

Revisions in State Establishment-based Employment Estimates Effective January 2013

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With the release of the payroll employment estimates for January 2013, nonfarm payroll employment, hours, and earnings data for states and areas were revised to reflect the incorporation of the 2012 benchmarks and the recalculation of seasonal adjustment factors for payroll employment estimates. The revisions affect all not seasonally adjusted data from April 2011 to December 2012, all seasonally adjusted data from January 2008 to December 2012, and select series subject to historical revisions before April 2011. This article provides background information on benchmarking methods, business birth/death modeling, seasonal adjustment of employment data, and details of the effects of the 2012 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 145,000 businesses and government agencies, representing approximately 557,000 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 non-sampling 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. Non-sampling error, by contrast, generally refers to errors in reporting and processing.²

In order to control both sampling and non-sampling 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 stated within 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 BLS Quarterly Census of Employment and Wages.³ As part of the benchmark process for benchmark year 2012, census derived employment counts replace CES payroll employment estimates for all 50 States and the District of Columbia for the period of April 2011 to September 2012.

UI tax reports are not collected on a timely enough basis to allow for replacement of CES payroll estimates for the fourth quarter, October 2012 to December 2012. For this period, revised estimates are produced by determining a new series level from census derived employment counts and using existing sample information and updated business birth/death factors to derive revised estimates for the months of the fourth quarter, October 2012 to December 2012.⁴

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.

Business birth/death modeling

Sample-based estimates are adjusted each month by a statistical model designed to reduce a primary source of non-sampling error, which is the inability of the sample to capture, on a timely basis, employment growth generated by new business formations. 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, non-sampling 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. 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.⁶

The second component is an ARIMA time series model designed to estimate the residual birth/death change to employment not accounted for by the imputation. During the net birth/death modeling process, simulated monthly estimates using all businesses from the universe of UI tax reports that are neither births nor deaths are created over a five year period and compared with population employment levels. The differences between the 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.⁷ The residuals exhibit a seasonal pattern and may be negative for some months. Finally, differences between forecasts of the nationwide 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.

The revised estimates of payroll employment for October 2012 to December 2012 differ from previously published estimates in terms of month-to-month employment change for the following reasons: (1) revised estimates are impacted by applying the existing sample link to a new level determined by census derived employment counts, and (2) revised estimates include updated birth/death factors that incorporate information from the most recently processed and available UI tax reports.

Seasonal adjustment

CES payroll employment data are seasonally adjusted by a two-step seasonal adjustment 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.⁸ Seasonally adjusted employment data for the most recent 13 months are published regularly in Table D-1.⁹

⁶ 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>.

⁷ Further information on the X-12 ARIMA model is available on the US Census Bureau website at <http://www.census.gov/srd/www/x12a/>.

⁸ Further information about the seasonal adjustment process and a list of all seasonally adjusted employment series are available at www.bls.gov/sae/saeries.htm.

⁹ Table D-1 can be viewed at www.bls.gov/sae/tables.htm.

With the release of the 2012 benchmark, seasonally adjusted employment data from January 1990 to the most recent month of CES payroll employment estimates are newly available for all 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands for the following aggregate series: total private, goods producing, service-providing, and private service-providing. The aggregation method of these seasonally adjusted series is the same as that employed to derive the seasonally adjusted total nonfarm employment series. Each seasonally adjusted aggregate series is the sum of its component industry series. Whenever available, seasonally adjusted industry level data comprise the components. In those cases when the industry level employment data exhibits no significant seasonality, the not seasonally adjusted data serves as the component.

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 four and sometimes five 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

Methodological Improvements

Beginning with the 2012 benchmark, CES introduced the Modified Fay-Harriot (MFH) model, which is used to estimate payroll employment in some areas with small sample size. This change in estimation methodology is designed to remove estimate volatility associated with small sample size.

