Benchmarking the Current Employment Statistics national estimates

The Current Employment Statistics (CES) survey is a large monthly survey of approximately 147,000 businesses and government agencies that represent about 634,000 individual worksites. It is used to produce detailed industry estimates of employment, hours, and earnings for the nation, states, and metropolitan areas. The CES program benchmarks its all-employee series annually to reanchor sample-based employment estimates to full population counts. This process improves the accuracy of the CES all-employee series by replacing estimates with full population counts that are not subject to the sampling or modeling errors inherent in the CES monthly estimates. These population counts are derived from administrative records and are much less timely than the sample-based estimates. However, they provide a near census of establishment employment. The authors describe the procedures currently used to benchmark the national CES all-employee estimates.

The Current Employment Statistics (CES) survey, conducted by the U.S. Bureau of Labor Statistics (BLS), is a monthly panel survey of approximately 147,000 businesses and government agencies representing, approximately 634,000 individual worksites. The survey provides detailed industry data on employment, hours, and earnings of workers on nonfarm payrolls.[1] As some of the most timely and sensitive economic indicators published by the federal government, national CES estimates are widely viewed as key measures of the health of the U.S. economy and are tracked closely by public policymakers, businesses, and academia.

The CES program reanchors its sample-based employment estimates to full population counts for March of each year. This process—known as benchmarking—improves the accuracy of the CES all-employee series, since these counts are not subject to sampling or modeling errors inherent in the CES monthly estimates. The CES program

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derives population counts from administrative records that provide a near total count of nonfarm employment on a lagged basis.

The Quarterly Census of Employment and Wages (QCEW) program,[2] which collects employment and wage data from states' unemployment insurance (UI) tax systems, is the primary source of benchmark data for the CES survey. All businesses and government agencies that are subject to UI tax laws must report employment and wage information quarterly to their states' Labor Market Information (LMI) agencies. These UI records cover about 97 percent of nonfarm wage and salary jobs on civilian payrolls. The remaining 3 percent of jobs that are within scope for CES estimates are exempt from UI tax law. An estimate for these employees, collectively referred to as "noncovered employment," is constructed from other sources.

The size of the benchmark revision is widely regarded as a measure of the accuracy of the CES estimates. For national total nonfarm employment, the absolute average annual benchmark revision has averaged about two-tenths of 1.0 percent (0.2 percent) over the past decade, with a range from −0.7 percent to +0.3 percent. (See table 1.)

Table 1. Percent and level differences between nonfarm employment benchmarks and estimates, total nonfarm, March 2007–March 2016

Type	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Percent	−0.2	−0.1	−0.7	−0.3	0.1	0.3	−0.1	0.0	−0.1	−0.1
Level	−293,000	−89,000	−902,000	−378,000	162,000	424,000	−119,000	67,000	−172,000	−81,000

Source: U.S. Bureau of Labor Statistics.

Benchmark data are available only for the all-employee series. However, most other series are recalculated during the benchmarking process because the all-employee series are used as inputs to their calculations.

Benchmark processing

The benchmark process involves several steps that help ensure the integrity of our time series. The first step involves the collection of all the necessary data in establishing the new benchmark level for March. Once this step is done, the next step involves deriving estimates for months other than March that account for the new March level and create a continuous time series. These changes will affect employment estimates as well as other data types such as production and women employees.

Establishing the benchmark level

The benchmark procedure for CES national estimates replaces the March sample-based all-employee estimates for each estimating cell with full population counts for that March. The difference between the previously published sample-based estimate and the benchmark level is called the benchmark error or the benchmark revision. For most industries, the March benchmark level is essentially the March QCEW employment figure. However, UI laws may not cover some groups of workers in certain industries and, hence, these groups are not included in the QCEW figures. Estimates for the noncovered employees are developed from other sources.

Noncovered employment results from a difference in scope between the CES program and the QCEW program. The QCEW data include all employment covered by each state's given UI tax laws. CES includes all nonfarm wage and salary workers for businesses and government agencies (excluding households) regardless of whether they are covered by UI tax laws. For example, students who participate in workstudy programs through school, elected officials, those working for religious organizations, and employees of railroad companies are typically exempt from UI tax coverage.[3] Since such data are outside the scope of the QCEW, CES must look to other data sources to account for this employment.

No single source of noncovered data exists. As a result, CES uses multiple sources to produce the employment counts. These sources include County Business Patterns and the Annual Survey of Public Employment and Payroll (both from the U.S. Census Bureau), the Railroad Retirement Board, and individual state LMI agencies.[4] Table 2 lists industries that include noncovered employment.

