Concurrent Seasonal Adjustment for Industry Employment Statistics
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Introduction: The Current Employment Statistics (CES) Survey, conducted by the Bureau of Labor Statistics (BLS), is a monthly panel survey of over 300,000 business establishments. The national CES estimates of employment, hours, and earnings are some of the most timely and sensitive economic indicators published by the federal government. They are widely viewed as a key measure of the health of the economy and are closely tracked by both public and private policy makers alike.

Over the course of a year, the National CES estimates, just like other measures of labor market activity, undergo sharp fluctuations due to seasonal events such as changes in weather, harvests, major holidays, and the opening and closing of schools. Because these seasonal events generally follow a regular annual pattern, adjusting the estimates from month to month can eliminate the seasonal influence on economic trends. These monthly adjustments make it easier to observe the cyclical and other non-seasonal movements in the series. In evaluating changes in a seasonally adjusted series, it is important to remember that seasonal adjustment is an approximation based on past experience and represents another source of error in estimation.

Most CES data users are interested in the seasonally adjusted over-the-month employment changes as a primary measure of overall national economic trends. Therefore, accurate seasonal adjustment is an important component in the precision of these monthly estimates. While seasonally adjusted series go through several monthly revisions and an annual benchmark revision, the first published estimates are the most widely anticipated and analyzed. Thus it is important to use the most efficient and reliable methods for seasonal adjustment of current months' data. Currently CES uses seasonal adjustment methodology that applies forecasted seasonal factors to the employment estimate. Twice a year seasonal factors are forecasted for 6 months into the future and applied to the not-seasonally adjusted estimates during the subsequent six months. However, beginning in June 2003, simultaneous with the program's conversion to the North American Industry Classification System (NAICS), CES will switch to concurrent seasonal adjustment in which new seasonal factors are calculated each month using all relevant data, up to and including the current month. This paper compares the two seasonal adjustment methodologies, examines results from recent research comparing the two methods, and discusses advantages and disadvantages of a CES conversion to concurrent seasonal adjustment.

Background on CES Estimates: One of the benefits of the Current Employment Statistics Survey is the timeliness of the estimates. CES estimates are published each month after only 2- ½ weeks of data collection. The primary deadline for data receipts, referred to as "first closing", is the last Friday of the reference month, and preliminary estimates are published on the first Friday following the reference month. For example, the first closing deadline for sample receipts for January estimates is the last Friday in January, and January preliminary estimates are published on the first Friday in February. In order to incorporate additional sample received after the primary deadline, each estimate undergoes two monthly revisions. The secondary cut-off, or "second closing", is usually three weeks after the primary deadline, and the third deadline, or "third closing" is three weeks after the second. Therefore, for any given month, second closing estimates are published the following month, and third closing estimates are published two months subsequent. Using the previous example, the January second closing deadline is mid-February and January second closing estimates are published the first Friday in March. Likewise, the January third closing deadline is mid-March, and January third closing estimates are published the first Friday in April.

CES estimates also undergo annual revisions called "benchmarks". Each year, the sample-based estimates for the previous year are adjusted to universe employment counts derived from State unemployment insurance tax records. This constitutes the final estimate for all reference months in the benchmark period. The size and direction of

revisions from the first closing estimate to the final benchmarked series are of particular concern to BLS and its CES data users because the first closing estimates are so widely used as an early gauge of monthly economic movements.

To seasonally adjust the estimates, CES uses X-12 ARIMA software developed by the US Census Bureau. Seasonal adjustment factors are recalculated semi-annually, in April and November, and projected factors are published in advance for the next 6 months. Current seasonal adjustment methodology used in the CES attempts to remove the seasonal influence from the employment, payroll, and hours series while controlling for several calendar effects. Adjustments include:

- *4 vs. 5 week adjustment -- This adjusts for inconsistencies in the seasonally adjusted series that arise because of variations of 4 or 5 weeks between reference periods in any given pair of months. In highly seasonal months and industries, this variation can be an important determinant of the magnitude of seasonal hires or layoffs that have occurred at the time the survey is taken, thereby complicating seasonal adjustment.*
- *Length of Pay Period adjustment – This adjusts for distortions in CES hours and earnings series caused by differences in the number of working days in a pay period from month-to-month.*
- *Holiday adjustment – This adjusts for significant effects associated with the relative timing of the reference period of the survey and the Easter and Labor Day holidays. These holidays do not occur at exactly the same time every year which complicates the seasonal adjustment process.*

