

Current Employment Statistics seasonal adjustment and the 2007–2009 recession

Removing the declines due to the 2007–2009 recession prior to seasonal adjustment in a number of experimental data series reveals that the recession did not create any bias causing a pattern of stronger increases in employment in the winter months of the fourth through the first quarter versus weaker increases from the second to the third quarter

Jurgen Kropf
and
Nicole Hudson

The Current Employment Statistics (CES) survey, conducted monthly by the Bureau of Labor Statistics (BLS), obtains data on payroll employment, hours, and earnings from business establishments and produces industry-based estimates. The month-to-month movements in these estimates are timely indicators of the overall strength and direction of the nation's economy and, as such, are closely followed by policymakers and forecasters. Over-the-month changes in CES series are nearly always analyzed on a seasonally adjusted basis; therefore, accurate seasonal adjustment is an important component in the usefulness of these monthly data. Standard seasonal adjustment methodology relies heavily on the most recent 3 years to determine the expected seasonal change in employment for each month of the current year.

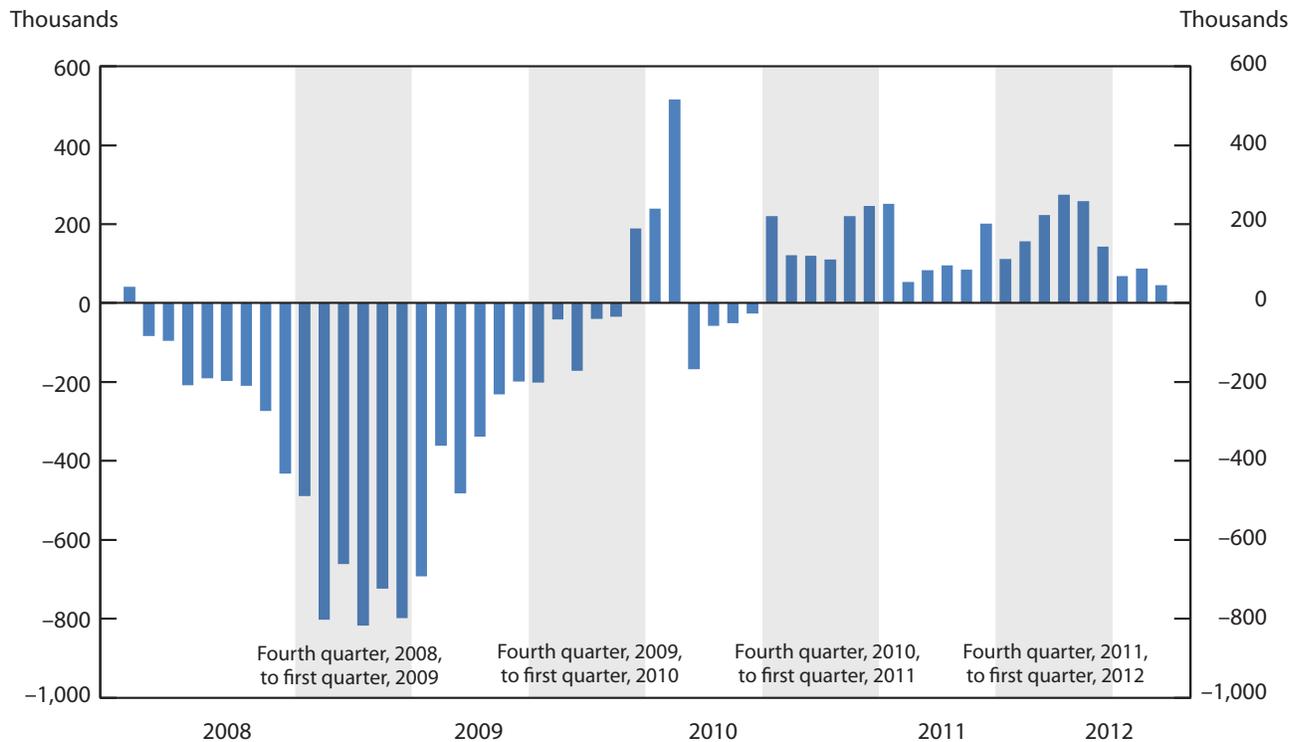
Seasonal adjustment and the recession

Recently, a concern has arisen as to whether the 2007–2009 recession has created a bias in the factors that are used in seasonal adjustment. The concern is that those factors may be causing a pattern of stronger increas-

es running from the fall and winter months making up the fourth quarter of one year through the first quarter of the next, compared with weaker increases occurring in the spring and summer months composing the second quarter of the year through the third quarter of the same year, in the most recent years after the recession. (See chart 1.) Specifically, the extreme declines seen in the recession in the fourth quarter of 2008 and first quarter of 2009 may have been absorbed into the seasonal factor currently used to calculate seasonally adjusted data for recent months. To address this issue, the analysis that follows applies an experimental treatment using additional outliers prior to seasonal adjustment in order to remove the effect of the recession. Although existing CES program standard practice permits the treatment of point outliers (i.e., outliers affecting only 1 month), the experimental treatment allows for additional outliers, including level shifts and ramps (affecting consecutive months). The analysis compares the experimental treatment with the original treatment to determine whether removing the effects of the recession affects the distribution of the seasonally adjusted employ-

Jurgen Kropf is
Division Chief,
Division of Industry
Data Development,
Office of Employment
and Unemployment
Statistics. Nicole
Hudson is an economist
in the same division.
Email: kropf.jurgen@bls.
gov or hudson.nicole@
bls.gov.

Chart 1. Month-to-month change in total nonfarm seasonally adjusted employment, January 2008–June 2012



SOURCE: U.S. Bureau of Labor Statistics.

ment increases across quarters.

