Benchmark Article

BLS Establishment Estimates Revised to Incorporate March 2010 Benchmarks

- Introduction
- Summary of the benchmark revisions
- Revisions in the post-benchmark period
- Corrected historical CES data for the other federal government series
- Other changes to the CES published series
- Why benchmarks differ from estimates
- Benchmark revision effects for other data types
- Methods
- Introduction of quarterly net birth/death adjustments
- Availability of revised data
- Small domain model
- Seasonal adjustment procedure
- Special model adjustments
- Seasonal adjustment of new all employee hours and earning series

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Introduction

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With the release of data for January 2011, the Bureau of Labor Statistics (BLS) introduced its annual revision of national estimates of employment, hours, and earnings from the Current Employment Statistics (CES) monthly survey of nonfarm establishments. Each year, the CES survey realigns its sample-based estimates to incorporate universe counts of employment—a process known as

benchmarking. Comprehensive counts of employment, or benchmarks, are derived primarily from unemployment insurance (UI) tax reports that nearly all employers are required to file with State Workforce Agencies.

Summary of the benchmark revisions

The March 2010 benchmark level for total nonfarm employment is 128,584,000; this figure is 378,000 below the sample-based estimate for March 2010, an adjustment of -0.3 percent. Table 1 shows the total nonfarm percentage benchmark revisions for the past ten years.

Table 1. Percent differences between nonfarm employment benchmarks and estimates by industry supersector, March 2001-2010 [1]

Industry	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total	- 0.1	- 0.2	- 0.1	0.2	- 0.1	0.6	-0.2	-0.1	-0.7	-0.3
Total private	- .2	- .4	- .2	.2	- .2	.7	-.2	-.1	-.9	-.4
Mining & logging			.9	.7	-.3	1.2	[2]	.4	-3.5	-3.0
Construction			-.8	.6	.5	2.6	.1	.7	-2.9	-1.3
Manufacturing			-1.1	-.4	-.3	-.1	-1.0	-.1	-.7	-1.0
Trade, transportation, & utilities			[2]	.2	.3	.6	.5	.2	-1.2	-.6
Information			-2.6	-1.0	-2.1	-.5	-1.8	.3	-1.5	-.4
Financial activities			.2	.1	-.8	.4	-1.3	-.3	-.1	.4
Professional & business services			-.7	-.2	-.4	1.3	.2	-.4	-.8	[2]
Education & health services			.3	.2	[2]	.5	-.2	-.1	-.3	[2]
Leisure & hospitality			.5	1.2	.4	.3	-.8	-1.1	-.6	-.6
Other services			1.4	.5	-1.3	.5	.3	.2	-.8	.2
Government	.3	1.0	.3	.1	[2]	[2]	-.2	.2	.1	.1

[1] Differences are based on comparisons of final published March estimates and benchmark levels, as originally published.
[2] Less than 0.05 percent.

Table 2 shows the nonfarm employment benchmarks for March 2010, not seasonally adjusted, by industry. The majority of super sectors had downward revisions, with the exception of government, financial activities, professional and business services, and other services. The largest downward revision occurred in trade, transportation, and utilities with a revision of -143,000, or -0.6 percent. Within this sector, the revision is concentrated in wholesale trade, which revised by -124,500, or -2.3 percent. It is of note that within

trade, transportation, and utilities there were a series of large offsetting revisions made to utilities. Utilities as a whole was only revised downwards 3,400, or 0.6 percent, but electric power generation was revised by -67,800, or -39.9 percent. This revision was offset by a positive revision in electric power transmission and distribution, revised upwards by 65,600, or 28.7 percent. Manufacturing had a downward revision of 119,000, or 1.0 percent, and leisure and hospitality had a revision of -80,000, or -0.6 percent. The revision in manufacturing was concentrated in durable goods with a downward revision of 82,000, or 1.2 percent, while nondurable goods was revised downward by 37,000, or 0.8 percent. The largest downward revision within leisure and hospitality was food services and drinking places with a revision of 92,700, or 1.0 percent.

Table 2. Nonfarm employment benchmarks by industry for March 2010 (in thousands)

Industry	Benchmark	Estimate	Differences	
			Amount	Percent
Total nonfarm	128,584	128,962	-378	-0.3
Total private	105,671	106,062	-391	-.4
Goods-producing	17,248	17,454	-206	-1.2
Service-providing	111,336	111,508	-172	-.2
Private service-providing	88,423	88,608	-185	-.2
Mining and logging	668	688	-20	-3.0
Logging	48	46	2	4.2
Mining	621	642	-21	-3.4
Oil and gas extraction	156	161	-5	-3.2
Mining, except oil and gas	194	205	-11	-5.7
Coal mining	79	81	-2	-2.5
Support activities for mining	271	276	-5	-1.8
Construction	5,213	5,280	-67	-1.3
Construction of buildings	1,186	1,214	-28	-2.4
Heavy and civil engineering construction	735	721	14	1.9
Specialty trade contractors	3,292	3,345	-53	-1.6
Manufacturing	11,367	11,486	-119	-1.0
Durable goods	6,960	7,042	-82	-1.2
Wood products	333	339	-6	-1.8
Nonmetallic mineral products	358	369	-11	-3.1

Table 2. Nonfarm employment benchmarks by industry for March 2010 (in thousands) — continued				
			Differences	
Industry	Benchmark	Estimate	Amount	Percent
Primary metals	353	362	-9	-2.5
Fabricated metal products	1,253	1,273	-20	-1.6
Machinery	978	980	-2	-.2
Computer and electronic products	1,093	1,091	2	.2
Computer and peripheral equipment	159	158	1	.6
Communications equipment	116	119	-3	-2.6
Semiconductors and electronic components	366	362	4	1.1
Electronic instruments	406	405	1	.2
Electrical equipment and appliances	353	364	-11	-3.1
Transportation equipment	1,319	1,336	-17	-1.3
Furniture and related products	356	356	0	(1)
Miscellaneous manufacturing	564	572	-8	-1.4
Nondurable goods	4,407	4,444	-37	-.8
Food manufacturing	1,418	1,427	-9	-.6
Beverages and tobacco products	178	179	-1	-.6
Textile mills	119	123	-4	-3.4
Textile product mills	118	121	-3	-2.5
Apparel	159	165	-6	-3.8
Leather and allied products	27	29	-2	-7.4
Paper and paper products	393	394	-1	-.3
Printing and related support activities	487	494	-7	-1.4
Petroleum and coal products	110	110	0	(1)
Chemicals	785	781	4	.5
Plastics and rubber products	614	622	-8	-1.3
Trade, transportation, and utilities	24,278	24,421	-143	-.6
Wholesale trade	5,410	5,535	-125	-2.3
Electronic markets and agents and brokers	799	823	-24	-3.0
Retail trade	14,204	14,222	-18	-.1
Motor vehicle and parts dealers	1,599	1,608	-9	-.6
Automobile dealers	997	1,009	-12	-1.2

Table 2. Nonfarm employment benchmarks by industry for March 2010 (in thousands) — continued				
			Differences	
Industry	Benchmark	Estimate	Amount	Percent
Furniture and home furnishings stores	432	435	-3	-.7
Electronics and appliance stores	492	479	13	2.6
Building material and garden supply stores	1,132	1,154	-22	-1.9
Food and beverage stores	2,779	2,776	3	.1
Health and personal care stores	974	968	6	.6
Gasoline stations	804	809	-5	-.6
Clothing and clothing accessories stores	1,318	1,334	-16	-1.2
Sporting goods, hobby, book, and music stores	585	593	-8	-1.4
General merchandise stores	2,935	2,903	32	1.1
Department stores	1,453	1,448	5	.3
Miscellaneous store retailers	747	754	-7	-.9
Nonstore retailers	408	410	-2	-.5
Transportation and warehousing	4,111	4,108	3	.1
Air transportation	462	452	10	2.2
Rail transportation	211	215	-4	-1.9
Water transportation	60	61	-1	-1.7
Truck transportation	1,208	1,201	7	.6
Transit and ground passenger transportation	437	429	8	1.8
Pipeline transportation	42	39	3	7.1
Scenic and sightseeing transportation	21	22	-1	-4.8
Support activities for transportation	532	534	-2	-.4
Couriers and messengers	514	517	-3	-.6
Warehousing and storage	625	639	-14	-2.2
Utilities	553	556	-3	-.5
Information	2,715	2,726	-11	-.4
Publishing industries, except Internet	762	762	0	(1)
Motion picture and sound recording industries	365	342	23	6.3
Broadcasting, except Internet	294	295	-1	-.3
Telecommunications	913	942	-29	-3.2
Data processing, hosting and related services	244	249	-5	-2.0

