

# Examining the Impact of Updating More Months of Concurrent Seasonally Adjusted Industry Estimates in the Current Employment Statistics October 2014

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## Abstract

With each monthly release of not seasonally adjusted employment estimates, the Current Employment Statistics (CES) program updates the two previous months preliminary estimates to reflect additional data receipts. The updated estimates are then used to produce concurrent seasonal adjustment factors and these are applied only to the revised estimate levels. As a result, part of the seasonally adjusted over-the-month change for two months prior to the newly released month is attributed to levels produced from different concurrent runs, creating what we call a seam effect. This paper uses simulated data, created by using the original seasonal adjustment specifications, to examine the impact of changing from the current monthly seasonal adjustment process to updating up to 61 months of seasonally adjusted data with each monthly release, a process similar to what is done during the annual benchmark process. Updating 61 months of data moves the seam effect from two months prior to 61 months back to provide a five year history of seam effect free estimates. The change also results in a higher probability of the peak and trough dates shifting and higher exposure of variability.

**Key Words:** Concurrent seasonal adjustment, CES Seasonal adjustment, Current employment statistics seasonal adjustment

## 1. Introduction

The Current Employment Statistics (CES) program replaced the use of projected factor seasonal adjustment with concurrent seasonal adjustment in June 2003. The findings that lead to this change indicated that seasonally adjusted data experienced smaller revision between first preliminary and the final annually revised (benchmarked) data and equal or less variability in the over-the-month changes between first and second, and first and third closings when using concurrent seasonal adjustment factors. However, in the initial research for concurrent seasonal adjustment implementation there was a concern that monthly revisions between closings would increase since the seasonal factors can change each month. When concurrent seasonal adjustment was implemented in June 2003, there was no change to the number of times the seasonally adjusted estimate is revised.

The current CES policy dictates that with each monthly release of not-seasonally adjusted (NSA) estimates, the two previous months are updated to reflect additional data receipts

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<sup>1</sup> Any opinions expressed in this paper are those of the author and do not constitute policy of the Bureau of Labor Statistics.

and seasonally adjusted (SA) estimates are revised by applying the seasonal factors created by concurrent seasonal adjustment only to the most recent three months (the current month and the previous two months). This research studies the possibility of revising more than the previous two months of seasonally adjusted data to reduce the impact on the revisions to the over-the-month change (OTMC) caused by updates to seasonal adjustment factors, while minimizing changes to the peak and trough dates and values.

### **1.1 Background on CES estimates**

The CES is a monthly survey that covers approximately 557,000 worksites. The national CES estimates are published each month after a approximately 10 to 16 days of data collection, making them one of the timeliest estimates of employment, hours, and earnings published by the Federal Government. CES first preliminary estimates are released to the public on a Friday three weeks after the week that includes the 12<sup>th</sup> day of the month, referred to internally as “first closing”. Additional sample received after first closing is incorporated into the estimate at the second and third cut-off dates, referred to as “second closing” and “third closing” respectively. The cut-off dates between closings are usually about three weeks apart. The second closing estimates are published the following month and the third closing estimates are published two months after first closing.

CES estimates are seasonally adjusted (SA) each month after first closing not-seasonally adjusted (NSA) estimates have been produced. The CES uses concurrent seasonal adjustment, meaning that each month the most recent (first closing) NSA estimate and the revised previous two (second and third closings) months are included in the inputs to create the seasonal factors. The new factors are applied to first, second, and third closing estimates (the current month and the previous two months or the most recent three months). Concurrent seasonal adjustment takes into account the timeliest information available.

NSA and SA data undergo the same number of revisions on a monthly basis but a different number of months are revised during the annual benchmark processing. Every year on January, CES “benchmarks” the previous March NSA estimate to the population value. In January, the previous 21 months of NSA data are revised with the benchmark. The revised NSA data are used to create new seasonal factors and the previous five years of seasonally adjusted data are updated with new factors. Seasonally adjusted data undergoes five separate annual revisions before becoming finalized.

### **1.2 The term “closing”, “position”, and “replacement period”**

CES has three official closings for collecting data and revising NSA and SA data. These are referred to as first closing, second closing, and third closing. In this paper, the term “closing” will also be used to refer to seasonally adjusted data that is updated with new seasonal factors, even when the not seasonally adjusted data are not being revised.

The term “position” refers to the position of each reference date within the most recent first closing release. For example, for the January 2015 estimate release, January 2015 would be position one, December 2014 would be position two, November 2014 would be position three, and October 2014 would be position four and so on through January 2010, which would be assigned position 61. The position is a location designation and neither NSA nor SA need to be updated to be assigned a position.

The “replacement period” is the number of times an estimate for a point in time is updated with concurrent seasonal adjustment factors. For example, a replacement period of 14

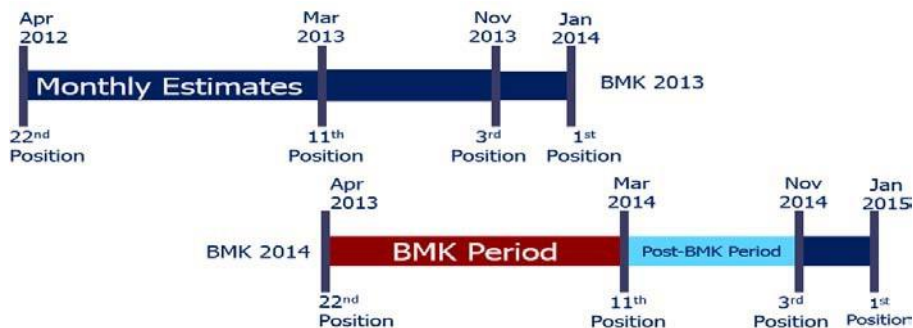
should be interpreted as applying the latest seasonal factors to the current month's first closing estimate and the previous 13 months.

