A Report to Congress on the Bureau of Labor Statistics' Current Employment Statistics Methodology for Metropolitan Statistical Areas

2015

Index

Executive Summary

This report is a response to language included in the Joint Explanatory Statement that accompanied the Consolidated and Further Continuing Appropriations Act, 2015, directing the Bureau of Labor Statistics (BLS) to conduct a review of the methodology used in the collection and reporting of Current Employment Statistics (CES) survey data for Metropolitan Statistical Areas (MSAs). The specific language included in the Statement was:

> *The Bureau of Labor Statistics (BLS) is directed to conduct a review of methodology for the collection and reporting of data for Metropolitan Statistical Areas within the Current Employment Statistics program. Within 180 days of enactment of this act, BLS shall submit a report to the House and Senate Committees on Appropriations on ways that reporting for Metropolitan Statistical areas could be improved and any estimated costs of implementation.*

This report provides background information about the CES survey, a summary of data collection procedures and estimation methodologies, information about quality measures tracked by the CES program, options to improve both the data collection and estimation methodologies, and the costs associated with those improvements.

The CES program produces estimates published in two national news releases designated by the Office of Management and Budget (OMB) as Principal Federal Economic Indicators, and in two subnational news releases. The estimates are one of the first indicators of the health of the national, state, and MSA economies and as such they are highly scrutinized. Because of this, quality measures are closely monitored. Quality measures that are closely tracked include collection rates, revisions to the data to reflect additional sample collection, and benchmark revisions. These measures are reviewed both within BLS, and they are shared routinely with the public by being published on CES web pages on the BLS website.

In general, current CES estimation procedures have been utilized for many years. Over time, refinements to those procedures have been implemented. In recent years, the single largest improvement was the implementation of a probability-based sampling and weighting procedure in 2003. Additionally, state and MSA estimate review procedures were formalized and improved over several years between 2009 and 2012.

The CES survey data collection procedures are successful, especially for a repeated monthly survey. The collection rate[1], a measure of success in repeated collection of reports from participating businesses, has increased substantially over time. In 1981, the annual average collection rate at the first release of data was 39.6 percent, and that rate had risen to 78.1 percent for 2014. In addition, in 2003, a major sample redesign was fully phased-in that transitioned the design from a quota sample[2] to a modern

[1] The collection rate is the number of businesses reporting data divided by the number of businesses that are expected to report data that month. This measure excludes from the denominator business that are not within nonfarm industries or out of business, and also excludes businesses who are permanent refusals.

[2] A quota sample is a non-probabilistic version of stratified sampling. Samples selected using this procedure may be biased because not every member of the population has a chance of selection.

probability-based design. The result of this transition was generally smaller benchmark revisions – or adjustments to align the sample estimates with population estimates.

Since the probability-based sampling and weighting procedure was implemented in 2003, CES estimates have done a good job estimating population trends as evidenced by generally small benchmark revisions, which are the difference between survey and population measures.

This report proposes several potential improvements. These are briefly summarized below:

- Provide BLS with legislated authority to make response to the CES survey mandatory. This option costs little, and would be expected to convert some large business non-respondents into respondents, thereby improving overall response and reducing error levels.
- Increase the sample size by 47,000 businesses. This option would decrease the relative error in smaller MSAs (those with less than 100,000 employees) by 10 – 12 percent, at an annual cost of $9 million.
- Increase the sample size by 85,000 businesses. This option would decrease the relative error in smaller MSAs (those with less than 100,000 employees) by 35 – 60 percent, at an annual cost of $16 million.
- If research shows that estimates would be improved, provide funding to align CES estimates more frequently with population estimates. Aligning CES estimates with population estimates twice a year instead of once would require $4 million per year in additional funding. Aligning the sample estimates with population estimates four times a year instead of once would require $7.5 million per year in additional funding.

A Report to Congress on the Bureau of Labor Statistics' Current Employment Statistics methodology for Metropolitan Statistical Areas 2015

Purpose of report

The Joint Explanatory Statement that accompanied the Consolidated and Further Continuing Appropriations Act, 2015, included language directing the Bureau of Labor Statistics (BLS) to conduct a review of the methodology used in the collection and reporting of Current Employment Statistics (CES) survey data for Metropolitan Statistical Areas (MSAs). The specific language is included below:

> *The Bureau of Labor Statistics (BLS) is directed to conduct a review of methodology for the collection and reporting of data for Metropolitan Statistical Areas within the Current Employment Statistics program. Within 180 days of enactment of this act, BLS shall submit a report to the House and Senate Committees on Appropriations on ways that reporting for Metropolitan Statistical areas could be improved and any estimated costs of implementation.*

This report is the BLS response to the directive.

CES Background

The Current Employment Statistics (CES) program, also known as the payroll survey or the establishment survey, is a sample of approximately 143,000 businesses and government agencies representing about 588,000 individual worksites. The sample covers about one-third of total employment in the United States, a very large percent coverage as compared to most sample surveys. From this sample the Bureau of Labor Statistics (BLS) calculates and publishes estimates of employment, hours, and earnings at the National, State, and Metropolitan Statistical Area (MSA) levels each month. Businesses are classified into and estimates are published by industry according to the North American Industry Classification System (NAICS 2012). Major published employment data types are: all employees, women employees, and production /non-supervisory employees. Other major data types are: average hourly earnings and average weekly hours for all employees and for production/non-supervisory workers, and numerous derivative series (e.g. index of aggregate hours). The level of industry detail available varies across National, State, and MSA levels, mainly dependent on the adequacy of sample sizes.

CES also publishes seasonally adjusted data for many of its series. Seasonal adjustment removes the effect of regularly recurring seasonal events to better reveal the underlying economic trend of the data. Examples of seasonal events are holiday-related hiring in retail trade in December, and weather-related layoffs in construction in January. In total, the CES program publishes about 27,000 national data series each month, and about 23,000 State and MSA data series. The national data series, published in *The Employment Situation* and in the *Real Earnings* news releases, have been designated by the Office of Management and Budget (OMB) as Principal Federal Economic Indicators (PFEIs). The State data are released with BLS' *Regional and State Employment and Unemployment* news release, and the MSA data are reported in the *Metropolitan Area Employment and Unemployment* news release.

The reference period for the survey is the pay period that includes the 12th of the month. Pay periods are typically one week, two weeks, semi-monthly, or monthly.

The CES program publishes estimates on a very timely basis; first preliminary estimates are published in the month following the reference month. For example, National estimates for March are generally published the first Friday in April, with State and MSA publication following two weeks later. The CES maintains its published data as economic time series meaning that when non-economic changes occur (such as changes in the industry classification system), CES reconstructs historical data to conform to the new classification to the extent possible. Reconstruction removes non-economic movements in the data series which aids in the analysis of economic change. For example, the national CES total nonfarm employment series starts in 1939.

The CES program uses a state of the art probability sample design; it is a simple random sample clustered by Unemployment Insurance (UI) account, and stratified by industry, geography, and employment size class. The current design was phased into production between June 2000 and June 2003 as part of a major redesign of the CES program. Prior to the implementation of the probability sample, CES used a type of quota sampling[3] where the quotas were set by State and Metropolitan Statistical Area (MSA).

The overall national CES sample size is set according to the level of program resources. The CES program uses a State-based sample design meaning that a total sample size is set for each State and then an optimum allocation procedure is used to distribute that sample within each State. This procedure distributes the fixed number of sample units across the allocation strata, a set of industry and employment size classes, to minimize variance on the primary estimate of interest. The current breakout by state can be found on the BLS website: http://www.bls.gov/sae/sample.htm.

For CES the primary estimate of interest is the monthly change in total nonfarm employment. The sample frame for each State is sorted by MSA which helps to distribute the sample proportional to the population distribution across sub-state geographies and improves the variance of the total nonfarm estimate of employment for each MSA. The entire sample is redrawn once a year[4], and there is a semi-annual update to select a sample of new business births midway between the annual sample draws.

The CES survey is one of several BLS statistical programs that is operated as a Federal/State cooperative program. Each fiscal year, 53 State Workforce Agencies (SWA) sign a cooperative agreement with the BLS to participate in CES activities. Cooperative Agreements are signed by all States, the District of Columbia, Puerto Rico, and the Virgin Islands for CES. With BLS-provided funding, State agencies perform some of the program functions. Originally, States were responsible for sample selection, most data collection, and production and dissemination of monthly estimates for their Statewide and MSA series. Over time, BLS assumed responsibility for most of these functions in order to reduce program costs and ensure consistency of methods and procedures across the program. In March 2011, BLS completed a restructuring of the CES State and Area program that transferred the State and Metropolitan Area estimation function from individual State Workforce Agencies to the BLS. States retain responsibility for gathering and providing to BLS information on local economic events that may not be captured by the CES sample, and for providing analysis and dissemination services to state and local data users.

CES national employment data are highly valued. These employment series are the first economic indicator of current economic trends each month, together with data from the Current Population Survey including the

[3] A quota sample is a non-probabilistic version of stratified sampling. Samples selected using this procedure may be biased because not every member of the population has a chance of selection.

[4] While the sample is redrawn every year, most selected businesses remain in the sample between 2 and 4 years, and large business remain a part of the sample on a continuous basis.

unemployment rate. The national CES data are used in many ways to gauge the health of the U.S. economy, including:

- The overall health of the economy (employment)
- Earnings trends (average hourly earnings)
- Short-term fluctuations in demand (average weekly hours)

CES employment data also are used as inputs into other major economic indicators, including:

- Personal income (aggregate earnings)
- Industrial Production (aggregate hours in manufacturing, mining, and public utilities)
- Index of Leading Economic Indicators (average weekly hours of production employees in manufacturing)
- Index of Coincident Indicators (employment)
- Productivity measures (aggregate hours)

CES employment data also are used to inform other areas of business, research, and policy:

- Public policy
- Wage negotiations
- Economic research and planning
- Industry studies

CES State and MSA data serve similar uses for State and MSA customers:
Private Sector:

- To guide decisions about plant location, sales, and purchases
- To compare one business against the industry or economy as a whole
- To negotiate labor contracts based upon industry or area hourly earnings and weekly hours
- To determine the employment base of States and areas for bond ratings
- To detect and plan for swings in the business cycle using the average weekly hours series

Public Sector:

- To evaluate the health of the State and MSAs
- To guide monetary policy decisions
- To assess the growth of industries
- To forecast tax revenue for States and areas
- To measure employment, hours, and earnings, as a means of determining growth in the economy

The CES program traces its origins to 1915, when BLS first began to collect employment and payroll data for four manufacturing industries. After 100 years of improvements, CES has emerged as a world-class survey that other nations gauge their programs against, both in data collection methodologies and in estimation procedures. The CES program maintains a robust research agenda, targeted at developing improved procedures and methodologies, and BLS periodically invites outside researchers to conduct research to determine new avenues for possible improvements.

CES Data Collection Methodology

The goal of CES data collection efforts is to attain the highest response rate possible given fixed resources while minimizing respondent burden. CES collection methods have evolved significantly over time to achieve these goals. Presently, CES uses 6 main data collection methods each month to best fit the needs of respondents. Regardless of method, the CES collection period for the first preliminary release of National data ranges between 10 and 16 days. Data collection efforts begin on the next business day after the 12th day of the month and

continue through the Monday of the release week. In recent years, CES has collected on average over 77 percent of the reports expected each month in time for the first preliminary release of data.[5]

On average, respondents are part of the sample between 2 to 4 years, and are asked to provide data monthly. Because of this, and given that the CES survey is voluntary under Federal law, every effort is made to accommodate respondents' preferred method of data collection. In order to reduce respondent refusals as much as possible, CES uses a data bargaining[6] hierarchy with the lowest to highest priority given to women employees, production employees hours and earnings, production employees, all employees hours and earnings, and as a last resort, only total employment will be collected. In addition, CES attempts to collect data at the individual worksite level; however, as a last resort CES accepts totals at the unemployment insurance (UI) account level, usually referred to as a state-wide total.

Respondents are introduced to the CES survey via a welcome letter and form, which clearly states the purpose of the CES survey and that a data collection interviewer will be calling them. They do not fill the form out on their own. A data collection interviewer will call the respondent using a Computer Assisted Telephone Interview (CATI) instrument. The primary goals of the initial contact are to explain why the respondent's participation is important, what will be collected each month, confirm the correct establishment has been contacted, and set up a follow-up appointment to collect their data. Typically over 73 percent of respondents contacted will initially agree to participate in the survey. However, given that respondents are in the sample a minimum of 2 years, the on-going participation rate averages out to around 63 percent.

Six months after the initial contact, respondents are transitioned to their permanent method of collection. Respondents can be transitioned to self-reporting methods such as Touchtone Data Entry (TDE) or web based collection. About 3 percent of respondents use TDE and another 16 percent use the web. TDE respondents call a toll-free number each month and enter their data using the telephone keypad. While TDE is easy to use, it is a cumbersome method to collect a lot of information from respondents. Presently, the majority of TDE respondents are government agencies, since CES only collects all employees and women employee totals from those respondents. Mid-size firms across all industries like using the web-based platform to report their data. CES uses the BLS Internet Data Collection Facility to collect data via the web. Respondents receive an email prompt each month with a hyperlink to the site. Web respondents have a higher item response rate than other methods perhaps because respondents feel compelled to fill in the data entry grid. Both self-reporting methods are very cost efficient for on-going collection, however the attrition level is higher than with other methods and the first preliminary response rate is about 10 percent lower than CATI.

Respondents who report more than 10 worksites are offered Fax as a reporting method. This accounts for about 4 percent of monthly collection. Respondents are faxed a data entry form each month, they fill out the forms, and then fax the forms back. Data collection interviewers key-punch the data into the CATI system. Response rates tend to be higher than web but less than CATI, and costs are more than web but less than CATI.

Sometimes respondents are not transitioned away from CATI, but remain on that method permanently. This occurs for a variety of reasons, but mostly because respondents indicate that without a monthly phone call to collect their data, they would not participate. Additionally, they remain CATI respondents if their data are erratic month to month, and requires an explanation code that the data collection specialist places on the data after talking to the respondent. CATI data are of the highest quality because they are being edited in real-time and the

[5] The CES program releases the collection rates for the first preliminary release, second preliminary release, and final release of data each month. Those rates can be found at http://www.bls.gov/web/empsit/cesregrec.htm,

[6] Data bargaining is a procedure that reduces the number of data items that a respondent is asked to report, in order to retain their response to other data items.

data collection interviewer can correct or add an explanation code immediately. The collection rates for CATI are also the highest, typically over 82 percent for the first release of data, but the trade-off is that it is the most expensive.

The CES program also collects a lot of worksite level data by Electronic Data Interchange (EDI) where very large firms electronically send in a monthly file that contains all of their worksites across the country. This is very cost efficient for BLS and the respondent once the file format is created and data quality is verified. The main drawbacks to EDI collection is that it is all or nothing, meaning the whole company reports or it does not, and when companies change their payroll processing systems, they often stop reporting and it takes months to years to have them start reporting again. While currently around 85 firms report using EDI, they represent about 42 percent of the reports CES receives each month because of the amount of individual worksites provided.

States are the main collector of state government data. Most of the time they have an arrangement with the state government payroll office and receive a consolidated report. CES also sparingly offers respondents the option of email reporting and reporting via spreadsheet. CES is currently researching ways to make these options scalable as they are fairly labor intensive.

CES collects monthly data through a variety of modes each with their advantages and disadvantages. The overall goal is to collect as much quality data as possible as soon as possible given the fixed resources available.[7]

CES Estimation Methodology

The CES program utilizes a number of estimation procedures in order to produce employment, hours, and earnings data. The primary national employment estimator is called a *weighted link-relative estimator*. This reflects the two major components of the estimate: the link, or the ratio of summed weighted current month employment to summed prior month weighted employment for businesses who reported in both months, and the prior months' employment estimate. Another factor is an adjustment called the net birth/death factor, which is a model-based adjustment used to account for the net difference between business birth and death employment. This factor is explained in greater detail in the BLS' Handbook of Methods, Chapter 2. The link-relative estimator is depicted below:

$$\widehat{AE}_c = \widehat{AE}_p \frac{\sum_i ae_{c,i}}{\sum_i ae_{p,i}} + b_c$$

Where

- AE is all employees,
- c is current month,
- p is prior month,
- b is the net birth/death factor, and
- i is a sampled business.

More complex estimators are used to produce estimates of hours and earnings.

The primary employment estimator for State and MSA employment is called the *robust estimator*. The robust estimator is similar to the link-relative estimator, except that it includes a statistical procedure to automatically

[7] For a more detailed review of CES data collection history and current methods see "Data Collection in the U.S. Bureau of Labor Statistics' Current Employment Statistics Survey," by Kenneth Robertson and Julie Hatch-Maxfield available at http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.44/2012/mtg2/WP20.pdf and in Appendix A.

identify observations with unusual over-the-month change and reduce their influence on the estimates. This is very important in smaller domains, as they have fewer reports contributing to the estimates, and each report may therefore have a large influence on the estimate of change.

Several additional estimators are used in the production of MSA estimates.

Relatively small sample sizes in some State/MSA/industry strata limit the reliability of employment estimates produced using the *robust estimator*. For these cases, BLS uses the CES *small domain model*. The *small domain model* estimate can be described as a weighted average of three inputs: (1) an estimate based on available CES sample for that series, (2) an estimate based on a large CES sample from the same industry for the entire State, and (3) an Autoregressive Integrated Moving Average (ARIMA) projection based on trend from 10 years of historical data from the Quarterly Census of Employment and Wages (QCEW) program for the State/MSA/industry.

To estimate employment for State super-sector cells with smaller sample size, the CES program utilizes an estimator based on the *Fay-Herriot model*. In the smaller cells, a direct sample-based estimate of the over-the-month change in employment often is unreliable due to the large variance, although the direct estimator is assumed to be approximately unbiased. In order to make more stable estimates, additional information is used. The model is formulated for a set of States in a given super-sector at a given month. The resulting *Fay-Herriot model* estimate can be presented as a weighted average of the sample-based estimate and an adjusted ARIMA forecast. A version of the *Fay-Herriot model* is also used to estimate many series in smaller MSAs.

Additional information on CES estimation procedures is provided in the BLS Handbook of Methods at http://www.bls.gov/opub/hom/pdf/homch2.pdf, also found in Appendix B.

Quality of CES MSA Estimates

BLS maintains a number of measures to monitor data quality for national, state, and MSA data series. BLS routinely calculates and reports on the following measures of CES estimate accuracy:

Benchmark revisions

Annual CES benchmark revisions are often regarded as a proxy for total survey error, as they measure the overall difference between CES sample-based employment estimates and a more complete universe estimate of employment on an annual basis. The universe count is an estimate derived primarily from Unemployment Insurance tax reports that nearly all employers are required to file with their State Workforce Agency, combined with an estimate of non-covered employees. Benchmark revisions can be more precisely interpreted as the difference between two independently developed employment counts, each subject to its own error sources. Benchmark revisions are tabulated for all published CES series at the national, State, and Metropolitan Statistical Area levels.

National Benchmark Revisions

The March 2014 benchmark level for national CES total nonfarm employment was 137,214,000; this figure was 67,000 above the sample based estimate for March 2014, an adjustment of less than 0.05 percent.
Table 1 below shows the recent history of national CES total nonfarm percentage benchmark revisions. Over the prior six years, the annual benchmark revision at the total nonfarm level has averaged 0.3 percent (in absolute terms), with an absolute range of less than 0.05 percent to 0.7 percent.

Table 1. Percent differences between nonfarm employment benchmarks and estimates by industry, National CES, March 2009 – March 2014[1]

CES Industry Code	CES Industry Title	2009	2010	2011[2]	2012	2013[3]	2014
00-000000	Total nonfarm	-0.7	-0.3	0.1	0.3	-0.1	[4]
05-000000	Total private	-0.9	-0.4	[4]	0.4	-0.1	0.1
10-000000	Mining and logging	-3.5	-3	-0.4	1.6	-1.2	-1.8
20-000000	Construction	-2.9	-1.3	-0.5	1.8	0.3	1.6
30-000000	Manufacturing	-0.7	-1	0.1	-0.2	0.2	0.4
40-000000	Trade, transportation, and utilities	-1.2	-0.6	0.4	0.6	-0.5	-0.1
50-000000	Information	-1.5	-0.4	-0.4	1.8	-0.2	2.4
55-000000	Financial activities	-0.1	0.4	-0.2	0.6	-0.1	0.2
60-000000	Professional and business services	-0.8	[4]	0.7	[4]	[4]	-0.8
65-000000	Education and health services	-0.3	[4]	-0.6	[4]	-0.3	-0.1
70-000000	Leisure and hospitality	-0.6	-0.6	0.7	0.8	0.5	0.3
80-000000	Other services	-0.8	0.2	-2	1.1	-0.4	1.1
90-000000	Government	0.1	0.1	0.1	-0.3	[4]	-0.2

[1] The differences listed in this table reflect the error due to normal benchmarking procedures. Typically this error is equal to the March benchmarked level minus the published March estimated level. However in some years, other factors beyond normal benchmarking procedures influence the difference between the benchmarked and published March estimate levels. Those years are footnoted.

[2] A review of industries for the possible presence of noncovered employment in benchmark 2011 yielded 13 additional industries. As a result of including these industries, employment in the amount of 95,000 was added to the Total nonfarm benchmark level. The difference between the benchmarked and published March 2011 estimate level was 162,000. For this table, the 95,000 amount was added to the original published Total nonfarm and Total private March 2011 estimates before calculating the percent and level differences. Portions of the 95,000 amount were also added as appropriate to the original published March 2011 estimates of super sectors Financial activities and Education and health services before calculating the percent differences.

[3] The percent and level differences in this column reflect reconstructions to series within CES supersectors Financial activities and Education and healthcare services. Each first quarter, the Quarterly Census of Employment and Wages (QCEW) program, whose data account for approximately 97 percent of the CES universe scope (see www.bls.gov/web/empsit/cestn.htm#section1), incorporates updated industry assignments. In 2013, these updates included two substantial groups of nonrandom, noneconomic code changes, one to Funds, trusts, and other financial vehicles (NAICS 525), and the other, a reclassification of approximately 466,000 in employment from Private households (NAICS 814), which is out of scope for CES, to Services for the elderly and persons with disabilities (NAICS 62412), which is in scope. These changes also had an impact, beyond what would be considered typical for a given benchmark year, on corresponding CES series. For more information about the changes to these industries, see the QCEW First Quarter 2013 News Release available at www.bls.gov/news.release/archives/cewqtr_09262013.htm.

[4] Less than 0.05 percent.

State Benchmark Revisions

The average absolute percent benchmark revision across all states for total nonfarm payroll employment was 0.5 percent for March 2014. This compares to the average of 0.6 percent for the same measure during the five prior benchmark years of 2009 to 2013, with an absolute range of 0.4 percent to 0.9 percent during that time period. For March 2014, the percent revision for total nonfarm payroll employment across all states ranged from -1.5 to 2 percent. Table 2 below shows the recent history of percentage differences between state employment estimates and benchmarks for total nonfarm and super sectors. Over the prior six years, the annual benchmark revision across all states at the total nonfarm level has averaged 0.6 percent (in absolute terms), with an absolute range of less than 0.4 percent to 0.9 percent.

Table 2. Average absolute percentage differences between state employment estimates and benchmarks by industry, March 2009–March 2014 (all values in percent)

CES Industry Code	CES Industry Title	2009	2010	2011	2012[(1)]	2013[(2)]	2014
00-000000	Total nonfarm	0.9	0.4	0.5	0.7	0.4	0.5
10-000000	Mining and logging	6.0	7.5	3.2	4.7	3.7	2.8
20-000000	Construction	4.0	3.6	3.2	4.4	3.1	3.0
30-000000	Manufacturing	2.2	1.8	1.4	1.5	1.4	1.2
40-000000	Trade, transportation, and utilities	1.6	1.2	0.9	1.1	1.0	0.7
50-000000	Information	3.3	2.3	2.4	3.2	2.2	2.0
55-000000	Financial activities	1.6	1.8	1.9	2.2	1.6	2.0
60-000000	Professional and business services	2.2	2.2	1.8	1.9	1.8	1.6
65-000000	Education and health services	0.8	1.0	0.9	1.4	1.6	0.9
70-000000	Leisure and hospitality	1.7	1.8	1.9	2.3	1.4	1.4
80-000000	Other services	1.9	1.9	2.4	2.7	2.1	2.4
90-000000	Government	0.6	0.8	0.7	1.0	0.7	1.0

(1) CES State and Area payroll employment estimates are typically replaced with census derived employment counts through the third quarter of the benchmark year. However, in the 2011 benchmark year, CES estimates were replaced only through the second quarter of 2011 (through June 2011). As a result, the March 2012 benchmark revisions reflect revisions to cumulatively more months of sample-based estimates than is typical, contributing to generally higher rates of revision. For more information, see http://www.bls.gov/sae/benchmark2013.pdf.

(2) The CES estimates in this column were subject to large revisions and historical reconstructions due to substantial reclassifications by the QCEW program in the Financial activities and Education and health services sectors. For more information, see http://www.bls.gov/news.release/archives/cewqtr_09262013.htm.

Overall the size of the state benchmark revisions is comparable from 2007 to 2014. Table 3 shows the mean revision, average absolute revision, and range of statewide benchmark revisions for all states from 2007 to 2014.

Table 3. Statewide Benchmark Revisions
Total Nonfarm, March 2007 - 2011

Year	Mean Revision	Average Absolute Revision	Range
2007	[1]	0.4	-1.5 to 1.2
2008	-0.1	0.4	-1.4 to 1.0
2009	-0.8	0.9	-3.8 to 1.1
2010	-0.1	0.4	-1.3 to 1.4
2011	0.2	0.5	-1.8 to 1.4
2012	0.6	0.7	-1.5 to 2.2
2013	0.3	0.4	-0.7 to 2.9
2014	0.1	0.5	-1.5 to 2.0

[1] Less than 0.05 percent

Metropolitan Statistical Area (MSA) Benchmark Revisions

On February 28, 2013, the Office of Management and Budget (OMB) announced changes to statistical area delineations based on the application of new data standards from the 2010 Census. Prior to the release of 2014 benchmark data, CES area definitions were derived from the 2009 OMB delineations. The 2010 updates from OMB created time series breaks within all areas being re-delineated, and for areas not previously covered by BLS no historical data were available. In order to provide consistent time series to its data users, BLS reconstructed both All Employee (AE) and non-AE time series for all areas affected by the re-delineation, including the creation of new time series for newly covered areas. These updates to the 2010 OMB delineations were released with the 2014 benchmark. This also maintained consistency with the release schedule of the last OMB decennial update, which was released by OMB in 2003 and updated by BLS in 2005.

This area re-delineation and the resulting reconstructions impacted how BLS presented benchmark revisions at the area level for March 2014. Areas experiencing compositional changes due to the re-delineation were subject to larger than normal benchmark revisions because the CES estimates that were revised were based on 2009 OMB statistical area delineations, while 2014 benchmark values are based on current OMB delineations. Because of this, benchmark revision values in those areas are significantly larger than previous benchmark years and are not an accurate reflection of the overall accuracy of the CES estimates. Additionally, newly created MSAs experienced no revisions because there previously were no CES estimates for these areas prior to the release of 2014 benchmark data. Therefore, new areas and areas impacted compositionally by the re-delineation were excluded in the evaluation of area benchmark revisions in 2014.

For metropolitan statistical areas (MSAs) published by the CES program and not impacted by the re-delineation, the percentage revisions ranged from –7.0 to 6.1 percent, with an average absolute percentage revision of 1.1 percent across those MSAs for March 2014. Comparatively, at the statewide level the range was –1.5 to 2.0 percent, with an average absolute percentage revision of 0.5 percent for March 2014. Revisions are typically larger at the MSA level because the sample sizes are smaller. Additionally, as MSA size decreases so does the sample size, resulting in increases to both the range of percent revisions and the average absolute percent revision. Metropolitan areas with 1 million or more employees during March 2014 had an average absolute revision of 0.8 percent, while metropolitan areas with fewer than 100,000 employees had an average absolute revision of 1.4 percent (see Table 4).

Table 4. Benchmark revisions for nonfarm employment in non-changing metropolitan areas, March 2014

Measure	All MSAs	MSAs grouped by level of total nonfarm employment			
		Less than 100,000	100,000 to 499,999	500,000 to 999,999	1 million or more
Number of MSAs……..	270	135	102	11	22
Average absolute percentage revision……	1.1	1.4	0.9	0.9	0.8
Range……	-7.0 to 6.1	-7.0 to 6.1	-3.2 to 2.6	-0.9 to 2.4	-0.9 to 3.6
Mean……..	0.4	0.3	0.4	0.3	0.7
Standard deviation……..	1.5	1.8	1.0	1.2	1

Overall, there is little difference in the size of the benchmark revisions at the MSA level over time. As Table 5 illustrates, from 2007 to 2014 the mean and average absolute benchmark revisions at the MSA level are all similar.

Table 5. Metropolitan Statistical Area Percent Benchmark Revisions Total Nonfarm, March 2007 – 2014

Year	Mean Revision	Average Absolute Revision	Range
2007	-0.2	0.9	-5.1 to 4.4
2008	-0.3	1.0	-5.7 to 3.6
2009	-1.4	1.8	-12.1 to 4.1
2010	0	1.1	-7.1 to 6.0
2011	0.1	1.1	-5.6 to 5.0
2012	0.4	1.6	-9.7 to 7.9
2013	0.4	1.2	-5.3 to 8.1
2014	0.4	1.1	-7.0 to 6.1

Likewise, there is little difference in the size of the average absolute benchmark revisions for MSA's of different employment size over time. As Table 5a illustrates, from 2007 to 2014 the average absolute benchmark revisions at the MSA by size level are similar over time.

Table 5a. Metropolitan Statistical Area Benchmark Revisions, by MSA employment size

Total nonfarm, March 2007 - 2014								
	Mar 2007	Mar 2008	Mar 2009	Mar 2010	Mar 2011	Mar 2012	Mar 2013	Mar 2014*
Average absolute percentage revision								
- All MSAs	0.9	1.0	1.8	1.1	1.1	1.6	1.2	1.1
- MSAs grouped by level of total nonfarm employment								
- Less than 100,000	1.1	1.3	2.1	1.4	1.4	2.0	1.4	1.4
- 100,000 to 499,999	0.8	0.9	1.6	0.9	0.9	1.5	1.1	0.9
- 500,000 to 999,999	0.7	0.6	1.4	0.7	0.8	0.9	0.8	0.9
- 1 million or more	0.6	0.5	0.9	0.5	0.7	0.7	1.1	0.7
Range of percentage revisions								
- All MSAs	-5.1 : 4.4	-5.7 : 3.6	-12.1 : 4.1	-7.1 : 6.0	-5.6 : 5.0	-9.7 : 7.9	-5.3 : 8.1	-7.0 : 6.1
- MSAs grouped by level of total nonfarm employment								
- Less than 100,000	-5.1 : 4.4	-5.7 : 3.6	-12.1 : 4.1	-7.1 : 6.0	-5.2 : 5.0	-9.7 : 7.9	-5.3 : 8.1	-7.0 : 6.1
- 100,000 to 499,999	-4.0 : 2.2	-4.1 : 3.2	-5.3 : 2.2	-2.6 : 3.7	-5.6 : 3.7	-5.3 : 7.3	-2.8 : 5.6	-3.2 : 2.6
- 500,000 to 999,999	-1.2 : 3.1	-1.6 : 0.8	-3.9 : 1.1	-0.8 : 2.0	-1.4 : 2.5	-1.6 : 2.3	-1.1 : 3.8	-0.9 : 2.4
- 1 million or more	-2.5 : 1.0	-4.2 : 0.7	-2.9 : 0.1	-0.8 : 1.7	-0.8 : 2.3	0.2 : 2.2	-1.4 : 4.0	-0.9 : 1.9

*Revisions are for unchanged metropolitan areas and NECTAs only. The following areas are excluded: areas that experienced compositional changes, areas that are new in the 2010 delineations, areas that have been dropped from the 2010 delineations, areas that experienced FIPS code changes,

Collection Rates and Response Rates

One measure of quality for all sample surveys is the response rate (the percentage of sampled units collected). Lower response rates can diminish the expectation that a collected sample is representative of the population because lower response rates may lead to biased estimates. The CES program has several measures of response that it tracks. The first is the "Response Rate", and the second is the "Collection Rate"; the difference is the group of businesses included in the denominator (or base) of the rate. The response rate denominator includes all businesses in the sample that are still in business and within the nonfarm industries. The collection rate denominator is the same, except that it excludes those businesses who have opted on a permanent basis to not respond to the survey, and therefore only includes businesses who have been actively reporting data.

The initiation response to the CES survey is above 73 percent (of businesses surveyed), while the final response rate for fully enrolled private establishments ranged between 54 percent and 64 percent between 2009 and 2015. However, the CES is a repeated longitudinal survey. That is, BLS asks smaller businesses to report on their

employment, hours, and earnings every month for two to four years, and large businesses are in the sample continuously. For repeated collections such as this, some respondents will, over time, change their mind about continuing to report. Therefore, the collection rate is a measure of the percentage of businesses we expect to collect data from in a given month, while the response rate is the percentage of the original sample that we are collecting data from.

The CES national collection rate data (http://www.bls.gov/web/empsit/cesregrec.htm) show that the annual average collection rates for the first release of data were at 39.6 percent in 1981, and over time have risen to 78.1 percent annual average in 2014. Since state data are produced after national data, the preliminary collection rates for state and metropolitan area data are slightly higher. The annual average collection rate for the final release of national data in 1982 was 87.1 percent, and it was 96.9 percent in 2014.

Response and collection rates can also be measured by the amount of unweighted employment in the collected data versus the actively-reporting sample. The average collection rate in 2014 for employment was 68.0 percent at the first release of data, and 92.6 percent for the final release.

