

## Changes in the publication of seasonally adjusted Employment Cost Index series

*Various factors have influenced the publication of ECI seasonally adjusted series, increasing the number of series published; these factors include the transition to NAICS and SOC, new publication procedures, the seasonal status of a series, and improvements in ECI processing*

E. Raphael Branch

Since the first seasonally adjusted Employment Cost Index (ECI) data were published in the December 1990 ECI news release, which contained 33 seasonally adjusted series, the Bureau of Labor Statistics (BLS) has periodically introduced improvements to the publication of ECI seasonally adjusted data.<sup>1</sup> That first release of data included a total of 43 series in the seasonally adjusted data table, 10 of which were not seasonally adjusted because no measurable seasonality was found. In September 1991, 3 more series were added to the list of candidates for seasonal adjustment, and 37 of the 46 series published in the seasonal adjustment table were seasonally adjusted. From September 1991 through 2005, the year before major changes were introduced into the ECI, the number of series published in the seasonal adjustment table remained the same, at 46, and by 2005, 44 of them were seasonally adjusted. Except for the additions in 1991, from 1990 through 2005 changes in the number of seasonally adjusted series were due solely to changes in the seasonal status of the series. Beginning with the March 2006 estimates, however, changes in the publication of seasonally adjusted series were due not only to changes in the seasonal status of a series, but also to changes in how ECI data are classified, published,

and processed. As of 2012, the ECI news release contains 136 candidate series for seasonal adjustment, and 132 seasonally adjusted series are published each quarter, providing users with more extensive information on changes in the cost of wages and benefits, free from the effects of events that follow regular patterns each year. This article describes the changes implemented by BLS and their effect on the availability of seasonally adjusted data.

The Employment Cost Index (ECI) is a measure of change in the cost of labor, without the influence of shifts in occupational and industry employment. The ECI, which is part of the National Compensation Survey, is a Principal Federal Economic Indicator, which means that it is one of the major statistical series that describe the current condition of the economy of the United States. Uses of the ECI include formulating monetary policy, adjusting wages in long-term contracts, and indexing hospital charges for Medicare reimbursement, to name a few.<sup>2</sup>

BLS publishes ECI estimates for civilian,<sup>3</sup> private industry, and state and local government workers by occupational and industry groups, excluding federal government workers, self-employed workers, and households. Published ECI estimates include indexes, 3-month percent changes, and 12-month percent changes for total compensation, wages and salaries, and benefits costs.<sup>4</sup> These data are published each quarter in the ECI news release and in histori-

E. Raphael Branch is an economist in the Office of Compensation and Working Conditions, Bureau of Labor Statistics. E-mail: branch.raphael@bls.gov.

cal listings.<sup>5</sup> Selected ECI series are seasonally adjusted and published in tables 1 through 3 of the ECI news release and the current-dollar ECI historical listings.<sup>6</sup> Each year, historical revisions to seasonally adjusted indexes, 3-month percent changes, and revised seasonal factors for the coming year are published 2 days before the release of the March ECI data. When the March ECI estimates are released, the seasonally adjusted revisions appear in the current-dollar historical listing. BLS also publishes ECI data in LABSTAT, the agency's public database on the Internet.<sup>7</sup>

Seasonal adjustment is a procedure that removes from an economic data series the effects of events that follow a more or less regular pattern each year. Examples of such events are increased construction activities during warm weather and school openings in the fall of the year. Removing these effects from an economic data series makes it easier for analysts to observe the long-run and cyclical changes in the series. Seasonal effects are reflected in many economic data series, including most of the Employment Cost Index series. For example, seasonally adjusted estimates for state and local government education services are substantially different from the estimates that are not seasonally adjusted, as shown in table 1.

The set of seasonally adjusted series in ECI publications has changed each year since BLS began publishing the ECI classified by the North American Industry Classification System (NAICS)<sup>8</sup> and the Standard Occupational Classification (SOC)<sup>9</sup> system in the March 2006 ECI news release. The changes are due to four main factors: (1) the ECI transition from the Standard Industrial Classification system (SIC)<sup>10</sup> and the Occupational Classification System (OCS)<sup>11</sup> to NAICS and SOC, respectively,<sup>12</sup> (2) a change in how estimates are published in the seasonally adjusted data tables, (3)

changes in the seasonal status of particular series, and (4) improvements in ECI production systems.

The first section discusses the seasonal adjustment methodology used in the ECI and how a seasonally adjusted series is chosen for publication. The next four sections of the article contain details about the four factors that influenced the publication of seasonally adjusted series from March 2006 to March 2011. The sixth section includes a comparison of the March 2006 and March 2011 seasonally adjusted ECI data series; it highlights the differences between the two sets of series and relates them to the factors that influenced their publication. The article ends with a summary that includes implications for the future.

### Seasonal adjustment methodology

Seasonal adjustment of the ECI is calculated by two methods, direct and indirect. Direct seasonal adjustment of the ECI is calculated by dividing an original index by its seasonal factor, the estimated value of the seasonal component of the series. Seasonal factors are estimated with X-12-ARIMA<sup>13</sup> and a 10-year data span<sup>14</sup> that ends with the most recent year of data that are available. The estimated seasonal factors for the most recent year of available data are used as projected seasonal factors for the coming year. Indirect seasonal adjustment is calculated as a weighted sum of directly adjusted component indexes.<sup>15</sup> ECI seasonally adjusted indexes and 3-month percent changes are subject to revision for 5 years. The revision is conducted annually after the production and release of December ECI estimates. This timing provides for the inclusion of a full year of the most recent data in the data span, which is required as part of the ECI seasonal adjustment methodology. (For examples of direct and indirect seasonal adjustment calculations, see the appendix.)

As part of the ECI direct seasonal adjustment methodology, three quality control statistics produced by the X-12-ARIMA program are used to evaluate seasonality in an ECI series: the F

**Table 1. ECI 3-month percent changes in education services, seasonally adjusted and not seasonally adjusted, 2006–2012**

