# Effects of seasonal adjustment on the money stock

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The emphasis placed on money stock changes in the conduct and analysis of monetary policy has recently increased interest in the seasonal adjustment of the money stock. This new interest can be seen several ways. Money market analysts, for example, are using an apparent seasonal pattern in the seasonally adjusted money stock as an aid to prediction. Also, annual revisions in the seasonal adjustment factors the Federal Reserve uses in adjusting raw money figures seem to be getting bigger. The most recent revisions were the largest ever.

These developments suggest there could be problems with the current procedure for seasonally adjusting the money stock. As a result, the Federal Reserve has appointed a commission of outside economists and statisticians to review the seasonal adjustment techniques used by the Board of Governors in adjusting financial data.

This article examines the effect of seasonal adjustment on the money stock and discusses some of the problems in seasonally adjusting this series. Though the article concentrates on the money stock, much of the discussion applies to any series in which the adjustments for seasonal variations are large.

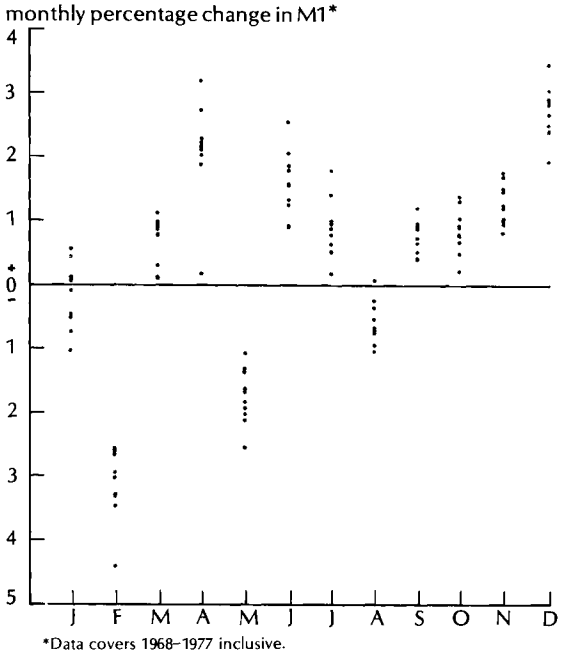
Data are seasonally adjusted to reveal underlying trends. Retail sales always increase in December, and housing starts always increase in March. Without adjustment for these patterns, changes can be deceiving, creating an impression that the underlying trend in retail sales or housing starts has suddenly accelerated. Removal from the data of "normal" changes expected during these months reveals the underlying trend.

Calendar months serve as proxies for contemporaneous changes in economic forces. Retail sales in December reflect year-end holiday buying. Housing starts in March reflect the beginning of favorable weather for building. Seasonal adjustments are based on an assumption that such influences are regular enough to be represented by calendar months.

### The seasonal pattern

Even casual examination of changes in the money stock shows a pronounced seasonal pattern. This is true regardless of the measure of the money stock. But it is most pronounced for the narrowest measure—M1 (currency plus demand deposits)—on which this article focuses.

**Unadjusted money data show a seasonal pattern**




*Data covers 1968–1977 inclusive.

The money stock contracts for the first two months of the year, and then expands through the April tax date. It contracts in May, then expands through June and July. August shows a mild contraction before an expansion that culminates in the year-end holiday season.

The seasonal adjustment of money is complex. A simplified description of the adjustment is useful in explaining the effects—and problems—of the adjustment process.[1] The new money-stock figure published every month is adjusted by dividing previously determined *seasonal adjustment factors* into the raw (unadjusted) figures to obtain the seasonally adjusted money stock. Thus, a seasonal adjustment factor of 1.02 indicates the effect of that particular month is expected to raise the unadjusted data 2 percent above the annual average.

The predetermined seasonal adjustment factors used to adjust data when they are first published are the most current set of factors—usually those used to adjust the previous year's money stock. The seasonal adjustment factor used to adjust the first-published figure for November 1978, say, will be the same factor used in the 1978 revision of the November 1977 figure. The factor used to adjust a particular month's figure is revised annually for several years after the first published figure appears. In this article, the first published seasonally adjusted figure for a particular month is taken to be the first figure for that month appearing in the *Federal Reserve Bulletin*.

In the adjustment of M1, separate seasonal adjustments are made to currency and demand deposits and the two components are then combined to obtain the seasonally adjusted money stock. Unadjusted monthly figures for each component are divided by the average monthly figure for the year surrounding that month. The resulting series of monthly figures, called the *seasonal irregular ratios,* shows whether the component tends to be high or low that month. The high level of demand deposits in December, for example, is reflected in seasonal irregular ratios that from 1968 through 1977 were always above 1.02. Over that period, December demand deposits were always at least 102 percent of the surrounding 12-month average.

