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Introducing 2012 fixed employment weights for the Employment Cost Index

Beginning with the release of December 2013 estimates, the ECI was reweighted to reflect 2012 employment counts. This reweighting accounted for updates to the occupational and industry classification systems, incorporating the 2010 Standard Occupational Classification system and the 2012 North American Industry Classification System. There changes had minimal impact on the historical continuity of the ECI.

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The Employment Cost Index (ECI) is a quarterly economic data series that measures changes in the costs of employing a fixed set of labor inputs in the U.S. economy.[1] It is a fixed-employment-weighted Laspeyres index that, like most Laspeyres indexes, has fixed weights that are updated periodically.[2] With the release of December 2013 estimates, the ECI introduced 2012 fixed-employment weights to replace the 2002 fixed-employment weights that were in use from March 2006 through September 2013.[3] The new weights are based on data from the U.S. Bureau of Labor Statistics (BLS) Occupational Employment Statistics (OES) survey, along with data from the Quarterly Census of Employment and Wages (QCEW) program.[4]

In addition to the new fixed-employment weights, BLS also changed the occupational and industry classification systems for the ECI. It now classifies occupations and industries with the 2010 Standard Occupational Classification (SOC) system and the 2012 North American Industry Classification System (NAICS), respectively. Because there are so few SOC and NAICS changes for the ECI at the publication level, switching to the new classification systems has had little impact on the historical continuity between the old indexes and the new.

This article examines the reweighting of the ECI and discusses its effects. Additionally, the article discusses the impact of reweighting on the seasonally adjusted ECI series and changes in seasonal adjustment methodology.

The article concludes with a discussion of cost estimates from the Employer Costs for Employee Compensation (ECEC) data.

Background

For the ECI, BLS uses a probability-proportional-to-size (PPS) sampling procedure to select establishments from a sample frame, then assigns a 6-digit NAICS code to each establishment. For each sampled establishment, BLS field economists use an additional sampling procedure that ensures a random sample of jobs. Once the jobs are selected, they are matched to occupations, as defined by the SOC system. At the initial contact with the establishment, the field economists collect wage and benefit data pertaining to the selected jobs and subsequently update the data each quarter.

Weights are used to derive population estimates from the survey sample. With regard to the ECI, employment cost data from the sample are multiplied by the appropriate weights to obtain unbiased estimates for U.S. civilian, state and local government, and private-industry workers.[5] Two sets of weights are used in the ECI: sample weights and fixed-employment weights.

Sample weights. Sample weights, also referred to as establishment–occupation weights, are assigned to each surveyed occupation within each establishment in the ECI sample. They reflect the inverse probability of selection of the establishment from the sample frame of all establishments within the scope of the ECI. Further, they reflect the inverse probability of selection of each occupation within the establishment. The sample weights are used to calculate current- and previous-quarter average hourly compensation costs for occupational groups within industry categories in private industry and state and local governments.

Fixed weights in the ECI. Fixed weights in the ECI are employment counts that remain the same over time until the next reweighting. A fixed employment weight applies to the broad occupational category within an industry category that the specific jobs represent. For example, in a particular industry, data might be collected from 20 establishments. In each establishment, a set of occupations will be selected randomly with a probability proportionate to the occupation's employment in the establishment. In one establishment, the field economist might select industrial engineers, secretaries, and janitors. In another establishment in the same industry, the field economist might select architects, order clerks, and cooks. When BLS economists in the Office of Compensation and Working Conditions (OCWC) assign these occupations to the 2010 SOC categories of the ECI, they classify engineers and architects into the professional and related occupations category, secretaries and order clerks into the office and administrative support occupations category, and janitors and cooks into the service occupations category.

Occupational groups within industry categories are known as estimation cells, or cells for short. There are nine occupational groups (including management, business, and financial occupations; sales and related occupations; and service occupations) defined for each industry in both private industry and state and local governments. While the occupational groups for private industry and state and local governments are the same, the industry categories are different.

There are 58 industry categories defined for private industry (including construction, and food services and drinking places) and 13 industry categories defined for state and local governments (including health care and social assistance, and colleges, universities, and professional schools). Private industry sample jobs are sorted

into 522 estimation cells (9 major occupational groups sorted across 58 industries) while state and local government sample jobs are sorted into 234 estimation cells (9 major occupation groups sorted across 13 industries).

