CES National Benchmark Article ([HTML](#))

BLS Establishment Survey National Estimates Revised to Incorporate March 2021 Benchmarks

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Summary of the revisions

With the release of January 2022 data on February 4, 2022, the Bureau of Labor Statistics (BLS) introduced its annual revision to national estimates of employment, hours, and earnings from the Current Employment Statistics (CES) monthly survey of nonfarm establishments.

The March 2021 benchmarked seasonally adjusted employment level for total nonfarm employment is 144,431,000. The not seasonally adjusted benchmarked employment level is 143,308,000.

Compared with the sample-based, seasonally adjusted published estimate for March 2021, total nonfarm employment had a revision of 374,000, or 0.3 percent. The not seasonally adjusted total nonfarm employment estimate was revised by -7,000, or less than 0.05 percent.

Table 1 presents revised total nonfarm employment data on a seasonally adjusted basis for January 2021 through December 2021. The revised data for April 2021 forward incorporate the effect of applying the rate of change measured by the sample to the new benchmark employment level, as well as updated net birth-death model forecasts and new seasonal adjustment factors. Revisions to November and December also reflect incorporation of additional sample receipts. For more information about the methodology of benchmarking in the CES program, see the CES Technical Notes available at www.bls.gov/web/empsit/cestn.htm#section7b.

Table 1. Differences in seasonally adjusted levels and over-the-month changes, total nonfarm employment, January to December 2021 (in thousands)

2021	Levels			Over-the-month Changes		
	As Revised	As Previously Published	Difference	As Revised	As Previously Published	Difference
January	143,017	142,736	281	520	233	287
February	143,727	143,272	455	710	536	174
March	144,431	144,057	374	704	785	-81
April	144,694	144,326	368	263	269	-6
May	145,141	144,940	201	447	614	-167
June	145,698	145,902	-204	557	962	-405
July	146,387	146,993	-606	689	1,091	-402
August	146,904	147,476	-572	517	483	34
September	147,328	147,855	-527	424	379	45
October	148,005	148,503	-498	677	648	29
November	148,652	148,752	-100	647	249	398
December[(p)]	149,162	148,951	211	510	199	311

Footnotes
[(p)] Preliminary

Overview

Establishment survey benchmarking is done each year to align employment estimates from the survey with employment counts derived primarily from the administrative file of employees covered by Unemployment Insurance (UI). All employers covered by UI laws are required to report employment and wage information to the appropriate state UI agency four times per year. The UI data are obtained and edited by each state's Labor Market Information agency. They are tabulated and published through the BLS Quarterly Census of Employment and Wages (QCEW) program. Both the QCEW and CES categorize their data using the North American Industry Classification System (NAICS). About 97 percent of total nonfarm employment within the scope of the establishment survey is covered by UI and is available to the CES program via QCEW records.

An employment count for the remaining 3 percent is constructed from other sources, primarily records from the Railroad Retirement Board and Census Bureau data from County Business Patterns and the Annual Survey of Public Employment and Payroll. This 3 percent is referred to as noncovered employment. The combination of QCEW and noncovered employment data make up the benchmark level. The full benchmark employment level developed for March replaces the March sample-based estimate for each basic cell.

The total annual revision is the difference between the benchmark level for a given March and the published March sample-based employment estimate. The overall accuracy of the establishment survey is usually gauged by the size of the benchmark revision, which is often regarded as a proxy for total survey error. Typically, the total revision is equal to the benchmark revision—as is the case for this year's benchmark revision. However, in years with historical reconstructions, affected CES series are re-estimated prior to benchmarking. The benchmark revision, in these cases, is the difference between the benchmark level and the newly reconstructed sample-based estimate. The benchmark revision is the difference between two independently derived employment counts, each subject to its own error sources.

In order to create a continuous time series between the new March benchmark level and historical sample-based data from the prior March benchmark level, employment estimates for the months between the most recent March benchmark and the previous year's benchmark are adjusted using a linear "wedge-back" procedure. This procedure assumes that the total estimation error accumulated at a steady rate since the last benchmark. For the 9 months following the March benchmark (also called the post-benchmark period), BLS applies previously derived over-the-month sample changes to the revised March level to get the revised estimates. New net birth-death model forecasts are also calculated and applied during post-benchmark estimation. More information on benchmarks in the CES program is available in the Benchmarks section of the CES Technical Notes and in the October 2017 Monthly Labor Review, "Benchmarking the Current Employment Statistics National Estimates."

Seasonally adjusted estimates

BLS seasonally adjusts 5 years of CES data with each annual benchmark for all industries and directly estimated data types. However, reconstructed series are seasonally adjusted over their

revised time spans if the revised timespan is greater than 5 years. Details about seasonal adjustment during the 2021 benchmark are described below.

Seasonal adjustment changes due to the COVID-19 pandemic

Selecting outliers, or any data points that fall outside of the normal monthly values, is a standard part of seasonally adjusting any time series. Until the 2021 benchmark, BLS included only point outliers in its annual seasonal adjustment processing. With the 2021 benchmark, BLS decided to use additional types of outliers to better account for seasonal patterns without removing the effect of the COVID-19 pandemic. For more information about the changes to CES seasonal adjustment outlier selection, see the Recent Outliers section of the CES Technical Notes.

For technical information on how seasonal adjustment is performed in the CES program, see the Seasonal Adjustment section of the CES Technical Notes.

For information on seasonal adjustment model specifications and special model adjustments, see the CES Seasonal Adjustment Files and Documentation page.

