

BLS National Establishment Estimates Revised to Incorporate March 2003 Benchmarks

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With the release of data for January 2004, 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 reflect more currently available universe counts of employment—a process known as benchmarking. Comprehensive counts of employment, or benchmarks, are derived primarily from employment data reported on unemployment insurance (UI) tax reports that nearly all employers are required to file with State Employment Security Agencies. Beginning this year, the benchmark release date has been accelerated from June to February. This acceleration is due, in large part, to the earlier availability of the UI data.

Summary of the benchmark revisions

The March 2003 benchmark level for total nonfarm employment is 129,148,000; this figure is 122,000 below the sample-based estimate for March 2003, an adjustment of -0.1 percent. Table 1 shows the total nonfarm benchmark revisions in percentage terms for the past 10 years.

Table 2 shows the employment benchmarks for March 2003, not seasonally adjusted, by industry. The majority of this year's benchmark revision was in manufacturing and in professional and business services. Employment estimates in manufacturing were revised downward by 156,000, or 1.1 percent. Within manufacturing, durable goods contributed the most, with a downward revision of 110,000, or 1.2 percent. Nondurable goods employment was revised downward by 46,000, or 0.8 percent. In professional and business services, employment estimates were revised downward by 110,000, or 0.7 percent.

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Benchmark revisions in other supersectors were generally smaller. Government employment was revised upward by 76,000, or 0.3 percent. The revision was mainly attributable to State government education, which was revised upward by 77,000, or 3.2 percent. Other services employment was revised upward by 75,000, or 1.4 percent. This was largely due to an upward revision of 34,000, or 2.7 percent, in personal and laundry services, and an upward revision of 22,000, or 0.8 percent, in membership associations and organizations. Employment in leisure and hospitality was revised upward by 53,000, or 0.5 percent. The revision was largely driven by an upward revision of 39,000, or 0.4 percent, in accommodations and food services. Only a minor upward revision of 10,000 occurred in trade, transportation, and utilities. However, within the trade, transportation, and utilities supersector, wholesale trade employment was revised upward by 35,000, or 0.6 percent, which was offset by a downward revision in retail trade of 72,000, or 0.5 percent. Natural resources and mining was revised upward by 5,000, or 0.9 percent.

The information industry employment series was revised downward by 82,000, or 2.6 percent. This was largely driven by a downward revision of 46,000, or 4.2 percent, in telecommunications. Construction employment was revised downward by 53,000, or 0.8 percent. The majority of the revision in construction was in construction of buildings, with a downward revision of 29,000, or 1.9 percent, and in specialty trade contractors, with a downward revision of 25,000, or 0.6 percent.

Changes to the CES published series list

The 2003 benchmark resulted in several changes to the list of CES published series. The changes result from a review of sample employment coverage for all estimating cells. There are four series that are newly published effective with the 2003 benchmark release. (See exhibit 1.) Exhibits 2 through 4 show additional changes to published and unpublished series effective with the introduction of March 2003 benchmark levels.

Table 1. Percent differences between nonfarm employment benchmarks and estimates by industry sector, March 1994-2003¹

Industry	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total nonfarm	0.7	0.5	(²)	0.4	(²)	0.2	0.4	-0.1	-0.2	-0.1
Total private .....	.7	.5	0.1	.5	0.1	.2	.3	-.2	-.4	-.2
Government .....	.4	.2	-.1	-.4	-.2	.1	.6	.3	1.0	.3

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. Differences between nonfarm employment benchmarks and estimates by industry sector and selected industry detail, March 2003

(Numbers in thousands)

Industry	Benchmark	Estimate	Difference	
			Amount	Percent
Total nonfarm	129,148	129,270	-122	-.1
Total private	107,131	107,329	-198	-.2
Goods-producing	21,529	21,733	-204	-.9
Natural resources and mining	556	551	5	.9
Logging	64	60	4	6.3
Mining	492	491	1	.2
Oil and gas extraction	120	122	-2	-1.7
Mining, except oil and gas	196	202	-6	-3.1
Coal mining	71	72	-1	-1.4
Support activities for mining	175	167	8	4.6
Construction	6,319	6,372	-53	-.8
Construction of buildings	1,511	1,540	-29	-1.9
Heavy and civil engineering construction	812	810	2	.2
Specialty trade contractors	3,997	4,022	-25	-.6
Manufacturing	14,654	14,810	-156	-1.1
Durable goods	9,066	9,176	-110	-1.2
Wood products	529	535	-6	-1.1
Nonmetallic mineral products	486	495	-9	-1.9
Primary metals	489	494	-5	-1.0
Fabricated metal products	1,492	1,490	2	.1
Machinery	1,171	1,197	-26	-2.2
Computer and electronic products	1,387	1,432	-45	-3.2
Computer and peripheral equipment	231	231	0	.0
Communications equipment	160	177	-17	-10.6
Semiconductors and electronic components	472	494	-22	-4.7
Electronic instruments	434	436	-2	-.5
Electrical equipment and appliances	470	478	-8	-1.7
Transportation equipment	1,792	1,791	1	.1
Furniture and related products	581	583	-2	-.3
Miscellaneous manufacturing	670	682	-12	-1.8
Nondurable goods	5,588	5,634	-46	-.8
Food manufacturing	1,493	1,492	1	.1
Beverages and tobacco products	198	192	6	3.0
Textile mills	275	282	-7	-2.5
Textile product mills	186	191	-5	-2.7
Apparel	327	320	7	2.1
Leather and allied products	47	46	1	2.1
Paper and paper products	522	533	-11	-2.1
Printing and related support activities	685	695	-10	-1.5
Petroleum and coal products	114	118	-4	-3.5
Chemicals	916	923	-7	-.8
Plastics and rubber products	826	843	-17	-2.1
Service-providing	107,619	107,537	82	.1
Private service-providing	85,602	85,596	6	(¹)
Trade, transportation, and utilities	24,994	24,984	10	(¹)
Wholesale trade	5,598	5,563	35	.6
Electronic markets and agents and brokers	652	618	34	5.2
Retail trade	14,648	14,720	-72	-.5
Motor vehicle and parts dealers	1,861	1,861	0	.0
Automobile dealers	1,246	1,239	7	.6
Furniture and home furnishings stores	540	544	-4	-.7
Electronics and appliance stores	511	522	-11	-2.2
Building material and garden supply stores	1,143	1,152	-9	-.8

See footnote at end of table.

Table 2. Differences between nonfarm employment benchmarks and estimates by industry sector and selected industry detail, March 2003—Continued

(Numbers in thousands)

Industry	Benchmark	Estimate	Difference	
			Amount	Percent
Retail trade—Continued				
Food and beverage stores	2,818	2,786	32	1.1
Health and personal care stores	931	956	-25	-2.7
Gasoline stations	871	896	-25	-2.9
Clothing and clothing accessories stores	1,261	1,246	15	1.2
Sporting goods, hobby, book, and music stores	635	631	4	.6
General merchandise stores	2,734	2,762	-28	-1.0
Department stores	1,575	1,658	-83	-5.3
Miscellaneous store retailers	918	928	-10	-1.1
Nonstore retailers	425	437	-12	-2.8
Transportation and warehousing	4,166	4,108	58	1.4
Air transportation	545	532	13	2.4
Rail transportation	213	214	-1	-.5
Water transportation	52	49	3	5.8
Truck transportation	1,304	1,303	1	.1
Transit and ground passenger transportation	391	362	29	7.4
Pipeline transportation	41	40	1	2.4
Scenic and sightseeing transportation	22	23	-1	-4.5
Support activities for transportation	514	520	-6	-1.2
Couriers and messengers	566	556	10	1.8
Warehousing and storage	519	510	9	1.7
Utilities	581	593	-12	-2.1
Information	3,214	3,296	-82	-2.6
Publishing industries, except Internet	935	952	-17	-1.8
Motion picture and sound recording industries	367	365	2	.5
Broadcasting, except Internet	326	325	1	.3
Internet publishing and broadcasting	30	34	-4	-13.3
Telecommunications	1,097	1,143	-46	-4.2
ISPs, search portals, and data processing	410	431	-21	-5.1
Other information services	48	46	2	4.2
Financial activities	7,910	7,897	13	.2
Finance and insurance	5,895	5,888	7	.1
Monetary authorities - central bank	23	22	1	4.3
Credit intermediation and related activities	2,758	2,747	11	.4
Depository credit intermediation	1,741	1,758	-17	-1.0
Commercial banking	1,276	1,297	-21	-1.6
Securities, commodity contracts, investments	761	797	-36	-4.7
Insurance carriers and related activities	2,270	2,238	32	1.4
Funds, trusts, and other financial vehicles	83	84	-1	-1.2
Real estate and rental and leasing	2,014	2,009	5	.2
Real estate	1,361	1,344	17	1.2
Rental and leasing services	627	637	-10	-1.6
Lessors of nonfinancial intangible assets	26	27	-1	-3.8
Professional and business services	15,700	15,810	-110	-.7
Professional and technical services	6,697	6,824	-127	-1.9
Legal services	1,131	1,120	11	1.0
Accounting and bookkeeping services	935	1,031	-96	-10.3
Architectural and engineering services	1,212	1,228	-16	-1.3
Computer systems design and related service	1,113	1,145	-32	-2.9
Management and technical consulting services	739	731	8	1.1
Management of companies and enterprises	1,668	1,686	-18	-1.1
Administrative and waste services	7,335	7,300	35	.5
Administrative and support services	7,022	6,991	31	.4
Employment services	3,115	3,122	-7	-.2
Temporary help services	2,069	2,044	25	1.2
Business support services	750	751	-1	-.1
Services to buildings and dwellings	1,514	1,486	28	1.8
Waste management and remediation services	313	309	4	1.3

See footnote at end of table.