### 1.3 Benchmark revisions to NSA estimates

NSA estimates are revised annually to align the previous year's March sample-based estimates to the population employment counts, referred to as the benchmark (BMK). The population employment counts are derived from State Unemployment Insurance tax records, records from the Railroad Retirement Board (RRB), and County Business Patterns (CBP). In January, the difference between the derived population employment and the third closing estimate for the previous March is distributed back to April by adding eleven-twelfths of the March difference to the February estimate, ten-twelfths to the January estimate, and so on, back to the previous April estimate, which receives one-twelfth of the March difference. The post-benchmark period is revised by applying the original third closing estimate link to the new benchmark level from March and updating the birth death factors.<sup>2</sup> See Figure 1 for a depiction of the benchmark process periods.

The new sample is also introduced with the November third closing estimates and is used from that point forward. The November third, December second, and January first closing estimates are calculated using normal monthly estimation procedures. A large discrepancy between the benchmark March value and the sample-based estimate can trigger a historical reconstruction. Historical reconstructions are done to avoid series breaks and can be extended back to 1990. Figure 1 below depicts the normal benchmark process periods for the BMK 2013 and BMK 2014.

**Figure 1:** Benchmark process periods



Once the benchmark revisions are made to the NSA data, these are seasonally adjusted and five years of seasonally adjusted data are revised. The benchmarked NSA data and the updated five years of seasonally adjusted data are released with the January estimates.

### 1.4 Effect of benchmark revisions on seasonal adjustment

Seasonal adjustment uses 10 years of data as inputs. It is important to note that the NSA data used as inputs includes benchmarked data, post-benchmark data, third closing data, one second closing, and one first closing data point. Every January's first closing release, at minimum, the prior 21 months of NSA data are affected by the benchmark processes. Hence, the use of this mix of NSA data implies that part of the OTMC observed in the

<sup>2</sup> More information about the CES benchmark process is available at <http://www.bls.gov/web/emp/sit/cestn.htm#section6b>.

seasonally adjusted data after third closing estimates can be caused by changes to the input data as well as changes to seasonal adjustment factors.

Unless otherwise noted, in this paper the estimates released with the January first closing are excluded from the analysis to reduce the effect caused directly by the benchmark processing. Excluding all the data associated with the January first closing release removes a maximum of seven observations of over-the-month changes per series and closing. The recreated data starts from the January 2005 to December 2012, 7 years, in which the January release data for each year was excluded. While this does not completely isolate the effect of seasonal adjustment, it helps provide an analysis for decreasing or minimizing the part of the OTMC that comes from using different seasonal adjustment runs, given the current CES processes.

The analysis focuses on the over-the-month changes between closings because the NSA levels are revised to a different benchmark level every year and can aggregate the differences between replacement periods.

### 1.5 Concurrent seasonal adjustment implementation by CES

Each month the seasonally adjusted third closing estimate becomes quasi-final (until the annual benchmark process) with a different seasonal adjustment run: this can cause part of the over-the-month change to be attributed to a change in the seasonal factor and not an economic change. For example, the seasonal factor for July as calculated in September can be different than the seasonal adjustment factor for July calculated in October. The September seasonal adjustment run will contain revised NSA estimates for July (third closing) and August (second closing) and the new estimate for September (first closing) and only these estimates will be updated with the new seasonal factors. Then in October the seasonal adjustment run will contain revised NSA estimates for August (third closing) and September (second closing) and the new estimate for October (first closing) and the new factors will only be applied to these three months. July will remain with the seasonal adjustment factor calculated in September. Since the July estimate is not updated with the new October factors, part of the over the month change between July third closing and August third closing will be a function of distinct seasonal adjustment runs.

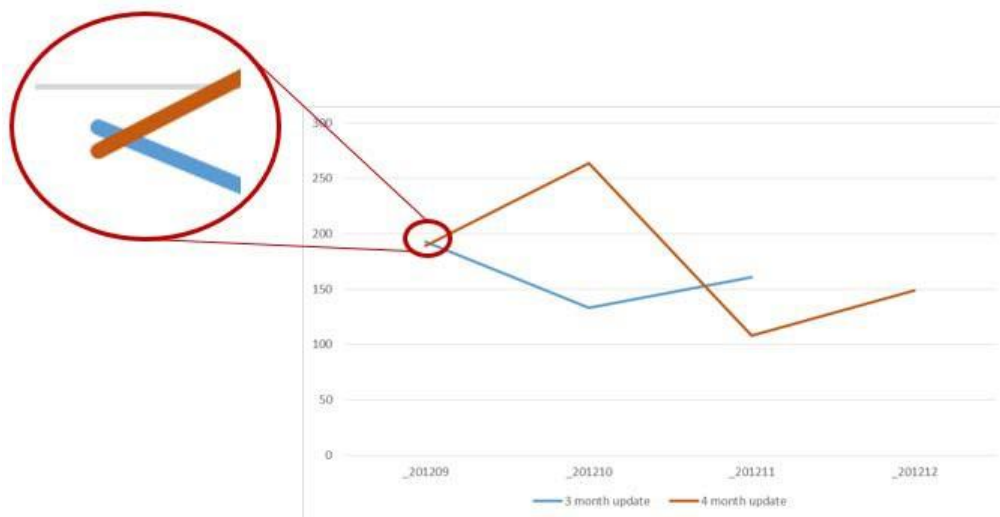
**Figure 2:** Current implementation of concurrent seasonal adjustment