Currently, new seasonal factors are published in June and December of each year. The June CES publication incorporates annual benchmark revisions that include recalculation of seasonally adjusted data for the most recent 5 years. After 5 years of seasonal adjustment revisions, figures are frozen. For example, the March 2001 benchmark revision, published in June 2002, provided revised seasonally adjusted data for 1997 through the first quarter of 2002. Data prior to 1997 were not revised. BLS and major data users desire minimal revisions, both between "closings" and between first closing estimates and the final benchmarked series. It is in this complex environment of time-critical first preliminary estimates and subsequent incremental revisions that the effects of concurrent seasonal adjustment on CES data must be evaluated.

Testing concurrent seasonal adjustment: Intuition tells us that using all relevant information available should allow us to produce better seasonally adjusted data. In reviewing several alternative methods during the late 1970's, Wayne Fuller (1978) states that "the biggest potential gain in seasonal adjustment lies in the inclusion of the current observation in the construction of the seasonal factor for that observation." Subsequent years yielded substantial statistical work supporting that pronouncement, which led to the adoption of concurrent adjustment within several organizations. Statistics Canada and the Census Bureau adopted concurrent adjustment for most series based on theoretical and empirical work by Estela Dagum (1982), McKenzie (1984), and Pierce and McKenzie (1987), respectively. Kenny and Durbin (1982) in the U.K. also found positive results. Methee and McIntire (1987) and Buszuwski (1987) added empirical evidence from BLS's CPS and PPI series.

In order to accurately determine the effects of a potential change from the current projected seasonal factors to concurrent seasonal adjustment, the concurrent method must be closely analyzed. Such research is critical prior to considering a change in methodology for CES because it affects such an important and widely followed series. BLS has been researching the impact of concurrent adjustment on CES data for several years. Each month, parallel to the monthly production of CES seasonally adjusted data using projected factor methodology, CES runs concurrent seasonal adjustment for research purposes. The parallel tests are structured in a way to measure only the effect of incorporating additional months of data into the seasonal adjustment process. To do that, virtually all controllable variables are kept constant across the two methodologies. For example, in any particular series, the same ARIMA model is used under both methods (as opposed to letting the X12 software automatically choose the ARIMA model). Likewise, any special treatment applied to the series, such as to treat calendar effects, is applied under both methods. Also, for any particular series, the same outliers are specified under both procedures.

Inputs to the concurrent run are almost identical to those used in CES production. Current CES standard practice requires ten years of historical data to be used as input to the X-12 ARIMA model. The same historical data set is used for the parallel concurrent run. Therefore, any prior adjustments originally made to the data during production, such as to account for strikes or editing and screening, are included in the concurrent simulations as well. The only difference in inputs between the two runs is that

concurrent adjustment also incorporates up to five months of additional estimates when calculating the seasonally adjusted data.

Estimates are also seasonally adjusted on the same level under the two parallel runs. With just a few exceptions, the published CES employment series have historically been seasonally adjusted at the two-digit SIC level. Higher aggregates are formed by summation of their components. In this analysis, all series are adjusted in accordance with this standard.

Incorporation of revised seasonal factors is handled within the normal CES monthly revisions procedures. With the calculation of first closing estimates for a current month, the second closing and third closing estimates for the prior two months are revised on an unadjusted basis to incorporate further sample receipts. Likewise, the concurrent seasonally adjusted data are recalculated using revised second closing and third closing estimates, mirroring the current production process. Finally, all published data types are seasonally adjusted under both methods; however, because the all employee series is the most closely watched series published by CES, it is the focus of this paper.

