CES National Benchmark Article (HTML)

BLS Establishment Survey National Estimates Revised to Incorporate March 2020 Benchmarks

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Table of Contents

BLS Establishment Survey National Estimates Revised to Incorporate March 2020 Benchmarks 1
Table of Contents 2
Summary of the revisions 3
Overview 4
Seasonally adjusted revisions 5
Not seasonally adjusted revisions 6
Benchmark revision effects for other data types 9
Revisions to net birth-death 13
Forecasted vs. actual net birth-death 14
Net birth-death adjustments to the post-benchmark period 14
Net birth-death changes due to the COVID-19 pandemic 16
QCEW imputation 18
Changes to the CES published series 19
Small domain model updates 19
Series changes due to annual sample review 19
Availability of revised data 22
Table of figures 23
Tables 23
Exhibits 23

Summary of the revisions

With the release of January 2021 data on February 5, 2021, 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 2020 benchmarked seasonally adjusted employment level for total nonfarm employment is 150,840,000. The not seasonally adjusted benchmarked employment level is 149,952,000.

Compared with the sample-based, seasonally adjusted published estimate for March 2020, total nonfarm employment had a revision of −250,000 or −0.2 percent. The not seasonally adjusted total nonfarm employment estimate was revised by −121,000 or −0.1 percent.

Table 1 presents revised total nonfarm employment data on a seasonally adjusted basis for January 2020 through December 2020. The revised data for April 2020 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 2020 (in thousands)

2020	Levels			Over-the-month Changes		
	As Revised	As Previously Published	Difference	As Revised	As Previously Published	Difference
January	152,234	152,212	22	315	214	101
February	152,523	152,463	60	289	251	38
March	150,840	151,090	-250	-1,683	-1,373	-310
April	130,161	130,303	-142	-20,679	-20,787	108
May	132,994	133,028	-34	2,833	2,725	108
June	137,840	137,809	31	4,846	4,781	65
July	139,566	139,570	-4	1,726	1,761	-35
August	141,149	141,063	86	1,583	1,493	90
September	141,865	141,774	91	716	711	5
October	142,545	142,428	117	680	654	26
November	142,809	142,764	45	264	336	-72
December[(p)]	142,582	142,624	-42	-227	-140	-87

Footnotes
(p) Preliminary

To Table of Figures

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. About 97 percent of total nonfarm employment within the scope of the establishment survey is covered by UI. 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).

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, but 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 revisions

Table 2 presents revised employment data on a seasonally adjusted basis for March 2020 by major industry sector. The revision to seasonally adjusted total nonfarm employment is −250,000.

Table 2. Seasonally adjusted employment revisions for major industry sectors, March 2020 (in thousands)

CES Industry Code	CES Industry Title	As Revised	As Previously Published	Differences	
				Amount	Percent
00-000000	Total nonfarm	150,840	151,090	-250	-0.2
05-000000	Total private	128,066	128,362	-296	-0.2
06-000000	Goods-producing	20,949	21,086	-137	-0.7
07-000000	Service-providing	129,891	130,004	-113	-0.1
08-000000	Private service-providing	107,117	107,276	-159	-0.1
10-000000	Mining and logging	674	706	-32	-4.7
20-000000	Construction	7,557	7,574	-17	-0.2
30-000000	Manufacturing	12,718	12,806	-88	-0.7
31-000000	Durable goods	7,961	8,031	-70	-0.9
32-000000	Nondurable goods	4,757	4,775	-18	-0.4
40-000000	Trade, transportation, and utilities	27,729	27,723	6	(1)
41-420000	Wholesale trade	5,876.6	5,922.2	-45.6	-0.8
42-000000	Retail trade	15,483.6	15,586.6	-103.0	-0.7
43-000000	Transportation and warehousing	5,822.1	5,668.2	153.9	2.6
44-220000	Utilities	547.0	545.9	1.1	0.2
50-000000	Information	2,898	2,888	10	0.3
55-000000	Financial activities	8,850	8,827	23	0.3
60-000000	Professional and business services	21,318	21,456	-138	-0.6
65-000000	Education and health services	24,347	24,408	-61	-0.3
70-000000	Leisure and hospitality	16,133	16,124	9	0.1
80-000000	Other services	5,842	5,850	-8	-0.1
90-000000	Government	22,774	22,728	46	0.2

Footnotes
(1) Absolute revision is less than 0.05 percent.