Each third closing estimate is fused together to create a time series; however each third closing estimate is seasonally adjusted with factors created with a different concurrent seasonal adjustment run, causing what will be referred to in this paper as the *seam effect*. The *seam effect* is the part of the OTMC caused by using two seasonal adjustment runs.

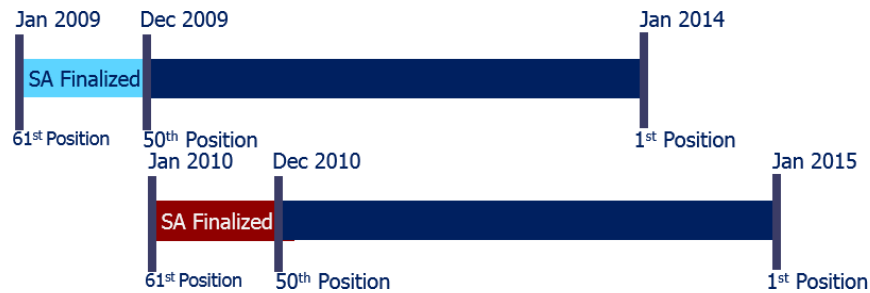
For the current process of updating only the latest three months of seasonally adjusted estimates, the *seam effect* would be the difference between the OTMC for a given reference date estimate at its third closing and the OTMC the same reference date had it been updated with new seasonal factors for a fourth time. For example, see Figure 3 below, the seam effect would be the difference between OTMC for September 2012 third closing when released with the November 2012 first closing estimates and the OTMC for September 2012 if it were to be updated with new seasonal factors with the release of December 2012 first closing estimates. On average, at the Total Nonfarm level, the difference is 9,626 for January 2005 through September 2012, which 7.6% of the third closing OTMC for September 2012, and .0072% of the September 2012 level. Compared to the Total Nonfarm employment level the difference is miniscule.

**Figure 3:** OTMC difference between a three and four month seasonal adjustment factor update



The only way to completely remove the seam effect is by seasonally adjusting the entire CES history every month otherwise the seam is just being pushed back. CES currently uses 10 years of historical data as inputs. Currently, the longest span CES revises seasonally adjusted data is five years. The five year update occurs with the seasonal adjustment annual processing and is released with the January first closing estimates. The five year mark is the center point for the input data and where the most is known about the data: five years back and five years into the future. When data are finalized at its center point, it is less likely to vary with the addition of one new estimate, as it is done in concurrent seasonal adjustment. The annually finalized seasonally adjusted data are used as the yardstick in this paper. However, the annual process does not remove the original problem: it only pushes it back. Every January when five years of SA estimates are updated with new factors, the same problem exists. For example, with the January 2015 estimates release, part of the over the month change from December 2009 to January 2010 will be a function of December 2009 being finalized with the January 2014 seasonal adjustment run. January 2009 is the center point for the January 2014 run, but it is not the center point for the rest of the months in that year. The center point for February 2014 is February 2009 and so on through December. The annual run process finalizes SA data where the January estimate from five years back is position 61 and December data from five years back is position 50.

**Figure 4:** Seasonal adjustment annual update



## 2. Research

### 2.1 Recreating CES seasonal adjustment factors and seasonally adjusted estimates<sup>3</sup>

Concurrent seasonal adjustment data for the “All Employee” data type was recreated by using the original X12 A RIMA specification files’ parameters, the monthly manually identified outliers, the prior adjustments (also referred to as the strike adjustments file), and the user defined regression files (dummy variable files) that were applied to the original concurrent seasonal adjustment run for each month from January 2005 through December 2012. Following the same process used by CES for production, seasonal adjustment was done at the basic series level and aggregated to create the summary series. The production process for series indirectly seasonally adjusted was also mirrored. The main difference between the data recreated for this research and CES production data is that the CES concurrent seasonal adjustment process uses unrounded data for seasonal adjustment and the recreated process used rounded<sup>4</sup> data as inputs to seasonal adjustment<sup>5</sup>. Both the recreated and the original data used the Census X12 A RIMA program for seasonal adjustment. This research focuses mainly in Total nonfarm (TNF) and Total private (TP); both are summary series.

#### 2.1.1 Using the recreated data to analyze possible scenarios

Ten years of seasonally adjusted estimates and factors were saved for each month’s first closing estimate from the recreated CES seasonally adjusted data. Saving this information allows for the simulation of different scenarios.

Each series, each date beginning with the first closing for the current reference date, was assigned the corresponding closing for the estimate. For example, September 2005 was

<sup>3</sup> More information about the seasonal adjustment process is available at <http://www.bls.gov/web/empsit/cesseasadj.htm>

<sup>4</sup> Only rounded CES estimates were made available for this research.