For other employment series in which small sample size limits the reliability of sample estimation methods, CES uses a small domain model (SDM) to derive an estimate of payroll employment. The SDM utilizes both sample information and historical data as factors. For area level estimates, statewide industry employment estimates are incorporated as an additional factor. CES has refined the SDM model to incorporate more concurrent information by updating both the sample factor and the statewide employment estimate factor with the timeliest information available.

Additional information on CES estimation methods can be obtained by visiting the CES state and area internet webpage or by consulting the resources listed at the end of this article.

¹⁰ For more information on the presence and treatment of calendar effects in CES data, see www.bls.gov/ore/pdf/st960190.pdf.

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 2012. The average absolute percentage revision across all states for total nonfarm payroll employment is 0.7 percent for March 2012. This compares to the average of 0.5 percent for the same measure during the five prior benchmark years of 2007 to 2011. For March 2012, the range of the percentage revision for total nonfarm payroll employment across all states is from -1.5 to 2.2 percent. (See Table 1a.)

For December 2012, the average absolute percentage revision for state total nonfarm payroll employment is 0.9 percent. The range of the percentage revision for state total nonfarm payroll employment is from -0.4 to 3.8 percent for December 2012. (See Table 1a.)

Table 1a. Percentage differences between state employment estimates and benchmarks by industry, March 2007–March 2012 and December 2012 (all values in percent)

Industry	Mar 2007	Mar 2008	Mar 2009	Mar 2010	Mar 2011	Mar 2012	Dec 2012
Average absolute percent differences							
Total nonfarm.....	0.4	0.4	0.9	0.4	0.5	0.7	0.9
Mining and logging.....	3.8	4.3	6.0	7.5	3.2	4.7	6.1
Construction.....	2.2	2.6	4.0	3.6	3.2	4.4	4.3
Manufacturing.....	1.2	1.3	2.2	1.8	1.4	1.5	2.1
Trade, transportation, and utilities.....	0.7	0.6	1.6	1.2	0.9	1.1	1.4
Information.....	2.2	2.0	3.3	2.3	2.4	3.2	3.8
Financial activities.....	1.1	1.0	1.6	1.8	1.9	2.2	2.7
Professional and business services...	1.5	1.3	2.2	2.2	1.8	1.9	2.4
Education and health services.....	0.7	0.8	0.8	1.0	0.9	1.4	1.7
Leisure and hospitality.....	1.1	0.9	1.7	1.8	1.9	2.3	2.7
Other services.....	1.5	1.3	1.9	1.9	2.4	2.7	3.0
Government.....	0.5	0.6	0.6	0.8	0.7	1.0	1.4
Total nonfarm:							
Range.....	-1.5 : 1.2	-1.4 : 1.0	-3.8 : 1.1	-1.3 : 1.4	-1.8 : 1.4	-1.5 : 2.2	-0.4 : 3.8
Mean.....	0.0	-0.1	-0.8	-0.1	0.2	0.6	0.8
Standard deviation.....	0.5	0.5	0.8	0.5	0.6	0.7	0.8

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 2012. 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.

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 the industries of Mining and Logging and Construction are both 3.2 percent for March 2011. However, for March 2011 the absolute level revision across all states for the Mining and Logging industry is 500, while the absolute level revision across all states for the Construction industry is 3,300. (See Table 1b.) Relying on a single measure to characterize the magnitude of benchmark revisions in an industry can potentially lead to an unreliable interpretation.