To Table of Figures

Typically, 5 years of seasonally adjusted data are revised with each CES annual benchmark. However, reconstructed series are seasonally adjusted over their revised time spans.

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.

Not seasonally adjusted revisions

Table 3 presents the employment benchmarks for March 2020, not seasonally adjusted, by major industry sector. The total revision to not seasonally adjusted total nonfarm employment is −121,000.

Table 3. Not seasonally adjusted employment benchmarks for major industry sectors, March 2020 (in thousands)

CES Industry Code	CES Industry Title	Benchmark	Estimate	Differences	
				Amount	Percent
00-000000	Total nonfarm	149,952	150,073	-121	-0.1
05-000000	Total private	126,825	127,009	-184	-0.1
06-000000	Goods-producing	20,638	20,738	-100	-0.5
07-000000	Service-providing	129,314	129,335	-21	(1)
08-000000	Private service-providing	106,187	106,271	-84	-0.1
10-000000	Mining and logging	669	696	-27	-4.0
20-000000	Construction	7,297	7,295	2	(1)
30-000000	Manufacturing	12,672	12,747	-75	-0.6
31-000000	Durable goods	7,949	8,013	-64	-0.8
32-000000	Nondurable goods	4,723	4,734	-11	-0.2
40-000000	Trade, transportation, and utilities	27,423	27,399	24	0.1
41-420000	Wholesale trade	5,847.9	5,895.9	-48	-0.8
42-000000	Retail trade	15,286.8	15,365.1	-78.3	-0.5
43-000000	Transportation and warehousing	5,741.7	5,592.8	148.9	2.6
44-220000	Utilities	546.5	545.4	1.1	0.2
50-000000	Information	2,888	2,874	14	0.5
55-000000	Financial activities	8,805	8,780	25	0.3
60-000000	Professional and business services	21,050	21,173	-123	-0.6
65-000000	Education and health services	24,471	24,518	-47	-0.2
70-000000	Leisure and hospitality	15,745	15,714	31	0.2
80-000000	Other services	5,805	5,813	-8	-0.1
90-000000	Government	23,127	23,064	63	0.3

Footnotes
(1) Absolute revision is less than 0.05 percent.

To Table of Figures

Benchmarks for more detailed industries can be found at www.bls.gov/web/empsit/cesbmart-tables.htm.

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 0.2 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 2010 to 2020 (in thousands)