Table 2. Nonfarm employment benchmarks by industry for March 2010 (in thousands) — continued				
			Differences	
Industry	Benchmark	Estimate	Amount	Percent
Other information services	138	136	2	1.4
Financial activities	7,606	7,572	34	.4
Finance and insurance	5,695	5,656	39	.7
Monetary authorities - central bank	21	21	0	(1)
Credit intermediation and related activities	2,544	2,567	-23	-.9
Depository credit intermediation	1,727	1,748	-21	-1.2
Commercial banking	1,304	1,310	-6	-.5
Securities, commodity contracts, investments	796	791	5	.6
Insurance carriers and related activities	2,249	2,194	55	2.4
Funds, trusts, and other financial vehicles	86	85	1	1.2
Real estate and rental and leasing	1,911	1,915	-4	-.2
Real estate	1,379	1,368	11	.8
Rental and leasing services	506	523	-17	-3.4
Lessors of nonfinancial intangible assets	25	25	0	(1)
Professional and business services	16,343	16,346	-3	(1)
Professional and technical services	7,468	7,469	-1	(1)
Legal services	1,109	1,101	8	.7
Accounting and bookkeeping services	1,005	1,025	-20	-2.0
Architectural and engineering services	1,261	1,261	0	(1)
Computer systems design and related services	1,417	1,429	-12	-.8
Management and technical consulting services	982	974	8	.8
Management of companies and enterprises	1,850	1,815	35	1.9
Administrative and waste services	7,025	7,062	-37	-.5
Administrative and support services	6,681	6,722	-41	-.6
Employment services	2,517	2,571	-54	-2.1
Temporary help services	1,908	1,922	-14	-.7
Business support services	809	799	10	1.2
Services to buildings and dwellings	1,591	1,576	15	.9
Waste management and remediation services	344	340	4	1.2
Education and health services	19,599	19,592	7	(1)

Table 2. Nonfarm employment benchmarks by industry for March 2010 (in thousands) — continued				
			Differences	
Industry	Benchmark	Estimate	Amount	Percent
Educational services	3,285	3,283	2	.1
Health care and social assistance	16,314	16,309	5	(1)
Ambulatory health care services	5,924	5,873	51	.9
Offices of physicians	2,306	2,308	-2	-.1
Outpatient care centers	594	548	46	7.7
Home health care services	1,066	1,056	10	.9
Hospitals	4,666	4,697	-31	-.7
Nursing and residential care facilities	3,105	3,102	3	.1
Nursing care facilities	1,649	1,646	3	.2
Social assistance	2,620	2,637	-17	-.6
Child day care services	868	882	-14	-1.6
Leisure and hospitality	12,578	12,658	-80	-.6
Arts, entertainment, and recreation	1,740	1,737	3	.2
Performing arts and spectator sports	370	371	-1	-.3
Museums, historical sites, zoos, and parks	119	121	-2	-1.7
Amusements, gambling, and recreation	1,251	1,245	6	.5
Accommodation and food services	10,838	10,920	-82	-.8
Accommodation	1,679	1,668	11	.7
Food services and drinking places	9,159	9,252	-93	-1.0
Other services	5,304	5,293	11	.2
Repair and maintenance	1,128	1,139	-11	-1.0
Personal and laundry services	1,259	1,265	-6	-.5
Membership associations and organizations	2,917	2,890	27	.9
Government	22,913	22,900	13	.1
Federal	2,905	2,895	10	.3
Federal, except U.S. Postal Service	2,244	2,235	9	.4
U.S. Postal Service	661	661	0	(1)
State government	5,280	5,315	-35	-.7
State government education	2,507	2,540	-33	-1.3
State government, excluding education	2,774	2,775	-1	(1)

Table 2. Nonfarm employment benchmarks by industry for March 2010 (in thousands) — continued

Industry	Benchmark	Estimate	Differences	
			Amount	Percent
Local government	14,728	14,690	38	.3
Local government education	8,432	8,379	53	.6
Local government, excluding education	6,296	6,312	-16	-.3

(1)Less than 0.05 percent.

Table 3. Differences in seasonally adjusted levels and over-the-month changes, total nonfarm employment, January 2010-December 2010 (in thousands)

2010	Levels			Over-the-month changes		
	As previously published	As revised	Difference	As previously published	As revised	Difference
January	129,602	129,281	-321	14	-39	-53
February	129,641	129,246	-395	39	-35	-74
March	129,849	129,438	-411	208	192	-16
April	130,162	129,715	-447	313	277	-36
May	130,594	130,173	-421	432	458	26
June	130,419	129,981	-438	-175	-192	-17
July	130,353	129,932	-421	-66	-49	17
August	130,352	129,873	-479	-1	-59	-58
September	130,328	129,844	-484	-24	-29	-5
October	130,538	130,015	-523	210	171	-39
November	130,609	130,108	-501	71	93	22
December(p)	130,712	130,229	-483	103	121	18

(p) Preliminary

Construction was revised by -67,000, or -1.3 percent, while mining and logging was revised -20,000, or -3.0 percent. One of the largest revisions within construction was to building equipment contractors, which was revised downward by 32,700, or 2.1 percent. Information had a downward revision of 11,000, or 0.4 percent. Within the supersector the largest revision was in telecommunications with a revision of -29,000, or -3.2 percent.

Four sectors saw positive revisions. Financial activities was revised upward by 34,000, or 0.4 percent. The revision in financial activities was concentrated in insurance carriers and related activities which was revised upward by 55,000, or 2.5 percent. Government was revised upward by 13,000, or 0.1 percent, and other services had a revision of 11,000, or 0.2 percent. Education and health services had a negligible revision upward of 7,000, or less than 0.05 percent.

Revisions in the post-benchmark period

Post-benchmark period estimates from April 2010 to December 2010 were calculated for each month based on new benchmark levels. Also, beginning in April, model-based estimates for the net birth/death employment were revised to incorporate information from the most recent year of universe employment counts. Text table A shows the net birth/death model figures for the supersectors over the post-benchmark period. From April 2010 to December 2010, the cumulative net birth/death model added 537,000, compared with 759,000 in the previously published April to December estimates.

Text Table A. Net Birth/Death Estimates, Post-Benchmark 2010 (in thousands)

2010	Mining & Logging	Construction	Manufacturing	Trade, Transportation, & Utilities	Information	Financial Activities	Professional & Business Services	Education & Health Services	Leisure & Hospitality	Other Services	Monthly Amount Contributed
April	0	8	-9	-1	2	-2	50	20	66	7	141
May	1	36	7	21	3	6	18	15	78	7	192
June	2	21	5	12	1	5	15	-7	72	5	131
July	1	-18	-11	-19	-3	-11	-1	2	29	-7	-38
August	1	5	3	11	4	5	19	19	21	3	91
September	1	4	0	6	0	-1	-9	11	-36	-1	-25
October	1	0	-3	16	4	11	42	45	-44	-1	71
November	0	-16	1	-2	1	0	2	7	-24	-1	-32
December	0	-19	0	6	2	11	-2	2	4	2	6
Cumulative Total	7	21	-7	50	14	24	134	114	166	14	537

Revisions to November and December also reflect incorporation of the annual CES sample update and the routine inclusion of additional sample units not available for the respective months' preliminary estimates.

Corrected historical CES data for the other federal government series

With the 2010 benchmark revision BLS corrected historical CES employment levels for all employees and women employees for the other federal government series (91-999900). CES data series on hours and earnings for all employees and for production and nonsupervisory employees were not impacted. The corrections affected April 2009 to April 2010 data, and reflect corrections to initial counts for Census temporary and intermittent workers for Census 2010. These corrections were applied before any benchmark processing was done. The corrected March 2010 value was used to calculate the benchmark revision for this industry, and the corrected values from April 2009 to February 2010 were then subject to the normal wedging process. (For more information on the wedging process please reference the section on benchmark methods.) The corrected values for March and April 2010 were used to calculate a sample link for April 2010, which was applied to the new benchmark level during the post-benchmark processing to generate the April 2010 post-benchmark estimate. These corrections did not impact employment levels after April 2010; post-benchmark estimates for May through October 2010 were calculated using a sample link generated from previously published values. Exhibit 1 shows the previously published employment level, the corrected value applied before benchmark processing, and the difference between the two for all employees. Exhibit 2 shows the same for women employees.