Table 2. Differences between nonfarm employment benchmarks and estimates by industry sector and selected industry detail, March 2003—Continued

(Numbers in thousands)

Industry	Benchmark	Estimate	Difference	
			Amount	Percent
Education and health services	16,632	16,585	47	.3
Educational services	2,817	2,842	-25	-.9
Health care and social assistance	13,815	13,743	72	.5
Ambulatory health care services	4,731	4,732	-1	(¹)
Offices of physicians	1,987	2,034	-47	-2.4
Outpatient care centers	423	413	10	2.4
Home health care services	712	697	15	2.1
Hospitals	4,229	4,209	20	.5
Nursing and residential care facilities	2,772	2,771	1	(¹)
Nursing care facilities	1,579	1,581	-2	-.1
Social assistance	2,083	2,031	52	2.5
Child day care services	771	739	32	4.2
Leisure and hospitality	11,769	11,716	53	.5
Arts, entertainment, and recreation	1,665	1,651	14	.8
Performing arts and spectator sports	359	340	19	5.3
Museums, historical sites, zoos, and parks	109	105	4	3.7
Amusements, gambling, and recreation	1,197	1,206	-9	-.8
Accommodations and food services	10,104	10,065	39	.4
Accommodations	1,725	1,728	-3	-.2
Food services and drinking places	8,379	8,338	41	.5
Other services	5,383	5,308	75	1.4
Repair and maintenance	1,233	1,214	19	1.5
Personal and laundry services	1,254	1,220	34	2.7
Membership associations and organizations	2,896	2,874	22	.8
Government	22,017	21,941	76	.3
Federal Government	2,774	2,778	-4	-.1
Federal Government, except U.S. Postal Service	1,961	1,957	4	.2
U.S. Postal Service	813	821	-8	-1.0
State government	5,164	5,090	74	1.4
State government education	2,405	2,328	77	3.2
State government, excluding education	2,759	2,762	-3	-.1
Local government	14,079	14,073	6	(¹)
Local government education	8,055	8,064	-9	-.1
Local government, excluding education	6,024	6,009	15	.2

¹ Less than 0.05 percent.

Revisions to indexes

The entire historical data series for all indexes of aggregate weekly hours and aggregate weekly payrolls have been recalculated with this benchmark. This was necessary because the indexes are based on the 2002 annual averages, and these annual averages were revised during the 2003 benchmarking process. Future benchmark revisions will not have an impact on the 2002 base-year estimates.

Revisions in the postbenchmark period

Postbenchmark period employment estimates from April to October 2003 were calculated for each month based on new benchmark levels and new business net birth/death figures. (See table 3.)

Table 4 shows the net birth/death model figures for the supersectors over the postbenchmark period. From April to December 2003, the cumulative net birth/death model increased employment by 695,000.

Why benchmarks differ from estimates

A benchmark revision is the difference between the benchmark level for a given March and its corresponding sample-based estimate. The overall accuracy of the establishment survey usually is 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 recordkeeping

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 any sample survey, 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 insures 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

Exhibit 1. Newly published series effective with March 2003 benchmark revisions

Series title	NAICS code	Sector	March 2003 benchmark employment (in thousands)
Railroad rolling stock	3365	Manufacturing	22.8
Ice cream and frozen desserts	31152	Manufacturing	21.5
Electronic shopping and electronic auctions	454111, 2	Retail trade	51.2
Limousine service	48532	Transportation and warehousing	35.2

Exhibit 2. Published series with changed scope effective with March 2003 benchmark revisions

Series title	NAICS code	March 2003 benchmark employment (in thousands)	Series disposition
Computer terminals and other computer peripheral equipment	334113, 9	72.0	Computer terminals (published), NAICS 334113 <i>is collapsed into</i> Other computer peripheral equipment, NAICS 334119
Electronic connectors and miscellaneous electronic components	334415, 6, 7, 9	101.3	Electronic connectors (unpublished), NAICS 334417 <i>is collapsed into</i> Miscellaneous electronic components, NAICS 334115, 6, 9
Commercial gravure and miscellaneous commercial printing	323111, 5, 7, 8, 9	129.4	Commercial gravure printing (unpublished), NAICS 323111 <i>is collapsed into</i> Miscellaneous commercial printing, NAICS 323115, 7, 8, 9
Other major household appliances (unpublished)	335221, 4, 8	49.2	Household cooking appliances (published), NAICS 335221 <i>and</i> Household laundry equipment (unpublished), NAICS 335224 <i>are collapsed into</i> Other major household appliances (unpublished), NAICS 335228

Exhibit 3. Discontinued published series effective with March 2003 benchmark revisions, by data type

Series title	NAICS code	Sector
	Production workers, average weekly hours, average hourly earnings, and average weekly earnings series	
Turbine and turbine generator set units	333611	Manufacturing
Directory and mailing list publishers	51114	Information
Tour operators	56152	Professional and business services
All other personal services	81299	Other services
	Average overtime hours	
Men's cut and sew apparel contractors	315211	Manufacturing
Petroleum refineries	32411	Manufacturing

Exhibit 4. **Discontinued series effective with March 2003 benchmark revisions**

Series title	NAICS code	Next-highest published level
Primary aluminum production (unpublished)	331312	NAICS 3313, Alumina and aluminum production
Aluminum sheet, plate, and foil (unpublished)	331315	NAICS 3313, Alumina and aluminum production
Lawn and garden equipment (unpublished)	333112	NAICS 33311, Agricultural implements
Semiconductor machinery (published)	333295	NAICS 3332, Industrial machinery
Overhead cranes, hoists, and monorail systems (unpublished)	333923	NAICS 33392, Material handling equipment
Household vacuum cleaners (unpublished)	335212	NAICS 33521, Small electrical appliances
Other communication and energy wires (unpublished)	335929	NAICS 33592, Communication and energy wires and cables
Miscellaneous transportation equipment (unpublished) ...	336992, 9	NAICS 3369, Other transportation equipment
Cellulosic organic fibers (unpublished)	325221	NAICS 3252, Resin, rubber, and artificial fibers
Noncellulosic organic fibers (unpublished)	325222	NAICS 3252, Resin, rubber, and artificial fibers

N.A. = not available.

Table 3. **Revisions in total nonfarm employment, seasonally adjusted, January-December 2003**

(In thousands)

Year and month	Levels			Over-the-month changes		
	As previously published	As revised	Difference	As previously published	As revised	Difference
2003						
January	130,356	130,190	-166	158	94	-64
February	130,235	130,031	-204	-121	-159	-38
March	130,084	129,921	-163	-151	-110	41
April	130,062	129,901	-161	-22	-20	2
May	129,986	129,873	-113	-76	-28	48
June	129,903	129,859	-44	-83	-14	69
July	129,846	129,814	-32	-57	-45	12
August	129,881	129,789	-92	35	-25	-60
September	129,980	129,856	-124	99	67	-32
October	130,080	129,944	-136	100	88	-12
November	130,123	130,027	-96	43	83	40
December ^p	130,124	130,043	-81	1	16	15

p = preliminary.

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, with an absolute range from less than 0.05 percent to 0.7 percent.

Benchmark revisions effects for other data types

The routine benchmarking process results in revisions in the series on women workers and production or nonsupervisory workers. There are no benchmark employment levels for these series. They are revised by preserving ratios of employment

for the particular series to all employees 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 levels of the hours and earnings series are derived as weighted averages. The production or nonsupervisory worker employment estimates for the basic cells are used as weights for the hours and earnings estimates

Table 4. Net birth/death estimates for private nonfarm sectors, post-benchmark 2003

(In thousands)

Year and month	Natural resources and mining	Construction	Manufacturing	Trade, transportation, and utilities	Information	Financial activities	Professional and business services	Education and health services	Leisure and hospitality	Other services	Total monthly amount contributed
2003											
April	-1	13	-15	-4	-3	9	61	32	29	7	128
May	1	35	5	21	4	8	32	6	72	8	192
June	1	28	5	18	0	6	21	-4	83	6	164
July	0	-8	-29	-19	-4	-11	-22	-20	40	-10	-83
August.....	1	16	6	17	2	8	31	14	24	5	124
September	1	9	3	17	0	4	15	12	-29	1	33
October	1	8	-7	13	-1	14	18	26	-27	0	45
November	-1	-7	3	17	3	7	10	10	-14	2	30
December	0	-8	1	18	3	13	9	7	15	4	62
Cumulative total	3	86	-28	98	4	58	175	83	193	23	695

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 workers 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 5 shows the previous and revised hours and earnings estimates and the differences for specific hours and earnings series resulting from the March 2003 benchmark. At the total private level, there was a decrease of one-tenth of an hour in average weekly hours from the previously published level, while average hourly earnings decreased by 3 cents from the previously published level.