CES Industry Code	CES Industry Title	Type	2010[1]	2011[2]	2012	2013[3]	2014	2015[4]	2016	2017[5]	2018[6]	2019[7]	2020
00-000000	Total nonfarm	Percent	-0.3	0.1	0.3	-0.1	[8]	-0.1	-0.1	0.1	[8]	-0.3	-0.1
		Level	-378	162	424	-119	67	-172	-81	135	-16	-489	-121
05-000000	Total private	Percent	-0.4	0.1	0.4	-0.1	0.1	-0.2	-0.1	0.1	-0.1	-0.4	-0.1
		Level	-391	134	481	-126	105	-232	-151	133	-104	-505	-184
10-000000	Mining and logging	Percent	-3	-0.4	1.6	-1.2	-1.8	-2.2	-3.2	-4.6	-1.1	-2.1	-4
		Level	-20	-3	13	-10	-16	-19	-22	-30	-8	-15	-27
20-000000	Construction	Percent	-1.3	-0.5	1.8	0.3	1.6	0.6	0.7	0.8	0.6	-0.1	[8]
		Level	-67	-26	93	14	90	39	47	52	44	-4	2
30-000000	Manufacturing	Percent	-1	0.1	-0.2	0.2	0.4	-0.1	0.5	0.1	-0.1	[8]	-0.6
		Level	-119	9	-25	23	43	-12	58	15	-18	-4	-75
40-000000	Trade, transportation, and utilities	Percent	-0.6	0.4	0.6	-0.5	-0.1	[8]	-0.4	0.3	-0.3	-0.4	0.1
		Level	-143	95	145	-131	-31	-5	-110	75	-77	-117	24
41-420000[9]	Wholesale trade	Percent	-2.3	-0.2	0.8	-0.4	-0.8	-0.7	-1.1	-0.4	-0.9	-0.7	-0.8
		Level	-124.5	-13.1	45.3	-20.2	-45.4	-41.3	-66.6	-21.2	-54.4	-38.6	-48.0
42-000000[9]	Retail trade	Percent	-0.1	0.6	0.5	-0.8	[8]	-0.2	-0.8	0.1	-0.6	-1.0	-0.5
		Level	-18.4	83.8	78.9	-110.3	5.5	-23.5	-118.2	15.4	-96.4	-150.8	-78.3
43-000000[9]	Transportation and warehousing	Percent	0.1	0.5	0.7	0.1	0.2	1.4	1.7	1.6	1.4	1.4	2.6
		Level	3.1	22.4	29.4	3.6	9.7	65.3	83.5	79.8	72.7	75.8	148.9
44-220000[9]	Utilities	Percent	-0.6	0.5	-1.5	-0.8	-0.1	-0.8	-1.6	0.2	0.3	-0.7	0.2
		Level	-3.4	2.8	-8.5	-4.6	-0.6	-4.7	-8.7	1.0	1.8	-4.1	1.1
50-000000	Information	Percent	-0.4	-0.4	1.8	-0.2	2.4	-1.6	-0.1	2.5	2.1	1.2	0.5
		Level	-11	-12	47	-5	66	-44	-2	70	59	35	14
55-000000	Financial activities	Percent	0.4	0.9	0.6	-0.1	0.2	-0.1	[8]	0.1	-0.1	0.8	0.3
		Level	34	69	45	-10	19	-9	-4	7	-12	68	25
60-000000	Professional and business services	Percent	[8]	0.7	[8]	[8]	-0.8	-0.6	-0.6	-1.3	-0.4	-0.8	-0.6
		Level	-3	125	2	4	-147	-110	-125	-270	-72	-159	-123
65-000000	Education and health services	Percent	[8]	-0.5	[8]	-0.3	-0.1	[8]	-0.4	0.3	[8]	-0.4	-0.2
		Level	7	-108	-2	-61	-16	-7	-83	70	5	-95	-47
70-000000	Leisure and hospitality	Percent	-0.6	0.7	0.8	0.5	0.3	-0.3	0.7	0.8	[8]	-1.1	0.2
		Level	-80	93	104	72	38	-45	102	126	-4	-170	31
80-000000	Other services	Percent	0.2	-2	1.1	-0.4	1.1	-0.4	-0.2	0.3	-0.4	-0.8	-0.1
		Level	11	-108	59	-22	59	-20	-12	18	-21	-44	-8
90-000000	Government	Percent	0.1	0.1	-0.3	[8]	-0.2	0.3	0.3	[8]	0.4	0.1	0.3
		Level	13	28	-57	7	-38	60	70	2	88	16	63

Footnotes

(1) With the 2010 benchmark, BLS reconstructed historical national employment levels of all employees for other federal government (91-999900) to reflect corrections to initial counts for temporary and intermittent workers for the 2010 Census. The reconstructions resulted in about 4,000 in employment being added to other federal government. For more information, see the Reconstructions section in the 2010 CES Benchmark Article.

(2) 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.

(3) 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.

(4) 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.

(5) 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.

(6) 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.

(7) 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.

(8) Absolute revision is less than 0.05 percent.

(9) Indented industries are part of trade, transportation, and utilities.

To Table of Figures

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

To Table of Figures

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 2020 benchmark. At the total private

level, there was no change in average weekly hours estimates for AE or PE from the previously published level. Total private average hourly earnings increased by 3 cents for AE and increased by 4 cents for PE from the previously published level.