Existing seasonal adjustment procedure

The CES program uses X-12-ARIMA software for seasonal adjustment. Developed by the Census Bureau, X-12-ARIMA uses a common time series decomposition method (see Appendix A) and a weighted moving average to estimate the components of seasonal adjustment.¹ The CES program employs a concurrent seasonal adjustment methodology in which new seasonal factors are calculated each month, incorporating all relevant data up to and including data for the current month.² Prior to seasonal adjustment, the estimates (input data) are adjusted to remove known nonseasonal events, such as strikes, to ensure that these events are not included in the calculation of the seasonal factors. In addition, the X-12-ARIMA automatic outlier detection procedure is used to identify and adjust for point outliers, also called additive outliers, which affect only 1 month. This is done to prevent extreme values from distorting the seasonal

factors. Once the seasonal factors are calculated, they are applied to the original, non-seasonally-adjusted data to calculate the seasonally adjusted estimate. Multiplicative or additive seasonal adjustment is used, depending on the seasonal variation of the series. Seasonal adjustment is performed at the three-digit North American Industry Classification System level, and more detailed levels for some industries. Both direct and indirect seasonal adjustment methods are used to generate the CES seasonally adjusted employment series. The total nonfarm seasonally adjusted employment series is generated indirectly by aggregating 158 directly adjusted series.³

Removing the impact of the recession

The aforesaid experimental outlier treatment is used to evaluate concerns that the existing procedure does not sufficiently account for all recession-related effects.⁴ The experimental treatment uses additional types of outliers that are not used in the existing procedure for removing the effect of the recession from the non-seasonally-adjust-

ed data prior to seasonal adjustment. The additional types of outlier are (1) *level shifts*, in which there is a sudden change in the level of the series in a particular month and the series continues at a new level in the months that follow, (2) *temporary changes*, in which there is a sudden change in the level of the series in a particular month and the series slowly returns to the previous level in the months that follow, and (3) *ramps*, in which there is a gradual change in the level of the series and the series continues at the new level. (See Appendix B.) Additive outliers, temporary changes, and level shifts can be automatically detected by the X-12-ARIMA software; ramps, however, must be defined manually.

Many industries experienced a gradual change due to the recession, rather than a sudden change in the level of the series. Typically, the change lasted 6 months or more, but it varied with the industry. To remove the impact of the 2007–2009 recession prior to seasonal adjustment, ramps were fitted to each series that displayed a significant decline during the recession. In order to use ramps, the X-12-ARIMA software requires that a beginning and ending date be specified for the ramp of each series. Because the timespan of the decline due to the recession varied across industries, the beginning and ending date of the ramp for each industry varies as well. To determine these dates, the peak and trough in each industry were identified with methods developed by researchers at the National Bureau of Economic Research (NBER).⁵ The dates of the peaks and troughs were used to define the dates of the ramps for the X-12-ARIMA software for most industries. The beginning and ending dates of the ramps do not necessarily correspond to the official peaks and troughs. In addition to the manually identified ramps, the automatically identified types of outlier were used to adjust the original series for extreme values prior to seasonal adjustment.

Exhibit 1 shows the type, year, and month of experimental outlier regressors for all BLS seasonally adjusted industries. If the ramp identified on the basis of the peak and trough of an industry had a *t*-statistic greater than 3.5, then the ramp was used in the experimental treatment to remove the decline due to the recession. In addition, the X-12-ARIMA software selected any outliers found with a *t*-statistic greater than 3.5. The figure 3.5 is the optimal critical value routinely used to detect outliers.

Experimental treatment of nonfarm employment

To measure a quantity's growth over time, the cumulative change in the quantity is commonly used, beginning at a point in time. Accordingly, in what follows, the cumulative change in employment beginning in the fourth quar-

ter of 2011 through the first quarter of 2012 is compared for the original and the experimental series. The concern is that removing the impact of the recession, particularly the steep declines that took place in the months making up the fourth quarter of 2008 through the months constituting the first quarter of 2009, would result in a significant shift in employment growth from the former period to the latter. The cumulative change in employment beginning in the second quarter of 2011 and running through the third quarter of that year also is compared for the original and the experimental series, in order to determine whether there was a significant shift in employment growth as a result of removing the impact of the recession. At the time of this analysis, the final employment estimates for the third quarter of 2012 were not available; therefore, the cumulative change from the second quarter of 2011 through the third quarter of the same year is used for comparison.

Chart 2 compares the month-to-month changes in total nonfarm employment from the original seasonally adjusted employment series with those from the experimental seasonally adjusted employment series with the decline due to the recession removed prior to seasonal adjustment. From the second through the third quarter of 2011, the cumulative change of the original series was 892,000, compared with 916,000 for the experimental series, a difference of 24,000. From the fourth quarter of 2011 through the first quarter of 2012, the cumulative month-to-month change of the original series was 1.106 million, compared with 1.087 million for the experimental series, a difference of 19,000. Removing the decline due to the recession results in an increase of 24,000 in the cumulative change from the second quarter of 2011 through the third quarter of that year and a decline of 19,000 in the cumulative change from the fourth quarter of 2011 through the first quarter of 2012. The shift in the distribution of cumulative employment change across quarters does not alter the pattern of stronger employment increases from the fourth through the first quarter and weaker employment increases from the second through the third quarter. The overall trend is consistent between the original and experimental series. Following the standard procedure for calculating seasonally adjusted total nonfarm employment, the experimental series is aggregated from 158 directly adjusted series. The remainder of this article gives examples of several of the directly adjusted series.