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). Beginning this year, the process has been accelerated from previous years' June releases to a February release due, in large part, to the earlier availability of the UI data. 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 postbenchmark estimation. This year, the Federal Government employment series was recalculated from May to September 2003 because of a substantial increase in the size of its sample. The revisions were incorporated with the March 2003 benchmarking process.

Benchmark source material. The principal source of benchmark data for private industries is the Quarterly Census of Employment and Wages (QCEW), also known as the ES-202 report. This report contains employment data 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 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 nonoffice insurance sales workers, child day care 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

Table 5. Effect of March 2003 benchmark revisions on 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	33.7	-0.1	\$15.34	\$15.31	-\$0.03
Goods-producing	39.7	39.7	0	16.59	16.60	.01
Natural resources and mining	43.8	43.8	0	17.58	17.50	-.08
Construction	38.2	38.2	0	18.73	18.74	.01
Manufacturing	40.3	40.3	0	15.62	15.62	0
Durable goods	40.6	40.6	0	16.33	16.34	.01
Wood products	39.8	39.8	0	12.51	12.52	.01
Nonmetallic mineral products	42.0	42.0	0	15.52	15.53	.01
Primary metals	42.6	42.6	0	17.86	17.88	.02
Fabricated metal products	40.4	40.4	0	14.97	14.97	0
Machinery	40.7	40.7	0	16.19	16.17	-.02
Computer and electronic products	40.4	40.4	0	16.55	16.57	.02
Electrical equipment and appliances	40.5	40.4	-.1	14.25	14.27	.02
Transportation equipment	41.5	41.6	.1	21.07	21.07	0
Furniture and related products	38.2	38.2	0	12.93	12.92	-.01
Miscellaneous manufacturing	38.5	38.5	0	13.22	13.22	0
Nondurable goods	39.9	39.9	0	14.53	14.51	-.02
Food manufacturing	39.1	39.1	0	12.70	12.73	.03
Beverages and tobacco products	38.8	38.8	0	17.69	17.85	.16
Textile mills	39.7	39.7	0	11.92	11.92	0
Textile product mills	39.3	39.2	-.1	10.98	10.96	-.02
Apparel	36.0	36.0	0	9.45	9.44	-.01
Leather and allied products	39.9	39.9	0	11.62	11.59	-.03
Paper and paper products	41.6	41.6	0	17.22	17.10	-.12
Printing and related support activities	38.6	38.6	0	15.33	15.32	-.01
Petroleum and coal products	45.9	45.9	0	24.17	24.09	-.08
Chemicals	42.6	42.6	0	18.33	18.33	0
Plastics and rubber products	40.1	40.1	0	14.00	14.01	.01
Private service-providing	32.5	32.4	-.1	15.00	14.96	-.04
Trade, transportation, and utilities	33.4	33.4	0	14.34	14.34	0
Wholesale trade	37.9	37.8	-.1	17.29	17.32	.03
Retail trade	30.6	30.6	0	11.90	11.90	0
Transportation and warehousing	36.7	36.6	-.1	16.23	16.19	-.04
Utilities	41.1	41.1	0	24.41	24.47	.06
Information	36.3	36.2	-.1	20.88	20.78	-.10
Financial activities	36.0	36.0	0	16.89	16.91	.02
Professional and business services	34.4	34.5	.1	17.36	17.34	-.02
Education and health services	32.6	32.3	-.3	15.62	15.54	-.08
Leisure and hospitality	25.7	25.7	0	8.73	8.75	.02
Other services	31.9	31.5	-.4	14.02	13.85	-.17

by the Census Bureau. Benchmark data from these sources are available only on a 1- or 2-year lagged basis. Extrapolation to a current level is accomplished by assuming and 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 6 to 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. The research demonstrated that sampling for births was not feasible in the

very short CES production timeframes. Therefore, BLS 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 uses business deaths to impute employment for 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 (Auto-Regressive Integrated Moving Average) time series model designed to estimate the residual net birth/death employment not accounted for by the imputations. The historical time series used to create and test the ARIMA model was derived from the UI universe microlevel database, and reflects the actual residual net of births and deaths over the past 5 years. The ARIMA model component is reviewed on a quarterly basis. The net birth/death model component figures are unique to each month and include negative adjustments in some months. Furthermore, these figures may exhibit a seasonal pattern observed in the historical UI universe data series.

The most significant potential drawback to this or any model-based approach is that time series modeling assumes a predictable continuation of historical patterns and relationships, and therefore is likely to have some difficulty producing reliable estimates at economic turning points or during periods when there are sudden changes in trend. BLS will continue researching alternative model-based techniques for the net birth/death component. It is likely to remain the most problematic part of the estimation process.

Availability of revised data

LABSTAT, the BLS public database on the Internet, contains all historical employment, hours, and earnings data revised because of this benchmark, both unadjusted and seasonally adjusted data. The data can be accessed at <http://www.bls.gov/ces/>, the Current Employment Statistics homepage. Employment, hours, and earnings estimates also are published monthly in *Employment and Earnings*.

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. BLS computes seasonal factors concurrently with the monthly estimation production. Individual series are seasonally adjusted using either a multiplicative or an additive model. For employment, seasonal adjustment factors are directly applied to the component levels. Individual three-digit NAICS levels are seasonally adjusted, and higher level aggregates are formed by summation of 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 from the previous 3 years. All else being 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 has adopted REGARIMA (regression with autocorrelated 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 autocorrelated over time. That is, each month's value is significantly dependent on the observations that precede it. These series, thus, usually can be successfully fit using ARIMA models. If autocorrelated 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 autocorrelation. Thus, the REGARIMA technique is appropriate for measuring relationships among variables of interest in series that exhibit autocorrelation, 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 were fitted with the most recent 10 years of data available, the standard timespan 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 previously used.

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, which are described below.

Construction series. BLS continues its special treatment in seasonally adjusting the construction industry series, which began with the 1996 benchmark revision. 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 permitted 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 also continues 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.

Local government series. A special adjustment also is made in the local government, excluding education series in November of each year to account for variations in

employment due to the presence or absence of poll workers.

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 semimonthly 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. Currently, the CES processing system can accommodate only one conversion factor per reporter.

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

Additive and multiplicative models. Prior to the March 2002 benchmark release, all CES series were adjusted using multiplicative seasonal adjustment models. Although the X-12-ARIMA seasonal adjustment program provides for either an additive or a multiplicative adjustment, depending on which model best fits the individual series, the previous CES processing system was unable to utilize additive adjustments. A new processing system, introduced simultaneously with the NAICS conversion, is able to utilize both additive and multiplicative adjustments. See exhibit 5 for a list of which series are adjusted with additive and multiplicative models and which series are subject to the calendar-effects modeling described earlier.

Exhibit 5. Mode of adjustment used for seasonal adjustment of nonfarm payroll series

Industry	Mode of adjustment	Special adjustments			
		4/5 week	10/11 day	Easter/Labor Day	Other
All employees					
Logging	Multiplicative	X			
Oil and gas extraction	Multiplicative	X			
Mining, except oil and gas	-	X			Indirect ¹
Coal mining	Multiplicative	X			
Support activities for mining	Multiplicative	X			
Construction of buildings	-	X			Indirect ¹
Heavy and civil engineering construction	Additive	X			
Specialty trade contractors	-	X			Indirect ¹
Wood products	Additive	X			
Nonmetallic mineral products	Additive	X			
Primary metals	Multiplicative	X			
Fabricated metal products	Multiplicative	X			
Machinery	Multiplicative	X			
Computer and electronic products	-	X			Indirect ¹
Computer and peripheral equipment	Additive	X			
Communications equipment	Additive	X			
Semiconductors and electronic components	Multiplicative	X			
Electronic instruments	Multiplicative	X			
Electrical equipment and appliances	Multiplicative	X			
Transportation equipment	Multiplicative				
Furniture and related products	Additive	X			
Miscellaneous manufacturing	Multiplicative	X			
Food manufacturing	Multiplicative	X			
Beverages and tobacco products	Multiplicative	X			
Textile mills	Additive	X			
Textile product mills	Additive	X			
Apparel	Multiplicative	X			
Leather and allied products	Multiplicative	X			
Paper and paper products	Multiplicative	X			
Printing and related support activities	Additive	X			
Petroleum and coal products	Additive	X			
Chemicals	Multiplicative	X			
Plastics and rubber products	Multiplicative	X			
Wholesale trade, durable goods	Multiplicative	X			
Wholesale trade, nondurable goods	Multiplicative	X			
Electronic markets and agents and brokers	Multiplicative	X			
Motor vehicle and parts dealers	-	X			Indirect ¹
Automobile dealers	Additive	X			
Furniture and home furnishings stores	Multiplicative	X			
Electronics and appliance stores	Multiplicative	X			
Building material and garden supply stores	Multiplicative	X			
Food and beverage stores	Multiplicative	X			
Health and personal care stores	Multiplicative	X			
Gasoline stations	Multiplicative	X			
Clothing and clothing accessories stores	Multiplicative	X			
Sporting goods, hobby, book, and music stores	Multiplicative	X			
General merchandise stores	-	X			Indirect ¹
Department stores	Multiplicative	X			
Miscellaneous store retailers	Additive	X			
Nonstore retailers	Multiplicative	X			
Air transportation	Multiplicative	X			
Rail transportation	Multiplicative	X			
Water transportation	Multiplicative	X			
Truck transportation	Additive	X			
Transit and ground passenger transportation	Additive				
Pipeline transportation	Additive	X			
Scenic and sightseeing transportation	Multiplicative	X			
Support activities for transportation	Additive	X			
Couriers and messengers	Multiplicative	X			
Warehousing and storage	Multiplicative	X			

See footnotes at end of exhibit.