Benchmark effects on hours and earnings for more detailed industries can be found at www.bls.gov/web/empsit/cesbmart-tables.htm.

Table 6. Effect of March 2020 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	34.3	34.3	0.0	$28.88	$28.91	$0.03
06-000000	Goods-producing	39.9	39.9	0.0	29.66	29.66	0.00
08-000000	Private service-providing	33.2	33.2	0.0	28.70	28.73	0.03
10-000000	Mining and logging	45.3	45.4	0.1	35.21	34.89	-0.32
20-000000	Construction	38.6	38.6	0.0	31.33	31.35	0.02
30-000000	Manufacturing	40.4	40.4	0.0	28.41	28.42	0.01
31-000000	Durable goods	40.7	40.7	0.0	29.75	29.76	0.01
32-000000	Nondurable goods	39.8	39.8	0.0	26.10	26.11	0.01
40-000000	Trade, transportation, and utilities	34.2	34.2	0.0	24.86	24.84	-0.02
41-420000	Wholesale trade	39.1	39.1	0.0	31.95	31.93	-0.02
42-000000	Retail trade	30.7	30.7	0.0	20.35	20.36	0.01
43-000000	Transportation and warehousing	37.8	37.8	0.0	25.26	25.16	-0.10
44-220000	Utilities	42.1	42.1	0.0	42.84	42.82	-0.02
50-000000	Information	36.7	36.8	0.1	43.57	43.66	0.09
55-000000	Financial activities	38.2	38.2	0.0	37.20	37.20	0.00
60-000000	Professional and business services	36.4	36.4	0.0	34.92	34.94	0.02
65-000000	Education and health services	33.0	33.0	0.0	27.94	28.06	0.12
70-000000	Leisure and hospitality	24.4	24.4	0.0	16.90	16.93	0.03
80-000000	Other services	31.7	31.6	-0.1	25.99	26.18	0.19

To Table of Figures

Table 7. Effect of March 2020 benchmark revisions to production and nonsupervisory employee average weekly hours and average hourly earnings estimates, major industry sectors

		Average Weekly Hours			Average Hourly Earnings		
CES Industry Code	**CES Industry Title**	**Estimated**	**Revised**	**Difference**	**Estimated**	**Revised**	**Difference**
05-000000	Total private	33.5	33.5	0.0	$24.23	$24.27	$0.04
06-000000	Goods-producing	40.5	40.5	0.0	25.13	25.14	0.01
08-000000	Private service-providing	32.3	32.3	0.0	24.05	24.09	0.04
10-000000	Mining and logging	45.8	45.9	0.1	31.09	30.99	-0.10
20-000000	Construction	38.9	38.9	0.0	28.95	28.97	0.02
30-000000	Manufacturing	41.1	41.1	0.0	22.57	22.58	0.01
31-000000	Durable goods	41.3	41.3	0.0	23.55	23.56	0.01
32-000000	Nondurable goods	40.8	40.8	0.0	20.97	20.97	0.00
40-000000	Trade, transportation, and utilities	33.9	34.0	0.1	21.05	21.04	-0.01
41-420000	Wholesale trade	38.7	38.7	0.0	26.49	26.47	-0.02
42-000000	Retail trade	30.5	30.5	0.0	17.04	17.04	0.00
43-000000	Transportation and warehousing	37.7	37.7	0.0	22.70	22.60	-0.10
44-220000	Utilities	42.5	42.5	0.0	37.87	37.85	-0.02
50-000000	Information	35.8	35.9	0.1	34.86	34.98	0.12
55-000000	Financial activities	37.3	37.3	0.0	28.66	28.67	0.01
60-000000	Professional and business services	35.7	35.7	0.0	28.90	28.92	0.02
65-000000	Education and health services	32.2	32.2	0.0	24.88	24.98	0.10
70-000000	Leisure and hospitality	23.1	23.1	0.0	14.69	14.71	0.02
80-000000	Other services	30.7	30.6	-0.1	22.14	22.34	0.20

To Table of Figures

Revisions to net birth-death

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

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.