Monthly seasonal irregular ratios form the base for the seasonal adjustment factors. Since the seasonal irregular ratios are obtained by dividing the unadjusted monthly figure by the average for the surrounding 12 months, there is an implicit adjustment for growth in the money stock. Also, the seasonal irregular ratio is based on an assumption that the effects of different months can be expressed as percentage changes in the unadjusted figure. If seasonal effects were assumed constant—regardless of the size of the money stock—then the 12-month surrounding average would be subtracted from the unadjusted figure.

**The effect of changing seasonals**

Seasonal adjustment factors can be obtained from seasonal irregular ratios in several ways. One consideration is whether the seasonal adjustment factors are assumed constant or whether they are assumed to change over time. If they are assumed constant, equal weight is given to the same month every year. If the factors are believed to change over time, more weight is given to seasonal irregular ratios in nearby years.

Current seasonal adjustment of the money stock assumes that seasonal factors are changing. The rationale for a moving seasonal is that the economic forces for which the seasonals serve as proxy may be changing. The importance of some holidays—or vacation habits—may change slowly over time, changing seasonal adjustment factors.

The extent to which the seasonal for any calendar month is allowed to vary over

[1]For a more comprehensive description of the seasonal adjustment process, see Thomas A. Lawler, "Seasonal Adjustment of the Money Stock: Problems and Policy Implications," *Economic Review*, vol. 63: no. 6, p. 23, (November-December, 1977), Federal Reserve Bank of Richmond. This article and its companion article discuss some of the issues raised here and list references to other works on the same topic.

different years depends critically on the relative weight given to the seasonal irregular ratios for that month in determining the seasonal adjustment factor. The more weight given the current year's seasonal irregular ratio, the more seasonal adjustment factors are allowed to vary from year to year.

At one extreme, every year's seasonal irregular ratio is given the same weight and the seasonal adjustment factors are equal for every year. The seasonal adjustment factor for a particular calendar month can, of course, change over time with the addition of new information. At the other extreme, the seasonal irregular ratio is given all the weight, making the seasonal adjustment factor identical to the seasonal irregular ratio in that month.

The first extreme, having constant seasonals, produces a fairly volatile money stock. The second, with more volatile seasonals, produces a money stock that moves smoothly with changes in trend growth.

In practice, each seasonal adjustment factor is determined by a seven-year span of seasonal irregulars centered on that year, the weights declining as data move away from the center year. Thus, the November 1978 seasonal adjustment factor will eventually be determined by November seasonal irregular ratios from 1975 through 1981. This procedure allows seasonal adjustment factors to vary significantly year to year, since the three middle years of the seven-year span are each given a fifth of the total weight in determining the seasonal adjustment.

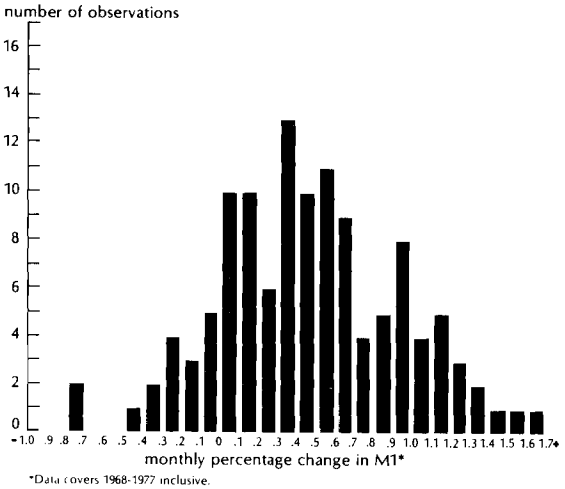
Seasonal adjustment factors, however, are not obtained simply by the mechanical manipulation of the seasonal irregular ratios. Extreme seasonal irregular ratios are given less weight in determining seasonal adjustment factors. This provides a more stable seasonal adjustment factor series and prevents an inordinate response to extreme changes in the data. More important, seasonal adjustment factors are adjusted judgmentally to take account of other factors. Often of significant magnitude, these judgmental adjustments can take account of sharply changing factors that, while known to affect the money stock, would not be picked up by a moving seasonal. Examples are monetary policy changes and changes in tax dates and holidays.

### The smoothing effect of seasonal revisions

The process used to adjust money-stock data produces large subsequent revisions that smooth out the first-published figures. When the money stock figure is first published, the seasonal adjustment factor used for the month gives no weight to the unadjusted money stock for that month. Later revisions, however, use that month's seasonal irregular ratio in determining the seasonal adjustment factor. As a result, revisions move the seasonal adjustment factor closer to the actual seasonal irregular ratio. This has the effect of smoothing seasonally adjusted changes in the money stock.