Seasonally adjusted revisions

Table 2 presents revised employment data on a seasonally adjusted basis for March 2021 by major industry sector. The revision to seasonally adjusted total nonfarm employment is 374,000.

Table 2. Seasonally adjusted employment revisions for major industry sectors, March 2021 (in thousands)

CES Industry Code	CES Industry Title	As Revised	As Previously Published	Differences	
				Amount	Percent
00-000000	Total nonfarm	144,431	144,057	374	0.3
05-000000	Total private	122,572	122,515	57	[1]
06-000000	Goods-producing	20,227	20,360	-133	-0.7
07-000000	Service-providing	124,204	123,697	507	0.4
08-000000	Private service-providing	102,345	102,155	190	0.2
10-000000	Mining and logging	551	613	-62	-11.3
20-000000	Construction	7,408	7,448	-40	-0.5
30-000000	Manufacturing	12,268	12,299	-31	-0.3
31-000000	Durable goods	7,626	7,636	-10	-0.1
32-000000	Nondurable goods	4,642	4,663	-21	-0.5
40-000000	Trade, transportation, and utilities	27,503	27,186	317	1.2
41-420000[2]	Wholesale trade	5,635.5	5,658.0	-22.5	-0.4
42-000000[2]	Retail trade	15,328.6	15,234.6	94.0	0.6
43-000000[2]	Transportation and warehousing	5,995.8	5,753.1	242.7	4
44-220000[2]	Utilities	542.7	539.8	2.9	0.5
50-000000	Information	2,768	2,683	85	3.1
55-000000	Financial activities	8,733	8,787	-54	-0.6

CES Industry Code	CES Industry Title	As Revised	As Previously Published	Differences Amount	Percent
60-000000	Professional and business services	21,021	20.807	214	1
65-000000	Education and health services	23,541	23,396	145	0.6
70-000000	Leisure and hospitality	13,423	13,757	-334	-2.5
80-000000	Other services	5,356	5,539	-183	-3.4
90-000000	Government	21,859	21,542	317	1.5

Footnotes

[1] Absolute revision is less than 0.05 percent.

[2] Indented industries are part of trade, transportation, and utilities.

Not seasonally adjusted estimates

Benchmark employment levels for March are compared to CES estimates that have not been seasonally adjusted to calculate the new March employment level. Twenty-one months of not seasonally adjusted CES estimates for all data types are revised based on this new March level, prior to seasonal adjustment. Revisions to not seasonally adjusted CES estimates are described below.

Not seasonally adjusted revisions

Table 3 presents the employment benchmarks for March 2021, not seasonally adjusted, by major industry sector. The total revision to not seasonally adjusted total nonfarm employment is -7,000.

Table 3. Not seasonally adjusted employment benchmarks for major industry sectors, March 2021 (in thousands)

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences Amount	Percent
00-000000	Total nonfarm	143,308	143,315	-7	(1)
05-000000	Total private	121,165	121,421	-256	-0.2
06-000000	Goods-producing	19,934	20,080	-146	-0.7
07-000000	Service-providing	123,374	123,235	139	-0.1
08-000000	Private service-providing	101,231	101,341	-110	-0.1
10-000000	Mining and logging	547	610	-63	-11.5
20-000000	Construction	7,162	7,203	-41	-0.6
30-000000	Manufacturing	12,225	12,267	-42	-0.3
31-000000	Durable goods	7,609	7,630	-21	-0.3
32-000000	Nondurable goods	4,616	4,637	-21	-0.5
40-000000	Trade, transportation, and utilities	27,204	26,897	307	1.1
41-420000	Wholesale trade	5,609.3	5,632.9	-23.6	-0.4
42-000000	Retail trade	15,099.1	15,041.2	57.9	0.4
43-000000	Transportation and warehousing	5,953.7	5,683.6	270.1	4.5
44-220000	Utilities	542.1	539.3	2.8	0.5
50-000000	Information	2,759	2,675	84	3.0
55-000000	Financial activities	8,686	8,750	-64	-0.7

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences	
				Amount	Percent
60-000000	Professional and business services	20,767	20,549	218	1.0
65-000000	Education and health services	23,643	23,518	125	0.5
70-000000	Leisure and hospitality	12,876	13,448	-572	-4.4
80-000000	Other services	5,296	5,504	-208	-3.9
90-000000	Government	22,143	21,894	249	1.1

Footnotes
[1] Absolute revision is less than 0.05 percent.

Benchmarks for more detailed industries are available on the CES detailed industry tables page.

Table 4 below shows the recent history of not seasonally adjusted total nonfarm percent and level benchmark revisions. Over the prior 10 years, the annual benchmark revision at the total nonfarm level has averaged 0.1 percent (in absolute terms), with a range of -0.3 percent to 0.3 percent.

The differences listed in table 4 and beyond reflect the error due to normal benchmarking procedures after the incorporation of reconstructions. Those years are footnoted.