Residential remodelers

Employment declines in construction began before the

Exhibit 1. Experimental outlier regressors for BLS seasonally adjusted industries, t-statistic > 3.5

Industry	Type, year, and month of regressor	
	Ramp (beginning–end)	Automatically identified outliers
Logging	None	TC2005.04, LS2009.03
Oil and gas extraction	RP2008.12–2009.12	AO2008.04
Coal mining	RP2009.01–2009.12	None
Metal ore mining	RP2008.10–2009.10	AO2003.06, AO2008.12
Nonmetallic mineral mining and quarrying	RP2007.06–2010.05	TC2008.05
Support activities for mining	RP2008.09–2009.10	None
New single-family general contractors	RP2006.04–2011.07	AO2002.11, AO2003.05, LS2009.01
New multifamily general contractors	RP2006.06–2011.09	None
New housing operative builders	RP2006.12–2012.02	TC2004.06
Residential remodelers	RP2006.10–2010.02	LS2009.03
Industrial building	RP2008.04–2011.05	None
Commercial building	RP2008.03–2010.09	AO2005.01, AO2006.07, AO2009.05
Heavy and civil engineering construction	RP2007.06–2010.02	TC2005.06, AO2005.12, AO2007.02, LS2009.04, LS2010.12, LS2012.05
Residential specialty trade contractors	RP2006.02–2010.12	None
Nonresidential specialty trade contractors	RP2008.01–2010.06	AO2007.02
Poured concrete structure contractors	RP2006.04–2011.08	AO2007.02
Steel and precast concrete contractors	RP2008.02–2010.11	None
Framing contractors	RP2005.11–2011.01	LS2009.01
Masonry contractors	RP2006.08–2012.02	AO2007.02, LS2009.03
Glass and glazing contractors	RP2008.02–2010.10	TC2003.06, AO2005.05
Roofing contractors	RP2006.01–2010.02	None
Siding contractors	RP2006.03–2011.01	None
Other building exterior contractors	RP2008.02–2010.12	None
Electrical contractors	RP2007.06–2010.11	None
Plumbing and HVAC contractors	RP2007.07–2010.06	None
Other building equipment contractors	RP2008.04–2010.03	LS2003.03
Drywall and insulation contractors	RP2006.08–2010.09	None
Painting and wall covering contractors	RP2006.05–2011.01	None
Flooring contractors	RP2007.05–2012.01	LS2009.02
Tile and terrazzo contractors	RP2006.08–2012.02	None
Finish carpentry contractors	RP2006.04–2011.04	LS2009.02
Other building finishing contractors	RP2006.09–2010.08	None
Site preparation contractors	RP2007.01–2011.04	TC2008.10
All other specialty trade contractors	RP2006.04–2010.05	TC2005.01, AO2005.11
Wood products	RP2006.02–2011.07	AO2009.02
Nonmetallic mineral products	RP2006.04–2011.10	TC2008.10
Primary metals	RP2008.09–2009.07	LS2008.10, LS2009.07
Fabricated metal products	RP2008.09–2010.01	AO2009.01
Machinery	RP2008.12–2010.01	AO2005.10
Computer and peripheral equipment	RP2008.11–2009.04	LS2003.01, LS2006.01, LS2007.01, LS2009.05
Communications equipment	None	AO2005.01, TC2011.02
Audio and video equipment	None	AO2002.05, TC2011.05
Semiconductors and electronic components	None	TC2007.01
Electronic instruments	None	TC2003.01, LS2007.03
Magnetic media manufacturing and reproduction	None	LS2002.12, LS2004.06, TC2007.08
Electrical equipment and appliances	RP2008.07–2010.01	TC2009.04
Transportation equipment	RP2008.07–2009.06	LS2009.01, TC2009.02
Motor vehicles and parts	RP2008.01–2009.06	AO2009.01, LS2009.01, TC2009.05
Furniture and related products	None	LS2003.04
Miscellaneous manufacturing	RP2008.11–2010.06	None
Food manufacturing	None	None
Beverages and tobacco products	RP2008.04–2010.07	TC2004.11, TC2011.01
Textile mills	RP2008.01–2010.01	AO2010.01
Textile product mills	None	TC2003.08, LS2009.03
Apparel	None	AO2009.06
Leather and allied products	RP2008.09–2010.04	None

See footnote at end of table.

