June 23, 2003

Issues When Comparing Adjustments from the New versus the Old Type-of-Construction Codes

There are three reasons why the seasonal adjustments for the New Type-of-Construction (TC) codes don't match the adjustment for the Old TCs:

1. Many of the New TC series are being adjusted at a different level of aggregation than their counterpart Old TC series.
2. Series that are adjusted at the same level of aggregation are now shorter series (don't go as far back in the past) as they did before.
3. Because of the differences listed above, we are using different modeling and seasonal filter options for most of the series.

We believe that the adjustments for the New TC series are better adjustments than those for the Old TC series, mainly because we have more detail about the component series and can adjust the components individually. This also allows us to select better options for the X-12-ARIMA seasonal adjustment program because the series going into the program are more homogeneous.

Below we describe in detail the three reasons above. We also explain briefly some of the issues in comparing adjustments of the same series.

Different Levels of Aggregation

Many of the New TC series are now broken down into component series along with the total for a category of construction. The total is also an aggregate series. If a time series is a sum of component series that are seasonally adjusted, we can adjust the total directly or indirectly. The *direct adjustment* is produced by summing the component series first and then adjusting the total directly. The *indirect adjustment* of the aggregate series is produced when we sum the seasonally adjusted component series to get implied seasonal factors for the total.

When the component series have quite distinct seasonal patterns (and don't have so many zeros that they can't be adjusted), indirect seasonal adjustment is usually of better quality than the direct adjustment. On the other hand, when the component series have similar seasonal patterns then summing the series may result in noise cancellation, and the direct seasonal adjustment is usually of better quality than the indirect adjustment.

Note: By quality adjustment, we mean an adjustment without residual seasonality and with revisions as small as possible. We also like to see smoother adjustments as long as that doesn't make the revisions larger.

Now that we have the New TC series, we were able to look at the components of some of the larger categories, and we found that often the component series did have very different seasonal patterns. Therefore, we adjusted the components individually and summed then to get an implied factor for the total. For the Old TC series, there was no opportunity to look at the component series for many of the categories, so we had to adjust directly. The adjustments aren't going to match, and we don't want them to match. Based on our results, the indirect adjustments are better.

For the U.S. Total, both the New and Old TC adjustments are indirect adjustments, but again, they aren't going to match because the pieces don't match. But because we feel that the New TC adjustments are of better quality, the indirect from the New TC codes should also be of better quality.

Different Lengths of the Series

If a series changes over the course of time, it is sometimes beneficial to shorten the series and only use the last few years for the adjustment process. This is what has happened with Single Family. The seasonal patterns have been changing over the years, and when the series was shortened to make it match the other New TC series, the seasonal factors changed.

Because this series is changing and uses very short seasonal filters, it's a good idea to shorten the series anyway, even without the constraints from the other New TC series.

Different Models and Seasonal Filter Options

Because we're adjusting lower-level component series, and because some of the series are now shorter, we are using different modeling and seasonal filter options for most of the series. For the New TC series, we used the options that gave us the best diagnostics for the best quality adjustment. It would have been impossible to use options that matched the options for the Old TC series.

Comparing Different Adjustments of the Same Series

When comparing different adjustment of the same series, we often see patterns in the differences or percent differences. These patterns appear to be seasonal. For example, for the U.S. Total we see lower numbers for the New TCs early in the year and higher numbers for the New TCs later in the year.

There is a mathematical reason why this happens, and we've included the algebra in the appendix. For a more detailed explanation and more information on comparing direct and indirect adjustments, there is a paper on the web called "Comparing Direct and Indirect Seasonal Adjustments of Aggregate Series," by Catherine Hood and David Findley at www.census.gov/ts/papers/choodasa2001.pdf.

Also keep in mind that the seasonal adjustment procedure in X-12-ARIMA is designed to give us seasonal adjustments where the yearly totals match as closely as possible the yearly totals of the original series. So if adjusted values for one set of months is lower than another adjustment, then there must be another set of months that is higher than the other adjustment so that both adjustments' yearly totals match the original series totals.

Appendix

We now give a mathematical explanation of why the ratio of two adjustments for the same series could be seasonal.

Let Y_t be the original series. Let $S_t^{(1)}$ be one estimate of the seasonal factors. Let $S_t^{(2)}$ be a second estimate of the seasonal factors. For multiplicative adjustment (as we have with the Value-Put-in-Place series), the adjusted series, A_t is the original series divided by the seasonal factor estimates. So for two different seasonal factors we have two different adjustments:

$$A_t^{(1)} = \frac{Y_t}{S_t^{(1)}} \quad \text{and} \quad A_t^{(2)} = \frac{Y_t}{S_t^{(2)}}.$$

If both seasonal factor estimates are about the same from year to year, i.e., $S_{t-12}^{(1)} \approx S_t^{(1)}$ and $S_{t-12}^{(2)} \approx S_t^{(2)}$, then the ratio will be the same from year to year also, and we will see a seasonal pattern in the ratio since

$$\frac{A_t^{(1)}}{A_t^{(2)}} = \frac{Y_t/S_t^{(1)}}{Y_t/S_t^{(2)}} = \frac{S_t^{(2)}}{S_t^{(1)}}. \qquad (1)$$

Let's look at an example.

Let's say that the seasonal factors for the first adjustment, $S_t^{(1)}$, are 0.93 for January, telling us the original unadjusted January numbers should be increased by 7%. Let's also assume that the estimates of the seasonal factors for January are reasonably stable ($S_{t-12}^{(1)} \approx S_t^{(1)}$), so that all the estimates for January are approximately 0.93. Let's say that the seasonal factors for the second adjustment, $S_t^{(2)}$, are approximately 0.96 (a 4% increase) for January, and again the estimates of the seasonal factors are reasonably stable. Therefore, when we divide both seasonal factors into the same original series, the ratio of the two seasonal factors (see equation (1) above) for January is 0.96/0.93 = 1.032. Because the estimates are stable, the ratio will be approximately 1.032 for all the January estimates. If the same is true for the estimates for the other months, then we have a series of ratios that are periodic, and we will see a seasonal pattern in the ratio.