Revisions to preliminary over-the-month estimates

Another measure of quality for the CES survey is the revision to the over-the-month change from the preliminary estimate to the final estimate. Preliminary estimates are made before all of the data are collected for a specific reference month. These revisions are a design feature of the CES program.

Revisions to the statewide Total Nonfarm employment estimate tend to be small, with the majority of the revisions smaller than 0.1 percent of employment (in absolute value), and about 90 percent of revisions less than 0.3 percent of employment. There are, however, a few large revisions to the over-the-month change in data from March 2011 to March 2013.

State revisions during the period from March 2011 to March 2013 varied by industry. With the exception of three industries, 90 percent of the over-the-month revisions were less than 1.3 percent of employment, except in mining and logging, in trade, transportation, and utilities, and in information.

Metropolitan area revisions to the over-the-month change, during this period, also tended to be mostly small; 90 percent of these revisions were less than 0.8 percent of total nonfarm employment, and 95 percent were less than 1.6 percent.

Percentile distribution of MSA absolute revisions to Total Nonfarm as a percent of employment, March 2011 – March 2013

25th	50th	75th	90th	95th
0.1	0.2	0.3	0.8	1.6

More information about over-the-month revisions to CES data is available at http://www.bls.gov/osmr/pdf/ec130070.pdf, and in Appendix E.

Options to Improve CES Data Collection

Make the survey mandatory – potential issues, benefits, and costs

The Bureau of Labor Statistics does not have statutory authority to make response to the CES survey mandatory. Survey literature suggests that making a [mandatory] survey voluntary may reduce (mail) cooperation rates and significantly drive up costs. Conversely then, we might assume that making a voluntary survey mandatory might improve survey cooperation rates. A research paper[8] on this topic finds that additional nonresponse occurs when a survey is voluntary.

The impact of voluntary collection on businesses surveys can be difficult to quantify. The CES survey obtains a high level of initial and ongoing survey cooperation even though it is a voluntary survey. The largest businesses in the nation are continuously part of the CES survey sample. Because of their size these businesses can have a large impact on the accuracy of the monthly survey estimates. We assume that some contingent of these businesses have a policy of only responding to mandatory government surveys. If the CES survey were mandatory then this subset of large businesses might respond and provide monthly data to the CES program.

In order to make the CES survey mandatory, the BLS would have to be provided with legislative authority to mandate response. There is little federal cost associated with this – only the cost to add an appropriate citation to the CES collection form and training of staff to respond to questions about this authority. The cost to the public is the burden associated with surveyed respondents who – without this authority – would typically not report their data to BLS.

The benefit would likely be higher response among the largest of units. This would improve response rates to some extent, and reduce the possibility of bias –ensuring higher quality CES estimates especially for the metropolitan areas.

Increase the sample size – potential options, benefits, and costs

All data collections have error sources. For example, a program that collects a periodic census will have error because a subset of respondents provide an incorrect report (i.e. reporting error). This may be because of errors in recall or in the data systems used to generate the data, or errors caused by misunderstanding what data are being requested. There also might be errors due to data entry, and errors incurred during processing. All of these errors also are possible in a sample survey. However, because a sample survey is generally a fraction the size of a census, more effort can be expended in controlling and minimizing these errors. In addition to these controllable errors, a sample survey also has error because it is targeting collection from a sample rather than the entire population. This last error is called sampling error, and it is easily quantifiable if the survey follows standard statistical sampling procedures. The CES survey follows modern survey design principles, and so the sampling error is part of the survey statistics that are available to data users. The CES sample size already is quite large. However, given its importance in gauging the real-time performance of the national, state, and local economies, improvements in reliability would benefit a great number of policy makers, private businesses, and academics in assessing the state of these economies. Fortunately, the sampling error can be reduced by increasing the size of the sample used to measure a population.

[8] Who doesn't respond when a survey is voluntary? Deborah H. Griffin and Michael D. Starsinic, U.S. Census Bureau, https://www.amstat.org/sections/SRMS/Proceedings/y2012/Files/400234_500675.pdf

For CES, sample size increases are scalable to conform to funding increases. Given that, two examples of potential sample size increases are provided here, and with them the reduction in expected sampling error and how much funding would be required to implement them.

Sample Size Option 1. The first alternative increases the sample from 143,000 unemployment insurance (UI) accounts (representing about 588,000 individual worksites) to 190,000 UI accounts (for an increase of 47,000 UI accounts). In this simulation, we increased the sample size, and allocated it following the current allocation process, which distributes sample to State/industry Super-Sector/Employment Size Class strata so that the statewide total employment estimate has the smallest error possible for the given sample size. This increase would reduce the standard error in small metropolitan areas (i.e. those with less than 100,000 employment) by 10 – 12 percent. The error reduction in larger MSAs would be less. The cost to implement a CES sample size increase is primarily the cost to hire additional contract data collectors, plus the additional workspace and computer needs. The cost to increase the sample by 47,000 UI accounts is $9 million per year.

Sample Size Option 2. The second alternative increases the sample size by 85,000 UI accounts. In this simulation, we increased the sample size, but altered the current allocation process. The original 143,000 UI accounts were allocated following the original distribution mechanism. However, the increased sample was allocated to ensure that every State/Industry Super-Sector had 30 or more UI accounts in the sample. That is, if the original sample had less than 30 UI accounts, and the population had 30 UI accounts or more, then the sample size was increased to 30 UI accounts in that stratum. This increase would reduce the standard error in small metropolitan areas (i.e. those with less than 100,000 employment) by 35 – 60 percent[9]. The error reduction in larger MSAs would be less. See the table below. The cost to increase the sample by 85,000 UI accounts is $16 million per year.

		Approximate Standard Error Reduction		
Allocation	**Sample Size Increase**	**Small MSAs Employment Less than 100,000**	**Medium MSAs Employment Between 100,000 and 1,000,000**	**Large MSAs Employment Greater Than 1,000,000**
Proportional Increase	47,000 units	10% - 12%	6% - 8%	5%
Require at least 30 sampled UI accounts per MSA / Super-sector	85,000 units	35% - 60%	3% - 8%	< 1%

[9] There are many small MSAs. Different MSAs would experience different levels of benefit from the allocation process described here. Therefore, some of the small MSAs would see a 35 percent reduction in standard error, while other small MSAs would see a larger reduction in the standard error of up to 60 percent for the over-the-month employment change.

Options to improve CES MSA methodology

Potential for more frequent benchmarking – issues and costs

CES employment data, unlike many sample surveys, are aligned with population values at regular intervals. This alignment is designed to keep employment values by industry at levels consistent with population values. For a number of reasons, the procedure used to align national data with population values differs from the procedure used to align state and metropolitan area data.

The national procedure aligns CES data with adjusted QCEW data[10] (called 'population' data) for March of each year. When March QCEW data become available, the CES data are updated to reflect the population March values, and the difference between the original CES and updated CES is used to adjust the prior 11 months using a linear wedge technique. The CES state and area data essentially replace CES estimates, once a year, with 'population' data. The assumptions used for each are rooted in history. When the QCEW first became available as a quarterly microdata file in the mid-1980's, a review of CES estimates showed substantial revisions to state and area data – but not to national data. It was determined at that time that the administrative errors in the QCEW data were preferable over the month-to-month sampling errors associated with the wedge-based benchmarking technique for state and area data.

In 2003, a major CES program improvement was completed, converting all estimates from a quota-sample basis to a modern probability-sample basis. This change resulted in generally smaller benchmark revisions. However, sufficient data to revisit the differences in benchmarking methodologies have not been available until recently. BLS has instituted general research to determine if an alternative benchmarking methodology would improve the quality of national data, state and metropolitan area data, or both.

A number of CES data users currently utilize QCEW data (published each quarter) with CES state and metropolitan area estimates to improve forecasts of employment for other purposes, for example to improve revenue forecasts. The premise for improvement is based on the assumption that the CES data will eventually be replaced by adjusted QCEW data. However, there is an implicit assumption in this process, the assumption that the QCEW data errors are preferable over the CES data errors. This is part of what current CES research is evaluating.

The current CES benchmark research is likely to lead to one of four possible major outcomes. Two of these outcomes would require additional funding to implement. The possible outcomes are listed below.

Possible Outcome 1. It is possible that the current research would find that the current procedures should continue to be used – if this were the case then no change would be made.

Possible Outcome 2. It is possible that the research would find that the national wedge procedure should be applied to state and metropolitan area data, or that the replacement procedure should be applied to national data – but that no change in periodicity of benchmarking were recommended. If this were the case, then no additional funding would be needed to implement the change.

Possible Outcome 3. Another possibility is that the research would indicate that benchmarking – either the wedge or replacement procedure – should be done twice a year rather than only once. This would align CES data with QCEW more frequently, and reduce the periods between benchmarks. This option would require additional funding ($4 million per year).

[10] QCEW data used to benchmark CES is adjusted to match the CES scope, i.e. total nonfarm industries. Added to the adjusted QCEW is employment not covered by the state Unemployment Insurance systems.

Possible Outcome 4. The final possibility is that the research would indicate that benchmarking – either the wedge or replacement procedure – should be done four times a year rather than only once. This would align CES data with QCEW every time new QCEW data were released, and reduce the time between benchmarks to the smallest possible period. This option would require additional funding ($7.5 million per year).

Appendices

Appendix A

Data Collection in the U.S. Bureau of Labor Statistics' Current Employment Statistics Survey

Kenneth W. Robertson and Julie Hatch-Maxfield, Bureau of Labor Statistics

Seminar on New Frontiers for Statistical Data Collection, 2012

United Nations Economic Commission for Europe

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UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

CONFERENCE OF EUROPEAN STATISTICIANS

Seminar on New Frontiers for Statistical Data Collection
(Geneva, Switzerland, 31 October-2 November 2012)

Topic (iv): Data collection using mixed modes and multiple sources

DATA COLLECTION IN THE U.S. BUREAU OF LABOR STATISTICS' CURRENT EMPLOYMENT STATISTICS SURVEY

Contributed Paper

Prepared by Kenneth W. Robertson and Julie Hatch-Maxfield, Bureau of Labor Statistics, United States

I. Introduction

1. The U.S. Bureau of Labor Statistics' Current Employment Statistics (CES) survey is a large-scale, quick-response, establishment survey that utilizes numerous modes of data collection. The CES program produces monthly estimates of employment, hours, and earnings, by industry, for the nation, states, and metropolitan statistical areas. The data produced by the survey are utilized by federal and state government policy makers, and by economists, Wall Street, businesses, and others, to assess the health of the U.S. economy. The national data from the program have been designated by the U.S. Office of Management and Budget as Principle Federal Economic Indicators. Data from the survey are used to produce four news releases each month.

2. The CES program was, for many decades, a mail-based survey. The CES program has changed its data collection strategy significantly over the last few decades. Mail is no longer the primary mode of collection for the survey; instead, mail is now primarily used as part of the strategy for soliciting cooperation from businesses new to the survey.

3. In this paper the authors present a broad background of the CES program, a timeline of major changes to data collection operations and procedures, and a synopsis of the current multi-modal procedures used to collect data for the survey.

II. Background

A. A Broad History of the CES Program

4. In October 1915, the U.S. Bureau of Labor Statistics (BLS) started to collect and publish employment statistics on a monthly basis for four industries: boots and shoes, cotton goods, cotton finishing, and hosiery and underwear. By November 1916, the survey had been expanded to cover nine additional industries, and in December 1916, the survey had a sample size of 574 establishments. By October 1923, 52 manufacturing industries were covered by the survey. In December 1929, the sample size for the survey included 34,400 establishments. The Great Depression (1930s) and World War II (1939-1945) both highlighted the importance of current information on industry employment, and led to the survey becoming more comprehensive. The

current scope of the survey is all non-farm industries. The size of the sample collected every month is very large, including 141,000 businesses covering approximately 486,000 individual establishments.

5. A mail shuttle form was the primary method used to collect data for the survey from 1915 through 1983. The shuttle form was mailed to the business, where the form was filled out for the month and mailed back. BLS agents would receive the form, key-punch the data, and mail it back to the business. The form would thus shuttle back and forth until it was filled out for 12 months, and then a new form was mailed to the business. In 1984, the staff of the CES program began exploring innovative electronic methods to improve data collection for the program. Since then, Computer Assisted Telephone Interviewing, Electronic Data Interchange, Touchtone Data Entry, and Web collection have eclipsed mail to become the major modes of data collection for the survey.

B. CES Data Uses and Users

6. The CES program produces over 44,000 data series every month. Among these data are series on employment, hours, earnings, overtime hours, hours and earnings of production and nonsupervisory employees, women employees, and employment diffusion indexes. These data are among the first available indicators of current economic trends each month, and they are used to assess the overall health of the economy (using employment), to assess earnings trends (using average hourly earnings), and to identify short-term fluctuations in demand (using average weekly hours). CES data series are used as inputs into other major U.S. economic indicators, including Personal Income, Industrial Production, Index of Leading Economic Indicators, Index of Coincident Indicators, and Productivity measures. CES data are also used to assess other areas of business, research, and policy, including public policy, wage negotiations, economic research and planning, and industry studies.

7. The CES data collected for the program are used to produce four news releases each month. The data for *The Employment Situation* and the *Real Earnings* news releases are revised twice, while the data for the *Regional and State Employment and Unemployment* and the *Metropolitan Area Employment and Unemployment* news releases are revised once. To accomplish this, data for a reference period continues to be collected two to three months past the initial release. This schedule requires the data collection operation to be managed against five deadlines every month to produce these revised and initial estimates.

III. Data collection in the CES survey

A. Data Collection: 1915 - 1983

8. The CES survey was almost exclusively collected by mail in a decentralized environment until the early 1990s. Each month, individual State Workforce Agencies funded by BLS would mail the survey form to establishments to fill out and mail back as soon as possible. Collection rates for the preliminary estimates ranged between 40 to 50 percent; however, by the final release of the estimates almost 90 percent of the data had been collected.

9. Mail reporting was prone to several types of error, and error correction was slow and problematic. States had to examine the data and determine if the error was introduced by the respondent or occurred when it was being transcribed by the state. If respondent follow-up was necessary a phone call or personal visit would be used depending on the perceived importance, complexity of the error, or available resources.

10. Receiving the form in the mail served as the prompt to report data. Non-response was treated with a phone call, personal visit, or sample substitution depending on how important the state deemed the establishment was when making its estimates.

11. Mail collection is costly in several different ways. The forms had to be mailed to respondents each month and they mailed them back using Business Reply Mail envelopes, so postage was paid twice each month. Then there is the labor cost to transcribe, compile, perform edit reconciliation, and follow up on non-respondents. Lastly, lower response rates for preliminary estimates lead to larger revisions.

B. Data Collection 1984 – 2003; Innovative Electronic Methods Explored

(a) Computer Assisted Telephone Interview (CATI), 1984

12. The CES program began to experiment with Computer Assisted Telephone Interviewing (CATI) in 1984 with 400 test cases. A larger-scale production test started in 1987, involved 11 states, lasted 7 years and ended with a test sample size of 5,500 cases. BLS decided CATI was a viable option for the CES program and by 1995 about 10,000 cases were collected each month through CATI. Collection had also been centralized in regional data collection centers.

13. CATI-collected data offers several advantages over other methods of collection. The timeliness of the data is greatly improved; this is especially important to the CES program since there are only 10 to 16 days to collect the data before the preliminary release of the estimates. CATI collection rates for the preliminary release typically average around 85 percent. Respondents are mailed a postcard each month with the scheduled appointment time that ideally occurs as soon as the data are available at a mutually agreeable time. The postcards serve as an advance-notice prompt. Compared to self-reporting methods, respondents have more incentive to report on time as they are aware that someone will be calling to collect their data. With self-reporting, it is up to the respondent to initiate the collection procedure.

14. In addition to timeliness, CATI-collected data contain fewer errors. While the respondent is still on the phone, their microdata are being edited in real time as the interviewer is entering it into the system. Most questionable changes in data can be reconciled immediately leading to fewer revisions in the published estimates between releases. Without immediate validity checks, data that fail edit checks may not be corrected before the first release, lowering the amount of usable sample data. Or data that were reported wrong initially, but were used in the first release, would cause revisions when corrected at a later time.

15. Another driving force behind the CES program's decision to collect data through CATI was the transition from a quota-based sample to a probability sample. Prior to this point, solicitation and refusal conversion activities were not standardized. However, collecting data from the specific establishment that was selected to be in sample is critical to the success of the probability sample design. All newly selected sample units are enrolled and initially collected by the CATI Data Collection Centers (DCCs). During the initiation phase the registry[1] information is verified and updated as necessary. Respondents are educated on data uses, data items, and the collection cycle. Refusal conversion activities are a routine part of the collection activity in the DCCs.

16. The main disadvantage of CATI collection is the interviewer cost. For the CES program, CATI collection costs account for a significant portion of the overall collection resources.

(b) Touchtone Data Entry (TDE), 1987

17. As the use of touchtone phones expanded in the United States, CES began to experiment with Touchtone Data Entry (TDE) as a way to lower collection costs compared to CATI, but have higher response rates than mail. Tests started in 1987 with 200 cases divided equally between Maine and Florida. The CES program had great success with TDE collection. Between 1994 and 2003 over 30 percent of the CES sample was collected by TDE.

[1] The CES sample registry includes information from the sampling frame on the location, industry, and employment of all businesses in the sample.

18. Respondents transition from CATI collection to self-reporting on TDE after about 6 months of training. Once respondents are comfortable with the concepts and the timing, they are offered TDE as a reporting option. Respondents that are identified as difficult cases, either because of the complexity of their payrolls or because they are likely to become refusals, are kept on CATI collection.

19. The CES program experimented with various prompting methods and incentives over the years to arrive at the current procedures, which maximize collection rates for the preliminary release of the estimates, while optimizing data collection resources. TDE collection rates typically vary from 75 to 80 per cent for the first release of estimates.

20. When TDE was first introduced, each state had its own toll-free number and was responsible for edit reconciliation and staffing a help desk to answer respondents' questions. To minimize respondent burden, data are edited after the session is over. For this reason there is a delay between when the data are collected and when they can reasonably be corrected. This is one of the main disadvantages to TDE collection.

(c) Voice Recognition (VR), 1989

21. By the late 1980s, only 75-85 per cent of CES respondents had a touchtone phone. Since the CES program did not have resources for full CATI collection and desired higher response rates than what mail was able to provide, voice recognition (VR) software was explored. Similarly to TDE, VR was offered to respondents after they had been introduced to the survey and its concepts by CATI interviewers.

22. During testing, VR was favorably accepted by respondents, yielded collection rates similar to TDE, and had about the same error rate. However, by the time the testing phase had ended, the use of touchtone phones had become even more widespread and the CES program decided not to devote resources to another self-reporting method using the telephone since the TDE systems were already established.

(d) Electronic Data Interchange, 1995

23. Automated collection methods up to this point relied on the survey programs themselves to have sophisticated technologies available to them, but there was a low technological burden on the respondent. However, as computer usage became more common in the business world, the concept of electronic data interchange (EDI) became more widespread. The BLS has several surveys that collect data from employers. Large employers, especially those with multiple worksites in many states, tend to be included with certainty in several BLS surveys. Large employers wanted to know how BLS could reduce their reporting burden as a condition of their participation.

24. The CES program opened up the EDI center in February 1995, specifically to collect data electronically from very large employers. Shortly after the EDI center opened, the Multiple Worksite Report[2] (MWR) – part of the BLS' Quarterly Census of Employment and Wages program – was also added as one of the reports that businesses could submit to the EDI center.

25. EDI reporting lowered the response burden for these large employers as well as their cost of reporting. BLS benefited by improving data quality, reducing collection costs, and capturing more data. The EDI center created a single file format for CES and MWR, reducing design costs for both the respondent and BLS. There is significant start-up time and cost associated with converting a company to EDI reporting; however, ongoing collection costs for both surveys are

[2] The Multiple Worksite Report (MWR) form asks most multi-location employers (with 10 or more employees) to provide employment and wage data for all of their establishments covered under one Unemployment Insurance (UI) account in a State.

low. A company has to be willing to devote resources to create files, answer any follow-up data quality questions, and be willing to transmit the file in time to be used in estimates.

26. Once the test files are of acceptable quality, the company will start submitting monthly files to the EDI center via one of several secure means. One of the disadvantages of EDI reporting is that it is *all or nothing*, either a firm transmits a file in time for first release or not. Usually the EDI center's last contact with the company is someone in the business's IT department, who cannot answer questions about changes in the data. If the payroll staff have changed between implementation and the present time, finding someone in the company who can answer questions can sometimes be difficult. EDI collection rates are the most volatile of all the CES collection methods as some respondent files are transmitted every month on the same calendar day regardless of when the preliminary release of the estimates is scheduled.

(e) One Point Touchtone Data Entry (One Point TDE), 1996

27. In June 1996, One Point Touchtone Data Entry originated with two states. Instead of individual states having their own toll-free TDE number and associated support, states elected to turn responsibilities over to BLS. Under the One Point TDE model, BLS was responsible for collection, prompting, updating registry information, and error corrections. The changes were transparent to the respondent, but it allowed the Bureau to start consolidating resources. In addition, prompting and editing procedures were standardized.

(f) FAX, 1995

28. The CES program needed a way to collect data from medium sized firms—those that were too small for EDI collection, but where TDE or even traditional CATI was too burdensome. FAX technology was becoming more widespread in the establishment world, so the CES program developed a faxable version of the traditional form specifically for respondents who provide data for multiple worksites. Each month a blank form is faxed to the respondent, which serves as a reminder to report the data. After that, the data are faxed back and key punched in by CATI interviewers. The error rate is similar to other methods of self-reporting.

29. In terms of cost, FAX is less expensive than mail or CATI, but more expensive than TDE. The collection rate for FAX is similar to CATI at first closing, averaging around 85 per cent.

(g) Web Reporting, 1996

30. The CES survey was the first U.S. Federal Survey to experiment with internet reporting. Unlike TDE which only requires access to a touchtone phone, internet collection relies on the respondent having access to a computer, an internet connection, and email. The CES program started off with a small scale test of seven TDE respondents, which quickly grew to over 50 respondents. By 1998, the CES program decided to support internet collection.

31. One of the biggest advantages over TDE was that the prior month's data could be displayed. This provided visual clues to the respondent and allowed for fairly complex editing while the respondent was still engaged in the session. Also item response rates are the highest of any collection method, perhaps because respondents are compelled to fill in the grid which mirrors that used on the collection form.

32. Prompting is similar to TDE in the timing and message, although instead of FAX, Web respondents receive the prompt through email. The edit failure rates are lower than TDE because data can be edited in real time. Sending prompts electronically and the lower error rate means Web reporting is more cost efficient for the Bureau.

33. Since CES was an early innovator in the use of the Internet, a lot of trial and error occurred during this time. Collection rates were not as high as TDE because respondents needed a password to log onto the system or to install a digital certificate. These added features, while

providing more security, proved to be a barrier to entry as respondents forgot passwords or the knowledge did not get passed on if there was a respondent change. This is unlike TDE because the only information respondents need is their CES report number.

C. Data Collection 2004 – 2012; Innovation Continues

(a) One Point TDE, 2004

34. By July 2004, all states agreed to consolidate their TDE processes to the One Point TDE system maintained by BLS. This allowed for even more efficiencies in BLS. Instead of funding each state to staff a help desk, make prompting phone calls, and follow up with edit errors, those activities were centralized.

(b) The decline of mail-based reporting

35. At the time the probability sample was introduced, there were several options to report CES data that did not involve mail, were easier for the respondent, were more cost efficient for the Bureau, and produced higher collection rates. The CES program stopped promoting mail as a reporting method and used it only as an option of last resort. By 2008, the last of the mail respondents were converted over to other collection methods, and mail currently is only used to mail the enrolment packages, replacement forms, and postcard reminders.

(c) Web-Lite, Internet Data Collection Facility

36. In 2004, CES Web collection was moved to the BLS enterprise-level Internet Data Collection Facility (IDCF). The consolidated platform offered BLS several advantages. There only had to be one system to manage security and continuity of operations for multiple survey programs. Also Web pages were standardized in look and feel and an individual respondent could report for different BLS surveys in the same session. As more BLS programs began to offer Web collection, the price per transaction decreased.

37. At the same time, Web response rates were consistently below those of TDE even though both modes were self-reporting methods that should appeal to similar types of respondents. In 2006, BLS conducted a test to see if a new version of the CES Web collection site that did not require passwords yielded higher collection rates. The new version - referred to as "Web-Lite" - required respondents to only remember their unique CES 9-digit report number and use a CAPTCHA[3] authentication. The results were favorable as the collection rate and respondent satisfaction was higher under the Web-Lite version.

38. However, there was a trade-off between less security and higher collection rates. Since only the unique CES report number was necessary to report data, previous months' data and respondent-identifying information could not be shown during the session. This means that edits comparing current months' data to prior months could not be performed in real time. Also updating contact information became more problematic since the respondent did not know if CES had the correct information on file. Despite these drawbacks, the CES program concluded that consistently higher collection rates under the Web-Lite system were worth giving up some features of the more secure model. CES currently only transitions self-reporters to the Web-Lite version of the website.

39. In 2005, the CES program added several data items to its monthly survey: all employee hours and earnings, and gross monthly earnings for all employees (this latter item was later dropped). Since

[3] The term CAPTCHA (for Completely Automated Public Turing Test To Tell Computers and Humans Apart) was coined in 2000 by Luis von Ahn, Manuel Blum, Nicholas Hopper and John Langford of Carnegie Mellon University. CAPTCHAs are used to ensure that the data entry attempt is made by a human and not a computer.

the number of items CES was requesting of its respondents almost doubled, the TDE interview was viewed as too long and burdensome for most respondents. As a result, BLS started to transition respondents from CATI to Web over TDE in most cases. TDE is still offered to respondents who specifically request it, or to those who only report employment, such as Government units. Currently, TDE typically has a higher collection rate at the preliminary release of the estimates than Web; however, 85 percent of TDE respondents are in local government, who tend to have higher collection rates than average. Starting in 2011, Spanish was offered as an option to Web respondents, and in 2012 for TDE respondents.

(d) Email, 2006

40. At the same time the CES program was testing Web-Lite, it was also investigating email data collection. Email transmissions are designed to work by transmitting the data that are displayed on the screen. Thus the only method to transmit the data is to click reply and fill in the data on the embedded form, which may or may not display correctly for the end-users due to many different HTML rendering standards employed by email clients. CES used a third party software package that tried to circumvent the inherent downside of email data transmission by embedding HTML that implicitly allowed respondents to access the website through the submit button. The process only worked under very specific conditions and the data collection involved heavy manual intervention. Based on this feedback, the CES program elected not to pursue email data collection any further.

(e) WebFTP, 2007

41. In 2007, BLS assumed responsibility for the remaining state data collection and editing operations. As a result of the centralization activities, several states that were receiving files electronically indicated that they wanted CES to take over processing. West Virginia had created an Excel spreadsheet for respondents to report their data that was very popular for medium-sized businesses. Using the West Virginia spreadsheet as a template, CES began to offer a standardize Excel spreadsheet to select respondents and referred to the option as WebFTP. This reporting method is offered to respondents who have at least five locations but less than 100. The files are uploaded electronically using the same website as CES Web-Lite; instead of viewing the data grid, these respondents are shown a file upload option.

42. Respondents in mid-sized firms are very comfortable with Excel, which is both a positive and negative. There is no learning curve; however, there are savvy users who will modify the worksheet or link the CES worksheet to one of their own, which causes problems during data processing. WebFTP is very efficient if the submitted spreadsheets can be processed without human interaction. However, when there are problems, they tend to take longer to fix and require a higher degree of specialized review. Also respondents sometimes think that a person reviews the spreadsheets individually, and will include comments that may or may not be read in a timely manner. Prompting and edit corrections are handled in a similar manner to Web.

(f) A New Form for Solicitation and Ongoing Collection

43. The CES survey form has not altered substantially from the 1-page grid design since 1939. Over time, problems with the form have arisen and as a result the CES program designed a new booklet style form to address some of the reoccurring issues. The new form design was field tested in 2011 and the beginning of 2012. Two of the goals were to provide a clearer explanation of what the respondent was asked to do and to persuade respondents to participate. In terms of response rates, the redesigned form performed as well as the current 1-page form, but the biggest difference was in item response. The booklet style form consistently had higher item response rates during the testing cycle. CES CATI interviewers responsible for enrolling new sample members also indicated they preferred the new form over the old. The U.S. Office of Management and Budget approved the new booklet style form and the large scale rollout will begin in January 2013.

IV. Current Methods, Costs, and Collection Rates

44. Currently, the CES monthly data collection operations include most of the methods, or modes, discussed in this paper. For the initial solicitation, the program achieves a response rate in excess of 75%. Because the program keeps businesses in the survey for multiple years CES reports a collection rate for ongoing sample response. The collection rate calculation removes from the denominator those businesses that are out-of-scope or out-of-business, and those that have declined to participate in the survey. The optimization of sample collection across modes is fairly straightforward; excluding businesses who report by EDI, the program keeps as many respondents on CATI as possible. For those businesses that are not reporting via EDI and who cannot be retained as a CATI reporter, they are offered their choice of self-reporting method (with Web being the first option mentioned to most respondents). The distribution of sample over time by collection mode, and the current collection rates and costs are provided in the tables below.

Table 1. Distribution of CES sample by collection mode over time

Collection Mode	1915	1993	2004	2011
Mail	100%	86%	3%	0%
CATI	0	4	20	18
TDE	0	8	27	4
EDI	0	0	30	45
FAX	0	0	14	5
WEB	0	0	1	25
Other	0	2	5	3

Table 2. Collection rates and costs by mode, 2011 Average

Mode	Collection rates at first release	On-going collection cost, per unit
CATI	90.8%	$10.38
TDE	84.6%	$2.88
EDI	59.2%	$.50
FAX	85.8%	$5.86
WEB	78.5%	$2.40
Other	Varies	Varies

V. Concluding Remarks

45. The CES data collection process is a very large monthly operation with critical deadlines several times each month. These operations are managed centrally, and conducted in four Data Collection Centers, an Electronic Data Interchange Center, and an Internet Data Collection Facility. Data are collected by various modes from 141,000 businesses representing 486,000 establishments every month.

46. The transition of data collection from decentralized operations in over 50 states to the central management of the DCCs has resulted in substantial efficiencies, by reducing duplicative management structures while maintaining enough geographic separation in data collection sites to protect against single points of failure due to adverse events. Managing data collection operations in this multi-modal environment is challenging: it requires a staff of professionals dedicated to this task who can identify and resolve problems very quickly when they occur. And it requires a staff of experts who continue to innovate so that the program maintains its reputation as a principle economic survey of the 21st century.

VI. References

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Any opinions expressed in this paper are those of the authors and do not constitute policy of the Bureau of Labor Statistics.

Appendix B

BLS' Handbook of Methods Chapter 2

Employment, Hours, and Earnings from the Establishment Survey

http://www.bls.gov/opub/hom/pdf/homch2.pdf

Chapter 2.
Employment, Hours, and Earnings from the Establishment Survey

The Bureau of Labor Statistics (BLS) conducts the Current Employment Statistics (CES) survey, collecting data each month on employment, hours, and earnings from a sample of nonagricultural establishments. The sample includes about 140,000 businesses and government agencies, which cover approximately 440,000 individual worksites drawn from a sampling frame of roughly 9.0 million Unemployment Insurance tax accounts. The active CES sample includes approximately one-third of all nonfarm payroll employees. From these data, BLS, along with State labor market information agency partners, prepares and publishes a large number of employment, hours, and earnings series in considerable industry and geographic detail. CES data are available at **http://www.bls.gov/ces/home.htm**.

IN THIS CHAPTER

Background

The first monthly studies of employment and payrolls by BLS began in 1915 and covered four manufacturing industries. With increasing interest in employment data during the Great Depression, BLS increased its output; and by 1933, employment, average hourly earnings, and average weekly hours were published for total manufacturing, 90 manufacturing industries, and 14 nonmanufacturing categories. Early estimates of hours and earnings were made for production and nonsupervisory employees, who represented about 80 percent of all employees in the private sector. In 2010, BLS published official hours and earnings for all private-sector employees for the first time.

Interest in employment statistics for States and areas also grew. Even before BLS entered the field, in 1915, three States—Massachusetts, New York, and New Jersey—were preparing employment statistics. In 1915, New York and Wisconsin entered into cooperative agreements with BLS, whereby sample data collected from employers by a State agency would be used jointly with BLS to prepare State and national series. By 1940, estimates of total nonfarm employment for all 48 States and the District of Columbia were available. Since 1949, the CES program has been a Federal-State program that provides employment, hours, and earnings information by industry on a national, State, and metropolitan area basis. By 1980, cooperative arrangements were in effect with all 50 States, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands. (National estimates exclude data for Puerto Rico and the U.S. Virgin Islands.)

Concepts

Establishment

An *establishment* is an economic unit, such as a factory, mine, store, or office that produces goods or services. It generally is at a single location and is engaged predominantly in one type of economic activity. Where a single location encompasses two or more distinct activities, these are treated as separate establishments, if separate payroll records are available, and the various activities are classified under different industry codes.

Employment

Employment data refer to persons on establishment payrolls who received pay for any part of the pay period that includes the 12th day of the month.

Data exclude proprietors, the unincorporated self-employed, unpaid volunteer or family workers, farm workers, and domestic workers. Salaried officers of corporations are included. Government employment covers only civilian employees; military personnel are excluded. Employees of the Central Intelligence Agency, the National Security Agency, the National Imagery and Mapping Agency, and the Defense Intelligence Agency also are excluded.

