

# COVID-19 recession is tougher on women

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According to a new study, working women are experiencing the worst effects of the COVID-19 recession, unlike in previous downturns, which hit working men the hardest. In [“The Impact of COVID-19 on Gender Equality”](#) (National Bureau of Economic Research, Working Paper 26947, April 2020), researchers Titan Alon, Matthias Doepke, Jane Olmstead-Rumsey, and Michèle Tertilt suggest that more women in the United States will have lost their jobs because the industries they tend to work in have been harder hit by the effects of the pandemic. The study points out two major reasons that the current recession is tougher for women.

First, the crisis has battered industry sectors in which women’s employment is more concentrated—restaurants and other retail establishments, hospitality, and health care. This was not the case in past recessions, which tended to hurt male-dominated industry sectors like manufacturing and construction more than other industries. In past recessions, men have faced greater risk of unemployment than women, partly because of the gender composition of different sectors of the economy. A larger fraction of employed men (46 percent) than employed women (24 percent) work in construction; manufacturing; and trade, transportation, and utilities. These are considered highly cyclical sectors that typically suffer during “normal” recessions. On the other hand, 40 percent of all working women are employed in government and in health and education services compared with just 20 percent of working men.

Second, the coronavirus shutdowns have closed schools and daycare centers around the country, keeping kids at home and making it even harder for parents (especially mothers who tend to provide the majority of childcare) to keep working. Childcare poses an additional challenge to working mothers during the pandemic.

Working women are also at a greater disadvantage compared with working men in the current crisis because fewer women have jobs that allow them to telecommute: 22 percent of female workers compared with 28 percent of male workers. According to the researchers’ analysis of data from the American Time Use Survey from 2017 and 2018, single parents will face the greatest challenge. Only 20 percent of single parents reported being able to telecommute compared with 40 percent of married people with children. In two-parent households where only one parent works in the labor market, the stay-at-home parent, usually the mother, is likely to assume primary childcare duties during coronavirus-related school closures. However, in 44 percent of married couples with children, both spouses work full-time. Among these couples, mothers provide about 60 percent of childcare. Men perform 7.2 hours of childcare per week versus 10.3 hours for women.

The study also compared the current pandemic to World War II, which led to significant changes in American family dynamics and gender norms, as millions of women joined the labor force for the first time. The huge influx of women into the workforce during the Second World War was a change that did not revert once the war was over. The comparison suggests that temporary changes to the distribution of labor between men and women may have a lasting impact. As of now, millions of American fathers are taking more, and in some cases, primary responsibility

for child care. It is possible that the COVID-19 crisis may erode gender norms that currently lead to a lopsided distribution of the division of labor in housework and childcare at home.

The current economic downturn resulting from the COVID-19 pandemic is disproportionately hurting women's employment, with ramifications that could be long lasting. The authors estimate that 15 million single mothers in the United States will be the most severely affected, with little potential for receiving other sources of childcare and a smaller likelihood of continuing to work during the crisis. However, the study points out that many businesses are becoming much more aware of their employees' childcare needs and have responded by adopting more flexible work schedules and telecommuting options. The authors hope that by promoting flexible work arrangements and making childcare obligations of both genders a priority, the crisis may reduce labor-market barriers in the long run. Although the evidence suggests that women's employment opportunities will suffer severely during the crisis, the authors see cause for optimism over the longer term.

# Comparing characteristics and selected expenditures of dual- and single-income households with children

*Using 2015–17 data from the Consumer Expenditure Surveys, this article compares the food, transportation, and education expenditures of dual- and single-income households with children under age 18. The analysis finds that these expenditures vary by both parental employment status and children's age.*

The percentage of dual-income households with children under age 18 has been on the rise since the 1960s, surpassing the percentage of father-only-employed households in the 1970s.<sup>1</sup> This rise most likely reflects a cultural shift involving women in the workforce. The female labor force participation rate increased from 1960 onward, peaking at 60 percent in 1999.<sup>2</sup> Monitoring and analyzing this trend is important, because the expenditure patterns of dual-income households could differ from those of single-income households, affecting the U.S. economy.

This article examines the characteristics and employment-status proportions of dual- and single-income (couple-led) households with children, comparing their expenditures on food, transportation, childcare, and private education.

These expenditure categories are selected under the assumption that working full time entails tradeoffs involving time for meal preparation, time for childrearing, and commuting expenses. Using 2015–17 data from the Consumer Expenditure Surveys (CE), the analysis first compares family characteristics (such as number of children) across the following three categories that capture the employment status of parents in households with at least one full-time worker: “both full time,” “one full time, one part time,” and “one full time, one not working.” The analysis then examines CE expenditure patterns, by children's age, within each employment category.



