 1984.[5] The money stock revisions reduced the deceleration in M1 from 12.7 percent in the six months ending May 1983 to 5.9 percent in the six months ending January 1984. According to press reports at the time, this lessened expectations of a deceleration in economic activity in 1984.[6]

Most importantly, the 1983 revisions are of interest because the underlying forces that caused them illustrate two major problems faced by monetary policymakers trying to use seasonally adjusted money stock data as a guide to policy: (1) changes in government regulations and policies can cause abrupt changes in the effect of a seasonal event (such as a holiday or a tax date) on the demand for money, and (2) the current year's seasonal factors may at times be inappropriately influenced by past movements in the money stock not related to seasonal events. The purpose of this article is to discuss the goal and possible pitfalls of using seasonally adjusted data as a guide to policy and to illustrate these pitfalls by examining two factors that contributed to the 1983 revisions.

II.

THE GOAL OF USING SEASONALLY ADJUSTED MONEY STOCK DATA FOR POLICY PURPOSES

It is widely believed that the monetary authority should focus on seasonally adjusted money stock data in order to reduce seasonal variations in interest rates.[7] In discussing this goal, it is useful to focus on two behavioral relationships : the public's demand for money and the Federal Reserve's policy reaction function. The public's demand for money varies inversely with interest rates and positively with the volume of monetary transactions and has a random element that reflects movement in money demand not explainable by interest rates or transactions. The Federal Reserve reaction function links movements in various policy targets-such as the money stock or national income-to the Federal Reserve's policy instrument.[8] For instance, when the money stock is growing at a greater-than-desired rate, the Federal Reserve might move its policy instrument in order to put upward pressure on the Federal funds rate and other short-term rates, which, in turn, would decrease the demand for money and bring the money stock back to its desired path.

In terms of the goal of eliminating seasonal movements in interest rates, an ideal seasonal adjustment procedure would have two features. First, it would construct seasonal factors that eliminate movements in the money stock due to the effect of seasonal events (i.e., events that recur at around the same time every year) on the demand for money. The major seasonal events that bring an increase in transactions are holidays (especially Christmas) and tax dates (especially April). The logic here is straightforward. The effect of these seasonal events on the demand for money is temporary. Hence, if the Federal Reserve initially reacts to them by moving its policy instrument in order to put upward pressure on the funds rate and other short-term rates, it will subsequently react by reversing this action. For instance, there is a huge seasonal increase in the demand for money in April to pay Federal income taxes. If the Federal Reserve reacted to this strength by moving its policy instrument in order to put upward pressure on short-term interest rates, this movement in rates would simply have to be reversed in May after the seasonal movement in the demand for money subsided.

[5] See, Milton Friedman, "A Recession Warning," Newsweek, January 16, 1984, p. 68. Also, "More Analysts Doubt Concensus Prediction of Brisk 1984 Growth," Wall Street Journal, January 19, 1984, p. 1.

[6] For example, "[Several analysts said] that the revised figures also should make Reagan Administration officials somewhat happier. Some administrative officials have voiced concern that the Fed was being too restrictive in its credit policy and that the money supply's slow growth since last July might produce a new recession sometime this year [1984]" ("Interest Rates Rise." Wall Street Journal, February 7, 1984, p. 45). Of course, the money supply decelerated sharply even with the revisions. Hence, concern regarding the likelihood of a recession persisted in some quarters. For example, see the comments by Anna Schwartz in "Bonds Continue to Fall on Expectations Fed's Tight Credit Grip May Last a While," Wall Street Journal, February 8, 1984, p. 47.

[7] See [l, pp. 37-39], [4, pp. 292-96] and [9, p. 1] for discussions of the goals and effects of seasonally adjusting the money stock.

[8] The question of what is the Federal Reserve's policy instrument is purposefully left vague here for two reasons. which are discussed in Wallich [13]. First, over the years the policy instrument has changed (at different times it has been the Federal funds rate, the level of nonborrowed reserves, the level of borrowed reserves, etc.). Second, observers occasionally differ as to what term best describes the Federal Reserve's policy instrument at any point in time.

The second feature of an ideal seasonal adjustment procedure would be to avoid eliminating movement in the money stock not due to the effect of seasonal events on the demand for money. In particular, an ideal seasonal adjustment procedure would prevent the seasonal factors from being influenced by movement in the money stock of an apparent seasonal nature that is not due to seasonal events.[9] Such movements could occur if (1) the random term in the money demand equation by chance temporarily has a seasonal pattern, or (2) the Federal Reserve reaction function by chance temporarily introduces seasonality into the Federal funds rate which in turn causes seasonality in the demand for money. The logic here is that seasonality in the money stock due to these forces will not be of a recurring nature. Hence, if the seasonal factors are changed to reflect these temporary forces, in subsequent years the Federal Reserve may react inappropriately to observed seasonally adjusted money. To see why, consider the following example. Suppose for some reason it happens that for two or three years in a row the Federal Reserve moves its policy instrument in a manner that puts downward pressure on the Federal funds rate and other short-term rates in the second half of the year, and as a result money grows more rapidly in the second half of the year than the first. If seasonal factors are constructed that eliminate this movement, then in subsequent years (i.e., after this intra-yearly pattern of short-term rates is no longer present) seasonally adjusted money growth will actually be inappropriately low in the second half of the year. In this case the Federal Reserve might react inappropriately to the perceived weakness in the money supply.