Classification systems. Beginning with the release of the March 2006 ECI, industries were classified by the NAICS 2002 and occupation groups were classified by the SOC 2000 system. With the release of December 2007 ECI data, industries were classified by the NAICS 2007. This continued until the December 2013 release, when the industry and occupational classifications were updated once again, to the NAICS 2012 and the SOC 2010, respectively.[6]

These changes to the classification systems have affected ECI estimates to varying degrees. The 2010 edition of the SOC had changes that necessitated reclassification of some occupations to a different occupational category.[7] The change that had the most potential to impact the ECI, because of the number of workers affected, was the reclassification of flight attendants from service occupations to transportation and material moving occupations. However, because the overlap between 2000 SOC and 2010 SOC for these occupations is greater than 98 percent, this change had a negligible impact on the service occupations and transportation and material moving series.

The update from the 2002 NAICS to the 2007 NAICS, and the subsequent update from the 2007 NAICS to the 2012 NAICS, had minimal impact on the ECI estimates.

Reasons for reweighting

ECI measures are used in three main types of analysis:

- Measurement of the total change in labor cost over the time period for which the indexes are available
- Comparisons of changes in labor costs over different subperiods (for example, comparison of the change between September 2013 and September 2014 with that between September 2010 and September 2011)
- Measurement of the current rate of change in labor costs

No single index can be ideal for all three types of analysis. For instance, an index that is appropriate for analyzing long-run changes will not be the best for measuring the current rate of labor cost increases, and vice versa.

If the ECI were used only to measure the long-run change in labor costs of a fixed set of labor inputs, the employment weights would seldom need to be updated. Similarly, the value of the ECI in comparing changes in labor costs over different subperiods depends on holding the weights fixed for extended periods. The unchanging weights are necessary, in these cases, to ensure that the same set of labor inputs are compared over time.

In contrast, if the ECI is used to measure the recent rate of labor cost increases, then weights should be as current as possible. With current weights, the index of labor costs would measure the change between, for example, September 2012 and December 2012 in the cost of purchasing the set of labor inputs employed in September 2012. An index with current weights differs from the existing ECI Laspeyres index, which would estimate current labor cost increases as the change between September 2012 and December 2012 in the cost of purchasing the set of labor inputs employed at the reference point of the 2002 Occupational Employment Statistics (OES) survey (the source of the fixed employment weights used to derive ECI estimates from 2006 through September 2013). In

general, the accuracy of a Laspeyres index varies inversely with the magnitude of shifts in employment among industries and occupations.

If the ECI's employment weights were changed every quarter to improve the measurement of current rates of labor cost increases, it would be possible to derive a type of Laspeyres index by multiplying together quarter-to-quarter changes (expressed as ratios). Such a "chain" index would provide a better estimate of the rate of labor cost increase for each quarter than the current ECI, which does not change employment weights every quarter. The chain index would not, however, provide the change in the cost of a fixed set of workers for periods longer than one quarter, and changes for different subperiods would not be for the same set of labor inputs.

The ECI is a compromise between a pure Laspeyres index, which would hold employment weights fixed permanently, and an index that uses new weights each quarter; that is, the ECI's weights are changed periodically after remaining fixed for a number of years. Because the ECI's employment weights remain fixed for long periods, the index could lose its value as a measure of current change.

A number of ECI studies have indicated that the period-to-period change in a fixed-weight Laspeyres index is relatively insensitive to the weights used when the weights vary within the range common to many economic variables. Thus, the quarter-to-quarter changes calculated with a Laspeyres index are apt to be quite close to the quarter-to-quarter changes obtained by using the previous quarter's employment weights.[8] For this reason, the ECI has employed one set of weights for a number of years. This approach preserves the analytical value of the Laspeyres index as a measure of change in labor costs both different subperiods and over the long run.

As the weights become older, however, it becomes increasingly likely that current rates of change using the fixed weights could differ from those based on more recent weights by an amount great enough to be important in economic analysis.[9] To ensure that the ECI will continue to provide a good approximation of the current rate of labor cost increase, more recent weights were introduced. In addition, changes to industry and occupation classification systems, such as the mandated changes to the NAICS and SOC systems, made it necessary to reweight the ECI. Without such changes, the ECI would be less relevant to the economy and less useful when relating to other statistical measures that have transitioned to the new systems.

Consequences of reweighting

The new weights alter what the ECI is measuring when comparisons are made between estimates based on different sets of employment weights. That is, any change calculated by dividing an ECI index number based on new weights by an index number using earlier weights is not in the strictest sense a Laspeyres index estimate. Reweighting improves the currency of the index, but has the potential to disrupt historical continuity.

For example, between any two periods from December 2005 to September 2013, when 2002 weights were used, the relative difference in the index would be the change in the cost of employing the 2002 workforce. Between any two periods after September 2013, the relative difference would be the change in the cost of employing the 2012 workforce. However, the ratio of an index for a period after September 2013 to one for a period before September 2013 cannot be interpreted in terms of the cost of employing any fixed workforce; that is, the ratio is not a true Laspeyres index number.