<sup>5</sup> The mean difference between the recreated data and the estimate levels published for first, second, and third closings for Total Nonfarm (TNF) was 2,125 and 1,440 at Total Private (TP). The recreated data were also compared against the original production data from September 2009 to December 2011. The average difference between the simulated estimate levels and the original runs was 1,717 at TNF and 903 at TP. Each month when DIDD seasonally adjusts the estimates they seasonally adjust 120 months back but only update second and third closing estimated levels with the new seasonal adjustment factors.

assigned a closing=1 when the first closing estimates for September 2005 were created, August 2005 was assigned a closing=2, and July a closing=3. When concurrent seasonal adjustment was run for October 2005 first closing estimates, October 2005 was assigned closing=1, September 2005 was given a closing=2, August was assigned a closing= 3, and July was given a closing = 4. Although, July NSA data were not updated with more microdata receipts, it is given a closing of 4 because the seasonally adjusted data is being updated with new seasonal factors. The process was repeated through closing 61 for each first closing release date. The left picture in Figure 5 depicts a portion of the process.

The current process links the third closing estimates to create a time series. Using the recreated data, the fourth closings were linked to simulate and analyze how different the OTMC would be from the current process, if the latest four months of data were to be updated with new seasonal factors. The same was done by linking a 11th, 15th, 19th, 23rd, 27th, 31st, 35th, 39th, 43rd, 47th, 51st, 55th, 59th, through 60 closing to analyze and compare the different scenarios. The OTMC is calculated for each closing within each seasonal adjustment run. The revision to the OTMC is calculated for each reference date at the different closings. The revisions for closing one is always zero, since that is the first time the estimate for that reference date is produced. On the other hand, the OTMC for first closing is the difference between the current reference date's first closing and the previous month's second closing estimate level. The OTMC crosses reference months and closings while the revision to the OTMC maintains the reference month constant and only crosses closings. The revisions to the OTMC are based on the OTMC, which crosses reference months and closings.

Equation 1.  $00000000_{t,cc} = XX_{t,cc} - XX_{t-1,cc+1}$

Equation 2.  $RRRRRR_{t,cc+1} = 0000000_{t,cc+1} - 0000000_{t,cc}$

Where,

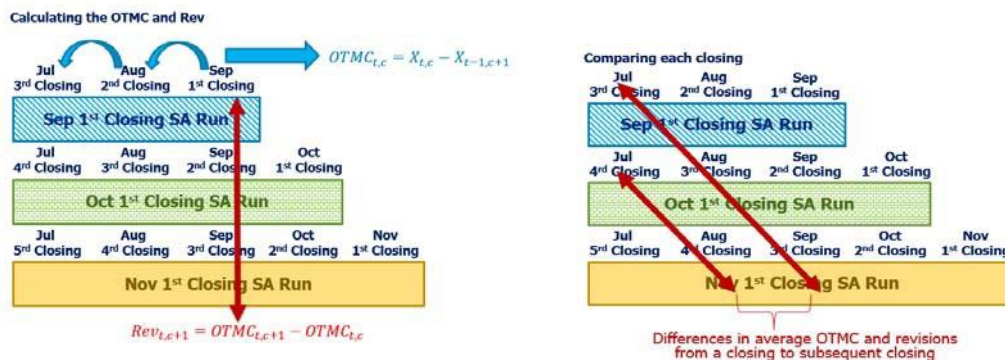
X= employment estimate level

t = reference date (year and month)

c = closing

Once the over-the-month changes and revisions are calculated the average OTMC and average revision for each closing is compared against the subsequent closing's average OTMC and average revision.

**Figure 5:** Seasonal adjustment annual update



To reduce or minimize the seam effect, the difference in the over-the-month-change (OTMC) should be as small as possible between the number of months being updated and the previous month that is not being updated. In the following sections the seasonal adjustment factors, the OTMC, and revisions to OTMC are examined for different

scenarios. The complex CES processes make it difficult separate the part of the seasonally adjusted revisions to the OTMC caused by the seasonal factor changes and what is caused by monthly and annual revisions to NSA data and show how these scenarios will affect the revisions CES currently provides to the public. Therefore, the seasonal factors are observed separately than the seasonally adjusted levels.

Section 2.2 analyzes the seasonal factors for the three month replacement (the current process), 14 month replacement (14<sup>th</sup> closing), 61 month replacement (61<sup>st</sup> closing), and the current annual seasonal adjustment update (January release data for closings 50 through 61). The seasonal factors are examined for all basic series with one main characteristics in mind: seasonal adjustment should cause a mean change of approximately zero for the year.

Section 2.3 focuses on the seasonally adjusted OTMC in levels. It analyzes the scenarios of changing CES policy to replacement periods of four through 61. Differences in means were used to determine how different each scenario could be. The average OTMC at each closing was compared to each subsequent closing, compared to the annually finalized seasonally adjusted estimates, compared to the center point (closing 61), and differences were tested for significance. The average absolute revision to the OTMC are reviewed for the same scenarios. Counts of the number of times the magnitude of the OTMC revised for a given reference month were also observed. How a change in policy could affect the peak and trough dates<sup>6</sup> and the root mean square for each replacement period to the finalized seasonally adjusted OTMC were also examined.