Exhibit 1. Corrections to all employees for other federal government (91-999900)

Month	Previously published employment	Corrected value applied before benchmark processing	Difference
Apr-09	1,377.2	1,373.4	-3.8
May-09	1,330.4	1,324.2	-6.2
Jun-09	1,289.5	1,292.3	2.8
Jul-09	1,298.8	1,301.6	2.8
Aug-09	1,296.3	1,300.3	4.0
Sep-09	1,287.9	1,292.3	4.4
Oct-09	1,296.9	1,301.4	4.5
Nov-09	1,285.3	1,288.8	3.5
Dec-09	1,287.3	1,291.0	3.7
Jan-10	1,289.4	1,291.9	2.5

Exhibit 1. Corrections to all employees for other federal government (91-999900) — continued			
Month	Previously published employment	Corrected value applied before benchmark processing	Difference
Feb-10	1,312.9	1,314.5	1.6
Mar-10	1,367.3	1,371.6	4.3
Apr-10	1,452.5	1,443.7	-8.8

Exhibit 2. Corrections to women employees for other federal government (91-999900)			
Month	Previously published employment	Corrected value applied before benchmark processing	Difference
Apr-09	654.3	652.5	-1.8
May-09	626.8	623.9	-2.9
Jun-09	603.9	605.2	1.3
Jul-09	606.3	607.6	1.3
Aug-09	604.9	606.8	1.9
Sep-09	602.1	604.2	2.1
Oct-09	607.9	610.0	2.1
Nov-09	604.0	605.7	1.7
Dec-09	605.0	606.7	1.7
Jan-10	608.2	609.4	1.2
Feb-10	623.0	623.7	0.7
Mar-10	650.6	652.6	2.0
Apr-10	691.3	686.9	-4.4

Other changes to the CES published series

All CES series are evaluated annually for sample size, coverage, and response rates. The following series changes result from a re-evaluation of the sample and universe coverage for NAICS industries. Some small industries no longer have sufficient sample to be estimated and published separately and have been combined with other similar industries for estimation and publication purposes, as shown below. Most of the collapsed and deleted series are in the manufacturing sector where employment has been declining over a number of years. Historical data for the series with changed scope were reconstructed to provide consistent time series.

Exhibit 3. Series with changed scope effective with the March 2010 benchmark revisions

Industry title	NAICS code	CES industry code	Industries collapsed
Prefabricated metal buildings, components, and plate work	332311,3	31-332313	Prefabricated metal buildings and components (31-332311) is collapsed into Plate work (31-332313). The collapsed series is renamed Prefabricated metal buildings, components, and plate work.
Miscellaneous electronic instruments	334512,4,6-9	31-334519	Automatic environmental controls (31-334512) is collapsed into Miscellaneous electronic instruments (31-334519).
Railroad rolling stock and other transportation equipment	3365,9	31-336900	Railroad rolling stock (31-336500) is collapsed into Other transportation equipment (31-336900). The collapsed series is renamed Railroad rolling stock and other transportation equipment.
Stationery and other converted paper products	32223,9	32-322290	Stationery products (32-322230) is collapsed into Other converted paper products (32-322290). The series is renamed Stationery and other converted paper products.
Miscellaneous commercial printing	323115-9	32-323119	Manifold business forms printing (32-323116) is collapsed into Miscellaneous commercial printing (32-323119).
All other nondurable goods wholesalers	42494,5,9	41-424990	Tobacco and tobacco products (41-424940) is collapsed into Paint, painting supplies, and other nondurable goods (41-424990). The series is renamed All other nondurable goods wholesalers.
Urban, interurban, rural, and charter bus transportation	4851,2,5	43-485500	Urban transit, interurban and rural bus transportation (43-485200) is collapsed into Charter bus industry (43-485500). The series is renamed Urban, interurban, rural, and charter bus transportation.

Exhibit 4. Discontinued all employee series

Industry title	NAICS code	CES industry code	Next highest published level
Hand and edge tools	332212	31-332212	Cutlery and hand tools (31-332200)
Conveyor and conveying equipment	333922	31-333922	Material handling equipment (31-333920)

Exhibit 4. Discontinued all employee series — continued

Industry title	NAICS code	CES industry code	Next highest published level
Dairy products, except frozen	31151	32-311510	Dairy products (32-311500)
Ice cream and frozen dessert	31152	32-311520	Dairy products (32-311500)
Broadwoven fabric finishing mills	313311	32-313311	Textile and fabric finishing mills (32-313300)
Coated and laminated package materials and paper	322221,2	32-322222	Paper bags and coated and treated paper (32-322220)
Miscellaneous coated and treated paper and paper bags	322223-6	32-322226	Paper bags and coated and treated paper (32-322220)

Exhibit 5. Discontinued production employment, hours, and earnings series

Industry title	NAICS code	CES industry code	Next highest published level
Metal ore mining	2122	10-212200	Mining, except oil and gas (10-212000)
Nonmetallic mineral mining and quarrying	2123	10-212300	Mining, except oil and gas (10-212000)
Other nonmetallic mineral mining	21239	10-212390	Mining, except oil and gas (10-212000)
Audio and video equipment	3343	31-334300	Computer and electronic products (31-334000)
Miscellaneous electronic instruments	334514,6-9	31-334519	Electronic instruments (31-334500)
Magnetic media manufacturing and reproduction	3346	31-334600	Computer and electronic products (31-334000)
Railroad rolling stock	3365	31-336500	Transportation equipment (31-336000)
Other transportation equipment	3369	31-336900	Transportation equipment (31-336000)
Miscellaneous commercial printing	323111,5,7-9	32-323119	Commercial lithograph printing (32-323110)
Paint, painting supplies, and other nondurable goods	42499	41-424990	Miscellaneous nondurable goods (41-424900)
Scenic and sightseeing transportation	487	43-487000	Transportation and warehousing (43-000000)
Credit card issuing	52221	55-522210	Nondepository credit intermediation (55-522200)
Other nondepository credit intermediation	52229	55-522290	Nondepository credit intermediation (55-

Exhibit 5. Discontinued production employment, hours, and earnings series — continued			
Industry title	**NAICS code**	**CES industry code**	**Next highest published level**
			522200)
Miscellaneous nondepository credit intermediation	522293,4,8	55-522298	Nondepository credit intermediation (55-522200)
Miscellaneous intermediation	52391	55-523910	Other financial investment activities (55-523900)
All other financial investment activities	52399	55-523990	Other financial investment activities (55-523900)
Amusement parks and arcades	7131	70-713100	Amusements, gambling, and recreation (70-713000)
Other amusement and recreation industries	7139	70-713900	Amusements, gambling, and recreation (70-713000)
All other amusement and recreation industries	71399	70-713990	Amusements, gambling, and recreation (70-713000)

Exhibit 6. Discontinued all employee and production employee average overtime series		
Industry title	**NAICS code**	**CES industry code**
Audio and video equipment	3343	31-334300
Miscellaneous electronic instruments	334514,6-9	31-334519
Magnetic media manufacturing and reproduction	3346	31-334600
Miscellaneous commercial printing	323111,5,7-9	32-323119

Why benchmarks differ from estimates

A benchmark revision is the difference between the benchmark employment level for a given March and its corresponding sample-based estimate. The overall accuracy of the establishment survey is usually gauged by the size of this difference. The benchmark revision often is regarded as a proxy for total survey error, but this does not take into account error in the universe data. The employment counts obtained from quarterly unemployment insurance tax forms are administrative data that reflect employer record-

keeping practices and differing State laws and procedures. The benchmark revision can be more precisely interpreted as the difference between two independently derived employment counts, each subject to its own error sources.

Like all sample surveys, the establishment survey is susceptible to two sources of error: sampling error and nonsampling error. Sampling error is present any time a sample is used to make inferences about a population. The magnitude of the sampling error, or variance, relates directly to sample size and the percentage of the universe covered by that sample. The CES monthly survey captures slightly under one-third of the universe, exceptionally high by usual sampling standards. This coverage ensures a small sampling error at the total nonfarm employment level.

Both the universe counts and the establishment survey estimates are subject to nonsampling errors common to all surveys—coverage, response, and processing errors. The error structures for both the CES monthly survey and the UI universe are complex. Still, the two programs generally produce consistent total employment figures, each validating the other. Over the last decade, annual benchmark revisions at the total nonfarm level have averaged 0.3 percent (in absolute terms), with an absolute range of 0.1 percent to 0.7 percent.