In practice, identifying whether movement in the money stock is in fact due to seasonal events can be very difficult. Although one can identify seasonal events fairly easily, their effect on the demand for money can change over time, sometimes abruptly. Government action as well as technological change can alter the seasonal demand for money related to any specific event. Consider, for example, the April tax date when the seasonal demand for money is positively related to the amount of nonwithheld Federal income taxes that have to be paid. Government action could increase the tax date effect on M1 by raising taxes, decrease its effect on M1 by increasing withholding of taxes at other times during the year, or change the timing of the effect by changing the tax date. Similarly, technological change could influence the seasonal movement in money by increasing the ease of substitution between M1 and other assets or by contributing to the development of new assets not included in M1 with transactions capabilities, such as money market funds.

The question remains: How well does the actual seasonal adjustment procedure incorporate the two features of an ideal seasonal adjustment procedure discussed above, and under what circumstances does the actual procedure depart from this ideal procedure? Prior to 1982, the money stock was seasonally adjusted using the X-11 seasonal adjustment program developed at the Bureau of the Census of the U.S. Commerce Department. Since then, the money stock has been seasonally adjusted with a variant of the X-11 procedure called X-11-ARIMA.

The X-11 program is essentially a ratio-to-moving average seasonal adjustment procedure.[10] For a monthly series the basic steps of this procedure are (1) a 12-month centered moving average of the original series is constructed; (2) this centered average is then divided into the original series to get ratios (called seasonal-irregular ratios) for each month in the series ; and (3) a moving average of these ratios is computed separately for each month (i.e., a separate average of the ratios for January, the ratios for February, etc.). This average is an estimate of the seasonal factor for each month. The use of a moving average of the ratios allows for a seasonal pattern that changes gradually over time.

The version of X-11 used to adjust the money stock data derives seasonal adjustment factors for each individual month in the series primarily from a weighted 7-term moving average of the ratios in the corresponding calendar months of surrounding years. For example, the adjustment factor for January 1980 is derived primarily from a weighted average of the January ratios for the years 1977-1983 inclusive. Where a month is in one of the terminal years of the series, the span of the moving average is reduced since data for a full centered 7-term moving average are not available.

[9] Also, the ideal seasonal adjustment procedure would not allow one-time events, such as the 1980 credit controls, to be transmitted to the estimates of the seasonal factors. See [3, pp. 880-81] for a discussion of the effect of the credit controls on the money stock and the action taken to prevent it from distorting the seasonal factor estimates.

[10] This is a highly simplified description. For a detailed description of the procedure see Shiskin [11]. Lawler [S] contains a step-by-step summary of the X-11 seasonal adjustment of the money stock. Two more recent articles describing the X-11 and X-11-ARIMA procedures are Cleveland and Pierce [3] and Hein and Ott [5]. Cleveland and Pierce also give an excellent discussion of the work done by the staff of the Board of Governors on methods to improve the seasonal adjustment procedures.

The X-11-ARIMA modification of the X-11 procedure differs only in that it uses an ARIMA (autoregressive-integrated-moving-average) model to generate forecasts of future values of the money stock.[11] The forecasted values are then used to project the money stock series into the future, thereby enabling the same weights to be applied to this extended series as are applied to years when all the actual necessary data are available.

There are at least two major sets of circumstances under which this seasonal adjustment procedure departs from the requirements of the ideal procedure discussed above. First, seasonal factors will not fully adjust in one year to an abrupt change in the effect of a seasonal event on the demand for money. Of course, the seasonal factors will not reflect the change at all if it occurs in the current year. Second, the seasonal adjustment procedure can not effectively distinguish between movement in money due to seasonal events and movement of an apparent seasonal nature due to other factors. Hence, the possibility exists that the seasonal factors will at times be inappropriately affected by movements in money not due to seasonal events.[12,13]

These two problems represent opposite extremes for the X-11 seasonal adjustment procedure. The procedure could deal more effectively with abrupt changes in the effect of seasonal events on the demand for money by shortening the number of years used to calculate a given year's seasonal factors. However, doing so would increase the risk that the seasonal factors would be influenced by movement in the money stock due to policy or random events. Conversely, the risk of the seasonal factors being influenced by policy or random events could be reduced by lengthening the number of years used to calculate a given year's seasonal factors. But this would make the seasonal factors less responsive to abrupt changes in the influence of seasonal events on the demand for money.