Exhibit 5. Mode of adjustment used for seasonal adjustment of nonfarm payroll series—Continued

Industry	Mode of adjustment	Special adjustments			
		4/5 week	10/11 day	Easter/Labor Day	Other
All employees					
Utilities	Multiplicative	X			
Publishing industries, except Internet	Multiplicative	X			
Motion picture and sound recording industries	Multiplicative	X			
Broadcasting, except Internet	Multiplicative	X			
Internet publishing and broadcasting	Multiplicative	X			
Telecommunications	Multiplicative	X			
ISPs, search portals, and data processing	Multiplicative	X			
Other information services	Additive	X			
Monetary authorities – central bank	Additive	X			
Credit intermediation and related activities	-	X			Indirect ¹
Depository credit intermediation	Multiplicative	X			
Commercial banking	Multiplicative	X			
Securities, commodity contracts, investments	Multiplicative	X			
Insurance carriers and related activities	Multiplicative	X			
Funds, trusts, and other financial vehicles	Multiplicative	X			
Real estate	Multiplicative	X			
Rental and leasing services	Multiplicative	X			
Lessors of nonfinancial intangible assets	Multiplicative	X			
Professional and technical services	-	X			Indirect ¹
Legal services	Multiplicative	X			
Accounting and bookkeeping services	Multiplicative	X			
Architectural and engineering services	Multiplicative	X			
Computer systems design and related services	Multiplicative	X			
Management and technical consulting services	Multiplicative	X			
Management of companies and enterprises	Multiplicative	X			
Administrative and support services	-	X			Indirect ¹
Employment services	Multiplicative	X			
Temporary help services	Multiplicative	X			
Business support services	Multiplicative	X			
Services to buildings and dwellings	Multiplicative	X			
Waste management and remediation services	Multiplicative	X			
Educational services	Additive	X			
Ambulatory health care services	-	X			Indirect ¹
Offices of physicians	Additive	X			
Outpatient care centers	Additive	X			
Home health care services	Additive	X			
Hospitals	Additive	X			
Nursing and residential care facilities	-	X			Indirect ¹
Nursing care facilities	Additive	X			
Social assistance	-	X			Indirect ¹
Child day care services	Multiplicative	X			
Performing arts and spectator sports	Multiplicative	X			
Museums, historical sites, zoos, and parks	Multiplicative	X			
Amusements, gambling, and recreation	Multiplicative	X			
Accommodations	Multiplicative	X			
Food services and drinking places	Additive	X			
Repair and maintenance	Additive	X			
Personal and laundry services	Multiplicative	X			
Membership associations and organizations	Additive				
Federal Government, except U.S. Postal Service	Multiplicative	X			
U.S. Postal Service	Multiplicative	X			
State government education	Additive	X			
State government, excluding education	Multiplicative	X			
Local government education	Additive	X			
Local government, excluding education	Additive	X			Election ²

See footnotes at end of exhibit.

Exhibit 5. Mode of adjustment used for seasonal adjustment of nonfarm payroll series—Continued

Industry	Mode of adjustment	Special adjustments			
		4/5 week	10/11 day	Easter/Labor Day	Other
Women workers					
Natural resources and mining	Additive	X			
Mining	Additive	X			
Construction	Multiplicative	X			
Manufacturing, durable goods	Multiplicative	X			
Manufacturing, nondurable goods	Multiplicative	X			
Wholesale trade	Multiplicative	X			
Retail trade	Multiplicative	X			
Transportation and warehousing	Multiplicative	X			
Utilities	Multiplicative	X			
Information	Multiplicative	X			
Finance and insurance	Multiplicative	X			
Real estate and rental and leasing	Additive	X			
Professional and technical services	Multiplicative	X			
Management of companies and enterprises	Multiplicative	X			
Administrative and waste services	Multiplicative	X			
Educational services	Multiplicative	X			
Health care and social assistance	Multiplicative	X			
Arts, entertainment, and recreation	Multiplicative	X			
Accommodations and food services	Multiplicative	X			
Other services	Multiplicative	X			
Federal Government	Additive	X			
State government	Multiplicative	X			
Local government	Multiplicative	X			Election ²
Production or nonsupervisory workers ³					
Natural resources and mining	Multiplicative	X			
Construction	Additive	X			
Wood products	Additive	X			
Nonmetallic mineral products	Additive	X			
Primary metals	Multiplicative	X			
Fabricated metal products	Multiplicative	X			
Machinery	Additive	X			
Computer and electronic products	Multiplicative	X			
Electrical equipment and appliances	Multiplicative	X			
Transportation equipment	Multiplicative	X			
Furniture and related products	Additive	X			
Miscellaneous manufacturing	Multiplicative	X			
Food manufacturing	Multiplicative	X			
Beverages and tobacco products	Additive	X			
Textile mills	Additive	X			
Textile product mills	Additive	X			
Apparel	Additive	X			
Leather and allied products	Multiplicative	X			
Paper and paper products	Additive	X			
Printing and related support activities	Additive	X			
Petroleum and coal products	Additive	X			
Chemicals	Additive	X			
Plastics and rubber products	Multiplicative	X			
Wholesale trade	Multiplicative	X			
Retail trade	Multiplicative	X			
Transportation and warehousing	Additive	X			
Utilities	Multiplicative	X			
Information	Multiplicative	X			
Financial activities	Additive	X			
Professional and business services	Multiplicative	X			
Education and health services	Multiplicative	X			
Leisure and hospitality	Multiplicative	X			
Other services	Additive	X			

See footnotes at end of exhibit.

Exhibit 5. Mode of adjustment used for seasonal adjustment of nonfarm payroll series—Continued

Industry	Mode of adjustment	Special adjustments			
		4/5 week	10/11 day	Easter/Labor Day	Other
Average weekly hours ³					
Natural resources and mining	Multiplicative	X		X	
Construction	Additive	X		X	
Wood products	Additive	X		X	
Nonmetallic mineral products	Additive	X		X	
Primary metals	Multiplicative	X		X	
Fabricated metal products	Multiplicative	X		X	
Machinery	Multiplicative	X		X	
Computer and electronic products	Multiplicative	X		X	
Electrical equipment and appliances	Multiplicative	X		X	
Transportation equipment	Multiplicative	X		X	
Furniture and related products	Additive	X		X	
Miscellaneous manufacturing	Additive	X		X	
Food manufacturing	Additive	X		X	
Beverages and tobacco products	Multiplicative	X		X	
Textile mills	Additive	X		X	
Textile product mills	Additive	X		X	
Apparel	Additive	X		X	
Leather and allied products	Additive	X		X	
Paper and paper products	Multiplicative	X		X	
Printing and related support activities	Additive	X		X	
Petroleum and coal products	Multiplicative	X		X	
Chemicals	Multiplicative	X			
Plastics and rubber products	Multiplicative	X		X	
Wholesale trade	Multiplicative		X	X	
Retail trade	Multiplicative		X		
Transportation and warehousing	Multiplicative		X	X	
Utilities	Multiplicative	X			
Information	Multiplicative		X		
Financial activities	Multiplicative		X		
Professional and business services	Multiplicative		X	X	
Education and health services	Multiplicative		X		
Leisure and hospitality	Additive		X		
Other services	Multiplicative		X	X	
Average overtime hours ⁴					
Manufacturing, durable goods	Additive	X		X	
Manufacturing, nondurable goods	Additive	X		X	
Average hourly earnings ³					
Natural resources and mining	Additive	X			
Construction	Additive	X			
Manufacturing, durable goods	Additive	X			
Manufacturing, nondurable goods	Multiplicative	X			
Wholesale trade	Multiplicative		X		
Retail trade	Multiplicative	X			
Transportation and warehousing	Additive	X			
Utilities	Multiplicative	X			
Information	Multiplicative	X			
Financial activities	Multiplicative		X		
Professional and business services	Multiplicative		X		
Education and health services	Multiplicative	X			
Leisure and hospitality	Additive	X			
Other services	Multiplicative		X		

¹ Seasonal adjustment occurs at the finest industry detail available.

² Special adjustment for the presence/absence of poll workers in local government.

³ Data relate to production workers in natural resources and

mining and manufacturing; construction workers in construction; and nonsupervisory workers in private service-providing industries.

⁴ Data relate to production workers in manufacturing.