Benchmark revision effects for other data types

The routine benchmarking process results in revisions to the series for production and nonsupervisory workers. There are no benchmark employment levels for these series; they are revised by preserving ratios of employment for the particular data type to all employees employment prior to benchmarking, and then applying these ratios to the revised all employee figures. These figures are calculated at the basic cell level and then aggregated to produce the summary estimates.

Average weekly hours and average hourly earnings are not benchmarked; they are estimated solely from reports supplied by survey respondents at the basic estimating cell level.

The aggregate industry level of the hours and earnings series are derived as a weighted average. The production or nonsupervisory employee employment estimates for the basic cells are used as weights for the hours and earnings estimates for broader industry groupings. Adjustments of the all employee estimates to new benchmarks may alter the weights, which, in turn, may change the estimates for hours and earnings of production or nonsupervisory employees at higher levels of aggregation.

Generally, new employment benchmarks have little effect on hours and earnings estimates for major groupings. To influence the hours and earnings estimates of a broader group, employment revisions have to be relatively large and must affect industries that have hours or earnings averages that are substantially different from those of other industries in their group. Table 4A and Table 4B give information on the levels of specific hours and earnings series resulting from the March 2010 benchmark. At the total private level,

there was no change in average weekly hours for all employees and production and nonsupervisory employees from the previously published level. Average hourly earnings increased by 3 cents for all employees and 4 cents for production and nonsupervisory employees from the previously published level.

Table 4a. Effect of March 2010 benchmark revisions to all employee hours and earnings estimates, selected industries

Industry	Average weekly hours			Average hourly earnings		
	As previously published	As revised	Difference	As previously published	As revised	Difference
Total private	33.8	33.8	0.0	$22.48	$22.51	$0.03
Goods-producing	39.1	39.1	0	23.95	23.97	.02
Private service-providing	32.8	32.7	-.1	22.13	22.18	.05
Mining and logging	42.7	42.8	.1	27.38	27.34	-.04
Construction	37.0	36.9	-.1	25.26	25.23	-.03
Manufacturing	39.9	39.9	0	23.18	23.22	.04
Durable goods	40.2	40.2	0	24.66	24.72	.06
Wood products	38.3	38.3	0	17.31	17.24	-.07
Nonmetallic mineral products	38.6	38.6	0	20.22	20.22	0
Primary metals	42.2	42.2	0	23.46	23.55	.09
Fabricated metal products	39.6	39.6	0	21.19	21.21	.02
Machinery	40.6	40.6	0	24.14	24.14	0
Computer and electronic products	40.2	40.2	0	32.13	32.12	-.01
Electrical equipment and appliances	39.9	39.9	0	21.51	21.51	0
Transportation equipment	42.2	42.2	0	28.40	28.56	.16
Furniture and related products	38.1	38.1	0	18.41	18.46	.05
Miscellaneous manufacturing	38.2	38.2	0	23.01	23.02	.01
Nondurable goods	39.4	39.4	0	20.78	20.81	.03
Food manufacturing	39.2	39.2	0	17.22	17.21	-.01
Beverages and tobacco	36.9	36.9	0	23.51	23.51	0

Table 4a. Effect of March 2010 benchmark revisions to all employee hours and earnings estimates, selected industries — continued

Industry	Average weekly hours			Average hourly earnings		
	As previously published	As revised	Difference	As previously published	As revised	Difference
products						
Textile mills	40.8	40.9	.1	16.50	16.48	-.02
Textile product mills	37.2	37.2	0	14.54	14.55	.01
Apparel	36.2	36.2	0	15.43	15.42	-.01
Leather and allied products	37.4	37.4	0	16.94	16.94	0
Paper and paper products	40.6	40.6	0	22.73	22.75	.02
Printing and related support activities	37.3	37.3	0	20.56	20.56	0
Petroleum and coal products	41.5	41.5	0	34.05	33.99	-.06
Chemicals	40.3	40.3	0	27.32	27.31	-.01
Plastics and rubber products	41.3	41.3	0	19.76	19.77	.01
Trade, transportation, and utilities	33.8	33.7	-.1	19.68	19.61	-.07
Wholesale trade	37.6	37.6	0	25.99	25.99	0
Retail trade	30.8	30.9	.1	15.59	15.56	-.03
Transportation and warehousing	37.7	37.6	-.1	20.88	20.86	-.02
Utilities	40.4	40.3	-.1	32.75	32.39	-.36
Information	36.2	36.2	0	30.07	30.13	.06
Financial activities	36.7	36.7	0	26.88	26.96	.08
Professional and business services	35.0	35.1	.1	27.17	27.19	.02
Education and health services	32.7	32.6	-.1	22.62	22.70	.08
Leisure and hospitality	25.6	25.6	0	13.13	13.15	.02
Other services	31.5	31.3	-.2	19.97	20.25	.28

Table 4b. Effect of March 2010 benchmark revisions to production employee hours and earnings estimates, selected industries

Industry	Average weekly hours			Average hourly earnings		
	As previously published	As revised	Difference	As previously published	As revised	Difference
Total private	33.1	33.1	0.0	$18.91	$18.95	$0.04
Goods-producing	39.9	39.9	0	20.05	20.05	0
Private service-providing	32.0	32.0	0	18.68	18.72	.04
Mining and logging	43.6	43.7	.1	24.10	24.10	0
Construction	37.4	37.3	-.1	23.04	23.01	-.03
Manufacturing	40.8	40.9	.1	18.44	18.47	.03
Durable goods	41.1	41.1	0	19.63	19.67	.04
Wood products	38.7	38.7	0	14.80	14.76	-.04
Nonmetallic mineral products	40.4	40.4	0	17.30	17.30	0
Primary metals	43.3	43.3	0	20.11	20.19	.08
Fabricated metal products	40.8	40.9	.1	17.92	17.91	-.01
Machinery	41.8	41.7	-.1	18.56	18.55	-.01
Computer and electronic products	41.2	41.2	0	22.45	22.44	-.01
Electrical equipment and appliances	41.0	41.0	0	16.72	16.72	0
Transportation equipment	42.7	42.7	0	24.94	25.09	.15
Furniture and related products	38.4	38.5	.1	14.89	14.90	.01
Miscellaneous manufacturing	38.7	38.7	0	16.38	16.39	.01
Nondurable goods	40.5	40.5	0	16.65	16.67	.02
Food manufacturing	40.4	40.4	0	14.35	14.33	-.02
Beverages and tobacco products	35.6	35.6	0	22.13	22.13	0
Textile mills	41.2	41.3	.1	13.50	13.49	-.01
Textile product mills	39.6	39.6	0	11.61	11.61	0
Apparel	36.4	36.4	0	11.32	11.32	0

Table 4b. Effect of March 2010 benchmark revisions to production employee hours and earnings estimates, selected industries — continued

Industry	Average weekly hours			Average hourly earnings		
	As previously published	As revised	Difference	As previously published	As revised	Difference
Leather and allied products	38.6	38.6	0	13.19	13.19	0
Paper and paper products	42.3	42.3	0	19.78	19.80	.02
Printing and related support activities	38.0	38.0	0	17.04	17.04	0
Petroleum and coal products	42.4	42.3	-.1	31.56	31.48	-.08
Chemicals	42.1	42.1	0	20.55	20.55	0
Plastics and rubber products	41.9	41.9	0	15.65	15.65	0
Trade, transportation, and utilities	32.9	32.8	-.1	16.76	16.71	-.05
Wholesale trade	37.5	37.5	0	21.26	21.25	-.01
Retail trade	29.8	29.8	0	13.18	13.16	-.02
Transportation and warehousing	36.4	36.2	-.2	19.13	19.10	-.03
Utilities	41.4	41.2	-.2	30.02	29.73	-.29
Information	36.2	36.2	0	25.52	25.53	.01
Financial activities	35.8	35.8	0	21.35	21.42	.07
Professional and business services	34.8	34.8	0	22.66	22.66	0
Education and health services	32.0	32.0	0	19.80	19.93	.13
Leisure and hospitality	24.7	24.7	0	11.33	11.34	.01
Other services	30.6	30.5	-.1	16.87	17.13	.26

Methods

Benchmark adjustment procedure. Establishment survey benchmarking is done on an annual basis to a population derived primarily from the administrative file of employees covered by unemployment insurance (UI). The time required to complete the revision process—from the full collection of the UI population data to publication of the revised industry estimates—is about 10 months. The

benchmark adjustment procedure replaces the March sample-based employment estimates with UI-based population counts for March. The benchmark therefore determines the final employment levels, while sample movements capture month-to-month trends.