Table 4. Percent and level differences between nonfarm employment benchmarks and estimates by industry supersector, March 2011 to 2021 (in thousands)

CES Industry Code	CES Industry Title	Type	2011[1]	2012	2013[2]	2014	2015[3]	2016	2017[4]	2018[5]	2019[6]	2020	2021
00-000000	Total nonfarm	Percent	0.1	0.3	-0.1	[7]	-0.1	-0.1	0.1	[7]	-0.3	-0.1	[7]
		Level	162	424	-119	67	-172	-81	135	-16	-489	-121	-7
05-000000	Total private	Percent	0.1	0.4	-0.1	0.1	-0.2	-0.1	0.1	-0.1	-0.4	-0.1	-0.2
		Level	134	481	-126	105	-232	-151	133	-104	-505	-184	-256
10-000000	Mining and logging	Percent	-0.4	1.6	-1.2	-1.8	-2.2	-3.2	-4.6	-1.1	-2.1	-4	-11.5
		Level	-3	13	-10	-16	-19	-22	-30	-8	-15	-27	-63
20-000000	Construction	Percent	-0.5	1.8	0.3	1.6	0.6	0.7	0.8	0.6	-0.1	[7]	-0.6
		Level	-26	93	14	90	39	47	52	44	-4	2	-41
30-000000	Manufacturing	Percent	0.1	-0.2	0.2	0.4	-0.1	0.5	0.1	-0.1	[7]	-0.6	-0.3
		Level	9	-25	23	43	-12	58	15	-18	-4	-75	-42
40-000000	Trade, transportation, and utilities	Percent	0.4	0.6	-0.5	-0.1	[7]	-0.4	0.3	-0.3	-0.4	0.1	1.1
		Level	95	145	-131	-31	-5	-110	75	-77	-117	24	307
41-420000[8]	Wholesale trade	Percent	-0.2	0.8	-0.4	-0.8	-0.7	-1.1	-0.4	-0.9	-0.7	-0.8	-0.4
		Level	-13.1	45.3	-20.2	-45.4	-41.3	-66.6	-21.2	-54.4	-38.6	-48	-23.6
42-000000[8]	Retail trade	Percent	0.6	0.5	-0.8	[7]	-0.2	-0.8	0.1	-0.6	-1	-0.5	0.4
		Level	83.8	78.9	-110.3	5.5	-23.5	-118.2	15.4	-96.4	-150.8	-78.3	57.9
43-000000[8]	Transportation and warehousing	Percent	0.5	0.7	0.1	0.2	1.4	1.7	1.6	1.4	1.4	2.6	4.5
		Level	22.4	29.4	3.6	9.7	65.3	83.5	79.8	72.7	75.8	148.9	270.1
44-220000[8]	Utilities	Percent	0.5	-1.5	-0.8	-0.1	-0.8	-1.6	0.2	0.3	-0.7	0.2	0.5
		Level	2.8	-8.5	-4.6	-0.6	-4.7	-8.7	1	1.8	-4.1	1.1	2.8
50-000000	Information	Percent	-0.4	1.8	-0.2	2.4	-1.6	-0.1	2.5	2.1	1.2	0.5	3
		Level	-12	47	-5	66	-44	-2	70	59	35	14	84
55-000000	Financial activities	Percent	0.9	0.6	-0.1	0.2	-0.1	[7]	0.1	-0.1	0.8	0.3	-0.7
		Level	69	45	-10	19	-9	-4	7	-12	68	25	-64
60-000000	Professional and business services	Percent	0.7	[7]	[7]	-0.8	-0.6	-0.6	-1.3	-0.4	-0.8	-0.6	1
		Level	125	2	4	-147	-110	-125	-270	-72	-159	-123	218
65-000000	Education and health services	Percent	-0.5	[7]	-0.3	-0.1	[7]	-0.4	0.3	[7]	-0.4	-0.2	0.5
		Level	-108	-2	-61	-16	-7	-83	70	5	-95	-47	125
70-000000	Leisure and hospitality	Percent	0.7	0.8	0.5	0.3	-0.3	0.7	0.8	[7]	-1.1	0.2	-4.4
		Level	93	104	72	38	-45	102	126	-4	-170	31	-572
80-000000	Other services	Percent	-2	1.1	-0.4	1.1	-0.4	-0.2	0.3	-0.4	-0.8	-0.1	-3.9
		Level	-108	59	-22	59	-20	-12	18	-21	-44	-8	-208
90-000000	Government	Percent	0.1	-0.3	[7]	-0.2	0.3	0.3	[7]	0.4	0.1	0.3	1.1
		Level	28	-57	7	-38	60	70	2	88	16	63	249

Footnotes

[1] A review of industries for the possible presence of noncovered employment yielded 13 additional industries. As a result of including these industries, employment in the amount of 95,000 was added to the benchmark nonfarm level. For more information, see the Changes to noncovered employment section in the 2011 CES Benchmark Article.

[2] With the 2013 benchmark, BLS reconstructed several national employment series. Each first quarter, the Quarterly Census of Employment and Wages (QCEW) program, whose data account for approximately 97 percent of the CES universe scope (see The Sample section of the CES Technical Notes), incorporates updated industry assignments. In 2013, these updates included two substantial groups of nonrandom, noneconomic code changes, one to funds, trusts, and other financial vehicles (NAICS 525), and the other, a reclassification of approximately 466,000 in employment from private households (NAICS 814), which is out of scope for CES, to services for the elderly and persons with disabilities (NAICS 62412), which is in scope. These changes also had an impact, beyond what would be considered typical for a given benchmark year, on corresponding CES series. For more information about the changes to these industries, see the QCEW First Quarter 2013 News Release or the Special notice regarding reconstructed data section in the 2013 CES Benchmark Article.