Although extremes of the seasonal irregular ratio are given reduced weight in the determination of seasonal adjustment factors, the smoothing effect of seasonal revisions on extreme changes in the money stock is pronounced. From 1968 to 1977, there were 17 instances where the first published data showed monthly increases in the money stock of more than 1 percent and 16 instances where the data showed declines. In the 1978

**The first published M1 figures . . .**




*Data covers 1968-1977 inclusive.

revision, every one of the 17 large increases had been reduced and 15 of the 16 declines showed smaller declines. Only seven instances of money declines remain in the most recent revision.

Two factors account for the difference between the first-published data and later revisions. One is changes in the underlying raw data. The other is changes in seasonal adjustment factors. Separation of the effects of these two factors make it clear that almost all the smoothing comes from seasonal revisions.

From 1968 through 1977, the first-published data show a mean monthly change in money of 0.461 percent. A measure of the dispersion in the data is the average absolute deviation from this mean value—the average difference (up or down) between each observation and the average observation. The average absolute deviation of first-published data is 0.376 percentage point. When the first-published data are adjusted to reflect revisions in the raw data, the mean monthly change rises to 0.494 percent and the average absolute deviation falls slightly to 0.364 percentage point. When these data are further adjusted to reflect the 1978 revisions in seasonal adjustment, the mean monthly change becomes 0.490 percent and the average absolute deviation falls to 0.267 percentage point.

Clearly, revisions in the seasonal adjustment sharply reduce the dispersion of the monthly percentage changes in the money supply—and the revisions are significant. The average absolute change produced by seasonal revisions was 0.220 percentage point—nearly half the mean percentage change before seasonal revision.

## A problem for analysis

The pronounced smoothing that comes from seasonal revisions raises several questions about the seasonally adjusted money series. Aside from whether the first-published data or the later revisions reflect seasonal adjustments more accurately, smoothing poses problems of consistency for analysts of monetary policy.

Most research that relates changes in the money stock to changes in economic activity uses the smoothed seasonally adjusted money series. Though seasonal revisions do not usually change the general pattern of acceleration or deceleration in growth of the money stock, the revised series is considerably smoother than the first-published data. By relating this smoothed series to variations in economic activity, analysts

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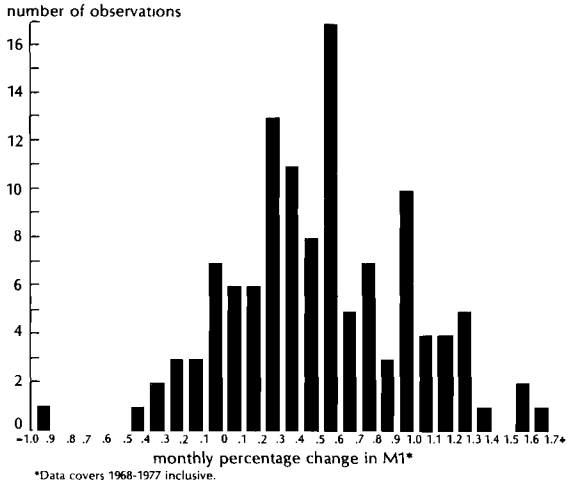


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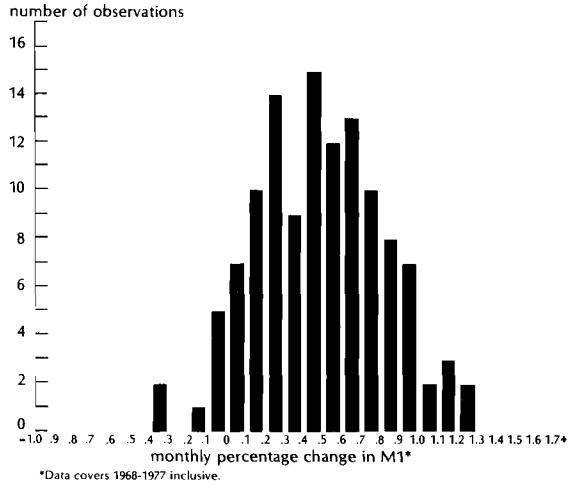

associate dampened accelerations or decelerations in money with fluctuations in economic activity. As a result, even small changes in money growth seem to have fairly large effects on economic activity. But the money data used in analyzing current policy are the volatile first-published figures. Inserted into the historical relationship between money and income, these unsmoothed data imply unduly large changes in economic activity.

As an example of the smoothing process, the first-published M1 data for February 1971 through January 1972 showed a six-month period in which the money stock grew at an annual rate of 12.5 percent followed by six months in which the annual rate was 0.9 percent. Recent revisions of the data show, however, that the money stock grew at a rate of 9.2 percent in the first six months and 4.4 percent in the second. Revisions reduced the deceleration in money growth from 11.6 percentage points to 4.8 percentage points.