Table 1b. Level differences between state employment estimates and benchmarks by industry, March 2007–March 2012 and December 2012 (all values payroll employment)

Industry	Mar 2007	Mar 2008	Mar 2009	Mar 2010	Mar 2011	Mar 2012	Dec 2012
Average absolute numeric differences							
Total nonfarm.....	11,200	11,500	20,700	7,600	10,200	14,800	19,600
Mining and logging.....	300	600	700	600	500	600	1,200
Construction.....	3,600	3,300	3,700	2,900	3,300	4,200	4,300
Manufacturing.....	2,700	2,500	3,200	2,000	2,100	2,200	3,300
Trade, transportation, and utilities.....	3,900	2,800	7,800	4,500	2,800	3,900	6,000
Information.....	900	1,000	1,300	1,200	1,300	1,500	1,900
Financial activities.....	1,900	1,800	2,300	2,300	2,600	2,500	3,000
Professional and business services...	6,100	6,200	6,500	4,600	4,700	5,500	6,600
Education and health services.....	3,100	3,100	2,800	2,800	3,000	4,600	5,100
Leisure and hospitality.....	3,100	2,600	3,500	3,500	3,100	5,200	6,200
Other services.....	1,400	1,200	1,900	1,600	1,900	2,300	2,900
Government.....	2,000	2,800	2,200	3,800	3,700	4,100	5,700
Total nonfarm:							
Range.....	-59,800 :	-112,300 :	-190,500 :	-38,700 :	-15,300 :	-28,900 :	-17,200 :
	96,200	44,000	10,900	28,900	57,500	59,400	128,700
Mean.....	400	-5,100	-19,600	-1,700	6,100	13,100	17,700
Standard deviation.....	20,800	21,000	31,500	11,300	15,300	16,200	28,800

NOTE: The range indicates the lowest and highest percentage revision at the total nonfarm level. The mean is the sum of all the items in a series divided by the number of items. The standard deviation is a measure of dispersion. It measures the extent to which the individual items in a series are scattered about the mean of the series and indicates the reliability of the mean. For example, in Table 1a, the March 2007 standard deviation (0.5) is low, relative to March 2009 (0.8). This is an indication that there is higher variation among State total nonfarm revisions in March 2009 (i.e., the mean is less representative of the group) than in March 2007 (i.e., the mean is more representative of the group). The standard deviation is computed by taking the difference of each item in a series from the mean of the series, squaring each difference, summing the squared differences, dividing the result by the number of items, and obtaining the square root of that figure.

For the present benchmark year, 2012, CES payroll employment estimates are replaced by census derived employment counts for all months from April 2011 to September 2012. This stands in contrast to the previous benchmark year, 2011, in which CES payroll employment estimates were replaced only through to the second quarter, June 2011. As a result of the short replacement period in the previous benchmark year, the March 2012 benchmark revisions reflect revisions to cumulatively more sample-based estimates than is typical for previous benchmark years. The March 2012 benchmark revisions affect nine months of sample-based CES payroll employment estimates, June 2011 to March 2012, as opposed to six months in previous years. In part due to the compounding from month to month of sample and non-sampling error, the March 2012 benchmark revisions are generally greater than in previous benchmark years.

The effect of compounding sample and non-sample error also applies to the December 2012 benchmark revisions, which are also generally greater than in previous years. The December 2012 benchmark revisions reflect the replacement of CES payroll employment estimates with census derived employment counts for fully fifteen months (July 2011 to September 2012) and three months of revised estimates (October 2012 to December 2012). This stands in contrast to previous benchmark years, in which the December benchmark revision amount would have reflected revisions to sample-based estimates for a period of only twelve months. The effect of compounding sample and non-sample error due to an increased number of months of

sample-based estimates should be taken into consideration when comparing the revision amounts of the current benchmark year, 2012, to any other previous benchmark year.

Revisions by State

For March 2012, 46 states revised nonfarm payroll employment upward, while 4 states and the District of Columbia revised payroll employment downward. (See Table 2. or Graph 1.) For March 2012, 17 states had revisions greater than -0.5 percent and less than 0.5 percent; 14 states had absolute percentage revisions of 1.0 percent or greater. (See Table 2. or Graph 1.)