Year	March		June		September		December	
	Not Seasonally adjusted	Seasonally adjusted	Not Seasonally adjusted	Seasonally adjusted	Not Seasonally adjusted	Seasonally adjusted	Not Seasonally adjusted	Seasonally adjusted
2006	0.1	0.5	0.3	0.8	2.6	1.5	0.4	0.6
2007	.3	.7	.2	.6	2.1	1.1	.7	.9
2008	.4	.7	.5	.9	2.0	1.0	.2	.5
2009	.3	.5	.3	.5	.9	.1	.2	.5
2010	.2	.4	.1	.4	.7	.0	.2	.4
2011	.2	.4	.0	.2	.5	.0	.1	.3
2012	.2	.4	.1	.3	.8	.2	.1	.3

statistic for stable seasonality ( $F_s$ ), the M7 statistic, and the Q statistic. An F statistic greater than 7.0 ( $F_s > 7.0$ ) indicates stable seasonality.<sup>16</sup> The M7 statistic measures the amount of moving seasonality<sup>17</sup> relative to the amount of stable seasonality. A value of M7 less than 1.0 ( $M7 < 1.0$ ) indicates identifiable seasonality. The Q statistic is a weighted sum of 11 quality control statistics (M1–M11) that measures the quality of seasonal adjustment.<sup>18</sup> A value of Q less than 1.0 ( $Q < 1.0$ ) indicates acceptable quality of the seasonal adjustment. For the ECI, the BLS uses the M7 and Q statistics together to assess identifiable seasonality; both values must be less than 1.0 to confirm identifiable seasonality. If both stable seasonality and identifiable seasonality are found ( $F_s > 7.0$ ,  $M7 < 1.0$ , and  $Q < 1.0$ ), then the series is declared seasonal; otherwise, it is declared that seasonality was not found. The ECI seasonal adjustment methodology also includes inspection of graphs of the original and seasonally adjusted index time series, seasonal factors, spectra of the seasonally adjusted and original series, and spectra of the irregular component.<sup>19</sup>

Once the seasonal status of an ECI series is determined on the basis of the three quality control statistics, BLS uses the following guidelines to determine when to seasonally adjust a series for publication and when to discontinue seasonal adjustment: (1) when seasonality is first found, a series is seasonally adjusted, and (2) when seasonality is not found for three consecutive revisions, seasonal adjustment is discontinued. The first guideline helps avoid residual seasonality in indirectly adjusted series. (Residual seasonality is a seasonal effect that can be estimated but remains in a seasonally adjusted series.) For instance, if seasonality is found in a series and seasonal adjustment is delayed to obtain more years of seasonal results, seasonality would remain in the series and in all of the aggregates of which it is a component until the series is seasonally adjusted. Seasonally adjusting a series when seasonality is first found helps solve this problem. The second guideline helps reduce the frequency of publication changes. Until seasonality is not found for three consecutive revisions, a series in which seasonality has been found at any revision within the 3-year period is treated as seasonal and continues to be seasonally adjusted. For direct seasonally adjusted series, once the decision is made to seasonally adjust an index, the series is designated for publication if its corresponding original series is published. The effect of the second guideline on publication is discussed further in the section entitled “Changes in seasonal status.”

After decisions concerning direct seasonal adjustment have been made, aggregate series are evaluated for indirect seasonal adjustment. An aggregate series is seasonally adjusted by the indirect method if any of its component

series are seasonally adjusted. Conversely, if none of the components are seasonally adjusted, the aggregate series is not seasonally adjusted. Next, seasonally adjusted 3-month percent changes are derived from the seasonally adjusted indexes. (For details on the percent change calculation, see the appendix.)

Exhibits 1 and 2 highlight how seasonal adjustment decisions are made when the guidelines are applied, using the retail trade industry wages and salaries series as of the 2010 and 2011 revisions, respectively. Seasonally adjusted estimates for this series were first published by NAICS and SOC in the March 2006 ECI news release. The series was discontinued from publication with the March 2010 ECI release, as seasonality was not found in three consecutive revisions. Seasonality was found in the March 2011 revision, and publication of the seasonally adjusted series resumed with the March 2011 ECI release. Exhibit 1 shows quality control statistics for three revisions that indicate no seasonality for the 2010 revision; therefore, in 2010 the series was not seasonally adjusted and no seasonal factors or seasonally adjusted revisions or current-year estimates were published. Exhibit 2 shows quality control statistics and projected seasonal factors for the same series from the 2011 revision. The 2011 quality control statistics indicate that the series is seasonal. Accordingly, the series is seasonally adjusted with 2010 seasonal factors from the 2011 revision used as projected seasonal factors for the 2011 current-quarter estimates.

The ECI historical indexes and 3-month percent changes for the private industry retail trade wages and salaries series are shown in table 2. The 2011 revision of historical seasonally adjusted data includes the estimates for 2006 through 2010. Estimates for years earlier than 2006 are final, as their 5-year revision periods have expired.

### Transition to NAICS and SOC

With the introduction of NAICS and SOC in the March 2006 ECI news release, BLS published 49 seasonally adjusted series. The set of series is similar in level of aggregation or summation to that formerly published under SIC and OCS. As part of the transition, estimates for two SIC categories and two OCS categories were published along with the NAICS and SOC estimates for 1 year. Transitional estimates for private manufacturing durable goods and nondurable goods, which do not exist in NAICS, and transitional estimates for white-collar and blue-collar occupations, which do not exist in SOC, were included among the original (not-seasonally-adjusted) published estimates and seasonality was found in them.<sup>20</sup>

**Exhibit 1. Seasonal adjustment decisions for ECI retail trade wages and salaries, 2010 ECI seasonal adjustment revision**

In the 2010 revision, seasonality was not found for three consecutive revisions. Seasonal adjustment and publication of the seasonally adjusted private industry retail trade wages and salaries estimates were discontinued for all four quarters of 2010 because the guidelines call for discontinuing seasonal adjustment when seasonality is not found in three consecutive revisions, as shown in the following table:

*Quality control statistics and seasonality status by revision*

Revision	Fs_	M7_	Q	Seasonality status
2008	4.047	1.229	0.93	Not seasonal
2009	2.529	1.368	0.94	Not seasonal
2010	4.422	0.975	0.86	Not seasonal

No projected seasonal factors were published for 2010 because seasonality was not found in the series. No revisions to historical seasonally adjusted indexes and 3-month percent changes were published.

**Exhibit 2. Seasonal adjustment decisions for ECI retail trade wages and salaries, 2011 ECI seasonal adjustment revision**

Seasonality was found in the 2011 revision. The private industry retail trade wages and salaries index was seasonally adjusted and published in 2011; the guidelines call for seasonally adjusting a series when seasonality is first found.

*Quality control statistics and seasonality status by revision*

Revision	Fs_	M7_	Q	Seasonality status
2009	2.529	1.368	0.94	Not seasonal
2010	4.422	0.975	0.86	Not seasonal
2011	10.075	0.677	0.63	Seasonal

Seasonal factors for the last year of the data span (2010) are used as projected seasonal factors for 2011. Five years of historical seasonally adjusted indexes and 3-month percent changes are revised and published. The projected seasonal factors are shown in the following table:

*Projected Seasonal factors*

Reference year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2011	0.9978466	1.0011608	1.0017605	0.9990753

When the March 2007 ECI data were released, BLS began publishing estimates for five high-level SOC groups and eight intermediate SOC groups, and the series in which seasonality was found were seasonally adjusted.<sup>21</sup> The first column of exhibit 3 shows the seasonally adjusted SOC group series that were published with the March 2007 ECI data. These series include 13 total compensation series, 12 wages and salaries series, and 5 benefits series. The previously published OCS group series were discontinued. BLS also discontinued the publication of the seasonally adjusted durable goods and nondurable goods series concurrently with the discontinuance of the original series. The second column of exhibit 3 shows the seasonally adjusted occupation and industry group series that were discontinued beginning with the March 2007 ECI release.