Table 2. Industries with noncovered employment[1]

Industry code	Industry title
524113	Direct life insurance carriers
524114	Direct health and medical insurance carriers
524126	Direct property and casualty insurers
524127	Direct title insurance carriers
524128	Direct title insurance and other direct insurance carriers
524130	Reinsurance carriers
524210	Insurance agencies and brokerages
531210	Offices of real estate agents and brokers
611110	Elementary and secondary schools
611210	Junior colleges
611310	Colleges universities, and professional schools
611410	Business and secretarial schools
611420	Business and secretarial schools and computer training
611430	Professional and management development training
611511	Cosmetology and barber schools
611512	Flight training
611513	Apprenticeship training
611519	Other technical and trade schools
611610	Fine arts schools
622110	General medical and surgical hospitals[2]
622210	Psychiatric and substance abuse hospitals[2]
622310	Specialty (except psychiatric and substance abuse) hospitals[2]
624310	Vocational rehabilitation services
624410	Child day care services
813110	Religious organizations
813211	Grantmaking foundations
813312	Environment, conservation and wildlife organizations
813410	Civic and social organizations
813910	Business associations
813940	Political organizations
813990	Miscellaneous professional and similar organizations

Notes:
See footnotes at end of table.

[1] Noncovered employment is defined as jobs exempt from unemployment insurance law.

[2] Indicates that noncovered employment is calculated for firms privately owned and state and local government owned.

Source: U.S. Bureau of Labor Statistics.

The Federal Unemployment Insurance Tax Act defines federal minimum standards for UI coverage that all states must follow. Some states, however, go beyond those standards and cover additional workers, which means that some groups of employees are covered in one state but not covered in another. The corporate officers group is a prominent example—in North Dakota, Oregon, Washington, and Idaho, corporate officers are exempt from UI coverage. Consequently, noncovered employment exists in most industries in those states. Employment levels for corporate officers and other state-specific UI-exempt employees are provided annually by the individual state LMI offices. In addition, BLS and staff in state LMI offices review the "Comparison of State UI Laws" publication each year from the U.S. Department of Labor's Employment and Training Administration to identify changes in UI coverage that affects benchmark employment counts.[5]

Distribution of unclassified employment

QCEW and CES data are classified according the North American Industry Classification System (NAICS). When first added to the QCEW files, some establishments are assigned an unclassified industry code, indicating insufficient information exists to assign an initial industry code. These records represent less than 1 percent of reports. For benchmarking purposes, the CES program distributes employment in the unclassified group to all other industries in proportion to their respective percentage of total nonfarm employment. For example, if an industry represents 4 percent of total nonfarm employment, that industry will be assigned 4 percent of the total unclassified employment. This step ensures that the unclassified employment is included in the benchmark level.

Reestimation for months other than March

Once the March benchmark level has been established, the monthly sample-based estimates for the 11 months preceding and the 9 months following the March benchmark are subject to revision. For example, March 2016 benchmark revisions (published in February 2017) resulted in revised estimates (not seasonally adjusted) from April 2015 through December 2016.

The monthly sample-based estimates for the 11 months preceding the March benchmark are revised with the use of a "wedge-back" procedure. The difference between the March population or benchmarked employment value and the March sample-based estimate is calculated and spread back across the previous 11 months for each basic estimating cell.[6] Employment estimates for basic cells are then summed to derive the benchmarked series for all higher level series up to total nonfarm. CES assumes the total benchmark error accumulated at a steady rate since the prior year's March benchmarked employment, resulting in a linear application (or wedge) of that error to the prior April. Specifically, 11/12ths of the March error (or difference) is added to the February estimate, 10/12ths to the January estimate, and so on, back to the previous April estimate, which receives 1/12th of the March difference.

Estimates for the 7 months following March (April–October) also are subject to revision. These estimates are adjusted by

1. applying the previously published sample-based monthly links to the new March benchmark level and

2. calculating new business birth/death factors for each month, which are revised to incorporate information from the most recent year of QCEW data. The next section titled "Updating the net birth/death model" provides more information on the recalculation of business net birth/death factors.

Estimates for the November and December subsequent to the March benchmark are revised because of the benchmark adjustments mentioned earlier as well as the receipt of additional sample.

Revisions to other data types

Data types other than all employees also are revised. Although no data are available from the QCEW or noncovered sources to benchmark these series directly, they are derived in part from all-employee counts and must be recalculated based on benchmarked employment estimates. Ratios of employment used in the monthly calculation of the number of women employees and production and nonsupervisory employees are preserved and applied to the revised all-employee counts to yield a revised estimate for those data types. These series are revised at the basic estimating cell level and aggregated to the summary level.

The basic-level series for average weekly hours, average hourly earnings, and average weekly overtime hours (in manufacturing) do not change with the benchmark revision. However, the aggregate levels of these data series can change. Reaggregation of these series uses either revised all-employee [series] or production and nonsupervisory-employee series, which serve as weights in the calculations. All other derivative series (such as real earnings and payroll indexes) also are recalculated.