Benchmarks are established for each basic estimating cell and are aggregated to develop published levels. On a not-seasonally-adjusted basis, the sample-based estimates for the year preceding and the year following the benchmark also are then subject to revision. Employment estimates for the months between the most recent March benchmark and the previous year's benchmark are adjusted using a "wedge-back" procedure. In this process, the difference between the benchmark level and the previously published March estimate for each estimating cell is computed. This difference, or error, is linearly distributed across the 11 months of estimates subsequent to the previous benchmark; eleven-twelfths of the March difference is added to February estimates, ten-twelfths to January estimates, and so on, ending with the previous April estimates, which receive one-twelfth of the March difference. The wedge procedure assumes that the total estimation error accumulated at a steady rate since the last benchmark. Applying previously derived over-the-month sample changes to the revised March level yields revised estimates for the months following the March benchmark. New net birth/death model estimates also are calculated and applied during post-benchmark estimation, and new sample is introduced from the annual update.

Benchmark source material. The principal source of benchmark data for private industries is the Quarterly Census of Employment and Wages (QCEW). These employment data are provided to State Employment Security Agencies by employers covered by State UI laws. BLS uses several other sources to establish benchmarks for the remaining industries partially covered or exempt from mandatory UI coverage, accounting for nearly 3 percent of the nonfarm employment total.

Data on employees covered under Social Security laws, published by the U.S. Census Bureau in *County Business Patterns*, are used to augment UI data for industries not fully covered by the UI scope, such as nonoffice insurance sales workers, child daycare workers, religious organizations, and private schools and hospitals. Benchmarks for State and local government hospitals and educational institutions are based on the Annual Census of Governments conducted by the Census Bureau. Benchmark data from these sources are available only on a lagged basis. Extrapolation to a current level is accomplished by applying the employment trends from the UI-covered part of the population in these industries to the noncovered part. Universe data for interstate railroads are obtained from the Railroad Retirement Board.

Business birth and death estimation. Regular updating of the CES sample frame with information from the UI universe files helps to keep the CES survey current with respect to employment from business births and business deaths. The timeliest UI universe files available, however, always will be a minimum of 9 months out of date. The CES survey thus cannot rely on regular frame maintenance alone to provide estimates for business birth and death employment contributions. BLS has researched both sample-based and model-based approaches to measuring birth units that have not yet appeared on the UI universe frame. Since the research

demonstrated that sampling for births was not feasible in the very short CES production timeframes, the Bureau is utilizing a model-based approach for this component.

Earlier research indicated that while both the business birth and death portions of total employment are generally significant, the net contribution is relatively small and stable. To account for this net birth/death portion of total employment, BLS is utilizing an estimation procedure with two components. The first component excludes employment losses from business deaths from sample-based estimation in order to offset the missing employment gains from business births. This is incorporated into the sample-based link relative estimate procedure by simply not reflecting sample units going out of business, but imputing to them the same trend as the other firms in the sample. The second component is an ARIMA time series model designed to estimate the residual net birth/death employment not accounted for by the imputation. The historical time series used to create and test the ARIMA model was derived from the UI universe micro level database, and reflects the actual residual net of births and deaths over the past five years. The net birth/death model component figures are unique to each month and include negative adjustments in some months. Furthermore, these figures exhibit a seasonal pattern similar to the seasonal patterns of the continuing businesses.

Only error from the second component is directly measurable. Error from this component is measured by comparing the actual residual from March 2009-10—once it becomes available—with the model-based estimate. As Exhibit 7 shows, the actual net birth/death residual for April 2009 to March 2010 was approximately 285,000 below the forecasted amount used in the CES monthly estimates for the time period.

Exhibit 7. Differences between forecasted and actual net birth/death from April 2009 to March 2010 (in thousands)

Benchmark 2010	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Total
Actual Net Birth/Death	-3	172	127	-70	81	-53	96	-35	0	-469	89	110	46
Forecast Net Birth/Death	124	185	134	-12	97	0	50	-23	23	-428	97	83	331
Difference	-127	-13	-7	-58	-16	-53	46	-12	-23	-41	-8	27	-285
Cumulative Difference	-127	-140	-147	-205	-221	-274	-228	-240	-263	-304	-312	-285	

Introduction of quarterly net birth/death adjustments

Also with the release of the January 2010 estimates BLS will begin updating the CES net birth/death model component of the estimation process on a quarterly basis instead of annually. This change allows for the incorporation of QCEW into the birth/death

model as soon as it becomes available and will reduce the post-benchmark revision in the CES series. This will not impact the timing or frequency of CES monthly and annual releases or when benchmarking is done. The first estimates that will be affected will be for the reference month of April 2011.

Methods and Timing. As described earlier, on a not seasonally adjusted basis, the sample-based estimates for the year preceding and the 9 months following the March benchmark are subject to revision. The 9 months following the March benchmark are referred to as the "post-benchmark" period. These 9 months of data are revised by applying previously derived over-the-month sample changes and newly calculated net birth/death residuals to the March benchmark level. The change between the original birth/death residuals used for this time period and the new residuals calculated as part of the benchmark process is a major component of the post-benchmark revision.

Availability of revised data

LABSTAT, the BLS public database on the Internet, contains all historical employment, hours, and earnings data revised as a result of this benchmark, including both unadjusted and seasonally adjusted data. The data can be accessed at http://www.bls.gov/ces/, the Current Employment Statistics homepage.

Small domain model

The CES Small Domain Model (SDM) is used for industries where the sample alone is insufficient for reliable estimates. The CES SDM is a Weighted Least Squares model with two employment inputs: (1) an estimate based on available CES sample for that series, and (2) an ARIMA projection based on 10 years of historical QCEW data. Further background on the SDM is provided in the CES technical notes.

There are six industries estimated by using the SDM. These industries are lessors of nonfinancial intangible assets, direct health and medical insurance carriers, tax preparation services, other technical consulting services, remediation services, and recreational and vacation camps.

Seasonal adjustment procedure

BLS uses X-12 ARIMA software developed by the U.S. Census Bureau to seasonally adjust national employment, hours, and earnings series derived from the CES program. Individual series are seasonally adjusted using either a multiplicative or an additive model (Exhibit 8), and seasonal adjustment factors are directly applied to the component levels. For employment, individual 3-digit NAICS

levels are seasonally adjusted, and higher level aggregates are formed by summing these components. Seasonally adjusted totals for hours and earnings are obtained by taking weighted averages of the seasonally adjusted data for the component series.

Special model adjustments

Variable survey intervals. Beginning with the release of the 1995 benchmark, BLS refined the seasonal adjustment procedures to control for survey interval variations, sometimes referred to as the 4- versus 5-week effect. Although the CES survey is referenced to a consistent concept— the pay period including the 12th of each month— inconsistencies arise because there are sometimes 4 and sometimes 5 weeks between the week including the 12th in a given pair of months. In highly seasonal industries, these variations can be an important determinant of the magnitude of seasonal hires or layoffs that have occurred at the time the survey is taken, thereby complicating seasonal adjustment.

Standard seasonal adjustment methodology relies heavily on the experience of the most recent 3 years to determine the expected seasonal change in employment for each month of the current year. Prior to the implementation of the adjustment, the procedure did not distinguish between 4- and 5-week survey intervals, and the accuracy of the seasonal expectation depended in large measure on how well the current year's survey interval corresponded with those of the previous 3 years. All else the same, the greatest potential for distortion occurred when the current month being estimated had a 5-week interval but the 3 years preceding it were all 4-week intervals, or conversely when the current month had a 4-week interval but the 3 years preceding it were all 5-week intervals.

BLS adopted REGARIMA (regression with auto-correlated errors) modeling to identify the estimated size and significance of the calendar effect for each published series. REGARIMA combines standard regression analysis, which measures correlation among two or more variables, with ARIMA modeling, which describes and predicts the behavior of data series based on its own past history. For many economic time series, including nonfarm payroll employment, observations are auto-correlated over time; that is, each month's value is significantly dependent on the observations that precede it. These series, therefore, usually can be successfully fit using ARIMA models. If auto-correlated time series are modeled through regression analysis alone, the measured relationships among other variables of interest may be distorted due to the influence of the auto-correlation. Thus, the REGARIMA technique is appropriate for measuring relationships among variables of interest in series that exhibit auto-correlation, such as nonfarm payroll employment.