Exhibit 1. Experimental outlier regressors for BLS seasonally adjusted industries, t-statistic > 3.5—Continued		
Industry	Type, year, and month of regressor	
	Ramp (beginning–end)	Automatically identified outliers
Paper and paper products	RP2008.07–2009.04	None
Printing and related support activities	None	AO2011.08
Petroleum and coal products	RP2008.07–2011.08	TC2007.07, TC2009.12, TC2011.01
Chemicals	RP2008.07–2011.01	LS2009.11
Plastics and rubber products	RP2008.07–2009.10	LS2009.01
Durable goods	None	None
Nondurable goods	RP2008.01–2010.09	None
Electronic markets and agents and brokers	RP2008.02–2010.01	None
Automobile dealers	RP2008.06–2009.11	LS2008.09, TC2008.09
Other motor vehicle dealers	RP2008.03–2010.01	None
Auto parts, accessories, and tire stores	RP2007.02–2009.03	AO2002.01
Furniture and home furnishings stores	RP2006.06–2010.08	LS2007.11
Electronics and appliance stores	RP2008.04–2009.11	TC2009.03
Building material and garden supply stores	RP2006.09–2010.11	LS2009.03
Food and beverage stores	RP2008.03–2010.06	None
Health and personal care stores	RP2008.01–2010.12	TC2002.11, AO2005.09, LS2006.01, TC2009.01
Gasoline stations	RP2008.01–2010.03	None
Clothing and clothing accessories stores	RP2007.11–2010.09	TC2007.11, LS2012.01
Sporting goods, hobby, book, and music stores	RP2008.01–2012.01	TC2004.09, TC2009.10, TC2011.12
Department stores	RP2008.01–2009.12	TC2002.04, LS2003.08, LS2003.11, LS2007.01, AO2012.01
Other general merchandise stores	RP2009.05–2009.12	AO2006.03, AO2007.03
Miscellaneous store retailers	RP2008.01–2010.12	AO2011.07
Nonstore retailers	RP2007.12–2010.01	AO2003.12, LS2008.12, TC2010.01
Air transportation	RP2008.03–2009.04	LS2003.04, TC2004.01, AO2006.11, TC2007.02, AO2007.05
Rail transportation	RP2007.03–2009.12	AO2002.04, AO2002.06, LS2002.11, AO2003.08, AO2008.06, TC2008.10, TC2009.01, LS2009.05, TC2009.06, LS2011.02
Water transportation	RP2008.07–2010.02	LS2004.08, AO2010.03
Truck transportation	RP2007.01–2010.03	None
Transit and ground passenger transportation	RP2008.08–2009.09	LS2002.07, LS2002.09, AO2009.06, AO2012.04
Pipeline transportation	RP2009.10–2010.11	LS2008.05, LS2009.09
Scenic and sightseeing transportation	None	AO2004.10, TC2007.01, LS2011.05
Support activities for transportation	RP2008.08–2010.02	None
Couriers and messengers	None	TC2006.10, AO2008.11, AO2009.12, AO2011.11
Warehousing and storage	RP2008.04–2010.01	None
Utilities	RP2009.02–2010.09	None
Publishing industries, except Internet	RP2008.07–2010.01	None
Motion picture and sound recording industries	None	None
Broadcasting, except Internet	RP2008.11–2011.11	None
Telecommunications	None	LS2002.12
Data processing, hosting and related services	RP2007.07–2010.08	None
Other information services	None	None
Monetary authorities—central bank	RP2008.09–2011.04	LS2004.05, TC2007.05, AO2007.07, LS2008.10, LS2011.12
Depository credit intermediation	RP2007.09–2010.08	TC2007.04
Commercial banking	RP2008.04–2010.06	AO2006.01, TC2007.04
Nondepository credit intermediation	RP2005.11–2010.06	AO2007.08, LS2007.08, LS2009.04
Activities related to credit intermediation	RP2006.05–2010.04	None
Securities, commodity contracts, investments	RP2008.08–2010.03	AO2010.09
Insurance carriers and related activities	RP2008.03–2010.03	None
Funds, trusts, and other financial vehicles	RP2008.11–2011.10	LS2005.01, TC2005.04, AO2011.07
Real estate	RP2007.05–2010.07	None
Rental and leasing services	RP2005.03–2011.06	None
Lessors of nonfinancial intangible assets	None	LS2005.04
Legal services	RP2007.05–2010.06	LS2005.09
Accounting and bookkeeping services	RP2008.01–2010.10	TC2002.05, AO2002.12, AO2003.02, AO2010.11, LS2011.05
Architectural and engineering services	RP2008.02–2010.09	None

See footnote at end of table.

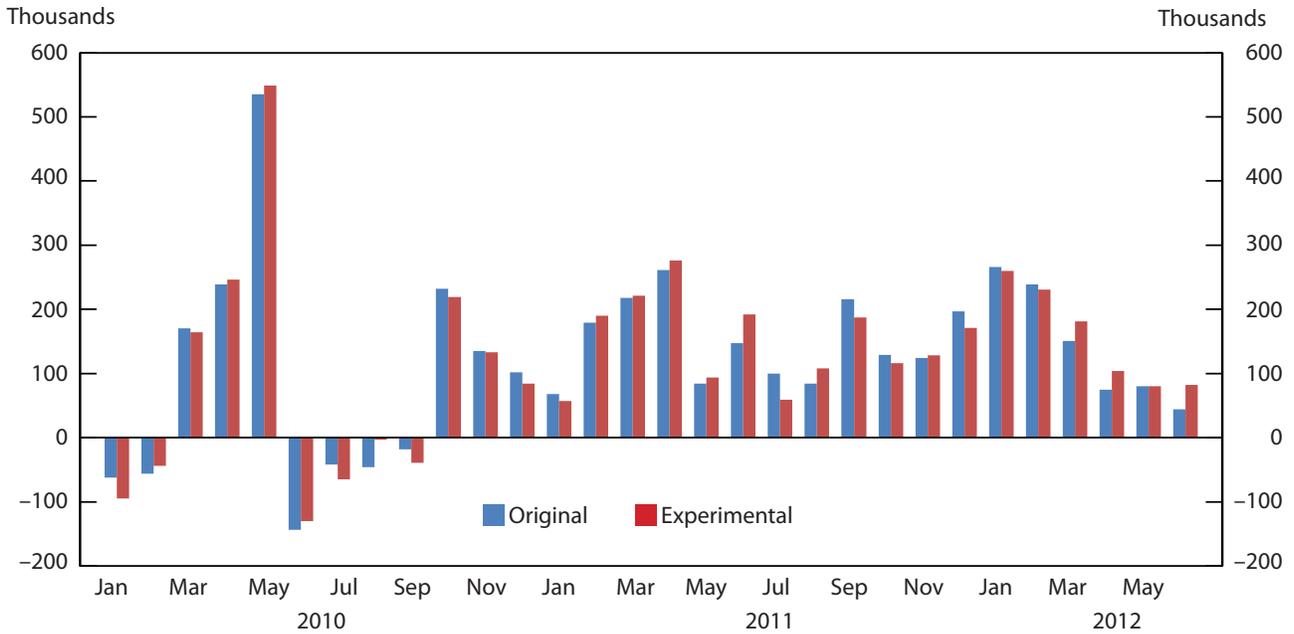
Exhibit 1. Experimental outlier regressors for BLS seasonally adjusted industries, t-statistic > 3.5—Continued