Results: The two methods are compared in terms of (1) mean absolute revisions to the over-the-month changes evident from first preliminary estimate to the benchmarked series, (2) the variation between monthly revisions, and (3) the smoothness of the seasonally adjusted series. Looking first at the smoothness of the series, Table 1 compares the third closing over-the-month changes in the seasonally adjusted employment figures for total nonfarm from January 2001 to December 2001 for the two methodologies. Column B lists the published over-the-month changes for third closing, while column C lists the third closing over-the-month change for the experimental series (i.e., what the over-the-month change would have been if CES had been using concurrent seasonal adjustment). Column D shows the absolute ratio between concurrent over-the-month change and published over-the-month change. In eight out of the twelve months in the table, the concurrent methodology produced a smaller over-the-month change in the seasonally adjusted employment level (as evidenced by an absolute ratio less than one). Furthermore, the absolute average over-the-month change for concurrent adjustment is smaller than the absolute average over-the-month change for the 6-month projected factor adjustment during the same time period. This suggests that concurrent adjustment produces a smoother seasonally adjusted series.

Table 1. Over-the-Month Changes for Total Nonfarm, January 2001 through December 2001

(A) Month	Third Closing Over-the-Month Change		
	(B) CES Published [Projected Factor]	(C) Experimental [Concurrent]	(D) Absolute Ratio (C) / (B)
Jan-01	289,000	169,000	.58
Feb-01	135,000	177,000	1.31
Mar-01	59,000	42,000	.71
Apr-01	-164,000	-72,000	.44
May-01	41,000	50,000	1.22
Jun-01	-100,000	-51,000	.51
Jul-01	18,000	16,000	.89
Aug-01	-54,000	-40,000	.74
Sep-01	-165,000	-211,000	1.28
Oct-01	-447,000	-332,000	.74
Nov-01	-356,000	-318,000	.89
Dec-01	-106,000	-115,000	1.08
Absolute Average	**161,000**	**133,000**	**.83**

Table 2 underscores the smoothness of the concurrent seasonally adjusted series for total nonfarm plus for all nine major industry divisions. The smoothness ratio shown in column B of Table 2 is a comparison measure of variability in the third closing over-the-month change of the seasonally adjusted estimate. The calculation compares the sum of the squared over-the month changes in the concurrently adjusted series to the sum of the squared over-the-month changes in the projected-factor adjusted series. A smoothness ratio below 1 indicates that concurrent seasonal adjustment has less variability in the over-the-month changes than does a series adjusted using projected seasonal factors. As Table 2 illustrates, concurrent adjustment produces a smoother seasonally adjusted

Table 2. Smoothness Ratio, January 2001 through June 2002

(A) Group	(B) Smoothness Ratio (Third Closing)
Total Nonfarm	.67
Mining	.77
Construction	.47
Manufacturing	.87
TPU	.78
Wholesale Trade	.88
Retail Trade	.56
FIRE	.68
Services	.58
Government	.67

series for all nine major industry divisions and their topside aggregate, total nonfarm. Taken with the results from Table 1, this indicates that CES will benefit from a switch to concurrent seasonal adjustment by producing employment series with less variability in the over-the-month changes.

Results to this point focused solely on estimates of seasonally adjusted over-the-month changes in employment. Also of interest is the revision to the estimate of the seasonally adjusted over-the-month change, both from first closing to the final benchmarked series, and between monthly closings. Table 3 illustrates the size of the mean absolute revision to the over-the-month change from first preliminary to the final benchmarked series for total nonfarm plus the nine major industry divisions under the two methodologies. Column B shows the mean absolute revision in the over-the-month change for the 6-month projected method for March 1998 through March 2001, while column C shows the same for the concurrent adjustment method. Column D shows the difference between the two methodologies (concurrent minus 6-month projected). As Table 3 illustrates, CES employment estimates that are seasonally adjusted under the concurrent method have smaller revisions in the over-the-month changes from first closing estimates to final benchmarked series in eight of nine industry divisions and total nonfarm. In Wholesale Trade, the revision statistic was larger for concurrent adjustment, but only by 0.2%.

