Seasonal Revisions

Last February, the Federal Reserve published revisions of the data for the 1983 monetary aggregates. The revisions reflected new estimates of the seasonal and benchmark adjustments routinely made for M1, M2 and M3. Such adjustments are highly technical subjects that normally do not arise in discussions of monetary policy, but the revisions for 1983 were different. They significantly raised the original estimates of M1-growth during the M1-monitoring period established for the second half of 1983 by the Federal Open Market Committee (FOMC)—the Fed's chief monetary policymaking body. Monetary policy that had been characterized as fairly "tight" under the original M1 figures appeared "easier" with the revised numbers (see the charts). This *Letter* discusses the use of seasonal adjustments and the likelihood that "misleading" estimates of M1 will re-occur.

Why and how?
Seasonal adjustments are designed to remove from the monetary statistics changes that are due to seasonal variations in the public's need for money. For example, the currency and checkable deposits in M1 tend to build up prior to Christmas as they are needed for shopping, and then taper off after the holiday season. Seasonal movements therefore reflect temporary changes in the public's demand to hold M1 and are independent of the trends in macroeconomic variables such as interest rates and GNP. Since seasonal movements in the public's money holdings have no effect on the future course of the economy, the Fed attempts to accommodate seasonal demands by formulating its monetary targets in terms of the seasonally adjusted monetary data.

The seasonal factors used in generating these data are estimated with a statistical method called X-11 ARIMA. To see how this method works, consider the simple case in which seasonal patterns do not change from year to year and the monetary aggregates follow no trend or cycle. In this case, a way to estimate the seasonal component for, say, January would be to calculate the difference between the average of M1 for all Januarys and the average of the series over all months.

The X-11 procedure extends this idea to allow for a trend/cycle component and changing seasonal patterns. The trend/cycle component is estimated with a centered moving average of the series (where the data closest to the month being adjusted receives the most weight). The seasonal factors for January are calculated by taking the ratio of each January in the sample to its respective centered moving average. Once the seasonal factors are calculated in this way, they are divided into the not-seasonally-adjusted money series to obtain the seasonally adjusted monetary data used in policymaking.

In employing centered moving averages, X-11 makes equal use of past and future data. However, when current data are being adjusted, the future data on the series are not yet available. This is where the ARIMA part of the estimation procedure comes in. An ARIMA model "explains" the monetary aggregate on the basis of its past values. It is used to project future values of the unadjusted series. The X-11 method then is applied using the actual past values and the ARIMA-projected future values.

At the beginning of each year, usually in February, the Fed replaces the projected data that had been used in calculating the original seasonal factors for that year with the actual data and revises the originally estimated seasonal factors accordingly. By their construction, seasonal revisions cannot alter growth in a monetary aggregate over a year as a whole, but they may affect the pattern of growth within a year.

At the same time, the Fed makes benchmark revisions in the monetary data. These revisions correct measurement error, whether due to the later availability of data from depository institutions that report infrequently or the discovery of reporting errors not detected earlier, in the seasonally unadjusted series.

The 1983 adjustments
The monthly differences between original and revised M1 in 1983 were quite large in some cases. Expressed as annualized growth rates, the largest monthly revision in 1983 was 7.6 percentage points in February. On average in 1983, the absolute difference between revised and original M1 averaged 3.1 percentage points of annualized growth for monthly data. Although large, revisions of this size are *not* out of line with previous experience—over the preceding three years, revisions of the preceding year's monthly data averaged 2.7 percentage points.

Large monthly errors normally do not give a misleading picture of the direction of monetary policy because the upward and downward adjustments tend to cancel out over the span of several months. Thus, the rather large monthly revisions noted above compare to the far smaller average quarterly and semi-annual revisions of 0.8 and 0.2 percentage points in the period from 1980 to 1982.

Last year was unusual in that there were large revisions in the semi-annual data. A long string of downward revisions in the months of the first half of 1983 were matched by a long series of upward revisions in the second half, leading to an average (absolute) semi-annual revision of 1.3 percentage points. In the first half of the year, benchmark revisions had no effect while seasonal revisions lowered M1 growth by 0.9 percentage point. In the second half of the year, benchmark changes caused an upward revision of 0.7 percent and seasonal changes caused an upward revision of 1.0 percent, for a total of 1.7 percent.

Growth in original M1 over the second-half monitoring period was 5.5 percent, near the bottom of the 5 to 9 percent monitoring range. This seemingly slow growth in original M1 indicated that monetary policy was fairly restrictive and suggested to some analysts that there might be a recession in 1984. Revised M1 gives a different picture. It shows M1 growing at a 7.2-percent rate, slightly above the midpoint of the monitoring range.

Why were seasonal revisions so large?
An important cause of the large 1983 seasonal revisions appears to be the ARIMA forecasts of M1, used as part of the calculation of the original 1983 seasonals, which did not correctly predict the pattern of actual M1 growth over the year. In essence, the ARIMA forecasts failed to anticipate the rapid M1 growth in the first half of 1983, and the deceleration later in the year.

This is not surprising, since the ARIMA model forecasts M1 on the basis of lagged values of M1 only, and incorporates no information about the Fed's policy actions. The rapid M1 growth in the latter half of 1982 and the first half of 1983 appears to have been significantly influenced by the sharp decline in interest rates beginning in August 1982. Since the ARIMA model incorporated no information about interest rate movements, it quite naturally underestimated M1 growth in the period following the interest rate decline.

When the actual data for 1983 replaced the ARIMA forecast in the seasonal adjustment program, the estimated seasonal factors for the first half of 1983 rose and forced a downward revision in estimated M1 growth. Since seasonal effects must "wash-out" over the year as a whole, the downward adjustment of seasonally adjusted M1 growth in the first half of the year required an upward adjustment of equal size in the second half.