Industry	Type, year, and month of regressor	
	Ramp (beginning–end)	Automatically identified outliers
Specialized design services	RP2008.01–2010.06	None
Computer systems design and related services	None	TC2002.07, AO2002.12, LS2003.07, LS2004.04, TC2006.01, LS2006.11
Management and technical consulting services	RP2008.09–2010.05	TC2002.08
Scientific research and development services	RP2008.10–2009.07	AO2007.09, LS2008.02
Advertising and related services	RP2007.09–2010.03	LS2003.07, TC2004.07, TC2008.10
Other professional and technical services	RP2008.04–2009.10	LS2006.07, AO2008.01, AO2009.10
Management of companies and enterprises	RP2008.08–2009.12	TC2009.01
Office administrative services	RP2008.05–2009.05	AO2002.07, TC2006.11
Facilities support services	RP2007.12–2012.02	None
Employment services	RP2006.08–2009.08	None
Temporary help services	RP2006.08–2009.08	None
Business support services	RP2008.11–2010.04	TC2004.06, LS2005.10, LS2006.01
Travel arrangement and reservation services	RP2007.07–2010.09	TC2005.10, LS2008.11, LS2009.02
Investigation and security services	RP2008.07–2010.04	AO2005.11, AO2008.11, AO2009.02
Services to buildings and dwellings	RP2007.12–2010.03	LS2002.04, AO2005.11, AO2009.05, AO2010.01, AO2010.03, TC2012.03
Other support services	RP2007.10–2010.01	AO2002.11
Waste management and remediation services	RP2008.01–2009.06	AO2003.07, TC2004.01
Educational services	None	AO2004.09
Offices of physicians	None	None
Offices of dentists	RP2008.11–2009.12	None
Offices of other health practitioners	None	None
Outpatient care centers	None	None
Medical and diagnostic laboratories	None	AO2007.07, LS2008.10, TC2010.03
Home health care services	None	None
Other ambulatory health care services	None	None
Hospitals	None	LS2003.07
Nursing care facilities	RP2003.06–2004.02	LS2011.11
Residential mental health facilities	None	LS2007.06
Community care facilities for the elderly	None	TC2005.09, AO2007.06
Other residential care facilities	None	LS2009.04
Individual and family services	None	None
Emergency and other relief services	RP2004.08–2005.07	AO2002.07
Vocational rehabilitation services	RP2007.10–2011.03	TC2006.05
Child daycare services	RP2008.12–2012.02	TC2002.06
Performing arts and spectator sports	None	LS2010.10
Museums, historical sites, and similar institutions	RP2008.05–2010.10	None
Amusements, gambling, and recreation	RP2008.02–2010.01	AO2009.09
Accommodation	RP2008.02–2010.02	TC2002.07
Food services and drinking places	RP2007.12–2010.02	LS2009.05
Repair and maintenance	RP2007.05–2010.02	None
Personal and laundry services	RP2008.09–2010.08	TC2006.01
Membership associations and organizations	RP2008.10–2011.07	None
Federal, except U.S. Postal Service	None	LS2003.04, LS2003.10, AO2003.11, AO2004.04, TC2005.12, LS2010.05
U.S. Postal Service	None	TC2002.05, TC2002.07, TC2006.07, LS2008.01, AO2008.12, AO2009.07, AO2009.12, LS2010.02
State government education	None	TC2002.02, LS2002.09, AO2009.07
State government, excluding education	None	AO2011.09
Local government education	None	AO2003.03, AO2003.05, AO2003.07, LS2003.09, LS2004.03, LS2005.06, TC2005.10, LS2006.01, LS2006.05, LS2006.09, AO2007.07, LS2007.12, TC2008.07, LS2008.10, AO2009.11, LS2010.09, AO2011.04, AO2011.06, AO2011.08
Local government, excluding education	None	TC2009.07

NOTE: AO = additive outlier; LS = level shift; RP = ramp; TC = temporary change.

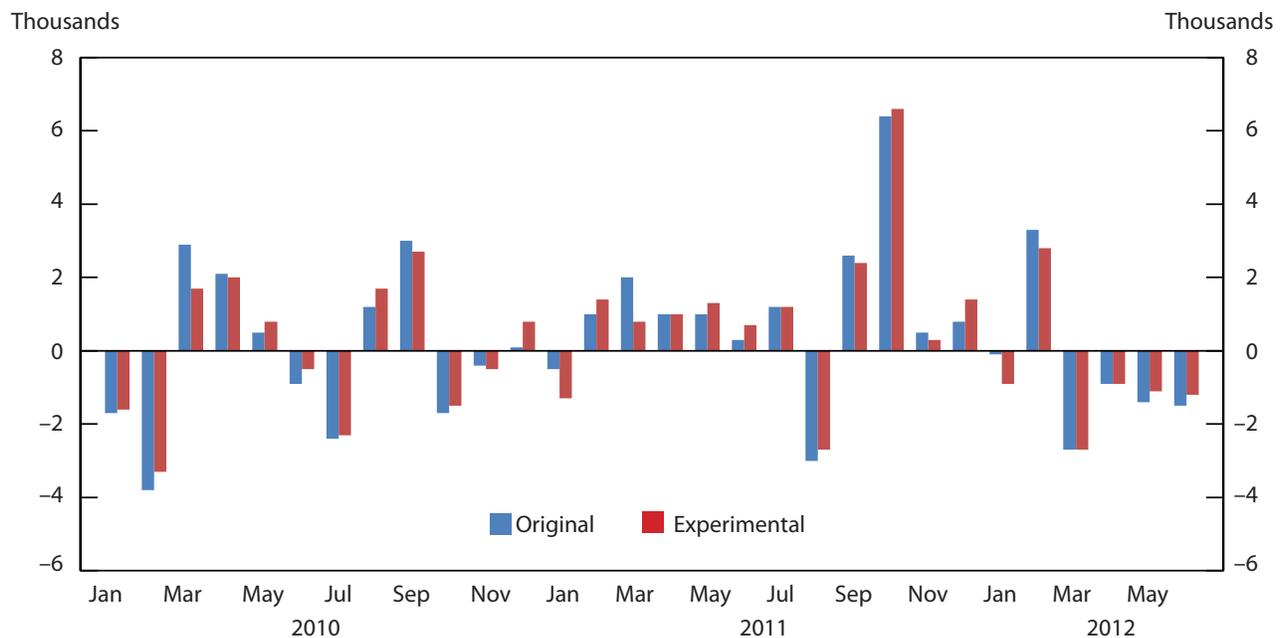
SOURCE: U.S. Bureau of Labor Statistics.