Persons on establishment payrolls who are on paid sick leave (for cases in which pay is received directly from the firm), on paid holiday, or on paid vacation, or who work during a part of the pay period—even though they are unemployed or on strike during the rest of the period—are counted as employed. Not counted as employed are persons who are on layoff, on leave without pay, or on strike for the entire period, or who were hired but have not yet reported during the period.

In addition to employment data for *all employees*, the total number of *women employees* is collected. In private industries, CES collects data on production and related employees in manufacturing and mining and logging, construction employees in construction, and nonsupervisory employees in private service-providing industries; collectively, all these workers are often referred to as production employees.

Production and related employees include working supervisors and all nonsupervisory employees (including group leaders and trainees) engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping, trucking, hauling, maintenance, repair, janitorial, guard services, product development, auxiliary production for plant's own use (for example, power plant), recordkeeping, and other services closely associated with the above production operations.

Construction employees in the construction sector include: Working supervisors, qualified craft workers, mechanics, apprentices, helpers, laborers, and so forth, engaged in new work, alterations, demolition, repair, maintenance, and the like, whether working at the site of construction or in shops or yards at jobs (such as precutting and preassembling) ordinarily performed by members of the construction trades.

Nonsupervisory employees include those individuals in private, service-providing industries who are not above the working-supervisor level. This group includes individuals such as office and clerical workers, repairers, salespersons, operators, drivers, physicians, lawyers, accountants, nurses, social workers, research aides, teachers, drafters, photographers, beauticians, musicians, restaurant workers, custodial workers, attendants, line installers and repairers, laborers, janitors, guards, and other employees at similar occupational levels whose services are closely associated with those of the employees listed.

An *employment benchmark* is a complete count of employment used to adjust estimates derived from a sample. CES sample-based estimates are benchmarked annually. The basic source of benchmark data for the CES survey is the Quarterly Census of Employment and Wages (QCEW) program, which collects employment and wage data from States' unemployment insurance (UI) tax records. The QCEW represents a virtual census of employment in the United States, covering about 97 percent of all jobs on civilian payrolls. (The benchmark process is explained in detail in later sections of this chapter.)

Indexes of diffusion of employment change measure the dispersion of employment change in industries over a specified time span. The overall indexes are calculated from seasonally adjusted employment series for 4-digit NAICS industries and cover all nonfarm payroll employment in the private sector. Diffusion indexes are also calculated for manufacturing using employment in 4-digit NAICS industries.

To derive the indexes, each component industry is assigned a value of 0, 50, or 100 percent, depending on whether its employment showed a decrease, no change, or an increase, respectively, over the time span. The average value (mean) is then calculated, and this percent is the diffusion index number.

The reference point for diffusion analysis is 50 percent, the value indicating that the same number of component industries had increased as had decreased. Index numbers above 50 show that more industries had increasing employment and values below 50 indicate that more had decreasing employment. The margin between the percent that increased and the percent that decreased is equal to the difference between the index and its complement—that is, 100 minus the index. For example, an index of 65 percent means that 30 percent more industries had increasing employment than had decreasing employment [65-(100-65) = 30]. However, for dispersion analysis, the distance of the index number from the 50-percent reference point is the most significant observation.

Although diffusion indexes commonly are interpreted as showing the percent of components that increased over the time span, the index reflects half of the unchanged components, as well. (This is the effect of assigning a value of 50 percent to the unchanged components when computing the index.)

Hours and earnings

The CES hours and earnings series are derived from reports of payrolls and the corresponding paid hours for all employees and also for the various types of production employees. Hours and earnings are for private-sector employees.

Payroll refers to the payroll for full- and part-time workers who received pay for any part of the pay period that includes the 12th day of the month. The payroll is reported before deductions of any kind, such as those for old-age and unemployment insurance, group insurance, withholding tax, bonds, or union dues; also included is pay for overtime,

holidays and vacation, sick leave paid directly by the firm, and commissions paid at least monthly. Bonuses (unless earned and paid regularly each pay period); other pay not earned in the pay period reported (such as retroactive pay); and the value of free rent, fuel, meals, or other payment in kind are excluded. Employee benefits (such as health and other types of insurance, contributions to retirement, and so forth, paid by the employer) also are excluded.

Total hours during the pay period include all hours worked (including overtime hours), hours paid for standby or reporting time, and equivalent hours for which employees received pay directly from the employer for sick leave, holidays, vacations, and other leave. Overtime and other premium pay hours are not converted to straight-time equivalent hours. The concept of total hours differs from those of scheduled hours and hours worked.

Average weekly hours relate to the average hours per worker for which pay was received and is different from standard or scheduled hours. Factors such as unpaid absenteeism, labor turnover, part-time work, and stoppages cause average weekly hours to be lower than scheduled hours of work for an establishment. Group averages further reflect changes in the workweek of component industries. Average weekly hours are the total weekly hours divided by the employees paid for those hours.

Overtime hours represent that portion of average weekly hours that exceeded regular hours and for which overtime premiums were paid. If an employee were to work on a paid holiday at regular rates, receiving as total compensation his holiday pay plus straight-time pay for hours worked that day, no overtime hours would be reported. Overtime hours data are collected only from manufacturing establishments.

Because overtime hours are premium hours by definition, weekly hours and overtime hours do not necessarily move in the same direction from month to month. Such factors as work stoppages, absenteeism, and labor turnover may not have the same influence on overtime hours as on average hours. Diverse trends at the industry group level also may be caused by a marked change in hours for a component industry in which little or no overtime was worked in both the previous and current months.

Average hourly earnings are on a "gross" basis. They reflect not only changes in basic hourly and incentive wage rates, but also such variable factors as premium pay for overtime and late-shift work and changes in output of workers paid on an incentive plan. They also reflect shifts in the number of employees between relatively high-paid and low-paid work and changes in workers' earnings in individual establishments. Averages for groups and divisions further reflect changes in average hourly earnings for individual industries.

Averages of hourly earnings differ from wage rates. Earnings are the actual return to the worker for a stated period; rates are the amount stipulated for a given unit of work or time. The earnings series do not measure the level of total labor costs on the part of the employer because the following are excluded: benefits, irregular bonuses, retroactive items, payroll taxes paid by employers.

Average hourly earnings, excluding overtime-premium pay, are computed by dividing the total worker payroll for the industry group by the sum of total worker hours and one-half of total overtime hours. No adjustments are made for other premium payment provisions, such as holiday pay, late-shift premiums, and overtime rates other than time and one-half. Average hourly earnings excluding overtime are calculated only for manufacturing industries.

Average weekly earnings are derived by multiplying average weekly hours estimates by average hourly earnings estimates. Therefore, weekly earnings are affected not only by changes in average hourly earnings but also by changes in the length of the workweek. Monthly variations in such factors as the proportion of part-time workers, stoppages for varying reasons, labor turnover during the survey period, and absenteeism for which employees are not paid may cause the average workweek to fluctuate.

Long-term trends of average weekly earnings can be affected by structural changes in the makeup of the workforce. For example, persistent long-term increases in the proportion of part-time workers in retail trade and many of the services industries have reduced average workweeks in these industries and have affected the average weekly earnings series.

Real earnings data (those expressed in constant 1982-84 dollars) result from the adjustment of average hourly and weekly earnings by the BLS Consumer Price Indexes. Real earnings for production and nonsupervisory employees are deflated by the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W), while real earnings for all employees are deflated by the Consumer Price Index for All Urban Consumers (CPI-U). Real earnings indicate the purchasing power of money earnings after adjustment for changes over time in the prices of consumer goods and services. These data cannot be used to measure changes in living standards as a whole, which are affected by other factors such as total family income, the extension and incidence of various social services and benefits, and the duration and extent of employment and unemployment. The long-term trends of these earnings data also are affected by changing mixes of full-time and part-time workers, high-paid and low-paid workers, and so on.

Indexes of aggregate weekly hours and payrolls. Indexes of aggregate weekly hours are calculated by dividing the current month's aggregate hours by the average of the 12 monthly figures, for the base year. Indexes are based on 2007 averages for all employees and on 2002 averages for production and nonsupervisory employees. For basic industries, the hours aggregates are the product of average weekly hours and employment of workers to which the hours apply (all employees or production and nonsupervisory employees). At all higher levels of industry aggregation, hours aggregates are the sum of the component aggregates.

Indexes of aggregate weekly payrolls are calculated by dividing the current month's aggregate by the average of the 12 monthly figures for the base year. Indexes are averages for production and nonsupervisory employees. For basic industries, the payroll aggregates are the product of average hourly earnings and aggregate weekly hours. At all higher levels of industry aggregation, payroll aggregates are the sum of the component aggregates.

Industrial classification

All data on employment, hours, and earnings for the Nation and for States and areas are classified in accordance with the 2007 North American Industry Classification System (NAICS), specified by the U.S. Office of Management and Budget. The United States, Canada, and Mexico share this classification system, and, thus, it allows a direct comparison of economic data across the three countries.

Establishments are classified into industries on the basis of their primary activity. Those that use comparable capital equipment, labor, and raw material inputs are classified together. This information is collected on a supplement to the quarterly unemployment insurance tax reports filed by employers. For an establishment engaging in more than one activity, the entire employment of the establishment is included under the industry indicated by the principal activity.

Sample Design

The CES sample design is a stratified, simple random sample of worksites, clustered by UI account number. The sample strata, or subpopulations, are defined by State, industry, and employment size, yielding a State-based design. Sampling rates for each stratum are determined through optimum allocation, which distributes a fixed number of sample units across a set of strata to minimize the overall variance or sampling error on the primary estimate of interest, the statewide total nonfarm employment level.

The sampling frame, and the CES sample itself, are updated twice a year with new quarters of UI-based universe data. This helps keep the sample up-to-date by adding firm births and deleting business deaths. In addition, the design specifies an annual update process, which includes sample frame maintenance and the redrawing of the entire sample for the first quarter of each year. Frame maintenance provides for the updating of industry, employment size class, and metropolitan area designations and for the merging of semiannual birth samples into the overall frame.

Data Sources and Collection Methods

Sample data

Each month, BLS collects data on employment, payroll, and paid hours from a sample of establishments. To encourage participation in this voluntary survey, BLS uses a variety of collection techniques, tailored to individual firm preferences. Data collection centers (DCCs) perform initial enrollment of each firm via telephone, collect the data for several months via Computer Assisted Telephone Interviewing (CATI) and where possible transfer respondents to a self-reporting mode such as touch-tone data entry (TDE), FAX or Internet collection. Very large, multi-establishment firms are often enrolled via personal visit, and ongoing reporting is established via electronic data interchange (EDI). These firms provide electronic files to BLS that include data from all their worksites.

For the few establishments that do not use the above methods, data are collected using mail, and transcript.

Sample enrollment. BLS has a comprehensive program of new sample unit solicitation in the DCCs. Approximately 55,000 new sample units are enrolled in the CES survey each year to account for the births of new firms, to realign the sample distribution with the universe distribution, and to rotate a portion of the sample. All firms with 1,000 or more employees are asked to participate in the survey, as is a sample of firms across all employment sizes. When firms are rotated into the sample, they are retained for 2 years or more. When a respondent is rotated out of the sample, BLS will not ask the firm to participate for at least 3 years.

Data reporting. Each month, respondents extract the employment, hours, and earnings data from their payroll records and submit it to BLS. Data are collected for the pay period that includes the 12th of each month.

A CES reporting form (BLS form 790 series) is provided to all CES respondents except those that report via electronic file. The form provides a convenient means to record payroll data each month. Six variations of the basic CES form are used, and each variation is tailored for the data items, concepts, and definitions of major industry sectors. Separate forms are used for mining and logging, construction, manufacturing, service-providing industries, public administration, and educational services.

CES data collection forms are available on the BLS Web site at **http://www.bls.gov/ces/idcfcesforms.htm**.

The design of the CES form is important for maintaining continuity and consistency in reporting from month to month. The use of a single form for a 6-month period allows the respondent to compare the latest data with data submitted in prior months.

All reported data, regardless of method of collection, are edited by BLS to ensure the information is correctly reported and is consistent with the data reported by the establishment in earlier months. The data are further edited to detect processing and reporting errors that might have been missed during collection. When questionable reports are discovered at any stage of the editing process, BLS contacts the respondents for clarification or correction. The staff of the BLS Washington office prepares national estimates of employment, hours, and earnings using the edited data. The State agencies also cooperate with BLS to develop State and metropolitan area estimates.

Estimating Methods

Benchmark data

For the establishment survey, annual benchmarks are constructed to realign the sample-based employment totals for March of each year with the UI-based population counts for March. These population counts are less timely than sample-based estimates and are used to provide an annual point-in-time census for employment. For National series, only the March sample-based estimates are replaced with UI counts. For State and metropolitan area series, all available months of UI data are used to replace sample-based estimates. State and area series are based on smaller samples and are, therefore, more vulnerable to both sampling and non-sampling errors than National estimates.

Population counts are derived from the administrative file of employees covered by UI. All employers covered by UI laws are required to report employment and wage information to the appropriate State workforce agency four times a year. Approximately 97 percent of total nonfarm employment within the scope of the establishment survey is covered by UI. A benchmark for the remaining 3 percent is constructed from alternate sources, primarily records from the Railroad Retirement Board and County Business Patterns. The full benchmark developed for March replaces the March sample-based estimate for each basic cell. The monthly sample-based estimates for the year preceding and the year following the benchmark are also then subject to revision.

Monthly estimates for the year preceding the March benchmark are readjusted using a "wedge back" procedure. The difference between the final benchmark level and the previously published March sample estimate is calculated and spread back across the previous 11 months. The wedge is linear; eleven-twelfths of the March difference is added 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. This assumes that the total estimation error since the last benchmark accumulated at a steady rate throughout the current benchmark year.

Estimates for the 7 months following the March benchmark also are recalculated each year. These post-benchmark estimates reflect the application of sample-based monthly changes to new benchmark levels for March and the computation of new business birth/death factors for each month.

Following the revision of basic employment estimates, estimates for women employees and production and nonsupervisory employees are recomputed using the revised all-employee estimates and the previously computed sample ratios of these workers to all employees. All basic series of employment, hours, and earnings are re-aggregated to obtain estimates for each sector and higher level of detail. Other derivative series (such as real earnings and payroll indexes) also are recalculated. New seasonal adjustment factors are calculated and all data series for the previous 5 years are re-seasonally adjusted before full publication of all revised data in February of each year.

Monthly Estimation

Stratification. The CES sample is stratified into basic estimation cells for purposes of computing national employment, hours, and earnings estimates. Basic cells are defined primarily by detailed industry at the 3-, 4-, 5-, or 6-digit NAICS level. Aggregation results in additional summary cells.

In addition to the basic and summary estimation cells, a small number of independently estimated cells exist and do not aggregate to the summary cell levels.

The Current Employment Statistics (CES) or establishment survey estimates of employment are generated through an annual benchmark and monthly sample link procedure. Annual universe counts or benchmark levels are generated primarily from administrative records on employees covered by unemployment insurance (UI) tax laws. These annual benchmarks, established for March of each year, are projected forward for each subsequent month based on the trend of the sample employment and an adjustment for the net of business births and deaths employment. Benchmarks and monthly estimates are computed for each basic estimating cell and summed to create aggregate-level employment estimates.

Matched sample. CES uses a matched sample concept to produce estimates. A matched sample is defined to be all sample members that have reported data for the reference month and the month prior. Excluded from the matched

sample is any sample unit that reports that it is out-of-business. This aspect of the estimation methodology is more fully described in the section on estimation of business births and deaths employment below.

Estimates of all employees require that only the number of total employees be reported for the current estimated month and the prior month. The matched sample for estimates of production/nonsupervisory employees includes reporting units that reported both all employees and production/nonsupervisory employees for both the previous and current months. The matched sample for estimates of women employees includes reporting units that reported both all employees and women employees for both the previous and current months.

The matched sample for average weekly hours and average hourly earnings of all employees includes responding units that have reported all employees and the corresponding worker hours and payrolls for both the previous and current months. The matched sample for average weekly hours and average hourly earnings of production/nonsupervisory employees, includes reporting units that have reported production/nonsupervisory employees and their corresponding worker hours and payrolls, as well as all employees, for both the previous and current months.

For average weekly overtime estimates of all employees, which are calculated for manufacturing industries only, the matched sample includes reporting units that have reported all employees and the corresponding work hours, payrolls, and overtime hours for both the previous and current months. The matched sample for average weekly overtime hours of production/nonsupervisory employees includes production/nonsupervisory employees and their corresponding worker hours, payrolls, and overtime hours, as well as all employees, for both the previous and current months.

Variables for national estimates. The weighted-link-relative formula is used to calculate estimates of all employees, while the difference-link-and-taper formula is used to calculate all other data types. Both formulas use data reported that meets the matched sample criteria. The difference-link-and-taper formula also uses estimates for the month prior to the reference month or derivatives of estimates, such as ratios. See the table of variable definitions for the link-relative and difference-link-and-taper formulas on page 7.

National employment. The weighted link-relative estimator for the all employee series uses the sample trend in the cell to move the previous level to the current-month estimated level. A model-based component is applied to account for the net employment resulting from business births and deaths not captured by the sample.

The weighted link-relative technique is efficient in that it takes advantage of a reliable, complete count of employment and of the high correlation between levels of employment in successive months in identical establishments.

Current-month estimate of all employees is defined as

$$\widehat{\mathrm{AE}}_c = \left(\widehat{\mathrm{AE}}_p - \sum_j \mathrm{ae}^*_{p,j}\right) \times \frac{\sum_i (w_i \times \mathrm{ae}_{c,i}) - \sum_j (w_j \times \mathrm{ae}^*_{c,j})}{\sum_i (w_i \times \mathrm{ae}_{p,i}) - \sum_j (w_j \times \mathrm{ae}^*_{p,j})} + \sum_j \mathrm{ae}^*_{c,j} + \mathrm{b}_c$$

$$\text{for all } i \in I \text{ and } j \in J$$

Business birth and death estimation. In a dynamic economy, firms are continually opening and closing. These two occurrences offset each other to some extent. That is, firms that are born replace firms that die. CES uses this fact to account for a large proportion of the employment associated with business births. This is accomplished by excluding business death units from the matched sample definition. Effectively, business deaths are not included in the sample-based link portion of the estimate, and the implicit imputation of their previous month's employment is assumed to offset a portion of the employment associated with births.

There is an operational advantage associated with this approach, as well. Most firms will not report that they have gone out of business; rather, they simply cease reporting and are excluded from the link, as are all other nonrespondents. As a result, extensive follow-up with monthly nonrespondents to determine whether a company is out-of-business or simply did not respond is not required.

Employment associated with business births will not exactly equal that associated with business deaths. The amount by which it differs varies by month and by industry. As a result, the residual component of the birth/death offset must be accounted for by using a model-based approach.

Birth-death residual = Population - Sample-based estimate + Error

During the net birth/death modeling process, simulated monthly probability estimates over a 5-year period are created and compared with population employment levels. Moving from a simulated benchmark, differences between the series across time represent a cumulative birth/death component. Those residuals are converted to month-to-month differences and used as input series to the modeling process.

Models are fit using X-12 autoregressive integrated moving average (ARIMA). Outliers, level shifts, and temporary ramps are automatically identified.

Variable definitions

- All estimated values are shown in upper case.
- All sample measures (shown in lower case) are based on a matched sample.
- The estimator for women employees takes the same form as the estimator for production/nonsupervisory employees, where PE and PER are the estimates for women employees and women-to-all employee ratio, respectively, and matched sample totals pe are the matched sample totals for women.
- The estimator for average weekly hours for production/nonsupervisory employees takes the same form as average weekly hours for all employees, where AE and AWH represent estimates of production/nonsupervisory employees and average weekly hours of production/nonsupervisory employees, respectively, and the matched sample totals ae and wh represent matched sample totals for production employees and wh for production/nonsupervisory employees, respectively.
- The estimator for average hourly earnings for production/nonsupervisory employees takes the same form as average hourly earnings for all employees, where AHE and WH represent estimates of production/nonsupervisory employees and their work hours, and the matched sample totals pr and wh represent matched sample totals of payroll and work hours for production/nonsupervisory employees
- The estimators for average weekly overtime take the same form as average weekly hours, where AWH represents the estimates of average weekly overtime hours and wh represents the matched sample for total overtime hours reported. Overtime estimates are calculated for manufacturing industries only.

Variable	Description	All employees	Production/ nonsupervisory (or women employees)	Average weekly hours (or average weekly overtime hours)	Average hourly earnings
*	Atypical sample data.	X	X	X	X
α	0.9		X	X	X
β	0.1		X	X	X
c	Current month.	X	X	X	X
p	Previous month.	X	X	X	X
$\widehat{AE}$	Estimated employment for all employees (or for production/ nonsupervisory employees when estimating their respective hours).	X	X	X	
ae	Reported all employees (or production/ nonsupervisory employees when estimating their respective hours).	X	X	X	
$\widehat{\text{AHE}}$	Estimated average hourly earnings for all employees (or for production/ nonsupervisory employees when estimating their respective earnings).				X

Variable	Description	All employees	Production/ nonsupervisory (or women employees)	Average weekly hours (or average weekly overtime hours)	Average hourly earnings
$\widehat{AWH}$	Estimated average weekly hours for all employees (or for production/ nonsupervisory employees when estimating their respective hours).			X	
b	net birth/death factor.	X			
i	a matched CES report for sample data variables shown in lower case.	X	X	X	X
j	a matched CES report where the current month is atypical.	X	X	X	X
$\widehat{PE}$	Estimated production/nonsupervisory (or women) employees.		X		
pe	Reported production/nonsupervisory (or women) employees.		X		
$\widehat{PER}$	Estimated ratio of production/ nonsupervisory (or women) employees to all employees.		X		
pr	Reported weekly payroll for all employees (or for production/ nonsupervisory employees when estimating their respective earnings).				X
w	Weight associated with a CES report.	X	X	X	X
wh	Reported weekly hours for all employees (or for production/ nonsupervisory employees when estimating their respective hours and earnings).			X	X
$\widehat{WH}$	Estimated weekly hours for all employees (or production/ nonsupervisory employees), derived from estimates of average weekly hours and employment.				X

The net birth/death model component figures are unique to each month and exhibit seasonal patterns that can result in negative adjustments in some months.

Weighted-link-and-taper estimator is used for all data types except for "all employees." The estimator accounts for the over-the-month change in the sampled units, but also includes a tapering feature used to keep the estimates close to the overall sample average over time. The taper is considered to be a level correction. This estimator uses matched sample data; it tapers the estimate toward the sample average for the previous month of the current matched sample before applying the current month's change; and it promotes continuity by heavily favoring the estimate for the previous month when applying the numerical factors.

Production and nonsupervisory employees. To obtain estimates of production (or construction or nonsupervisory) worker employment, the ratio of weighted production employees to the weighted all employees in the sample is assumed to equal the same ratio in the universe. The current month's production worker ratio, thus, is estimated and then multiplied by the all-employee estimate. The weighted-difference-link-and-taper formula, described in the section on hours and earnings, is used to estimate the current month's production worker ratio. This formula adds the change in the matched sample's production worker ratio (the weighted-difference link) to the prior month's estimate, which has been slightly modified to reflect changes in the sample composition (the taper). (See page 10.) An analogous method is used to estimate the number of women employees.

Women employees. Estimation of the series for women employees is identical to that described for production employees, with the appropriate substitution of women employees values for the production worker values in the previous formulas.

Estimates for each type of series (all employees, production employees, and women employees) for individual basic estimating cells are summed to obtain corresponding totals for broader industry sectors.

Hours and earnings

Average weekly hours and average hourly earnings. Independent benchmarks are not available for the hours and earnings series; consequently, the levels are derived directly from the CES weighted-sample averages. (See pages 10 and 11.) Before hours and earnings sample averages or estimates are calculated, all employees, production employees and aggregate hours and payrolls must be multiplied by sample weights both for the month for which estimates are being made and for the prior month. To establish average weekly hours for a basic estimating cell, the sum of reported worker hours for the establishments classified in the cell is divided by the total number of all employees or production employees reported for the same establishments. To establish average hourly earnings, the reported payroll is divided by the reported worker hours for the same establishments.

Average weekly hours and average hourly earnings for industries and groups above the basic estimating cell level are weighted averages of the figures for component cells. Average weekly hours for each basic estimating cell are multiplied by the corresponding estimate of the number of all employees to derive aggregate worker hours. Payroll aggregates are the product of the aggregate worker hours and average hourly earnings. Payroll and worker-hour aggregates for industry groups and divisions are the sums of the aggregates for the component industries.

Average weekly hours for industry groups are obtained by dividing the worker-hour aggregates by the corresponding all-employee estimates. Average hourly earnings for industry groups are computed by dividing payroll aggregates by worker-hour aggregates. This method is equivalent to weighting average weekly hours by the estimated number of all employees in the universe and weighting average hourly earnings by the estimated worker hours for the universe.

For all levels, from basic estimating cells to sector level and higher aggregates, average weekly earnings are computed by multiplying average hourly earnings by average weekly hours.

Current month estimate of overtime hours

Estimation of overtime hours is identical to that described for average weekly hours, with the appropriate substitution of overtime hours values for the weekly hours values in the previous formula.

Estimation formulas for *hours and earnings for production employees* are essentially the same as hours and earnings for all employee series, whereby all 'AE' estimates and 'ae' sample terms are replaced by 'PE' estimates and 'pe' sample, respectively.

Current-month estimate of production or nonsupervisory employees is defined as

$$\widehat{\mathrm{PE}}_c = \left(\left(\widehat{\mathrm{AE}}_c - \sum_j \mathrm{ae}^*_{c,j} \right) \times \widehat{\mathrm{PER}}_c \right) + \sum_j \mathrm{pe}^*_{c,j}$$

, where

$$\widehat{\mathrm{PER}}_c = \left(\alpha \times \widehat{\mathrm{PER}}_p\right) + \left(\beta \times \frac{\sum_i \left(w_i \times \mathrm{pe}_{p,i}\right) - \sum_j \left(w_j \times \mathrm{pe}^*_{p,j}\right)}{\sum_i \left(w_i \times \mathrm{ae}_{p,i}\right) - \sum_j \left(w_j \times \mathrm{ae}^*_{p,j}\right)} \right) +$$

$$\frac{\sum_i \left(w_i \times \mathrm{pe}_{c,i}\right) - \sum_j \left(w_j \times \mathrm{pe}^*_{c,j}\right)}{\sum_i \left(w_i \times \mathrm{ae}_{c,i}\right) - \sum_j \left(w_j \times \mathrm{ae}^*_{c,j}\right)} - \frac{\sum_i \left(w_i \times \mathrm{pe}_{p,i}\right) - \sum_j \left(w_j \times \mathrm{pe}^*_{p,j}\right)}{\sum_i \left(w_i \times \mathrm{ae}_{p,i}\right) - \sum_j \left(w_j \times \mathrm{ae}^*_{p,j}\right)}$$

for all $i \in I$ and $j \in J$

Current-month estimate of average weekly hours for all employees

$$\widehat{\mathrm{AWH}}_c = \alpha \times \widehat{\mathrm{AWH}}_p + \beta \times \left(\frac{\left(\frac{\sum_i \left(w_i \times \mathrm{wh}_{p,i}\right) - \sum_j \left(w_j \times \mathrm{wh}^*_{p,j}\right)}{\sum_i \left(w_i \times \mathrm{ae}_{p,i}\right) - \sum_j \left(w_j \times \mathrm{ae}^*_{p,j}\right)} \right) \times \left(\widehat{\mathrm{AE}}_p - \sum_j \mathrm{ae}^*_{p,j} \right) + \sum_j \mathrm{wh}^*_{p,j}}{\widehat{\mathrm{AE}}_p} \right)$$

$$+ \left(\frac{\left(\frac{\sum_i \left(w_i \times \mathrm{wh}_{c,i}\right) - \sum_j \left(w_j \times \mathrm{wh}^*_{c,j}\right)}{\sum_i \left(w_i \times \mathrm{ae}_{c,i}\right) - \sum_j \left(w_j \times \mathrm{ae}^*_{c,j}\right)} \right) \times \left(\widehat{\mathrm{AE}}_c - \sum_j \mathrm{ae}^*_{c,j} \right) + \sum_j \mathrm{wh}^*_{c,j}}{\widehat{\mathrm{AE}}_c} \right)$$

$$- \left(\frac{\left(\frac{\sum_i \left(w_i \times \mathrm{wh}_{p,i}\right) - \sum_j \left(w_j \times \mathrm{wh}^*_{p,j}\right)}{\sum_i \left(w_i \times \mathrm{ae}_{p,i}\right) - \sum_j \left(w_j \times \mathrm{ae}^*_{p,j}\right)} \right) \times \left(\widehat{\mathrm{AE}}_p - \sum_j \mathrm{ae}^*_{p,j} \right) + \sum_j \mathrm{wh}^*_{p,j}}{\widehat{\mathrm{AE}}_p} \right)$$

for all $i \in I$ and $j \in J$

Current month estimate of average hourly earnings for all employees

$$\widehat{\mathrm{AHE}}_c = \alpha \times \widehat{\mathrm{AHE}}_p + \beta \times \left(\frac{\left(\frac{\sum_i \left(w_i \times \mathrm{pr}_{p,i} \right) - \sum_j \left(w_j \times \mathrm{pr}^*_{p,j} \right)}{\sum_i \left(w_i \times \mathrm{wh}_{p,i} \right) - \sum_j \left(w_j \times \mathrm{wh}^*_{p,j} \right)} \right) \times \left(\widehat{WH}_p - \sum_j \mathrm{wh}^*_{p,j} \right) + \sum_j \mathrm{pr}^*_{p,j}}{\widehat{\mathrm{WH}}_p} \right)$$

$$+ \left(\frac{\left(\frac{\sum_i \left(w_i \times \mathrm{pr}_{c,i} \right) - \sum_j \left(w_j \times \mathrm{pr}^*_{c,j} \right)}{\sum_i \left(w_i \times \mathrm{wh}_{c,i} \right) - \sum_j \left(w_j \times \mathrm{wh}^*_{c,j} \right)} \right) \times \left(\widehat{\mathrm{WH}}_c - \sum_j \mathrm{wh}^*_{c,j} \right) + \sum_j \mathrm{pr}^*_{c,j}}{\widehat{\mathrm{WH}}_c} \right)$$

$$- \left(\frac{\left(\frac{\sum_i \left(w_i \times \mathrm{pr}_{p,i} \right) - \sum_j \left(w_j \times \mathrm{pr}^*_{p,j} \right)}{\sum_i \left(w_i \times \mathrm{wh}_{p,i} \right) - \sum_j \left(w_j \times \mathrm{wh}^*_{p,j} \right)} \right) \times \left(\widehat{\mathrm{WH}}_p - \sum_j \mathrm{wh}^*_{p,j} \right) + \sum_j \mathrm{pr}^*_{p,j}}{\widehat{\mathrm{WH}}_p} \right)$$

for all $i \in I$ and $j \in J$

Robust Estimation Procedure

The matched sample sometimes contains a small number of observations that may have a large and adverse effect on the estimate of the relative change. The influence of such observations may be due to large survey weights, an unusual level or change in reported employment, or the combined effect of these factors. If left untreated, influential observations may cause unreasonable jumps in the monthly estimates, especially at detailed publication levels.

The Robust Estimation procedure is designed to reduce the effect of the influential observations on the estimate of the relative over-the-month change. At the same time, it is recognized that the unusual and influential sample movements may represent similar behavior in the target population and a heavy intervention to the regular estimation procedure may lead to biased estimates. This is especially true if the sample is large. Therefore, the estimator is designed to reduce the volatility of the estimates due to extreme outlying reports while controlling the intervention to protect against the incurred bias.

Definition of influential reports. The CES weighted link relative estimate is based on the ratio of the two survey weighted sums. A scatterplot of the weighted employment reported in two consecutive months provides an insight on what units influence the estimate. Two examples are shown in Figure 1: the survey weighted employment reported for the month (t) is plotted against the weighted employment reported for the previous month (t-1). The line shows the survey weighted link relative trend of matched sample data.

An influential report would have a relatively large survey weight and/or a large change in its reported employment. Numerically, the influence of a report on the sample link relative estimate can be expressed in the form of weighted residuals:

$$d_{i,t} = w_i \left(y_{i,t} - R_t \, y_{i,t-1} \right) \qquad (1)$$

where,

$y_{i,t}$ and $y_{i,t-1}$ denote, respectively, a unit's current and previous months reported employment; w_i is the selection weight; R_t is the sample link relative estimate in a given basic estimation cell. The formula is identified by (1).

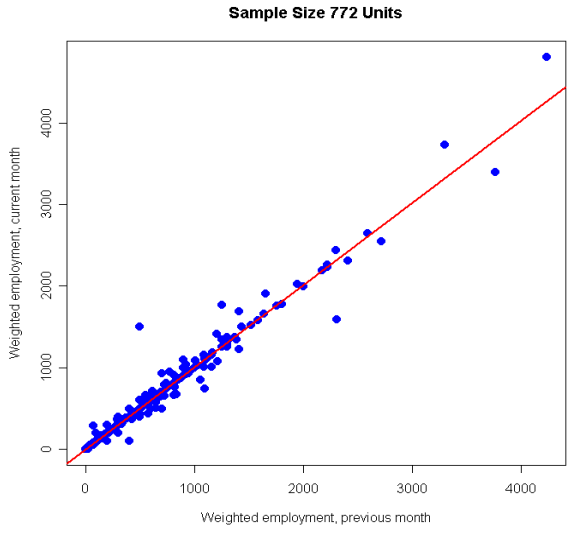
The influential reports are those having large positive or negative values of the weighted residuals compared to the other sample units. The extreme residuals are reduced to specific cut-off values. The cut-off values depend on the distribution of the weighted residuals in a given series and are determined independently for each month and industry series. Pushing the extreme residuals to the cut-off values is accomplished by using an appropriate weight adjustment factor.