These revisions reflect problems inherent in seasonally adjusting a quantity that is signifi-

Chart 1
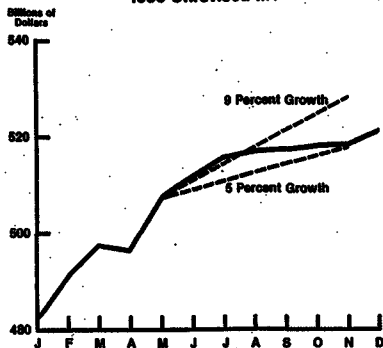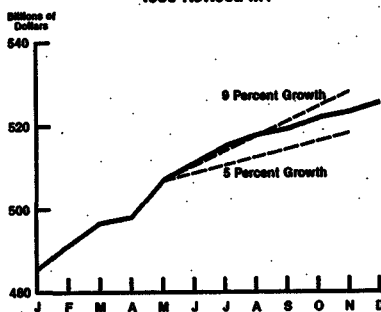**1983 Unrevised M1**

Billions of Dollars

Chart 2
1983 Revised M1

cantly affected by policy. As noted earlier, the goal of seasonal adjustment is to remove from the monetary aggregates movements in the public's seasonal *demands* for money. However, the seasonal adjustment procedures cannot distinguish between M1 movements caused by changes in demand and those induced by changes in monetary policy. By its very nature, X-11 ARIMA will attribute part of such policy movements to seasonality, unless policy follows a regular cyclical pattern.

None of this discussion is intended to suggest that information on monetary policy should be used in calculating seasonal factors. Seasonal adjustment of monetary data by the Federal Reserve is done under a strict constraint to be objective. In other words, monthly seasonal factors are calculated in an objective (non-judgmental) way that can be reproduced easily by the public. This approach conforms to the recommendation in 1981 of the Board's Committee of Experts on Seasonal Adjustment Techniques, made up of distinguished outside experts on this subject. Attempting to cope with problems of policy movements in money necessarily would involve the kind of judgmental adjustments that would violate the objectivity constraint under which the Federal Reserve operates.

Will the problem re-occur?
The revisions to M1 in 1983 raise an important policy issue. Are future seasonal revisions likely to change the picture of monetary policy as much as they did in 1983? The answer is probably not. The problems in 1983 were the result of the coincidence of three events unlikely to occur simultaneously again. First, the benchmark revisions were unusually large and their net

effects were entirely concentrated in the last half of the year. As discussed in the April 1984 *Federal Reserve Bulletin,* a large portion of these revisions were related to changes last year in reporting responsibilities, some associated with the introduction of new accounts, of some depository institutions, and are unlikely to happen again now that these institutions are more familiar with the new reporting system.

Second, although another large swing in M1 probably *would* cause another set of large revisions in the seasonals, an M1 swing like the one in 1982-83 is not likely to re-occur. Cumulative M1 movements of that size are highly unusual in the post-war period.

Finally, large seasonal and benchmark revisions in the second half of last year happened to correspond to the second half monitoring period established by the Federal Reserve for M1. Last year was the first time that the FOMC established a range that did not cover an entire one-year period. Annual ranges have the advantage that money growth from the end of one year to the end of the next, by definition, cannot be affected by seasonal revisions. One lesson to be learned from 1983, then, is that studying money growth over a semi-annual range involves a greater risk that data revisions will alter any interpretation of tightness or ease in monetary policy.

In sum, it seems fair to conclude that unless the FOMC establishes ranges shorter than a year, and unless historically large cumulative movements in M1 are observed during the year, the risk that data revisions will significantly distort one's picture of monetary policy appears to be small.

John P. Judd

BANKING DATA—TWELFTH FEDERAL RESERVE DISTRICT
(Dollar amounts in millions)

Selected Assets and Liabilities Large Commercial Banks	Amount Outstanding 6/06/84	Change from 5/30/84	Change from 12/28/83 Dollar	Percent Annualized
Loans, Leases and Investments[1] [2]	180,167	549	4,142	5.3
Loans and Leases[1] [6]	160,826	694	5,471	7.9
Commercial and Industrial	48,451	120	2,488	12.2
Real estate	59,927	45	1,028	3.9
Loans to Individuals	28,232	41	1,581	13.4
Leases	5,009	24	− 54	− 2.4
U.S. Treasury and Agency Securities[2]	11,973	28	− 534	− 9.6
Other Securities[2]	7,368	− 173	− 795	− 22.0
Total Deposits	189,708	2,102	− 1,289	− 1.5
Demand Deposits	45,610	1,105	− 3,627	− 16.6
Demand Deposits Adjusted[3]	29,963	2,190	− 1,368	− 9.8
Other Transaction Balances[4]	12,785	673	10	0.1
Total Non-Transaction Balances[6]	131,313	324	2,328	4.0
Money Market Deposit Accounts—Total	39,319	− 54	− 278	− 1.5
Time Deposits in Amounts of $100,000 or more	39,474	48	1,309	7.7
Other Liabilities for Borrowed Money[5]	19,956	149	− 3,051	− 29.9

Weekly Averages of Daily Figures	Week ended 6/4/84	Week ended 5/21/84	
Reserve Position, All Reporting Banks			
Excess Reserves (+)/Deficiency (−)	31	− 16	
Borrowings	167	55	
Net free reserves (+)/Net borrowed(−)	− 135	− 71	

[1] Includes loss reserves, unearned income, excludes interbank loans
[2] Excludes trading account securities
[3] Excludes U.S. government and depository institution deposits and cash items
[4] ATS, NOW, Super NOW and savings accounts with telephone transfers
[5] Includes borrowing via FRB, TT&L notes, Fed Funds, RPs and other sources
[6] Includes items not shown separately

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