In the remainder of this article it will be argued that the initial seasonally adjusted money stock data in 1983 were distorted by both of these problems. Section III will discuss an abrupt change in the effect of seasonal events on the demand for money caused by a change in government regulations. Section IV will discuss the possible impact on the original 1983 seasonal factors of past movements in money not due to seasonal events.

III.

AN ABRUPT CHANGE IN THE EFFECT OF A SEASONAL EVENT ON MONEY DEMAND: THE INTRODUCTION OF MONEY MARKET DEPOSIT ACCOUNTS

In December 1982, the money market deposit account (MMDA) was authorized by the Depository Institutions Deregulation Committee (DIDC). The principal features of the account were that it was not subject to an interest rate ceiling, it required an initial deposit and maintenance balance of at least $2500, and depository institutions could not promise to pay any fixed or indexed rate for a period greater than a month. Also, MMDAs were allowed only three transactions by check per month. For this reason the expectation was that they would be treated by investors as "savings" rather than "transactions" accounts and they were not included in M1.[14] This was similar to the decision that had been made in 1980 with respect to money market fund (MMF) shares, which were not included in M1 because most MMFs limit minimum check size to $500 [12]. The expectation regarding the use of MMDAs for transactions purposes has proved correct: the turnover rate of MMDAs has been about three times per year, which is actually a little below that of regular savings deposits. Table II combines MMDAs with MMF shares to get a total measure of non-M1 accounts with some transaction capabilities. The table shows that

[11] This and other proposed modifications to the X-11 seasonal adjustment procedure are discussed in [9, Section 3].

[12] It should be emphasized that this discussion does not imply that there is some easy way to deal with these problems. Following the recommendation of the Committee of Experts on Seasonal Adjustment Techniques [8], a continuing research program on seasonal adjustment methods has been established at the Board of Governors. The Board's staff has studied numerous possible improvements in the seasonal adjustment process. one of which was the ARIMA modification to the basic X-11 model. (See [3].) Another recommendation of the Committee of Experts was to study "model-based" approaches to seasonal adjustment of the money stock which would in part relate the seasonal factors directly to seasonal events. The staff of the Board of Governors responded to this recommendation by developing an experimental model-based approach to construction of the seasonal factors [10]. There is some evidence that this procedure is better able to identify seasonal movement in money strictly due to seasonal events than is X-11. (See footnote 21 later in this article.)

[13] A third problem, not discussed in this paper. is that there can be one-time events whose distortions are transmitted to the estimates of the seasonal factors (see footnote 9).

[14] A second account, the "Super-NOW," introduced in January 1983, was allowed unlimited transactions and included in M1.

Table II

THE CHANGING COMPOSITION OF TRANSACTIONS AND SAVINGS ACCOUNTS

Asset	Amount Outstanding ($ billions) Nov. 1980	Apr. 1981	Nov. 1981	Apr. 1982	Nov. 1982	Apr. 1983	Nov. 1983	Turnover Rate*	Can Be Used Directly for Transactions	Included in M1
Demand deposits and other checkable deposits	297.7	306.6	309.9	318.4	338.9	354.2	371.0	35**	Yes	Yes
MMDAs and money fund shares (general purpose and broker/dealer)	62.1	94.3	143.0	161.8	190.8	489.6	511.7	about 3	Yes	No
Savings deposits	414.5	375.3	343.4	346.6	366.8	321.9	315.4	3 to 4	No	No

* Turnover rates ore for consumer deposits.

** This estimate of the turnover rate on consumer demand deposits is from [12, p. 100].

by April 1983 the amount of these accounts outstanding was considerably greater than either transactions accounts included in M1 or regular savings accounts.

Despite their low turnover rate, MMDAs (and MMF shares) can be used just like regular savings deposits to cover large seasonal needs, such as tax payments in April and Christmas-related expenditures. Unlike regular savings deposits, however, these accounts can be used *directly* for seasonal transactions purposes, and this can reduce the seasonal use of M1 that normally occurs at the April tax date and at Christmas. The reasoning is as follows. Regular savings deposits have to be moved into transactions accounts before they can be used to cover seasonal transactions needs. Ordinarily, these funds are moved into demand deposits, which are included in M1. Consequently, unadjusted M1 rises before the April tax date and before Christmas and then subsequently falls. In contrast to savings deposits, MMDA and MMF accounts can be used at tax time and Christmas time without being moved into M1. To the extent this is done, it reduces the buildup and subsequent contraction of M1 deposits. Consequently, the greater the use of non-M1 transaction accounts to cover seasonal transaction needs, the smaller will be the amplitude of the cycle in unadjusted M1 for any given seasonal event. The possible effects of MMDAs and MMFs on the seasonal demand for M1 around the April tax date and Christmas in 1983 are considered below.