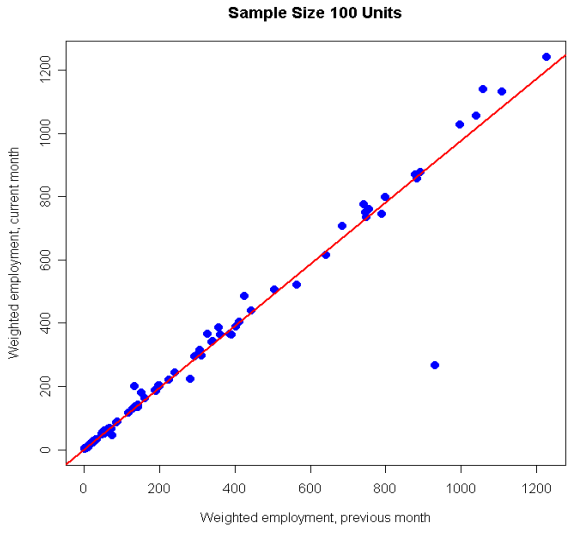
The procedure used for the CES robust estimation is a particular variation of a general method of weight reduction known as "winsorization." See Kokic and Bell (1994).

The actual cut-off values are determined by examining the relative distances of units with extreme weighted residuals to the nearest but less extreme values in the same cell and month.

Determining Weight Adjustment Factors. The first step consists of calculating the weighted residuals using formula (1). The weighted residuals from individual establishments are aggregated to the UI account level within each estimation cell. This is done because reports within a UI account may have similar reported change in employment. Since they are similar, it is possible that none of the individual reports will be identified as an outlying unit. At the same time, the UI level residual aggregated from all the responding establishments may be extreme and very different from other responding UI accounts in the cell.

Figure 1





The residuals may legitimately have very different values depending on the employment size class of the sampled UI accounts. To remove the effect of the size class, the residuals are "centered" within each size class, i.e., the average of the residuals within size classes is subtracted from each original residual.

The cut-off values are determined separately for the extreme positive and extreme negative residuals. The procedures are similar for the positive and negative residuals and are described here only for the positive residuals.

First, sort the residuals in each cell in descending order. Let d_i denote the *i*-th largest centered positive residual:

$$d_1 \geq d_2 \geq \ldots \geq d_n.$$

Set the value $F_1 = d_1$ and $F_2 = 2d_2 - d_1$.

The general formula for F_k is:

$$F_k = (k + 1)\, d_k - (d_1 + d_2 + \ldots + d_k). \qquad (2)$$

Proceed with the computations of the sequence of $F_1,\ldots,F_k$ until, at some step *k*, $F_k \leq 0$. Typically, this point is reached after only a few steps. Next, compute the cut-off value as the point between residuals d_k and d_{k-1} using the formula:

$$L = a \cdot d_k + (1 - a) \cdot d_{k-1}, \qquad (3)$$

where

$$a = 0.8F_{k-1} / (0.8F_{k-1} - 0.2F_k).$$

The initial adjustments for units whose residuals are greater than L are:

$$init.adj_i = L/d_i.$$

The cut-off values defined using the described procedure are always placed between some neighboring ordered residuals, so that all the residuals on the right from a cut-off value are greater than the cut-off value, although they may be very close to it. Based on the historical CES estimates, it has been found that the following rules for determining the final adjustments work the best.

For certainty units, if the initial adjustment is less than 0.5, then a unit is declared to be atypical, representing only itself. The atypical data is removed from the matched sample set and is not used in the estimation of the sample link relative. If the initial adjustment for a certainty unit is greater or equal to 0.5, no intervention is required and the adjustment is reset to 1.

For non-certainty units, if the initial adjustment is less than or equal to 0.3, then a unit is declared atypical and it is not used in the sample link relative estimation. If the initial adjustment is greater than 0.4, then the final adjustment is reset to 1. Adjustments between 0.3 and 0.4 are applied to the sample weight. The final adjusted weight is required to be equal or greater than 1. For example, if the resulting adjusted weight falls below 1, the final weight is reset to 1.

An intervention, such as a weight adjustment, into the regular estimation procedure would reduce the variance of the estimate but it may introduce a bias. Therefore, the intervention, especially in samples of moderate to large sizes, should be done with caution. For example, it is possible that there exist units in the non-sampled part of the population that are similar to the influential observations in the sample. Moderating the effect of the sample's influential units may lead to a reduction in the representativeness of the sample. Since the non-sampled part of the population is not available, it is difficult to judge the amount and the need of intervention based only on the observed sample. One way to protect against unwarranted intervention is to verify its necessity using historical CES estimates. If the estimate falls within the historically observed bounds, then the intervention is deemed unnecessary and the weight adjustments are discarded.

At the very first step of the procedure, the sample link relative estimate is used when defining the residuals. This estimate may itself be affected by the extreme influential observations. Therefore, the whole procedure is performed a second time. The atypical units determined during the initial run are not used in calculating the adjustment factors during the second run.

The reports identified by the robust estimation techniques are treated as atypical in the link-relative technique, while all other matched sample responses are treated as typical in the link-relative technique.

Special Estimation Situations

Small domain model. Relatively small sample sizes in some industries limit the reliability of the weighted-link-relative estimates of all employees. For a few industries (identified in the annual benchmark article, **http://www.bls.gov/web/cesbmart.htm**), BLS uses the CES small domain model (SDM). In addition, BLS and some cooperating State partners use the CES SDM for those State and metropolitan area employment series that have small samples. Estimation of nonsupervisory employees, average weekly hours, and average weekly and hourly earnings uses the standard weighted link-and-taper methodology.

The CES SDM is a weighted least squares (WLS) model with two employment inputs: (1) an estimate based on available CES sample for that series, and (2) an ARIMA projection based on trend from 10 years of historical QCEW data.

Estimator Based on Fay-Herriot Model. To estimate employment for State supersector cells with smaller sample sizes, the CES program uses an estimator based on the Fay-Herriot model. See Fay and Harriot (1979). In the smaller cells, a direct sample-based estimate of the over-the-month change in employment is often unreliable due to the large variance, although the direct estimator is assumed to be approximately unbiased.

In order to make more stable estimates, additional information is used. The model is formulated for a set of States in a given supersector *b* and at a given month *t*. (Since the indexes *b* and *t* in the following description are the same for all States involved in the model, they are suppressed to simplify the notation.)

Let R_a denote a true value of the relative over-the-month employment change in State *a*, $R_a^{(1)}$ is a direct sample-based estimate, and $R_a^{(2)}$ is an ARIMA forecast of the relative change. The model used in CES is formulated as follows:

$$R_a^{(1)} = R_a + e_a \qquad (1)$$

and

$$R_a = \beta R_a^{(2)} + u_a, \quad (2)$$

for a set of States $a = 1,\ldots,K$ (within a supersector *b* at time *t*). The error terms e_a and u_a are assumed to be independent and normally distributed, with mean zero. The variance of the direct sample estimate $R_a^{(1)}$ (and thus the variance of e_a) is $V_a^{(1)}$. It is estimated based on the sample and is smoothed using several years of data, to add stability. The values for the variance of the random effects of u_a, denoted A, and the parameter β are estimated from the model using the method described in the Fay and Herriot (1979) paper.

The resulting model estimator $R_a^{(FH)}$ can be presented as a weighted average of the sample-based estimate and an adjusted ARIMA forecast, as follows:

$$R_a^{(FH)} = \gamma_a^{(1)} R_a^{(1)} + \gamma_a^{(2)}(2)\,\beta\, R_a^{(2)} \qquad (3)$$

The weights $\gamma_a^{(1)}$ *and* $\gamma_a^{(2)}$ are:

$$\gamma_a^{(1)} = \frac{A}{A + V_a^{(1)}} \text{ and } \gamma_a^{(2)} = 1 - \gamma_a^{(1)}$$

The $\beta R_a^{(2)}$ component of the weighted average *a* described in equation (3) is called a synthetic part of the estimator. The variance, A, depends on the strength of the relationship between R_a and the forecasts $R_a^{(2)}$, across the States in a given supersector, as specified by equation (2). The relative magnitudes of A and $V_a^{(1)}$ indicate how much weight should be given to the synthetic part relative to how much weight should be given to the sample-based estimate. If the linear relationship described in (2) holds without error, A = 0, all weight would go to the synthetic part $\beta R_a^{(2)}$ however, if $R_a^{(2)}$ is a poor predictor, then A is large and more weight would be given to the direct sample estimate. The strength is "borrowed" across States within a supersector to estimate β, thus "correcting" the time series forecast using the "adjusted" $\beta R_a^{(2)}$ value, and to obtain A, the estimated "strength" of the prediction.

The model estimate of the employment level is obtained by applying the model-based estimate of the relative change to the preceding month's level of employment. For a month *t*, the estimator of the employment level is a State *a* supersector *b* is:

$$\gamma_{ab,t}^{(FH)} = \gamma_{ab,t-1} R_{ab,t}^{(FH)} \qquad (4)$$

Education and Religious Organizations. Due to the small sample in religious organizations (NAICS 8131), and definitional exclusions in the collection of data for educational services (NAICS 611), certain ratios for these series are recalculated with each benchmark to allow for the creation of aggregate totals. Production worker and women worker ratios, average hourly earnings, and average weekly hours for these series are calculated based on the weighted average of the previous year's professional and technical services, education and health services, leisure and hospitality, and other services' annual averages. BLS sets the March benchmark values based on the prior calendar year's annual averages.

The education services series uses the nonsupervisory employee ratio, average hourly earnings, and average weekly hours calculated from the weighted average. The religious organizations series uses the production employee ratio, women employee ratio, average hourly earnings, and average weekly hours calculated from the weighted average. In both cases, the ratios, average hourly earnings, and average weekly hours are held constant through the next benchmark.

Railroad estimates. BLS obtains monthly employment counts for class 1 railroads, which are not included in the QCEW universe. The Department of Transportation Surface Transportation Board (STB) publishes a mid-month employment count for the survey week of the previous month. (**http://www.stb.dot.gov/econdata.nsf/**) BLS uses this data to estimate employment for railroads. The data from STB are also used to set the benchmark employment levels and hours and earnings.

Residential and Nonresidential Specialty Trade Contractors estimates. Residential and nonresidential employment estimates in Specialty Trade Contractors (NAICS 238) are produced as breakouts under the standard NAICS coding structure. Benchmarks for these series are developed from the QCEW data and independent estimates for these series are made on a monthly basis and raked to the estimates produced under the standard structure to ensure that the sum of the residential specialty trade contractors and nonresidential specialty trade contractors series is consistent with the published total for specialty trade contractors at the 3-digit NAICS level.

The raking adjustment follows the following methodology:

Estimates are derived independently for the residential and nonresidential groups at the 4-digit NAICS level for each region. Regional estimates are rounded and summed to the 4-digit NAICS level for both the residential and nonresidential groups. Within each 4-digit NAICS series, ratios of residential-to-total employment and nonresidential-to-total employment are calculated.

At the 4-digit NAICS level, the sum of the residential/nonresidential series is subtracted from the official industry-region cell structure total to determine the amount that must

be raked. The total amount that must be raked is multiplied by the ratios to determine what percentage of the raked amount should be applied to the residential group and what percentage should be applied to the nonresidential group.

Once the residential and nonresidential groups receive their proportional amount of raked employment, the two groups are aggregated again to the 4-digit NAICS level. At this point, employment is equal to the 4-digit NAICS total derived from the official industry-region cell structure. This raking process also forces additivity at the 3-digit NAICS level.

No estimates of women employees, construction employees, or hours and earnings are made for the residential and nonresidential series.

Real earnings data are expressed in constant 1982–84 dollars. Real earnings are computed by dividing average hourly earnings and average weekly earnings by the BLS Consumer Price Indexes. Real earnings for all employees are deflated by the Consumer Price Index for All Urban Consumers (CPI-U), while real earnings for production and nonsupervisory employees are deflated by the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W).

Average hourly earnings, excluding overtime-premium pay, are computed by dividing the total worker payroll for the industry group by the sum of total worker hours and one-half of total overtime hours. No adjustments are made for other premium payment provisions, such as holiday pay, late-shift premiums, and overtime rates other than time and one-half. Average hourly earnings excluding overtime are calculated only for manufacturing industries.

Seasonally adjusted series

Many economic statistics reflect a regularly recurring seasonal movement that can be measured from past experience. By eliminating that part of the change attributable to the normal seasonal variation, it is possible to observe the cyclical and other non-seasonal movements in a series. Seasonally adjusted series are published regularly for selected employment, hours, and earnings series.

X-12 ARIMA software, developed by the U.S. Census Bureau, is used to seasonally adjust CES data on a concurrent basis, meaning the software incorporates estimates up through and including the current month's data to achieve the best possible series. Using special features of X-12 ARIMA, adjustments are made to remove the effect of the variable number of weeks between surveys from month to month (about 1 month in 3 has a 5-week instead of a 4-week interval) and to remove the effect of the variable number of work days in the reference month, to adjust for moving holidays, and to adjust for the variations in the number of election poll workers in November from year to year. CES processes concurrent seasonal adjustment on a monthly basis using the latest estimates of employment, hours, and earnings. Seasonally adjusted employment series for broader industry groups are obtained by summing the seasonally adjusted data for the component industries. Seasonally adjusted hours and earnings averages for broader level industry groups are weighted averages of the seasonally adjusted component series. For more information on seasonal adjustment of CES series, see **http://www.bls.gov/ces/cesseasadj.htm**.

Data Presentation

The national series on employment, hours, and earnings are available on the Internet and appear in several BLS publications. The summary data are first published each month in *The Employment Situation* news release (**http://www.bls.gov/ces/#news**), which contains preliminary national estimates of nonfarm employment, average weekly hours, and average hourly and weekly earnings in the preceding month for industry sectors. Preliminary estimates are based on tabulations of data for less than the full sample to permit early release of these widely used economic indicators. This release is normally issued on Friday, 3 weeks after the reference week. The news release also includes a brief analysis of current trends in employment, hours, and earnings. The *Real Earnings* news release is published concurrent with the *Consumer Price Index* news release.

Detailed employment, hours, and earnings data also are available on the Internet on the morning of The *Employment Situation* news release. Data can be accessed through the CES database section on the CES homepage (**http://www.bls.gov/ces/#data**). Where sample adequacy and response rates allow, estimates at the NAICS 4-, 5-, and 6-digit detail are published on the Internet on a 1-month lag. Final (prebenchmark) figures are issued 1 month later. In addition, special articles describe technical developments in the program. The *Monthly Labor Review* also presents CES data in articles analyzing industry employment, hours, and earnings trends.

National data also are disseminated in the publications or online databases of other Federal agencies, such as the U.S. Department of Commerce, the Board of Governors of the Federal Reserve System, and the Council of Economic Advisers. Data also are regularly republished in summary form or for specific industries in many trade association journals, the labor press, and in general reference works.

In addition to national estimates, monthly employment estimates for all 50 States, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and selected metropolitan areas are published in the online *Employment and Earnings*.[1]

Detailed State and metropolitan area industry data also are available monthly in releases published by the State employment security agencies that cooperate with BLS in producing the State and area estimates. State and area data also are available from the State and area current employment statistics homepage **http://www.bls.gov/sae/**, which contains extensive information related to the CES State and area program, including contacts, news releases, and data.

[1] Employment, hours, and earnings for the Nation as a whole exclude Puerto Rico and the U.S. Virgin Islands.

Comparison with the Current Population Survey

The Bureau of Labor Statistics (BLS) has two monthly surveys that measure employment levels and trends: the Current Employment Statistics (CES) survey, also known as the payroll or establishment survey, and the Current Population Survey (CPS), also known as the household survey. Employment estimates from both surveys are published in *The Employment Situation* news release each month. The estimates differ because the surveys have distinct definitions of employment and distinct survey and estimation methods.

The Current Employment Statistics survey, also known as the payroll survey, excludes unpaid family workers, domestic workers in private homes, agricultural workers, proprietors, and other self-employed persons, all of whom are covered by the CPS. Moreover, the payroll survey counts a person who is employed by two or more establishments at each place of employment, but the household survey counts a person only once, and classifies the individual according to the major activity. Certain persons on unpaid leave for the entire reference period are counted as employed under the household survey but are not included in the employment count derived from the payroll survey.

The household survey emphasizes the employment status of individuals and provides information on the demographic characteristics (sex, age, and race) of the labor force. The survey is not well suited to furnishing detailed information on the industrial and geographic distribution of employment. The establishment survey provides limited information on personal characteristics of workers; however, it is an excellent source for detailed industrial and geographic data. In addition, it provides hours and earnings information that relates directly to the employment figures. The payroll and household surveys thus complement each other.

To better understand differences in the surveys' employment measures, as well as divergences that sometimes occur in their trends, see **http://www.bls.gov/web/ces_cps_trends.pdf**. Additional information on the methodologies of the two surveys can be found in the *Quick Guide to Methods and Measurement Issues* on the BLS Web site at **http://www.bls.gov/bls/empsitquickguide.htm**.

Uses

Data from the CES program, along with CPS data, are the first major economic indicators released each month. As such, they are used in the formulation of fiscal and economic policy. CES employment estimates are a primary component of the Index of Coincident Economic Indicators and have proved to be an extremely reliable measure of current economic activity. The manufacturing average weekly hours series is used in the Index of Leading Economic Indicators (LEI), which forecasts changes in the business cycle.

Aggregate earnings data are the major component of the preliminary personal income estimates in the National Income and Product Accounts. Productivity measures (chapters 10 and 11) and the Industrial Production Index are based on the aggregate hours data. Employment series are a basic input for employment projections by BLS (chapter 13) and State labor market information agencies.

The series also are used in the private sector by business firms, labor unions, universities, trade associations, and private research organizations to study economic conditions and to develop plans for the future. Business firms, for example, use the employment, hours, and earnings data for guidance in plant location, sales, and purchases.

Reliability of Estimates

The establishment survey, like other sample surveys, is subject to two types of error, sampling and non sampling error. The magnitude of sampling error, or variance, is directly related to the size of the sample and the percentage of universe coverage achieved by the sample. The establishment survey sample covers over one-third of total universe employment; this yields a very small variance on the total nonfarm estimates.

Most sample surveys publish sampling error as their only measure of error; however, the CES can derive an annual approximation of total error, on a lagged basis, because of the availability of the independently derived universe data. While the benchmark error is used as a measure of total error for the CES survey estimate, it actually represents the difference between two independent estimates derived from separate survey processes (specifically, the CES sample process and the UI administrative process) and thus reflects the errors present in each program. Historically, benchmark revisions have been very small for total nonfarm employment, ranging from -0.7 to +0.6 percent.

The estimation of sample variance for the CES survey is accomplished through use of the method of Balanced Half Samples (BHS). This replication technique uses half samples of the original sample and calculates estimates using those subsamples. The CES survey uses a modification to the basic BHS method known as Fay's method. Rather than using only half of the sample in deriving each replicate estimate, this method uses adjustments to the original sample weights applied to both halves of the sample, thus allowing use of all sample units for each replicate estimate. The sample variance is calculated by measuring the variability of the replicate estimates. The sample units in each sampling strata are divided into two random groups. Columns of the Hadamard matrix (which is a special 0-1 matrix) of appropriate order are mapped to the strata. Each row of the Hadamard matrix defines a replicate subsample: the random group indicators are matched to the 0-1 entries of each row of the Hadamard matrix thus defining a set of units for each replicate. Weights for units that belong to a replicate half-sample are multiplied by a factor of $1+y$, where weights for units in the other half of the sample are multiplied by a factor of $1-y$. Replicate estimates are calculated using the same estimation formula as used for the full-sample estimate.

The formula used to calculate CES variances

$$v_{\kappa}^{+}\left(\hat{\theta}\right)=\frac{1}{\gamma^{2}\kappa}\sum_{\alpha=1}^{\kappa}\left(\hat{\theta}_{\alpha}^{+}-\hat{\theta}\right)^{2}$$

where

$\hat{\theta}_{\alpha}^{+}=\theta\left(\hat{Y}_{\alpha}^{+},\hat{X}_{\alpha}^{+},.....\right)$ is the α th replicate estimate,

$\gamma=1/2$,

k is the number of replicates, and, $\hat{\theta}$ is the original full–sample estimates.

Variances statistics are useful for comparison purposes, but they do have some limitations. Variances reflect the error component of the estimates that is due to surveying only a subset of the population, rather than conducting a complete count of the entire population. However, they do not reflect the non-sampling error, such as response errors and bias due to non response. The overall performance of the CES employment estimates is best measured in terms of the benchmark revisions. The variances of the over-the-month change estimates are very useful in determining when changes are significant at some level of confidence.

Technical References

Employment from the BLS household and payroll surveys: summary of recent trends. Describes differences in the employment measures from the CES and CPS surveys, as well as divergences that sometimes occur in their trends. (See **http://www.bls.gov/web/ces_cps_trends.pdf**.)

Seasonal Adjustment in the Current Employment Statistics Program. Describes in detail the seasonal adjustment methodology and software employed by the Current Employment Statistics Program. It is important to note that this describes seasonal adjustment only as it relates to the CES program's implementation. (See **http://www.bls.gov/ces/cessa_oview.pdf**.)

Technical Notes To Establishment Data Published in Employment and Earnings. An up-to-date, concise description of concepts and methods used to develop establishment-based employment, hours, and earnings data from the Current Employment Statistics program. Provides tables that present measures of the reliability of the data and the magnitude of revisions due to benchmark adjustments. (See **http://www.bls.gov/ces/#technical**.)

Technical Information: Estimation Methods for Business Births and Deaths. (See **http://www.bls.gov/ces/cesbdtech.htm**.)

Mueller, Kirk, "Impact of business births and death in the payroll survey," May 2006, *Monthly Labor Review*.

Kokic, P. N., and Bell, P. A. (1994), "Optimal Winsorizing Cutoffs for a Stratified Finite Population Estimator," *Journal of Official Statistics*, 10, 419-435.

Fay, R.E. and Herriot, (1979). Estimates of Income for Small Places: an Application of James-Stein Procedure to Census Data, *Journal of the American Statistical Association*, 74, 269-277.

Appendix C

CES National Benchmark Article

http://www.bls.gov/web/empsit/cesbmart.pdf

CES National Benchmark Article

BLS Establishment Survey National Estimates Revised to Incorporate March 2014 Benchmarks

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Introduction

With the release of January 2015 data on February 6, 2015, the Bureau of Labor Statistics (BLS) introduced its annual revision of national estimates of employment, hours, and earnings from the Current Employment Statistics (CES) monthly survey of nonfarm establishments. Each year, the CES survey realigns its sample-based estimates to incorporate universe counts of employment—a process known as benchmarking. Comprehensive counts of employment, or benchmarks, are derived primarily from unemployment insurance (UI) tax reports that nearly all employers are required to file with State Workforce Agencies.

Summary of the benchmark revisions

The March 2014 benchmark level for total nonfarm employment is 137,214,000; this figure is 67,000 above the sample-based estimate for March 2014, an adjustment of less than 0.05 percent. Table 1 below shows the recent history of total nonfarm percentage benchmark revisions. Over the prior ten years, the annual benchmark revision at the total nonfarm level has averaged 0.3 percent (in absolute terms), with an absolute range of 0.1 percent to 0.7 percent.

Table 1. Percent differences between nonfarm employment benchmarks and estimates by industry supersector, March 2004-2014 [(1)]

CES Industry Code	CES Industry Title	2004	2005	2006	2007	2008	2009	2010	2011 [(2)]	2012	2013 [(3)]	2014
00-000000	**Total nonfarm**	0.2	-0.1	0.6	-0.2	-0.1	-0.7	-0.3	0.1	0.3	-0.1	[(4)]
(Level difference in thousands)		(203)	(-158)	(752)	(-293)	(-89)	(-902)	(-378)	(67)	(424)	(-119)	(67)
05-000000	**Total private**	.2	-.2	.7	-.2	-.1	-.9	-.4	[(4)]	.4	-.1	.1
10-000000	**Mining and logging**	.7	-.3	1.2	[(4)]	.4	-3.5	-3.0	-.4	1.6	-1.2	-1.8
20-000000	**Construction**	.6	.5	2.6	.1	.7	-2.9	-1.3	-.5	1.8	.3	1.6
30-000000	**Manufacturing**	-.4	-.3	-.1	-1.0	-.1	-.7	-1.0	.1	-.2	.2	.4
40-000000	**Trade, transportation, and utilities**	.2	.3	.6	.5	.2	-1.2	-.6	.4	.6	-.5	-.1
50-000000	**Information**	-1.0	-2.1	-.5	-1.8	.3	-1.5	-.4	-.4	1.8	-.2	2.4
55-000000	**Financial activities**	.1	-.8	.4	-1.3	-.3	-.1	.4	-.2	.6	-.1	.2
60-000000	**Professional and business services**	-.2	-.4	1.3	.2	-.4	-.8	[(4)]	.7	[(4)]	[(4)]	-.8
65-000000	**Education and health services**	.2	[(4)]	.5	-.2	-.1	-.3	[(4)]	-.6	[(4)]	-.3	-.1
70-000000	**Leisure and hospitality**	1.2	.4	.3	-.8	-1.1	-.6	-.6	.7	.8	.5	.3
80-000000	**Other services**	.5	-1.3	.5	.3	.2	-.8	.2	-2.0	1.1	-.4	1.1
90-000000	**Government**	.1	[(4)]	[(4)]	-.2	.2	.1	.1	.1	-.3	[(4)]	-.2

[(1)] The differences listed in this table reflect the error due to normal benchmarking procedures. Typically this error is equal to the March benchmarked level minus the published March estimated level. However in some years, other factors beyond normal benchmarking procedures influence the difference between the benchmarked and published March estimate levels. Those years are footnoted.

(2) A review of industries for the possible presence of noncovered employment in benchmark 2011 yielded 13 additional industries. As a result of including these industries, employment in the amount of 95,000 was added to the total nonfarm benchmark level. The difference between the benchmarked and published March 2011 estimate level was 162,000. For this table, the 95,000 amount was added to the original published total nonfarm and total private March 2011 estimates before calculating the percent and level differences. Portions of the 95,000 amount were also added as appropriate to the original published March 2011 estimates of supersectors financial activities and education and health services before calculating the percent differences.
(3) The percent and level differences in this column reflect reconstructions to series within CES supersectors financial activities and Education and healthcare services. Each first quarter, the Quarterly Census of Employment and Wages (QCEW) program, whose data account for approximately 97 percent of the CES universe scope (see www.bls.gov/web/empsit/cestn.htm#section1), incorporates updated industry assignments. In 2013, these updates included two substantial groups of nonrandom, noneconomic code changes, one to funds, trusts, and other financial vehicles (NAICS 525), and the other, a reclassification of approximately 466,000 in employment from private households (NAICS 814), which is out of scope for CES, to services for the elderly and persons with disabilities (NAICS 62412), which is in scope. These changes also had an impact, beyond what would be considered typical for a given benchmark year, on corresponding CES series. For more information about the changes to these industries, see the QCEW First Quarter 2013 News Release available at www.bls.gov/news.release/archives/cewqtr_09262013.htm.
(4) Less than 0.05 percent.

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Table 2 shows the nonfarm employment benchmarks for March 2014, not seasonally adjusted, by industry. The revision to the reconstructed total nonfarm employment is 67,000.

Six supersectors had upward revisions. The largest upward revision occurred in construction by an amount of 90,000 or 1.6 percent. Within this supersector, the revision was concentrated in specialty trade contractors, which was revised upward by 92,700, or 2.5 percent. Information had an upward revision of 66,000, or 2.4 percent. Other services was revised upward by 59,000 or 1.1 percent. Manufacturing was revised upward by 43,000, or 0.4 percent, with the majority of the increase attributed to nondurable goods, which experienced an upward revision of 30,000, or 0.7 percent. Leisure and hospitality was also revised upward by 38,000, or 0.3 percent. The smallest upward revision of 19,000, or 0.2 percent occurred in financial activities.

The remaining five supersectors saw negative revisions. The largest downward revision occurred in professional and business services, which decreased by 147,000, or 0.8 percent. Within this supersector, the largest revision was in admistrative and support services with a revision of -169,400, or -2.2 percent. The next largest negative revision occurred in government, which experienced a drop of -38,000, or -0.2 percent. Trade, transportation, and utilities was also revised downward by -31,000, or -0.1 percent, with a large decrease occurring in wholesale trade (-45,400, or -0.8 percent). Mining and logging and education and health services exhibited identical level decreases of -16,000 (-1.8 percent and -0.1 percent, respectively).

Table 2. Nonfarm employment benchmarks by industry, March 2014 (in thousands)

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences	
				Amount	Percent
00-000000	**Total nonfarm**	137,214	137,147	67	(1)
05-000000	**Total private**	114,989	114,884	105	0.1
06-000000	**Goods-producing**	18,675	18,558	117	0.6
07-000000	**Service-providing**	118,539	118,589	-50	(1)
08-000000	**Private service-providing**	96,314	96,326	-12	(1)
10-000000	**Mining and logging**	868	884	-16	-1.8
10-113300	**Logging**	50	52.8	-2.8	-5.6
10-210000	**Mining**	817.6	830.8	-13.2	-1.6
10-211000	**Oil and gas extraction**	192.7	206.2	-13.5	-7
10-212000	**Mining, except oil and gas**	201	205.8	-4.8	-2.4
10-212100	**Coal mining**	73.6	77.7	-4.1	-5.6
10-213000	**Support activities for mining**	423.9	418.8	5.1	1.2
20-000000	**Construction**	5,746	5,656	90	1.6
20-236000	**Construction of buildings**	1,283.4	1,286.2	-2.8	-0.2
20-236100	**Residential building**	615.2	621.7	-6.5	-1.1

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences	
				Amount	Percent
20-236200	Nonresidential building	668.2	664.5	3.7	0.6
20-237000	Heavy and civil engineering construction	823.9	823.8	0.1	(1)
20-238000	Specialty trade contractors	3,638.2	3,545.5	92.7	2.5
30-000000	Manufacturing	12,061	12,018	43	0.4
31-000000	Durable goods	7,600	7,587	13	0.2
31-321000	Wood products	361.9	358	3.9	1.1
31-327000	Nonmetallic mineral products	369.1	371.4	-2.3	-0.6
31-331000	Primary metals	396.3	396.6	-0.3	-0.1
31-332000	Fabricated metal products	1,438.5	1,440.2	-1.7	-0.1
31-333000	Machinery	1,116.1	1,115.2	0.9	0.1
31-334000	Computer and electronic products	1,048.3	1,055.7	-7.4	-0.7
31-334100	Computer and peripheral equipment	158.2	161.9	-3.7	-2.3
31-334200	Communications equipment	95.3	99.5	-4.2	-4.4
31-334400	Semiconductors and electronic components	368	368.6	-0.6	-0.2
31-334500	Electronic instruments	389.6	387.7	1.9	0.5
31-335000	Electrical equipment and appliances	375.3	374.8	0.5	0.1
31-336000	Transportation equipment	1,547.4	1,533.9	13.5	0.9
31-337000	Furniture and related products	366	362.5	3.5	1
31-339000	Miscellaneous durable goods manufacturing	581	578.4	2.6	0.4
32-000000	Nondurable goods	4,461	4,431	30	0.7
32-311000	Food manufacturing	1,460.8	1,458	2.8	0.2
32-313000	Textile mills	117.2	116.9	0.3	0.3
32-314000	Textile product mills	113.2	110.7	2.5	2.2
32-315000	Apparel	142.6	135.6	7	4.9
32-322000	Paper and paper products	372.1	374.5	-2.4	-0.6
32-323000	Printing and related support activities	452.7	440.7	12	2.7
32-324000	Petroleum and coal products	107.5	110.5	-3	-2.8

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences	
				Amount	Percent
32-325000	Chemicals	797.9	797.4	0.5	0.1
32-326000	Plastics and rubber products	668.6	659.2	9.4	1.4
32-329000	Miscellaneous nondurable goods manufacturing	228.3	227.6	0.7	0.3
40-000000	Trade, transportation, and utilities	25,852	25,883	-31	-0.1
41-420000	Wholesale trade	5,758.3	5,803.7	-45.4	-0.8
41-423000	Durable goods	2,883.8	2,917.2	-33.4	-1.2
41-424000	Nondurable goods	1,989	1,985.6	3.4	0.2
41-425000	Electronic markets and agents and brokers	885.5	900.9	-15.4	-1.7
42-000000	Retail trade	15,009.5	15,004	5.5	(1)
42-441000	Motor vehicle and parts dealers	1,826.3	1,822.9	3.4	0.2
42-441100	Automobile dealers	1,163.7	1,157.5	6.2	0.5
42-442000	Furniture and home furnishings stores	444	442.2	1.8	0.4
42-443000	Electronics and appliance stores	483.2	497.8	-14.6	-3
42-444000	Building material and garden supply stores	1,210.5	1,207.2	3.3	0.3
42-445000	Food and beverage stores	2,943.8	2,957.8	-14	-0.5
42-446000	Health and personal care stores	1,010.3	1,008.4	1.9	0.2
42-447000	Gasoline stations	863.4	859.7	3.7	0.4
42-448000	Clothing and clothing accessories stores	1,320.5	1,338.5	-18	-1.4
42-451000	Sporting goods, hobby, book, and music stores	591.9	574.6	17.3	2.9
42-452000	General merchandise stores	3,043.7	3,053.9	-10.2	-0.3
42-452100	Department stores	1,312.8	1,301.3	11.5	0.9
42-453000	Miscellaneous store retailers	791.3	774.1	17.2	2.2
42-454000	Nonstore retailers	480.6	466.9	13.7	2.9
43-000000	Transportation and warehousing	4,534.5	4,524.8	9.7	0.2
43-481000	Air transportation	440.2	455.2	-15	-3.4
43-482000	Rail transportation	230.3	232.7	-2.4	-1
43-483000	Water transportation	64.9	65.3	-0.4	-0.6