Chart 2. Month-to-month change in total nonfarm seasonally adjusted employment, original series (including 2007–2009 recession) and experimental series (excluding 2007–2009 recession), January 2010 to June 2012



SOURCE: U.S. Bureau of Labor Statistics.

Chart 3. Month-to-month change in residential remodelers seasonally adjusted employment, original series (including 2007–2009 recession) and experimental series (excluding 2007–2009 recession), January 2010 to June 2012



SOURCE: U.S. Bureau of Labor Statistics.

2007–2009 recession for most industries in this sector. For residential remodelers, employment reached its peak in late 2006 and its trough in early 2010. A ramp for this period was used to remove the impact of the decline due to the recession prior to seasonal adjustment. Chart 3 compares the month-to-month changes in residential remodelers from the original seasonally adjusted employment series with those from the experimental seasonally adjusted employment series with the decline due to the recession removed prior to seasonal adjustment. From the second quarter of 2011 through the third quarter of that year, the cumulative change in the original series was 3,100, compared with 3,900 for the experimental series, a difference of less than a thousand. From the fourth quarter of 2011 through the first quarter of 2012, the cumulative change in the original series was 8,200, compared with 7,500 for the experimental series, a difference of less than a thousand.

Electronic and appliance stores

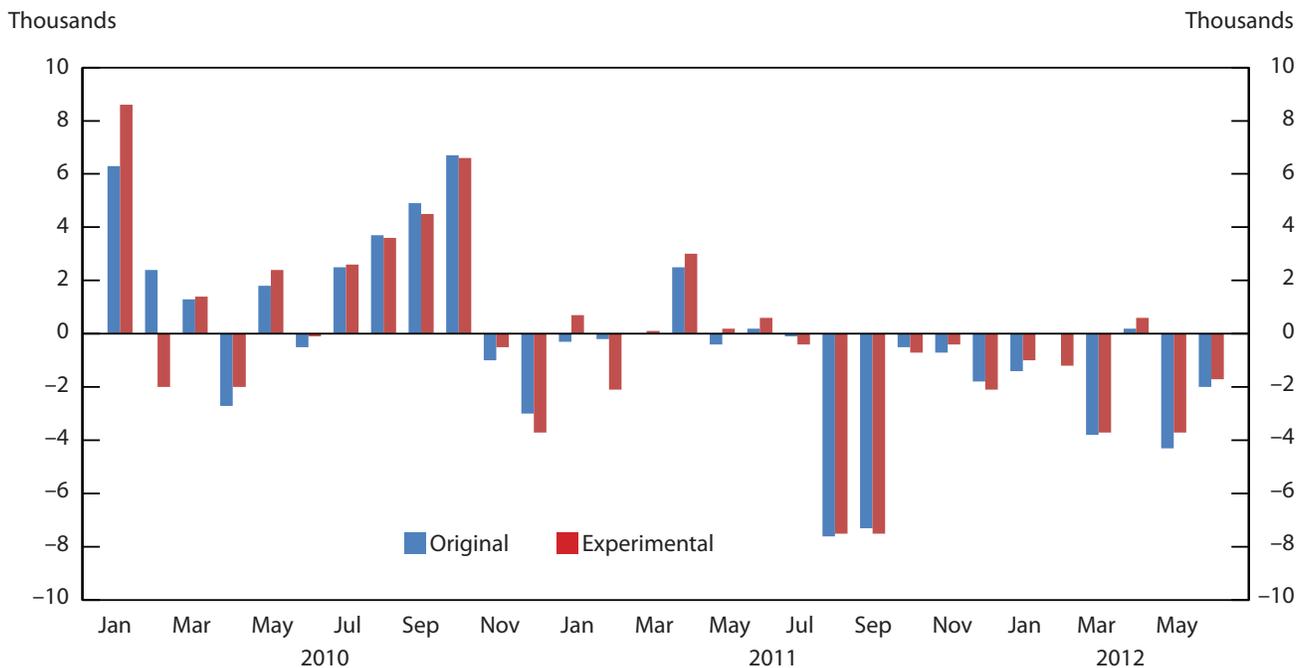
Employment declines in retail began close to the 2007–2009 recession for most industries in this sector. For

electronic and appliance stores, employment reached its peak in early 2008 and its trough in late 2009. A ramp for this period was used to remove the impact of the decline due to the recession prior to seasonal adjustment. Chart 4 compares the month-to-month changes in electronic and appliance stores from the original seasonally adjusted employment series with those from the experimental seasonally adjusted employment series with the decline due to the recession removed prior to seasonal adjustment. From the second quarter of 2011 through the third quarter of that same year, the cumulative change in the original series was –12,700, compared with –11,600 for the experimental series, a difference of 1,100. From the fourth quarter of 2011 through the first quarter of 2012, the cumulative change in the original series was –8,200, compared with –9,100 for the experimental series, a difference of less than a thousand.