The April Experience

Because transactions related to the April tax date are concentrated over a very short period of time, it is possible--at least for 1983-to use weekly MMDA and MMF data to illustrate the effect of the use of MMDAs and MMFs on the normal seasonal buildup in M1. The Treasury normally takes the week of the tax date (April 15) and the following two weeks to fully process and collect tax payments. Table III shows that changes in MMDAs and MMF shares the week including April 15 and the following two weeks were very low relative to the surrounding weeks. Since these three weeks coincide with the period in which transactions balances normally decline as the Treasury collects tax payments, it is reasonable to attribute the weakness in MMDAs and MMFs at this time to their use for tax payments.

Table III also shows a hypothetical path for MMDAs and MMF shares that would have occurred in the absence of the tax date. The path is based on the assumption that were it not for tax payments, weekly changes in MMDAs and MMF shares would have been at least equal to the smallest weekly change for the two weeks on either side of the three-week tax period. The total difference of $8.8 billion between the hypothetical and actual paths of MMDAs and MMF shares is a very rough estimate of the extent to which these accounts were used for tax purposes.[15] The total amount of nonwithheld indi-

[15] This estimate does not imply that nothing else was affecting the weekly flows of MMDAs and MMF shares over the period shown in Table III, only that the weakness of each asset in the weeks from April 20 through May 4 relative to the surrounding weeks can be attributed to tax payments. A number of specific points related to this general comment are: (1) The weakness in MMF shares and the strength in MMDAs over the whole period shown in Table III reflects the movement of funds out of MMFs into MMDAs during this period. The estimate in the text abstracts from this movement by comparing the growth of each asset in the tax payment period to its own growth in the surrounding weeks. (2)

Table III

WEEKLY CHANGES IN MMDAs and MMF SHARES

($ billions)

1983	MMDAs Actual	MMDAs Hypothetical	MMDAs Difference	MMF Shares (general purpose and broker/dealer) Actual	MMF Shares Hypothetical	MMF Shares Difference
March 23	5.7			- 1.0		
March 30	4.0			- 1.6		
April 6	5.6			- 1.3		
April 13	5.7			- 1.6		
April 20	1.7	4.4	2.7	- 3.1	- 1.6	1.5
April 27	1.1	4.4	3.3	- 2.5	- 1.6	0.9
May 4	4.1	4.4	0.3	- 1.7	- 1.6	0.1
May 11	5.2			- 1.0		
May 18	4.4			- 0.1		
May 25	3.8			- 0.1		
June 1	3.0			- 0.2		

Note: Hypothetical path equals the smallest change for two weeks on either side of the three tax payment weeks.

vidual income tax payments in April and May of 1983 was $33.1 billion. Hence, this estimate implies that about one-fourth of these payments were made with MMDAs and MMF shares.

This $8.8 billion figure can be used to get a rough estimate of the effect of MMDAs and MMFs on the M1 growth rate in April. A dollar of funds that is moved into demand deposits to pay taxes stays there about one-half of a month.[16] On the basis of this estimate, MMDAs and MMFs together lowered the monthly average level of M1 in April by $4.4 billion. If the assumption is made that the M1 seasonal factors had already fully captured the effect of the MMF shares outstanding in April 1982 ($161.8 billion-or 33.0 percent of the April 1983 combined level of MMDAs and MMF shares), then the introduction of MMDAs lowered the seasonally adusted level of M1 in April 1983 by $2.9 billion and reduced the seasonally adjusted growth rate by 7.0 percentage points.

Christmas

A second major period of seasonal need for transactions funds occurs in the months preceding Christmas. Typically the monthly average level of unadjusted M1 begins to rise in September, peaks in December and then falls through February.[17] Because of this pattern, the seasonal factors reduce the growth rate of M1 in the period from September through December and increase it in January and February.

Unlike the April tax date, when transactions are

Tax refunds may have been boosting MMDAs throughout this period,-but there is no reason to believe they were boosting MMDAs in the tax payment weeks any less than in the surrounding weeks. (3) There may have been some buildup in MMDAs in early April for tax payment purposes. However, the use of a post-tax date week to get the hypothetical MMDA path should prevent this possibility from affecting the path. (4) The monthly flow of funds into IRAs in 1983 reached its peak in April. Growth in IRAs at commercial banks! thrift institutions, and MMFs was $4.8 billion in April compared to an average 1983 monthly increase of $2.0 billion. Some part of these funds probably came out of MMDAs and MMF shares at around the tax date. If so, the procedure used in the text may bias upward the estimated effect of these accounts on M1 growth. However, the increased IRA payments in April are small compared to the payments for nonwithheld taxes, so the bias should be small.

[16] This estimate is based on the ratio of the strictly seasonal movement in M1 in April-calculated as the difference between the unadjusted and seasonally adjusted changes-to total nonwithheld individual income taxes in April and early May, which ranged from 46 to 51 percent in the years from 1976 through 1980. (The ratios in the years after 1980 are excluded because they were probably affected by the growth of MMFs.) While this estimate might seem high, it is evident from the weekly unadjusted data that the buildup in M1 starts well before the 15th and the contraction in M1 takes till the end of the month. The slowness of the contraction in M1 following the tax date occurs because it takes the Treasury 2 to 3 weeks to process and collect all the tax payments. (The daily pattern of Treasury tax collections is available from the Daily Statement of the U. S. Treasury).