BLS National Establishment Estimates Revised to Incorporate March 2003 Benchmarks

Hazel Lejarde

With the release of data for January 2004, 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 reflect more currently available universe counts of employment—a process known as benchmarking. Comprehensive counts of employment, or benchmarks, are derived primarily from employment data reported on unemployment insurance (UI) tax reports that nearly all employers are required to file with State Employment Security Agencies. Beginning this year, the benchmark release date has been accelerated from June to February. This acceleration is due, in large part, to the earlier availability of the UI data.

Summary of the benchmark revisions

The March 2003 benchmark level for total nonfarm employment is 129,148,000; this figure is 122,000 below the sample-based estimate for March 2003, an adjustment of -0.1 percent. Table 1 shows the total nonfarm benchmark revisions in percentage terms for the past 10 years.

Table 2 shows the employment benchmarks for March 2003, not seasonally adjusted, by industry. The majority of this year's benchmark revision was in manufacturing and in professional and business services. Employment estimates in manufacturing were revised downward by 156,000, or 1.1 percent. Within manufacturing, durable goods contributed the most, with a downward revision of 110,000, or 1.2 percent. Nondurable goods employment was revised downward by 46,000, or 0.8 percent. In professional and business services, employment estimates were revised downward by 110,000, or 0.7 percent.

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Benchmark revisions in other supersectors were generally smaller. Government employment was revised upward by 76,000, or 0.3 percent. The revision was mainly attributable to State government education, which was revised upward by 77,000, or 3.2 percent. Other services employment was revised upward by 75,000, or 1.4 percent. This was largely due to an upward revision of 34,000, or 2.7 percent, in personal and laundry services, and an upward revision of 22,000, or 0.8 percent, in membership associations and organizations. Employment in leisure and hospitality was revised upward by 53,000, or 0.5 percent. The revision was largely driven by an upward revision of 39,000, or 0.4 percent, in accommodations and food services. Only a minor upward revision of 10,000 occurred in trade, transportation, and utilities. However, within the trade, transportation, and utilities supersector, wholesale trade employment was revised upward by 35,000, or 0.6 percent, which was offset by a downward revision in retail trade of 72,000, or 0.5 percent. Natural resources and mining was revised upward by 5,000, or 0.9 percent.

The information industry employment series was revised downward by 82,000, or 2.6 percent. This was largely driven by a downward revision of 46,000, or 4.2 percent, in telecommunications. Construction employment was revised downward by 53,000, or 0.8 percent. The majority of the revision in construction was in construction of buildings, with a downward revision of 29,000, or 1.9 percent, and in specialty trade contractors, with a downward revision of 25,000, or 0.6 percent.

Changes to the CES published series list

The 2003 benchmark resulted in several changes to the list of CES published series. The changes result from a review of sample employment coverage for all estimating cells. There are four series that are newly published effective with the 2003 benchmark release. (See exhibit 1.) Exhibits 2 through 4 show additional changes to published and unpublished series effective with the introduction of March 2003 benchmark levels.

Table 1. Percent differences between nonfarm employment benchmarks and estimates by industry sector, March 1994-2003¹

Industry	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total nonfarm	0.7	0.5	(²)	0.4	(²)	0.2	0.4	-0.1	-0.2	-0.1
Total private .....	.7	.5	0.1	.5	0.1	.2	.3	-.2	-.4	-.2
Government .....	.4	.2	-.1	-.4	-.2	.1	.6	.3	1.0	.3

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. Differences between nonfarm employment benchmarks and estimates by industry sector and selected industry detail, March 2003

(Numbers in thousands)

Industry	Benchmark	Estimate	Difference	
			Amount	Percent
Total nonfarm	129,148	129,270	-122	-.1
Total private	107,131	107,329	-198	-.2
Goods-producing	21,529	21,733	-204	-.9
Natural resources and mining	556	551	5	.9
Logging	64	60	4	6.3
Mining	492	491	1	.2
Oil and gas extraction	120	122	-2	-1.7
Mining, except oil and gas	196	202	-6	-3.1
Coal mining	71	72	-1	-1.4
Support activities for mining	175	167	8	4.6
Construction	6,319	6,372	-53	-.8
Construction of buildings	1,511	1,540	-29	-1.9
Heavy and civil engineering construction	812	810	2	.2
Specialty trade contractors	3,997	4,022	-25	-.6
Manufacturing	14,654	14,810	-156	-1.1
Durable goods	9,066	9,176	-110	-1.2
Wood products	529	535	-6	-1.1
Nonmetallic mineral products	486	495	-9	-1.9
Primary metals	489	494	-5	-1.0
Fabricated metal products	1,492	1,490	2	.1
Machinery	1,171	1,197	-26	-2.2
Computer and electronic products	1,387	1,432	-45	-3.2
Computer and peripheral equipment	231	231	0	.0
Communications equipment	160	177	-17	-10.6
Semiconductors and electronic components	472	494	-22	-4.7
Electronic instruments	434	436	-2	-.5
Electrical equipment and appliances	470	478	-8	-1.7
Transportation equipment	1,792	1,791	1	.1
Furniture and related products	581	583	-2	-.3
Miscellaneous manufacturing	670	682	-12	-1.8
Nondurable goods	5,588	5,634	-46	-.8
Food manufacturing	1,493	1,492	1	.1
Beverages and tobacco products	198	192	6	3.0
Textile mills	275	282	-7	-2.5
Textile product mills	186	191	-5	-2.7
Apparel	327	320	7	2.1
Leather and allied products	47	46	1	2.1
Paper and paper products	522	533	-11	-2.1
Printing and related support activities	685	695	-10	-1.5
Petroleum and coal products	114	118	-4	-3.5
Chemicals	916	923	-7	-.8
Plastics and rubber products	826	843	-17	-2.1
Service-providing	107,619	107,537	82	.1
Private service-providing	85,602	85,596	6	(¹)
Trade, transportation, and utilities	24,994	24,984	10	(¹)
Wholesale trade	5,598	5,563	35	.6
Electronic markets and agents and brokers	652	618	34	5.2
Retail trade	14,648	14,720	-72	-.5
Motor vehicle and parts dealers	1,861	1,861	0	.0
Automobile dealers	1,246	1,239	7	.6
Furniture and home furnishings stores	540	544	-4	-.7
Electronics and appliance stores	511	522	-11	-2.2
Building material and garden supply stores	1,143	1,152	-9	-.8

See footnote at end of table.

Table 2. Differences between nonfarm employment benchmarks and estimates by industry sector and selected industry detail, March 2003—Continued

(Numbers in thousands)

Industry	Benchmark	Estimate	Difference	
			Amount	Percent
Retail trade—Continued				
Food and beverage stores	2,818	2,786	32	1.1
Health and personal care stores	931	956	-25	-2.7
Gasoline stations	871	896	-25	-2.9
Clothing and clothing accessories stores	1,261	1,246	15	1.2
Sporting goods, hobby, book, and music stores	635	631	4	.6
General merchandise stores	2,734	2,762	-28	-1.0
Department stores	1,575	1,658	-83	-5.3
Miscellaneous store retailers	918	928	-10	-1.1
Nonstore retailers	425	437	-12	-2.8
Transportation and warehousing	4,166	4,108	58	1.4
Air transportation	545	532	13	2.4
Rail transportation	213	214	-1	-.5
Water transportation	52	49	3	5.8
Truck transportation	1,304	1,303	1	.1
Transit and ground passenger transportation	391	362	29	7.4
Pipeline transportation	41	40	1	2.4
Scenic and sightseeing transportation	22	23	-1	-4.5
Support activities for transportation	514	520	-6	-1.2
Couriers and messengers	566	556	10	1.8
Warehousing and storage	519	510	9	1.7
Utilities	581	593	-12	-2.1
Information	3,214	3,296	-82	-2.6
Publishing industries, except Internet	935	952	-17	-1.8
Motion picture and sound recording industries	367	365	2	.5
Broadcasting, except Internet	326	325	1	.3
Internet publishing and broadcasting	30	34	-4	-13.3
Telecommunications	1,097	1,143	-46	-4.2
ISPs, search portals, and data processing	410	431	-21	-5.1
Other information services	48	46	2	4.2
Financial activities	7,910	7,897	13	.2
Finance and insurance	5,895	5,888	7	.1
Monetary authorities - central bank	23	22	1	4.3
Credit intermediation and related activities	2,758	2,747	11	.4
Depository credit intermediation	1,741	1,758	-17	-1.0
Commercial banking	1,276	1,297	-21	-1.6
Securities, commodity contracts, investments	761	797	-36	-4.7
Insurance carriers and related activities	2,270	2,238	32	1.4
Funds, trusts, and other financial vehicles	83	84	-1	-1.2
Real estate and rental and leasing	2,014	2,009	5	.2
Real estate	1,361	1,344	17	1.2
Rental and leasing services	627	637	-10	-1.6
Lessors of nonfinancial intangible assets	26	27	-1	-3.8
Professional and business services	15,700	15,810	-110	-.7
Professional and technical services	6,697	6,824	-127	-1.9
Legal services	1,131	1,120	11	1.0
Accounting and bookkeeping services	935	1,031	-96	-10.3
Architectural and engineering services	1,212	1,228	-16	-1.3
Computer systems design and related service	1,113	1,145	-32	-2.9
Management and technical consulting services	739	731	8	1.1
Management of companies and enterprises	1,668	1,686	-18	-1.1
Administrative and waste services	7,335	7,300	35	.5
Administrative and support services	7,022	6,991	31	.4
Employment services	3,115	3,122	-7	-.2
Temporary help services	2,069	2,044	25	1.2
Business support services	750	751	-1	-.1
Services to buildings and dwellings	1,514	1,486	28	1.8
Waste management and remediation services	313	309	4	1.3

See footnote at end of table.