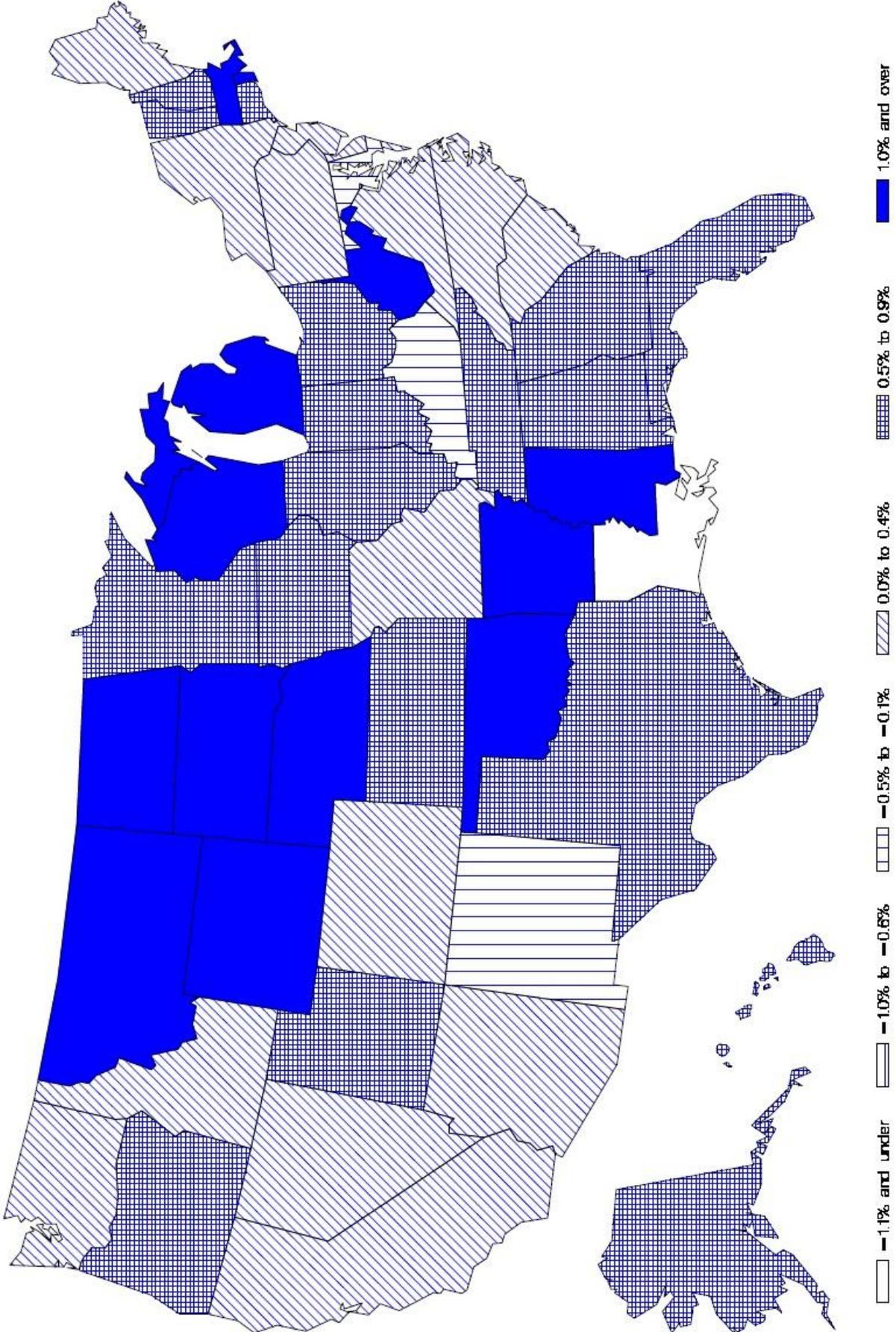
For December 2012, 15 states had revisions greater than -0.5 percent and less than 0.5 percent; 18 states had absolute percentage revisions of 1.0 percent or greater. (See Table 2. or Graph 2.)