## **2.2 Examining the seasonal adjustment factors**

A characteristic desirable in any seasonal adjustment method is for the average over-the-year-change (OTYC) caused by seasonal adjustment to approximate zero. For series adjusted multiplicatively a product of the factors equal to 1 would have the desired characteristic and for series adjusted additively it would be a factor sum of zero. The factors can only be examined at the basic level since the summary series are created by aggregating these. This characteristic will be explored in this section by looking at the product and sum of factors for the year for the following scenarios:

- 1) Three month replacement period—this is the current CES policy.
- 2) 14 month replacement period—the benefit of using 14<sup>th</sup> month replacement period is that the seasonally adjusted over-the-year change reported on the monthly release would come from one seasonal adjustment run.
- 3) 61 month replacement period—the benefit of doing a 61<sup>st</sup> replacement period as the final value for the estimate is that this is the center point for the series (since 10 years or 120 points of data are used as inputs. However, this will also cause the seasonal adjustment factors for the finalized year to come from 12 different seasonal adjustment runs.
- 4) Seasonal adjustment annual process update—the benefit of continuing to finalize SA estimates with the current annual process is that the seasonal factors for the entire year being finalized come from one seasonal adjustment run. However, aside from the January estimate the rest of the months in the year are not being finalized at their center point.

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<sup>6</sup> More information about the peaks and troughs is available at <http://www.bls.gov/ces/cespeaktrough.htm>.



CES adjusts for variable survey interval effects when these are significant. The variable survey interval adjustment regulates inconsistencies that arise when there is a difference in the number of weeks (4 weeks or 5 weeks) between the 12<sup>th</sup> of the month in a given consecutive pair of months. The variable survey interval nets out over ten years, therefore, seasonal adjustment factors for a year will only approximate zero rather than equal zero.

Equation 3. Additive factors

$$a_{cc,ss,aa,yy} = \frac{1}{n} \prod_{t=1}^{12} a_{cc,ss,aa,yy,tt} \approx 0$$

Equation 4. Multiplicative factors

$$m_{cc,ss,mm,yy} = \frac{1}{n} \prod_{t=1}^{12} a_{cc,ss,mm,yy,tt} \approx 1$$

- Where,
- n = number of seasonally adjusted series
  - F = seasonal adjustment factors
  - c = closing
  - s = seasonally adjusted series
  - a = additive mode
  - m = multiplicative mode
  - y = year
  - t = month {1=Jan, 2=Feb, 3=Mar...12=Dec}

Table 1 shows the average annual change caused by the seasonal factors in the replacement periods 3, 14, 61, and the annual seasonal adjustment process. The current annual seasonal adjustment process outperforms the replacement periods 14 and 61 for the multiplicative series and the three alternative periods for the additive series. The 3 and 14 months replacement periods outperform the 61 month replacement period. The seasonal adjustment process normalizes the seasonal factors to cause a change of zero for the year. Hence, when only part of the year is updated the normalization may not be as effective, as observed in the results from replacement period 61.

<b>Table 1: Seasonal adjustment factors annual change (the values for additive series are in thousands)</b>								
Year	3 month update		14 month update		61 month update		Annual Process (Jan 61st closing --Dec 50th closing)	
	Add	Mult	Add	Mult	Add	Mult	Add	Mult
2005	-7.33	0.9960	-6.0900	0.9976	21.62	1.0145	-1.05	0.9951
2006	-9.01	0.9954	-9.4300	0.9944	18.19	1.0143	0.14	0.9948
2007	-6.05	0.9951	-6.3752	0.9926	31.20	1.0138	2.11	0.9954
2008	-4.63	0.9974	-6.1505	0.9916	24.46	1.0141	1.41	0.9943
2009	-8.53	0.9945	-6.5070	0.9924	28.21	1.0152	0.87	0.9967
2010	-9.00	0.9952	-3.5904	0.9981	36.18	1.0142	2.67	0.9943
2011	-9.81	0.9958	-5.4669	0.9962	30.63	1.0138	-2.05	0.9962
2012	-10.63	0.9962	-11.8121	0.9933	21.61	1.0155	-0.26	0.9957
<b>Average</b>	<b>-8.12</b>	<b>0.9957</b>	<b>-6.9278</b>	<b>0.9945</b>	<b>26.51</b>	<b>1.0144</b>	<b>0.48</b>	<b>0.9953</b>

### 2.3 Examining the seasonally adjusted levels

The levels were examined to identify possible replacement period options that could reduce the seam effect. As mentioned earlier, in order to reduce or minimize the seam effect, the change in the over-the-month-change (OTMC) should be as small as possible between the number of months being updated and the previous month that is not being updated.

In this section, the differences in the average over-the-month changes and revisions are examined for each replacement period. Other factors that are analyzed include how the magnitude of the OTMC is affected and how additional revisions could impact the peak and trough's dates. The OTMC at each closing was tested for significant differences in the mean OTMC between each replacement period and the subsequent replacement period, the final seasonally adjusted mean OTMC, and the center point mean OTMC. Finally, the root mean square for each replacement period to the annually finalized seasonally adjusted OTMC is observed.

None of the differences in mean from each closing to the subsequent were statistically significant at the .10 significance level. Since the differences in mean OTMC were not found to be statistically significant, the analysis focuses on finding replacement period options that reduce the current process' seam effect.