In this application, the correlations of interest are those between employment levels in individual calendar months and the lengths of the survey intervals for those months. The REGARIMA models evaluate the variation in employment levels attributable to 11 separate survey interval variables, one specified for each month, except March. March is excluded because there are almost always 4 weeks between the February and March surveys. Models for individual basic series are fit with the most recent 10 years of data available, the standard time span used for CES seasonal adjustment.

The REGARIMA procedure yields regression coefficients for each of the 11 months specified in the model. These coefficients provide estimates of the strength of the relationship between employment levels and the number of weeks between surveys for the 11 modeled months. The X-12 ARIMA software also produces diagnostic statistics that permit the assessment of the statistical significance of the regression coefficients, and all series are reviewed for model adequacy.

Because the 11 coefficients derived from the REGARIMA models provide an estimate of the magnitude of variation in employment levels associated with the length of the survey interval, these coefficients are used to adjust the CES data to remove the calendar effect. These "filtered" series then are seasonally adjusted using the standard X-12 ARIMA software.

For a few series, REGARIMA models do not fit well; these series are seasonally adjusted with the X-12 software but without the interval effect adjustment. There are several additional special effects modeled through the REGARIMA process; they are described below.

Construction series. Beginning with the 1996 benchmark revision, BLS utilized special treatment to adjust construction industry series. In the application of the interval effect modeling process to the construction series, there initially was difficulty in accurately identifying and measuring the effect because of the strong influence of variable weather patterns on employment movements in the industry. Further research allowed BLS to incorporate interval effect modeling for the construction industry by disaggregating the construction series into its finer industry and geographic estimating cells and tightening outlier designation parameters. This allowed a more precise identification of weather-related outliers that had masked the interval effect and clouded the seasonal adjustment patterns in general. With these outliers removed, interval effect modeling became feasible. The result is a seasonally adjusted series for construction that is improved because it is controlled for two potential distortions: unusual weather events and the 4- versus 5-week effect.

Floating holidays. BLS is continuing the practice of making special adjustments for average weekly hours and average weekly overtime series to account for the presence or absence of religious holidays in the April survey reference period and the occurrence of Labor Day in the September reference period, back to the start date of each series.

Local government series. A special adjustment also is made in November each year to account for variations in employment due to the presence or absence of poll workers in the local government, excluding educational services series.

Refinements in hours and earnings seasonal adjustment. With the release of the 1997 benchmark, BLS implemented refinements to the seasonal adjustment process for the hours and earnings series to correct for distortions related to the method of accounting for the varying length of payroll periods across months. There is a significant correlation between over-the-month changes in both the

average weekly hour (AWH) and the average hourly earnings (AHE) series and the number of weekdays in a month, resulting in noneconomic fluctuations in these two series. Both AWH and AHE show more growth in "short" months (20 or 21 weekdays) than in "long" months (22 or 23 weekdays). The effect is stronger for the AWH than for the AHE series.

The calendar effect is traceable to response and processing errors associated with converting payroll and hours information from sample respondents with semi-monthly or monthly pay periods to a weekly equivalent. The response error comes from sample respondents reporting a fixed number of total hours for workers regardless of the length of the reference month, while the CES conversion process assumes that the hours reporting will be variable. A constant level of hours reporting most likely occurs when employees are salaried rather than paid by the hour, as employers are less likely to keep actual detailed hours records for such employees. This causes artificial peaks in the AWH series in shorter months that are reversed in longer months.

The processing error occurs when respondents with salaried workers report hours correctly (vary them according to the length of the month), which dictates that different conversion factors be applied to payroll and hours. The CES processing system uses the hours conversion factor for both fields, resulting in peaks in the AHE series in short months and reversals in long months.

REGARIMA modeling is used to identify, measure, and remove the length-of-pay-period effect for seasonally adjusted average weekly hours and average hourly earnings series. The length-of-pay-period variable proves significant for explaining AWH movements in all the service-providing industries except utilities. For AHE, the length-of-pay-period variable is significant for wholesale trade, retail trade, information, financial activities, professional and business services, and other services. All AWH series in the service-providing industries except utilities have been adjusted from January 1990 forward. The AHE series for wholesale trade, retail trade, information, financial activities, professional and business services, and other services have been adjusted from January 1990 forward as well. For this reason, calculations of over-the-year change in the establishment hours and earnings series should use seasonally adjusted data.

The series to which the length-of-pay-period adjustment is applied are not subject to the 4- versus 5-week adjustment, as the modeling cannot support the number of variables that would be required in the regression equation to make both adjustments.

Seasonal adjustment of new all employee hours and earning series

Although the seasonal adjustment process used by CES has proven effective for many years, the limited history of the new all employees hours and earnings series estimates complicates the use of existing adjustment techniques. CES has less than 5 years of history for the new hours and earnings series; in contrast, CES uses 10 years of data when seasonally adjusting all other data types.

The X-12 ARIMA software requires at least 3 years of data to perform seasonal adjustment; the new series met this requirement, consisting of 46 months of data at initial publication (March 2006 through January 2010). Nevertheless, there are several limitations and concerns associated with seasonally adjusting the new series with such a limited amount of input data. For example, the limited history is not sufficient to utilize the automatic model selection feature of X-12, which is typically used to select the ARIMA model for other data types. Secondly, there is a risk of the irregular component affecting the seasonal component. But the most significant limitation is that there is insufficient history to allow the use of the existing calendar effects treatment method described above. In particular, at least 5 years of data are required to adjust for variation due to the calendar effects (4 vs. 5 week, 10 vs. 11 day). Therefore, an alternative approach has been implemented to address these concerns until sufficient history is available to use the current procedure.

ARIMA Model Selection. Unable to utilize X-12 ARIMA's automatic model selection due to the short length of the new series, CES elected to utilize an (0 1 1)(0 1 1) model for these series in the interim. This model diminishes noise in time series by using an exponentially weighted moving average of past values. As hours and earnings data tend to exhibit fluctuations around slowly-varying means, use of the exponential smoothing model is a sensible choice. Experimental results confirmed that this model is highly effective and will suffice until the all employees hours and earnings series reach the necessary length to allow the integration of automatic model selection.

Choice of Seasonal Filter. By default, X-12 ARIMA uses a 3x3 moving average to calculate the initial seasonal factors in each iteration, and a 3x5 moving average to calculate the final seasonal averages. However, the shortness of the new series imposes a technical limitation in that the only available option is to utilize a stable seasonal filter. A stable seasonal filter computes a single seasonal factor for each month by first calculating the average of all the values for each month, which reduces the chance of the irregular component affecting the seasonal component—a concern with short series. The effectiveness of the stable filter was demonstrated in experimental testing.

Treatment of Calendar Effects. The existing seasonal adjustment method for production employees' hours and earnings relies on the REGARIMA modeling approach described earlier that implicitly treats each month; the alternate technique treats only the months for which calendar effects impact the data. Affected months are manually treated as outliers when defining parameters for X-12 ARIMA. This treatment dampens the calendar effects, but spikes from the 10/11 day effect are still present in the adjusted series.

Based on manually-designated outliers, X-12 ARIMA produces a prior adjusted series by imputing for outlier observations based on the trend of the non-outlier observations. By default, X-12 ARIMA relies upon this prior-adjusted series when decomposing seasonality and estimating seasonal factors for time series; however, it then applies those factors to the original time series rather than

the prior-adjusted series. Under normal circumstances, application of seasonal factors to the original time series is sensible, as the original time series consists of the series true values.

In the context of CES' efforts to eliminate calendar effects from these estimates, it is undesirable to apply the seasonal factors to the original time series. Because the calendar effects are part of the original series—and because we cannot remove these effects with standard treatment procedures—it is therefore necessary that we apply the seasonal factors to the prior-adjusted series.

An additional problem is that the series' average for seasonally adjusted data is not preserved relative to the unadjusted average, because the adjustment is applied outside of X-12 ARIMA. A common goal when performing seasonal adjustment is to eliminate series' seasonality without altering series' levels. This goal is accomplished by smoothing seasonal fluctuations across the given time span such that some observations are elevated while others are diminished depending on the direction of the seasonality such that the net change is offsetting. Therefore, application of seasonal factors to prior-adjusted series—series which often exhibit lower means than their unadjusted analogues—may result in seasonally adjusted series with lower means than those of corresponding unadjusted series. Such outcomes are contradictory to established CES practices in that CES takes series' true levels to be defined by those of the unadjusted data. Therefore, a second step is required to preserve the series' average.