Table 2. Percent differences between nonfarm payroll employment benchmarks and estimates by state, March 2007–March 2012 and December 2012 (all numbers in percent)

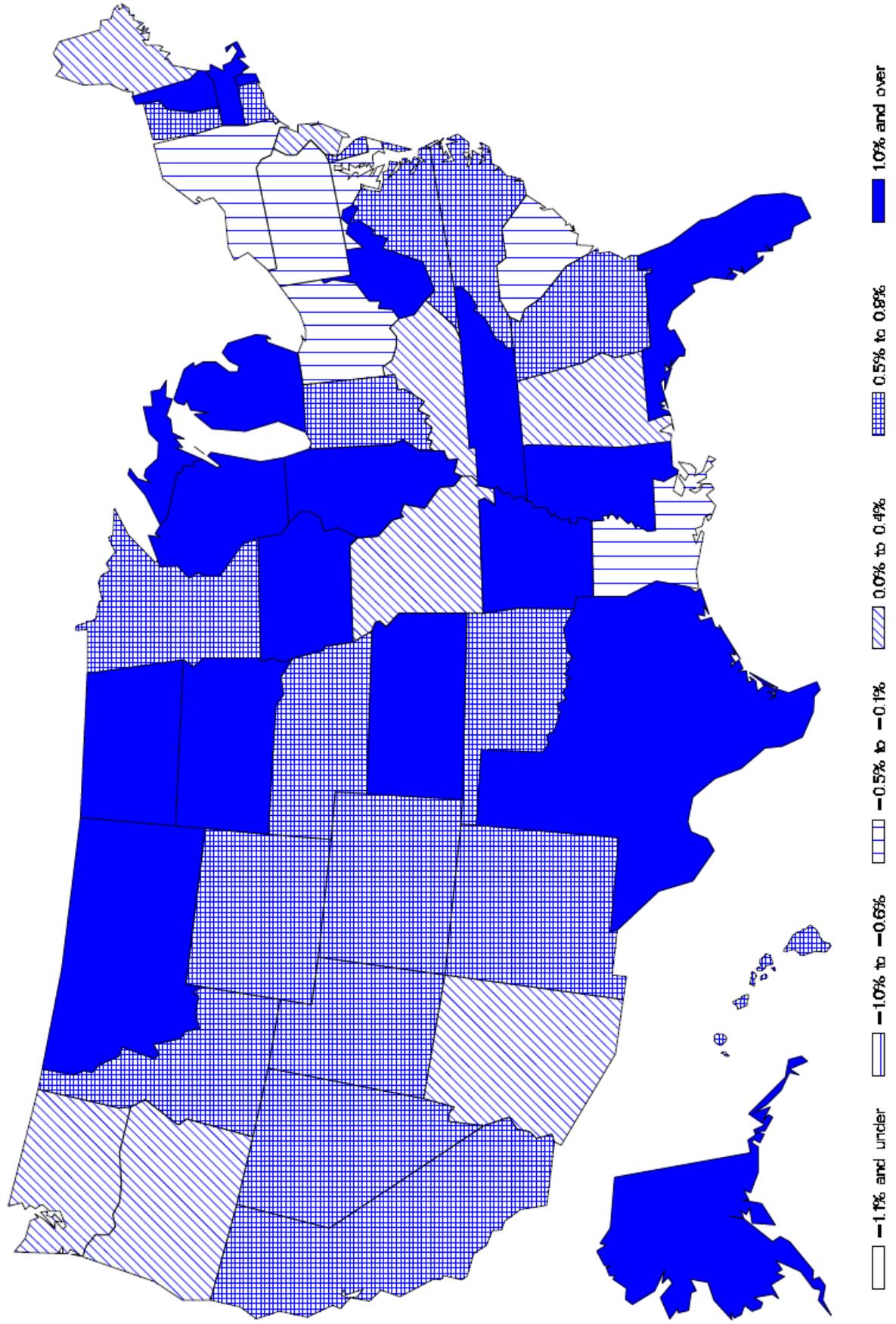
State	Mar 2007	Mar 2008	Mar 2009	Mar 2010	Mar 2011	Mar 2012	Dec 2012
Alabama.....	(1)	-0.6	-1.1	0.3	-0.1	0.6	0.3
Alaska.....	-0.2	0.4	-0.5	-1.3	-0.2	0.8	1.4
Arizona.....	-1.5	-0.4	-0.1	-0.3	0.6	0.3	0.2
Arkansas.....	(1)	(1)	-0.3	-0.3	-1.1	1.2	1.1
California.....	-0.4	-0.3	-1.3	-0.1	(1)	0.3	0.9
Colorado.....	0.4	-0.2	-0.3	0.5	0.7	0.2	0.8
Connecticut.....	-0.3	0.5	-0.5	-1.3	(1)	0.6	0.9
Delaware.....	-0.8	(1)	0.7	-0.4	0.7	0.1	0.6
District of Columbia.....	-0.1	-0.1	-0.6	-0.4	1.4	-0.8	-0.3
Florida.....	-0.2	-1.4	-1.4	-0.2	0.5	0.5	1.0
Georgia.....	0.4	-0.7	-0.9	0.2	1.4	0.7	0.5
Hawaii.....	(1)	-0.3	-1.2	-0.5	(1)	0.5	0.7
Idaho.....	-0.1	-0.1	-1.2	-0.2	-0.4	0.3	0.9
Illinois.....	(1)	-0.3	-0.3	0.1	(1)	0.7	1.0
Indiana.....	0.2	-0.6	-1.3	-0.2	0.7	0.7	0.5
Iowa.....	-0.4	0.1	-0.3	-0.5	-0.2	0.8	1.3
Kansas.....	(1)	0.5	-0.8	-0.3	1.2	0.9	1.1
Kentucky.....	0.2	-1.2	-1.3	-0.4	-0.3	-0.1	(1)
Louisiana.....	0.4	-0.5	-1.4	-0.6	0.9	-1.5	-0.4
Maine.....	0.1	0.3	-0.7	0.3	-0.4	0.3	0.3
Maryland.....	(1)	-0.8	-0.6	-0.1	1.1	-0.2	-0.1
Massachusetts.....	-0.2	0.2	0.1	0.9	0.3	1.3	1.0
Michigan.....	-0.6	-0.1	-0.5	0.2	0.2	1.1	1.3