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences	
				Amount	Percent
43-484000	Truck transportation	1,374.3	1,367.7	6.6	0.5
43-485000	Transit and ground passenger transportation	476.9	468.3	8.6	1.8
43-486000	Pipeline transportation	46.5	45.1	1.4	3
43-487000	Scenic and sightseeing transportation	24.5	23.8	0.7	2.9
43-488000	Support activities for transportation	613.7	599.8	13.9	2.3
43-492000	Couriers and messengers	539.2	541	-1.8	-0.3
43-493000	Warehousing and storage	724	725.9	-1.9	-0.3
44-220000	Utilities	549.7	550.3	-0.6	-0.1
50-000000	Information	2,719	2,653	66	2.4
50-511000	Publishing industries, except Internet	723.7	726.5	-2.8	-0.4
50-512000	Motion picture and sound recording industries	380.1	313	67.1	17.7
50-515000	Broadcasting, except Internet	281.5	287.5	-6	-2.1
50-517000	Telecommunications	849.4	854.4	-5	-0.6
50-518000	Data processing, hosting and related services	274.4	267.8	6.6	2.4
50-519000	Other information services	209.6	203.3	6.3	3
55-000000	Financial activities	7,889	7,870	19	0.2
55-520000	Finance and insurance	5,894.9	5,868.9	26	0.4
55-521000	Monetary authorities - central bank	18.2	18	0.2	1.1
55-522000	Credit intermediation and related activities	2,562.8	2,571.1	-8.3	-0.3
55-522100	Depository credit intermediation	1,712.6	1,705	7.6	0.4
55-522110	Commercial banking	1,301.2	1,280.9	20.3	1.6
55-523000	Securities, commodity contracts, investments, and funds and trusts	874.2	870.5	3.7	0.4
55-524000	Insurance carriers and related activities	2,439.7	2,409.3	30.4	1.2

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences	
				Amount	Percent
55-530000	**Real estate and rental and leasing**	1,994.2	2,000.6	-6.4	-0.3
55-531000	**Real estate**	1,459.4	1,458.3	1.1	0.1
55-532000	**Rental and leasing services**	511.3	520.2	-8.9	-1.7
55-533000	**Lessors of nonfinancial intangible assets**	23.5	22.1	1.4	6
60-000000	**Professional and business services**	18,685	18,832	-147	-0.8
60-540000	**Professional and technical services**	8,310.3	8,326.6	-16.3	-0.2
60-541100	**Legal services**	1,118	1,134.4	-16.4	-1.5
60-541200	**Accounting and bookkeeping services**	1,058	1,052.3	5.7	0.5
60-541300	**Architectural and engineering services**	1,344.1	1,369.1	-25	-1.9
60-541500	**Computer systems design and related services**	1,742.1	1,728.6	13.5	0.8
60-541600	**Management and technical consulting services**	1,208.2	1,199.1	9.1	0.8
60-550000	**Management of companies and enterprises**	2,146.5	2,112.8	33.7	1.6
60-560000	**Administrative and waste services**	8,228	8,392.2	-164.2	-2
60-561000	**Administrative and support services**	7,852.1	8,021.5	-169.4	-2.2
60-561300	**Employment services**	3,251.7	3,427.2	-175.5	-5.4
60-561320	**Temporary help services**	2,626	2,741.2	-115.2	-4.4
60-561400	**Business support services**	873.8	858.5	15.3	1.8
60-561700	**Services to buildings and dwellings**	1,803.9	1,802.3	1.6	0.1
60-562000	**Waste management and remediation services**	375.9	370.7	5.2	1.4
65-000000	**Education and health services**	21,465	21,481	-16	-0.1
65-610000	**Educational services**	3,555.4	3,539.1	16.3	0.5

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences	
				Amount	Percent
65-620000	Health care and social assistance	17,909.8	17,941.4	-31.6	-0.2
65-621000	Ambulatory health care services	6,556.1	6,597.3	-41.2	-0.6
65-621100	Offices of physicians	2,448.7	2,473.9	-25.2	-1
65-621400	Outpatient care centers	698.5	705.9	-7.4	-1.1
65-621600	Home health care services	1,240	1,265.7	-25.7	-2.1
65-622000	Hospitals	4,767.3	4,792.7	-25.4	-0.5
65-623000	Nursing and residential care facilities	3,239.6	3,234.9	4.7	0.1
65-623100	Nursing care facilities	1,644.3	1,644.1	0.2	(1)
65-624000	Social assistance	3,346.8	3,316.5	30.3	0.9
65-624400	Child day care services	866.4	876.1	-9.7	-1.1
70-000000	Leisure and hospitality	14,181	14,143	38	0.3
70-710000	Arts, entertainment, and recreation	1,927.5	1,939.7	-12.2	-0.6
70-711000	Performing arts and spectator sports	421	420.9	0.1	(1)
70-712000	Museums, historical sites, and similar institutions	138	134.5	3.5	2.5
70-713000	Amusements, gambling, and recreation	1,368.5	1,384.3	-15.8	-1.2
70-720000	Accommodation and food services	12,253.4	12,203.2	50.2	0.4
70-721000	Accommodation	1,819.2	1,805.9	13.3	0.7
70-722000	Food services and drinking places	10,434.2	10,397.3	36.9	0.4
80-000000	Other services	5,523	5,464	59	1.1
80-811000	Repair and maintenance	1,232.3	1,209	23.3	1.9
80-812000	Personal and laundry services	1,351.9	1,351.7	0.2	(1)
80-813000	Membership associations and organizations	2,938.6	2,903.4	35.2	1.2
90-000000	Government	22,225	22,263	-38	-0.2
90-910000	Federal	2,716	2,705	11	0.4
90-911000	Federal, except U.S. Postal Service	2,127.5	2,117.6	9.9	0.5
90-919120	U.S. Postal Service	588.2	587.1	1.1	0.2

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences	
				Amount	Percent
90-920000	**State government**	5,211	5,217	-6	-0.1
90-921611	**State government education**	2,565.4	2,565.2	0.2	[(1)]
90-922000	**State government, excluding education**	2,645.1	2,651.8	-6.7	-0.3
90-930000	**Local government**	14,298	14,341	-43	-0.3
90-931611	**Local government education**	8,129	8,147.8	-18.8	-0.2
90-932000	**Local government, excluding education**	6,169.3	6,193.1	-23.8	-0.4

[(1)] Less than 0.05 percent.

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Revisions in the postbenchmark period

From April 2014 to December 2014, also known as the postbenchmark period, estimates were calculated for each month based on new benchmark levels and new net birth/death factors. Net birth/death factors were revised to incorporate information from the most recent year of universe employment counts. Table 3 shows the net birth/death model values for the supersectors over the postbenchmark period. From April 2014 to December 2014, the net birth/death model cumulatively added 968,000, compared with 841,000 in the previously published April to December employment estimates.

Table 3. Net birth/death estimates by industry supersector, April – December 2014 (in thousands)

CES Industry Code	CES Industry Title	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Cumulative Total
10-000000	**Mining and logging**	2	2	2	2	1	1	1	1	0	12
20-000000	**Construction**	35	37	24	12	12	7	12	-10	-21	108
30-000000	**Manufacturing**	0	6	4	-3	4	1	3	2	0	17
40-000000	**Trade, transportation, and utilities**	21	24	12	7	14	9	28	10	4	129
50-000000	**Information**	0	5	0	-1	3	-1	6	3	0	15
55-000000	**Financial activities**	8	8	4	3	4	-1	16	3	10	55
60-000000	**Professional and business services**	81	22	5	35	19	-12	76	14	-10	230
65-000000	**Education and health services**	22	13	-14	7	21	12	35	14	-3	107
70-000000	**Leisure and hospitality**	82	81	86	62	23	-33	-17	-22	4	266
80-000000	**Other services**	12	6	6	-2	3	-2	4	1	1	29
Total nonfarm birth/death adjustment		263	204	129	122	104	-19	164	16	-15	968

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Table 4 presents revised total nonfarm employment data on a seasonally adjusted basis for January 2014 through December 2014. The revised data for April 2014 forward incorporate the effect of applying the rate of change measured by the sample to the new benchmark level, as well as updated net birth/death model adjustments and new seasonal adjustment factors.

Table 4. Differences in seasonally adjusted levels and over-the-month changes, total nonfarm employment, January – December 2014 (in thousands)

2014	Levels			Over-the-month changes		
	As Previously Published	As Revised	Difference	As Previously Published	As Revised	Difference
January	137,539	137,642	103	144	166	22
February	137,761	137,830	69	222	188	-34
March	137,964	138,055	91	203	225	22
April	138,268	138,385	117	304	330	26
May	138,497	138,621	124	229	236	7
June	138,764	138,907	143	267	286	19
July	139,007	139,156	149	243	249	6
August	139,210	139,369	159	203	213	10
September	139,481	139,619	138	271	250	-21
October	139,742	139,840	98	261	221	-40
November	140,095	140,263	168	353	423	70
December[(p)]	140,347	140,592	245	252	329	77

[(p)]Preliminary.

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Changes to the CES published series

With the release of the January 2015 first preliminary estimates, CES incorporated series changes related to annual sample adequacy and disclosure review, and began publishing previously available but not published seasonally adjusted derivative series.

Series changes

All CES series are evaluated annually for sample size, coverage, and response rates. The following series changes result from a reevaluation of the sample and universe coverage for NAICS industries.

Some series have new CES industry codes or titles as a result of the series changes (Exhibit 1). These CES industry code or title changes have been applied to all data types published for the designated series. Historical data for those series with new CES industry codes or CES industry titles were impacted as noted on the remainder of this section; historical data are available under the new CES industry codes or CES industry titles.

Exhibit 1. Series with CES industry code or title changes

NAICS Code	Previous		New	
	CES Industry Code	CES Industry Title	CES Industry Code	CES Industry Title
332996,9	31-332999	Miscellaneous fabricated metal products	31-332999	Miscellaneous fabricated metal products and ball and roller bearings
3346	31-334600	Miscellaneous media manufacturing and reproduction	31-334600	Miscellaneous computer and electronic products

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Exhibit 2 through Exhibit 7 show the new CES industry codes and titles, not the previous CES industry codes and titles, as noted in Exhibit 1.

Only directly estimated data types[1] are included in the exhibits:

- All Employees (AE)
- AE Average Weekly Hours (AE AWH)
- Production Employees (PE)
- PE Average Weekly Hours (PE AWH)

[1] CES estimates data in two ways: directly and indirectly. Directly estimated data types refer to data types for which estimates are calculated directly from the responding sample. Indirectly estimated data types refer to data types for which estimates are calculated from other directly estimated data types. Average weekly earnings of all employees and indexes of aggregate weekly hours of all employees are examples of indirectly estimated data types. For more information on indirectly estimated data types, see the CES Technical Notes at www.bls.gov/web/empsit/cestn.htm.

- AE average hourly earnings (AE AHE)
- AE Average Weekly Overtime Hours (AE AWOH)
- Women Employees (WE)
- PE average hourly earnings (PE AHE)
- PE Average Weekly Overtime Hours (PE AWOH)

The directly estimated data types listed except for AE are collectively called non-AE data types. In order to more easily identify affected series, since AE series are published at a more detailed industry level than non-AE series, series changes exhibits are split by AE and non-AE data types. The non-AE tables cover all directly estimated non-AE data types.

The first group of series changes exhibits contains three exhibits referencing the AE data type and the second group contains three exhibits referencing all non-AE data types. The three exhibits in each group display the discontinued, collapsed, and new series. Discontinued series exhibits (Exhibit 2 and Exhibit 5) display series for which the data types noted are no longer published. Collapsed series exhibits (Exhibit 3 and Exhibit 6) display series for which the data types noted are no longer published because the industry no longer has sufficient sample to be estimated and published separately. Affected industries have been combined with other similar industries for estimation and publication purposes. Historical data for these series were reconstructed to provide consistent time series. New series exhibits (Exhibit 4 and Exhibit 7) display series for which the data types noted are now published.

AE exhibits

Exhibit 2. Discontinued AE series

There are no discontinued AE series.

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Exhibit 3. Collapsed AE series

NAICS Code	CES Industry Code	CES Industry Title	Collapsed into CES Industry
332991	31-332991	Ball and roller bearings	Collapsed into miscellaneous fabricated metal products and ball and roller bearings (31-332999)
3343	31-334300	Audio and video equipment	Collapsed into miscellaneous computer and electronic products (31-334600)
45393	42-453930	Manufactured and mobile home dealers	Collapsed into all other miscellaneous store retailers (42-453990)

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Exhibit 4. New AE series

There are no new AE series published.

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Non-AE exhibits

Exhibit 5. Discontinued Non-AE series

NAICS Code	CES Industry Code	CES Industry Title	Discontinued From Publication	Next Highest Published Industry[(2)]
236116	20-236116	New multifamily general contractors	AE AHE, AE AWH	Residential building (20-236100)
236117	20-236117	New housing operative builders	AE AHE, AE AWH	Residential building (20-236100)
3311	31-331100	Iron and steel mills and ferroalloy production	WE	Primary metals (31-331000)
3313	31-331300	Alumina and aluminum production	WE	Primary metals (31-331000)
33151	31-331510	Ferrous metal foundries	AE AHE, AE AWH, AE AWOH	Foundries (31-331500)
33152	31-331520	Nonferrous metal foundries	AE AHE, AE AWH, AE AWOH	Foundries (31-331500)
332321	31-332321	Metal windows and doors	AE AWOH	Ornamental and architectural metal products (31-332320)
332323	31-332323	Ornamental and architectural metal work	AE AWOH	Ornamental and architectural metal products (31-332320)
332999	31-332999	Miscellaneous fabricated metal products	AE AHE, AE AWH, AE AWOH, PE, PE AHE, PE AWH, PE AWOH, WE	All other fabricated metal products (31-332990)
333517	31-333517	Machine tool manufacturing	AE AHE, AE AWH, AE AWOH, PE, PE AHE, PE AWH, PE AWOH	Metalworking machinery (31-333500)
337122	31-337122	Nonupholstered wood household furniture	AE AHE, AE AWH, AE AWOH, PE, PE AHE, PE AWH, WE	Other household and institutional furniture (31-337120)
337124,5,7	31-337127	Miscellaneous household and institutional furniture	AE AHE, AE AWH, AE AWOH, PE, PE AHE, PE AWH, WE	Other household and institutional furniture (31-337120)

NAICS Code	CES Industry Code	CES Industry Title	Discontinued From Publication	Next Highest Published Industry[(2)]
311611	32-311611	Animal, except poultry, slaughtering	AE AWOH	Animal slaughtering and processing (32-311600)
311612,3	32-311613	Meat processed from carcasses, and rendering and meat byproduct processing	AE AWOH	Animal slaughtering and processing (32-311600)
45399	42-453990	All other miscellaneous store retailers	AE AHE, AE AWH, PE, PE AHE, PE AWH, WE	Other miscellaneous store retailers (42-453900)
54186	60-541860	Direct mail advertising	PE, PE AHE, PE AWH	Advertising and related services (60-541800)

(2) The industry listed is the next highest published industry for all data types discontinued from publication.

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Exhibit 6. Collapsed Non-AE series

There are no collapsed non-AE series.

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Exhibit 7. New Non-AE series

There are no new non-AE series published.

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Seasonally adjusted data publication change

Seasonally adjusted estimates for the indirectly estimated data types associated with series not available until the second preliminary release are now available with the second preliminary release. This change in publication status does not impact the seasonally adjusted series published for a given month with the first preliminary release of CES data. Approximately 8,300 more seasonally adjusted derivative series will be published.

Why benchmarks differ from estimates

A benchmark revision is the difference between the benchmark employment level for a given March and its corresponding sample-based estimate. The overall accuracy of the establishment

survey is usually gauged by the size of this difference. The benchmark revision often is regarded as a proxy for total survey error, but this does not take into account error in the universe data or infrequent events such as historical reconstructions. The employment counts obtained from quarterly UI tax forms are administrative data that reflect employer record-keeping practices and differing state laws and procedures. The benchmark revision can be more precisely interpreted as the difference between two independently derived employment counts, each subject to its own error sources.

Like all sample surveys, the establishment survey is susceptible to two sources of error: sampling error and nonsampling error. Sampling error is present any time a sample is used to make inferences about a population. The magnitude of the sampling error, or variance, relates directly to sample size and the percentage of the universe covered by that sample. The CES monthly survey captures slightly under one-third of the universe, exceptionally high by usual sampling standards. This coverage ensures a small sampling error at the Total nonfarm employment level.

Both the universe counts and the establishment survey estimates are subject to nonsampling errors common to all surveys – measurement, response, and processing errors. The error structures for both the CES monthly survey and the UI universe are complex. Still, the two programs generally produce consistent total employment figures, each validating the other.

Benchmark revision effects for other data types

The routine benchmarking process results in revisions to the series for production and nonsupervisory employees and women employees. There are no benchmark employment levels for these series; they are revised by preserving ratios of employment for the particular data type to all employee employment prior to benchmarking, and then applying these ratios to the revised all employee figures. These figures are calculated at the basic cell level and then aggregated to produce the summary estimates. Average weekly hours, average hourly earnings, and in manufacturing industries, average weekly overtime hours are not benchmarked; they are estimated solely from reports supplied by survey respondents at the basic estimating cell level.

The aggregate industry levels of the hours and earnings series are derived as a weighted average. The all employee employment estimates or the production and nonsupervisory employee employment estimates for the basic cells essentially act as weights for their respective hours and earnings estimates for broader industry groupings. Adjustments of the all employee estimates to new benchmarks may alter the weights used for both AE and PE hours and earnings, which, in turn, may change the estimates for both AE and PE hours and earnings at higher levels of aggregation.

Generally, new employment benchmarks have little effect on hours and earnings estimates for major industry groupings. To influence the hours and earnings estimates of a broader industry group, employment revisions have to be relatively large and must affect industries that have hours or earnings averages that are substantially different from those of other industries in their broader group. Table 5 and Table 6 provide information on the levels of specific hours and earnings series

resulting from the March 2014 benchmark. Total private average hourly earnings increased by two cents for AE and PE from the previously published level.

Table 5. Effect of March 2014 benchmark revisions to AE AWH and AE AHE estimates, selected industries

CES Industry Code	CES Industry Title	Average Weekly Hours			Average Hourly Earnings		
		Estimated	Revised	Difference	Estimated	Revised	Difference
05-000000	Total private	34.7	34.7	0	$24.48	$24.50	$0.02
06-000000	Goods-producing	40.5	40.5	0	25.64	25.62	-.02
08-000000	Private service-providing	33.6	33.6	0	24.21	24.23	.02
10-000000	Mining and logging	45	45.1	.1	31.13	31.04	-.09
20-000000	Construction	38.7	38.6	-.1	26.55	26.53	-.02
30-000000	Manufacturing	41	41	0	24.80	24.79	-.01
31-000000	Durable goods	41.5	41.5	0	26.17	26.18	.01
31-321000	Wood products	41	41	0	18.20	18.17	-.03
31-327000	Nonmetallic mineral products	41.7	41.7	0	22.63	22.63	0
31-331000	Primary metals	43.6	43.6	0	24.92	24.94	.02
31-332000	Fabricated metal products	41.6	41.6	0	22.20	22.20	0
31-333000	Machinery	41.8	41.8	0	26.94	26.95	.01
31-334000	Computer and electronic products	40.2	40.2	0	33.73	33.73	0
31-335000	Electrical equipment and appliances	40.6	40.6	0	25.05	25.05	0
31-336000	Transportation equipment	43.1	43.1	0	29.85	29.94	.09
31-336001	Motor vehicles and parts	43.4	43.5	.1	24.40	24.50	.10
31-337000	Furniture and related products	39.9	39.9	0	19.43	19.46	.03
31-339000	Miscellaneous durable goods manufacturing	39.3	39.3	0	23.71	23.71	0
32-000000	Nondurable goods	40.3	40.2	-.1	22.38	22.34	-.04

CES Industry Code	CES Industry Title	Average Weekly Hours			Average Hourly Earnings		
		Estimated	Revised	Difference	Estimated	Revised	Difference
32-311000	Food manufacturing	39.8	39.8	0	18.46	18.47	.01
32-313000	Textile mills	41.4	41.4	0	17.53	17.53	0
32-314000	Textile product mills	37.8	37.8	0	16.14	16.13	-.01
32-315000	Apparel	37.2	37.3	.1	17.15	17.17	.02
32-322000	Paper and paper products	42.4	42.4	0	24.58	24.60	.02
32-323000	Printing and related support activities	37.5	37.5	0	22.65	22.65	0
32-324000	Petroleum and coal products	43.6	43.4	-.2	38.09	37.58	-.51
32-325000	Chemicals	41.8	41.8	0	29.83	29.83	0
32-326000	Plastics and rubber products	41.3	41.3	0	20.53	20.52	-.01
32-329000	Miscellaneous nondurable goods manufacturing	37.4	37.4	0	21.32	21.32	0
40-000000	Trade, transportation, and utilities	34.6	34.6	0	21.45	21.44	-.01
41-420000	Wholesale trade	39.3	39.3	0	28.18	28.17	-.01
42-000000	Retail trade	31.3	31.3	0	16.94	16.95	.01
43-000000	Transportation and warehousing	38.6	38.6	0	22.88	22.90	.02
44-220000	Utilities	42.3	42.3	0	35.72	35.72	0
50-000000	Information	37.5	37.4	-.1	34.05	34.08	.03
55-000000	Financial activities	37.8	37.8	0	30.87	30.87	0
60-000000	Professional and business services	36.6	36.7	.1	29.39	29.49	.10
65-000000	Education and health services	32.8	32.8	0	24.57	24.59	.02
70-000000	Leisure and hospitality	26.5	26.5	0	13.78	13.79	.01

CES Industry Code	CES Industry Title	Average Weekly Hours			Average Hourly Earnings		
		Estimated	Revised	Difference	Estimated	Revised	Difference
80-000000	**Other services**	32	32.1	.1	21.87	21.96	.09

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Table 6. Effect of March 2014 benchmark revisions to PE AWH and PE AHE estimates, selected industries

CES Industry Code	CES Industry Title	Average Weekly Hours			Average Hourly Earnings		
		Estimated	Revised	Difference	Estimated	Revised	Difference
05-000000	**Total private**	33.8	33.8	0	$20.59	$20.61	$0.02
06-000000	**Goods-producing**	41.3	41.3	0	21.42	21.42	0
08-000000	**Private service-providing**	32.6	32.6	0	20.42	20.44	.02
10-000000	**Mining and logging**	47.6	47.6	0	26.79	26.75	-.04
20-000000	**Construction**	39.2	39.2	0	24.43	24.43	0
30-000000	**Manufacturing**	41.9	41.9	0	19.54	19.53	-.01
31-000000	**Durable goods**	42.4	42.4	0	20.63	20.65	.02
31-321000	**Wood products**	41.8	41.8	0	15.56	15.53	-.03
31-327000	**Nonmetallic mineral products**	42.5	42.5	0	18.63	18.64	.01
31-331000	**Primary metals**	44.1	44.2	.1	22.06	22.07	.01
31-332000	**Fabricated metal products**	42.5	42.5	0	18.63	18.63	0
31-333000	**Machinery**	43.2	43.3	.1	20.95	20.96	.01
31-334000	**Computer and electronic products**	40.8	40.8	0	23.57	23.57	0
31-335000	**Electrical equipment and appliances**	41.3	41.3	0	18.10	18.10	0
31-336000	**Transportation equipment**	43.7	43.7	0	24.91	24.98	.07

CES Industry Code	CES Industry Title	Average Weekly Hours			Average Hourly Earnings		
		Estimated	Revised	Difference	Estimated	Revised	Difference
31-336001	Motor vehicles and parts	43.9	43.9	0	21.44	21.51	.07
31-337000	Furniture and related products	40.8	40.8	0	15.63	15.63	0
31-339000	Miscellaneous durable goods manufacturing	40	40	0	17.47	17.47	0
32-000000	Nondurable goods	41.2	41.2	0	17.72	17.68	-.04
32-311000	Food manufacturing	40.3	40.3	0	15.50	15.50	0
32-313000	Textile mills	41.7	41.7	0	14.09	14.09	0
32-314000	Textile product mills	37.5	37.5	0	13.25	13.25	0
32-315000	Apparel	39.1	39.2	.1	13.34	13.34	0
32-322000	Paper and paper products	43.7	43.7	0	20.16	20.18	.02
32-323000	Printing and related support activities	39	39	0	18.02	18.02	0
32-324000	Petroleum and coal products	45.9	45.7	-.2	36.37	35.70	-.67
32-325000	Chemicals	43	43	0	21.47	21.47	0
32-326000	Plastics and rubber products	41.9	41.9	0	16.36	16.36	0
32-329000	Miscellaneous nondurable goods manufacturing	40.3	40.3	0	18.72	18.72	0
40-000000	Trade, transportation, and utilities	33.6	33.6	0	18.26	18.26	0
41-420000	Wholesale trade	39	39	0	23.22	23.21	-.01
42-000000	Retail trade	29.8	29.8	0	14.34	14.35	.01
43-000000	Transportation and warehousing	38.3	38.4	.1	20.40	20.44	.04
44-220000	Utilities	42	42	0	32.84	32.84	0

CES Industry Code	CES Industry Title	Average Weekly Hours			Average Hourly Earnings		
		Estimated	Revised	Difference	Estimated	Revised	Difference
50-000000	**Information**	36.4	36.2	-.2	28.84	28.83	-.01
55-000000	**Financial activities**	37.3	37.3	0	24.78	24.77	-.01
60-000000	**Professional and business services**	35.8	35.8	0	24.47	24.55	.08
65-000000	**Education and health services**	32.1	32	-.1	21.49	21.51	.02
70-000000	**Leisure and hospitality**	25.5	25.5	0	11.99	11.99	0
80-000000	**Other services**	31	31	0	18.40	18.50	.10

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Vintage data

Due to user interest in versions of CES estimates from original to current publication, CES compiled vintage data tables that display the CES published employment values for a given reference month across time. CES vintage data can be found at www.bls.gov/ces/cesvininfo.htm.

Three-month moving average

Effective with the release of January 2015 data, the establishment survey will introduce two new data series: total nonfarm employment, 3-month average change and total private employment, 3-month average change. Both series are seasonally adjusted.

Methods

Benchmark adjustment procedure

Establishment survey benchmarking is done on an annual basis to a population derived primarily from the administrative file of employees covered by UI. The time required to complete the revision process—from the full collection of the UI population data to publication of the revised industry estimates—is about ten months. The benchmark adjustment procedure replaces the March sample-based employment estimates with UI-based population counts for March. The benchmark therefore determines the final employment levels, while sample movements capture month-to-month trends.

Benchmarks are established for each basic estimating cell and are aggregated to develop published levels. On a not seasonally adjusted basis, the sample-based estimates for the year preceding and the nine months following the benchmark also are then subject to revision. Employment estimates for the months between the most recent March benchmark and the previous year's benchmark are adjusted using a "wedge-back" procedure. In this process, the difference between the benchmark level and the previously published March estimate for each estimating cell is computed. This difference, or error, is linearly distributed across the 11 months of estimates subsequent to the previous benchmark; eleven-twelfths of the March difference is added to February estimates, ten-twelfths to January estimates, and so on, ending with the previous April estimates, which receive one-twelfth of the March difference. The wedge procedure assumes that the total estimation error accumulated at a steady rate since the last benchmark. Applying previously derived over-the-month sample changes to the revised March level yields revised estimates for the nine months following the March benchmark (also referred to as the post benchmark period, see Revisions in the post benchmark period). New net birth/death model estimates also are calculated and applied during post benchmark estimation.

Benchmark source material

The principal source of benchmark data for private industries is the Quarterly Census of Employment and Wages (QCEW). The QCEW scope is defined by employment data provided to state employment security agencies by employers covered by state UI laws. BLS uses several other sources to establish benchmarks for the industries partially covered or exempt from mandatory UI coverage, accounting for nearly 3 percent of the nonfarm employment total.

Data on employees covered under Social Security laws, published by the U.S. Census Bureau in County Business Patterns, are used to augment UI data for industries not fully covered by the UI scope, such as Non-office insurance sales workers, child daycare workers, Religious organizations, and Private schools and hospitals. Noncovered employment for state and local government hospitals and educational institutions is based on the Annual Survey of Public Employment and Payroll (ASPEP) conducted by the Census Bureau. Noncovered employment data from these sources are available only on a lagged basis. Extrapolation to a current level is accomplished by applying the employment trends from the UI-covered part of the population in these industries to the noncovered part. Universe data for interstate railroads are obtained from the Railroad Retirement Board. More information on calculating noncovered employment in the CES program is available in the CES Technical Notes at www.bls.gov/web/empsit/cestn.htm#NCE.

Business birth and death estimation

Regular updating of the CES sample frame with information from the UI universe files helps to keep the CES survey current with respect to employment from business births and deaths. However, the timeliest UI universe files available will always be a minimum of six to seven months out of date. The CES survey thus cannot rely on regular frame maintenance alone to provide estimates for business birth and death employment contributions. BLS has researched both sample-based and model-based approaches to measuring birth units that have not yet appeared on the UI universe frame. Since the research demonstrated that sampling for births was not feasible in the very short CES production timeframes, the Bureau is utilizing a model-based approach for this component.

Earlier research indicated that while both the business birth and death portions of total employment are generally significant, the net contribution is relatively small. To account for this net birth/death portion of total employment, BLS is utilizing an estimation procedure with two components. The first component excludes employment losses from business deaths from sample-based estimation in order to offset the missing employment gains from business births. This is incorporated into the sample-based link relative estimate procedure by simply not reflecting sample units going out of business, but imputing to them the same trend as the other firms in the sample. The second component is an Autoregressive Integrated Moving Average (ARIMA) time series model designed to estimate the net birth/death employment not accounted for by the imputation. The historical time series used to create and test the ARIMA model was derived from the UI universe micro level database, and reflects the actual net of births and deaths over the past five years. The net birth/death model component figures are unique to each month and include negative adjustments in some months. Furthermore, these figures exhibit a seasonal pattern similar to the seasonal patterns of the continuing businesses.

Only error from the second component is directly measurable. Error from this component is measured by comparing the actual net of births and deaths from March 2013-14 — once it becomes available — with the model-based estimate. As Table 7 shows, the actual net birth/death for April 2013 to March 2014 was approximately 202,000 above the forecasted amount used in the CES monthly estimates for the time period.

Table 7. Differences between forecasted and actual net birth/death, total private employment, April 2013 – March 2014 (in thousands)

Benchmark 2014	2013									2014			Total
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Actual Net Birth/Death	277	201	129	143	127	-19	164	22	-26	-252	141	64	971
Forecast Net Birth/Death	236	210	140	86	99	-30	159	-11	-12	-307	124	75	769
Difference	41	-9	-11	57	28	11	5	33	-14	55	17	-11	202
Cumulative Difference	41	32	21	78	106	117	122	155	141	196	213	202	

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Availability of revised data

LABSTAT, the BLS public database, contains all historical employment, hours, and earnings data revised as a result of this benchmark, including both not seasonally adjusted and seasonally adjusted data. The data can be accessed at www.bls.gov/ces/, the CES homepage. Some data published on previous dates can be accessed through the CES Vintage data webpage at www.bls.gov/ces/cesvininfo.htm.

Seasonal adjustment procedure

For technical information on how seasonal adjustment is performed in the CES program, refer to the Seasonal Adjustment section of the CES Technical Notes, available at www.bls.gov/web/empsit/cestn.htm#section5e. For more information on seasonal adjustment model specifications and special model adjustments, please see the Seasonal Adjustment Model Specification List section of the CES Seasonal Adjustment Files and Documentation page, available at www.bls.gov/web/empsit/cesseasadj.htm#samodel.

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Appendix D

Revisions in State Establishment-based Employment Estimates Effective January 2014

http://www.bls.gov/sae/benchmark2014.pdf

Revisions in State Establishment-based Employment Estimates Effective January 2014

Vidalina Abadam, Nicole Havins, and Liza Kelly

Introduction

With the release of the payroll employment estimates for January 2014, nonfarm payroll employment, hours, and earnings data for states and areas were revised to reflect the incorporation of the 2013 benchmarks and the recalculation of seasonal adjustment factors for payroll employment estimates. The revisions affect all not seasonally adjusted data from April 2012 to December 2013, all seasonally adjusted data from January 2009 to December 2013, and select series subject to historical revisions before April 2012. This article provides background information on benchmarking methods, business birth/death modeling, seasonal adjustment of employment data, and details of the effects of the 2013 benchmark revisions on state and area payroll employment estimates.

Benchmark methods

The Current Employment Statistics (CES) program, also known as the payroll survey, is a federal and state cooperative program that provides, on a timely basis, estimates of payroll employment, hours, and earnings for states and areas by sampling the population of employers. Each month the CES program surveys about 144,000 businesses and government agencies, representing approximately 554,000 individual worksites, in order to provide detailed industry level data on employment and the hours and earnings of employees on nonfarm payrolls for all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and about 400 metropolitan areas and divisions.[1]

As with data from other sample surveys, CES payroll employment estimates are subject to both sampling and nonsampling error. Sampling error is an unavoidable byproduct of forming an inference about a population based on a limited sample. The larger the sample is, relative to the population, the smaller the sampling error. The sample-to-population ratio varies across states and industries. Nonsampling error, by contrast, generally refers to errors in reporting and processing.[2]

In order to control both sampling and nonsampling error, CES payroll employment estimates are benchmarked annually to employment counts from a census of the employer population. These counts are derived primarily from employment data provided in unemployment insurance (UI) tax reports that nearly all employers are required to file with state workforce agencies. The UI tax reports are collected, reviewed, and edited by the staff of the BLS Quarterly Census of Employment and Wages (QCEW).[3] As part of the benchmark process for benchmark year 2013, census-derived employment counts replace CES payroll employment estimates for all 50 States and the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and about 400 metropolitan areas and divisions for the period of April 2012 to September 2013.