A correction factor forces the average of each series adjusted for calendar effects to the average of the corresponding unadjusted series. The factor is defined as:

$$\text{Correction Factor} = \frac{\sum_{t=1}^{n} X_t}{\sum_{t=1}^{n} \hat{X}_t}$$

X_t= Unadjusted value of series at month *t*

$\hat{X}_t$= Adjusted, calendar-effect-treated value of series at month *t*

The factor is applied multiplicatively to all observations in the seasonally-adjusted series. Testing has shown that this method effectively reconciles level shifts introduced by the modified calendar effects treatment procedure, thereby maintaining consistency between series' unadjusted and seasonally-adjusted levels.

See Exhibit 8 for series that have the calendar effects modeling described above.

Exhibit 8. Model specifications Seasonal Adjustment – AE

NAICS Tabcode	Tabcode title	Mode	4/5 week adj	Other adj
1011330000	Logging	MULT	X	
1021100000	Oil and gas extraction	MULT	X	
1021200000	Mining, except oil and gas		X	Indirect[1]
1021210000	Coal mining	MULT	X	
1021300000	Support activities for mining	MULT	X	
2023610000	Residential building		X	Indirect
2023620000	Nonresidential building		X	Indirect
2023700000	Heavy and civil engineering construction	ADD	X	
2023800000	Specialty trade contractors		X	Indirect
2023800100	Residential specialty trade contractors	ADD	X	Raked[2]
2023800200	Nonresidential specialty trade contractors	ADD	X	Raked
3132100000	Wood products	ADD	X	
3132700000	Nonmetallic mineral products	ADD	X	
3133100000	Primary metals	MULT	X	
3133200000	Fabricated metal products	MULT	X	
3133300000	Machinery	MULT	X	
3133400000	Computer and electronic products		X	Indirect
3133410000	Computer and peripheral equipment	MULT	X	
3133420000	Communications equipment	MULT	X	
3133440000	Semiconductors and electronic components	MULT	X	
3133450000	Electronic instruments	MULT	X	
3133500000	Electrical equipment and appliances	MULT	X	
3133600000	Transportation equipment	ADD		
3133600100	Motor vehicles and parts	ADD		
3133700000	Furniture and related products	ADD	X	
3133900000	Miscellaneous manufacturing	MULT	X	
3231100000	Food manufacturing	MULT	X	
3231200000	Beverages and tobacco products	MULT	X	
3231300000	Textile mills	MULT	X	
3231400000	Textile product mills	MULT	X	
3231500000	Apparel	MULT	X	

Exhibit 8. Model specifications Seasonal Adjustment – AE — continued				
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**Other adj**
3231600000	Leather and allied products	MULT	X	
3232200000	Paper and paper products	MULT	X	
3232300000	Printing and related support activities	MULT	X	
3232400000	Petroleum and coal products	MULT	X	
3232500000	Chemicals	MULT	X	
3232600000	Plastics and rubber products	ADD	X	
4142300000	Durable goods	MULT	X	
4142400000	Nondurable goods	MULT	X	
4142500000	Electronic markets and agents and brokers	MULT	X	
4244100000	Motor vehicle and parts dealers		X	Indirect
4244110000	Automobile dealers	ADD	X	
4244200000	Furniture and home furnishings stores	MULT	X	
4244300000	Electronics and appliance stores	MULT	X	
4244400000	Building material and garden supply stores	MULT	X	
4244500000	Food and beverage stores	MULT	X	
4244600000	Health and personal care stores	MULT	X	
4244700000	Gasoline stations	MULT	X	
4244800000	Clothing and clothing accessories stores	MULT	X	
4245100000	Sporting goods, hobby, book, and music stores	MULT	X	
4245200000	General merchandise stores		X	Indirect
4245210000	Department stores	MULT	X	
4245300000	Miscellaneous store retailers	MULT	X	
4245400000	Nonstore retailers	MULT	X	
4348100000	Air transportation	MULT	X	
4348200000	Rail transportation	MULT	X	
4348300000	Water transportation	MULT	X	
4348400000	Truck transportation	ADD	X	
4348500000	Transit and ground passenger transportation	ADD		
4348600000	Pipeline transportation	MULT	X	
4348700000	Scenic and sightseeing transportation	ADD	X	
4348800000	Support activities for transportation	MULT	X	

Exhibit 8. Model specifications Seasonal Adjustment – AE — continued				
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**Other adj**
4349200000	Couriers and messengers	MULT	X	
4349300000	Warehousing and storage	ADD	X	
4422000000	Utilities	MULT	X	
5051100000	Publishing industries, except Internet	MULT	X	
5051200000	Motion picture and sound recording industries	MULT	X	
5051500000	Broadcasting, except Internet	MULT	X	
5051700000	Telecommunications	MULT	X	
5051800000	Data processing, hosting and related services	MULT	X	
5051900000	Other information services	MULT	X	
5552100000	Monetary authorities central bank	MULT	X	
5552200000	Credit intermediation and related activities		X	Indirect
5552210000	Depository credit intermediation	MULT	X	
5552211000	Commercial banking	MULT	X	
5552300000	Securities, commodity contracts, investments	MULT	X	
5552400000	Insurance carriers and related activities	MULT	X	
5552500000	Funds, trusts, and other financial vehicles	ADD	X	
5553100000	Real estate	MULT	X	
5553200000	Rental and leasing services	ADD	X	
5553300000	Lessors of nonfinancial intangible assets	MULT	X	
6054000000	Professional and technical services		X	Indirect
6054110000	Legal services	MULT	X	
6054120000	Accounting and bookkeeping services	ADD	X	
6054130000	Architectural and engineering services	MULT	X	
6054150000	Computer systems design and related services	ADD	X	
6054160000	Management and technical consulting services	MULT	X	
6055000000	Management of companies and enterprises	MULT	X	
6056100000	Administrative and support services		X	Indirect
6056130000	Employment services	ADD	X	
6056132000	Temporary help services	ADD	X	
6056140000	Business support services	ADD	X	
6056170000	Services to buildings and dwellings	MULT	X	

Exhibit 8. Model specifications Seasonal Adjustment – AE — continued

NAICS Tabcode	Tabcode title	Mode	4/5 week adj	Other adj
6056200000	Waste management and remediation services	MULT	X	
6561000000	Educational services	ADD	X	
6562100000	Ambulatory health care services		X	Indirect
6562110000	Offices of physicians	ADD	X	
6562140000	Outpatient care centers	MULT	X	
6562160000	Home health care services	ADD	X	
6562200000	Hospitals	ADD	X	
6562300000	Nursing and residential care facilities		X	Indirect
6562310000	Nursing care facilities	MULT	X	
6562400000	Social assistance		X	Indirect
6562440000	Child day care services	ADD	X	
7071100000	Performing arts and spectator sports	MULT	X	
7071200000	Museums, historical sites, zoos, and parks	MULT	X	
7071300000	Amusements, gambling, and recreation	ADD	X	
7072100000	Accommodation	MULT	X	
7072200000	Food services and drinking places	ADD	X	
8081100000	Repair and maintenance	MULT	X	
8081200000	Personal and laundry services	MULT	X	
8081300000	Membership associations and organizations	ADD		
9091100000	Federal, except U.S. Postal Service	MULT	X	
9091912000	U.S. Postal Service	MULT	X	
9092161100	State government education	ADD	X	
9092200000	State government, excluding education	MULT	X	
9093161100	Local government education	ADD	X	
9093200000	Local government, excluding education	MULT	X	Election adjustment[3]