[17] For more detail on the behavior of unadjusted M1 around Christmas see Broaddus and Cook [2].

concentrated at one date, Christmas-related expenditures are distributed over a period of months, making it difficult to illustrate the use of these accounts at Christmas by looking at weekly data. Also, as noted above, MMDAs are limited to three transactions by check per month and most MMFs limit minimum check size to $500. The April tax payment is ideally suited to these accounts since it involves only one large payment. In contrast, Christmas expenditures involve numerous smaller transactions, not all of which can be handled directly by these accounts because of the limitations on transactions. However, one can also use these accounts at Christmas indirectly by making numerous small expenditures with a credit card before Christmas and one large transaction in January with an MMDA or MMF account. To the extent that this was done, the use of MMFs and MMDAs to finance Christmas-related expenditures was spread out over an even longer period going well into January.

Tables IV and V present evidence that MMDAs and MMFs were used around Christmas for transactions purposes both directly and indirectly in conjunction with credit cards. Table IV shows that redemptions of MMDAs and MMF shares were high in both December and January. The high level of redemptions in January suggests that credit cards were in fact used in conjunction with MMDAs and MMFs to circumvent the restrictions on the use of those accounts for transactions purposes. If this was the case, then revolving (i.e., credit card) installment credit (on a seasonally adjusted basis) should have grown relatively rapidly in the months prior to Christmas and then relatively weakly after Christmas as people wrote checks against their MMDA and MMF accounts. As shown in Table V, revolving installment credit grew at a much faster rate than non-revolving installment credit in the months prior to Christmas and at a much slower rate in January. From December to January the differential between the growth rate of revolving installment credit and other installment credit fell by 17 percentage points.[18]

Additional evidence on the possible effect of

[18] A couple of caveats should be made about the interpretation of the differential between the growth rates of revolving and non-revolving installment credit. First, the monthly growth rates of revolving and non-revolving installment credit are volatile. There are other instances when this differential has fallen by as much as 17 percentage points, although not over the December-January period. Hence, the swing in this differential should only be viewed as consistent with-not proof of--the position that credit cards were used in conjunction with MMDAs around Christmas. Second, the growth rates referred to are seasonally adjusted rates. If the seasonal pattern of revolving installment credit has changed around Christmas, then the revolving credit seasonal factors will change over time to reflect this. In future years the sharp drop in the differential between the growth rates of revolving and other installment credit from December to January will be eliminated. The situation is analogous to the impact of MMDAs on the M1 seasonal factors.

Table IV

REDEMPTIONS AND TURNOVER RATES OF MMDAs AND MMF SHARES

($ billions)

	MMDAs			MMFs (excluding institutions-only)		
1983-1984	Monthly Redemptions	Outstanding (monthly avg.)	Turnover Rate	Monthly Redemptions	Outstanding (average of end of current and previous months)	Turnover Rate
July	50.3	217.0	2.8	26.6	130.3	2.4
August	54.6	217.5	3.0	27.7	130.3	2.6
September	53.5	219.7	2.9	26.8	129.4	2.5
October	58.4	222.0	3.2	24.9	128.7	2.3
November	53.3	225.3	2.8	24.0	128.7	2.2
December	62.2	228.4	3.3	26.7	127.2	2.5
January	66.1	232.5	3.4	29.4	127.0	2.8
February	56.8	236.5	2.9	24.6	129.5	2.3

Source: MMDA data are from April 17, 1984 Federal Reserve Statistical Release G.6, "Debits and Deposit Turnover at Commercial Banks." MMF data ore from various issues of Donoghue's Money Fund Report of Holliston, MA 01746.

Note: Turnover rate equals monthly redemptions multiplied by 12 and divided by amount outstanding.

Table V

THE BEHAVIOR OF REVOLVING CREDIT OVER THE 1983-84 M1 CHRISTMAS PERIOD

(seasonally adjusted)

	Revolving Installment Credit		Other Installment Credit		Difference
	Change in Outstanding ($ millions)	Percentage Increase (SAAR)	Change in Outstanding ($ millions)	Percentage Increase (SAAR)	(in percentage points)
July	821	14.8	4,019	16.7	-1.9
August	313	5.6	3,075	12.6	-7.0
September	479	8.5	1,896	7.7	0.8
October	1,145	20.1	3,740	15.1	5.0
November	1,300	22.5	3,371	13.4	9.1
December	1:720	29.3	4,890	19.3	10.0
January	504	8.4	3,996	15.4	-7.0
February	1,270	20.9	5,340	20.5	0.4

Source: Federal Reserve Statistical Release G.19.