Subindexes. The impact of reweighting on each ECI subindex, considered separately, is the same as that on the aggregate index. The reweighting causes the change in cost for the subindex to be closer to the change in current cost, but it can also result in a disruption of the subindex as a measure of long-run change and of change between periods before and periods after the new weights are introduced. An additional issue is raised, however, when the reweighted subindexes are introduced. This issue concerns the relationship between the change in the aggregate index and the changes in the component subindexes.

The aggregate Laspeyres index can be expressed as a weighted sum of any set of exhaustive and mutually exclusive Laspeyres subindexes where the weights sum to one.[10] This is a very desirable property for two reasons. First, it guarantees that the change in the aggregate index falls within the range of changes in the subindex; the change in the aggregate index cannot be greater than the largest change among the subindexes or less than the smallest (except when rounding). Second, the property also makes it possible to assign the change in the aggregate index to the subindex; that is, one can determine how much of the change in the aggregate is attributable to the change in each subindex.

For comparisons spanning the date on which the new weights were introduced, the aggregate Laspeyres index cannot be expressed as the weighted sum of any set of exhaustive and mutually exclusive subindexes. Accordingly, the change in the aggregate index between March 2013 and March 2014 might be larger or smaller than the change in any of the subindexes.

Sources of new weights

The primary source of the new weights is the BLS OES survey, supplemented by data from the QCEW program.[11] The OES survey is a semiannual mail survey of 1.2 million nonfarm establishments over a 3-year cycle. The survey collects occupational employment data by industry and area. BLS produces the OES survey materials and selects the establishments to be surveyed. State Workforce Agencies mail the survey materials to the selected establishments and make follow-up calls to request data from nonrespondents or to clarify data.

Most cells used OES employment counts directly. However, for some state and local government cells (excluding hospitals, educational services, and public administration), employment counts are not available for individual industries because those industries have relatively small employment figures. For these industries, the OES provided total employment by occupational group for state and local governments separately using data imputed from the QCEW.

The imputation for missing industry detail was done by, first, apportioning total OES employment in the combined industries among the component industries using data from the QCEW, and second, apportioning total employment for each industry among the occupational groups by assuming the same occupational distribution in each of the industries as that of state and local governments separately.

Table 1 compares percent distribution by private industry and occupation of the 2002 and 2012 weights. Among occupations, there has been a shift toward management, business and financial occupations; professional and related occupations; and service occupations. Among industries, there has been a shift toward educational services, health services, and leisure and hospitality.

Table 1: Percent distribution of employment within the scope of the Employment Cost Index, private industry

Occupational and industry group	2002	2012
All workers	100.0	100.0
Occupational group		
Management, business, and financial	9.3	9.8
Professional and related	14.0	16.4
Sales and related	12.5	12.7
Office and administrative support	17.9	16.6
Construction, extraction, farm, fishing, and forestry	5.3	4.3
Installation, maintenance, and repair	4.4	4.2
Production	10.1	7.7
Transportation and material moving	8.1	7.4
Service	18.3	20.9
Industry group		
Goods-producing industries	21.1	16.8
Mining	.5	.7
Construction	6.3	5.2
Manufacturing	14.4	10.9
Service-providing industries	78.9	83.2
Utilities	.6	.5
Transportation and warehousing	4.0	4.0
Wholesale trade	5.3	5.2
Retail trade	14.3	13.8
Information	3.1	2.5
Financial Activities	7.2	6.9
Professional and business services	15.0	16.4
Educational services	1.8	2.5
Health services	12.6	15.4
Leisure and hospitality	11.3	12.5
Other services	3.5	3.5

Source: U.S. Bureau of Labor Statistics, Occupational Employment Survey.

Testing the effects of the new weights

To evaluate the impact of using 2012 weights in place of 2002 weights, BLS researchers conducted a test that estimated the rates of change for 2005–13 using the 2012 weights. Researchers then compared the results with the published estimates based on 2002 weights. The test results, presented in table 2 show that, for the group with the highest level of aggregation—civilian workers—rates of change in compensation costs for 2005–13 vary only slightly when 2012 weights rather than 2002 weights are used. For example, on the basis of 2012 weights, the estimated change in compensation costs over the 7½-year period ending June 2013, 18.9 percent (the cumulative index change at that date), is essentially the same as the change obtained with 2002 weights, 19.0 percent. The 3-month changes never differed by more than one-tenth of a percentage point over the entire March 2006–June 2013 period.