Minnesota.....	-0.4	-0.3	-0.1	-0.4	0.8	0.8	0.7
Mississippi.....	-0.5	(1)	-1.2	-0.1	-0.4	1.1	1.5
Missouri.....	-0.1	0.1	-1.1	-0.5	-0.4	0.4	0.4
Montana.....	0.6	-0.4	-2.4	0.2	-0.7	2.1	2.4
Nebraska.....	-0.5	-0.8	0.1	-0.2	-0.6	1.5	0.8
Nevada.....	-1.2	-0.9	-3.8	-0.6	-0.1	0.4	0.8
New Hampshire.....	0.3	-1.2	-1.5	-0.7	(1)	0.8	1.5
New Jersey.....	-0.6	0.4	-1.2	-0.1	-0.2	0.3	0.3
New Mexico.....	0.1	(1)	-1.6	-0.1	(1)	-0.2	0.7
New York.....	0.4	0.3	-0.4	0.3	0.7	(1)	-0.1
North Carolina.....	1.2	-0.3	-0.1	(1)	0.8	0.3	0.8
North Dakota.....	-0.3	1.0	-0.9	0.8	0.3	2.0	3.8
Ohio.....	-0.3	-0.7	-0.5	(1)	-0.3	0.6	-0.3
Oklahoma.....	(1)	0.7	-1.2	0.1	(1)	1.5	0.9
Oregon.....	0.6	-0.4	-1.3	0.1	-0.3	0.7	0.3
Pennsylvania.....	-0.2	0.1	-0.4	0.3	0.3	0.4	-0.1
Rhode Island.....	-0.5	0.2	-0.3	1.4	(1)	1.7	1.6
South Carolina.....	0.8	-0.3	-1.4	-1.2	0.3	0.3	-0.1
South Dakota.....	-0.4	0.1	-0.4	-0.1	0.5	1.4	1.6
Tennessee.....	-0.3	0.2	-1.3	(1)	0.7	0.8	1.1
Texas.....	0.9	0.4	-0.7	(1)	-0.1	0.5	1.1
Utah.....	0.2	-0.9	-1.9	-0.5	0.2	0.9	0.7
Vermont.....	-0.3	-0.1	1.1	0.1	-1.8	0.5	0.5
Virginia.....	-0.3	-0.1	-0.4	(1)	0.5	0.1	0.5
Washington.....	0.6	0.3	-0.6	-0.7	0.1	0.1	0.1
West Virginia.....	-0.1	0.1	0.8	0.8	0.4	1.0	2.5
Wisconsin.....	0.6	0.5	0.4	0.7	0.1	2.2	2.4
Wyoming.....	0.9	0.6	-1.5	-0.1	0.1	1.0	0.6