MMDAs and MMFs on M1 during the 1983-84 Christmas period comes from a comparison of the buildup and subsequent contraction in unadjusted M1 in 1983-84 to previous years. Table VI shows that in the five years before 1983-84 the growth rate of unadjusted M1, net of trend, in the four months preceding Christmas averaged 12.5 percent. However, in 1983 the growth rate, net of trend, was only 10.9 percent. It is impossible to prove that this weakness in the pre-Christmas buildup of M1 was neces-

Table VI

CHRISTMAS M1 CYCLE

(annualized unadjusted growth rates)

	(1) August to February	(2) August to December	(3) December to February	(4) August to December Detrended (col. 2 - col. 1)	(5) December to February Detrended (col. 3 - col. 1)
1973-74	4.2	16.8	-20.0	12.6	-24.2
1974-75	1.6	15.5	-24.8	13.9	-26.4
1975-76	2.0	13.3	-19.9	11.3	-21.9
1976-77	5.2	17.5	-18.3	12.3	-23.5
1977-78	4.9	18.5	-21.1	13.6	-26.0
1978-79	2.6	17.6	-25.9	15.0	-28.5
1979-80	2.3	13.4	- 19.0	11.1	-21.3
1980-81	3.1	15.3	-20.2	12.2	-23.3
1981-82	3.4	14.8	- 18.6	11.4	-22.0
1982-83	11.6	24.2	-12.7	12.6	-24.3
Average 1973-78				12.7	-24.4
Average 1978-83				12.5	-23.9
1983-84	3.3	14.2	-17.7	10.9	-21.0

sarily due to MMDAs and MMFs. However, in conjunction with the redemption and revolving credit data this interpretation is certainly plausible.[19]

IV.

INAPPROPRIATE INFLUENCE ON SEASONAL FACTORS OF MOVEMENT IN MONEY NOT DUE TO SEASONAL EVENTS: THE CASE OF 1981-82

As noted in Section II, the current seasonal adjustment procedure can not effectively distinguish between movement in the money stock related to seasonal events and movement of an apparent seasonal nature resulting from other forces. An apparent seasonal pattern in money not related to seasonal events might occur for a number of reasons. One possibility would be that, for whatever reason, the Federal Reserve moved its policy instrument in a manner that caused the Federal funds rate and other short-term rates to move in a similar pattern over more than one year. This would tend to impart a seasonal influence on money (via the demand for money) which would influence the calculation of the seasonal factors. It appears likely that this phenomenon occurred over the 1981-82 period.

Chart 1 graphs the intra-yearly pattern of the Federal funds rate in 1981 and 1982. In both years the funds rate was at or close to its yearly high at around midyear and then fell sharply to its yearly low at year-end. In 1981 the funds rate fell from 19.04 percent in July to 12.37 percent in December, while in 1982 the funds rate fell from 14.15 percent in June to 8.95 percent in December.

In order to get a measure of the effect of movement in the funds rate on the intra-yearly pattern of the demand for money, it is necessary to use the interest rate coefficients of a money demand equation. Chart 2 shows the intra-yearly pattern in money demand in 1981 and 1982 predicted by the movement in the funds rate in those years and the interest rate coefficients of the San Francisco Federal Reserve Bank's money demand equation [6].[20] The values in the chart are shown as deviations in billions of dollars from the average predicted level for each year and are solely dependent on interest rate movements (the procedure used to get these values is described in a note to the chart). A high value in a given month means that the current and lagged funds rate was causing the demand for money to be high in that month relative to the average level for the year. The latter five months of 1982 are extremely high relative to the rest of 1982. This pattern is also evident, but to a lesser degree, in 1981.

The relative strength of the series shown in Chart 2 in the latter months of 1981 and 1982 suggests that Federal Reserve policy may have introduced seasonality into the money stock in the 1981-82 period. Of course, this "policy-related" seasonality would

[19] A second factor that may have affected the pattern of M1 around Christmas is the increased share of other checkable deposits (OCDs) in M1. The argument would be that OCDs have a greater "savings" component than the rest of M1 (see [7]) and that therefore their inclusion in M1 should decrease the amplitude of the cycle in unadjusted M1 around Christmas. The seasonal behavior of OCDs is hard to assess because they have only been sizable since 1980-i.e., over four Christmas periods. Of these, the seasonal pattern of OCDs around Christmas was distorted by the introduction of nationwide NOW accounts in January 1981 and super-NOW accounts in January 1983. Furthermore, throughout the period there is a strong upward trend in OCDs. In the 1983-84 cycle the seasonal increase in OCDs does appear to have been weaker than the seasonal increase in the rest of M1. However, as shown in Table VI, the seasonal increase in M1 prior to Christmas in the three years before 1983-84 averaged 12.1 percentage points, which was considerably above the 1983-84 buildup. This suggests that another factor was at work in 1983-84.

[20] Actually, the interest rate used in the San Francisco money demand equation is the six-month commercial paper rate, not the Federal funds rate. However, the two rates are very closely correlated over the 1981-82 period, as evidenced by a simple correlation coefficient of .94. Consequently, applying the San Francisco interest rate coefficients to the Federal funds rate gives a close approximation of the interest rate effect on the demand for money predicted by that equation.