Table 2. Indexes and percent changes in total compensation costs by weight periodicity, civilian workers, December 2005–June 2013[1]

Reference year and quarter	2002 weights			2012 weights		
	Index	3-month percent change	12-month percent change	Index	3-month percent change	12-month percent change
2005-Q4	100.0	0.5	3.2	100.0	0.5	3.1
2006-Q1	100.7	.7	2.8	100.7	.7	2.7
2006-Q2	101.6	.9	3.0	101.5	.8	2.9
2006-Q3	102.7	1.1	3.3	102.7	1.2	3.2
2006-Q4	103.3	.6	3.3	103.4	.7	3.4
2007-Q1	104.2	.9	3.5	104.2	.8	3.5
2007-Q2	105.0	.8	3.3	105.0	.8	3.4
2007-Q3	106.1	1.0	3.3	106.1	1.0	3.3
2007-Q4	106.7	.6	3.3	106.8	.7	3.3
2008-Q1	107.6	.8	3.3	107.6	.7	3.3
2008-Q2	108.3	.7	3.1	108.4	.7	3.2
2008-Q3	109.2	.8	2.9	109.2	.7	2.9
2008-Q4	109.5	.3	2.6	109.5	.3	2.5
2009-Q1	109.9	.4	2.1	110.0	.5	2.2
2009-Q2	110.2	.3	1.8	110.3	.3	1.8
2009-Q3	110.8	.5	1.5	110.8	.5	1.5
2009-Q4	111.0	.2	1.4	111.0	.2	1.4
2010-Q1	111.8	.7	1.7	111.8	.7	1.6
2010-Q2	112.3	.4	1.9	112.2	.4	1.7
2010-Q3	112.9	.5	1.9	112.9	.6	1.9
2010-Q4	113.2	.3	2.0	113.2	.3	2.0
2011-Q1	114.0	.7	2.0	113.9	.6	1.9
2011-Q2	114.8	.7	2.2	114.6	.6	2.1
2011-Q3	115.2	.3	2.0	115.1	.4	1.9
2011-Q4	115.5	.3	2.0	115.4	.3	1.9
2012-Q1	116.2	.6	1.9	116.2	.7	2.0
2012-Q2	116.8	.5	1.7	116.8	.5	1.9
2012-Q3	117.4	.5	1.9	117.3	.4	1.9
2012-Q4	117.7	.3	1.9	117.6	.3	1.9
2013-Q1	118.4	.6	1.9	118.3	.6	1.8
2013-Q2	119.0	.5	1.9	118.9	.5	1.8

Notes:

[1] Most of the estimates in this table are classified by the North American Industry Classification System (NAICS) and the Standard Occupational Classification (SOC) system. The 2002-weighted 3-month percent change for 2005-Q4 and the 2002-weighted 12-month percent changes for 2005-Q4 through 2006-Q3 are based on data classified by the Standard Industrial Classification system and the Occupational Classification System Manual.

Source: U.S. Bureau of Labor Statistics, National Compensation Survey.

Table 3 shows that the effects of the weight change are more substantial below the most aggregate level than at the aggregate level. The largest difference in indexes is 1.2 index points for the information industry, but expressed as an average annual rate of change (over the 7½ years since the base period of the index, December 2005), the difference was only 0.1 percentage point per year.

Table 3. Total compensation cost indexes and percent changes for economic sectors and selected occupational and industry groups, June 2013 (December 2005=100)

Category	Index		Average annual percent change[1]	
	2002 weights	2012 weights	2002 weights	2012 weights
Civilian workers	119.0	118.9	2.3	2.3
State and local government	120.7	120.8	2.5	2.6
Private industry	118.6	118.5	2.3	2.3
Occupational group				
Management, business, and financial	119.3	119.1	2.4	2.4
Professional and related	119.5	119.6	2.4	2.4
Sales and related	114.5	113.7	1.8	1.7
Office and administrative support	120.4	120.1	2.5	2.5
Construction, extraction, farming, fishing, and forestry	118.9	119.3	2.3	2.4
Installation, maintenance, and repair	119.3	119.2	2.4	2.4
Production	116.1	116.6	2.0	2.1
Transportation and material moving	118.6	119.1	2.3	2.4
Service occupations	118.3	117.6	2.3	2.2
Industry group				
Goods-producing	117.0	117.1	2.1	2.1
Construction	117.6	117.4	2.2	2.2
Manufacturing	116.3	116.1	2.0	2.0
Service-providing	119.1	118.8	2.4	2.3
Utilities	127.4	127.3	3.3	3.3
Transportation and warehousing	119.7	119.0	2.4	2.3
Wholesale trade	116.8	116.3	2.1	2.0
Retail trade	117.4	117.2	2.2	2.1
Information	118.6	117.4	2.3	2.2
Financial activities	118.0	117.1	2.2	2.1
Professional and business services	120.7	120.5	2.5	2.5
Educational services	119.9	119.7	2.4	2.4
Health services	119.9	119.8	2.4	2.4
Leisure and hospitality	116.9	116.7	2.1	2.1
Other services, except public administration	119.8	119.9	2.4	2.4

Notes:

[1] The average annual percent change here is the geometric mean percent change over 7 ½ years, from December 2005 (the base period of the index) to June 2013.