**Change in publication procedure**

Beginning with the March 2006 ECI news release, BLS revised its publication procedure. In the news releases covering the period from December 1990 to December 2005, the set of seasonally adjusted series was the same each year, with the exception of nonmanufacturing series, which were introduced in the September 1991 release. However, seasonality was not found in all of the series that were published among the seasonally adjusted data. These series complete the industry and occupational group content within aggregate categories and are accompanied by a footnote explaining that identifiable seasonality was not found. For example, in the release for March 2005, the wages and salaries series for the SIC category titled “transportation and public utilities” is included among the seasonally adjusted data accompanied by the footnote, “No identifiable seasonality was found for this series.” Beginning with the March 2006 ECI news release, BLS has excluded series in which seasonality is not found from the seasonally adjusted data. Therefore, when using ECI seasonally adjusted data, users need to take into account that the published series within aggregate industry or occupational groups may represent less than the entire aggregate.

The procedure for the publication of seasonally adjusted data in the historical listing and in LABSTAT has changed. Like the news releases, the historical listing excludes series in which seasonality was not found, with the exception of previously published estimates. First estimates of seasonally adjusted series begin with 5 years of historical data. For instance, the seasonally adjusted series first published by NAICS and SOC in the March 2006 ECI news release were accompanied by data in the historical listing that be-

Year	Not seasonally adjusted				Seasonally adjusted			
	Mar.	June	Sep.	Dec.	Mar.	June	Sep.	Dec.
	Index							
2001	88.7	89.3	90.0	91.6	88.7	89.1	89.9	91.9
2002	91.5	93.2	93.2	93.0	91.5	93.1	93.2	93.1
2003	93.2	93.8	95.3	95.3	93.2	93.7	95.3	95.4
2004	95.8	96.7	96.9	97.4	95.9	96.6	96.8	97.4
2005	98.0	98.8	99.6	100.0	98.1	98.7	99.5	100.0
2006	100.5	100.9	101.9	102.8	100.7	100.9	101.8	102.8
2007	103.1	104.2	105.1	106.1	103.3	104.2	105.0	106.1
2008	106.4	107.6	108.1	108.1	106.6	107.5	107.9	108.1
2009	108.3	108.9	110.0	110.4	108.5	108.8	109.8	110.5
2010	111.0	112.0	112.0	112.0	111.2	111.9	111.8	112.1
2011	112.2	113.1	—	—	112.4	113.0	—	—
	3-month percent change							
2001	1.4	0.7	0.8	1.8	1.0	0.5	0.9	2.2
2002	-.1	1.9	.0	-.2	-.4	1.7	.1	-.1
2003	.2	.6	1.6	.0	.1	.5	1.7	.1
2004	.5	.9	.2	.5	.5	.7	.2	.6
2005	.6	.8	.8	.4	.7	.6	.8	.5
2006	.5	.4	1.0	.9	.7	.2	.9	1.0
2007	.3	1.1	.9	1.0	.5	.9	.8	1.0
2008	.3	1.1	.5	.0	.5	.8	.4	.2
2009	.2	.6	1.0	.4	.4	.3	.9	.6
2010	.5	.9	.0	.0	.6	.6	-.1	.3
2011	.2	.8	—	—	.3	.5	—	—

NOTE: Dashes indicate that data were not available.

gin with 2001 estimates. The starting period of seasonally adjusted series introduced after 2006 varies with when the series was introduced. For example, the wages and salaries series for insurance carriers and related activities, seasonally adjusted, was first introduced with the March 2009 release, and the historical data begin with March 2004 estimates. When a seasonally adjusted series is discontinued from publication, the existing published estimates are not revised and the series is not published in the historical seasonal adjustment revision listing, which contains only the revised estimates; the current-dollar historical listing, which contains all the historical estimates, includes the historical seasonally adjusted estimates as they existed prior to the revision.<sup>22</sup>

### Changes in seasonal status

The final seasonal status of directly adjusted series and the seasonal status of indirectly adjusted series determine whether a published seasonally adjusted series is continued, added, or discontinued. As long as seasonality is found in a series it will be seasonally adjusted and published. The guideline for discontinuing seasonal adjustment, which calls for three consecutive revisions in which seasonality is not found in a series, has two effects on publication: (1) it reduces the frequency of publication changes that would be necessary if seasonal adjustment were discontinued when seasonality is not found more frequently, and (2) when seasonal adjustment is discontinued, publication

**Exhibit 3. Changes in seasonally adjusted Employment Cost Index series in the March 2007 ECI news release, private industry**

SOC series introduced	OCS and SIC series discontinued
<p><b>News release table 1 – total compensation</b></p> <p>Management, professional, and related  Management, business, and financial  Professional and related</p> <p>Sales and office  Sales and related  Office and administrative support  Natural resources, construction, and maintenance  Construction, extraction, farm, fishing, and forestry  Installation, maintenance, and repair  Production, transportation, and material moving  Production  Transportation and material moving  Service occupations</p>	<p><i>Occupational group</i></p> <p>White-collar occupations  Blue-collar occupations</p> <p><i>Industry</i></p> <p>Durable goods  Nondurable goods</p>
<p><b>News release table 2 – wages and salaries</b></p> <p>Management, professional, and related  Management, business, and financial  Professional and related</p> <p>Sales and office  Sales and related  Office and administrative support  Natural resources, construction, and maintenance  Construction, extraction, farm, fishing, and forestry  Installation, maintenance, and repair  Production, transportation, and material moving  Transportation and material moving</p>	<p><i>Occupational group</i></p> <p>White-collar occupations  Blue-collar occupations</p> <p><i>Industry</i></p> <p>Durable goods  Nondurable goods</p>
<p><b>News release table 3 – benefits</b></p> <p>Management, professional, and related  Sales and office  Natural resources, construction, and maintenance  Production, transportation, and material moving  Service occupations</p>	<p><i>Occupational group</i></p> <p>White-collar occupations  Blue-collar occupations</p>

NOTE: Estimates for wages and salaries for service occupations did not appear in the March 2007 release because seasonality was not found for the series in the 2007 seasonal adjustment revision.

of the seasonally adjusted series is discontinued and the historical data are not revised.