Chart 1

THE INTRA-YEARLY PATTERN OF THE FEDERAL FUNDS **RATE: 1981 AND 1982**

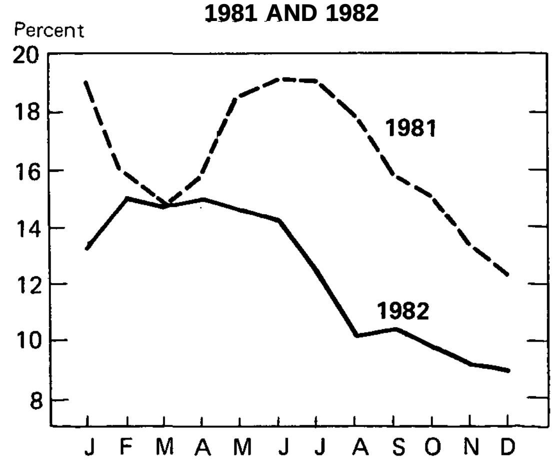
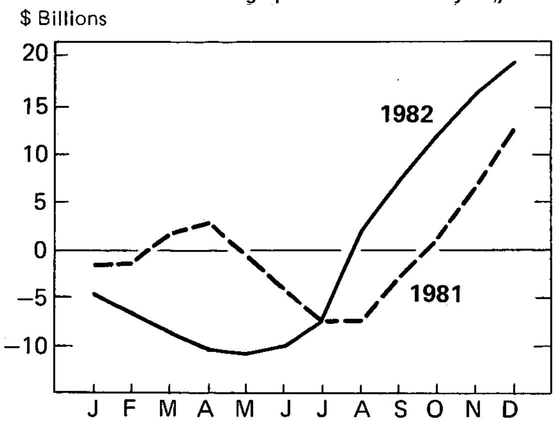


Chart 2

ESTIMATE OF THE EFFECT OF MOVEMENT IN THE FUNDS RATE ON THE SEASONAL PATTERN OF M1 IN 1981 AND 1982

(Differences between predicted value for month and average predicted value for year,)



Note: The estimates in this chart were calculated as follows:

1. Values for the interest rate effect (IE) on money demand were calculated for each month using the interest rate coefficients of the San Francisco Federal Reserve Bank's money demand equation (estimated with data from August 1976 through December 1981):

$$IE = -.059 \ln (RFF) - .041 \ln (RFF-1) - .027 \ln (RFF-2) - .015 \ln (RFF-3) - .007 \ln (RFF-4) - .002 \ln (RFF-5)$$

2. The predicted level of M1 each month was calculated by the equation

$$\ln (M1) = b + IE$$

where b is a constant set at a value (6.495) so that the average predicted level of M1 in the 1981-82 period would equal its actual average level. The effect of this simplification is to abstract from the impact on money demand of the other variables-personal income and changes in bank loans-in the San Francisco equation.

be a problem in interpreting the seasonally adjusted 1983 M1 data only if it influenced the calculation of the 1983 seasonal factors. However, given the nature of the X-11 seasonal adjustment procedure, it is reasonable to expect. that the 1983 seasonal factors would, in fact, be affected by the increase in money demand resulting from the sharp decline in the funds rate in the latter months of 1981 and 1982.

A way to get a crude estimate of the possible effect of policy-related seasonality in 1981 and 1982 on the original seasonally adjusted growth rates of the money stock in 1983 is to compare these growth rates to growth rates calculated using seasonal factors from the period before 1981 and 1982. This was done using the original seasonal factors for 1980. Over the five months ending in December 1983, M1 computed with the 1980 seasonal factors grew at an annual rate of 4.8 percent; this is 2.2 percentage points greater than the growth rate of M1 calculated with the original 1983 seasonal factors.[21]

This estimate of the effect of policy-related seasonality in 1981 and 1982 on the original seasonally adjusted M1 growth rate over the last five months of 1983 rests on the assumption that nothing else in 1981 and 1982 was changing the seasonal pattern of M1 in a way that would increase growth over that period relative to the first seven months of the year. Ultimately, perhaps the best test of whether policy-related seasonality in 1981 and 1982 distorted the original seasonally adjusted M1 data in 1983 is whether the seasonal factors eventually revert to their pre-1981 levels. The 1984 seasonal factor revisions, which provide some evidence on this point, are discussed below.

V.