UI tax reports are not collected on a timely enough basis to allow for replacement of CES payroll estimates for the fourth quarter, October 2013 to December 2013. For this period, estimates based on existing sample information are revised using the new series level from census-derived employment counts and updated business birth/death factors.[4]

Special notice regarding industry reclassifications

Each first quarter, the QCEW program incorporates updated industry assignments as they improve their classifications of establishments. Usually reclassifications are spread among industries. In 2013, substantial changes were made to two industries in particular: services for the elderly and persons with disabilities and funds, trusts, and other financial vehicles.

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[1] Further information on the sample size for each state is available at www.bls.gov/sae/sample.htm.

[2] Further information on the reliability of CES estimates is contained in the Technical Note of the latest Regional and State Employment and Unemployment press release and is available at www.bls.gov/sae/news.htm.

[3] Further information on the BLS Quarterly Census of Employment and Wages program is available at www.bls.gov/cew/.

[4] Further information on the monthly estimation methods of the CES program can be found in Chapter 2 of the *BLS Handbook of Methods* and is available at www.bls.gov/opub/hom/pdf/homch2.pdf.

Prior to 2013, UI records from several state-funded programs that provide nonmedical, home-based services for the elderly and persons with disabilities were incorrectly classified under the North American Industry Classification System (NAICS) code for private households (NAICS 814110), which is out of scope for the CES program. As of the first quarter 2013, this employment is now coded in services for the elderly and persons with disabilities (NAICS 624120), which is in scope. The introduction of employment due to a coding change would create large, noneconomic breaks in CES time series data. To prevent these breaks and to properly allocate historic employment, CES worked with QCEW microdata and information from the affected states to reconstruct the histories of the affected series.

Six states were most affected by the reclassification of data in NAICS 624120: California, Massachusetts, Missouri, Nebraska, Texas, and Washington. Education and health services series in these states, and all of the series that include them, are subject to historical reconstructions. (See exhibit 2.)

In a similar reclassification, employment was largely removed from NAICS 525: funds, trusts and other financial vehicles. QCEW staff determined that, because establishments in this classification are legal entities with very little employment, they should be reclassified according to each establishment's primary economic activity. When necessary, series were historically reconstructed to prevent the appearance of economic changes when the underlying cause was noneconomic. The effects of this reclassification were much smaller than those seen with NAICS 624120 and limited to states and areas with detailed level financial services series. Nearly all affected employment remained within the financial services sector, affecting mostly series containing NAICS 522, 523, and 524 but leaving aggregate series largely unaltered.

Business birth/death modeling

Sample-based estimates are adjusted each month by a statistical model designed to reduce a primary source of nonsampling error: the inability of the sample to capture employment growth generated by new business formations on a timely basis. There is an unavoidable lag between an establishment opening for business and its appearance in the sample frame making it available for sampling. Because new firm births generate a portion of employment growth each month, nonsampling methods must be used to estimate this growth.

Earlier research indicated that, while both the business birth and death portions of total employment are generally significant, the net contribution is relatively small and stable. To account for this net birth/death portion of total employment, BLS uses an estimation procedure with two components. The first component excludes employment losses due to business deaths from sample-based estimation in order to offset the missing employment gains from business births. This is incorporated into the sample-based estimate procedure by simply not reflecting sample units going out of business, but rather imputing to them the same trend as the other continuing firms in the sample. This step accounts for most of the birth and death changes to employment.[5]

The second component is an autoregressive integrated moving average (ARIMA) time series model designed to estimate the residual birth/death change to employment not accounted for by the imputation. To develop the history for modeling, the same handling of business deaths as described for the CES monthly estimation is applied to the population data. Establishments that go out of business have employment imputed for them based on the rate of change of the continuing units. The employment associated with continuing units and the employment imputed from deaths are aggregated and compared to actual population levels. The differences between the two series reflect the actual residual of births and deaths over the past five years. The historical residuals are converted to month-to-month differences and used as input series to the modeling process. Models for the residual series are then fit and forecasted using X-12 ARIMA software.[6] The residuals exhibit a seasonal pattern and may be negative for some months. Finally, differences between forecasts of the nationwide

[5] Technical information on the estimation methods used to account for employment in business births and deaths is available at http://www.bls.gov/web/empsit/cesbd.htm.

[6] Further information on the X-12 ARIMA model is available on the US Census Bureau website at http://www.census.gov/srd/www/x12a/.

birth/death factors and the sum of the states' birth/death factors are reconciled through a ratio-adjustment procedure, and the factors are used in monthly estimation of payroll employment in 2014. The updated birth/death factors are also used as inputs to produce the revised estimates of payroll employment for October 2013 to December 2013.

Seasonal adjustment

CES payroll employment data are seasonally adjusted by a two-step process. BLS uses the X-12 ARIMA program to remove the seasonal component of month-to-month employment changes. This process uses the seasonal trends found in census-derived employment counts to adjust historical benchmark employment data while also incorporating sample-based seasonal trends to adjust sample-based employment estimates. By accounting for the differing seasonal patterns found in historical benchmark employment data and the sample-based employment estimates, this technique yields improved seasonally adjusted series with respect to analysis of month-to-month employment change.[7] Seasonally adjusted employment data for the most recent 13 months are published regularly in table D-1.[8]

The aggregation method of seasonally adjusted data is based upon the availability of underlying industry data. For all 50 states, the District of Columbia, and Puerto Rico, the following series are sums of underlying industry data: total private, goods producing, service-providing, and private service-providing. The same method is applied for the Virgin Islands with the exception of goods producing, which is independently seasonally adjusted because of data limitations. For all 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands, data for manufacturing, trade, transportation, and utilities, financial activities, education and health services, leisure and hospitality, and government are aggregates wherever exhaustive industry components are available; otherwise these industries' employment data are directly seasonally adjusted. In a very limited number of cases, the not seasonally adjusted data for manufacturing, trade, transportation, and utilities, financial activities, education and health services, leisure and hospitality, and government do not exhibit enough seasonality to be adjusted; in those cases the not seasonally adjusted data are used to sum to higher level industries. The seasonally adjusted total nonfarm data for all metropolitan statistical areas (MSAs) are not an aggregation but are derived directly by applying the seasonal adjustment procedure to the not seasonally adjusted total nonfarm level.[9]

Variable survey intervals

BLS utilizes special model adjustments to control for survey interval variations, sometimes referred to as the 4 vs. 5 week effect, for all nonfarm seasonally adjusted series. Although the CES survey is referenced to a consistent concept, the pay period including the 12th day of each month, inconsistencies arise because there are sometimes 4 and sometimes 5 weeks between the week including the 12th day in a given pair of months. In highly seasonal industries, these variations can be an important determinant of the magnitude of seasonal hires or layoffs that have occurred at the time the survey is taken.[10]

Combined Areas

BLS currently publishes both seasonally and not seasonally adjusted total nonfarm data for 12 combined areas. For the 2013 benchmark, rather than directly and independently applying the seasonal adjustment factors to the combined areas as in the previous years, the seasonally adjusted data for these 12 areas is derived by summing the seasonally adjusted data from each of their contributing metropolitan divisions or nonstandard areas.[11] Given the availability of longer sample histories, this change in process maintains methodological consistency since the not

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[7] A list of all seasonally adjusted employment series are available at www.bls.gov/sae/saeseries.htm.
[8] Table D-1 can be viewed at www.bls.gov/sae/tables.htm.
[9] A list of BLS standard MSAs is available at http://www.bls.gov/sae/saeseries.htm.
[10] For more information on the presence and treatment of calendar effects in CES data, see www.bls.gov/ore/pdf/st960190.pdf.
[11] The twelve combined areas include 10 Metropolitan Statistical Areas (MSAs) large enough to be subdivided into metropolitan divisions, the New York-White Plains-Wayne, NY-NJ Metropolitan Division which is subdivided into nonstandard CES areas, and Kansas City, MO-KS MSA which is subdivided into nonstandard CES areas. More information on metropolitan divisions and nonstandard areas is available at http://www.bls.gov/sae/saemd.htm and http://www.bls.gov/sae/saenonstd.htm, respectively.

seasonally adjusted data of the combined areas are also the sum of their respective components' not seasonally adjusted data. Accordingly, with the 2013 benchmark, BLS has replaced the seasonally adjusted total nonfarm data for the 12 combined areas back to 1990.

Methodological improvements

Implementation of the Probability Sample Redesign in Puerto Rico
With the release of January 2014 preliminary data, the CES program will complete the implementation of its probability sample redesign for all private industries in Puerto Rico. Probability sampling is the internationally recognized standard for sample surveys and has been utilized in all 50 states and the District of Columbia since 2003. Previously, the CES program used a quota-based sampling technique in Puerto Rico, which was potentially subject to non-negligible biases. Probability sampling ensures a proper representation of the universe of nonfarm business establishments through randomized selection techniques.[12]

Benchmark revisions

Revisions by industry

The magnitude of benchmark revisions is commonly gauged by the percentage difference between the sample-based estimates of payroll employment and the revised benchmark payroll employment levels for March of the benchmark year, presently March 2013. The average absolute percentage revision across all states for total nonfarm payroll employment is 0.4 percent for March 2013. This compares to the average of 0.6 percent for the same measure during the five prior benchmark years of 2008 to 2012. For March 2013, the range of the percentage revision for total nonfarm payroll employment across all states is from -0.7 to 2.9 percent. (See table 1a.)

For December 2013, the average absolute percentage revision for state total nonfarm payroll employment is 0.7 percent. The range of the percentage revision for state total nonfarm payroll employment is from –1.2 to 3.7 percent for December 2013. (See table 1a.)

Absolute level revisions provide further insight on the magnitude of benchmark revisions. Absolute level revisions are measured as the absolute difference between the sample-based estimates of payroll employment and the benchmark levels of payroll employment for March 2013. A relatively large benchmark revision in terms of percentage can correspond to a relatively small benchmark revision in terms of level due to the amount of employment in the reference industry.

[12] Further information on the monthly estimation methods of the CES program can be found in Chapter 2 of the *BLS Handbook of Methods* and is available at www.bls.gov/opub/hom/pdf/homch2.pdf.

Table 1a. Percentage differences between state employment estimates and benchmarks by industry, March 2008–March 2013 and December 2013 (all values in percent)

Industry	Mar 2008	Mar 2009	Mar 2010	Mar 2011	Mar 2012[1]	Mar 2013[2]	Dec 2013[2]
	Average absolute percent differences						
Total nonfarm	0.4	0.9	0.4	0.5	0.7	0.4	0.7
Mining and logging	4.3	6.0	7.5	3.2	4.7	3.7	5.4
Construction	2.6	4.0	3.6	3.2	4.4	3.1	3.7
Manufacturing	1.3	2.2	1.8	1.4	1.5	1.4	1.7
Trade, transportation, and utilities	0.6	1.6	1.2	0.9	1.1	1.0	1.2
Information	2.0	3.3	2.3	2.4	3.2	2.2	3.2
Financial activities	1.0	1.6	1.8	1.9	2.2	1.6	2.1
Professional and business services	1.3	2.2	2.2	1.8	1.9	1.8	2.1
Education and health services	0.8	0.8	1.0	0.9	1.4	1.6	1.7
Leisure and hospitality	0.9	1.7	1.8	1.9	2.3	1.4	1.4
Other services	1.3	1.9	1.9	2.4	2.7	2.1	2.5
Government	0.6	0.6	0.8	0.7	1.0	0.7	1.0
Total nonfarm:							
Range	-1.4 to 1.0	-3.8 to 1.1	-1.3 to 1.4	-1.8 to 1.4	-1.5 to 2.2	-0.7 to 2.9	-1.2 to 3.7
Mean	-0.1	-0.8	-0.1	0.2	0.6	0.3	0.4
Standard deviation	0.5	0.8	0.5	0.6	0.7	0.6	0.8

[1] CES State and Area payroll employment estimates are typically replaced with census derived employment counts through the third quarter of the benchmark year. However, in the 2011 benchmark year, CES estimates were replaced only through the second quarter of 2011 (through June 2011). As a result, the March 2012 benchmark revisions reflect revisions to cumulatively more months of sample-based estimates than is typical, contributing to generally higher rates of revision. For more information, see http://www.bls.gov/sae/benchmark2013.pdf.

[2] The CES estimates in this column are subject to large revisions and historical reconstructions due to substantial reclassifications by the QCEW program in the Financial activities and Education and health services sectors. For more information, see http://www.bls.gov/news.release/archives/cewqtr_09262013.htm or the section of this article titled "Special notice on industry reclassifications."

The following example demonstrates the necessity of considering both percentage revision and level revision when evaluating the magnitude of a benchmark revision in an industry. The average absolute percentage benchmark revision across all states for financial activities and for professional and business services are both 2.1 percent for December 2013. However, for December 2013 the absolute level revision across all states for the financial activities industry is 2,200, while the absolute level revision across all states for the professional and business services industry is 5,800. (See table 1b.) Relying on a single measure to characterize the magnitude of benchmark revisions in an industry can potentially lead to an incomplete interpretation.

Table 1b. Level differences between state employment estimates and benchmarks by industry, March 2008–March 2013 and December 2013 (all values payroll employment)

Industry	Mar 2008	Mar 2009	Mar 2010	Mar 2011	Mar 2012[1]	Mar 2013[2]	Dec 2013[2]
	Average absolute numeric differences						
Total nonfarm	11,500	20,700	7,600	10,200	14,800	16,900	23,900
Mining and logging	600	700	600	500	600	600	900
Construction	3,300	3,700	2,900	3,300	4,200	2,700	3,700
Manufacturing	2,500	3,200	2,000	2,100	2,200	1,500	1,800
Trade, transportation, and utilities	2,800	7,800	4,500	2,800	3,900	3,900	4,600
Information	1,000	1,300	1,200	1,300	1,500	800	1,600
Financial activities	1,800	2,300	2,300	2,600	2,500	2,000	2,200
Professional and business services	6,200	6,500	4,600	4,700	5,500	4,100	5,800
Education and health services	3,100	2,800	2,800	3,000	4,600	12,000	13,000
Leisure and hospitality	2,600	3,500	3,500	3,100	5,200	2,900	2,900
Other services	1,200	1,900	1,600	1,900	2,300	2,000	2,300
Government	2,800	2,200	3,800	3,700	4,100	2,500	4,100
Total nonfarm:							
Range	-112,300 to 44,000	-190,500 to 10,900	-38,700 to 28,900	-15,300 to 57,500	-28,900 to 59,400	-13,700 to 428,200	-20,200 to 564,000
Mean	-5,100	-19,600	-1,700	6,100	13,100	13,800	19,600
Standard deviation	21,000	31,500	11,300	15,300	16,200	60,800	79,600

[1] CES State and Area payroll employment estimates are typically replaced with census derived employment counts through the third quarter of the benchmark year. However, in the 2011 benchmark year, CES estimates were replaced only through the second quarter of 2011 (through June 2011). As a result, the March 2012 benchmark revisions reflect revisions to cumulatively more months of sample-based estimates than is typical, contributing to generally higher rates of revision. For more information, see http://www.bls.gov/sae/benchmark2013.pdf.

[2] The CES estimates in this column are subject to large revisions and historical reconstructions due to substantial reclassifications by the QCEW program in the Financial activities and Education and health services sectors. For more information, see http://www.bls.gov/news.release/archives/cewqtr_09262013.htm or the section of this article titled "Special Notice on Industry Reclassifications."

Revisions by State

For March 2013, 31 states and the District of Columbia revised nonfarm payroll employment upward, while 19 states revised payroll employment downward. (See table 2 or graph 1.) The 20th, 40th, 60th, 80th, and 100th percentiles for March 2013 revisions were -0.2%, 0%, 0.2%, 0.6%, and 2.9% respectively. (See exhibit 1). The nth percentile means that the corresponding revisions is greater than n percent of the rest. For example, the 80th percentile revision in March 2013 is 0.6%, meaning 80 percent of states had revisions less than 0.6%.

For December 2013, 36 states and the District of Columbia revised nonfarm payroll employment upward, while 14 states revised payroll employment downward. (See table 2 or graph 2.) The 20th, 40th, 60th, 80th, and 100th percentiles for December 2013 revisions were -0.2%, 0.2%, 0.5% 1.0%, and 3.7% respectively. (See exhibit 1.)

Revisions for the six states that were historically reconstructed to account for the reclassification of employment in NAICS 624120 may be larger than they would have been without any reclassification. An approximation of what the revisions for those states may have been in March 2013 had the data been classified in 624120 prior to the benchmark is shown in exhibit 2. The "Adjusted CES Estimate" column is the CES published final estimate plus the employment that was reclassified. Removing the approximate impact of the reclassification yields revisions that are more comparable to other states. The "Benchmark Revision" numbers come from table 2.

Table 2. Percent differences between nonfarm payroll employment benchmarks and estimates by state, March 2008–March 2013 and December 2013 (all numbers in percent)

State	Mar 2008	Mar 2009	Mar 2010	Mar 2011	Mar 2012	Mar 2013	Dec 2013
Alabama	-0.6	-1.1	0.3	-0.1	0.6	0.4	1.2
Alaska	0.4	-0.5	-1.3	-0.2	0.8	0.1	1.0
Arizona	-0.4	-0.1	-0.3	0.6	0.3	0.3	0.3
Arkansas	(1)	-0.3	-0.3	-1.1	1.2	-0.5	-0.8
California	-0.3	-1.3	-0.1	(1)	0.3	2.9	3.7
Colorado	-0.2	-0.3	0.5	0.7	0.2	0.5	1.0
Connecticut	0.5	-0.5	-1.3	(1)	0.6	0.2	0.6
Delaware	(1)	0.7	-0.4	0.7	0.1	0.2	0.5
District of Columbia	-0.1	-0.6	-0.4	1.4	-0.8	1.1	1.9
Florida	-1.4	-1.4	-0.2	0.5	0.5	0.3	0.5
Georgia	-0.7	-0.9	0.2	1.4	0.7	(1)	-0.1
Hawaii	-0.3	-1.2	-0.5	(1)	0.5	1.0	0.6
Idaho	-0.1	-1.2	-0.2	-0.4	0.3	0.2	(1)
Illinois	-0.3	-0.3	0.1	(1)	0.7	0.1	-0.1
Indiana	-0.6	-1.3	-0.2	0.7	0.7	-0.2	-0.3
Iowa	0.1	-0.3	-0.5	-0.2	0.8	-0.1	0.9
Kansas	0.5	-0.8	-0.3	1.2	0.9	-0.2	0.4
Kentucky	-1.2	-1.3	-0.4	-0.3	-0.1	-0.3	0.2
Louisiana	-0.5	-1.4	-0.6	0.9	-1.5	-0.1	0.1
Maine	0.3	-0.7	0.3	-0.4	0.3	(1)	0.6
Maryland	-0.8	-0.6	-0.1	1.1	-0.2	-0.4	-0.7
Massachusetts	0.2	0.1	0.9	0.3	1.3	1.2	1.0
Michigan	-0.1	-0.5	0.2	0.2	1.1	0.9	0.7
Minnesota	-0.3	-0.1	-0.4	0.8	0.8	(1)	0.5
Mississippi	(1)	-1.2	-0.1	-0.4	1.1	-0.7	-0.8
Missouri	0.1	-1.1	-0.5	-0.4	0.4	1.1	1.1
Montana	-0.4	-2.4	0.2	-0.7	2.1	0.6	0.5
Nebraska	-0.8	0.1	-0.2	-0.6	1.5	1.3	1.0
Nevada	-0.9	-3.8	-0.6	-0.1	0.4	0.5	1.5
New Hampshire	-1.2	-1.5	-0.7	(1)	0.8	(1)	0.4
New Jersey	0.4	-1.2	-0.1	-0.2	0.3	-0.1	-0.5
New Mexico	(1)	-1.6	-0.1	(1)	-0.2	0.2	0.2
New York	0.3	-0.4	0.3	0.7	(1)	(1)	0.3
North Carolina	-0.3	-0.1	(1)	0.8	0.3	-0.3	0.1
North Dakota	1.0	-0.9	0.8	0.3	2	-0.2	-0.9
Ohio	-0.7	-0.5	(1)	-0.3	0.6	0.9	1.2
Oklahoma	0.7	-1.2	0.1	(1)	1.5	0.4	0.6
Oregon	-0.4	-1.3	0.1	-0.3	0.7	0.2	0.7
Pennsylvania	0.1	-0.4	0.3	0.3	0.4	(1)	-0.1
Rhode Island	0.2	-0.3	1.4	(1)	1.7	0.4	0.3
South Carolina	-0.3	-1.4	-1.2	0.3	0.3	0.2	0.7
South Dakota	0.1	-0.4	-0.1	0.5	1.4	-0.1	-0.9
Tennessee	0.2	-1.3	(1)	0.7	0.8	-0.2	0.1
Texas	0.4	-0.7	(1)	-0.1	0.5	(1)	0.3
Utah	-0.9	-1.9	-0.5	0.2	0.9	-0.2	1.1
Vermont	-0.1	1.1	0.1	-1.8	0.5	0.1	-0.6
Virginia	-0.1	-0.4	(1)	0.5	0.1	0.3	-0.2
Washington	0.3	-0.6	-0.7	0.1	0.1	1.9	2.1
West Virginia	0.1	0.8	0.8	0.4	1	-0.7	-1.2
Wisconsin	0.5	0.4	0.7	0.1	2.2	0.6	0.3
Wyoming	0.6	-1.5	-0.1	0.1	1	0.4	(1)

(1) Less than +/- 0.05 percent

Exhibit 1. Percentiles of Percent Revisions March 2013 and December 2013 (all values in percent)

Percentiles of Percent Revisions	March 2013	December 2013
20th percentile	-0.2	-0.2
40th percentile	0.0	0.2
60th percentile	0.2	0.5
80th percentile	0.6	1.0
100th percentile	2.9	3.7

Exhibit 2. Estimated effect of NAICS 624120 reclassification on March 2013 benchmark revisions (all values in percent)

State	March 2013 Benchmark Revision	March 2013 Adjusted CES Estimate Revision
California	2.9	0.5
Massachusetts	1.2	0.3
Missouri	1.1	0.5
Nebraska	1.3	0.7
Texas	(1)	-0.1
Washington	1.9	0.5

(1) Less than +/- 0.05 percent

Revisions by metropolitan statistical areas (MSAs)

For metropolitan statistical areas (MSAs) published by the CES program, the percentage revisions ranged from –5.3 to 8.1 percent, with an average absolute percentage revision of 1.2 percent across all MSAs for March 2013.[13] (See table 3a.) Comparatively, at the statewide level the range was –0.7 to 2.9 percent, with an average absolute percentage revision of 0.4 percent for March 2013. (See table 1a.) As MSA size decreases so does the sample size, resulting in larger relative standard errors and therefore increasing both the range of percent revisions and the average absolute percent revision. Metropolitan areas with 1 million or more employees during March 2013 had an average absolute revision of 1.1 percent, while metropolitan areas with fewer than 100,000 employees had an average absolute revision of 1.4 percent. (See table 3a.)

For December 2013, the percentage revisions ranged from –5.7 to 9.6 percent, with an average absolute percentage revision of 1.6 percent across all MSAs. (See table 3b.) Comparatively, at the statewide level the range was –1.2 to 3.7 percent, with an average absolute percentage revision of 0.7 percent for December 2013. (See table 1a.) As noted previously, both the range of percentage revisions and the average absolute percentage revision generally increase as the amount of employment in an MSA decreases. Metropolitan areas with 1 million or more employees during December 2013 had an average absolute revision of 1.3 percent, while metropolitan areas with fewer than 100,000 employees had an average absolute revision of 1.8 percent. (See table 3b.)

[13] The CES program published employment series for 372 MSAs in 2013. This number excludes metropolitan divisions and Puerto Rico. A list of BLS standard MSAs is available at http://www.bls.gov/sae/saeseries.htm.

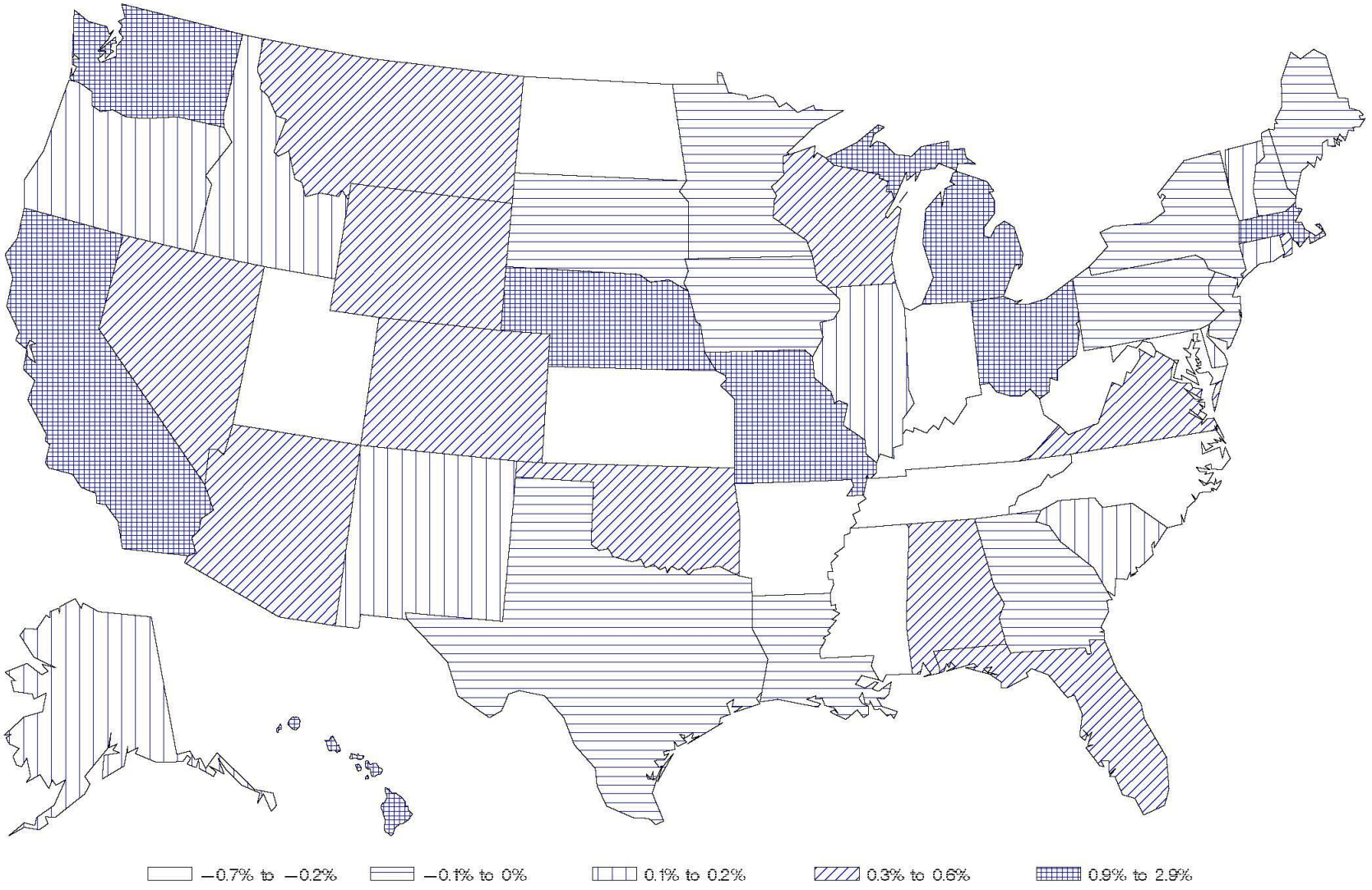
Table 3a. Benchmark revisions for nonfarm employment in metropolitan areas, March 2013

Measure	All MSAs	MSAs grouped by level of total nonfarm employment			
		Less than 100,000	100,000 to 499,999	500,000 to 999,999	1 million or more
Number of MSAs……..	372	181	140	25	26
Average absolute percentage revision…….	1.2	1.4	1.1	0.8	1.1
Range……	-5.3 to 8.1	-5.3 to 8.1	-2.8 to 5.6	-1.1 to 3.8	-1.4 to 4.0
Mean.....	0.4	0.3	0.3	0.6	0.8
Standard deviation……...	1.6	1.8	1.4	1.1	1.4

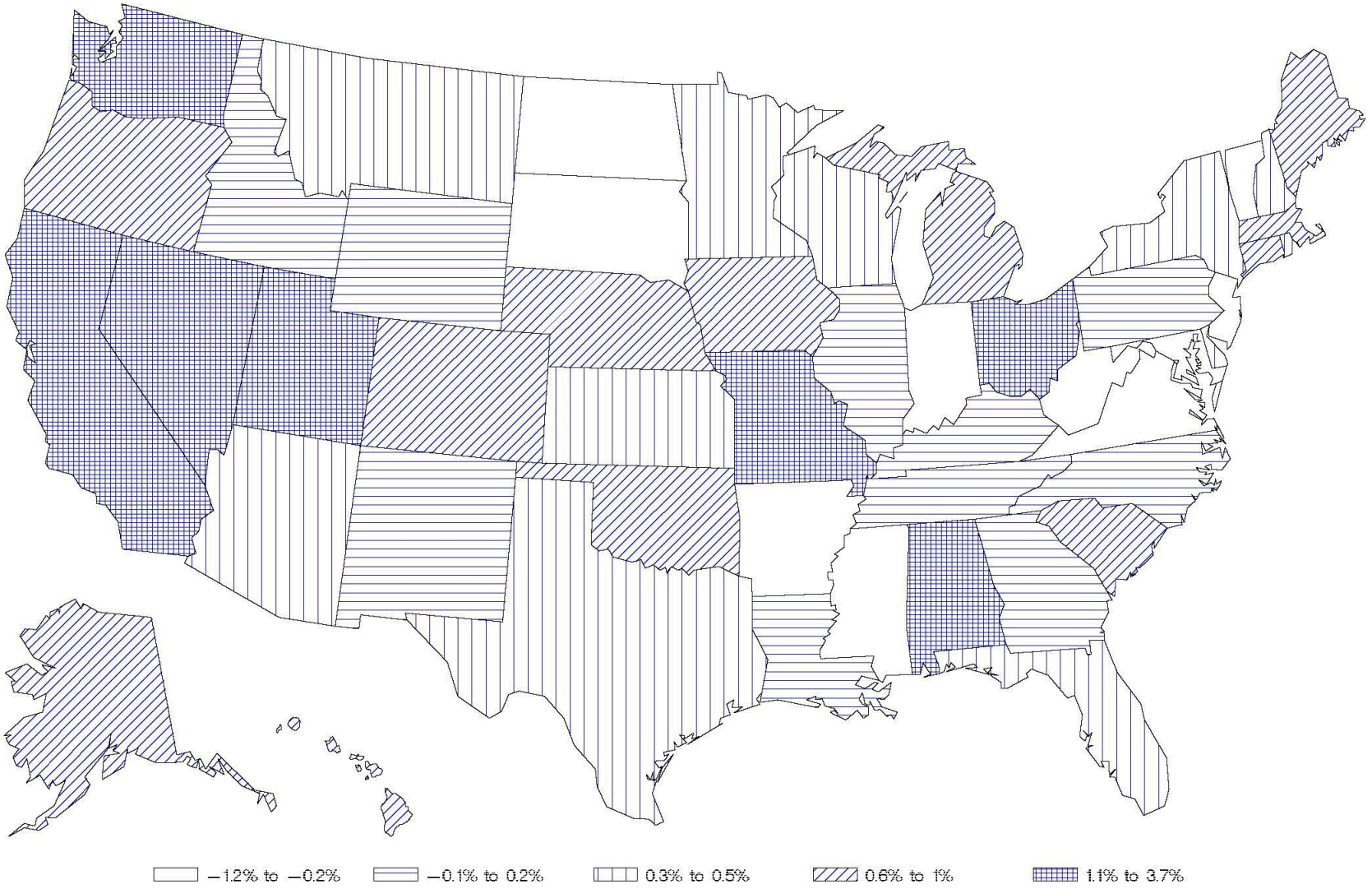
Table 3b. Benchmark revisions for nonfarm employment in metropolitan areas, December 2013

Measure	All MSAs	MSAs grouped by level of total nonfarm employment			
		Less than 100,000	100,000 to 499,999	500,000 to 999,999	1 million or more
Number of MSAs……..	372	181	140	25	26
Average absolute percentage revision…….	1.6	1.8	1.4	1.1	1.3
Range……	-5.7 to 9.6	-5.7 to 9.6	-3.8 to 7.3	-1.3 to 3.6	-1.8 to 5.6
Mean.....	0.6	0.7	0.4	0.9	0.9
Standard deviation……...	2.0	2.3	1.9	1.3	1.7

Graph 1. Percent differences between nonfarm payroll employment benchmarks and estimates by State, March 2013



Graph 2. Percent differences between nonfarm payroll employment benchmarks and estimates by State, December 2013



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Additional information

Historical state and area employment, hours, and earnings data are available on the BLS internet website at the following URL: www.bls.gov/sae. Users may access data by use of retrieval tools available on the BLS internet website. Inquiries for additional information on the methods or estimates derived from the CES survey should be sent by email to ***sminfo@bls.gov***. Assistance and response to inquiries by telephone is available by dialing (202) 691-6559 during the hours of 8:30 am to 4:30 pm EST and Monday through Friday.