[3] With the 2015 benchmark, BLS reconstructed the national employment series 65-624120, services for the elderly and persons with disabilities back to January 2000. BLS previously reconstructed this series with the 2013 benchmark; however, between the 2013 and 2015 benchmark, a better source of information for the employment within NAICS 62412 for the state of California was found. The inclusion of the reconstructed series resulted in total nonfarm and total private employment that was 27,000 less than the originally published March 2015 estimate level. The difference between the benchmarked and originally published March 2015 estimate level is −199,000 or −0.1 percent. This table displays March 2015 data after accounting for the decrease of 27,000 from the reconstructed series. Similarly, for the education and health services supersector, this table displays March 2015 data after incorporating the reconstructed series. For more information, see the Reconstructions section in the 2015 CES Benchmark Article.

[4] With the 2017 benchmark, BLS reconstructed the national employment series 60-561613, security guards and patrols and armored car services back to October 2016 to correct a microdata error. The inclusion of the reconstructed series resulted in total nonfarm and total private employment that was 3,000 more than the originally published March 2017 estimate level. The difference between the benchmarked and originally published March 2017 estimate level is 138,000 or 0.1 percent. This table displays March 2017 data after accounting for the increase of 3,000 from the reconstructed series. Similarly, for the professional and business services supersector, this table displays March 2017 data after incorporating the reconstructed series. For more information, see the Reconstructions section in the 2017 CES Benchmark Article.

[5] With the 2018 benchmark, BLS reconstructed several national employment series. A recoding effort in the QCEW resulted in about 336,000 in employment in wholesale trade agents and brokers (41-425120) moving into other series within the wholesale trade, retail trade, transportation and warehousing, and professional and business services major industry sectors. Affected basic series were reconstructed for their entire history, generally back to January 1990. Additionally, a reclassification of a state employer to private ownership caused a shift of about 17,000 in employment from the CES series other state government (90-922999) into services for the elderly and persons with disabilities (65-624120). Affected basic series were reconstructed from March 2018 back to January 2018. For more information, see the Reconstructions section in the 2018 CES Benchmark Article.

[6] With the 2019 benchmark, BLS reconstructed some national employment series in transportation to correct an error in rail transportation (43-482000), which had resulted in 16,000 in employment being double counted. The reconstruction removed the doubled-counted employment and affected aggregates of rail transportation, up to and including total nonfarm, back to January 1990. While the difference between the benchmarked and originally published March 2019 estimate level is −505,000, or −0.3 percent, this table displays March 2019 data after accounting for the removal of 16,000 from the published series. For more information, see the Reconstructions section in the 2019 CES Benchmark Article.

[7] Absolute revision is less than 0.05 percent.

[8] Indented industries are part of trade, transportation, and utilities.

Benchmark revision effects for other data types

Benchmarking also affects the series for production and nonsupervisory employees (PE) and women employees (WE). There are no benchmark employment levels for these series; they are revised by preserving ratios of employment for the particular data type to the all employee (AE) level prior to benchmarking, and then applying these ratios to the revised all employee level. These figures are calculated at the basic cell level and then aggregated to produce the summary estimates. Average weekly hours (AWH), average hourly earnings (AHE), and, in manufacturing industries, average weekly overtime hours (AWOH) are not benchmarked; they are estimated solely from reports supplied by survey respondents at the basic estimating cell level. New employment benchmarks can additionally affect indirectly estimated data types. For more information on indirectly estimated data types, see the Available Data section in the CES Technical Notes.

Table 5 lists directly estimated data types and their common abbreviations. Directly estimated data types except for AE are collectively called non-AE data types.

Table 5. Directly estimated data types

Data Type	Abbreviation
All employees	AE
Production and nonsupervisory employees	PE
Women employees	WE
Average weekly hours of all employees	AE AWH
Average hourly earnings of all employees	AE AHE
Average weekly overtime hours of all employees	AE AWOH
Average weekly hours of production and nonsupervisory employees	PE AWH
Average hourly earnings of production and nonsupervisory employees	PE AHE
Average weekly overtime hours of production and nonsupervisory employees	PE AWOH

The aggregate industry levels of the hours and earnings series are derived as a weighted average. AE and PE estimates for basic cells act as weights for their respective hours and earnings estimates for broader industry groupings. Adjustments of AE estimates to new benchmarks may alter the implicit weights used for both AE and PE hours and earnings, which, in turn, may change the estimates for both AE and PE hours and earnings at higher levels of aggregation.

Generally, new employment benchmarks have little effect on hours and earnings estimates for major industry groupings. To influence the hours and earnings estimates of a broader industry 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 broader group.

Table 6 and table 7 provide information on the not seasonally adjusted levels of major industry sector hours and earnings series resulting from the March 2021 benchmark. At the total private

level, there was no change in average weekly hours estimates for AE and average weekly hours for PE increased by 0.1 hours from the previously published level. Total private average hourly earnings increased by 8 cents for AE and PE from the previously published level.

Benchmark effects on hours and earnings for more detailed industries are available on the CES detailed industry tables page.