#### 2.3.1 Revisions and differences in the OTMC between replacement periods

Under the current seasonal adjustment process, first, second and third closing are updated with new seasonal factors. A significant difference of the mean OTMC between the third closing and the fourth closing could support the claim that the concurrent seasonal adjustment implementation by CES causes large revisions to the estimates. The means tests show that there is no significant difference between the mean OTMC at third closing and the fourth closing for TNF or TP, with and without January estimate release data included in the analysis, at the .10 significance level.

The mean difference of the OTMC is presented in charts 1 and 2 in absolute value because the magnitude of the difference, not the sign, is what is being targeted. The charts show how different the mean of a replacement period is than the subsequent period's mean. Currently CES uses a three month replacement period. The value shown for replacement period three on chart 2 shows how different the OTMC of the three month replacement is from the four month replacement period, which is not being updated with the new seasonal factor. In essence, it shows how large the magnitude of the seam effect (the part of the OTMC that comes from not updating the previous month's seasonal factor) could be.

Equation 5. Mean difference in absolute value of OTMC

$$\frac{1}{n_{pp+1}} \left( \sum_{pp+1,tt,cc} |OTMC_{pp+1,tt,cc} - X_{pp+1,tt-1,cc+1}| \right) - \frac{1}{n_{pp}} \left( \sum_{pp,tt,cc} |OTMC_{pp,tt,cc} - X_{pp,tt-1,cc+1}| \right)$$

Where,  
 X= employment estimate level  
 p = replacement period  
 t = reference date (year and month)  
 c = closing

Chart 3 presents the mean absolute revision to the OTMC to show the average magnitude of the revision for each reference date at each replacement period. The revision for first closing is zero because it is the first time an estimate has been produced for the reference

date. The revision for the current process is shown by replacement period four, which shows the average revision to the OTMC from the fourth replacement period to the third (current process).

Equation 6. Mean absolute revision to OTMC by closing

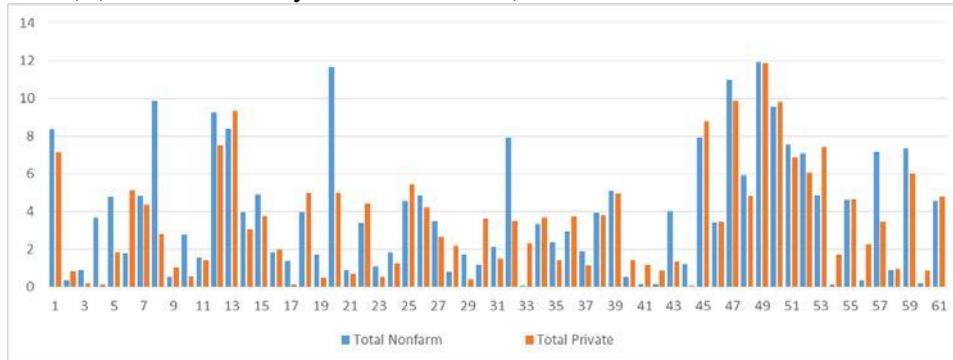
$$\frac{\sum_{pp+1}^{mmRRRRRR} |OTMC_{pp+1,tt,cc+1} - OTMC_{pp,tt,cc}|}{n}$$

Where,  
 OTMC= Over the month change  
 p = replacement period  
 t = reference date (year and month)  
 c = closing

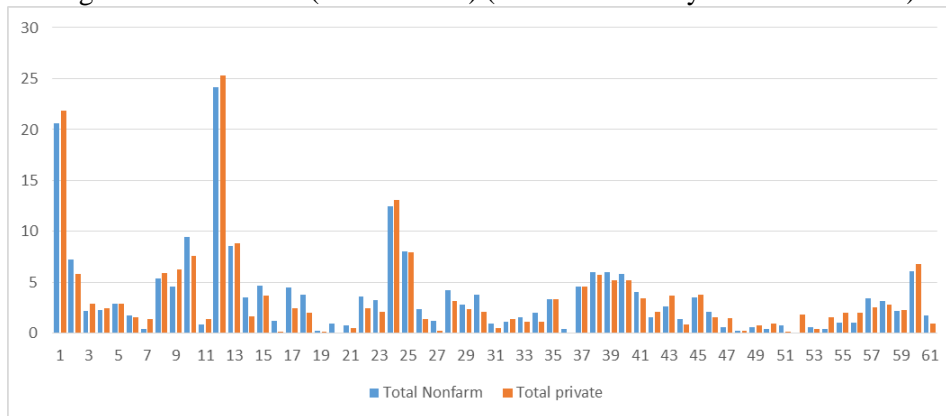
### 2.3.1.1 Mean difference in absolute value of OTMC

Notice that chart 1 does not show the intuitive trend expected (larger revisions on earlier replacement periods and smaller revisions as the replacement period increases). When the data are not truncated expansion and contraction periods have a large effect on the mean OTMC. The data were truncated on chart 2.