In another case, the direction of changes was actually reversed. First-published data from February 1972 through January 1973 showed M1 grew at an annual rate of 9.9 percent in the first six months and 6.5 percent in the second six months. The most recent revision shows a growth of 8.1 percent in the first six months and 10.5 percent in the second. Revisions show that instead of slowing in the second six months, growth in the money stock was picking up.

Consistent analysis requires adjustments either to the money stock used in relating money to economic activity or the first-published money figures. Otherwise, the interpretation of recent monetary policy is apt to exaggerate its consequences.

The most important question raised by the smoothing of money growth rates through seasonal revisions, however, is whether data are improved. Every seasonal adjustment produces a seasonally adjusted money series. Without an independent measure of the "true" adjusted money supply figures, there is no obvious way of deciding which of these seasonally adjusted series (and, therefore, the seasonal adjustment factors that produced them) is correct. Revisions in seasonal adjustments that produce the smoothest money-stock figures are not necessarily the best seasonals. As noted earlier, giving exclusive weight to each monthly seasonal irregular in determining the seasonal adjustment factor can purge the monthly data of all volatility except slight changes in trend. But too much volatility can be removed from the series.

The smoothing effects of the seasonal revisions raise methodological questions in assessing the seasonal adjustment process. How can it be said that the seasonal adjustment is known, if it is known only after the unadjusted data has been observed? The problem hangs on the difference between explanation and prediction. Substantial revision of seasonals can *explain* away almost all the volatility in unadjusted money—after the volatility has been seen. These same revised seasonal adjustment factors, however, are much less useful at *predicting* future money figures and removing the volatility in the first-published data.

The size of the seasonal revisions raises other questions about the seasonal adjustment process. Since calendar months serve as proxies for contemporaneous economic forces, the seasonal adjustment of money assumes that the forces are regular enough to be represented by calendar months. If, however, these forces are changing by large and unpredictable amounts, then it does not seem reasonable to represent these forces with seasonals. Instead, it might be better to leave the influence of the forces in the seasonally adjusted data and identify these forces as determinants of the adjusted data.

**The influence of policy**

One reason seasonal adjustment is more complicated for money than for most seasonally sensitive economic series is the crucial importance of policy in determining the money stock. Monetary policy can have a direct and immediate effect on the money stock. Were this not so, it would make little sense to interpret monetary policy in terms of

changes in the money stock.

Suppose that for two or three successive years monetary authorities ran an easy or tight policy the same month, producing large or small rates of growth in money. Clearly, the policy effects should be kept in the seasonally adjusted money stock series. But unless some adjustment is made to take account of these policy effects, the seasonal revision process is such that policy effects would be treated as a shift in seasonal factors. They would be removed from the revised seasonally adjusted data. Then, in later years when money figures revert to normal, the first-published data will be made more volatile by the interim change in the seasonal. The importance of policy makes the judgmental contribution to seasonal adjustment of the money stock an important factor. Effects of policy could, in fact, explain the appearance of seasonals in seasonally adjusted data.

Policy considerations complicate seasonal adjustment in another way. To a great extent, the seasonal variation in the money supply is itself a product of monetary policy. The seasonal movement is actually a change in the demand for credit. Before the Federal Reserve was established, the seasonal effect was felt primarily on interest rates and not nearly as much on money. The year-end increase in credit demands, for example, resulted largely in higher interest rates. The increase in money was only slight.

Since the Federal Reserve was established, it has acted to dampen the seasonal movement in interest rates. This is done by increasing reserves and money when seasonal demands for credit rise and reducing them when credit demands fall. In this way, the monetary authorities smooth out interest rates over the year but intensify the seasonal variation in money.

While it is usually better to leave the effects of policy in the seasonally adjusted numbers, policy effects producing a regular seasonal in money seem different. If year in and year out, policy produces a seasonal movement in the money stock, it would seem better to remove the policy effect from the seasonally adjusted numbers. The difficulty is in distinguishing this recurring seasonal pattern from the ephemeral effects of contracyclical policy that happen to show some seasonal pattern over a period of years.

**Summary**

The importance of money and the increasing volatility of the money stock have focused attention on the seasonal adjustment of the money stock data. There is clearly a pronounced seasonal in the money stock. It is not clear, however, exactly what the pattern is or how it changes over time.

One important characteristic of the current method of seasonal adjustment is the pronounced smoothing in the rate of growth in the money stock produced by successive revisions of the seasonal adjustment factors. This smoothing creates a danger of inconsistency in the application of relationships estimated with revised data to the analysis of current monetary policy.

More important, it raises the question of whether the smoothing process produces better seasonally adjusted data. The answer involves serious problems of methodology as well as economics. Finally, the role of monetary policy in determining the money stock makes judgmental modifications of seasonal adjustment factors important.