Table 6. Effect of March 2021 benchmark revisions to all employee average weekly hours and average hourly earnings estimates, major industry sectors

CES Industry Code	CES Industry Title	Average Weekly Hours			Average Hourly Earnings		
		Estimated	Revised	Difference	Estimated	Revised	Difference
05-000000	Total private	34.7	34.7	0.0	$29.95	$30.03	$0.08
06-000000	Goods-producing	40.1	40	-0.1	30.39	30.35	-0.04
08-000000	Private service-providing	33.6	33.7	0.1	29.85	29.95	0.10
10-000000	Mining and logging	45.1	45	-0.1	34.72	34.45	-0.27
20-000000	Construction	39	39	0.0	32.20	32.16	-0.04
30-000000	Manufacturing	40.4	40.4	0.0	29.12	29.12	0.00
31-000000	Durable goods	40.7	40.7	0.0	30.60	30.57	-0.03
32-000000	Nondurable goods	39.9	40	0.1	26.62	26.68	0.06
40-000000	Trade, transportation, and utilities	34.1	34.2	0.1	25.74	25.71	-0.03
41-420000	Wholesale trade	38.8	38.8	0.0	32.94	32.97	0.03
42-000000	Retail trade	30.4	30.3	-0.1	21.41	21.39	-0.02
43-000000	Transportation and warehousing	38.8	38.8	0.0	25.64	25.57	-0.07
44-220000	Utilities	42.5	42.5	0.0	44.41	44.38	-0.03
50-000000	Information	36.7	36.7	0.0	43.72	43.83	0.11
55-000000	Financial activities	37.4	37.4	0.0	39.64	39.69	0.05
60-000000	Professional and business services	36.5	36.5	0.0	35.85	35.73	-0.12
65-000000	Education and health services	33.2	33.3	0.1	29.19	29.41	0.22
70-000000	Leisure and hospitality	26.2	26.2	0.0	17.68	17.63	-0.05
80-000000	Other services	32.3	32.4	0.1	27.06	27.51	0.45

Table 7. Effect of March 2021 benchmark revisions to production and nonsupervisory employee average weekly hours and average hourly earnings estimates, major industry sectors

CES Industry Code	CES Industry Title	Average Weekly Hours			Average Hourly Earnings		
		Estimated	Revised	Difference	Estimated	Revised	Difference
05-000000	Total private	34.1	34.2	0.1	$25.25	$25.33	$0.08
06-000000	Goods-producing	41	41	0.0	25.88	25.86	-0.02
08-000000	Private service-providing	33	33	0.0	25.12	25.22	0.10
10-000000	Mining and logging	46.7	46.5	-0.2	30.70	30.48	-0.22
20-000000	Construction	39.6	39.5	-0.1	29.69	29.67	-0.02
30-000000	Manufacturing	41.6	41.6	0.0	23.33	23.36	0.03
31-000000	Durable goods	41.9	41.9	0.0	24.34	24.36	0.02
32-000000	Nondurable goods	41.1	41.1	0.0	21.72	21.77	0.05
40-000000	Trade, transportation, and utilities	34.2	34.2	0.0	21.74	21.72	-0.02
41-420000	Wholesale trade	38.6	38.6	0.0	27.10	27.10	0.00
42-000000	Retail trade	30.8	30.7	-0.1	17.98	17.98	0.00
43-000000	Transportation and warehousing	38.4	38.4	0.0	22.92	22.83	-0.09
44-220000	Utilities	42.6	42.6	0.0	39.92	39.90	-0.02
50-000000	Information	36	35.9	-0.1	36.61	36.70	0.09
55-000000	Financial activities	37	37	0.0	30.06	30.06	0.00
60-000000	Professional and business services	36	36	0.0	29.97	29.88	-0.09
65-000000	Education and health services	32.5	32.5	0.0	26.21	26.41	0.20
70-000000	Leisure and hospitality	24.8	24.8	0.0	15.34	15.30	-0.04
80-000000	Other services	31.3	31.5	0.2	23.13	23.59	0.46

Net birth-death revisions

The difference between CES estimates and the population employment results from various sources, and disaggregating it into its components is complex. Both are subject to nonresponse and reporting error. Additionally, the CES estimates are subject to sampling error and business birth and death modeling error.

The CES sample alone is not sufficient for estimating the total nonfarm employment level because each month new establishments generate employment that cannot be captured through the sample. There is an unavoidable lag between an establishment opening for business and its appearance on the CES sample frame. The sample frame is built from UI quarterly tax records. These records cover virtually all U.S. employers and include business births, but they only become available for updating the CES sampling frame 7 to 9 months after the reference month. After the births appear on the frame, there is also time required for sampling, contacting, and soliciting cooperation from the establishments, and verifying the initial data provided. In practice, BLS cannot sample and begin to collect data from new establishments until they are at least a year old.

BLS has researched both sample-based and model-based approaches to measuring employment from business births and deaths 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, so BLS uses a model-based approach to account for this employment. This model incorporates two components. The first component is an indirect imputation for business deaths. The second component is an autoregressive integrated moving average (ARIMA) time series model designed to estimate the net birth-death employment not accounted for by the imputation from the first component. More information on the CES birth-death model is available in the [Birth-Death Model](#) section of the CES Technical Notes.

An analysis of error in the birth-death model and the effect of those errors on CES estimation follows.

Net birth-death changes due to the COVID-19 pandemic

Current estimates of not seasonally adjusted employment include both a sample-based component and a model-based component. The model-based portion, called the net birth-death forecast, is intended to account for businesses that have closed or opened since the sample was initially drawn. While this model performs well in times of relative stability, it has not traditionally included a mechanism to account for rapid changes in the most recent months of employment estimates.