Table 2. Differences between nonfarm employment benchmarks and estimates by industry sector and selected industry detail, March 2003—Continued

(Numbers in thousands)

Industry	Benchmark	Estimate	Difference	
			Amount	Percent
Education and health services	16,632	16,585	47	.3
Educational services	2,817	2,842	-25	-.9
Health care and social assistance	13,815	13,743	72	.5
Ambulatory health care services	4,731	4,732	-1	(¹)
Offices of physicians	1,987	2,034	-47	-2.4
Outpatient care centers	423	413	10	2.4
Home health care services	712	697	15	2.1
Hospitals	4,229	4,209	20	.5
Nursing and residential care facilities	2,772	2,771	1	(¹)
Nursing care facilities	1,579	1,581	-2	-.1
Social assistance	2,083	2,031	52	2.5
Child day care services	771	739	32	4.2
Leisure and hospitality	11,769	11,716	53	.5
Arts, entertainment, and recreation	1,665	1,651	14	.8
Performing arts and spectator sports	359	340	19	5.3
Museums, historical sites, zoos, and parks	109	105	4	3.7
Amusements, gambling, and recreation	1,197	1,206	-9	-.8
Accommodations and food services	10,104	10,065	39	.4
Accommodations	1,725	1,728	-3	-.2
Food services and drinking places	8,379	8,338	41	.5
Other services	5,383	5,308	75	1.4
Repair and maintenance	1,233	1,214	19	1.5
Personal and laundry services	1,254	1,220	34	2.7
Membership associations and organizations	2,896	2,874	22	.8
Government	22,017	21,941	76	.3
Federal Government	2,774	2,778	-4	-.1
Federal Government, except U.S. Postal Service	1,961	1,957	4	.2
U.S. Postal Service	813	821	-8	-1.0
State government	5,164	5,090	74	1.4
State government education	2,405	2,328	77	3.2
State government, excluding education	2,759	2,762	-3	-.1
Local government	14,079	14,073	6	(¹)
Local government education	8,055	8,064	-9	-.1
Local government, excluding education	6,024	6,009	15	.2

¹ Less than 0.05 percent.

Revisions to indexes

The entire historical data series for all indexes of aggregate weekly hours and aggregate weekly payrolls have been recalculated with this benchmark. This was necessary because the indexes are based on the 2002 annual averages, and these annual averages were revised during the 2003 benchmarking process. Future benchmark revisions will not have an impact on the 2002 base-year estimates.

Revisions in the postbenchmark period

Postbenchmark period employment estimates from April to October 2003 were calculated for each month based on new benchmark levels and new business net birth/death figures. (See table 3.)

Table 4 shows the net birth/death model figures for the supersectors over the postbenchmark period. From April to December 2003, the cumulative net birth/death model increased employment by 695,000.

Why benchmarks differ from estimates

A benchmark revision is the difference between the benchmark level for a given March and its corresponding sample-based estimate. The overall accuracy of the establishment survey usually is 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 recordkeeping

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 any sample survey, 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 insures 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

Exhibit 1. Newly published series effective with March 2003 benchmark revisions

Series title	NAICS code	Sector	March 2003 benchmark employment (in thousands)
Railroad rolling stock	3365	Manufacturing	22.8
Ice cream and frozen desserts	31152	Manufacturing	21.5
Electronic shopping and electronic auctions	454111, 2	Retail trade	51.2
Limousine service	48532	Transportation and warehousing	35.2

Exhibit 2. Published series with changed scope effective with March 2003 benchmark revisions

Series title	NAICS code	March 2003 benchmark employment (in thousands)	Series disposition
Computer terminals and other computer peripheral equipment	334113, 9	72.0	Computer terminals (published), NAICS 334113 <i>is collapsed into</i> Other computer peripheral equipment, NAICS 334119
Electronic connectors and miscellaneous electronic components	334415, 6, 7, 9	101.3	Electronic connectors (unpublished), NAICS 334417 <i>is collapsed into</i> Miscellaneous electronic components, NAICS 334115, 6, 9
Commercial gravure and miscellaneous commercial printing	323111, 5, 7, 8, 9	129.4	Commercial gravure printing (unpublished), NAICS 323111 <i>is collapsed into</i> Miscellaneous commercial printing, NAICS 323115, 7, 8, 9
Other major household appliances (unpublished)	335221, 4, 8	49.2	Household cooking appliances (published), NAICS 335221 <i>and</i> Household laundry equipment (unpublished), NAICS 335224 <i>are collapsed into</i> Other major household appliances (unpublished), NAICS 335228

Exhibit 3. Discontinued published series effective with March 2003 benchmark revisions, by data type

Series title	NAICS code	Sector
	Production workers, average weekly hours, average hourly earnings, and average weekly earnings series	
Turbine and turbine generator set units	333611	Manufacturing
Directory and mailing list publishers	51114	Information
Tour operators	56152	Professional and business services
All other personal services	81299	Other services
	Average overtime hours	
Men's cut and sew apparel contractors	315211	Manufacturing
Petroleum refineries	32411	Manufacturing

Exhibit 4. **Discontinued series effective with March 2003 benchmark revisions**

Series title	NAICS code	Next-highest published level
Primary aluminum production (unpublished)	331312	NAICS 3313, Alumina and aluminum production
Aluminum sheet, plate, and foil (unpublished)	331315	NAICS 3313, Alumina and aluminum production
Lawn and garden equipment (unpublished)	333112	NAICS 33311, Agricultural implements
Semiconductor machinery (published)	333295	NAICS 3332, Industrial machinery
Overhead cranes, hoists, and monorail systems (unpublished)	333923	NAICS 33392, Material handling equipment
Household vacuum cleaners (unpublished)	335212	NAICS 33521, Small electrical appliances
Other communication and energy wires (unpublished)	335929	NAICS 33592, Communication and energy wires and cables
Miscellaneous transportation equipment (unpublished) ...	336992, 9	NAICS 3369, Other transportation equipment
Cellulosic organic fibers (unpublished)	325221	NAICS 3252, Resin, rubber, and artificial fibers
Noncellulosic organic fibers (unpublished)	325222	NAICS 3252, Resin, rubber, and artificial fibers

N.A. = not available.

Table 3. **Revisions in total nonfarm employment, seasonally adjusted, January-December 2003**
(In thousands)

Year and month	Levels			Over-the-month changes		
	As previously published	As revised	Difference	As previously published	As revised	Difference
2003						
January	130,356	130,190	-166	158	94	-64
February	130,235	130,031	-204	-121	-159	-38
March	130,084	129,921	-163	-151	-110	41
April	130,062	129,901	-161	-22	-20	2
May	129,986	129,873	-113	-76	-28	48
June	129,903	129,859	-44	-83	-14	69
July	129,846	129,814	-32	-57	-45	12
August	129,881	129,789	-92	35	-25	-60
September	129,980	129,856	-124	99	67	-32
October	130,080	129,944	-136	100	88	-12
November	130,123	130,027	-96	43	83	40
December ^p	130,124	130,043	-81	1	16	15

p = preliminary.

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, with an absolute range from less than 0.05 percent to 0.7 percent.

Benchmark revisions effects for other data types

The routine benchmarking process results in revisions in the series on women workers and production or nonsupervisory workers. There are no benchmark employment levels for these series. They are revised by preserving ratios of employment

for the particular series to all employees 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 levels of the hours and earnings series are derived as weighted averages. The production or nonsupervisory worker employment estimates for the basic cells are used as weights for the hours and earnings estimates

Table 4. Net birth/death estimates for private nonfarm sectors, post-benchmark 2003

(In thousands)

Year and month	Natural resources and mining	Construction	Manufacturing	Trade, transportation, and utilities	Information	Financial activities	Professional and business services	Education and health services	Leisure and hospitality	Other services	Total monthly amount contributed
2003											
April	-1	13	-15	-4	-3	9	61	32	29	7	128
May	1	35	5	21	4	8	32	6	72	8	192
June	1	28	5	18	0	6	21	-4	83	6	164
July	0	-8	-29	-19	-4	-11	-22	-20	40	-10	-83
August.....	1	16	6	17	2	8	31	14	24	5	124
September	1	9	3	17	0	4	15	12	-29	1	33
October	1	8	-7	13	-1	14	18	26	-27	0	45
November	-1	-7	3	17	3	7	10	10	-14	2	30
December	0	-8	1	18	3	13	9	7	15	4	62
Cumulative total	3	86	-28	98	4	58	175	83	193	23	695

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 workers 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 5 shows the previous and revised hours and earnings estimates and the differences for specific hours and earnings series resulting from the March 2003 benchmark. At the total private level, there was a decrease of one-tenth of an hour in average weekly hours from the previously published level, while average hourly earnings decreased by 3 cents from the previously published level.