Changes in seasonal status occur at each revision, and under the new publication procedure the set of published seasonally adjusted series has the potential to change with each revision. Exhibit 4 shows the changes to published seasonally adjusted series through 2011. Beginning with March 2007 data, at each revision at least one seasonally adjusted series has been published for the first time because seasonality was found in the series. The first part of exhibit 4 shows these additions. The second part of exhibit 4 shows the discontinued series. Since the ECI transition to NAICS and SOC, the first time a seasonally adjusted series was discontinued because of a change in seasonal status was with the release of the March 2010 ECI estimates. Although seasonality was not found in some of the published seasonally adjusted series during the 2007 through 2009 revisions, seasonal adjustment of the series continued because seasonality had not been found for three consecutive revisions. Changes in seasonal status affect all the ECI products that contain seasonally adjusted data: the ECI news releases, the seasonal adjustment revision historical listings, the current-dollar ECI historical listings, the seasonal factor tables, and the data available in LABSTAT.

### **Production system improvements**

Two improvements to the production systems contributed to the substantial increase in the number of seasonally adjusted series that were published between the March 2006 and March 2011 ECI news releases. The first improvement is a redesigned computer system for the seasonal adjustment revision.<sup>23</sup> The second improvement is a new ECI quarterly production system implemented in 2006 with the ECI transition to NAICS and SOC. Improving the systems especially facilitated the large increase of 59 new series published in the March 2008 release. The additional seasonally adjusted series resulted in a closer match with the published set of original series. Exhibit 5 shows the added series, which include more detailed seasonally adjusted industry series for civilian, private industry, and state and local government workers.

### **Comparison of March 2006 and March 2011 published series**

Exhibits 6 through 8 compare series in the March 2006 and March 2011 ECI news releases in order to show how the four factors that influence the publication of seasonally

adjusted estimates contributed to the increased number of series. These exhibits show a list of the series that appear as tables 1 through 3 in the ECI news releases for seasonally adjusted total compensation, wages and salaries, and benefits series, respectively. Total compensation series, which are seasonally adjusted by the indirect seasonal adjustment method, reflect changes in the seasonal status of their wages and salaries and benefits components. If a wages and salaries or benefits component is seasonally adjusted, the total compensation series is seasonally adjusted and published in table 1 of the news release. (In fact, any aggregate series is seasonally adjusted if any of its component series are seasonally adjusted.)

The published total compensation series necessarily include all of the industry and occupational series that appear in the wages and salaries and benefits data. However, the published seasonally adjusted total compensation data may include series not published in the seasonally adjusted wages and salaries and benefits data. In these cases, seasonality was not found in the wages and salaries series, and seasonality was found in the corresponding benefits series, but the series is not published in the original data, and consequently, it is not published in the seasonally adjusted data. For example, the March 2011 list in exhibit 6 shows that seasonally adjusted total compensation estimates are published for civilian and private industry nursing and residential care facilities and for private industry real estate rental and leasing, but there are no corresponding published seasonally adjusted wages and salaries or benefits series in exhibits 7 and 8. Because seasonality was not found in the wages and salaries series and the benefits series (in which seasonality was found) are not published, only the total compensation series is published. Changing seasonal status is also reflected in exhibits 7 and 8, in which lower level wages and salaries and benefits series are seasonally adjusted directly, and aggregate wages and salaries and benefits series are seasonally adjusted indirectly.

Exhibit 6 shows seasonally adjusted total compensation series published in the March 2006 and March 2011 ECI news releases. The list of series in the March 2006 release shows the OCS white-collar and blue-collar occupational groups and the SIC durable goods and nondurable goods industry groups that were retained until the following year as part of the ECI transition to NAICS and SOC. By comparison, the March 2011 release includes SOC groups only, which replaced the OCS groups, and the durable goods and nondurable goods industry groups are not in the table. Reflecting the new publication procedure, the total compensation series for service occupations is

**Exhibit 4. Changes to publication due to change in seasonal status of a series**

Revision	Series	Measure	Seasonal status change
<b>Additions</b>			
2007	Private wholesale trade	Total compensation	Seasonality was found in the benefit cost series (unpublished) for the first time. (Seasonality was not found in the wages and salaries series.)
	Private service occupations	Total compensation	Seasonality was found in the benefit cost series (unpublished) for the first time. (Seasonality was not found in the wages and salaries series.)
	Private service occupations	Benefits cost	Seasonality was found in the series for the first time.
2008	Private other services, except public administration	Wages and salaries	Seasonality was found in the series for the first time.
2009	Private insurance carriers and related activities	Wages and salaries	Seasonality was found in the series for the first time.
	Private production occupations	Wages and salaries	Seasonality was found in the series for the first time.
2010	Private real estate and rental and leasing	Total compensation	Seasonality was found in the benefit cost series (unpublished) for the first time. (Seasonality was not found in the wages and salaries series.)
2011	Private retail trade	Wages and salaries	Seasonality was found in the series after it had not been found in the last three revisions and had been discontinued from publication in 2010.
	Private service occupations	Wages and salaries	Seasonality was found in the series for the first time.
<b>Discontinuations</b>			
2010	Private wholesale trade	Total compensation	Seasonality was not found in the benefits cost series for three consecutive revisions. Seasonality has not been found in the wages and salaries series.
	Civilian nursing and residential care	Wages and salaries	Seasonality was not found in the State and local governments nursing and residential care wages and salaries series for three consecutive revisions. Seasonality has not been found in the private industry nursing and residential care wages and salaries series.
	Private retail trade	Wages and salaries	Seasonality was not found for three consecutive revisions.
	Private Aircraft manufacturing	Total benefit costs	Seasonality was not found for three consecutive revisions



**Exhibit 5. Seasonally adjusted Employment Cost Index series added to publication in March 2008, facilitated by production system improvements**

**News release table 1 – total compensation**

**Civilian workers**

1. Goods-producing industries
2. Manufacturing
3. Service-providing industries
4. Education and health services
5. Education services
6. Elementary and secondary schools
7. Junior colleges, colleges, universities, and professional schools
8. Healthcare and social assistance
9. Hospitals
10. Nursing and residential care facilities
11. Public administration

**Private industry workers**

12. Aircraft manufacturing
13. Transportation and Warehousing
14. Utilities
15. Finance and insurance
16. Credit intermediation
17. Insurance carriers and related activities
18. Professional, scientific, and technical
19. Administrative and support and waste management and remediation services
20. Junior colleges, colleges, universities, and professional schools
21. Hospitals
22. Nursing and residential care facilities
23. Accommodation and food services

**State and local government workers**

24. Education and health services
25. Education services
26. Schools
27. Elementary and secondary schools
28. Health care and social assistance
29. Hospitals
30. Public administration

**News release table 2 – wages and salaries**

**Civilian workers**

31. Goods-producing industries
32. Manufacturing
33. Service-providing industries
34. Education and health services
35. Education services
36. Elementary and secondary schools
37. Junior colleges, colleges, universities, and professional schools
38. Healthcare and social assistance
39. Hospitals
40. Nursing and residential care facilities
41. Public administration

**Private industry workers**

42. Aircraft manufacturing
43. Transportation and Warehousing
44. Utilities
45. Finance and insurance
46. Credit intermediation and related activities
47. Professional, scientific, and technical services
48. Administrative and support and waste management and remediation services
49. Junior colleges, colleges, universities, and professional schools
50. Hospitals
51. Accommodation and food services

**State and local government workers**

52. Education and health services
53. Education services
54. Schools
55. Elementary and secondary schools
56. Health care and social assistance
57. Hospitals
58. Public administration

**News release table 3 – benefits**

**Private industry workers**

59. Aircraft manufacturing

NOTE: Seasonally adjusted estimates for private industry wages and salaries for the Other Services except public administration industry

was also published in the March 2008 release due to a change in seasonality, bringing the total number of newly published series to 60.