Source: U.S. Bureau of Labor Statistics, National Compensation Survey.

Effects of reweighting on seasonal adjustment

ECI series that have a seasonal pattern are seasonally adjusted, either directly or indirectly. Direct seasonal adjustments are calculated by dividing the index by the seasonal factor for the series. Indirect seasonal adjustments are calculated for aggregate series by taking a weighted sum of seasonally adjusted component indexes. The aggregation weights reflect the relative importance of each series in the base period. The use of indirect seasonal adjustment provides consistency between the seasonally adjusted aggregate and its adjusted-

directly components.[12] Seasonal factors are revised annually and historical seasonally adjusted indexes and 3-month percent changes are revised for 5 years, after which the estimates are final.[13]

In general, the choice of whether to use direct or indirect seasonal adjustment is related to the level of index aggregation. For series that are directly adjusted, the adjustment generally occurs at relatively low levels of aggregation, such as retail wages and salaries. An example of a series that is seasonally adjusted by the indirect method is civilian total compensation, for which there are 43 wages and salaries industry components and 43 total benefits cost industry components. All total compensation series are seasonally adjusted indirectly. Indexes for wages and salaries and total benefits for all aggregate industry and occupation groups (such as the trade, transportation, and utilities wages and salaries index and the management, professional, and related occupations indexes) are indirectly adjusted as well.[14]

Direct seasonal adjustment for December 2013. For the December 2013 direct seasonal adjustment of reweighted indexes, the seasonal factors are those estimated for the 2013 seasonal adjustment revision. These factors were derived from existing index values through December 2012 and based on the 2002 fixed employment weights. The use of these seasonal factors to adjust indexes for December 2013 is consistent with the analysis of the not-seasonally-adjusted series, which found relatively small differences between the 2002-weighted and 2012-weighted estimates for most series.

Indirect seasonal adjustment and linking December 2013 indexes to September 2013 indexes. For indexes with indirect seasonal adjustments, the introduction of the 2012 employment weights requires a change in the aggregation weight of each component series to reflect its relative importance in terms of employment in 2012 rather than in 2002. The absolute differences in aggregation weights based on the 2002 fixed employment weights and those based on the 2012 fixed employment weights range from near zero to 10.6 percentage points. The largest increase in component aggregation weights is for state and local government hospitals wages and salaries. The largest decrease in aggregation weight among published series is 5.4 percentage points for private industry production occupations wages and salaries.

Because the aggregation weights used for December 2013 are based on 2012 fixed employment weights and the aggregation weights for September 2013 (and previous quarters) are based on the 2002 fixed employment weights, an adjustment to the December 2013 seasonally adjusted indexes was necessary to maintain continuity between the two sets of aggregation weights. Without an adjustment, the observed changes between September and December 2013 would have reflected both the cost-change effect (the economic change) and the weight-change effect (the change due to using a different set of employment weights).

In order to remove the weight-change effect, researchers applied aggregation weight adjustment factors to the December 2013 seasonally adjusted indexes that were derived indirectly. For the period of the reweighting, the adjustment factors represent an adjustment to the December 2013 level of the index for the indirect seasonally adjusted series based on the difference in the aggregation of the September 2013 component indexes under the old weights versus the new weights. Therefore, the adjustment factor must also be applied to all subsequent quarters to ensure that the 3-month percent change in the index never reflects the weight-change effect. A detailed description of the aggregation weight adjustment procedure is presented in the Appendix.

Seasonal adjustment revision. Beginning with the March 2014 revision, to include the reweighted indexes, the 10-year data span of not seasonally adjusted indexes used to estimate revised seasonal factors consists of a joined series of 2002 fixed-employment-weighted indexes for September 2013 and earlier years and 2012 fixed employment-weighted indexes for December 2013 Since most of the data span currently consists of 2002 fixed employment-weighted indexes, the inclusion of reweighted indexes is not expected to have a substantial effect on the revised seasonal factors. But over time, as more reweighted indexes are included in the data span, the seasonal factors will reflect proportionally more of the 2012 reweighting. There is no change in the procedures for the 5-year revision of historical indexes and 3-month percent changes. The most recent revisions were introduced with the March 2016 ECI release.