Appendix E

A Working Paper Presenting a Profile of Revisions in the Current Employment Statistics Program

Kenneth W. Robertson, Bureau of Labor Statistics

August 2012

http://www.bls.gov/osmr/pdf/ec130070.pdf

BLS WORKING PAPERS

U.S. Department of Labor
U.S. Bureau of Labor Statistics
Office of Employment and Unemployment Statistics

A Working Paper Presenting a Profile of Revisions in the Current Employment Statistics program

Kenneth W. Robertson, U.S. Bureau of Labor Statistics

Working Paper 466
August 2013

A Working Paper Presenting a Profile of Revisions in the Current Employment Statistics program

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Abstract
The Current Employment Statistics (CES) survey, conducted by the U.S. Bureau of Labor Statistics, is a large monthly survey of businesses that produces timely estimates of employment, hours, and earnings by industry and geographic area. The survey produces estimates about three weeks after the week that includes the 12th of the month, and then produces revised estimates for the same reference period as additional responses for that reference period are collected over the next two months. This paper examines the distribution of response by several characteristics, and provides profiles of monthly revisions at the national, state, and metropolitan area level.

Key words: Bureau of Labor Statistics, Current Employment Statistics, response, revisions

1. Background

The U.S. Bureau of Labor Statistics' (BLS) Current Employment Statistics (CES) survey[1] is a monthly business survey that produces timely estimates of employment, hours, and earnings, by industry, for the nation and for states and metropolitan areas. Participating businesses provide data monthly for the pay period that includes the 12th day of the month. Preliminary estimates are published about 3 weeks after the week that includes the 12th of the month, with revised estimates published the following two months. These data are among the first indicators of the health of the U.S. economy at the national, state, and local levels. These statistics are highly valued because preliminary estimates are available very close to the reference period. In order to provide the best estimates possible, the BLS continues to collect data for a reference period for two months following its initial release, and publishes revised estimates that incorporate those additional reports.

Revisions are a design feature of the CES program. There are three sources of revisions for seasonally adjusted data. First, the national data for a particular reference period are revised twice in succession because more responses for that reference period have been collected. State and metropolitan area data are revised in a similar manner, although only once. The second source of revisions to national estimates is due to the use of a concurrent seasonal adjustment process. That is, each month the data are seasonally adjusted with all of the data collected to date. So, for example, the first release of January data is produced using all the data up to and including the preliminary January data. In February, the seasonal adjustment uses the February first release data, and includes revised January data, to calculate (not seasonally adjusted) estimates and new seasonal factors for December, January, and February. Finally, in March, seasonal adjustment is rerun to include preliminary March data, revised February data, and the final January data, to calculate new seasonal factors for January, February, and March. Concurrent seasonal adjustment is being considered for state and metropolitan area data, but it is not yet implemented; therefore, seasonal factors are not recalculated on a monthly basis for these data. Instead, seasonal factors for state and area data are generated once per year using an ARIMA X-12 forecast.

[1] See the end of the paper for references to additional information about the CES survey.

The third reason for revisions to the CES data is the annual benchmarking process. Once a year the estimates are adjusted so that the March data align with population totals. These totals are derived primarily from aggregated Unemployment Insurance reports collected in a federal/state cooperative program by the BLS' Quarterly Census of Employment and Wages (QCEW) program. Along with updates to the population totals, seasonally adjusted estimates are updated for the past 5 years for both national and state data. This paper focuses on revisions of the first type – revisions caused by the collection of additional data for a particular reference period. Note, however, that in some months these effects are commingled. For example, the December 2nd release of state estimates of over-the-month change includes benchmark effects while the 1st release estimates do not.

This document first presents an analysis of revisions at the national level by various characteristics and time periods, for not seasonally adjusted data, and provides a profile of national revisions. It then compares revisions to state estimates over several time periods, and provides a profile of recent revisions at the state and metropolitan area levels.

2. Response Characteristics

This section presents an analysis of response by several characteristics that might lead to revisions. The analyses compare the distribution of collection rates[2] at National 1st, 2nd, and 3rd closing by various characteristics. The term 'closing' refers to the cutoff of data collection associated with a particular release of estimates. Therefore, 1st closing is associated with the first release of data for a reference period, while the 2nd closing is associated with the 2nd release of data for that reference period. The state 2nd (final) closing typically falls after the national 2nd closing and before the 3rd. Since very little microdata are collected between 2nd and 3rd closing, the characteristics examined below for national closings are a good proxy for state and area closings. A response analysis based on unweighted sample reports would treat each report as equally important, regardless of the impact it may have on an estimate, while an analysis by weighted employment highlights the *potential* impact the report may have on the estimate. Note, however, that a report with a large *potential* impact on a revision may have little to no impact if it reports the same over the month trend as reported in aggregate by other responding units at a prior close. The response analyses in this paper are based on weighted employment.

The analysis examines method of collection, industry, employment size, geography, length of pay period, and single or multiple payrolls as characteristics that might potentially impact collection rates, and hence revisions. In the following tables, the collection rates at 1st closing (or publication) pertain only to the reports collected up to that point; over the last five years the survey has collected about 71 percent of the data by the 1st closing. The collection rates presented in the 2nd closing column portray only the responses received after the 1st closing up to the 2nd closing; this has averaged about 20 percent of the data, for a total of about 91 percent collected by this closing. The collection rates presented in the 3rd closing column represent only the responses received after the 2nd closing up to the 3rd closing; this has averaged about 2.4 percent over the last five years. The collection rates presented in the "All Closings" column represent the responses received for all closings, 1st through 3rd, and provide a final response distribution to compare the partial-response distributions against. Data from 2003 – 2012 were used. In 2003 probability sampling was fully implemented in the program, and the data were converted from a Standard Industrial Classification basis to the North American Industry Classification System; older data are not fully comparable.

[2] Collection rate is similar to response rate, except that it excludes businesses in the sample that are permanent refusals.

Method of Collection

CES data collection is multi-modal, that is, multiple methods of collection are used to facilitate the respondent's ease of reporting. The first analysis examines the distribution of response by method of collection.

Based on weighted employment there is a substantial shift in the distribution of collection rates by Collection Method at second closing. This shift is caused by a proportionally large increase in the weighted employment reported by Touchtone Data Entry (TDE) & State Collected units and by Electronic Data Interchange (EDI) units at second close, and by a decrease in employment reported by Computer Assisted Telephone Interviews (CATI). At third close the weighted employment reported by EDI drops, and the proportion of employment reported by CATI increases.

We have no reason to believe that revisions in over the month trends are associated specifically with the method of data collection. If a large company, such as those associated with EDI, report differently than other businesses then they can contribute to revisions; however, this is due to the size of the company, rather than the method used to collect the data.

Table 1. Distribution of Collection Rates by Collection Method and Closing
Based on Weighted Employment

Collection Method	1st Closing	2nd Closing	3rd Closing	All Closings
CATI	22.9%	12.1%	22.0%	20.9%
EDI	8.5%	15.1%	4.2%	9.6%
Web	43.9%	40.4%	41.2%	43.2%
TDE & State Collected	11.9%	19.0%	18.8%	13.4%
Other	12.8%	13.4%	13.8%	12.9%
	100.0%	100.0%	100.0%	100.0%

Industry

The next analysis examines response by industry.

Based on weighted employment and industry, the distribution of collection rates at first, second, and third release do exhibit differences. This is primarily due to substantial proportional increases in response in all sectors of the government.

Table 2. Distribution of Collection Rates by Industry and Closing
Based on Weighted Employment

Industry	1st Closing	2nd Closing	3rd Closing	All Closings
Natural Resources and Mining	0.5%	0.2%	0.1%	0.4%
Construction	4.5%	1.4%	0.4%	3.1%
Manufacturing	9.7%	4.2%	1.1%	6.9%
Wholesale Trade	4.5%	1.8%	0.6%	3.2%
Retail Trade	12.2%	5.8%	1.0%	8.7%
Transportation & Warehousing	3.2%	1.2%	0.3%	2.3%

Utilities	0.4%	0.3%	0.1%	0.3%
Information	1.8%	0.9%	0.2%	1.3%
Financial Activities	6.2%	2.4%	0.6%	4.3%
Professional & Business Services	12.0%	5.7%	1.6%	8.7%
Education & Health Services	15.9%	8.6%	2.0%	11.8%
Leisure & Hospitality	8.5%	4.5%	1.1%	6.3%
Other Services	3.1%	1.1%	0.3%	2.1%
Federal Government	2.4%	9.9%	14.3%	6.2%
State Government	3.6%	15.8%	23.9%	9.9%
Local Government	11.5%	36.2%	52.6%	24.4%
Totals	100.0%	100.0%	100.0%	100.0%

In general, the distribution itself does not provide any real evidence to support a proposition that differing collection rates by industry would lead to revisions. This is particularly the case because the sample is weighted at the industry level, and estimates are produced by industry and aggregated to summary levels. As shown above, however, a large proportion of government employment comes in after the initial release. Government education units can cumulatively have very large over the month changes, on the order of about a million jobs in certain months nationally. This is because of seasonal increases and decreases due to the opening and closing of schools. We impute for the largest of these units at the initial release when they don't arrive in time for a closing, and utilize the reported data in later releases when they arrive. If imputed changes differ substantially from reported changes for these imputed reports, this can lead to large revisions in this industry.

Employment Size Class

The next analysis is by employment size class.

Table 3. Distribution of Collection Rates by Employment Size Class and Closing Based on Weighted Employment

Size	1st Closing	2nd Closing	3rd Closing	All Closings
0-4	10.0%	4.6%	7.4%	8.9%
5-9	6.7%	3.9%	5.2%	6.1%
10-19	10.2%	6.5%	8.2%	9.5%
20-49	8.2%	6.1%	7.4%	7.8%
50-99	10.8%	8.8%	10.3%	10.4%
100-249	8.3%	7.6%	8.0%	8.2%
250-499	7.9%	8.0%	7.8%	7.9%
500-999	23.6%	26.8%	21.6%	24.2%
1000+	10.2%	24.6%	19.4%	13.0%
Blank	4.1%	3.0%	4.7%	3.9%
	100.0%	100.0%	100.0%	100.0%

The distributions of collection rates by employment size class, based on weighted employment, are somewhat different after the first closing. The largest size class (1,000+) has a substantial increase in proportional response at 2nd and 3rd closing, and that leads to a downward shift in the proportional response for other size

classes. There is no indication that a change in the size class response distribution by closing would lead to employment revisions. Furthermore, we have no reason to believe that late reporters in a particular size class would systematically report differently than earlier reporters in that size class. Note, however, that much of the employment in the largest size class is government employment. If these large establishments exhibit economic behavior different from the smaller establishments, then the smaller establishments may not do a good job of representing larger ones that don't report in time for the first release of estimates. Because of these issues, the imputation issues noted for the industry distribution are relevant here as well.

Geographic Region

The next analysis is by geographic region. Note that the regions are defined as shown in the table below.

Midwest Region	North Region	South Region	West Region
Illinois	Connecticut	Arkansas	Alaska
Indiana	Maine	Delaware	Arizona
Iowa	Massachusetts	District of Columbia	California
Kansas	New Hampshire	Florida	Colorado
Michigan	New Jersey	Georgia	Hawaii
Minnesota	New York	Kentucky	Idaho
Missouri	Pennsylvania	Louisiana	Montana
Nebraska	Rhode Island	Maryland	Nevada
North Dakota	Vermont	Mississippi	New Mexico
Ohio	Alabama	North Carolina	Oregon
South Dakota		Oklahoma	Utah
Wisconsin		South Carolina	Washington
		Tennessee	Wyoming
		Texas	
		Virginia	
		West Virginia	

Table 4. Distribution of Collection Rates by Geographic Region and Closing Based on Weighted Employment

Region	1st Closing	2nd Closing	3rd Closing	All Closings
Midwest	23.2%	20.9%	20.0%	22.7%
North	18.5%	14.5%	16.8%	17.7%
South	35.7%	36.6%	36.8%	35.9%
West	22.5%	28.0%	26.4%	23.6%
	100.0%	100.0%	100.0%	100.0%

The response distributions by geographic region, based on weighted employment, are very similar at each closing. There is no indication that these minor changes in distribution by closing would lead to over the month revisions. Further, we have no reason to believe that reporters in different regions would have different trends at later releases than they would for the initial release.

Length of Pay Period

The next analysis is by length of pay period[3].

Table 5. Distribution of Collection Rates by Length of Pay Period and Closing Based on Weighted Employment

Length of Pay Period	1st Closing	2nd Closing	3rd Closing	All Closings
Each Week	40.8%	42.1%	42.2%	41.8%
Every Two weeks	41.5%	40.3%	40.3%	40.6%
Twice a Month	13.7%	12.8%	12.8%	13.0%
Once a Month	4.1%	4.8%	4.8%	4.6%
	100.0%	100.0%	100.0%	100.0%

The distributions by length of pay period, based on weighted employment, are very similar at each closing. Therefore, there is no indication that response differences based on this characteristic lead to over the month revisions.

Single or Multiple Payrolls

The final analysis is by single and multiple payrolls; some businesses keep separate payroll reports, for example, for salaried and hourly workers.

Table 6. Distribution of Collection Rates by Multi-Pay and Closing Based on Weighted Employment

Multiple Payrolls	1st Closing	2nd Closing	3rd Closing	All Closings
No	95.2%	95.2%	95.1%	95.2%
Yes	4.8%	4.8%	4.9%	4.8%
	100.0%	100.0%	100.0%	100.0%

The distributions of collection rates for single and multiple payroll reporters, based on weighted employment, are very similar at each closing. Therefore, there is no indication that response differences based on this characteristic lead to revisions in employment estimates.

In summary, this response analysis does identify substantial differences in the distribution of late responders by method of collection and by industry. Minor differences are identified for the other variables included in this response analysis; employment size class, geographic region, length of pay period, and single / multiple payrolls. The differences in distribution by method of collection, except for Electronic Data Interchange (EDI), are not known to be associated with revisions. The EDI units are very large multi-state multi-worksite companies. Given their size they may have a substantial influence on an industries employment change if their over-the-month change is different from the industry average. Differences in response by industry are mostly caused by later responses in the government sector. In both cases, if a large business reports at a later closing differently than the imputed value for that report, then that difference can lead to revisions.

[3] Note that a subset of businesses provide CES with the length of the pay period; this is businesses that also provide hours and earnings data to the program.

3. Profile of National Revisions

This section presents a profile of national revisions, using data from January 2003 through November 2012.

3.1 General Profile of National Revisions

The revisions for national Total Nonfarm (TNF) employment, from 1st to 3rd release, are typically small and are centered near zero. At the 75th percentile, the absolute size of revisions is 66,000 which is 0.05 percent of TNF employment. Therefore, 75 percent of the national revisions to TNF employment are 0.05 percent of TNF employment or less. At the 95th percentile, the absolute revision is 129,000, which is about 0.10 percent of TNF employment[4]. For most surveys this would be an astonishing level of accuracy – but the statistic of most interest is not the level of TNF, but rather the over-the-month (OTM) change to that level. The OTM change to the level is, of course, much smaller; it has ranged in absolute value from 0 to 830,000 (seasonally adjusted) from January 2003 through November 2012.

Table 7. National Distribution of Absolute Revision (from 1st to 3rd release) of Total Nonfarm (TNF) employment, as a Percentage of TNF employment

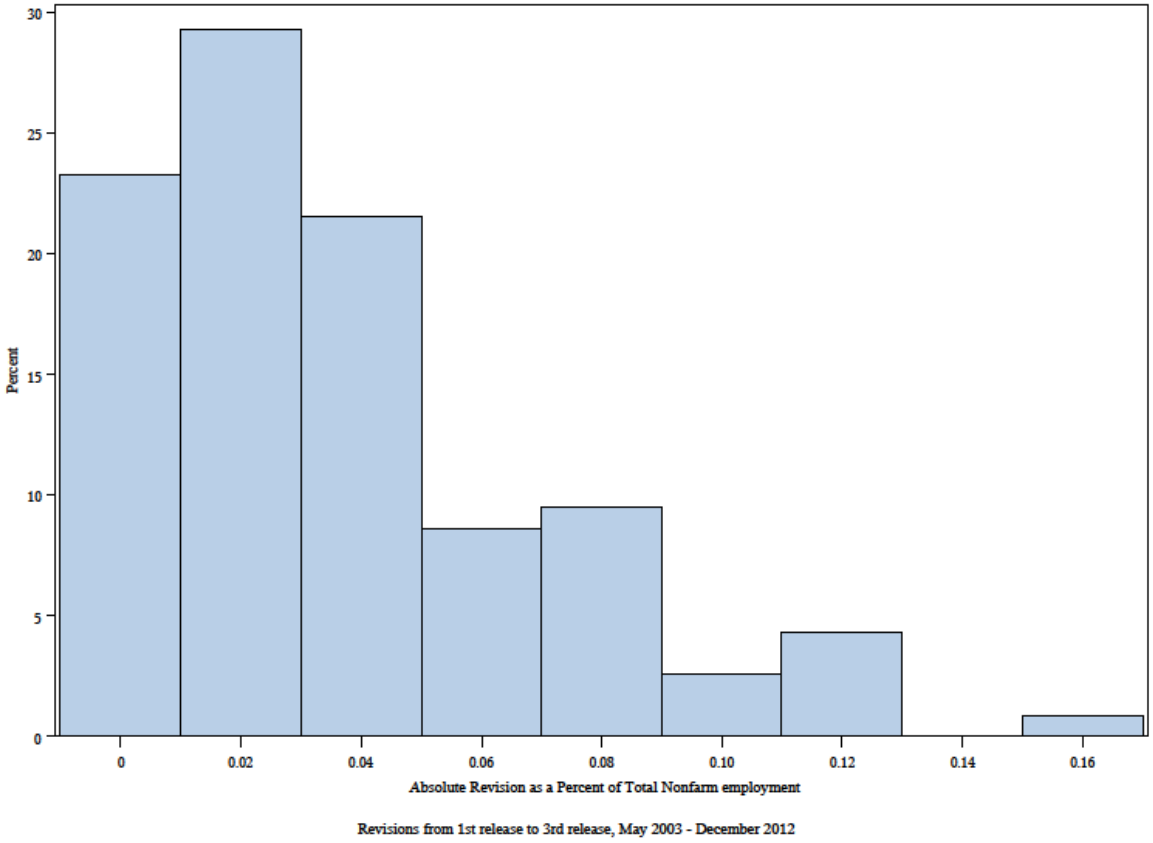
Percentile	Absolute Revision (in thousands)	%TNF
25	15	0.01%
50	38	0.03%
75	66	0.05%
90	115	0.09%
95	129	0.10%
99	169	0.13%

Another way to display this is with a histogram of the distribution of absolute revisions as a percent of Total Nonfarm employment.

As seen in the charts below, about 96 percent of the absolute revisions from 1st to 3rd release are less than 0.1 percent of Total Nonfarm employment.

[4] National Total Nonfarm (TNF) annual average employment for 2012, not seasonally adjusted, was 133,739,000.

Chart 1. Distribution of National absolute revisions



Another way to characterize revisions is to present the revisions as they relate to the standard error of the 1-month change. Note that this is not a measure of the standard error of the revision, but rather how the revision relates proportionally to a measure of reliability for the survey-based estimate. The ratio of the revision to the standard error can serve as a measure of relative importance of the size of a revision – if a revision is about the size of a significant OTM change at a high level of confidence, then the revision might be characterized as 'large'. A 'large' revision is one that substantively changes the picture of the state of the economy for a reference period, after considering the reliability of the estimate.

Table 8. National data – proportion of revisions compared to standard error of OTM change

Standard Errors	OTM employment change significant at the specified level of confidence	Proportion of revisions ≤ this value
1.282 (80% Confidence Interval)	71,000	60.7%
1.645 (90% Confidence Interval)	92,000	78.6%
1.960 (95% Confidence Interval)	109,000	93.2%
2.576 (99% Confidence Interval)	144,000	95.7%

As shown in Table 8, if we were to use a 95 percent level of confidence as a yardstick, we would identify a revision of 109,000 or greater as 'large'. About 93 percent of the revisions during the period studied would not be classified as large under this definition. If we were to set the measure using a 90 percent level of confidence,

then we would identify a revision of 92,000 or greater as 'large'; about 79 percent of the revisions during this period would not be classified as large using this definition.

3.2 Profile of National Revisions for selected time periods

This section presents a profile of national revisions, using data from January 2003 through November 2012, for time periods defined as expansions and contractions by the CES Total Nonfarm series. The time periods examined are defined as follows.

Time Period	Dates	Expansion or Contraction
1	September 2003 – January 2008	Expansion
2	February 2008 – February 2010	Contraction
3	March 2010 – December 2012	Expansion

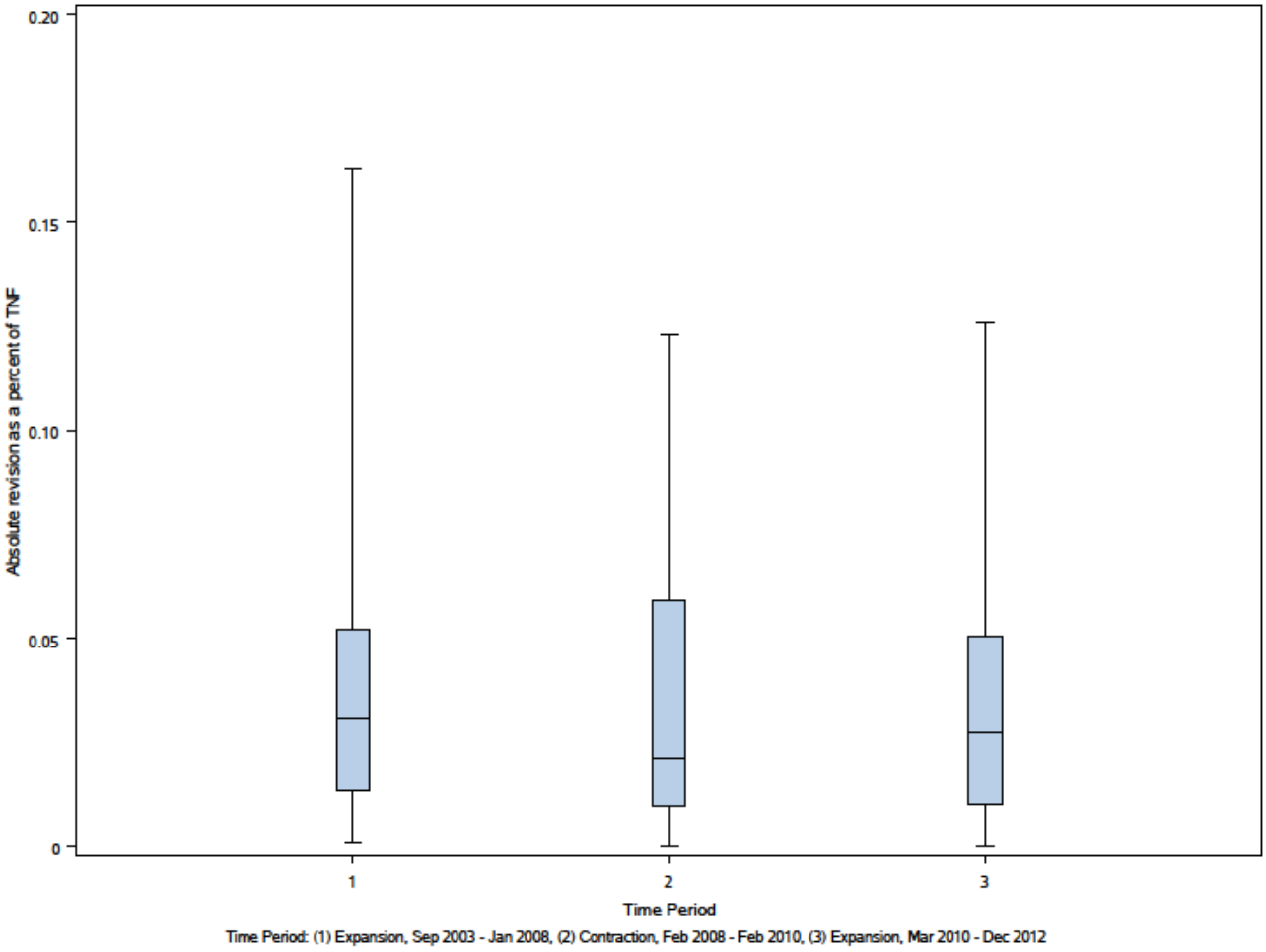
December 2012 is not the end of the final expansion period; rather it is the endpoint of the data for this analysis.

Table 9. Percentile distribution of national absolute revisions to Total Nonfarm employment as a percent of TNF, by Time Period

	Percentiles					
Time Period	**25th**	**50th**	**75th**	**90th**	**95th**	**Max**
1	0.01	0.03	0.05	0.08	0.12	0.16
2	0.01	0.02	0.06	0.09	0.09	0.12
3	0.01	0.03	0.05	0.09	0.13	0.13

The information in Table 9 can also be depicted as boxplots; see below.

Chart 2. Distribution of revisions to Total Nonfarm (TNF) as a percent of TNF employment



As shown in the table and by the boxplots above, the absolute revisions for these time periods are similar. The middle period – from February 2008 through February 2010 – has a bit broader inter-quartile range for the over-the-month revisions than the two expansionary periods.

4. State Revisions

4.1 A Comparison of State Revisions Over Time

State CES estimates are produced using the same sample reports as the national estimates; however, the data collection period for state estimates is a few days longer than it is for the national estimates. State CES revisions include the same revision sources as national CES data, except for the use of a concurrent seasonal adjustment procedure.

The state and metropolitan area part of the CES program has undergone a number of substantive procedural changes in the past few years, so we evaluate whether those changes had a substantial impact on the average size

of revisions. Prior to April 2011 these CES estimates were produced by state government staff in State Workforce Agency offices in cooperation with the BLS[5]. There were several procedural changes in the estimates production and review process that led up to the transition of production responsibility to BLS. In December 2008, the program implemented a more rigorous estimates review procedure, which required states to document and obtain approval for an estimate that deviated significantly from an independently developed, un-reviewed sample-based estimate. In November 2009, BLS implemented a refined version of that process, implemented within the estimation software. In April 2011, BLS assumed responsibility for the production of state and metropolitan area CES data.

The first analysis of these state data examines revisions across these different periods. For the analysis we take as the baseline the revisions produced by state staff from January 2003 through November 2008.

Table 10. Absolute revisions from 1st release to 2nd release for State's Total Nonfarm (TNF) employment, as a percentage of TNF

Median of State's median absolute percent revisions		Absolute Percentage Revision
State Estimates: Original Procedures	Jan 2003 - Nov 2008	0.06
Simulated Estimates (1)	Jan 2003 - Nov 2008	0.09
New Review Procedures (2)	Dec 2008 - Oct 2009	0.08
New Procedures in ACESWeb (3)	Nov 2009 - Feb 2011	0.08
BLS Producing Estimates (4)	Mar 2011 - Mar 2013	0.07
Simulated Estimates (1)	Mar 2011 - Mar 2013	0.08

(1) Simulated estimates are for Total Private industries, others are for Total Nonfarm
(2) Implementation of new review procedures began outside of the (ACESweb) processing system with the November 2008 final estimates
(3) Implementation of refined robust procedures in ACESweb implemented with October 2009 final estimates
(4) Estimates production transitioned from states to BLS with the production of March 2011 preliminary estimates

Table 10 provides a comparison of the median of the state's median absolute revisions[6] for different time periods. The first two rows compare state published revisions with a set of simulated revisions. The simulated revisions include an automated procedure to identify outliers, compared to a manual procedure utilized at this time by the states. The simulated estimates also include an imputation for key non-respondents, which was informally and manually utilized in the estimates during this period. For industry super-sectors where it is currently used, the Faye-Herriot estimator was used to produce the simulated estimates. The simulated estimates exclude adjustments for local events not captured in the sample (e.g. a strike); however, while these adjustments would impact the quality of the estimate, they would have little if any effect on the revision to the over-the-month change. The causes of differences between the published and simulated revisions during the first time period are not fully understood, but there are several potential issues. The data sets used to create the simulated estimates are unlikely to be exactly what the states used – different data may have been included or excluded. Also, the set of reports identified as atypical may have been different in each case; atypical reports are reweighted to account only for themselves. In many cases, states applied ad-hoc adjustments in an effort to improve the estimates – these ad-hoc adjustments were not included in the simulated estimates.

[5] For more information see *References*, item [4].
[6] For Table 10, first each State's median revision was calculated, and then the median of that set of median revisions was identified. The result is very close to an overall median, but ensures that each state median is part of the final calculation.

Simulated estimates were also prepared for the more recent time period being reviewed. Simulations for the more recent period, in addition to the adjustments and models mentioned above, include an adjustment to account for differential response rates. This procedure reweights reports to account for differences in industry response rates. The inclusion of this adjustment is expected to have a minor impact on the overall results. Simulated estimates for the most current period are closer to the published estimates than simulated estimates for the earlier period. This is not surprising, as both the published and the simulated estimates utilize an automated procedure to identify and reweight outliers, both use an imputation for key non-respondents, both utilize the Faye-Herriot estimator for smaller super-sectors, and both utilize an adjustment to account for differential response rates.

During the periods when the estimation process was being modified, BLS worked closely with state staff to identify the types of ad-hoc adjustments that states had periodically incorporated into the estimation process to account for unusual events and results. BLS now has standardized procedures that account for the adjustments that were found to be statistically sound and that state staff believed were most important. BLS continues to work with state staff via the Workforce Information Council and the CES Policy Council to explore additional improvements to the estimation process.

The data in Table 10 show that there was a noticeable increase in the median of the state's median absolute revisions for the set of statewide Total Nonfarm estimates, from the base time period to the following time periods. This is most noticeable during the periods when the procedures were evolving – the revisions are now similar in size to those made during the use of the original procedures.

It is also informative to examine these distributions in graphical form. The boxplots in Chart 3 below show that these are distributions with long tails. In the first time period, we see the tail extends to an absolute revision of about 4.5 percent and in the latest period it extends to a value near 4 percent. These values represent outliers. In order to better see the main body of the distribution, the absolute values of the revisions were censored at a value of 0.2 percent; the censored distributions are presented in Chart 4.

Chart 3. Distribution of absolute revisions from 1st to 2nd release of Statewide Total Nonfarm employment

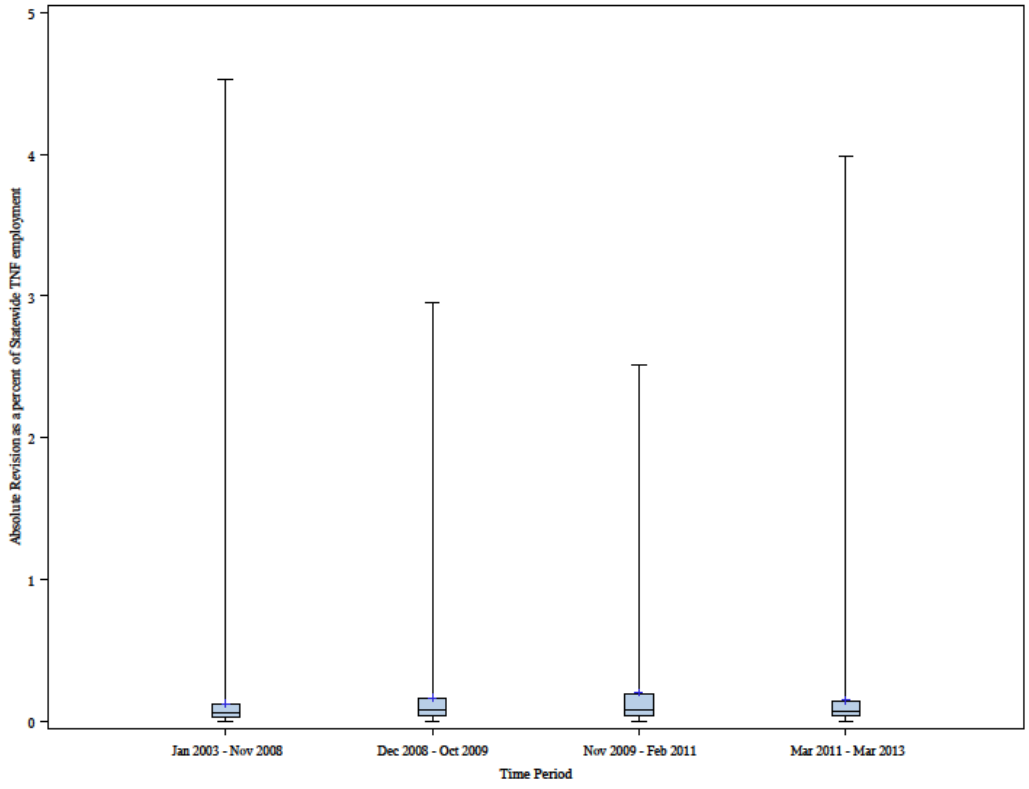
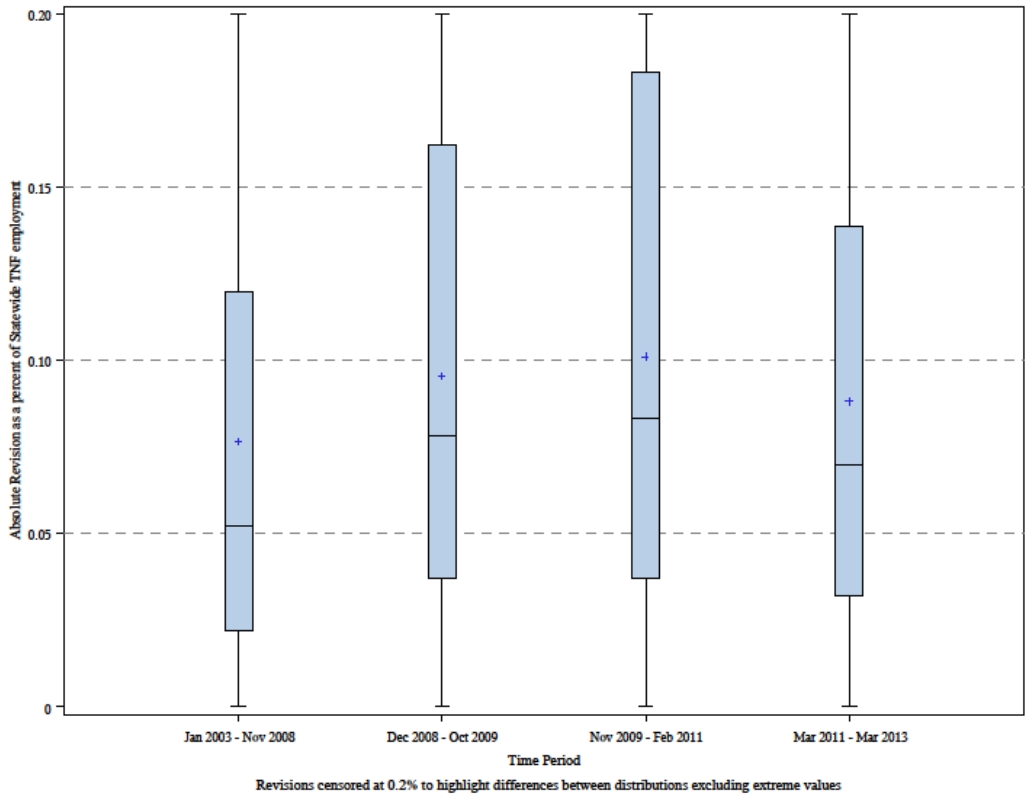


Chart 4. Distribution of absolute revisions from 1st to 2nd release of Statewide Total Nonfarm employment



The censored distributions in Chart 4 make it is easier to see the major features of these distributions, including the mean, and the 25th, 50th, and 75th percentiles. The mean is represented by the "+", the 25th percentile is the lower edge of the box, the median is the line inside the box, and the 75th percentile is the upper edge of the box. The distribution for the current period is shifted to marginally higher values for these key percentiles than is the distribution for the base time period, but the values are similar, and are lower than the values observed during the two periods where procedures were being actively developed. The improvement can be attributed in large part to incorporation of estimation features to account for nonresponse of key sample members (who may then report in time for the second estimate) and to account for extreme macro outliers. In the latter procedure, if the over-the-month (OTM) employment change exceeds pre-determined parameters and is unlike similar OTM estimates in other areas, a composite (sample plus model) estimate is used in place of the sample-based estimate.