Forecasted vs. actual net birth-death

Only error from the second component 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. Most recently, the data from April 2019 to March 2020 can be measured. As table 8 shows, the actual net birth-death from April 2019 to March 2020 was approximately 242,000 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 2019 to March 2020 (in thousands)

Benchmark 2020	2019									2020			
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
Actual Net Birth-Death	286	220	71	234	117	-118	340	27	-58	-140	123	-278	824
Forecast Net Birth-Death	282	209	109	186	95	-75	304	-16	-52	-145	143	26	1,066
Difference	4	11	-38	48	22	-43	36	43	-6	5	-20	-304	-242
Cumulative Difference	4	15	-23	25	47	4	40	83	77	82	62	-242	

To Table of Figures

Net birth-death adjustments to the post-benchmark period

From April 2020 to December 2020, 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 2020 to December 2020, the net birth-death model cumulatively added 796,000 jobs, compared with 789,000 in the previously published April 2020 to December 2020 employment estimates.

Table 9. Net birth-death forecasts by industry supersector, April to December 2020 (in thousands)

CES Industry Code	CES Industry Title	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Cumulative Total
10-000000	Mining and logging	-3	0	0	1	0	0	1	0	0	-1
20-000000	Construction	-41	73	31	9	10	4	29	-9	-11	95
30-000000	Manufacturing	-37	14	21	0	4	4	6	3	1	16
40-000000	Trade, transportation, and utilities	-72	25	20	19	18	17	49	10	10	96
41-420000[(1)]	Wholesale trade	-21	3	-7	-2	-4	0	9	2	2	-18
42-000000[(1)]	Retail trade	-28	18	18	12	12	8	23	-4	4	63
43-000000[(1)]	Transportation and warehousing	-23	4	9	8	10	9	17	12	4	50
44-220000[(1)]	Utilities	0	0	0	1	0	0	0	0	0	1
50-000000	Information	3	4	-1	6	4	-1	9	4	-1	27
55-000000	Financial activities	-11	11	-1	10	11	-2	30	3	9	60
60-000000	Professional and business services	-171	32	17	78	43	-33	134	4	31	135
65-000000	Education and health services	-24	24	-14	40	21	-7	70	8	-14	104
70-000000	Leisure and hospitality	-105	124	154	89	25	-43	22	-23	-4	239
80-000000	Other services	-9	12	8	2	6	-3	13	-1	-3	25
Total private net birth-death forecast		-470	319	235	254	142	-64	363	-1	18	796

Footnotes

(1) Indented industries are part of trade, transportation, and utilities.

To Table of Figures

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 final and subsequent months' first preliminary, second preliminary, and final estimates. "Excess returns from zero" were used in first, second, and final estimates from May to the present.

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.

The use of sample links as regression variables in the model initially accounted for a difference of –174,000 in the net birth-death forecasts from April 2020 to December 2020, with a range from –799,000 to 222,000. 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)

2020	Preliminary Forecast			Revised Forecast		
	With Adjustment	Without Adjustment	Difference	With Adjustment	Without Adjustment	Difference
April	-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	789	963	-174	796	1,028	-232

To Table of Figures

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 do use these two adjustments and a simulated CES series calculated without using either adjustment. The total private benchmark revision amount applied to March 2020 was –184,000. Without these adjustments to the birth-death model, the benchmark revision amount would have been 385,000 lower, or –569,000.

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

2020	Total Private Employment with Adjustments	Total Private Employment without Adjustments	Difference
March	127,009[(1)]	127,394	-385
April	108,158	111,786	-3,628
May	111,865	114,768	-2,903
June	117,309	119,280	-1,972
July	118,805	120,514	-1,708
August	119,717	121,313	-1,596
September	120,110	121,643	-1,533
October	121,571	123,024	-1,453
November	122,161	123,593	-1,433
December	122,026	123,418	-1,392

Footnotes

(1) Net birth-death forecasts for March were not adjusted to incorporate the sector sample link regressors. However, adjustments for excess reported zeroes were included in the estimates for March.