Truck transportation

Employment declines in transportation began close to the 2007–2009 recession for most industries in this sector. For truck transportation, employment reached its peak

Chart 4. Month-to-month change in electronic and appliance stores seasonally adjusted employment, original series (including 2007–2009 recession) and experimental series (excluding 2007–2009 recession), January 2010 to June 2012



SOURCE: U.S. Bureau of Labor Statistics.

in early 2007 and its trough in early 2010. A ramp for this period was used to remove the impact of the decline due to the recession prior to seasonal adjustment. Chart 5 compares the month-to-month changes in truck transportation from the original seasonally adjusted employment series with those from the experimental seasonally adjusted employment series with the decline due to the recession removed prior to seasonal adjustment. From the second quarter of 2011 through the third quarter of that same year, the cumulative change in the original series was 14.9 thousand, compared with 16.4 thousand for the experimental series, a difference of 1,500. From the fourth quarter of 2011 through the first quarter of 2012, the cumulative change in the original series was 27,900, compared with 26,500 in the experimental series, a difference of 1.4 thousand.

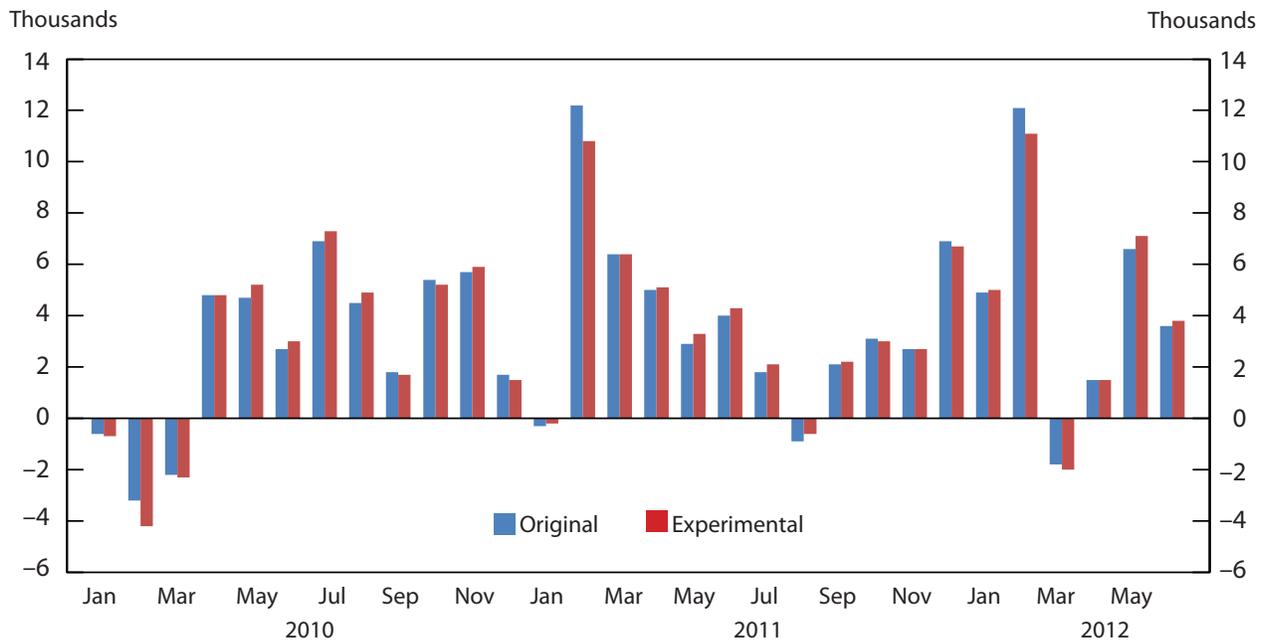
Temporary help services

The beginning of the employment declines in professional and business services varied across industries in this sector. For temporary help services, employment reached its peak in mid-2006 and its trough in mid-2009. A ramp for this period was used to remove the impact of the decline

due to the recession prior to seasonal adjustment. Chart 6 compares the month-to-month changes in temporary help services from the original seasonally adjusted employment series with those from the experimental seasonally adjusted employment series with the decline due to the recession removed prior to seasonal adjustment. From the second quarter of 2011 through the third quarter of that year, the cumulative change in the original series was 48,900, compared with 44,600 in the experimental series, a difference of 4,300. From the fourth quarter of 2011 through the first quarter of 2012, the cumulative change in the original series was 128,200, compared with 131,400 for the experimental series, a difference of 3,200. In contrast to the other industries presented, the shift in employment across quarters for this industry moves in the opposite direction: removing the impact of the decline due to the recession results in a *decrease* in the cumulative change from the second quarter of 2011 through the third quarter of that year and an *increase* in the cumulative change from the fourth quarter of 2011 through the first quarter of 2012.