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). Beginning this year, the process has been accelerated from previous years' June releases to a February release due, in large part, to the earlier availability of the UI data. 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 postbenchmark estimation. This year, the Federal Government employment series was recalculated from May to September 2003 because of a substantial increase in the size of its sample. The revisions were incorporated with the March 2003 benchmarking process.

Benchmark source material. The principal source of benchmark data for private industries is the Quarterly Census of Employment and Wages (QCEW), also known as the ES-202 report. This report contains employment data 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 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 nonoffice insurance sales workers, child day care 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

Table 5. Effect of March 2003 benchmark revisions on 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	33.7	-0.1	\$15.34	\$15.31	-\$0.03
Goods-producing	39.7	39.7	0	16.59	16.60	.01
Natural resources and mining	43.8	43.8	0	17.58	17.50	-.08
Construction	38.2	38.2	0	18.73	18.74	.01
Manufacturing	40.3	40.3	0	15.62	15.62	0
Durable goods	40.6	40.6	0	16.33	16.34	.01
Wood products	39.8	39.8	0	12.51	12.52	.01
Nonmetallic mineral products	42.0	42.0	0	15.52	15.53	.01
Primary metals	42.6	42.6	0	17.86	17.88	.02
Fabricated metal products	40.4	40.4	0	14.97	14.97	0
Machinery	40.7	40.7	0	16.19	16.17	-.02
Computer and electronic products	40.4	40.4	0	16.55	16.57	.02
Electrical equipment and appliances	40.5	40.4	-.1	14.25	14.27	.02
Transportation equipment	41.5	41.6	.1	21.07	21.07	0
Furniture and related products	38.2	38.2	0	12.93	12.92	-.01
Miscellaneous manufacturing	38.5	38.5	0	13.22	13.22	0
Nondurable goods	39.9	39.9	0	14.53	14.51	-.02
Food manufacturing	39.1	39.1	0	12.70	12.73	.03
Beverages and tobacco products	38.8	38.8	0	17.69	17.85	.16
Textile mills	39.7	39.7	0	11.92	11.92	0
Textile product mills	39.3	39.2	-.1	10.98	10.96	-.02
Apparel	36.0	36.0	0	9.45	9.44	-.01
Leather and allied products	39.9	39.9	0	11.62	11.59	-.03
Paper and paper products	41.6	41.6	0	17.22	17.10	-.12
Printing and related support activities	38.6	38.6	0	15.33	15.32	-.01
Petroleum and coal products	45.9	45.9	0	24.17	24.09	-.08
Chemicals	42.6	42.6	0	18.33	18.33	0
Plastics and rubber products	40.1	40.1	0	14.00	14.01	.01
Private service-providing	32.5	32.4	-.1	15.00	14.96	-.04
Trade, transportation, and utilities	33.4	33.4	0	14.34	14.34	0
Wholesale trade	37.9	37.8	-.1	17.29	17.32	.03
Retail trade	30.6	30.6	0	11.90	11.90	0
Transportation and warehousing	36.7	36.6	-.1	16.23	16.19	-.04
Utilities	41.1	41.1	0	24.41	24.47	.06
Information	36.3	36.2	-.1	20.88	20.78	-.10
Financial activities	36.0	36.0	0	16.89	16.91	.02
Professional and business services	34.4	34.5	.1	17.36	17.34	-.02
Education and health services	32.6	32.3	-.3	15.62	15.54	-.08
Leisure and hospitality	25.7	25.7	0	8.73	8.75	.02
Other services	31.9	31.5	-.4	14.02	13.85	-.17

by the Census Bureau. Benchmark data from these sources are available only on a 1- or 2-year lagged basis. Extrapolation to a current level is accomplished by assuming and 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 6 to 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. The research demonstrated that sampling for births was not feasible in the

very short CES production timeframes. Therefore, BLS 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 uses business deaths to impute employment for 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 (Auto-Regressive Integrated Moving Average) time series model designed to estimate the residual net birth/death employment not accounted for by the imputations. The historical time series used to create and test the ARIMA model was derived from the UI universe microlevel database, and reflects the actual residual net of births and deaths over the past 5 years. The ARIMA model component is reviewed on a quarterly basis. The net birth/death model component figures are unique to each month and include negative adjustments in some months. Furthermore, these figures may exhibit a seasonal pattern observed in the historical UI universe data series.

The most significant potential drawback to this or any model-based approach is that time series modeling assumes a predictable continuation of historical patterns and relationships, and therefore is likely to have some difficulty producing reliable estimates at economic turning points or during periods when there are sudden changes in trend. BLS will continue researching alternative model-based techniques for the net birth/death component. It is likely to remain the most problematic part of the estimation process.

Availability of revised data

LABSTAT, the BLS public database on the Internet, contains all historical employment, hours, and earnings data revised because of this benchmark, both unadjusted and seasonally adjusted data. The data can be accessed at <http://www.bls.gov/ces/>, the Current Employment Statistics homepage. Employment, hours, and earnings estimates also are published monthly in *Employment and Earnings*.

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. BLS computes seasonal factors concurrently with the monthly estimation production. Individual series are seasonally adjusted using either a multiplicative or an additive model. For employment, seasonal adjustment factors are directly applied to the component levels. Individual three-digit NAICS levels are seasonally adjusted, and higher level aggregates are formed by summation of 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 from the previous 3 years. All else being 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 has adopted REGARIMA (regression with autocorrelated 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 autocorrelated over time. That is, each month's value is significantly dependent on the observations that precede it. These series, thus, usually can be successfully fit using ARIMA models. If autocorrelated 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 autocorrelation. Thus, the REGARIMA technique is appropriate for measuring relationships among variables of interest in series that exhibit autocorrelation, 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 were fitted with the most recent 10 years of data available, the standard timespan 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 previously used.

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, which are described below.

Construction series. BLS continues its special treatment in seasonally adjusting the construction industry series, which began with the 1996 benchmark revision. 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 permitted 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 also continues 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.

Local government series. A special adjustment also is made in the local government, excluding education series in November of each year to account for variations in

employment due to the presence or absence of poll workers.

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 semimonthly 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. Currently, the CES processing system can accommodate only one conversion factor per reporter.

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

Additive and multiplicative models. Prior to the March 2002 benchmark release, all CES series were adjusted using multiplicative seasonal adjustment models. Although the X-12-ARIMA seasonal adjustment program provides for either an additive or a multiplicative adjustment, depending on which model best fits the individual series, the previous CES processing system was unable to utilize additive adjustments. A new processing system, introduced simultaneously with the NAICS conversion, is able to utilize both additive and multiplicative adjustments. See exhibit 5 for a list of which series are adjusted with additive and multiplicative models and which series are subject to the calendar-effects modeling described earlier.

Exhibit 5. Mode of adjustment used for seasonal adjustment of nonfarm payroll series

Industry	Mode of adjustment	Special adjustments			
		4/5 week	10/11 day	Easter/Labor Day	Other
All employees					
Logging	Multiplicative	X			
Oil and gas extraction	Multiplicative	X			
Mining, except oil and gas	-	X			Indirect ¹
Coal mining	Multiplicative	X			
Support activities for mining	Multiplicative	X			
Construction of buildings	-	X			Indirect ¹
Heavy and civil engineering construction	Additive	X			
Specialty trade contractors	-	X			Indirect ¹
Wood products	Additive	X			
Nonmetallic mineral products	Additive	X			
Primary metals	Multiplicative	X			
Fabricated metal products	Multiplicative	X			
Machinery	Multiplicative	X			
Computer and electronic products	-	X			Indirect ¹
Computer and peripheral equipment	Additive	X			
Communications equipment	Additive	X			
Semiconductors and electronic components	Multiplicative	X			
Electronic instruments	Multiplicative	X			
Electrical equipment and appliances	Multiplicative	X			
Transportation equipment	Multiplicative				
Furniture and related products	Additive	X			
Miscellaneous manufacturing	Multiplicative	X			
Food manufacturing	Multiplicative	X			
Beverages and tobacco products	Multiplicative	X			
Textile mills	Additive	X			
Textile product mills	Additive	X			
Apparel	Multiplicative	X			
Leather and allied products	Multiplicative	X			
Paper and paper products	Multiplicative	X			
Printing and related support activities	Additive	X			
Petroleum and coal products	Additive	X			
Chemicals	Multiplicative	X			
Plastics and rubber products	Multiplicative	X			
Wholesale trade, durable goods	Multiplicative	X			
Wholesale trade, nondurable goods	Multiplicative	X			
Electronic markets and agents and brokers	Multiplicative	X			
Motor vehicle and parts dealers	-	X			Indirect ¹
Automobile dealers	Additive	X			
Furniture and home furnishings stores	Multiplicative	X			
Electronics and appliance stores	Multiplicative	X			
Building material and garden supply stores	Multiplicative	X			
Food and beverage stores	Multiplicative	X			
Health and personal care stores	Multiplicative	X			
Gasoline stations	Multiplicative	X			
Clothing and clothing accessories stores	Multiplicative	X			
Sporting goods, hobby, book, and music stores	Multiplicative	X			
General merchandise stores	-	X			Indirect ¹
Department stores	Multiplicative	X			
Miscellaneous store retailers	Additive	X			
Nonstore retailers	Multiplicative	X			
Air transportation	Multiplicative	X			
Rail transportation	Multiplicative	X			
Water transportation	Multiplicative	X			
Truck transportation	Additive	X			
Transit and ground passenger transportation	Additive				
Pipeline transportation	Additive	X			
Scenic and sightseeing transportation	Multiplicative	X			
Support activities for transportation	Additive	X			
Couriers and messengers	Multiplicative	X			
Warehousing and storage	Multiplicative	X			

See footnotes at end of exhibit.