Impact of SOC changes on the Employer Costs for Employee Compensation

The Employer Costs for Employee Compensation (ECEC) is a product of the National Compensation Survey which was developed from wage and benefit data that was collected for the ECI program. The ECEC measures employer costs for wages, salaries and employee benefits for nonfarm private, state government, and federal government workers. ECEC estimates are based on current employment weights, so reweighting the ECI has no effect on those estimates. However, beginning with the fourth quarter of 2013, estimates from the ECEC were affected by SOC changes. One change in 2010 SOC that affected both the ECI and the ECEC was the reclassification of flight attendants from service occupations to transportation and material moving occupations. A second change defined registered nurses more narrowly by removing nurse anesthetists, nurse midwives, and nurse practitioners from this category. This affected the ECEC, and not the ECI, because the occupational categories published for the ECI are broader than the occupational categories in the SOC. (ECI categorizes occupations at the 2-digit SOC level, while nurses are categorized at the 6-digit SOC level.)

There are two general issues with regard to changing SOC definitions. (1) the overlap of employment between series defined on the basis of 2000 SOC and 2010 SOC; and (2) the difference in compensation costs for the two sets of definitions, specifically, whether the change in cost due to the SOC change is within the range of what could be expected from sampling variation.

Table 4 shows that the reclassification of flight attendants from service occupations to transportation and material moving occupations had little effect on 2010 SOC-based employment in either occupational category. The change was approximately less than 2 percent in both categories. For registered nurses, the effect was somewhat larger, but still approximately less than 6 percent.

Table 4. Selected effects of reclassification from the 2000 Standard Occupational Classification system (SOC) to the 2010 SOC on employment in the Employer Costs for Employee Compensation estimates, private industry, December 2013

Occupational group	Percent of SOC 2000 occupational employment in SOC 2010	Percent of SOC 2010 occupational employment in SOC 2000
Service occupations	99.2	100.0
Transportation and material moving occupations	100.0	97.7

See footnotes at end of table.

Table 4. Selected effects of reclassification from the 2000 Standard Occupational Classification system (SOC) to the 2010 SOC on employment in the Employer Costs for Employee Compensation estimates, private industry, December 2013

Occupational group	Percent of SOC 2000 occupational employment in SOC 2010	Percent of SOC 2010 occupational employment in SOC 2000
Registered nurses	94.3	100.0

Source: U.S. Bureau of Labor Statistics, National Compensation Survey.

Table 5 provides information on the effect of adopting the SOC 2010 on civilian compensation costs. For each of the three occupational categories affected by the reclassification, table 5 shows whether the cost based on 2010 SOC definitions falls within the 90 percent confidence interval of the cost based on 2000 SOC definitions. If the compensation measure based on SOC 2010 is greater than the lower bound and less than the upper bound, then we can be 90 percent confident that the change in cost due to reclassification from SOC 2000 to SOC 2010 is no greater than what might happen because of the sample chosen.[15] As the table shows, none of the estimates fell outside the confidence interval.

Table 5. Selected Employer Costs for Employee Compensation costs based on the 2000 Standard Occupational Classification system (SOC) and 2010 SOC, civilian workers, December 2013

Occupational group	Compensation measure	Cost per hour worked		Standard error	Confidence interval	
		SOC 2000 definition	SOC 2010 definition		Lower bound	Upper bound
Service workers	Total compensation	$16.96	$16.66	$0.25	$16.55	$17.39
	Wages and salaries	11.98	11.84	.16	11.73	12.25
	Total benefits	4.97	4.82	.13	4.76	5.20
Transportation and material moving	Total compensation	25.36	26.04	.81	23.98	26.64
	Wages and salaries	16.69	17.00	.47	15.89	17.43
	Total benefits	8.67	9.04	.38	8.02	9.28
Registered nurses	Total compensation	49.51	48.66	.69	48.37	50.65
	Wages and salaries	34.62	33.83	.52	33.77	35.47
	Total benefits	14.89	14.83	.36	14.30	15.48

Source: U.S. Bureau of Labor Statistics, National Compensation Survey.

With the release of December 2013 estimates, the ECI introduced 2012 fixed employment weights to replace the 2002 fixed employment weights used from March 2006 to September 2013. As with the earlier weighting released with the March 2006 estimates, the new weights are based primarily on data from the BLS Occupational Employment Statistics survey. Changing the weights at approximately 10-year intervals preserves the analytical value of the Laspeyres index as a measure of change in labor costs over both the long run and varying subperiods. At the same time, BLS updated the SOC and NAICS classifications systems used in the ECI from 2002 SOC to 2010 SOC and from 2007 NAICS to 2012 NAICS. Reweighting and changes in SOC and NAICS classifications resulted in minimal disruptions to the historical continuity of the ECI. For the December 2013 seasonally adjusted series, existing seasonal factors were used for direct seasonal adjustment based on the continuity tests on the not-seasonally-adjusted data. With the March 2014 and subsequent revisions, the seasonal

factors will be based on 2002 weighted data up to the point of the reweighting and reweighted data thereafter. The methodology for indirect seasonal adjustment of aggregate series was modified to remove weight-change effects resulting from the reweighting. The method now includes an aggregation weight factor that was applied to the December 2013 estimates and must be recalculated and applied to subsequent estimates each year as part of the annual seasonal adjustment revision. The effects of the change from 2002 SOC to 2010 SOC on selected Employer Costs for Employee Compensation estimates were tested and found not to be statistically significant at the 90-percent confidence level.