In March 2020, the COVID-19 pandemic created a severe economic shock to the global economy, resulting in massive job losses across the United States. This widespread disruption to labor markets and the potential impact to the birth-death model prompted BLS to revisit research conducted after the Great Recession (2007-09) and incorporate new ideas to account for changes in the number of business openings and closings. Two areas of research were implemented to improve the accuracy of the birth-death model in the CES estimates. These adjustments better reflect the net effect of the contribution of business births and deaths to the estimates. These two

methodological changes, one to adjust each of the two steps in the birth-death model, are the following:

- A portion of both reported zero employment and returns from zero in the current month from the sample were used in estimation to better account for the fact that business births and deaths do not offset.
- Current sample growth rates were included in the net birth-death forecasting model to better account for the changing relationships between business openings and closings.

First, a proportion of reports that fell to zero employment and reports that returned from zero employment in each month were used to adjust the weighted contribution of each report used in the calculation of the over-the-month change of the sample-based estimates. Typically, reports with zero employment in either the previous or current month are not included in estimation. To account for an excess amount of reports going to zero employment and reports returning from zero employment, BLS calculated the likelihood that either a reported zero or a return from zero exceeded what would be expected for the month. These "excess declines to zero" and "excess returns from zero" (collectively called excess reported zeroes) partially account for drops in employment (when more business deaths than are usually observed in historical population data occur) and for increases in employment (when there are more business births than normal). More specifically, "excess declines to zero" were used in March 2020 and subsequent months' first preliminary, second preliminary, and final estimates through September 2021. "Excess returns from zero" were used in first, second, and final estimates from May 2020 to September 2021.

Second, BLS adjusted the portion of business births and deaths that cannot be accounted for using sample data by including more recent information. Net birth-death forecasts are normally modeled using an ARIMA based on over-the-month changes of 5 years of historical birth-death residual values that end 9 months before the forecast of the current month. Instead of using only historical data—data that would not accurately account for how the labor market has changed due to COVID-19—a regression variable that includes data up to the current month was included in the model. The regression variable is the CES sample-based ratio of over-the-month change, known as the sample link, for each of the major industry sectors. Each major industry sector sample link was used as a regressor for the basic-level industry forecasts only within that sector from April 2020 to September 2021.

BLS did research on a monthly basis to determine when to return to normal estimation. BLS monitored responses to the CES survey for a reduction in rates of newly reported zeroes and returns from zero in the current month and the resumption of previous patterns in the net birth-death forecasts. Effective with the release of October 2021 preliminary estimates, BLS determined that adjustments to its birth-death methodology were no longer necessary.

The use of sample links as regression variables in the model initially accounted for a difference of 33,000 in the net birth-death forecasts from January 2021 to September 2021, with a range from -24,000 to 39,000. Exhibit 1 below outlines monthly differences due to the inclusion of the sample link regressor.

Exhibit 1. Preliminary and revised net birth-death forecasts for total private with and without regressor adjustments, not seasonally adjusted (in thousands)

Month	Preliminary Forecast			Revised Forecast		
	With Adjustment	Without Adjustment	Difference	With Adjustment	Without Adjustment	Difference
April 2020	-553	246	-799	-470	282	-752
May	345	207	138	319	203	116
June	295	73	222	235	68	167
July	241	193	48	254	211	43
August	154	104	50	142	95	47
September	-62	-99	37	-64	-96	32
October	344	293	51	363	313	50
November	6	2	4	-1	0	-1
December	19	-56	75	18	-48	66
Total 2020	789	963	-174	796	1,028	-232
January 2021	-143	-143	0	[1]	[1]	[1]
February	131	135	-4	[1]	[1]	[1]
March	38	-1	39	[1]	[1]	[1]
April	298	277	21	309	270[2]	39[2]
May	218	242	-24	239	260[2]	-21[2]
June	76	95	-19	106	118[2]	-12[2]
July	224	225	-1	264	244[2]	20[2]
August	142	135	7	146	134[2]	12[2]
September	-89	-103	14	-87	-96[2]	9[2]
Total 2021	895	862	33	977	930[2]	47[2]

Footnotes

[1] Net birth-death forecasts are only revised in the post-benchmark period for months April to December.

[2] Corrected from original publication.

The effect of these adjustments to CES estimates of employment reflect the pronounced impact of the COVID-19 pandemic. Exhibit 2 illustrates the difference at the total private level between the published CES estimates that use these two adjustments and a simulated CES series calculated without using either adjustment. The total private benchmark revision amount applied to March 2021 was -256,000. Without these adjustments to the birth-death model, the total private employment would have been 898,000 greater, and the benchmark revision amount would have been -1,154,000.

Exhibit 2. Effects of adjusted net birth-death and use of reported zeroes on total private employment before benchmarking, not seasonally adjusted (in thousands)

Month	Total Private Employment with Adjustments	Total Private Employment without Adjustments	Difference
April 2020	108,032	111,396	-3,364
May	111,800	114,378	-2,578
June	117,267	118,889	-1,622
July	118,797	120,130	-1,333
August	119,704	120,927	-1,223
September	120,101	121,260	-1,159
October	121,581	122,659	-1,078
November	122,128	123,257	-1,129
December	121,802	122,877	-1,075
January 2021	119,527	120,591	-1,064
February	120,369	121,352	-983
March	121,421	122,319	-898

Forecasted vs. actual net birth-death

Only error from the model-based component of CES estimation is directly measurable. Error from this component is measured by comparing the actual net of births and deaths with the model-based forecast that was used in the CES sample-based estimates during the previous benchmark year. Most recently, the data from April 2020 to March 2021 can be measured. As table 8 shows, the actual net birth-death from April 2020 to March 2021 was approximately 212,000 below the forecast used in the CES monthly estimates for the same period.