**Exhibit 6. Seasonally adjusted Employment Cost Index total compensation series, by occupational group and industry, March 2006 and March 2011 news releases**

March 2006 news release	March 2011 news release
<p><b>Civilian workers</b> All workers</p> <p><b>Private industry workers</b> All workers</p> <p><i>Occupational group</i> White-collar occupations</p> <p>Blue-collar occupations</p> <p><i>Industry</i> Goods-producing industries Construction. Manufacturing Durable goods Nondurable goods Service-providing industries Trade, transportation, and utilities Retail trade</p> <p>Information Financial activities</p>	<p><b>Civilian workers</b> All workers</p> <p><i>Industry</i> Goods-producing industries Manufacturing Service-providing industries Education and health services Education services Elementary and secondary schools Junior colleges, colleges, universities, and professional schools Health care and social assistance Hospitals Nursing and residential care facilities Public administration</p> <p><b>Private industry workers</b> All workers</p> <p><i>Occupational group</i> Management, professional, and related Management, business, and financial Professional and related Sales and office Sales and related Office and administrative support Natural resources, construction, and maintenance Construction, extraction, farming, fishing, and forestry Installation, maintenance, and repair Production, transportation, and material moving Production Transportation and material moving</p> <p>Service occupations</p> <p><i>Industry</i> Goods-producing industries Construction Manufacturing Aircraft manufacturing</p> <p>Service-providing industries Trade, transportation, and utilities Retail trade Transportation and warehousing Utilities Information Financial activities Finance and insurance Credit intermediation and related activities Insurance carriers and related activities Real estate and rental and leasing</p>

<b>Exhibit 6. Continued—Seasonally adjusted Employment Cost Index total compensation series, by occupational group and industry, March 2006 and March 2011 news releases</b>	
<b>March 2006 news release</b>	<b>March 2011 news release</b>
Professional and business services	Professional and business services Professional, scientific, and technical services Administrative and support and waste management and remediation services
Education and health services Education services	Education and health services Education services Junior colleges, colleges, universities, and professional schools
Health care and social assistance	Health care and social assistance Hospitals Nursing and residential care facilities
Leisure and hospitality	Leisure and hospitality Accommodation and food services
Other services, except public administration	Other services, except public administration
<b>State and local government workers</b> All workers	<b>State and local government workers</b> All workers <i>Industry</i> Education and health services Education services Schools Elementary and secondary schools Health care and social assistance Hospitals Public administration

omitted from the March 2006 release because seasonality was not found in either the wages and salaries or the benefits series. However, seasonality was found in the service occupations benefits series in the 2011 revision, and consequently the total compensation series is seasonally adjusted and published in the March 2011 estimates. Also in the March 2011 release, wholesale trade compensation is omitted because seasonality was not found in the wages and salaries or benefits series. Lastly, the March 2011 release has more detailed industry and occupational series than the March 2006 release; it includes civilian industry series, private sector intermediate SOC aggregations, and

selected industry groups at the three-digit NAICS level. These series represent a gain associated with the system improvements.

Exhibit 7 presents seasonally adjusted wages and salaries series published in the March 2006 and March 2011 ECI news releases. This exhibit shows the influence of all four factors affecting the publication of seasonally adjusted estimates. The effects of changes in the seasonal status of series are visible in the directly adjusted series. For example, the seasonally adjusted wages and salaries series for service occupations was published for the first time in the March 2011 release. The effect of the new publication procedure is



**Exhibit 7. Continued—Seasonally adjusted Employment Cost Index wages and salaries series, by occupational group and industry, March 2006 and March 2011 news releases**

March 2006 news release	March 2011 news release
<p>Service-providing industries</p> <p>Trade, transportation, and utilities</p> <p>Retail trade</p> <p>Information</p> <p>Financial activities</p> <p>Professional and business services</p> <p>Education and health services</p> <p>Education services</p> <p>Health care and social assistance</p> <p>Leisure and hospitality</p> <p><b>State and local government workers</b></p> <p>All workers</p>	<p>Service-providing industries</p> <p>Trade, transportation, and utilities</p> <p>Retail trade<sup>2</sup></p> <p>Transportation and warehousing</p> <p>Utilities</p> <p>Information</p> <p>Financial activities</p> <p>Finance and insurance</p> <p>Credit intermediation and related activities</p> <p>Insurance carriers and related activities</p> <p>Professional and business services</p> <p>Professional, scientific, and technical services</p> <p>Administrative and support and waste management and remediation services</p> <p>Education and health services</p> <p>Education services</p> <p>Junior colleges, colleges, universities, and professional schools</p> <p>Health care and social assistance</p> <p>Hospitals</p> <p>Leisure and hospitality</p> <p>Accommodation and food services</p> <p>Other services, except public administration</p> <p><b>State and local government workers</b></p> <p>All workers</p> <p><i>Industry</i></p> <p>Education and health services</p> <p>Education services</p> <p>Schools</p> <p>Elementary and secondary schools</p> <p>Health care and social assistance</p> <p>Hospitals</p> <p>Public administration</p>

<sup>1</sup> Seasonally adjusted indexes and 3-month percent changes for this series are being published for the first time with the 2011 seasonal adjustment revisions. Historical data for this series are published beginning with March 2006.

<sup>2</sup> The retail trade wages and salaries series is seasonal as of the 2011 revision. Seasonality was first found in the 2006 revision and the series continued to be seasonally adjusted until the 2010 revision, when it was continued for 1 year. Historical data for this series are published beginning with March 2001.

reflected in the absence of the wholesale trade wages and salaries series, which does not appear in either the March 2006 or March 2011 release; the series was neither seasonally adjusted nor published with the seasonally adjusted data, because seasonality was not found in it. The ECI transition to NAICS and SOC is evident in the March 2011 release, which shows the SOC series and does not show the white-collar and blue-collar series or the durable goods and nondurable goods series. Lastly, the increased number of published series in the March 2011 release reflects the production system improvements. There are more detailed NAICS categories in the March 2011 release than in the March 2006 release: credit intermediation and related activities; insurance carriers and related activities; and professional, scientific, and technical services are examples. (These series are footnoted in the March 2008 ECI news release as being seasonally adjusted for the first time.)