To Table of Figures

BLS continues to use sample links that account for excess reported zeroes and adjusted net birth-death forecasts in monthly employment estimates. Research is being done on a monthly basis into when to return to normal estimation. Several factors are being monitored, including reverting to expected proportions of units that newly report zero or return from zero in the current month, resumption of previous patterns in the birth-death forecasts, and some combination of the two.

QCEW imputation

Every quarter, the QCEW program imputes employment for UI accounts where reports were not received or were received but contained only wage information and no employment data. Typically, only a small concentration of worksites and employment are imputed. In the November 2020 QCEW news release of second quarter 2020 data and second published version of first quarter 2020 data, BLS implemented improvements to QCEW imputation methodology. Improvements to the QCEW imputation methodology are described in more detail at www.bls.gov/cew/additional-resources/imputation-methodology.htm.

Changes in the QCEW imputation methodology had little effect on the CES-National March 2020 benchmark. The total effect of the new imputation methodology on the QCEW portion of the employment population count was 0.02 percent.

Changes to the CES published series

With the release of the January 2021 first preliminary estimates on February 5, 2021, BLS incorporated series changes related to annual sample adequacy and disclosure review.

Small domain model updates

The CES small domain model is a weighted least squares model with two employment inputs: (1) an estimate based on available CES sample for that series, and (2) an ARIMA projection based on trend from 10 years of historical QCEW data. CES-National began using the small domain model in 2007. For more information about it, see the Small Domain Model section of the CES Technical Notes.

Two series estimated using the small domain model have been discontinued along with their component industries: direct health and medical insurance carriers (55-524114) and recreational and vacation camps (70-721214).

Two other series have received adequate sample and have stopped using the small domain model: other technical consulting services (60-541690) and remediation services (60-562910). These series are now being estimated using the standard CES weighted-link-relative technique.

BLS will continue to use the model for estimates in lessors of nonfinancial intangible assets (55-533000) and tax preparation services (60-541213).

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 at www.bls.gov/web/empsit/cesnewseries.htm.

A list of currently published CES series is available at www.bls.gov/web/empsit/cesseriespub.htm.

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
56145,9	60-561490	Other business support services	60-561490	Other business support services, including credit bureaus

To Table of Figures

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 for AE and non-AE data types. The first two tables in this section reference the AE data type and the third table references all non-AE data types. The tables display an AE collapse and discontinued series for AE and 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 no longer published because the 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
332721	31-332721	Precision turned products	Turned products and screws, nuts, and bolts (31-332720)
332722	31-332722	Bolts, nuts, screws, rivets, and washers	Turned products and screws, nuts, and bolts (31-332720)
3152	32-315200	Cut and sew apparel	Apparel (32-315000)
31521	32-315210	Cut and sew apparel contractors	Apparel (32-315000)
3151,9	32-315900	All other apparel manufacturing	Apparel (32-315000)
524113	55-524113	Direct life insurance carriers	Direct life and health insurance carriers (55-524110)
524114	55-524114	Direct health and medical insurance carriers	Direct life and health insurance carriers (55-524110)
721211	70-721211	RV parks and campgrounds	RV parks and recreational camps (70-721200)
721214	70-721214	Recreational and vacation camps	RV parks and recreational camps (70-721200)

To Table of Figures

Table 12. Collapsed all employees series

Previous			New		
NAICS Code	**CES Industry Code**	**CES Industry Title**	**NAICS Code**	**CES Industry Code**	**CES Industry Title**
56145	60-561450	Credit bureaus	56145,9	60-561490	Other business support services, including credit bureaus
56149	60-561490	Other business support services			

