3. Judging the quality of a preliminary seasonal adjustment model is based solely on statistical principles and thus are particularly useful in forecasting when theoretical knowledge is scarce. Information contained in time-series projections of the money-supply components can improve seasonal forecasts in the sense that subsequent revisions of the factor are reduced. When the X-11 is applied to an extended time series component, which consists of available observations and the projected values of the unidentified series, the resulting seasonal forecasts are closer to their final values, which are determined only after the future data are known.3

Another problem with the X-11 is that it does not accurately reflect the calendar effects as they do not occur in the same month each year. Although the X-11 has an option to eliminate the effects of the changing trading days in a month using a regression model, it has not been useful in eliminating such calendar effects in money. Recent studies have indicated that special analysis methods may prove useful for detecting calendar effects; the magnitudes of calendar effects then can be estimated using such methods.

Alternative models also may provide a framework for constructing an adequate filter. A statistical test suggests variations in the irregular component—the series after X-11 estimates of both trends and seasonal components have been factored out—are explained by the day of the week on which the month begins.4 A further implication is that estimating the impact of seasonal factors on various series is necessary to determine how much the money-supply measures are affected by the calendar effects. Unlike more ambitious efforts to modify the X-11 system, research on modifying the X-11 to detect and measure calendar effects is likely to produce more immediate improvements in seasonal adjustment of the money supply.

Improving Seasonal Adjustment Methods

In early 1978 the Federal Reserve Board initiated a comprehensive study to determine appropriate methods for seasonally adjusting financial data, particularly the money-supply measures. Published in 1981, the study's recommendations essentially outlined a continuing research program—one that subsequently was implemented. The study argued for improved adjustments in the widely used and accepted X-11 program, the Federal Reserve Board's continuing research effort initially will focus on developing model-based improvements, including time-series modeling options and calendar adjustments. The Federal Reserve also will experiment with more general model-based methods that can incorporate causal explanations of seasonal patterns and measure systematic effects. The Federal Reserve's research program thus can be expected to yield more immediate results from X-11 enhance-ment research while laying the foundation for fundamental changes—ideally, a break-through leading away from the basic adjustment framework. The study also recommended that the Federal Reserve Board consider using the present seasonal-adjustment procedure or its recommended modification on a concurrent basis to utilize all available data for estimating seasonal factors. Using the most current data would produce smoother initial estimates and reduce the size of revisions compared with the alternative of projecting seasonal factors for the year ahead. However, concurrent estimation would entail a number of costly revisions each month as new data are used by the procedure. A reasonable compromise might be to estimate the seasonal means annually, thus allowing incorporation of the most current information in the yearly review of the money targets. Semiannual calculations also would provide better estimates of the April seasonal soon after the raw data for April become available.

Federal Reserve Bank of Cleveland
Research Department
P.O. Box 6387
Cleveland, OH 44101

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Economic Commentary

The Problem of Seasonally Adjusting Money

by John B. Carlson

When an impending surge in the money supply filtered the financial news in March of this year, the reports stated that the surge would result from above-average income-tax payments and early Social Security payments. Consistent with expectations, M-1 (which includes currency plus checkable deposits) grew 11.8 percent (saar) in April 1982. But personal tax refunds occur every year. And early Social Security payments occur whenever the third day of a month falls on a Saturday, Sunday, or holiday. This fact that these same events affect seasonal is an economist with the Federal Reserve Bank of Cleveland.

The usual seasonality is that of the Federal Reserve Board of Governors of the Federal Reserve System.

Economist with the Federal Reserve Bank of Cleveland.

In its most limited sense, seasonality refers to movements in data that occur precisely at the same time each year with the same intensity. As it is typically used, seasonality refers to all repetitive movements that are determined by calendar events which but which need not occur on the same date nor with the same intensity. In the

May 31, 1982
broad sense, economic series that display
markedly different from calendar effects in
months. A monthly calendar effect that
would be calculated to contribute to the
seasonally adjusted value for the current
month is one that affects the seasonal
component in a month-to-month manner.

Seasonally adjusted numbers are
useful for such purposes as making
comparisons between different months
or years, or for comparing a single
month's data with the same month a
previous year. Seasonally adjusted
numbers can be compared to their
unadjusted counterparts to observe the
impact of seasonal patterns.

Seasonally Adjusted Annual Rates

<table>
<thead>
<tr>
<th>Year</th>
<th>Raw number, percent</th>
<th>Seasonal component, %</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>57.0</td>
<td>11.6</td>
<td>0.0</td>
</tr>
<tr>
<td>1979</td>
<td>64.5</td>
<td>12.1</td>
<td>0.0</td>
</tr>
<tr>
<td>1980</td>
<td>17.4</td>
<td>22.9</td>
<td>0.0</td>
</tr>
<tr>
<td>1981</td>
<td>24.2</td>
<td>29.8</td>
<td>0.0</td>
</tr>
<tr>
<td>1982</td>
<td>56.4</td>
<td>35.7</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Average: 54.2

Seasonally adjusted annual rates are
estimated using the ratio of the first
published seasonals for April and March.

The X-11 Method

The X-11 method is employed to estimate
seasonal factors. It involves two fundamental
steps: first, separating monthly time series
into three distinct series—the trend-cycle,
seasonal, and irregular components. The
first step isolates the trend-cycle component
from the seasonal and irregular components
by an estimate of the trend-cycle component.
The second step separates the seasonal and
irregular components from the monthly
series by an estimate of the trend-cycle
component. The X-11 procedure is iterative
in two senses: (1) it repeats the second step,
using a revised seasonal component from
which extreme irregular values are elimin-
ated or replaced with damped ones; (2) it
repeats both steps until the seasonal and
irregular components are essentially stable.
Thus, the user would choose to average as
many years of that monthly series as
appropriate to stabilize the seasonal
component. In this reason, the X-11 has an option
that averages seasonal irregular values of the
same month for all prior years available
giving equal weight to each year.

If the seasonal factor is believed to be
changing, then movements in the S1 component
reflect movements of both the long run
trend and the seasonal component. If this option
may be desirable. This option takes a five-year
moving average that changes each month as
a function of both the X-11 components,
seasonal and seasonal components of the series.
Although the X-11 automatically selects
default values for these options, the user
has available alternatives that permit
variations in the degrees of smoothing.
While estimating the final trend cycle,
the degree of smoothing (length of
average) would depend on the relative
importance (average percent
change) of the irregular variations to the
trend-cycle movements. The greater the
irregular movements relative to the trend
cycle, the longer the moving average
needed to smooth out the short-term
movements and reveal the trend.
Conversely, when the irregular
movements are minimal, then a short moving average
would bet
nerly to smooth out the systematic
movements of the series.

Similarly, when estimating the seasonal
component, the degree of smoothing
is desired would relative on the
importance of the regular variation. If a
component is reasonably regular
stationary, then all the movement in
the seasonal-irregular (S-I) component
from seasonal and irregular components
is essentially zero by the second month.
Thus, the user would choose to
average as many years of that month or
by taking into account the seasonal
component in the year being estimated. The two
years before and the two years after are
weigthed with lesser weights (decreasing
away from the year). When the
seasonal factor being estimated is for the
most recently available year, few other
values are included. Although a short
moving average may fail to average out
great increase in noise, it enhances the probability
that a seasonal factor would correctly incorpo-
reducetions in the determinants of seasonal-
ity. It also enhances the probability of
removal of irregular variations and their
guise of seasonal variations. The trade-
off is clear. If prior evidence exists that the
seasonal factor is stable relative to
irregular variation, then a short averaging period is
employed.