Given the marginal increase in TNF revisions between the first time period and the current period, an examination of the distributions by industry super-sector might help to identify if any particular super-sector is the major source of the increased size of revisions at the total nonfarm level.

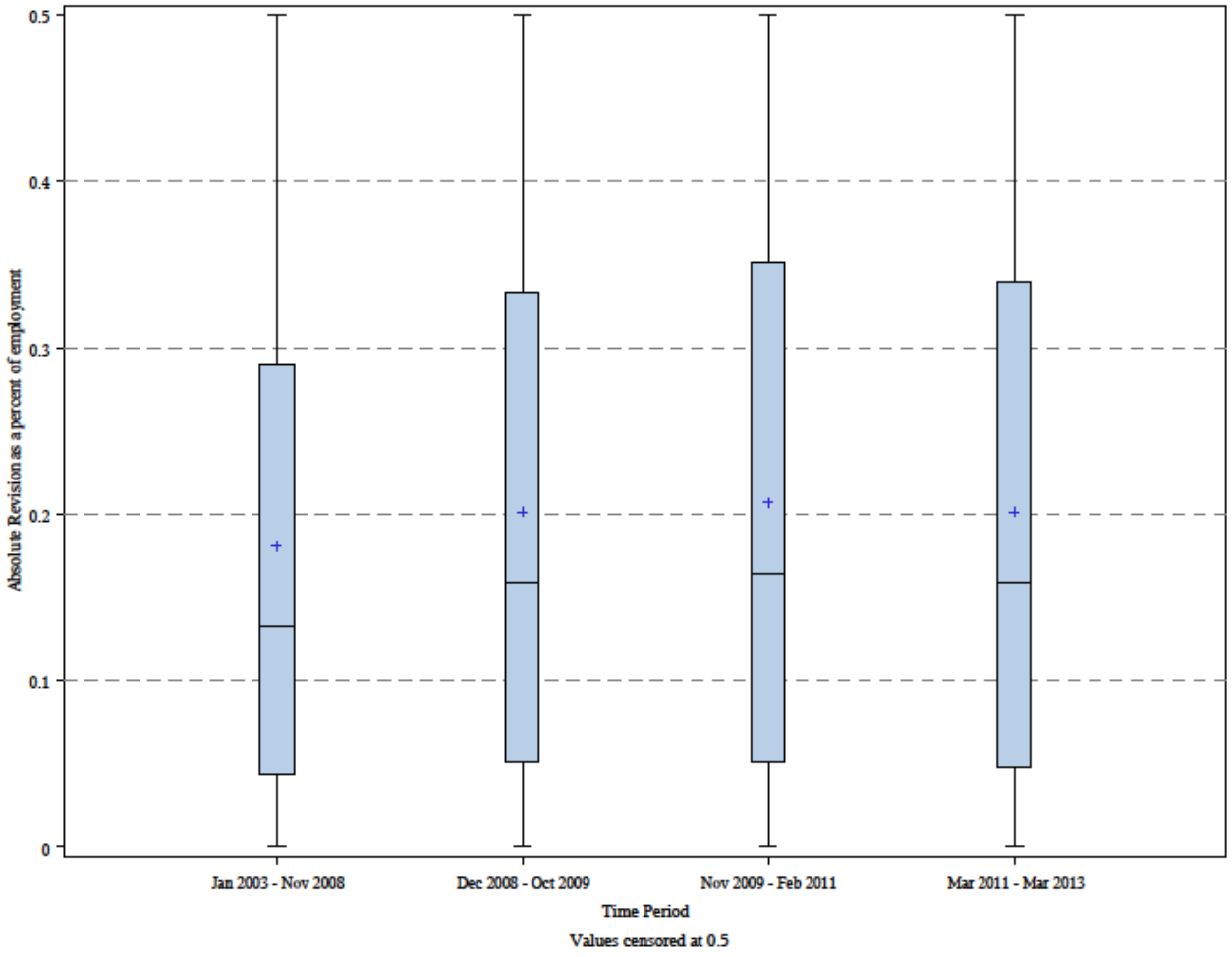
Table 11. Percentile distribution of absolute revisions from 1st to 2nd release, by industry, for initial and current time periods

	Percentiles											
	Jan 2003 – Nov 2008						Mar 2011 – Mar 2013					
Industry	**P25**	**P50**	**P75**	**P90**	**P95**	**P99**	**P25**	**P50**	**P75**	**P90**	**P95**	**P99**
Mining & Logging	0.0	0.0	0.9	2.9	5.0	5.0	0.0	0.0	1.4	5.0	5.0	5.0
Construction	0.1	0.2	0.6	1.4	2.6	5.0	0.1	0.3	0.7	1.3	2.7	5.0
Manufacturing	0.0	0.1	0.3	0.8	1.4	3.9	0.0	0.1	0.3	1.3	5.0	5.0
Trade, Transp. & Utils	0.2	0.5	1.2	2.5	4.3	5.0	0.2	0.6	1.1	2.5	4.7	5.0
Information	0.0	0.1	0.6	1.4	2.5	5.0	0.0	0.2	1.6	5.0	5.0	5.0
Finance	0.0	0.1	0.3	0.7	1.1	3.2	0.0	0.1	0.3	0.8	1.8	5.0
Prof. & Bus. Services	0.0	0.1	0.3	0.7	1.3	4.3	0.1	0.2	0.4	1.0	1.7	4.4
Education & Health	0.0	0.1	0.2	0.5	0.8	1.9	0.1	0.1	0.3	0.7	1.6	5.0
Leisure & Hospitality	0.0	0.1	0.3	0.7	1.2	3.1	0.1	0.2	0.4	0.9	1.8	4.7
Other Services	0.0	0.1	0.4	0.9	1.4	4.3	0.0	0.2	0.5	1.0	1.9	5.0
Government	0.0	0.1	0.3	0.6	1.0	2.2	0.0	0.1	0.3	0.8	1.5	3.0

In Table 11 we see minor differences in most industries between these two time periods; these minor differences tend to be small increases in the absolute size of revisions in the current time period. However, two industries appear to have a substantial increase in absolute revisions between the initial time period and the current time period: *Mining and Logging*, and *Information*. For these two industries the size of revision at the 75th and 90th percentiles are substantially larger in the current time period. *Manufacturing* has the upper end of the revisions distribution more skewed toward large revisions in the current timeframe than in the initial period; a 1.4 percent revision was found at the 95th percentile in the base period and a 1.3 percent revision was found at the 90th percentile in the current period.

Similar to the statewide data, an examination of the absolute value of revisions to Total Nonfarm employment between the 1st release and the 2nd release for Metropolitan Statistical Areas (MSAs) shows a modest increase in the size of revisions from the initial period to the current period.

Chart 5. Distribution of MSA absolute revisions as a percent of employment



With the production of March 2011 estimates in April 2011, BLS assumed responsibility for the production of state and MSA estimates, and in doing so completed the implementation of new estimation and review procedures. The new procedures include a methodology that automatically identifies and accounts for outliers based on statistical criteria, automated imputation procedures that account for key non-respondents[7], and consistent and transparent procedures to account for other non-sample adjustments (e.g. to account for a strike in businesses not in the survey). Based on this analysis of revisions over time, we conclude that, on average, the newly implemented procedures result in published revisions that are somewhat larger on average than those published during the baseline period. It appears that state-produced estimates included ad-hoc adjustments – currently undefined – that resulted in somewhat smaller revisions to the over-the-month change. However, BLS is confident that the current procedures produce estimates (and revisions) that reflect the properties of the

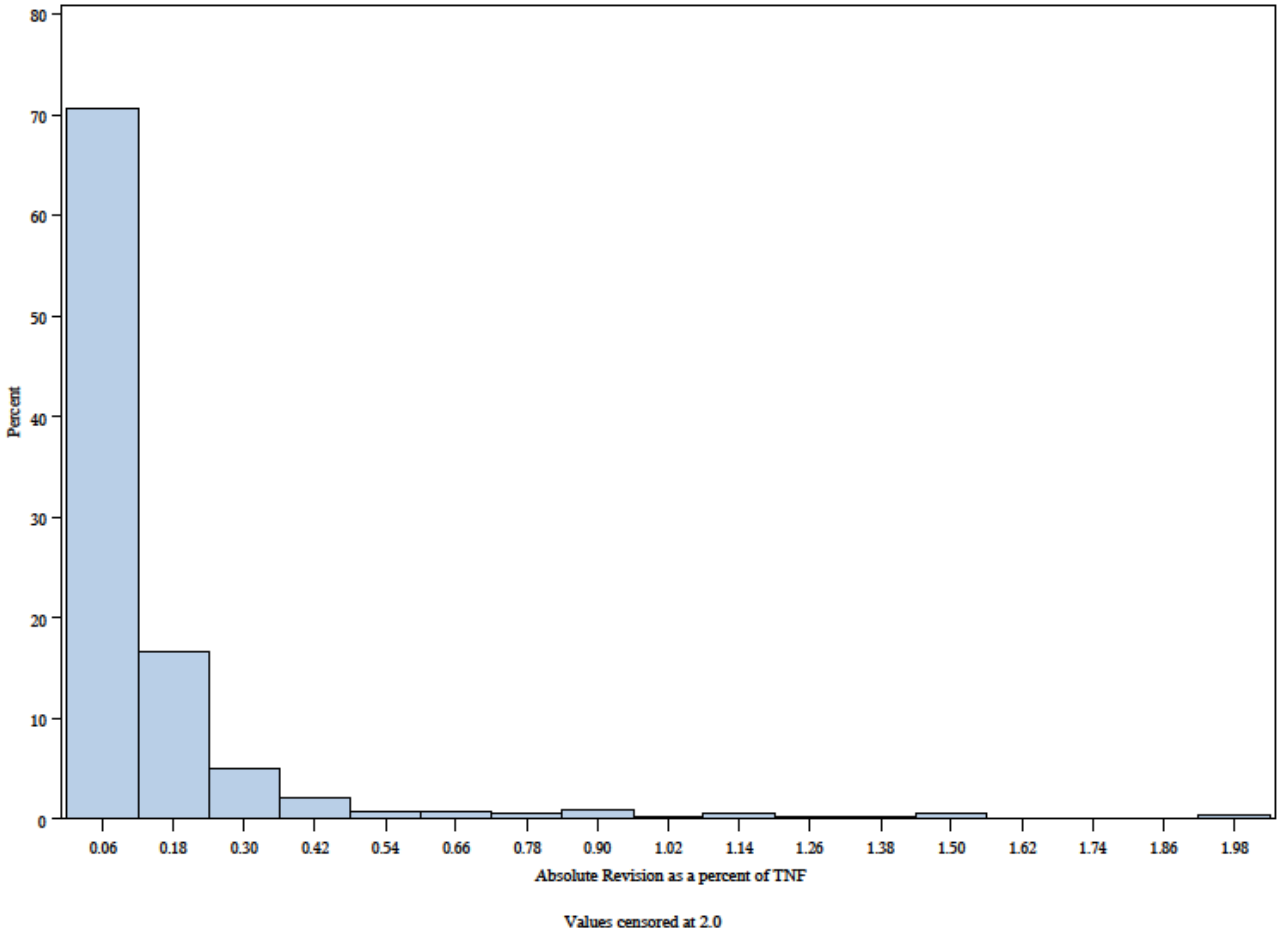
[7] Kennon Copeland and Lan Pham's research – *References* item [5] – laid the groundwork for the key non-respondent imputation procedure implemented by CES.

collected sample data, incorporating only well documented and transparent adjustments to account for non-sample factors. BLS continues to work with state staff, through the Workforce Information Council (WIC) and the CES Policy Council, to utilize their experience with these data to identify and prioritize research to improve the estimation and imputation procedures for the survey.

4.2 Profile of State Revisions to Total Nonfarm Employment

This section will provide a profile of state revisions, from the more recent period. First, we will take a look at revisions over this period as a percent of employment. The following chart includes estimates for statewide Total Nonfarm (TNF) employment.

Chart 6. Distribution of Statewide absolute revisions to Total Nonfarm as a percent of employment



The absolute percent revisions to statewide Total Nonfarm employment tend to be small, with the majority of revisions smaller than 0.1 percent of employment, and about 90 percent of the revisions less than 0.3 percent. Note, however, that there are a few revisions that are large, exceeding 2 percent of the associated employment level.

Table 12. Comparison of national and State distributions of absolute revisions, for total nonfarm (TNF) employment.

Percentile	National %TNF	State %TNF
25	0.01%	0.03%
50	0.03%	0.07%
75	0.05%	0.14%
90	0.09%	0.29%
95	0.10%	0.56%
99	0.13%	1.50%

In the table above we compare national and state absolute revisions to the total nonfarm estimate, as a percentage of total nonfarm employment. In this comparison state revisions tend to be larger than national revisions as a percentage of the associated employment. This is not unexpected. While the national and state estimates are independently derived at different points in time, one can still conceive of the national revision as approximating a sum of revisions to state data, with some of those revisions offsetting others. That is, some of the individual state revisions would be positive in a given month, and some would be negative, so the net revision would be smaller than the absolute sum of those revisions. Therefore, it is not surprising that national revisions tend to be smaller from this perspective than state revisions.

Another way to evaluate state revisions, as was done with the national revisions, is to see how they relate to the standard error of the change in employment. A revision of any size changes the level of significance of the OTM change; a larger revision has a correspondingly larger effect on the level of significance. If the revision to the state data is larger than a significant over-the-month change, then we might appropriately label the revision as 'large'. As with national data, a large revision is one that alters the data user's evaluation of the state of the economy, after taking into the account the level of reliability of the survey estimates.

Table 13. National and State absolute revisions for total nonfarm (TNF) employment – proportion of revisions compared to standard error of OTM change

National Standard Error	State Standard Error	Proportion of revisions ≤ this value
0.3	0.2	25%
0.7	0.3	50%
1.2	0.6	75%
2.1	1.3	90%
2.3	2.4	95%
3.0	5.0	99%

Table 13 presents information on how the revision between the 1st and 3rd release of national estimates compares to the revision between the 1st and 2nd release of state estimates of Total Nonfarm employment. The distributions are quite similar, with the exception that the most extreme values are larger for state revisions. Nearly 90% of the revisions for state estimates are less than the size of the standard error associated with the over-the-month change in employment. In general, we would not label these revisions as "large". A small number of state estimates – about 5 percent –experienced revisions during this time period that would be labeled as large. Similarly, about 5 percent of national revisions would be labeled as large.

4.3 Profile of State Revisions to Industry Super-Sector Employment

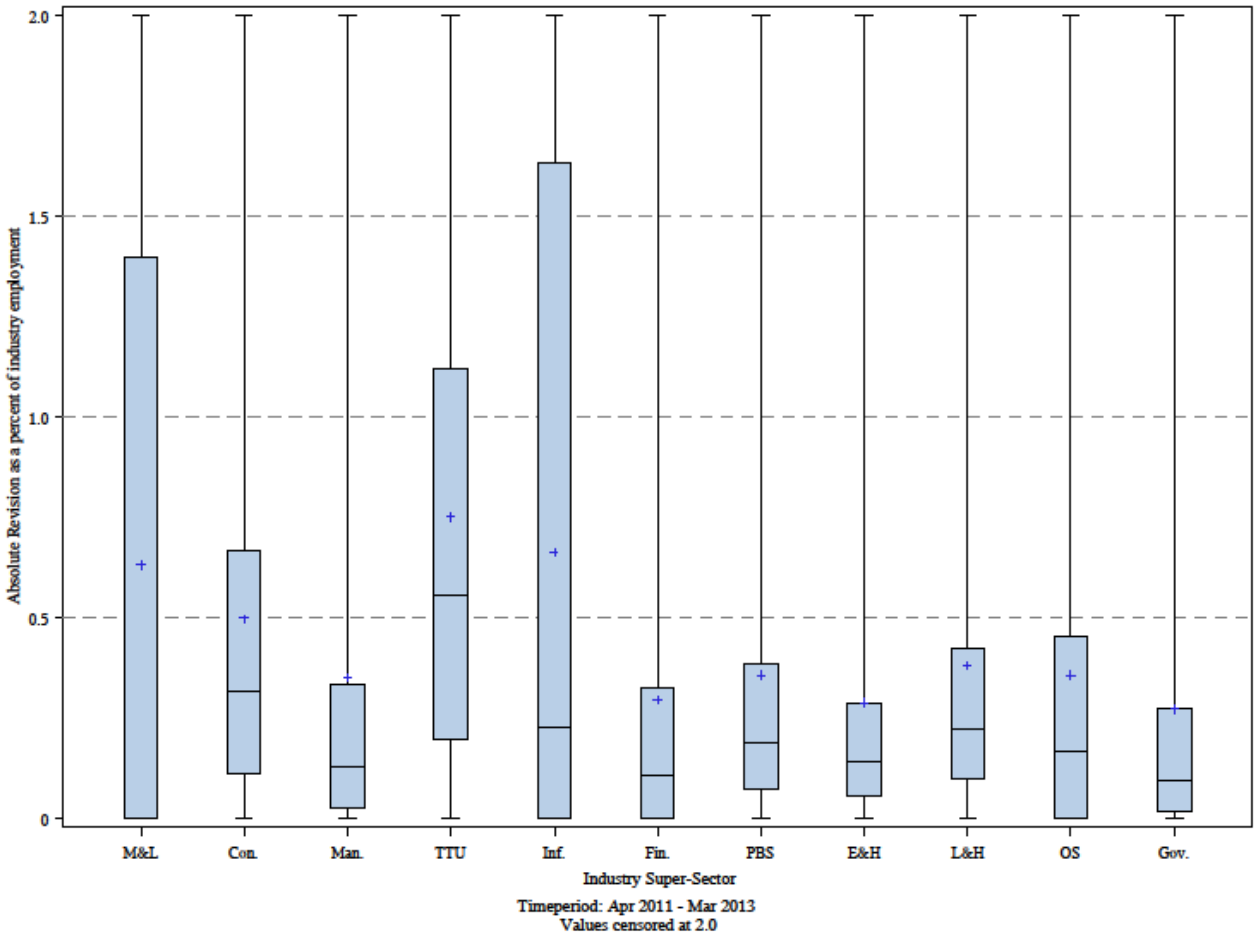
This section will provide a profile of revisions, from the most recent period, for statewide industry super-sectors.

Table 14. Percentile distribution of revisions from 1st to 2nd release as a percent of employment

	Percentile				
Industry	**25**	**50**	**75**	**90**	**95**
Mining and Logging	0.0	0.0	1.4	5.0	5.0
Construction	0.1	0.3	0.7	1.3	2.7
Manufacturing	0.0	0.1	0.3	1.3	5.0
Trade, Transp. & Utils	0.2	0.6	1.1	2.5	4.7
Information	0.0	0.2	1.6	5.0	5.0
Finance	0.0	0.1	0.3	0.8	1.8
Prof. and Business Services	0.1	0.2	0.4	1.0	1.7
Education and Health	0.1	0.1	0.3	0.7	1.6
Leisure and Hospitality	0.1	0.2	0.4	0.9	1.8
Other Services	0.0	0.2	0.5	1.0	1.9
Government	0.0	0.1	0.3	0.8	1.5

Table 14 shows that for most industries, revisions are small to moderate for about 90 to 95 percent of revisions. The main exceptions to this are *Mining and Logging* and *Information*, which have larger revisions for a much larger percentage of estimates. Note that these industries comprise 0.6 percent and 2.0 percent of national Total Nonfarm employment, respectively; they have small employment levels in most states. For *Mining and Logging*, the median 2012 statewide annual average is 9,900. A revision in the over-the-month change of 100 – the smallest possible change to a published value – is therefore greater than 1 percent for over half the states for this industry. The *Information* industry has somewhat larger employment; at the median state value, a revision of 300 results in a revision larger than 1 percent. *Trade, Transportation, and Utilities* also has a distribution of revisions larger than other industries. This industry super-sector comprises 19.1% of national Total Nonfarm employment (using 2012 annual averages).

Chart 7. Distribution of Statewide Super-Sector absolute revisions as a percent of employment



In the chart above, the following industry abbreviations are used.

Abbreviation	Industry Title	Abbreviation	Industry Title
M&L	Mining and Logging	PBS	Professional and Business Services
Con	Construction	E&H	Education and Health
Man	Manufacturing	L&H	Leisure and Hospitality
TTU	Trade, Transportation, and Utilities	OS	Other Services
Inf	Information	Gov	Government
Fin	Finance		

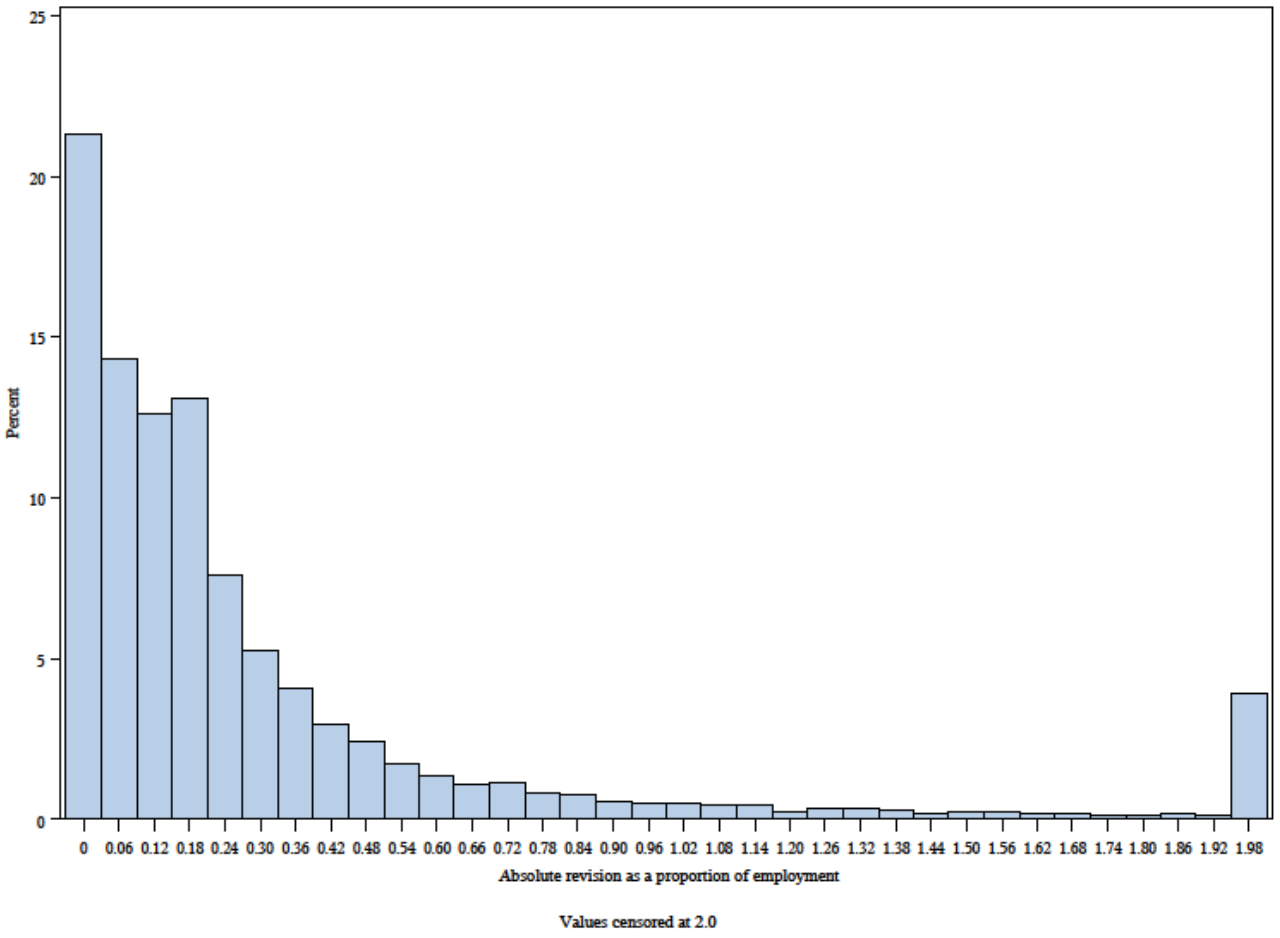
Chart 7 puts the distributions of these industry-based revisions in perspective. When examining the revisions in this manner it is easy to see that the industries discussed – *Mining and Logging*, *Information*, and *Trade, Transportation, and Utilities* – have distributions with larger inter-quartile ranges than other industries. While small revisions in states and industries with small employment will always result in larger percentage revisions, these industries may bear additional scrutiny in the future to see if there are other factors contributing to making these distributions larger than in other industries.

5. Profile of Metropolitan Area Revisions

This section of the paper provides a profile of revisions at the metropolitan area level.

First, we look at a histogram of MSA revisions to total nonfarm employment.

Chart 8. Distribution of MSA absolute revisions to Total Nonfarm as a proportion of employment



The percentile distribution presented in the chart above is also provided in Table 15 below.

Table 15. Percentile distribution of MSA absolute revisions to Total Nonfarm as a percent of employment, March 2011 – March 2013

Percentiles				
25th	50th	75th	90th	95th
0.1	0.2	0.3	0.8	1.6

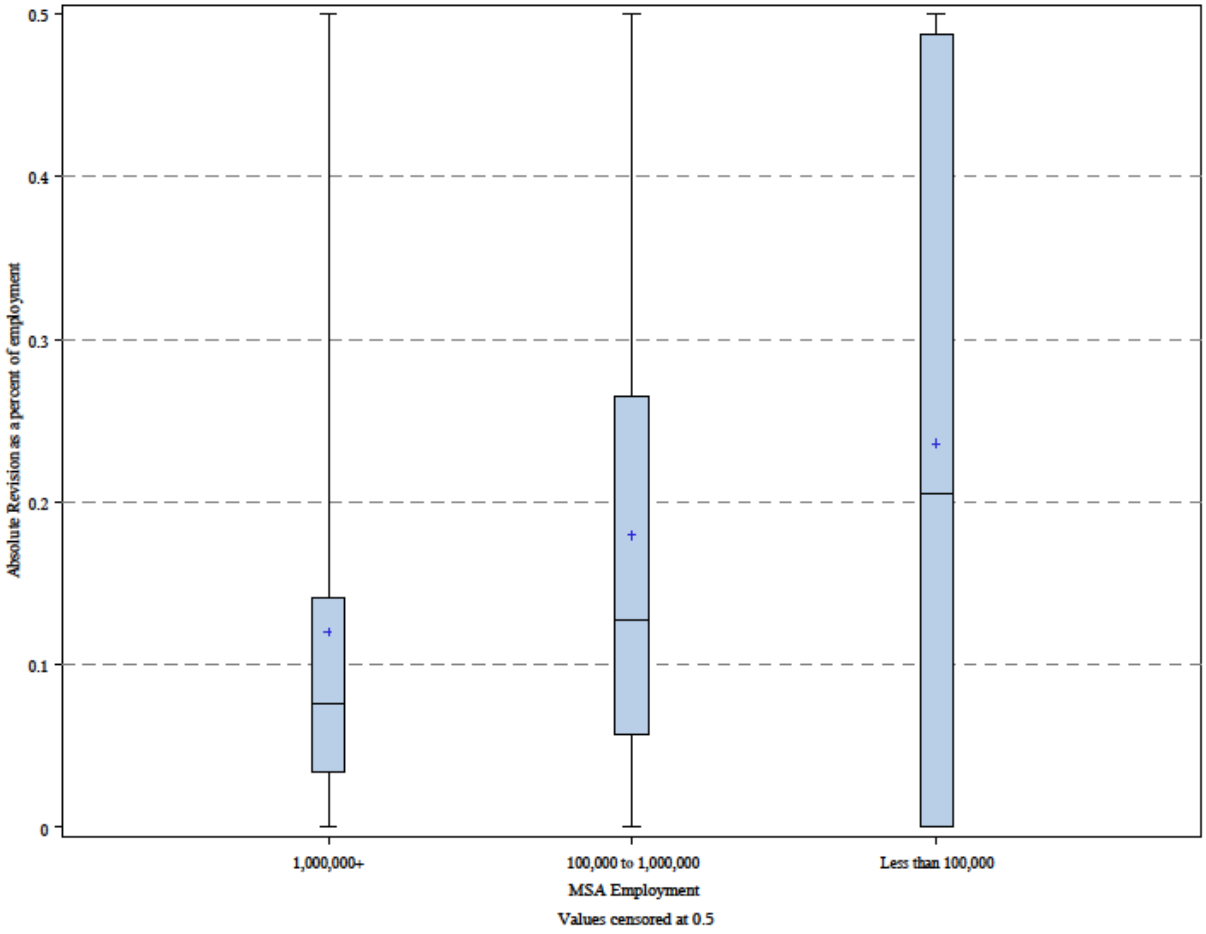
The chart and table above show that much of this distribution is comprised of moderate revisions. However, over 4 percent of the metropolitan area (MSA) revisions are greater than 2 percent of Total Nonfarm employment. This is a substantial number of large revisions at the Total Nonfarm level.

Table 16. Percentile distribution of MSA absolute revisions to Total Nonfarm as a percent of employment, by MSA employment size, April 2011 – March 2013

	Percentiles				
MSA Employment	**25th**	**50th**	**75th**	**90th**	**95th**
1,000,000+	0.0	0.1	0.1	0.3	0.7
100,000 – 999,999	0.1	0.1	0.3	0.6	1.1
Less than 100,000	0.0	0.2	0.5	1.2	2.0

Table 16 above shows the distribution of MSA revisions by MSA employment size; and these data are presented below in the censored boxplot.

Chart 9. Distribution of MSA absolute revisions as a percent of employment



It is clear that estimates for metropolitan areas with larger employment levels tend to have smaller revisions as a percent of that employment level. Smaller domains, because of their smaller sample sizes, are likely to be more sensitive to a small number of late reports than a larger MSA would be.

6. Concluding Remarks

This analysis has examined response patterns by various characteristics and revisions to the over-the-month change for employment estimates from the Current Employment Statistics survey. For the most part, these revisions to the not-seasonally-adjusted data are caused by additional reports that are collected after the first release of the data. The survey is designed this way because a quick release of information is a highly important feature of these data, even though this means that the data will be revised. In general, revisions tend to be small, but there is a long tail to the distributions, with the occasional large outlier.

We found that revisions tend to be largest when large establishments, especially in government, reported late with unusual over-the-month changes. We noted that national absolute revisions tend to be similar in size for expansions and contractions. We saw that absolute revisions for state estimates are marginally larger now than they were in the base period (January 2003 to November 2008) we studied. We also saw that the primary industries with large state revisions were *Mining and Logging*, *Information*, and to a lesser extent *Trade, Transportation, and Utilities*. And we determined that metropolitan area revisions to Total Nonfarm employment tend to be substantially larger as a percent of employment for smaller metropolitan areas than they are for larger domains.

In conclusion, we note that the CES program, both at the national and state levels, maintains a very strong tradition of research to improve the program's estimation procedures. The CES program has also worked closely with state staff in the past to make improvements to the state estimates, and that collaboration will continue to benefit the program and its customers. The issues noted in this paper will be added to the programs research agenda to see if they point to additional improvements.

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

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7. References

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