Table 3. Mean Absolute Revision in Over-the-Month Changes, March 1998 through March 2001

(A) Group	(B) Projected factor	(C) Concurrent	(D) Difference
Total Nonfarm	77,973	64,973	-13,000
Mining	1,892	1,865	-27
Const.	22,892	17,838	-5,054
Manuf.	13,757	12,487	-1,270
TPU	7,892	6,568	-1324
Wsle Tr.	11,135	11,162	27
Retail Tr.	32,162	21,946	-10,216
FIRE	6,919	5,703	-1216
Services	38,784	29,703	-9,081
Govt.	23,135	17,432	-5,703

In addition to revisions between first closing and the benchmarked series, revisions in the over-the-month changes between closing are of concern as well. In particular, there is the potential for these monthly revisions between closings to increase under concurrent adjustment because the seasonal factors can change with each iteration of the monthly adjustment process. However, results indicate that, in addition to a smaller revision between first closing and the final benchmarked series, concurrent seasonal adjustment leads to equal or even less variability in the over-the-month changes between closings. Figure 1 shows the revision to the over-the-month change between seasonally adjusted first closing and second closing total nonfarm estimates under both methods. The dashed line shows the published over-the-month changes between first and second closing, while the solid line shows the over-the-month change between first and second closing for the experimental series (i.e., what the over-the-month change would have been if CES had been using concurrent seasonal adjustment). The graph illustrates that, in general, the concurrently adjusted series shows slightly less variability in the seasonally adjusted over-the-month changes between revisions. Results were very similar for revisions between first closing and third closing.

Figure 1. Revisions to Over-the-month Changes, Seasonally Adjusted Total Nonfarm All Employees Series, March 1998 – March 2002

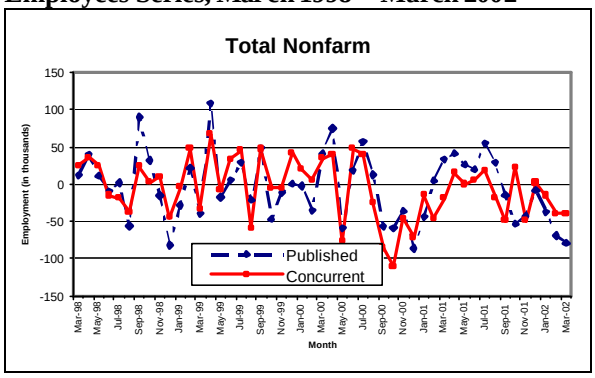

Table 4 summarizes revisions between closings for the currently published CES series and the same series adjusted concurrently for March 1998 through March 2002. As the table shows, the mean revision and mean absolute revision in the over-the-month change do not differ much between first closing and second closing across the two methods. However, from first closing to third closing, both the mean revision and mean absolute revision are lower in the concurrently adjusted series. These results, when combined with the results shown in Figure 1, suggest that concurrent seasonal adjustment will not increase revisions in the over-the-month changes between closings.

All the analysis presented to this point reflects actual practice in the survey, and thus gives a picture of what can realistically be expected under the two methodologies. The revision statistics include

Table 4. Mean Revision and Mean Absolute Revision in Over-the-Month Changes, Total Nonfarm All Employees, March 1998 through March 2002

Type	6-month projected	Concurrent	Difference
First closing to second closing			
Mean Revision	-4	-7	3
Mean Absolute Revision	37	34	-3
First closing to third closing			
Mean Revision	19	4	-15
Mean Absolute Revision	48	36	-12

revisions from benchmarking, as described in the Background section. A separate study of five particular series (see Table 5) used data all on the same benchmark, further isolating the effect of concurrent vs. projected factors. For this table, "final" values are based on a seasonal adjustment run with data through March 2000, the last available benchmark when these statistics were computed. The five series are Heavy Construction, Motor Vehicles and Equipment, Department Stores, Eating and Drinking Places, and Business Services. These series were specifically chosen because of their pronounced seasonality. Table 5 shows the percent mean absolute revision in the over-the-month change for both the projected-factor and concurrent seasonally adjusted series. With this purer comparison of methods, at least for these series, the reductions in the variability of the over-the-month changes with concurrent adjustment tend to be even larger than indicated by previous results.

