FRBSF WEEKLY LETTER

Inflation, Interest Rates, and Seasonality

Over the first four months of this year, "core" consumer inflation (measured by the Consumer Price Index, or CPI, less food and energy) jumped to a rate of 4½ percent, compared with its 3¼ percent annual increase for 1992. This development apparently induced market interest rates to jump, and led some Federal Reserve officials to express concern about a possible unexpected rise in the trend of inflation.

Since then, concern seems to have subsided as the core CPI for May through August came in at much more moderate rates, averaging only 2¼ percent. A number of explanations have been advanced for these developments. One relies on evidence that inflation responds to real accelerations and decelerations of real GDP with a short lag; therefore, the surge and subsequent decline in inflation could be related to the fact that real GDP growth accelerated sharply in the latter half of 1992, and then slowed in the first half of 1993.

Problems with seasonal adjustment also could help explain the inflation pattern in 1993, which, as it turns out, is not new. It has occurred to varying degrees in nine of the past eleven years, suggesting that the seasonally adjusted core CPI may contain a lingering seasonal element.

In this *Letter,* we examine this issue, and find significant *seasonal* movements in the seasonally adjusted CPI. We also find a close association between this phenomenon and seasonal movements in interest rates.

Seasonal adjustment

Economists and policymakers usually rely on seasonally adjusted data. Adjusting a series like the CPI removes changes in prices due to such seasonal factors as weather conditions, vacation practices, and holidays, which can obscure the underlying trend in inflation.

Most official government statistics, including the CPI, are adjusted using a statistical technique called X-11 ARIMA. To see how this method works, consider the simple case in which seasonal patterns do not change over time, and the series to be adjusted exhibits no trend or cycle.

In this case, an estimate of the seasonal component for, say, January would be the ratio of the average for all Januaries to the average of the series for all months.

The X-11 procedure extends this idea to allow for a trend/cycle component and for changing seasonal patterns (Bureau of the Census 1976, p. 90). The trend/cycle component is first removed by estimating a centered moving average of the series. Preliminary seasonal factors for the Januaries in the sample are calculated as the ratio of each January to its respective centered moving average. (A method for removing outliers from this process is also employed.) These factors then are smoothed to obtain final seasonal factors that are permitted to change only gradually over time as the underlying seasonal patterns in the data evolve. Once the seasonal factors for each month are calculated, they are divided into the unadjusted series to obtain seasonally adjusted data.

The CPI

About two weeks into each month, the Bureau of Labor Statistics publishes the CPI for the prior month, which is based upon a survey of nearly 21,000 retail and service establishments, 40,000 landlords, and 20,000 homeowners throughout the country (U.S. Department of Labor 1992). This index measures prices of over 8,000 different goods and services in the economy (such as white bread, taxi fares, and school books). The prices of these individual items are combined into a number of subcomponents of similar items (such as food, transportation, and educational expenses), which in turn are combined into the total price index. When aggregated, each item is weighted by the proportion of income that was spent on that item in a given base period. The base period currently in use is 1982–1984.

To adjust the CPI seasonally, each subcomponent is examined for a seasonal pattern. If a statistically significant pattern is found, the subcomponent is seasonally adjusted as an individual item. If not, the subcomponent is left unadjusted. The total seasonally adjusted CPI is formed by combining these various subcomponents into an aggregate index. A rationale for adjusting the series

at the subcomponent level is that each displays a different seasonal pattern.

Seasonal patterns in the seasonally adjusted CPI?
Figure 1 shows inflation over two subperiods of each year from 1982 to 1993 as measured by the core CPI. As shown, inflation has been higher in January–April than in May–December in nine of the past eleven years. Since 1982 inflation has averaged ¾ percent higher in the first four months of the year than in the last eight months. Formal (dummy variable) tests confirm that this pattern, starting in 1982, is statistically significant. (In conducting this test, we adjusted for the bias created by using a pre-examination of the data to split the months of the year at April/May and to focus on the post-1981 period; see Christiano 1989.)

The seasonal pattern does not show up as clearly in the total CPI (including food and energy). It appears that two volatile periods in the price of energy, early in 1982 and 1986, fortuitously offset what otherwise would have been a seasonal bias in the first few months of the year. As a result, we will focus on the core CPI.

Two possible causes for the seasonal pattern in the core CPI are considered. One possibility is that the seasonal components may behave differently over time due to evolving pricing practices. As discussed above, changing seasonal patterns will be incorporated only slowly into the X-11 estimated seasonal factors as the new information becomes available. An analysis of the seasonal factors of the major components of the CPI show that these factors have, in fact, been changing

Figure 1
Core CPI Inflation

Percent
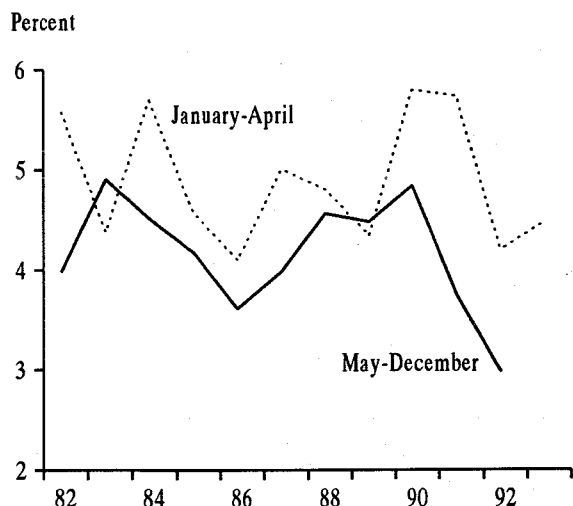
since 1982. Figure 2 plots the average ratio of the unadjusted to the seasonally adjusted core CPI series for the first four months versus the last eight months of each year. There was a sharp decline in the ratio for May–December in 1984, as well as a continued downward drift since then, supporting the view that underlying seasonal patterns have changed.

