A Simple Methodology for Using UI-Based Payroll Employment to Adjust CES-790 Survey-Based Estimates of Payroll Employment

This document describes the methodology used by MassBenchmarks to update the CES-790 monthly estimates of payroll employment.

Why Bother?

Each year in early March the U.S. Bureau of Labor Statistics (BLS) publishes new estimates of payroll employment (the CES-790) after undertaking a benchmark process to align the sample-based estimates of payroll employment (the CES-790) with the Unemployment Insurance system's population-based counts (the Quarterly Census of Employment and Wages, also known as the ES-202).[1] The CES-790 data comprise the headline employment estimates that the BLS and state agencies release each month. These estimates can contain substantial sampling and non-sampling error. The annual benchmark process "corrects" these errors for the period of time for which the more accurate ES-202 data are available, which is through the first six months of the prior calendar year, and provides the jumping-off point from which the BLS revises the last six months of the prior calendar year based on month-to-month changes from the CES-790 survey-based data. Other statistical adjustments to the CES-790 are made that can result in changes in the trend of the last six months of the prior calendar year in addition to the new June jumping-off point. When these newly-benchmarked data are released in early March, the employment level and pattern of the prior calendar year can look quite that different than before. Subsequently, in the next year (March 2013), this same year (2011) will be revised once more. The changes to the first half of the year will be modest, since they were based on the ES-202. The changes that *do* occur will reflect minor changes to the census ES-202 employment totals and new seasonal adjustment estimates. On the other hand, the changes to the second half of the year may be substantial, since they will involve replacing the sample-based survey estimates of the CES-790 with the population counts from the ES-202. Thus, the true, official, history of employment in 2011 will not be known until March of 2013.

There is no need to wait so long, however. The ES-202 data are released quarterly with a lag of less than seven months. For example, the data for the July 2011 through September 2011 period was just released on March 28, 2012. Data for the last quarter of 2011 will be released at the end of June 2012. The BLS could re-benchmark the data quarterly instead of annually, but they don't. However, the simple procedure described here can be used to provide quarterly estimates of "corrected" CES-790 employment through the period of time covered by the ES-202. These estimates are not official, nor are they exactly what the BLS would release if they *did* re-benchmark the data quarterly. However, they are reasonably accurate estimates of what the BLS would release, within known error bounds.

[1] This process is described by the U.S. Bureau of Labor Statistics in the following documents, available on-line at http://www.bls.gov/web/empsit/cestn1.htm, http://www.bls.gov/sae/benchmark2012.pdf, and http://www.bls.gov/web/empsit/cesbmart.htm.

The Methodology

For the period of time for which the ES-202 population counts were final in the last official benchmark, no changes to the CES-790 are needed. This period of time ends in December 2010.

For January 2011 and later, the methodology is a simplified form of methods used by the BLS, and involves two steps. In the first step, the BLS starts with employment counts from the ES-202, which are monthly payroll counts of all workers eligible under the Unemployment Insurance system who are on the payroll on the 12th of the month. To this number they add (or subtract) adjustments in each sector for workers not covered by the UI system, using sources such as County Business Patterns and the Annual Census of Governments, in order to make the coverage consistent with the scope of the CES-790. Data from these sources are available only a lagged basis, so they extrapolate data where necessary based on historical trends. The second step consists of seasonally-adjusting the employment by sector from the first step, using the X12-ARIMA software developed by the Census Bureau, with estimation options specific to each sector.

The simplified version of the BLS procedure used by MassBenchmarks assumes that the adjustments for coverage and seasonal factors are stable from year to year. In the first step, the adjustment for each sector for each month is taken from the same sector and month of the prior year. This coverage adjustment is simply the not-seasonally-adjusted official CES-790 employment minus the not-seasonally-adjusted ES-202 employment. In the second step, the seasonal factor for each month is taken from the same month in the prior year. This seasonal factor is simply the ratio of the not-seasonally-adjusted official CES-790 employment divided by the seasonally-adjusted official CES-790. In this second step, the prior year's seasonal factor is only needed for July (2011) and later months.[2]

In order to implement this simplified procedure, three sets of data are needed:

1. The (official) ES-202 employment data, by sector. These are not-seasonally-adjusted.
2. The official CES-790 employment data, by sector, not-seasonally-adjusted.
3. The official CES-790 employment data, by sector, seasonally-adjusted.