Table 5. Mean Absolute Revision in Over-the-Month Percent Change, May 1996 through April 1998

(A) Group	(B) 6-month projected	(C) Concurrent	(D) Ratio (C) / (B)
Heavy Constr. (except building materials)	.65%	.36%	.55
Motor vehicles and equipment	.33%	.16%	.49
Department Stores	.34%	.18%	.51
Eating and drinking places	.11%	.05%	.45
Business Services	.19%	.10%	.52
Average	---	---	**.50**

Implications of conversion to concurrent: For a survey as large and prominent as CES, the implications of a change in methodology must be carefully considered. Potential advantages and disadvantages related to a CES conversion to concurrent seasonal adjustment are discussed below.

Advantages

More accurate seasonal factors – Concurrent seasonal adjustment is technically superior to the 6-month projected factors because it takes into account the timeliest information available. Empirical results from this analysis illustrate that seasonally adjusted CES data are closer to the final benchmarked series under concurrent adjustment, leading to smaller revisions between first primary estimates and the final benchmark series. Furthermore, monthly revisions between first closing and third closing are slightly lower for concurrent adjustment, eliminating a potential disadvantage suggested by earlier studies that the monthly revisions could increase (Methee and McIntire, 1987).

Conversion to NAICS – As previously mentioned, the CES conversion to concurrent seasonal adjustment will take place in June 2003, when the CES program converts to NAICS industry coding. Using concurrent seasonal adjustment will be especially advantageous during the first few years following the NAICS conversion because most of the NAICS historical data will be reconstructed from the SIC-based sample. Only two years of NAICS history from a NAICS-based sample will be available. Therefore, under the projected-factor method, in the first year of the NAICS conversion, there would be only two historical NAICS-based estimates per month used to calculate projected seasonal factors, while with concurrent adjustment three actual NAICS-based estimates would be used (the previous two years of NAICS-based estimates plus the current one). The additional observations will be valuable because X-12 weights the most recent years more heavily than the past when calculating seasonal factors.

Familiarity with revisions – As discussed earlier, CES already revises two prior months of estimates with each month's release. As part of the current monthly production process, not-seasonally adjusted estimates are revised for the previous two months, and projected seasonal factors are applied to the revised estimate to calculate the new seasonally adjusted figures. Under concurrent adjustment, the

non-seasonally adjusted estimate for the previous two months would still be revised as before, and the seasonally adjusted data for these months will come from the concurrent run. No additional revisions will occur under concurrent seasonal adjustment.

Potential Disadvantages

Factors will not be available ahead of time – As discussed earlier, CES currently calculates seasonal factors twice a year and projected factors are published in advance for the next six months. Under concurrent seasonal adjustment, CES will not be able to publish factors in advance because the new seasonal factors are calculated each month. However, it is possible to make available beforehand the ARIMA model specifications used by BLS so that the seasonal adjustment run can be replicated if desired.

Operational / processing complexity – While this may be a concern with many new production processes, it is not an issue here as the concurrent adjustment methodology is easily being incorporated into the new CES production system currently under development. This new production system will be deployed in conjunction with the conversion to NAICS. Furthermore, the introduction of concurrent adjustment into the current process will neither significantly slow down the production process nor jeopardize the program's ability to produce monthly estimates on schedule. As mentioned earlier, for this research CES has been producing a parallel concurrently adjusted series with each regular first closing estimate since 1998 without any disruptions or delays to the production process. So the operational or processing impact is minimal.

Conclusion: To determine whether or not a conversion to concurrent seasonal adjustment would be beneficial for the Current Employment Statistics program, several factors were considered. The most important issue examined is the effect on revisions, both revisions from first closing to final benchmarked series and revisions between closings. The research done with the National CES employment series indicates that the CES will benefit from conversion to concurrent adjustment through smaller revisions from the first closing estimates to the final benchmarked estimate. Furthermore, it shows that concurrent adjustment will not increase revisions between closings and, in the case of third closing, will actually reduce revisions between first and third closing. Finally, the advantages of such a switch outweigh any disadvantages that might exist. Based on these results, simultaneous with the program's conversion to NAICS industry coding in June, 2003, CES will switch to concurrent seasonal adjustment methodology. At that time, the practice of publishing forecasted seasonal factors will be discontinued.

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