Figure 2
Seasonal Effects in Core CPI

*Calculated as the average of the ratios of seasonally adjusted to unadjusted core CPI for May to December of each year.
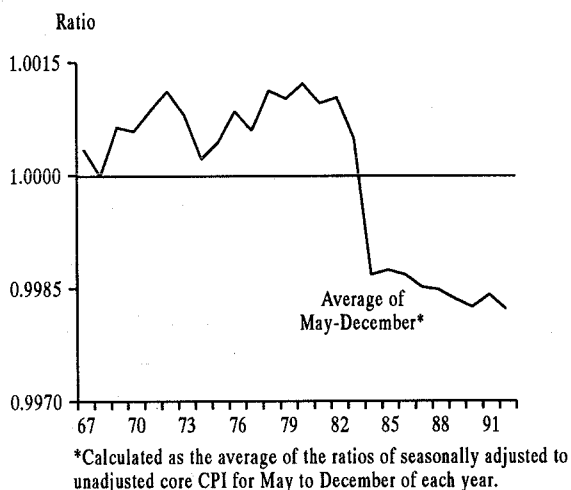
A second possible reason for seasonal problems in the CPI is that there may be an aggregation effect in the seasonal adjustment procedure. Since the subcomponents tend to be more volatile than the overall index, it is more difficult to estimate their seasonal patterns accurately. If seasonal patterns, even though statistically insignificant, remain in some of the component series after the X-11 procedure has been applied, they may show up as significant in the aggregate index, which in effect averages out much of the volatile non-seasonal movement across components. A good example of this problem is the entertainment component of the CPI, which is made up of two subcomponents, commodities and services. Since neither subcomponent shows significant seasonal movements, neither is seasonally adjusted, but the total of the two subcomponents shows very significant seasonality over 1982–1993.

A way to provide evidence on whether there is an aggregation effect in the overall series is to aggregate *prior* to seasonal adjustment with X-11. This exercise yields a seasonally adjusted core CPI series that does *not* show significant seasonality, which confirms the view that the practice of

seasonally adjusting the components may be playing a role in the CPI's apparent seasonal problems.
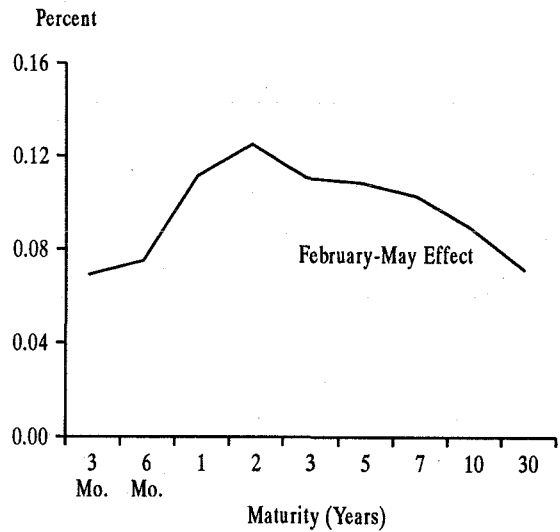
Is there seasonality in interest rates?

As noted above, the unexpected rise in reported inflation early this year seems to have been associated with a rise in interest rates. This could have occurred because higher reported inflation could have convinced the market that inflation had moved to a higher trend, thus raising the expected inflation component of nominal interest rates. In addition, the market could have believed that the Fed would react to higher inflation by tightening monetary policy, thus raising short-term and possibly longer-term interest rates.

The apparent seasonality in the seasonally adjusted core CPI over the past eleven years raises the question of whether interest rates have reacted in a consistent way over this period. To test for this possible effect, we regressed treasury yields at various maturities on their own lags (from four to twenty months, depending on maturity) and a (dummy) variable that tested for a change in the interest rate in February through May of each year relative to the other months of the year. (Reflecting lags in the release of CPI data, the period tested in the interest rate equations was lagged by one month behind the period in which inflation typically has surged.) Since seasonal problems in the CPI showed up only in 1982–1993 and not before, we ran the interest rate tests over this sample, and compared the results with those obtained for 1965–1981.

The results suggest that during 1982–1993 Treasury yields at all maturities were higher on average in February–May than they were in the other months of the year, all else equal; that is, there was a seasonal pattern in interest rates. The size of this effect varies from about 6 basis points at both the short and long ends of the maturity spectrum, to a peak of about 13 basis points for two- and three-year securities (Figure 3). Moreover, these differences are statistically significant (at the 10 percent level) for maturities ranging from two to ten years. Finally, during 1965–1981, when there does not appear to have been any significant seasonality in the seasonally adjusted core CPI, there also does not appear to have been a significant seasonal in interest rates.

Figure 3
Average Seasonal Effects in Treasury Yields: 1982–June 1993

In conclusion, these tests represent circumstantial evidence that seasonal movements in the seasonally adjusted core CPI have had moderate effects on interest rates over the past decade. In attempting to deal with the seasonality in the core CPI, it would be worthwhile to investigate the usefulness of seasonally adjusting the aggregate series, rather than adding up seasonally adjusted components.

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