Table 8. Differences between forecasted and actual net birth-death, total private employment, April 2020 to March 2021 (in thousands)

Benchmark 2021	2020									2021			Total
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Actual Net Birth-Death	-2,162	782	543	523	253	-27	585	10	-107	-85	230	65	610
Forecast Net Birth-Death	-470	319	235	254	142	-64	363	-1	18	-143	131	38	822
Difference	-1,692	463	308	269	111	37	222	11	-125	58	99	27	-212
Cumulative Difference	-1,692	-1,229	-921	-652	-541	-504	-282	-271	-396	-338	-239	-212	

Net birth-death adjustments to the post-benchmark period

From April 2021 to December 2021, also called the post-benchmark period, CES estimates were recalculated for each month based primarily on new benchmark levels and new net birth-death forecasts. Net birth-death forecasts were revised to incorporate information from the most recent year of universe employment counts. Table 9 shows the net birth-death values for the supersectors over the post-benchmark period. From April 2021 to December 2021, the net birth-death model cumulatively added 1,331,000 jobs, compared with 1,195,000 in the previously published April 2021 to December 2021 employment estimates.

Table 9. Net birth-death forecasts by industry supersector, April to December 2021 (in thousands)

CES Industry Code	CES Industry Title	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Cumulative Total
10-000000	Mining and logging	0	2	1	1	0	0	1	0	0	5
20-000000	Construction	30	31	23	16	19	4	27	-9	-17	124
30-000000	Manufacturing	1	10	3	2	7	1	9	4	1	38
40-000000	Trade, transportation, and utilities	21	33	19	23	19	10	51	17	8	201
41-420000[1]	Wholesale trade	4	7	1	2	3	-4	14	2	0	29
42-000000[1]	Retail trade	9	15	8	13	6	5	19	0	-1	74
43-000000[1]	Transportation and warehousing	8	11	10	8	10	9	18	15	9	98
44-220000[1]	Utilities	0	0	0	0	0	0	0	0	0	0
50-000000	Information	5	5	-1	7	3	0	11	3	1	34
55-000000	Financial activities	13	10	0	10	4	-8	32	1	7	69
60-000000	Professional and business services	97	26	-15	75	48	-20	135	9	-19	336
65-000000	Education and health services	40	20	-29	41	18	-13	76	14	-14	153
70-000000	Leisure and hospitality	88	93	95	84	20	-56	17	-22	-3	316
80-000000	Other services	14	9	10	5	8	-5	20	0	-6	55
Total private net birth-death forecast		309	239	106	264	146	-87	379	17	-42	1,331

Footnotes

[1] Indented industries are part of trade, transportation, and utilities.

Changes to the CES published series

With the release of the January 2022 first preliminary estimates on February 4, 2022, BLS incorporated series changes related to annual sample adequacy and disclosure review.

Series changes due to annual sample review

All CES series are evaluated annually for sample size, coverage, and response rates. The following changes result from a re-evaluation of the sample and universe coverage for CES industries, which are based on NAICS 2017. Some industries no longer have sufficient sample to be estimated and published separately and were discontinued or combined with other similar industries for estimation and publication purposes. This information is also available on the publication changes for the 2021 benchmark release page.

A list of currently published CES series is available at the CES published series page.

Table 10. Series with CES industry code or title changes

| NAICS Code | Previous | | New | |
	CES Industry Code	CES Industry Title	CES Industry Code	CES Industry Title
3313,4	31-331300	Alumina and aluminum production	31-331400	Other nonferrous metal production, including alumina and aluminum
3313,4	31-331400	Other nonferrous metal production		

In order to more easily identify affected series and because AE series are published at a more detailed industry level than non-AE series, series changes are shown separately for AE and non-AE data types. The first two tables in this section reference collapsed and discontinued series for AE only. The third table references discontinued series for all non-AE data types. Discontinued series tables (table 11 and table 13) display series for which the data types noted are no longer published. The collapsed series table (table 12) displays series for which the data types noted are published at a more aggregate level because the more detailed industry no longer has sufficient sample to be estimated and published separately. Affected industries have been combined with other similar industries for estimation and publication purposes. Historical data for these series were reconstructed to provide consistent time series. Industries that are no longer published for AE will also no longer be published for other directly estimated data types or derivative series.

Table 11. Discontinued all employees series

NAICS Code	CES Industry Code	CES Industry Title	Next Highest Published Industry
322211	32-322211	Corrugated and solid fiber boxes	Paperboard containers (32-322210)
322212,9	32-322219	Folding boxes and miscellaneous paperboard containers	Paperboard containers (32-322210)

Table 12. Collapsed all employees series

Previous			New		
NAICS Code	CES Industry Code	CES Industry Title	NAICS Code	CES Industry Code	CES Industry Title
3313	31-331300	Alumina and aluminum production	3313,4	31-331400	Other nonferrous metal production, including alumina and aluminum
3314	31-331400	Other nonferrous metal production			
33636	31-336360	Motor vehicle seating and interior trim	33634,6,9	31-336390	All other motor vehicle parts
33634,9	31-336390	All other motor vehicle parts			
42492	41-424920	Books and periodicals	42492,4,5,9	41-424990	All other nondurable goods wholesalers
42494,5,9	41-424990	All other nondurable goods wholesalers			