Exhibit 8 presents seasonally adjusted benefits series published in the March 2006 and March 2011 ECI news releases. This comparison shows the replacement of the Occupation Classification System (OCS) white- and blue-collar aggregate series with high-level SOC aggregations,

which were introduced in the March 2007 release as part of the ECI transition to NAICS and SOC. The service occupations series appears in the March 2011 news release as a result of a change in seasonal status that occurred with the March 2007 seasonal adjustment revision.

SINCE THE PUBLICATION of the March 2006 ECI, when BLS first published ECI data classified by NAICS and SOC, users have seen changes in the set of published seasonally adjusted series with each annual seasonal adjustment revision. This article has examined four factors that influenced these changes and their effect on the publication of seasonally adjusted ECI data: (1) The ECI transition to NAICS and SOC from SIC and OCS has led to the addition of more series and the discontinuance of series that are not defined in the new classifications. (2) Beginning with the March 2006 news release, a new publication procedure has been used for seasonally adjusted data. Before this change, selected series in which seasonality was not found were published with the seasonally adjusted data, accompanied by explanatory footnotes, in order to complete the representation of industry or occupational groups within aggregate categories. The cur-

**Exhibit 8. Seasonally adjusted Employment Cost Index benefits series, by occupational group and industry, March 2006 and March 2011 news releases**

March 2006 news release	March 2011 news release
<p><b>Occupational group and industry</b></p> <p><b>Civilian workers</b></p> <p>All workers</p> <p><b>Private industry workers</b></p> <p>All workers</p> <p><i>Occupational group</i></p> <p>White-collar occupations</p> <p>Blue-collar occupations</p> <p><i>Industry</i></p> <p>Goods-producing industries</p> <p>Manufacturing</p> <p>Service-providing industries</p> <p><b>State and local government workers</b></p> <p>All workers</p>	<p><b>Occupational group and industry</b></p> <p><b>Civilian workers</b></p> <p>All workers</p> <p><b>Private industry workers</b></p> <p>All workers</p> <p><i>Occupational group</i></p> <p>Management, professional, and related</p> <p>Sales and office</p> <p>Natural resources, construction, and maintenance</p> <p>Production, transportation, and material moving</p> <p>Service occupations</p> <p><i>Industry</i></p> <p>Goods-producing industries</p> <p>Manufacturing</p> <p>Service-providing industries</p> <p><b>State and local government workers</b></p> <p>All workers</p>

rent publication procedure calls for the exclusion from the seasonally adjusted data of series in which seasonality is not found. (3) Given the new publication procedure, a change in the seasonal status of a series, which takes into account guidelines for seasonal adjustment of the ECI, results in a change in the publication status of the series: it is either introduced into publication or discontinued. (4) Changes in ECI production systems have led to an increased number of published seasonally adjusted series.

The article compares the seasonally adjusted series published in the March 2006 ECI news release with those published in the March 2011 release in order to show the influence of the four factors on publication. Particularly evident is the substantial increase in the number of seasonally adjusted series published over the period. The article also provides information on how the seasonal

status of an ECI series is determined and how guidelines for seasonal adjustment influence the publication of ECI seasonally adjusted series.

In the future, users can look forward to annual revisions of seasonal factors and historical seasonally adjusted indexes and 3-month percent changes. The next revisions are scheduled to be released on Friday, April 26, 2013, 2 business days before the March 2013 ECI estimates are released. Users may see more changes in the set of seasonally adjusted series published from year to year, given that the seasonal status of ECI series may change, periodic revisions to NAICS and SOC may affect the ECI series, new publication approaches may be explored, and opportunities to publish more detail may arise. BLS is also considering updating the ECI seasonal adjustment methodology to use the X-13 ARIMA-SEATS seasonal adjustment program. □

## Notes

ACKNOWLEDGMENT: The author thanks James A. Buszuwski, Philip M. Doyle, Keenan Dworak-Fisher, Frances F. Harris, Natalie Kramer, Michael K. Lettau, Michelle Myers, Chester H. Ponikowski, Thomas G. Moehrl, Richard B. Tiller, William J. Wiatrowski, and Richard K. Yeast for reviewing this article and providing valuable comments.

<sup>1</sup> See *Employment Cost Index—December 1990*, USDL-91-31 (U.S. Bureau of Labor Statistics, January 29, 1991), [http://www.bls.gov/news.release/archives/eci\\_01291991.pdf](http://www.bls.gov/news.release/archives/eci_01291991.pdf). For a complete set of quarterly ECI news releases, see “Employment Cost Index Archived News Releases” (U.S. Bureau of Labor Statistics, February 1, 2013), [http://www.bls.gov/schedule/archives/eci\\_nr.htm](http://www.bls.gov/schedule/archives/eci_nr.htm).

<sup>2</sup> For more information on how the ECI is defined, see “National Compensation Measures,” *BLS Handbook of Methods* (U.S. Bureau of Labor Statistics), ch. 8, pp. 10–14, <http://www.bls.gov/opus/hom/pdf/homch8.pdf>.

<sup>3</sup> The National Compensation Survey defines civilian workers to include workers in private industry and state and local governments; it excludes federal and quasi-federal government, military and agricultural workers, private households, the self-employed, volunteers, unpaid workers, individuals receiving long-term disability compensation, and individuals working overseas.

<sup>4</sup> Total compensation as defined for the National Compensation Survey includes wages and salaries and employers’ costs of benefits. Benefits include paid leave—holidays, sick leave, and other leave; supplemental pay—premium pay for work in addition to the regular work schedule, shift differentials, and nonproduction bonuses (such as referral bonuses and lump sum payments provided in lieu of wage increases); insurance benefits—life, health, short-term disability, and long-term disability; retirement and savings benefits—defined benefit and defined contribution plans; and legally required benefits—Social Security, Medicare, Federal and State Unemployment Insurance, and Workers’ Compensation.

<sup>5</sup> For the most current ECI news release, see *Employment Cost Index—December 2012*, news release USDL-13-0143 (U.S. Bureau of La-

bor Statistics, January 31, 2013), [http://www.bls.gov/news.release/archives/eci\\_01312013.pdf](http://www.bls.gov/news.release/archives/eci_01312013.pdf). For earlier ECI news releases, see “Employment Cost Index Archived News Releases.”