The method is best described by the following set of symbols and equations. Let

- $E202_t$ be the ES-202 not-seasonally-adjusted official employment in month *t*.
- $E790_t$ be the CES-790 not-seasonally-adjusted official employment in month *t*.
- $XE790_t$ be the CES-790 seasonally-adjusted official employment in month *t*.
- $XE790*_t$ be the revised, unoffical estimate of CES-790 seasonally-adjusted employment in month *t*.
- A_t be the coverage adjustment in month *t*.
- SF_t be the seasonal adjustment factor for month *t*.

[2] It is presumed that the seasonal factors for January-June 2011 from BLS's benchmark process are more accurate than those of the prior year. On the other hand, the actual seasonal factors following June 2011 cannot be used since they are based on seasonal patterns in the survey data, which are different from those in the UI-based data.

In step 1 the coverage adjustments are defined as follows.

(1) $A_t = E790_t - E202_t$ if t is before January 2011.

(2) $A_t = E790_{t-12} - E202_{t-12}$ if t is January 2011 or later.

In step 2, the seasonal adjustment factors are defined as follows.

(3) $SF_t = E790_t / XE790_t$ if t is before July 2011.

(4) $SF_t = E790_{t-12} / XE790_{t-12}$ if t is July 2011 or later.

The revised estimate of the CES-790 is then calculated as:

(5) $XE790 *_t = (E202_t + A_t)/SF_t$.

Note that, by definition, the revised CES-790 estimate will be identical to the official CES-790 estimate before January 2011.

Since the totals for both not-seasonally-adjusted employment and seasonally-adjusted employment are the sum of the sectors, this simple two-step procedure applied to total employment gives exactly the same revised estimates as the sum of the revised estimates of individual sectors. This means that if one is not interested in sector detail, this simple procedure can be implemented with data on only four series: 1) total ES-202 (not seasonally-adjusted employment); 2) ES-202 (not seasonally-adjusted) employment for private household workers; 3) total CES-790 not-seasonally-adjusted employment; and 4) total CES-790 seasonally-adjusted employment. The second series is needed because it needs to be subtracted from total ES-202 employment before implementing the two steps. This is because the CES-790 scope excludes private household workers.

Standard Error of the Estimates

This simple procedure yields different estimates from the more accurate BLS procedure. The difference between the two is the error in the simple procedure in attempting to estimate what the official employment counts would have been had the BLS re-benchmarked the data. In order to quantify the magnitude of the error in the simple procedure, equations (2), (4), and (5) were used to calculate the estimates for total employment that would have been obtained by the simple procedure over the period January 2002 through December 2010, and errors were calculated as the difference between these estimates and the actual official CES-790 seasonally-adjusted employment over the same 108 months. The errors are consistent with a mean zero, normal distribution. The estimate of the standard error (standard deviation of the calculated errors) is 4,000 jobs. A 95 percent confidence interval for the estimate of total jobs is therefore the estimate given by the simple procedure plus or minus 8,000 jobs. The error bounds for 90 percent and 80 percent confidence intervals are 6,700 and 5,200 jobs respectively. The variance and mean of the errors do not appear to have any trend, although the variance appears to be higher in August, related to large and apparently fluctuating coverage adjustments in both private and public education; and the error is moderately positively autocorrelated.

Data and Estimates for Massachusetts

The data and estimates for Massachusetts are available in the spreadsheet file "rebenchmark_2011q3.xlsx". The official data are in the sheet labeled "data". The ES-202 series are in columns B-AC, the CES-790 seasonally-adjusted series are in columns AD-BC, and the CES-790 not-seasonally-adjusted series are in columns BD-CC.

Each sheet contains the calculations and estimates for a sector, with the TOTAL sheet being the sum of the sectors or total employment. The calculations for the coverage adjustment in equations (1) and (2) are in the column labeled "790-202", generally column E. The calculations for the seasonal factors in equations (3) and (4) are in the column labeled "SF", generally column H. The calculations for the revised estimated employment in equation (5) are in the column labeled "New 790SA", generally column I (the uppercase letter i). In the TOTAL sheet, the errors for the error analysis are in the column labeled "Error Total", column R. Except for ES-202 employment, all employment numbers are in thousands of jobs. Note that the CES-790 sector Other Services (sheet OS) excludes Private Household Workers, which is included in the ES-202 definition of Other Services.

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