Updating the net birth/death model

One limitation of the CES probability-based sample is the lack of timely data on business births. This limitation is because there is a lag between when a firm opens for business and when it appears on the CES sample frame. Another complication is that business death units are difficult to collect; often during monthly collection, CES cannot distinguish business deaths from nonrespondents. CES adjusts for these limitations using a statistical modeling technique that is based on two principals:

1. Overall employment change is largely driven by the net difference between expanding and contracting continuous businesses.
2. Employment associated with business births and deaths is substantial (both are between 1 and 2 million employees in size). However, the difference between the two is relatively small and stable, which permits one to be used as a proxy for the other, leaving a small residual that can be modeled.

Modeling is accomplished through a two-step process. In the first step, CES uses employment associated with business deaths as a proxy for business birth employment. In particular, employment from business death units is imputed during estimation in subsequent months by not reflecting the establishment as going out of business in the estimate but rather by replacing its death employment with the employment growth rate of reporting units. This implicit imputation of employment for business deaths is meant to account for the missing birth employment. However, the relationship is not one to one. Therefore, in the second step, CES models that difference using actual residual net birth/death figures derived from historical QCEW data. The model calculates a forecast of the residual for future months, which is then applied to the sample-based portion of the estimate each month. The

forecasts are produced once a year with the annual benchmark processing and are updated quarterly, with the addition of each new quarter of QCEW data.

Other activities during benchmark

The reanchoring of the CES estimates to full population counts drives the annual revision process. However, additional processes are performed that also contribute to the overall revision of the data.

Seasonal adjustment

Over the year, regular seasonal events, such as major holidays, weather, and school schedules, have large impacts on CES data. For most series that the CES program publishes, a regular and discernable seasonal pattern can be extracted from the time series to reveal underlying trends and cyclical patterns. The seasonally adjusted series are useful to data users and are highlighted in CES news releases.

CES uses concurrent methodology to seasonally adjust estimates each month.[7] As such, all controllable variables in the seasonal adjustment process remain fixed during the year. Each year during benchmark processing, model specifications—such as ARIMA (autoregressive integrated moving average) models, moving averages, historical outliers, and time series transformations—are determined and remain fixed throughout the year. In addition, seasonal factors derived with the use of the new specifications are applied to estimates for the 5 most recent years. For example, the March 2016 benchmark revisions (published in February 2017) resulted in revised seasonally adjusted series from January 2012 through December 2016. After 5 years of revisions, seasonally adjusted data are frozen, unless the historical data are changed because of other factors.

Changes to historical data

For most of its history, the CES program also has timed the release of any changes in publication status, methods, or procedures to coincide with the publishing of the benchmark revisions. The timing of these changes coincides with benchmark revisions because the changes often require revisions to historical time series. The coincident timing is efficient for both BLS data producers and the users of CES data because historical data revisions occur only once a year. Some examples of these types of changes follow.

Each year, CES reviews its sample by industry and may eliminate or combine the existing series or add a new series based on accuracy and confidentiality measures. When possible, historical series for all newly defined industry series are reconstructed.

Likewise, periodic changes are made to the NAICS, which CES uses to define industry classifications and publication structures. NAICS updates usually occur every 5 years. Generally, based on the new industry code, affected series are re-created, or reconstructed, back to 1990, although in some cases longer reconstructions may be made when longer historical data are available.

Methodological changes, while infrequent, are implemented with the annual benchmark processing because they can result in revisions to historical data. For example, several series in health care, state government education, and local government education were corrected, reconstructed, and introduced with the March 2016 benchmark revision released in February 2017.[8]

Conclusion

CES data provide users with a wide range of statistics on current labor conditions, the complexities of which necessitate the wide-ranging and comprehensive benchmark methodology outlined in this article. The processes associated with the CES annual benchmark methodology are done with the goal of ensuring data quality for our users. This goal is why the methodology is always being reviewed for improvements.

NOTES

[1] CES estimates are classified in accordance with the North American Industry Classification System (NAICS) 2012. Establishments are classified into industries based on their primary activity. Those establishments that use comparable inputs (capital equipment, labor, and raw materials) are classified together.

[2] The Quarterly Census of Employment and Wages also serves as the sampling frame for the CES.

[3] Employees of railroad companies are covered by a different unemployment insurance system administered by the Railroad Retirement Board.

[4] For more information on the County Business Patterns, see https://www.census.gov/programs-surveys/cbp.html, and for more information on the Annual Survey of Public Employment and Payroll, see https://www.census.gov/programs-surveys/apes.html.

[5] For more information on the "Comparison of State UI Laws" publication from the U.S. Department of Labor's Employment and Training Administration, see https://workforcesecurity.doleta.gov/unemploy/statelaws.asp.

[6] Basic cells are defined primarily by detailed industry at the 3-, 4-, 5-, or 6-digit NAICS level.

[7] In concurrent seasonal adjustment, seasonal factors are updated every month, incorporating all observations of the not seasonally adjusted series, up to and including the current month value. For more information on seasonal adjustment in the CES program, see https://www.bls.gov/web/empsit/cesseasadj.htm.

[8] For more information on reconstruction, see https://www.bls.gov/web/empsit/cesbmart.htm.

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