Exhibit 5. Mode of adjustment used for seasonal adjustment of nonfarm payroll series—Continued

Industry	Mode of adjustment	Special adjustments			
		4/5 week	10/11 day	Easter/Labor Day	Other
All employees					
Utilities	Multiplicative	X			
Publishing industries, except Internet	Multiplicative	X			
Motion picture and sound recording industries	Multiplicative	X			
Broadcasting, except Internet	Multiplicative	X			
Internet publishing and broadcasting	Multiplicative	X			
Telecommunications	Multiplicative	X			
ISPs, search portals, and data processing	Multiplicative	X			
Other information services	Additive	X			
Monetary authorities – central bank	Additive	X			
Credit intermediation and related activities	-	X			Indirect ¹
Depository credit intermediation	Multiplicative	X			
Commercial banking	Multiplicative	X			
Securities, commodity contracts, investments	Multiplicative	X			
Insurance carriers and related activities	Multiplicative	X			
Funds, trusts, and other financial vehicles	Multiplicative	X			
Real estate	Multiplicative	X			
Rental and leasing services	Multiplicative	X			
Lessors of nonfinancial intangible assets	Multiplicative	X			
Professional and technical services	-	X			Indirect ¹
Legal services	Multiplicative	X			
Accounting and bookkeeping services	Multiplicative	X			
Architectural and engineering services	Multiplicative	X			
Computer systems design and related services	Multiplicative	X			
Management and technical consulting services	Multiplicative	X			
Management of companies and enterprises	Multiplicative	X			
Administrative and support services	-	X			Indirect ¹
Employment services	Multiplicative	X			
Temporary help services	Multiplicative	X			
Business support services	Multiplicative	X			
Services to buildings and dwellings	Multiplicative	X			
Waste management and remediation services	Multiplicative	X			
Educational services	Additive	X			
Ambulatory health care services	-	X			Indirect ¹
Offices of physicians	Additive	X			
Outpatient care centers	Additive	X			
Home health care services	Additive	X			
Hospitals	Additive	X			
Nursing and residential care facilities	-	X			Indirect ¹
Nursing care facilities	Additive	X			
Social assistance	-	X			Indirect ¹
Child day care services	Multiplicative	X			
Performing arts and spectator sports	Multiplicative	X			
Museums, historical sites, zoos, and parks	Multiplicative	X			
Amusements, gambling, and recreation	Multiplicative	X			
Accommodations	Multiplicative	X			
Food services and drinking places	Additive	X			
Repair and maintenance	Additive	X			
Personal and laundry services	Multiplicative	X			
Membership associations and organizations	Additive				
Federal Government, except U.S. Postal Service	Multiplicative	X			
U.S. Postal Service	Multiplicative	X			
State government education	Additive	X			
State government, excluding education	Multiplicative	X			
Local government education	Additive	X			
Local government, excluding education	Additive	X			Election ²

See footnotes at end of exhibit.

Exhibit 5. Mode of adjustment used for seasonal adjustment of nonfarm payroll series—Continued

Industry	Mode of adjustment	Special adjustments			
		4/5 week	10/11 day	Easter/Labor Day	Other
Women workers					
Natural resources and mining	Additive	X			
Mining	Additive	X			
Construction	Multiplicative	X			
Manufacturing, durable goods	Multiplicative	X			
Manufacturing, nondurable goods	Multiplicative	X			
Wholesale trade	Multiplicative	X			
Retail trade	Multiplicative	X			
Transportation and warehousing	Multiplicative	X			
Utilities	Multiplicative	X			
Information	Multiplicative	X			
Finance and insurance	Multiplicative	X			
Real estate and rental and leasing	Additive	X			
Professional and technical services	Multiplicative	X			
Management of companies and enterprises	Multiplicative	X			
Administrative and waste services	Multiplicative	X			
Educational services	Multiplicative	X			
Health care and social assistance	Multiplicative	X			
Arts, entertainment, and recreation	Multiplicative	X			
Accommodations and food services	Multiplicative	X			
Other services	Multiplicative	X			
Federal Government	Additive	X			
State government	Multiplicative	X			
Local government	Multiplicative	X			Election ²
Production or nonsupervisory workers ³					
Natural resources and mining	Multiplicative	X			
Construction	Additive	X			
Wood products	Additive	X			
Nonmetallic mineral products	Additive	X			
Primary metals	Multiplicative	X			
Fabricated metal products	Multiplicative	X			
Machinery	Additive	X			
Computer and electronic products	Multiplicative	X			
Electrical equipment and appliances	Multiplicative	X			
Transportation equipment	Multiplicative	X			
Furniture and related products	Additive	X			
Miscellaneous manufacturing	Multiplicative	X			
Food manufacturing	Multiplicative	X			
Beverages and tobacco products	Additive	X			
Textile mills	Additive	X			
Textile product mills	Additive	X			
Apparel	Additive	X			
Leather and allied products	Multiplicative	X			
Paper and paper products	Additive	X			
Printing and related support activities	Additive	X			
Petroleum and coal products	Additive	X			
Chemicals	Additive	X			
Plastics and rubber products	Multiplicative	X			
Wholesale trade	Multiplicative	X			
Retail trade	Multiplicative	X			
Transportation and warehousing	Additive	X			
Utilities	Multiplicative	X			
Information	Multiplicative	X			
Financial activities	Additive	X			
Professional and business services	Multiplicative	X			
Education and health services	Multiplicative	X			
Leisure and hospitality	Multiplicative	X			
Other services	Additive	X			

See footnotes at end of exhibit.

Exhibit 5. Mode of adjustment used for seasonal adjustment of nonfarm payroll series—Continued

Industry	Mode of adjustment	Special adjustments			
		4/5 week	10/11 day	Easter/Labor Day	Other
Average weekly hours ³					
Natural resources and mining	Multiplicative	X		X	
Construction	Additive	X		X	
Wood products	Additive	X		X	
Nonmetallic mineral products	Additive	X		X	
Primary metals	Multiplicative	X		X	
Fabricated metal products	Multiplicative	X		X	
Machinery	Multiplicative	X		X	
Computer and electronic products	Multiplicative	X		X	
Electrical equipment and appliances	Multiplicative	X		X	
Transportation equipment	Multiplicative	X		X	
Furniture and related products	Additive	X		X	
Miscellaneous manufacturing	Additive	X		X	
Food manufacturing	Additive	X		X	
Beverages and tobacco products	Multiplicative	X		X	
Textile mills	Additive	X		X	
Textile product mills	Additive	X		X	
Apparel	Additive	X		X	
Leather and allied products	Additive	X		X	
Paper and paper products	Multiplicative	X		X	
Printing and related support activities	Additive	X		X	
Petroleum and coal products	Multiplicative	X		X	
Chemicals	Multiplicative	X			
Plastics and rubber products	Multiplicative	X		X	
Wholesale trade	Multiplicative		X	X	
Retail trade	Multiplicative		X		
Transportation and warehousing	Multiplicative		X	X	
Utilities	Multiplicative	X			
Information	Multiplicative		X		
Financial activities	Multiplicative		X		
Professional and business services	Multiplicative		X	X	
Education and health services	Multiplicative		X		
Leisure and hospitality	Additive		X		
Other services	Multiplicative		X	X	
Average overtime hours ⁴					
Manufacturing, durable goods	Additive	X		X	
Manufacturing, nondurable goods	Additive	X		X	
Average hourly earnings ³					
Natural resources and mining	Additive	X			
Construction	Additive	X			
Manufacturing, durable goods	Additive	X			
Manufacturing, nondurable goods	Multiplicative	X			
Wholesale trade	Multiplicative		X		
Retail trade	Multiplicative	X			
Transportation and warehousing	Additive	X			
Utilities	Multiplicative	X			
Information	Multiplicative	X			
Financial activities	Multiplicative		X		
Professional and business services	Multiplicative		X		
Education and health services	Multiplicative	X			
Leisure and hospitality	Additive	X			
Other services	Multiplicative		X		

¹ Seasonal adjustment occurs at the finest industry detail available.

² Special adjustment for the presence/absence of poll workers in local government.

³ Data relate to production workers in natural resources and

mining and manufacturing; construction workers in construction; and nonsupervisory workers in private service-providing industries.

⁴ Data relate to production workers in manufacturing.