<sup>6</sup> Various ECI historical listings are available on the BLS website; see “ECT Tables,” *Employment Cost Trends* (U.S. Bureau of Labor Statistics), <http://www.bls.gov/ncs/ect/#tables>. The current-dollar ECI historical listing provides data by NAICS and SOC; see “Current Dollar, March 2001–December 2012 (December 2005 = 100),” *Employment Cost Index Historical Listing—Volume III* (U.S. Bureau of Labor Statistics, January 2013), <http://www.bls.gov/web/eci/echistrynaics.pdf>.

<sup>7</sup> LABSTAT provides current and historical data for numerous BLS surveys and news releases. LABSTAT is composed of individual databases (in flat file format) corresponding to each of the surveys. For more information, see “LABSTAT Overview” (U.S. Bureau of Labor Statistics), <ftp://ftp.bls.gov/pub/doc/overview.txt>.

<sup>8</sup> Beginning with the release of March 2006 ECI data, industry groups were classified by the 2002 North American Industry Classification System (NAICS). Since the release of December 2007 ECI data, industries have been classified by the 2007 NAICS. For more information on the NAICS, see “North American Industry Classification System (NAICS) at BLS,” *BLS Information* (U.S. Bureau of Labor Statistics, September 9, 2011), <http://www.bls.gov/bls/naics.htm>.

<sup>9</sup> Beginning with the release of the March 2006 ECI, the non-seasonally-adjusted ECI occupation groups were classified by the 2000 Standard Occupational Classification (SOC) system. See *Standard Occupational Classification Manual: 2000* (Executive Office of the President, Office of Management and Budget, October 2000). See also “Standard Occupational Classification (SOC) User Guide,” *Standard Occupational Classification* (U.S. Bureau of Labor Statistics, December 2, 2004), <http://www.bls.gov/soc/2000/socguide.htm>.

<sup>10</sup> For more information on the SIC system, see *Standard Industrial Classification Manual, 1987* (Executive Office of the President, Office of Management and Budget, 1987); for a listing of the SIC classifications formerly used by the BLS, see “1987 Standard Industrial Classification (SIC) System” (U.S. Bureau of Labor Statistics), <ftp://ftp.bls.gov/pub/special.requests/oes/oessic87.pdf>.

<sup>11</sup> For more on the 1990 OCS, see *Occupational Classification System Manual for the Employment Cost Index Survey Program* (U.S. Bureau of Labor Statistics, December 1993).

<sup>12</sup> NAICS and SOC replaced the 1987 Standard Industrial Classification (SIC) system and the 1990 Occupational Classification System (OCS), respectively. For a discussion of the transition to NAICS and SOC, see “National Compensation Measures,” *BLS Handbook of Methods*, Chapter 8, pp. 3–4, <http://www.bls.gov/opub/hom/pdf/homch8.pdf>. See also Fehmida Sleemi, “Employment Cost Index publication plans,” *Monthly Labor Review*, April 2006, pp. 6–11, <http://www.bls.gov/opub/mlr/2006/04/art2full.pdf>; and Richard Carroll, “Changes affecting the Employment Cost Index, an Overview,” *Monthly Labor Review*, April 2006, pp. 3–5, <http://www.bls.gov/opub/mlr/2006/04/art1full.pdf>.

<sup>13</sup> The X-12-ARIMA seasonal adjustment program was developed by the Time Series Staff of the Statistical Research Division of the U.S. Census Bureau. For more details, see “The X-12-ARIMA program,” Census Bureau. As part of the seasonal adjustment procedure, a series is decomposed into three components: trend, seasonal, and irregular. For a detailed discussion of the decomposition calculations in X-12-ARIMA, see David F. Findley, Brian C. Monsell, William R. Bell, Mark C. Otto, and Bor-Chung Chen, “New Capabilities and Methods of the X-12-ARIMA Seasonal Adjustment Program” (U.S. Census Bureau, 1998), pp. 6–20, <http://www.census.gov/ts/papers/jbes98.pdf>.

<sup>14</sup> For more information on the 10-year time span, see E. Raphael Branch, James A. Buszuwski, Albert E. Schwenk, and Mark Gough, “Transitional Employment Cost Indexes for seasonal adjustment,” *Monthly Labor Review*, April 2008, pp. 25–39, <http://www.bls.gov/opub/mlr/2008/04/art3full.pdf>.

<sup>15</sup> Not all component series are seasonal. If a component series is not seasonal, the indirect seasonal adjustment calculation includes the original index.

<sup>16</sup> The critical value of 7.0 takes into account that some assumptions of the standard F-test may be violated. See J. Lothian and M. Morry, “A Test for the Presence of Identifiable Seasonality When Using the X-11-ARIMA Program” (Statistics Canada, October 1978), pp. 2–9. See also Dominique Ladiray and Benoît Quenneville, *Seasonal Adjustment with the X-11 Method* (New York, Springer-Verlag, 2001), pp. 57–58, 135–36.

<sup>17</sup> The term “moving seasonality” refers to changes in the seasonal variation in a series from year to year. An  $M7$  of less than 1.0 indicates that seasonality is identifiable by the X-11 seasonal adjustment rou-

time (enhanced as part of the X-12-ARIMA program). An  $M7$  greater than 1.0 indicates that either the series is not seasonal or seasonality in the series cannot be identified by X-11. For more details, see J. Lothian and M. Morry, “A Set of Quality Control Statistics for the X-11-ARIMA Seasonal Adjustment Method” (Statistics Canada, October 1978), pp. 11–12, <http://www.census.gov/ts/papers/LothianMorry1978.pdf>.

<sup>18</sup> For more details on the  $Q$  statistic, see Lothian and Morry, “A Set of Quality Control Statistics,” pp. 16–24.

<sup>19</sup> BLS reviews graphs of the seasonal factor estimates by quarter and graphs of the series that compare the original indexes with the seasonally adjusted indexes derived by X-12 ARIMA. In the ECI, because the seasonally adjusted and original indexes are often close or the same, differences in the time series graphs are often difficult to observe. Therefore, comparative spectrum graphs of the seasonally adjusted and original series are inspected to observe seasonal peaks in the series and their smoothing. Spectrum graphs of the irregular component are reviewed to help find residual seasonality. For more details on spectrum diagnostics, see Findley, Monsell, Bell, Otto, and Chen, “New Capabilities and Methods,” pp. 21–23.

<sup>20</sup> These aggregate estimates were created from data classified by SOC and NAICS, respectively. For more details on ECI computations and aggregation, see “National Compensation Measures,” pp.11–12.

<sup>21</sup> Construction and extraction occupations and farming, fishing, and forestry occupations are separate intermediate SOC groups that have been combined and counted as one intermediate SOC group.

<sup>22</sup> The durable goods and nondurable goods industry series are exceptions: these series were discontinued from publication but continued to be seasonally adjusted and revised. They are indirect seasonal adjustment components of the manufacturing series and were subject to revision. The two series were last published in 2006, and the 5-year period during which they were revised expired with the 2011 revision.