Appendix: indirect seasonal adjustment aggregation adjustment factor

The formula for the indirect seasonal adjustment of a seasonal ECI series follows:[16]

$$\hat{A}_{jt}^{indirect} = \sum_{i}^{n_j} W_{ijt}\hat{A}_{ijt}$$

With the reweighting of the ECI in December 2013, the aggregation weights were updated to reflect new employment counts for the industry–occupation cells. Therefore, the aggregation weights for December 2013 (W_{ijt+1}) are not equal to the aggregation weights for September 20 (W_{ijt}). Without any adjustment, the September-to-December change across the weight revision would include both a cost-change effect and a weight-change effect for the indirect series:

$$\frac{\hat{A}_{jt+1}^{indirect}}{\hat{A}_{jt}^{indirect}} = \frac{\sum_{i}^{n_j} W_{ijt+1}\hat{A}_{ijt+1}}{\sum_{i}^{n_j} W_{ijt}\hat{A}_{ijt}} = \underbrace{\left(\frac{\sum_{i}^{n_j} W_{ijt+1}\hat{A}_{ijt+1}}{\sum_{i}^{n_j} W_{ijt+1}\hat{A}_{ijt}}\right)}_{\text{cost-change effect}} * \underbrace{\left(\frac{\sum_{i}^{n_j} W_{ijt+1}\hat{A}_{ijt}}{\sum_{i}^{n_j} W_{ijt}\hat{A}_{ijt}}\right)}_{\text{weight-change effect}}.$$

To ensure that the September-to-December change in an indirect seasonally-adjusted index reflects only the effect of the cost change, the December 2013 index was multiplied by an adjustment factor equal to $\left(\frac{\sum_{i}^{n_j} W_{ijt}\hat{A}_{ijt}}{\sum_{i}^{n_j} W_{ijt+1}\hat{A}_{ijt}}\right)$.

Thus, $Adjusted\ \hat{A}_{jt+1}^{indirect} = \sum_{i}^{n_j} W_{ijt+1}\hat{A}_{ijt+1} * \left(\frac{\sum_{i}^{n_j} W_{ijt}\hat{A}_{ijt}}{\sum_{i}^{n_j} W_{ijt+1}\hat{A}_{ijt}}\right)$.

After the adjustment to the December index, its change from the September index reflects the cost-change effect only.

$$\frac{Adjusted\ \hat{A}_{jt+1}^{indirect}}{\hat{A}_{jt}^{indirect}} = \left(\frac{\sum_{i}^{n_j} W_{ijt+1}\hat{A}_{ijt+1}}{\sum_{i}^{n_j} W_{ijt+1}\hat{A}_{ijt}}\right).$$

For each indirect seasonally adjusted series, the weight adjustment factor will remain constant, theoretically, for periods beyond *t*+1 (until a subsequent reweight) because it is based on the index values for September 2013. The weight adjustment factors will be revised slightly each March through 2018 because the seasonal factors for the directly-adjusted component series are revised each March as part of the ECI seasonal adjustment 5-year historical revision.

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NOTES

1 For a more detailed discussion of the Employment Cost Index and its uses, see John W. Ruser, "The Employment Cost Index: what is it?" *Monthly Labor Review* (U.S. Bureau of Labor Statistics, September 2001), pp. 3–16, https://www.bls.gov/opub/mlr/2001/09/art1full.pdf; see also "Chapter 8. National compensation measures," *BLS Handbook of Methods* (U.S. Bureau of Labor Statistics), https://www.bls.gov/opub/hom/pdf/homch8.pdf.

2 A Laspeyres index is an index that uses base-period quantities, such as employment counts, as weights to measure change over time. Because the weights are constant from year to year, indexes for a series can be compared over time.