**Chart 1:** Difference in mean OTMC by replacement period, in absolute value (In thousands) (Excludes January estimates release)



**Chart 2:** Difference in mean OTMC by replacement period, in absolute value January 2005 through December 2007 (In thousands) (Excludes January estimates release)



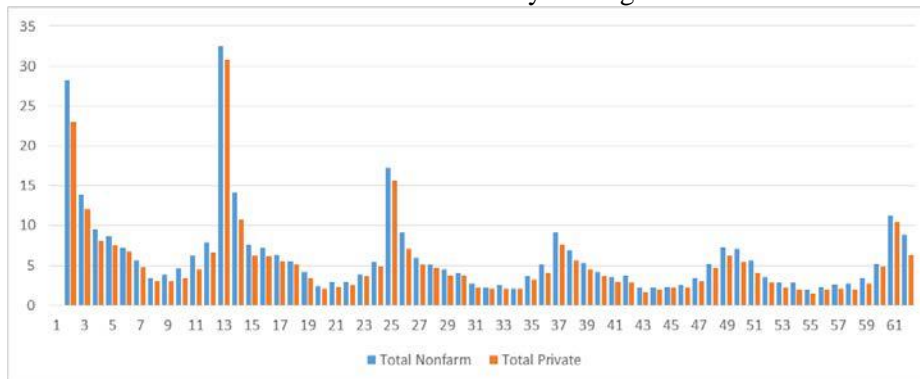
The latest closings have more data available, since all of the data points have had at least a 1<sup>st</sup> closing but not all of them have had a 61<sup>st</sup> closing. On December 2012, the latest reference month to have a closing 61 was December 2007. For chart 2 the data were truncated on December 2007 for calculating the mean OTMC to reduce the effect of expansion and contraction periods. The current process is displayed by replacement period

three on chart 2. At the TNF level, the difference in mean OTMC is 2,237, or 0.0017% of the September 2012 TNF level, and 1.425 % of the September 2012 OTMC. When the data are truncated, the average difference is minimized at replacement period 19 and replacement periods 4,6,7,11,16 are some of the replacement periods that exhibit smaller differences in OTMC than the current process.

### 2.3.1.2 Mean absolute revision to OTMC by closing

The absolute revisions to the OTMC were also calculated for each closing (see chart 3). The first closing revision is always zero because it is the first time an estimate is created for the reference date. The mean absolute revision to the OTMC for the current process is displayed by closing four in chart 3. The fourth closing revision represents the revision between the fourth closing and the third closing OTMC. On average, at the TNF level, the difference between the fourth closing and the third closing (current process) is 9,626 for January 2005 through September 2012, or 0.0072% of the September 2012 level, and 7.6% of the OTMC for September 2012. The revision is minimized at closing 55 but within the first 13 closings the revision is reduced by replacing the most recent eight months. The second best alternative is to replace the latest nine months of data. The mean absolute revisions from closing four through closing 12 are smaller than the mean absolute revision at third closing, which is the current process.

**Chart 3:** Mean absolute revisions to the OTMC by closing



### 2.3.2 Sign changes to revisions

Updating previously published data with new seasonal factors can have an effect on the magnitude of the OTMC but will generally not change the sign of the OTMC. If the magnitude of the OTMC is altered the size and sign of the revision to the OTMC can be affected. The revision to the OTMC can change from a positive to a negative revision. An alternating run is defined as consecutive sign changes to the revision and the number of consecutive sign changes in the series is the length of the alternating run. For example, if the seasonally adjusted OTMC for an individual reference month is revised with successive revisions in a pattern such as down by 10, then down by 20, then up by 11, down by 12, up by 30, down by 8, and down by 6 (-10, -20, +11, -12, +30, -8, -6), the series of revisions would contain one alternating run with a length of four.

At the Total Nonfarm level, from January 2005 to October 2007 (60 closings are available for each reference month for this period), the simulated data shows that if all 60 months prior to the current month were to be updated with concurrent factors each month the series would experience an average of 13 alternating sign runs (never exceeding a length of eight) to the revision of the over-the-month change. The sign of the OTMC for the reference

months in this period was affected a total of seven times out of the 2100 observations and these seven times were confined to three reference months. Additionally, it cannot be discarded that the sign change in the OTMC of these three reference months could be due to CES benchmark processing.

### *2.3.3 Effect on initial peaks and troughs*

The variability of the peak and trough dates at the TNF and TP levels was evaluated by running the peak and trough detection program used in production. Peaks and trough dates were compared for several replacement periods (4, 7, 14, 25, 37, 49, and 61) relative to the current process with a replacement period of 3. From a publication date of January 2005 to an end date of December 2012, a maximum of two peaks or two troughs were detected.

At the TNF and TP levels, the peaks and troughs dates change slightly as the number of months updated with new seasonal adjustment factors is increased. However, the changes are minimal, never exceeding a difference of more than three months, and do not tend to shift back and forth.

### *2.3.4 Differences between each scenario and the final annual 5 year update and the center point*

Seasonally adjusted data becomes final after 5 years annual revisions or at closings 50-61 which are published with the release of January estimates. The difference in the mean OTMC was statistically significant for various periods. Some of the periods where the OTMC is not statistically different at the .10 significance level are 5, 8, 13, 14, and 52-61. The mean over-the-month change (OTMC) was also compared to the center point data or closing 61. The difference between the mean OTMC at closing 61 and at second closing through the 18<sup>th</sup> closing are not statistically significant, at the .10 significance level.

The Wilcoxon-Mann-Whitney test was used to determine if there is a statistically significant difference between the underlying distribution between the mean OTMC at closing 61 and the mean OTMC at each closing. If the p-value for the Wilcoxon Test (two sided) is less than .05 we can say that the difference in the underlying distribution between the closings being compared is statistically significant. Going from closing 1 through 60, the earliest there is a statistically significant difference in the distribution is at closing 35 for Total Nonfarm and closing 36 for Total Private. The Kruskal-Wallis test indicates if there is a statistically significant difference between the closings being compared. When excluding the January release estimates no significant differences in the underlying distribution of closing 61 and each closing is observed. Since generally the underlying distributions for each closing are not significantly different than closing 61, it is assumed the evaluation done with the t-tests using unequal variances is still valid.