Seasonal Adjustment - AE AWH					
NAICS Tabcode	Tabcode title	Mode	4/5 week adj	10/11 day adj	Easter/Labor Day adj
1000000000	Mining and logging	MULT			X
2000000000	Construction	MULT			X
3132100000	Wood products	MULT			
3132700000	Nonmetallic mineral products	MULT			
3133100000	Primary metals	MULT			X
3133200000	Fabricated metal products	MULT			X
3133300000	Machinery	MULT			X
3133400000	Computer and electronic products	MULT			X
3133500000	Electrical equipment and appliances	MULT			X
3133600000	Transportation equipment	MULT			X
3133600100	Motor vehicles and parts	ADD			X
3133700000	Furniture and related products	MULT			X
3133900000	Miscellaneous manufacturing	MULT			X
3231100000	Food manufacturing	MULT			X
3231200000	Beverages and tobacco products	MULT			X
3231300000	Textile mills	MULT			X
3231400000	Textile product mills	MULT			X
3231500000	Apparel	MULT			X
3231600000	Leather and allied products	MULT			X
3232200000	Paper and paper products	MULT			X
3232300000	Printing and related support activities	MULT			X
3232400000	Petroleum and coal products	MULT			
3232500000	Chemicals	MULT			
3232600000	Plastics and rubber products	MULT			X
4142000000	Wholesale trade	MULT		X	
4200000000	Retail trade	MULT		X	
4300000000	Transportation and warehousing	MULT		X	
4422000000	Utilities	MULT			
5000000000	Information	ADD		X	
5500000000	Financial activities	MULT		X	

Seasonal Adjustment - AE AWH — continued					
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**10/11 day adj**	**Easter/Labor Day adj**
6000000000	Professional and business services	MULT		X	X
6500000000	Education and health services	MULT		X	
7000000000	Leisure and hospitality	MULT		X	
8000000000	Other services	MULT		X	

Seasonal Adjustment - AE AHE				
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**10/11 day adj**
1000000000	Mining and logging	ADD		
2000000000	Construction	MULT		
3100000000	Durable goods	ADD		
3200000000	Nondurable goods	ADD		
4142000000	Wholesale trade	ADD		X
4200000000	Retail trade	MULT		X
4300000000	Transportation and warehousing	MULT		X
4422000000	Utilities	ADD		
5000000000	Information	MULT		X
5500000000	Financial activities	ADD		X
6000000000	Professional and business services	MULT		X
6500000000	Education and health services	MULT		
7000000000	Leisure and hospitality	MULT		
8000000000	Other services	MULT		X

Seasonal Adjustment - AE AOH					
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**10/11 day adj**	**Easter/Labor Day adj**
3100000000	Durable goods	MULT			X
3200000000	Nondurable goods	MULT			X

Seasonal Adjustment – PE				
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**Other adj**
1000000000	Mining and logging	MULT	X	
2000000000	Construction	ADD	X	
3132100000	Wood products	ADD	X	
3132700000	Nonmetallic mineral products	ADD	X	
3133100000	Primary metals	ADD	X	
3133200000	Fabricated metal products	MULT	X	
3133300000	Machinery	MULT	X	
3133400000	Computer and electronic products	MULT	X	
3133500000	Electrical equipment and appliances	MULT	X	
3133600000	Transportation equipment	ADD		
3133600100	Motor vehicles and parts	ADD		
3133700000	Furniture and related products	ADD	X	
3133900000	Miscellaneous manufacturing	MULT	X	
3231100000	Food manufacturing	MULT	X	
3231200000	Beverages and tobacco products	MULT	X	
3231300000	Textile mills	MULT	X	
3231400000	Textile product mills	MULT	X	
3231500000	Apparel	MULT	X	
3231600000	Leather and allied products	MULT	X	
3232200000	Paper and paper products	MULT	X	
3232300000	Printing and related support activities	MULT	X	
3232400000	Petroleum and coal products	ADD	X	
3232500000	Chemicals	MULT	X	

Seasonal Adjustment – PE — continued				
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**Other adj**
3232600000	Plastics and rubber products	ADD	X	
4142000000	Wholesale trade	MULT	X	
4200000000	Retail trade	MULT	X	
4300000000	Transportation and warehousing	ADD	X	
4422000000	Utilities	MULT	X	
5000000000	Information	MULT	X	
5500000000	Financial activities	MULT	X	
6000000000	Professional and business services	MULT	X	
6500000000	Education and health services	ADD	X	
7000000000	Leisure and hospitality	MULT	X	
8000000000	Other services	MULT	X	

Seasonal Adjustment - PE AWH					
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**10/11 day adj**	**Easter/Labor Day adj**
1000000000	Mining and logging	MULT	X		X
2000000000	Construction	ADD	X		X
3132100000	Wood products	MULT	X		X
3132700000	Nonmetallic mineral products	ADD	X		X
3133100000	Primary metals	ADD	X		X
3133200000	Fabricated metal products	MULT	X		X
3133300000	Machinery	MULT	X		X
3133400000	Computer and electronic products	MULT	X		X
3133500000	Electrical equipment and appliances	MULT	X		X
3133600000	Transportation equipment	ADD	X		X
3133600100	Motor vehicles and parts	ADD	X		X
3133700000	Furniture and related products	MULT	X		X
3133900000	Miscellaneous manufacturing	MULT	X		X

Seasonal Adjustment - PE AWH — continued					
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**10/11 day adj**	**Easter/Labor Day adj**
3231100000	Food manufacturing	MULT	X		X
3231200000	Beverages and tobacco products	ADD	X		X
3231300000	Textile mills	MULT	X		X
3231400000	Textile product mills	MULT	X		X
3231500000	Apparel	MULT	X		X
3231600000	Leather and allied products	ADD	X		X
3232200000	Paper and paper products	MULT	X		X
3232300000	Printing and related support activities	MULT	X		X
3232400000	Petroleum and coal products	MULT	X		X
3232500000	Chemicals	MULT	X		
3232600000	Plastics and rubber products	MULT	X		X
4142000000	Wholesale trade	MULT		X	X
4200000000	Retail trade	MULT		X	
4300000000	Transportation and warehousing	MULT		X	X
4422000000	Utilities	MULT	X		
5000000000	Information	MULT		X	
5500000000	Financial activities	MULT		X	
6000000000	Professional and business services	MULT		X	X
6500000000	Education and health services	MULT		X	
7000000000	Leisure and hospitality	MULT		X	
8000000000	Other services	MULT		X	X

Seasonal Adjustment - PE AHE				
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**10/11 day adj**
1000000000	Mining and logging	MULT	X	
2000000000	Construction	MULT	X	
3100000000	Durable goods	ADD	X	
3200000000	Nondurable goods	MULT	X	

Seasonal Adjustment - PE AHE — continued				
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**10/11 day adj**
4142000000	Wholesale trade	MULT		X
4200000000	Retail trade	MULT		X
4300000000	Transportation and warehousing	MULT	X	
4422000000	Utilities	MULT	X	
5000000000	Information	MULT		X
5500000000	Financial activities	MULT		X
6000000000	Professional and business services	MULT		X
6500000000	Education and health services	ADD	X	
7000000000	Leisure and hospitality	MULT	X	
8000000000	Other services	ADD		X

Seasonal Adjustment - PE AOH					
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**10/11 day adj**	**Easter/Labor Day adj**
3100000000	Durable goods	MULT	X		X
3200000000	Nondurable goods	ADD	X		X

Seasonal Adjustment – WE				
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**Other adj**
1000000000	Mining and logging	MULT	X	
1021000000	Mining	MULT	X	
2000000000	Construction	ADD	X	
3100000000	Durable goods	MULT	X	
3200000000	Nondurable goods	MULT	X	
4142000000	Wholesale trade	MULT	X	
4200000000	Retail trade	MULT	X	
4300000000	Transportation and warehousing	MULT	X	
4422000000	Utilities	MULT	X	

Seasonal Adjustment – WE — continued				
NAICS Tabcode	**Tabcode title**	**Mode**	**4/5 week adj**	**Other adj**
5000000000	Information	MULT	X	
5552000000	Finance and insurance	MULT	X	
5553000000	Real estate and rental and leasing	MULT	X	
6054000000	Professional and technical services	MULT	X	
6055000000	Management of companies and enterprises	MULT	X	
6056000000	Administrative and waste services	MULT	X	
6561000000	Educational services	ADD	X	
6562000000	Health care and social assistance	ADD	X	
7071000000	Arts, entertainment, and recreation	ADD	X	
7072000000	Accommodation and food services	ADD	X	
8000000000	Other services	MULT	X	
9091000000	Federal	MULT	X	
9092000000	State government	ADD	X	
9093000000	Local government	ADD	X	Election adjustment[3]

(1) Seasonal adjustment occurs at the lowest available industry level.
(2) Residential and nonresidential specialty trade estimates are raked to the specialty trade estimates to ensure consistency.
(3)Special adjustment for the presence/absence of poll workers in local government.

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