3 Much of this article is based on three earlier articles discussing the shifts from the 1970–80, 1980–90, and 1990–2002 employment weights. For more information see Albert E. Schwenk, "Introducing new weights for the Employment Cost Index," *Monthly Labor Review* (June 1985), pp. 22–27, https://www.bls.gov/opub/mlr/1985/06/art3full.pdf; Albert E. Schwenk, "Introducing 1990 weights for the Employment Cost Index," *Compensation and Working Conditions* (U.S. Bureau of Labor Statistics, June 1995), pp. 1–5; and Stephanie L. Costo, "Introducing 2002 weights for the Employment Cost Index," *Monthly Labor Review* (U.S. Bureau of Labor Statistics, April 2006), pp. 28–32, https://www.bls.gov/opub/mlr/2006/04/art5full.pdf.

4 For more information on the OES program, see www.bls.gov/oes/home.htm. For more information on the QCEW program, see www.bls.gov/cew.

5 Includes data from both private industry and state and local government. Self-employed workers and farm and private household workers are excluded from private industry data. Federal government workers are excluded from the public sector.

6 Before March 2006, industries in the ECI were classified by the Standard Industrial Classification Manual, 1987 (Executive Office of the President, Office of Management and Budget, 1987) and occupations were classified by the 1990 *Standard Occupational Classification Manual*. See "Occupational Classification System Manual for the Employment Cost Index Survey Program," (U.S. Bureau of Labor Statistics, December 1993).

7 For a discussion of changes to occupational definitions for the SOC 2010 classification system, see Audrey L. Watson, "Implementing the 2010 Standard Occupational Classification in the Occupational Employment Statistics program," *Monthly Labor Review*, (U.S. Bureau of Labor Statistics, May 2013), pp. 36–49, available at https://www.bls.gov/opub/mlr/2013/05/art3full.pdf.

8 For example, Schwenk, “Introducing 1990 weights for the Employment Cost Index,” p. 4, compared ECI indexes and percent changes obtained by using 1980 weights with those obtained by using 1990 weights and found little difference between the two sets of weights. For further analysis of the sensitivity of the ECI, see Michael K. Lettau, Mark A. Loewenstein, and Steve P. Paben, “Is the ECI insensitive to the method of aggregation? An update,” *Monthly Labor Review*, December 2002, pp. 23–28, available at https://www.bls.gov/opub/mlr/2002/12/art3full.pdf.

9 It is difficult to determine at what point the difference between the fixed weights and more current weights is large enough to be important for economic analysis. The NCS program is currently investigating whether it would be appropriate to introduce new fixed weights more frequently than once about every 10 years.

10 For more information, see G. Donald Wood, "Estimation procedures for the Employment Cost Index," *Monthly Labor Review*, vol. 105, no. 5, May 1982, pp. 40–42, https://www.bls.gov/opub/mlr/1982/05/rpt3full.pdf.

11 The 1970 and 1980 fixed weights for the ECI were derived from the Census of Population for those years. For the 1990, 2002 and 2012 reweighting, the primary data source was the Occupational Employment Statistics survey.

12 If a series is not seasonal, the not-seasonally-adjusted index is used in the calculation.

13 Beginning with the March 2014 seasonal adjustment revision, seasonal factors will be estimated with the Census Bureau’s X–13–ARIMA–SEATS program, with no change in the ECI seasonal factor estimation methodology. Comparisons of estimation results from X–12–ARIMA and X–13ARIMA–SEATS shows that the same results were obtained.

14 For a brief summary of seasonal adjustment of the ECI, see www.bls.gov/ncs/ect/ectsfact.htm. For a more in-depth discussion about ECI seasonal adjustments, see E. Raphael Branch and Lowell Mason, “Seasonal adjustment in the ECI and conversion to NAICS and SOC,” *Monthly Labor Review* (U.S. Bureau of Labor Statistics, April 2006), pp. 12–21, https://www.bls.gov/opub/mlr/2006/04/art3full.pdf; see also E. Raphael Branch, “Changes in the publication of seasonally adjusted Employment Cost Index series,” Monthly Labor Review (U.S. Bureau of Labor Statistics, March 2013), pp. 68–85, https://www.bls.gov/opub/mlr/2013/03/art5full.pdf.

15 For more information on constructing confidence intervals, see Albert E. Schwenk, “Measuring Trends in the Structure and Levels of Employer Costs for Employee Compensation,” *Compensation and Working Conditions*, (U.S. Bureau of Labor Statistics, Summer, 1997), p. 14, https://www.bls.gov/opub/mlr/cwc/measuring-trends-in-the-structure-and-levels-of-employer-costs-for-employee-compensation.pdf.

16 For the formula for the indirect seasonal adjustment of an ECI seasonal series, see E. Raphael Branch, "Changes in the publication of seasonally adjusted Employment Cost index series,” *Monthly Labor Review,* (U.S. Bureau of Labor Statistics, March 2013), p. 84, https://www.bls.gov/opub/mlr/2013/03/art5full.pdf.

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