¹ Less than +/- 0.05 percent

Graph 1. Percent differences between nonfarm payroll employment benchmarks and estimates by state, March 2012



Graph 2. Percent differences between nonfarm payroll employment benchmarks and estimates by state, December 2012



Revisions by metropolitan statistical areas (MSAs)

For metropolitan statistical areas (MSAs) published by the CES program, the percentage revisions ranged from -9.7 to 7.9 percent, with an average absolute percentage revision of 1.6 percent across all MSAs for March 2012.¹¹ (See Table 3a.) Comparatively, at the statewide level the range was -1.5 to 2.2 percent, with an average absolute percentage revision of 0.7 percent for March 2012. (See Table 1a.) As MSA size decreases so does the sample-to-population ratio, 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 2012 had an average absolute revision of 0.7 percent, while metropolitan areas with fewer than 100,000 employees had an average absolute revision of 2.0 percent. (See Table 3a.)

For December 2012, the percentage revisions ranged from -9.4 to 12.3 percent, with an average absolute percentage revision of 1.9 percent across all MSAs. (See Table 3b.) Comparatively, at the statewide level the range was -0.4 to 3.8 percent, with an average absolute percentage revision of 0.9 percent for December 2012. (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 2012 had an average absolute revision of 0.9 percent, while metropolitan areas with fewer than 100,000 employees had an average absolute revision of 2.4 percent. (See Table 3b.)

Table 3a. Benchmark revisions for nonfarm employment in metropolitan areas, March 2012

Measure	All MSAs ⁸	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.....	381	182	141	30	26
Average absolute percentage revision.....	1.6	2.0	1.5	0.9	0.7
Range.....	-9.7 : 7.9	-9.7 : 7.9	-5.3 : 7.3	-1.6 : 2.3	0.2 : 2.2
Mean.....	0.4	0.4	0.4	0.6	0.7
Standard deviation.....	2.1	2.6	2.0	1.0	0.6

Table 3b. Benchmark revisions for nonfarm employment in metropolitan areas, December 2012

Measure	All MSAs ⁸	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.....	381	182	142	28	29
Average absolute percentage revision.....	1.9	2.4	1.6	1.2	0.9
Range.....	-9.4 : 12.3	-9.4 : 12.3	-7.6 : 5.7	-1 : 4.5	-1.5 : 2.6
Mean.....	0.7	0.7	0.6	1.1	0.8
Standard deviation.....	2.5	3.1	2	1.1	0.9

¹¹ The CES program published employment series for 381 MSAs in 2012. This number excludes metropolitan divisions and Puerto Rico. A list of BLS standard MSAs is available at www.bls.gov/sae.

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.