THE 1984 SEASONAL FACTOR REVISIONS

Table VII summarizes the effect of the 1984 revisions in the seasonal factors on the 1983 M1 growth rates for the periods discussed in this article. The revisions lowered the April growth rate by 4.6 percentage points and raised the May growth rate by a comparable amount. The revisions raised the growth rate of M1 in the four months preceding Christmas by 1.7 percentage points and lowered the growth rate by 2.5 percentage points in the two months following Christmas. The revisions raised the growth rate of M1 by 2.0 percentage points over the last five months of the year. Also, as shown earlier in Table I, all but one of the revisions in the seasonally

[21] An interesting question is whether the experimental model-based seasonal factors (see footnote 12) are less likely to be affected by policy-related seasonality than the X-11-ARIMA seasonal factors. The model-based seasonal factors have been published only since 1982. However, based on the 1982-83 experience, there is some evidence that they are superior in this regard. The early 1983 X-11-ARIMA seasonal factor revisions lowered the 1982 M1 growth rate from July to December by 1.9 percentage points, and then the early 1984 revisions raised the 1983 M1 growth rate over those months by 2.0 percentage points. In contrast, the early 1983 experimental model-based seasonal factors lowered the 1982 M1 growth rate from July through December by only 1.1 percentage points, and then the early 1984 revisions left the 1983 M1 growth rate over those months virtually unchanged.

Table VII

REVISIONS IN 1983 SEASONALLY ADJUSTED M1 GROWTH RATES DUE TO SEASONAL FACTOR REVISIONS

(annualized rates)

	Original Growth Rate	Revised Growth Rate (excluding benchmark)	Revision (percentage points)
April	- 2.7	1.9	+ 4.6
May	26.3	20.5	- 5.8
August to December	2.6	4.3	+ 1.7
December to February 1984	10.9	8.4	- 2.5
July to December	2.6	4.6	+ 2.0

source: Federal Reserve Statistical Release H.6 (February 10, 1984).

adjusted monthly growth rates were in the opposite direction of the early 1983 revisions of the 1982 growth rates.

Because of the very nature of the X-11-ARIMA seasonal adjustment procedure, it is impossible to positively identify what underlying development or developments caused the seasonal factors to change. However, the revisions are consistent with the hypotheses that (1) the introduction of MMDAs caused a change in the pattern of the demand for M1 around seasonal events and (2) the original 1983 seasonal factors were inappropriately influenced by policy-related seasonality in money demand in 1981 and 1982. (Although both developments relate in part to the last four or five months of the year and the upward revision in the, seasonally adjusted growth rate over this period may reflect one but not both of them.) The latter argument is also consistent with the fact that the revisions largely reversed the impact on the growth of M1 in the latter five months of the year caused by the early 1983 revisions.

VI.

CONCLUSIONS

The goal of focusing on seasonally adjusted money stock data for policy purposes is to reduce seasonal fluctuations in interest rates resulting from the impact of seasonal events on the demand for money. Given the nature of the current seasonal adjustment procedure, there are at least two major types of circumstances that could hinder this objective. First, there can be abrupt changes in the impact of seasonal events on the demand for money that are not fully captured initially by the seasonal adjustment procedure. Second, the seasonal adjustment factors may be affected inappropriately by movement in money not due to seasonal events.

It appears likely that the original 1983 seasonally adjusted money stock data were influenced by both these circumstances. The introduction of MMDAs probably decreased the use of M1 balances at times of major seasonal transactions needs, such as the April tax date and Christmas. And the policy-related seasonality in the money stock in 1981-82 probably affected the original 1983 seasonal factors. While the nature of the X-11 seasonal adjustment procedure makes it impossible to say for sure what underlying developments caused the large revisions in the 1983 M1 seasonal factors, the revisions were consistent with the view that these two problems did affect the original seasonally adjusted M1 data.

The discussion in this article points out a potential hazard of resetting the money supply target at midyear, as was done in 1983. The seasonal factors are calculated on a 12-month basis and seasonal factor problems frequently only become apparent as the year progresses. If annual targets are set, these problems simply wash out over the year. However, if the target is reset at midyear from a new base, the seasonal adjustment errors in the first half of the year are in effect built into the base of the new target.

As a final comment, there are two reasons to be optimistic that the problems in focusing on seasonally adjusted money stock data in coming years will not be as great as in 1983. First, it can be argued that difficulties in seasonally adjusting the money stock are most often associated with changes in government regulations and policies. The period from 1978 through 1983 included an extraordinary number of such changes, including some discussed in this paper (such as MMDAs) and others not discussed (the introduction of money market certificates in 1978, the October 1979 change in monetary policy operating strategy, the early 1981 introduction of nationwide NOW accounts, the 1980 credit controls). Many, if not most, of these developments were related to the deregulation of interest rates at depository institutions, which is a process that has largely been completed. Hence, this source of disruption to the seasonal pattern of M1 should be greatly diminished.

Second, the problems discussed in this paper relate specifically to the current seasonal adjustment procedure (i.e., X-11-ARIMA). In accordance with the recommendations of the Committee of Experts on Seasonal Adjustment Techniques [9], a continuing research program on seasonal adjustment methods has been established at the Board of Governors [3]. There is reason to hope that the work being done by the Board's staff will lead to a seasonal adjustment procedure that is better able to isolate the effect of seasonal events on the demand for money. In particular, model-based procedures that, at least in part, relate the construction of the seasonal factors directly to specific seasonal events may be fruitful in accomplishing this end.

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