### *2.3.7 Root mean Square*

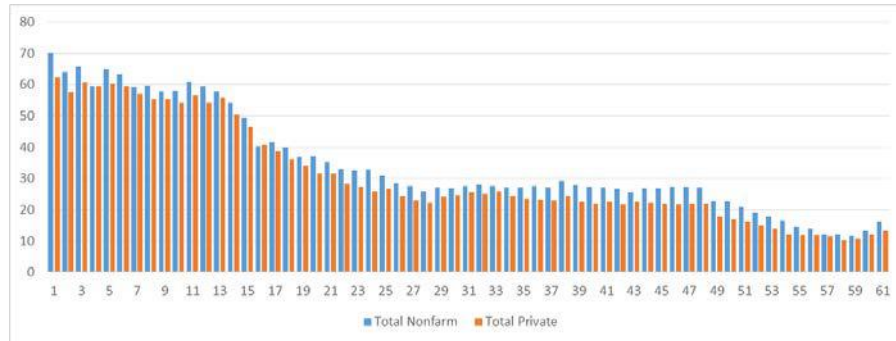
Chart 4 shows the root mean square (RMS) for each replacement period compared to the annually finalized seasonally adjusted OTMC and it seems to stabilize around replacement period 21. This outcome is expected since the latest 21 months of NSA data are revised with the annual benchmark. Chart 4 shows that as the replacement period increases the series gets closer to the final seasonally adjusted value.

Equation 7. RMS for average OTMC for each replacement period to finalized seasonally adjusted OTMC

$$\frac{RROORR}{pp,ss,tt} = \frac{1}{m} \left( \frac{RROORR}{pp,ss,tt} - \frac{0000000}{ff,ss,tt} \right)^2$$

Where, p = replacement period  
s = seasonally adjusted series  
t = reference date (year and month)  
f = finalized seasonally adjusted OTMC with the annual processing

**Chart 4:** Root mean square for each replacement period to the finalized seasonally adjusted OTMC



### 3. Summary

The CES National first published (or first closing) estimates are among the most widely anticipated and examined data. Revisions to these estimates are highly scrutinized. Currently, the NSA data for the two previous months are updated with additional data receipts and corrected data and this partially explains the changes observed in the seasonally adjusted data. This practice causes part of the OTMC between the three months updated with new seasonal factors and the previous month to be attributed to different seasonal adjustment runs and not an economic event, defined in this paper as the seam effect.

This paper examined the seasonal adjustment factors, the effect to the magnitude of the OTMC (sign of the revision to the OTMC), the effect to the peak and troughs dates, revisions to OTMC, compared the average OTMC for each replacement period to the average OTMC at closing 61 (center point) and the annual seasonal adjustment process, and the root mean square for each replacement period to the finalized seasonally adjusted OTMC.

The only way to completely remove the seam effect from the CES time series is to seasonally adjust the entirety of the series. Replacing the latest 61 months of data with each release would push back the seam effect to a period that may not be of highest importance to CES users. However, replacing the latest 61 months of data with each monthly release would cause for that prior fifth year of data to be seasonally adjusted with twelve different seasonal adjustment runs by the time December estimates for the current year are released. The seasonal adjustment process normalizes the seasonal factors to net out over the year. Table 1 shows that a replacement period of 61 causes a larger shift from zero change for the year than the current process.

The magnitude of the OTMC can be affected by updates to seasonal adjustment factors but in general the updates will not cause the OTMC to switch sign. The number of times the magnitude of the OTMC changes as more months of seasonally adjusted data are updated could signify that noise rather than a series improvement. As more seasonally adjusted data are updated there is a higher chance the peak or trough dates can change in relation to the third closing identified peak and trough dates.

The revisions to the OTMC and level become smaller as the relative position of the data increases. However, it is possible for larger revisions to occur to data in positions after the third position. BLS is currently assessing the impact of further revisions on the data users.

Replacing more months of data can reduce the seam effect. However, replacing more months of seasonally adjusted data with each monthly release does not yield a statistically significant improvement. The current process seems to be performing better or at par with several of the replacement periods discussed.

### **3.1 Future research**

Seasonal adjustment uses 10 years of NSA data as inputs. The 10 years of NSA data includes benchmark revisions to NSA data, making it difficult to isolate the effects of seasonal adjustment. The NSA data used as inputs to create concurrent seasonal factors includes benchmarked data, post-benchmark data, third closing data, one second closing, and one first closing data point. The benchmarked data are released with the January estimates, and these have been excluded to reduce the effects of the benchmark revisions to the input data. However, this does not completely exclude the BMK effects but it allows us to show the revisions the public would see in each given scenario. Future research could include running seasonal adjustment using input data from one data position at a time. In order to create 10 years of input data without benchmark revisions, the levels would need to be recreated using the OTMC link and based on the most recent benchmark level to avoid series breaks. The original levels cannot be used as they are since they can show large level changes due to the benchmarking process. Re-creating levels by data position would remove the benchmark effects from the analysis.

Additionally, residual seasonality could be explored.

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