Table 13. Discontinued series other than all employees

NAICS Code	CES Industry Code	CES Industry Title	Discontinued From Publication	Next Highest Published Industry
212312	10-212312	Crushed and broken limestone mining	PE, PE AHE, PE AWH	Stone mining and quarrying (10-212310)
212311,3,9	10-212319	Other stone mining and quarrying	PE, PE AHE, PE AWH	Stone mining and quarrying (10-212310)
321911	31-321911	Wood windows and doors	AE AHE, AE AWH, AE AWOH, PE, PE AHE, PE AWH, WE	Millwork (31-321910)
321912,8	31-321918	Cut stock, resawing lumber, planning, and other millwork, including flooring	AE AHE, AE AWH, AE AWOH, PE, PE AHE, PE AWH, WE	Millwork (31-321910)
3324	31-332400	Boilers, tanks, and shipping containers	PE AWOH	Fabricated metal products (31-332000)
33291	31-332910	Metal valves	AE AWOH, PE, PE AHE, PE AWH, PE AWOH	Other fabricated metal products (31-332900)
33299	31-332990	All other fabricated metal products	AE AWOH, PE, PE AHE, PE AWH, PE AWOH	Other fabricated metal products (31-332900)
3334	31-333400	HVAC and commercial refrigeration equipment	PE, PE AHE, PE AWH	Machinery (31-333000)
3339	31-333900	Other general purpose machinery	PE, PE AHE, PE AWH	Machinery (31-333000)
33392	31-333920	Material handling equipment	AE AWOH	Other general purpose machinery (31-333900)
337121	31-337121	Upholstered household furniture	PE, PE AHE, PE AWH	Other household and institutional furniture (31-337120)
339113	31-339113	Surgical appliances and supplies	AE AWOH, PE, PE AHE, PE AWH	Medical equipment and supplies (31-339100)
339116	31-339116	Dental laboratories	AE AHE, AE AWH, WE	Medical equipment and supplies (31-339100)

NAICS Code	CES Industry Code	CES Industry Title	Discontinued From Publication	Next Highest Published Industry
3113	32-311300	Sugar and confectionery products	AE AWOH, PE, PE AHE, PE AWH	Food manufacturing (32-311000)
3221	32-322100	Pulp, paper, and paperboard mills	AE AHE, AE AWH, WE	Paper and paper products (32-322000)
3222	32-322200	Converted paper products	AE AHE, AE AWH, WE	Paper and paper products (32-322000)
322211	32-322211	Corrugated and solid fiber boxes	AE AHE, AE AWH, AE AWOH, PE, PE AHE, PE AWH, PE AWOH, WE	Paperboard containers (32-322210)
324	32-324000	Petroleum and coal products	AE AWOH, PE, PE AHE, PE AWH, PE AWOH	Nondurable goods (32-000000)
32411	32-324110	Petroleum refineries	WE	Petroleum and coal products (32-324000)
32412,9	32-324190	Asphalt paving and roofing materials and other petroleum and coal products	WE	Petroleum and coal products (32-324000)
3252	32-325200	Resin, rubber, and artificial fibers	AE AHE, AE AWH	Chemicals (32-325000)
32611	32-326110	Plastics packaging materials, film, and sheet	AE AWOH, PE, PE AHE, PE AWH	Plastics products (32-326100)
312,6	32-329000	Miscellaneous nondurable goods manufacturing	AE AWOH, PE, PE AHE, PE AWH, PE AWOH	Nondurable goods (32-000000)
443141	42-443141	Household appliance stores	PE, PE AHE, PE AWH	Electronics and appliance stores (42-443000)
443142	42-443142	Electronics stores	PE, PE AHE, PE AWH	Electronics and appliance stores (42-443000)
52221	55-522210	Credit card issuing	WE	Nondepository credit intermediation (55-522200)

NAICS Code	CES Industry Code	CES Industry Title	Discontinued From Publication	Next Highest Published Industry
52222	55-522220	Sales financing	WE	Nondepository credit intermediation (55-522200)
5322	55-532200	Consumer goods rental	AE AHE, AE AWH	Rental and leasing services (55-53200)
5323	55-532300	General rental centers	AE AHE, AE AWH	Rental and leasing services (55-53200)
54186	60-541860	Direct mail advertising	AE AHE, AE AWH, WE	Advertising and related services (60-541800)
54192	60-541920	Photographic services	PE, PE AHE, PE AWH	Other professional and technical services (60-541900)
54193,9	60-541990	Miscellaneous professional and technical services	PE, PE AHE, PE AWH	Other professional and technical services (60-541900)
56174	60-561740	Carpet and upholstery cleaning services	PE, PE AHE, PE AWH	Services to buildings and dwellings (60-561700)
56179	60-561790	Other services to buildings and dwellings	PE, PE AHE, PE AWH	Services to buildings and dwelling (60-561700)
5622	60-562200	Waste treatment and disposal	PE, PE AHE, PE AWH	Waste management and remediation services (60-562000)
5629	60-562900	Remediation and other waste services	PE, PE AHE, PE AWH	Waste management and remediation services (60-562000)

Availability of revised data

LABSTAT, the BLS public database, contains all historical employment, hours, and earnings data revised as a result of this benchmark, including both not seasonally adjusted and seasonally adjusted data. The data can be accessed at the [CES-National Database](#) page.

Previously published data are available on both a not seasonally adjusted and seasonally adjusted basis for all CES industries down to the 3-digit level from the [CES Vintage Data](#) page. CES vintage data are typically updated in early March following the annual benchmark revision.

Benchmarks for detailed industries can be found at the [CES detailed industry tables](#) page.

Table of figures

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