To Table of Figures

Table 13. Discontinued series other than all employees

NAICS Code	CES Industry Code	CES Industry Title	Discontinued From Publication	Next Highest Published Industry
3334	31-333400	HVAC and commercial refrigeration equipment	PE AWOH	Machinery (31-333000)
33391	31-333910	Pumps and compressors	WE	Other general purpose machinery (31-333900)
33399	31-333990	All other general purpose machinery	WE	Other general purpose machinery (31-333900)
336211	31-336211	Motor vehicle bodies	AE AWH, AE AHE, AE AWOH, WE	Motor vehicle bodies and trailers (31-336200)
33637	31-336370	Motor vehicle metal stamping	AE AWH, AE AHE	Motor vehicle parts (31-336300)
339116	31-339116	Dental laboratories	PE, PE AWH, PE AHE	Medical equipment and supplies (31-339100)
3132	32-313200	Fabric mills	WE	Textile mills (32-313000)
3141	32-314100	Textile furnishings mills	WE	Textile product mills (32-314000)
3149	32-314900	Other textile product mills	WE	Textile product mills (32-314000)
3261	32-326100	Plastics products	PE AWOH	Plastics and rubber products (32-326000)
32611	32-326110	Plastics packaging materials, film, and sheet	PE AWOH	Plastics and rubber products (32-326000)
32614,5	32-326150	Foam products	PE AWOH	Plastics and rubber products (32-326000)
32619	32-326190	Other plastics products	PE AWOH	Plastics and rubber products (32-326000)
3262	32-326200	Rubber products	PE AWOH	Plastics and rubber products (32-326000)
42493	41-424930	Nursery stock and florists' supplies	PE, PE AWH, PE AHE	Misc. nondurable goods (41-424900)
5323	55-532300	General rental centers	PE, PE AWH, PE AHE	Rental and leasing services (55-532000)
71321	70-713210	Casinos, except casino hotels	WE	Gambling industries (70-713200)
71329	70-713290	Other gambling industries	WE	Gambling industries (70-713200)
811118	80-811118	Other automotive mechanical and elec. repair	AE AWH, AE AHE	Automotive mechanical and electrical repair (80-811110)

NAICS Code	CES Industry Code	CES Industry Title	Discontinued From Publication	Next Highest Published Industry
81231	80-812310	Coin-operated laundries and drycleaners	PE, PE AWH, PE AHE	Drycleaning and laundry services (80-812300)
81232	80-812320	Drycleaning and laundry services, except coin-operated	PE, PE AWH, PE AHE	Drycleaning and laundry services (80-812300)

To Table of Figures

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 www.bls.gov/ces/data/home.htm, 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 late February following the annual benchmark revision.

Benchmarks for detailed industries can be found at www.bls.gov/web/empsit/cesbmart-tables.htm.

Table of figures

Tables

Table 1. Differences in seasonally adjusted levels and over-the-month changes, total nonfarm employment, January to December 2020 (in thousands) 3
Table 2. Seasonally adjusted employment revisions for major industry sectors, March 2020 (in thousands) 5
Table 3. Not seasonally adjusted employment benchmarks for major industry sectors, March 2020 (in thousands) 6
Table 4. Percent and level differences between nonfarm employment benchmarks and estimates by industry supersector, March 2010 to 2020 (in thousands) 7
Table 5. Directly estimated data types 9
Table 6. Effect of March 2020 benchmark revisions to all employee average weekly hours and average hourly earnings estimates, major industry sectors 11
Table 7. Effect of March 2020 benchmark revisions to production and nonsupervisory employee average weekly hours and average hourly earnings estimates, major industry sectors 12
Table 8. Differences between forecasted and actual net birth-death, total private employment, April 2019 to March 2020 (in thousands) 14
Table 9. Net birth-death forecasts by industry supersector, April to December 2020 (in thousands) 15
Table 10. Series with CES industry code or title changes 19
Table 11. Discontinued all employees series 20
Table 12. Collapsed all employees series 20
Table 13. Discontinued series other than all employees 21

Exhibits

Exhibit 1. Preliminary and revised net birth-death forecasts for total private with and without regressor adjustments, not seasonally adjusted (in thousands) 17
Exhibit 2. Effects of adjusted net birth-death and use of reported zeroes on total private employment before benchmarking, not seasonally adjusted (in thousands) 18

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