<sup>23</sup> For the ECI, BLS began using X-12-ARIMA, version 0.2.10, to estimate seasonal factors for the 1999 seasonal adjustment revision, along with the X-12-graph batch program for graphic analysis that was available at that time. BLS currently uses the X-12-graph batch program, version 1.4 for the ECI. For more details on X-12-ARIMA programs, see “The X-12-ARIMA program,” Census Bureau, <http://www.census.gov/srd/www/x12a/>. The Census Bureau has recently updated the seasonal adjustment programs. For details on the Census Bureau’s most currently available seasonal adjustment programs, see *X-13-ARIMA-SEATS Seasonal Adjustment Program* (U.S. Census Bureau) <http://www.census.gov/srd/www/x13as/>.



**Appendix. Direct and indirect seasonal adjustment example calculations**

**Example 1: Direct seasonal adjustment of the private industry retail trade wages and salaries index, June 2011**

Consider the formula<sup>1</sup>

$$\hat{A}_{it}^{direct} = \frac{O_{it}}{\hat{S}_{it}},$$

where  $\hat{A}_{it}^{direct}$  is an estimated seasonally adjusted Employment Cost Index (ECI), computed by the direct seasonal adjustment method, for industry or occupation series index  $i$  and ECI time period  $t$ .  $O_{it}$  is the original (not-seasonally-adjusted) ECI for the same industry or occupation, and reference period.  $\hat{S}_{it}$  is the seasonal factor for the same series and time period  $t$ . In the example calculation that follows index  $i$  is private industry retail trade wages and salaries, and time period  $t$  is the June 2011 ECI reference period. The seasonally adjusted index for retail trade wages and salaries for June 2011 is calculated as follows:

$$\hat{A}_{it}^{direct} = \frac{113.1}{1.0011608} = 112.96886$$

The resulting directly adjusted index, 112.96886, is then rounded to 113.0.

**Example 2: Indirect seasonal adjustment of the private industry trade, transportation, and utilities wages and salaries index, June 2011**

Consider the formula<sup>2</sup>

$$\hat{A}_{jt}^{indirect} = \sum_i^{n_j} (W_{ijt} \hat{A}_{ijt}), \quad (1)$$

where  $\hat{A}_{jt}^{indirect}$  is an estimated seasonally adjusted ECI, computed by the indirect seasonal adjustment method, for aggregate industry or occupation index  $j$  for time period  $t$ . Seasonally ad-

justed industry and occupation aggregate indexes are calculated as a weighted sum of seasonally adjusted industry or occupation component indexes, respectively;  $n_j$  is the number of component indexes  $i$  that comprise aggregate index  $\hat{A}_{jt}^{indirect}$ .  $W_{ijt}$  is the aggregation weight for component index  $i$  of aggregate index  $j$  for time period  $t$ .  $\hat{A}_{ijt}$  is an estimated seasonally adjusted ECI for a component industry or occupation index  $i$  for time period  $t$ , computed by the direct seasonal adjustment method. ( $\hat{A}_{ijt}$  is the same as  $\hat{A}_{it}^{direct}$  in example 1.)

The example calculations that follow are for wages and salaries of private industry trade, transportation, and utilities, an aggregate industry  $j$ , and time period  $t$  is the June 2011 ECI reference period. Table A-1 shows data for the calculation, which includes four component indexes ( $n_j=4$ ). Note that the wholesale trade wages and salaries index in the seasonally adjusted index column is not seasonally adjusted. When seasonality is not found in a series, the original index is used in the calculation.

Formula (1) can be written as follows:

$$\hat{A}_{jt}^{indirect} = W_{1jt} \hat{A}_{1jt} + W_{2jt} \hat{A}_{2jt} + \dots + W_{n_jjt} \hat{A}_{n_jjt}, \quad (2)$$

where  $n_j$  is the number of component indexes in the  $j^{\text{th}}$  aggregate industry or occupation index. Substituting values for the four component weights and indexes into formula 2 gives the following calculation:

$$\begin{aligned} \hat{A}_{jt}^{indirect} &= ((.287491)(108.5)) + ((.470420)(113.0)) \\ &+ ((.200630)(111.7)) + ((.041459)(117.8)) \\ &= 31.192773 + 53.157460 + 22.410371 + 4.883870 \\ &= 111.644474 \end{aligned}$$

The resulting indirectly adjusted index, 111.644474, is then rounded to 111.6. (In actual calculations, unrounded indexes are used in the indirect adjustment calculation.)

**Table A-1. Component indexes and weighting for indirect seasonal adjustment of ECI Trade, transportation, and utilities wages and salaries, private industry, June 2011**

Industry	Direct seasonally adjusted index ( $\hat{A}_{jt}$ )	Aggregation weight ( $W_{jt}$ )	Weighted index ( $W_{jt} \hat{A}_{jt}$ )
Wholesale trade	108.5	0.287491	31.192773
Retail trade	113.0	.470420	53.157460
Transportation and warehousing	111.7	.200630	22.410371
Utilities	117.8	.041459	4.883870

<sup>1</sup> Seasonality was not found in the ECI wholesale trade wages and salaries series; therefore, the original index is used in the indirect seasonal adjustment calculation.

**Example 3: Seasonally adjusted percent-change calculation for private industry retail trade wages and salaries, June 2011**

Consider the percent-change formula<sup>3</sup>

$$R_t = \frac{\hat{A}_t - \hat{A}_{t-1}}{\hat{A}_{t-1}} \times 100,$$

where  $R_t$  represents a rate of change in any seasonally adjusted ECI  $i$ , for time period  $t$ ,  $\hat{A}_t$  is an estimated seasonally adjusted ECI for the same series and time period  $t$ , and  $\hat{A}_{t-1}$  is the estimated seasonally adjusted ECI for the preceding quarterly (3-month) time period  $t-1$ . In the example that follows, index  $i$  is private industry retail trade wages and salaries and time period  $t$  is the June 2011 ECI reference period. The 3-month

percent change is calculated as follows, with the exception that BLS uses unrounded values in the calculation:

$$R_t = \frac{113.0 - 112.4}{112.4} \times 100 = .53381$$

The resulting percent change, 0.53381, is then rounded to 0.5.

---

**Notes**

<sup>1</sup> The formula is from E. Raphael Branch and Lowell Mason, "Seasonal adjustment in the ECI and Conversion to NAICS and SOC," *Monthly Labor Review*, April 2006, p. 13, <http://www.bls.gov/opub/mlr/2006/04/art3full.pdf>.

<sup>2</sup> This formula is written differently than the one in Branch and Mason, "Seasonal adjustment in the ECI and Conversion to NAICS and SOC," p. 15, but its meaning is the same.

<sup>3</sup> Ibid.