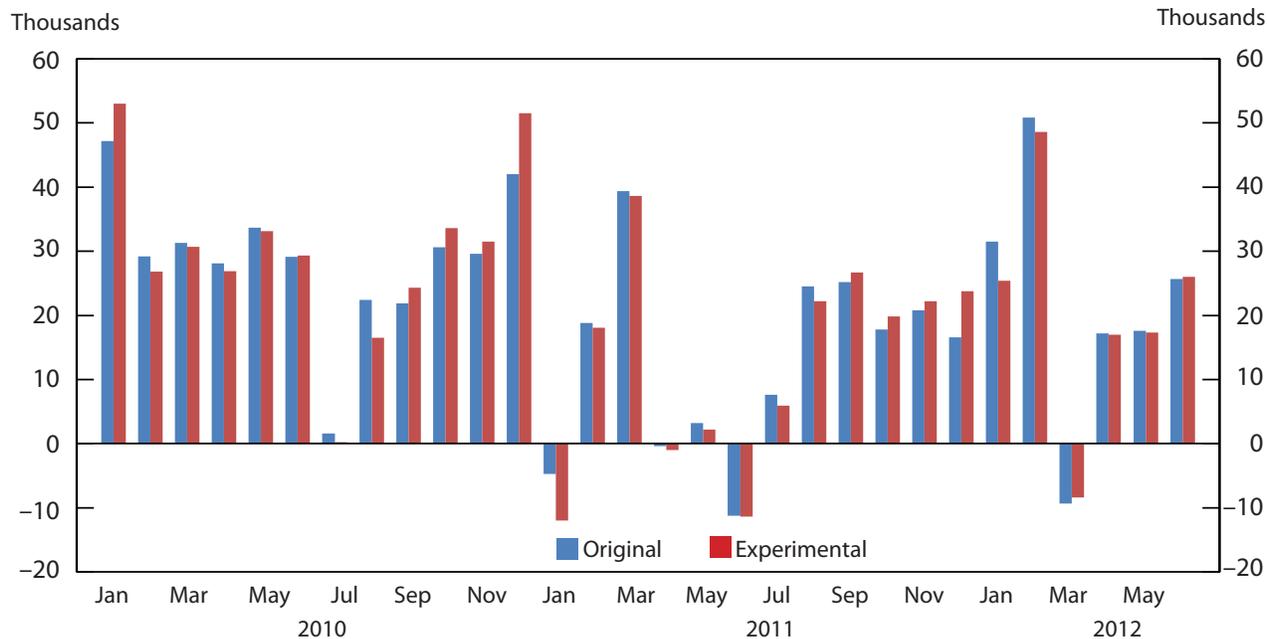
AFTER REMOVAL OF THE DECLINES due to the 2007–2009 recession prior to seasonal adjustment, the season-

Chart 5. Month-to-month change in truck transportation seasonally adjusted employment, original series (including 2007–2009 recession) and experimental series (excluding 2007–2009 recession), January 2010 to June 2012



SOURCE: U.S. Bureau of Labor Statistics.

Chart 6. Month-to-month change in temporary help services seasonally adjusted employment, original series (including 2007–2009 recession) and experimental series (excluding 2007–2009 recession), January 2010 to June 2012



SOURCE: U.S. Bureau of Labor Statistics.

ally adjusted month-to-month changes in employment from the experimental series show no significant difference from those of the original series. In addition, the pattern of stronger increases in employment from the fourth quarter of one year through the first quarter of the next and weaker increases from the second through the third quarter of the same year has persisted since 2011, even after the influence of the declines due to the recession is removed. CES employment data are not treated with additional interventions over and above the standard procedure, because that procedure produces accurate seasonally

adjusted estimates. Also, it is important to note that the experimental treatment presented in this article cannot be applied concurrently to the most recent data in real time: the additional types of outlier can be applied only retrospectively, after reviewing historical data. The X-12-ARIMA seasonal adjustment method, along with the concurrent update of seasonal factors, continues to provide accurate seasonally adjusted estimates and adapts to evolving changes in trends or seasonal patterns without allowing extreme changes to be absorbed into the seasonal component. □

Notes

¹ 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,” *Journal of Business and Economic Statistics*, vol. 16, no. 2, 1998, pp. 127–152.

² Jurgen Kropf, Christopher Manning, Kirk Mueller, and Stuart Scott, *Concurrent Seasonal Adjustment for Industry Employment Statistics* (U.S. Bureau of Labor Statistics, 2002).

³ Nathan Clausen, “Benchmark Article: BLS Establishment Estimates Revised to Incorporate March 2011 Benchmarks” (U.S. Bureau of Labor Statistics, 2012).

⁴ Demetra Lytras, *Modeling Recession Effects* (U.S. Census Bureau, 2012).

⁵ Gerhard Bry and Charlotte Boschan, *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs* (Cambridge, MA, National Bureau of Economic Research, 1971).

APPENDIX A. Basic time series decomposition**Non-seasonally-adjusted series**

Multiplicative:

$$\text{Observed} = \text{Trend} \times \text{Seasonal} \times \text{Irregular},$$

or

$$O = TSI.$$

Additive:

$$\text{Observed} = \text{Trend} + \text{Seasonal} + \text{Irregular},$$

or

$$O = T + S + I.$$

Seasonally adjusted series (SA)

Multiplicative:

$$SA = \frac{O}{S} = TI.$$

Additive:

$$SA = O - S = T + I.$$

In the preceding equations,

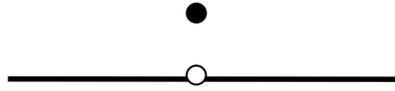
Observed (O) = the original time series,Trend (T) = the long-term progression of the time series combining the trend and business cycle,Seasonal (S) = the within-year fluctuations, monthly or quarterly, that are repeated every year, andIrregular (I) = the short-term random or erratic fluctuations that are not covered by the other components.

APPENDIX B. X-12-ARIMA types of outlier

Additive outliers (AO)

Series shifts at a single point in time (t):

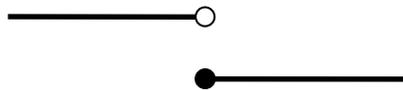
$$\begin{cases} 1 & \text{for } t = t_0 \\ 0 & \text{for } t \neq t_0 \end{cases}$$



Level shifts (LS)

Series shifts suddenly and then continues at new level:

$$\begin{cases} -1 & \text{for } t < t_0 \\ 0 & \text{for } t \geq t_0 \end{cases}$$



Ramps (RP)

Series is at one level, slowly shifts to another, and continues at the new level:

$$\begin{cases} -1 & \text{for } t \leq t_0 \\ (t - t_0)/(t_1 - t_0) - 1 & \text{for } t_0 < t < t_1 \\ 0 & \text{for } t \geq t_1 \end{cases}$$



Temporary changes (TC)

Series shifts suddenly and then declines slowly to original level:

$$\begin{cases} 0 & \text{for } t < t_0 \\ \alpha^{t-t_0} & \text{for } t \geq t_0 \end{cases}$$