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## Data

The CE expenditure data are collected by the U.S. Census Bureau for the U.S. Bureau of Labor Statistics in two component surveys: (1) the Interview Survey for major and/or recurring expenditure items and (2) the Diary Survey for minor and/or frequently purchased expenditure items.<sup>3</sup> (See appendix for more details about the data.) This article uses internal microdata from both surveys.<sup>4</sup> Data from the Interview Survey are used to compute employment-status proportions and other family characteristics, as well as monthly household expenditures on transportation, education, and childcare. Data from the Diary Survey are used to analyze weekly food expenditures.

The present analysis uses a subset of CE data consisting of consumer units (similar to families) that reported having a spouse and at least one child under age 18. This subset includes only married couples and their own minor-age children (i.e., children under age 18); no other family members (e.g., grandparents) are included.<sup>5</sup> As noted earlier, three analysis groups are formed on the basis of the employment status of the couples,<sup>6</sup> and the analysis includes only couples who reported their employment status for the entire previous year.<sup>7</sup> Full-time employment is defined as working at least 35 hours a week, and part-time employment is defined as working 1 to 34 hours a week. Lastly, to control for expenditure differences between families with younger and older children, the analysis breaks down the data by age of children in the household, forming three groups: households in which all children are under age 6; households in which all children are ages 6 to 11; and households in which all children are ages 12 to 17. To have large-enough sample sizes within each group, the analysis focuses on the 2015–17 period. The sample sizes are shown in table 1, by employment status and age of children, followed (in parentheses) by the number of households represented nationally.

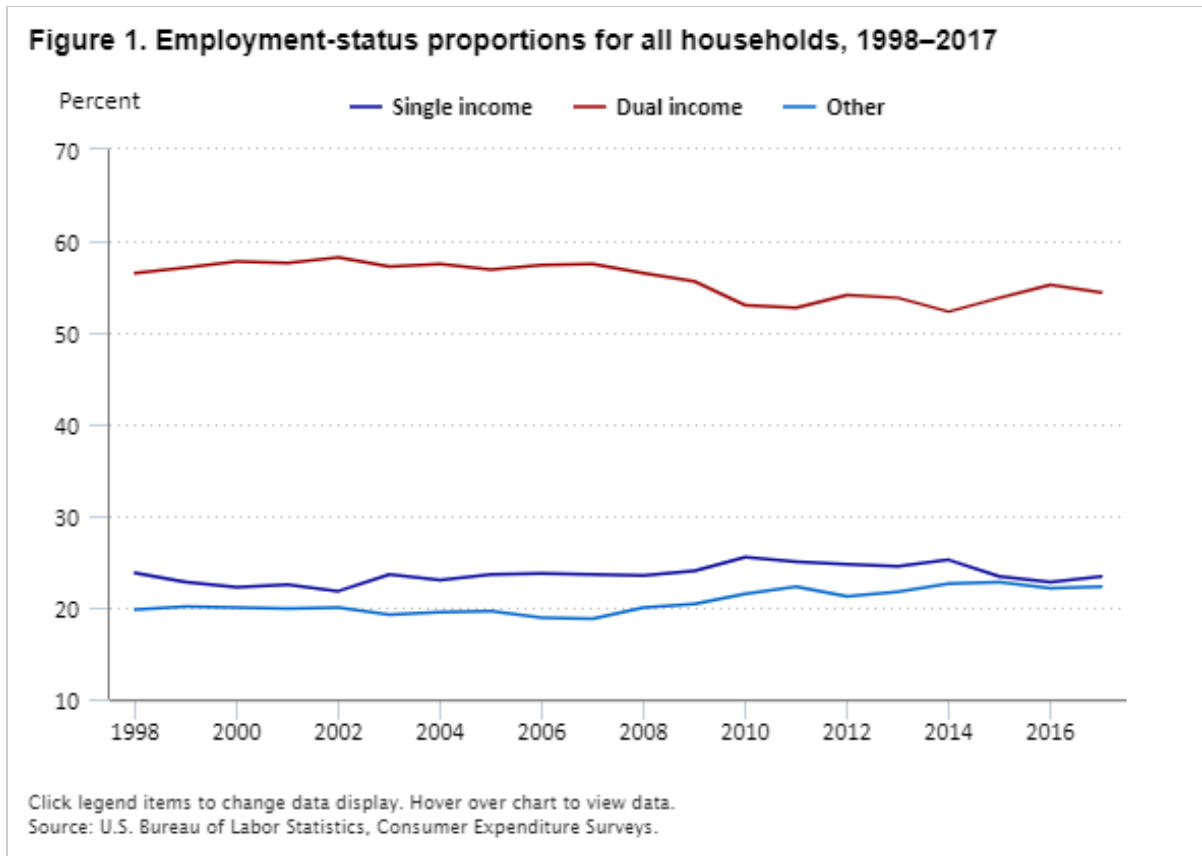
**Table 1. Sample sizes and (in parentheses) number of represented households, 2015–17**

Age of children	Employment status		
	One full time, one not working	One full time, one part time	Both full time
All children under age 6	707 (1,215,385)	274 (480,165)	1,047 (1,815,244)
All children ages 6 to 11	290 (461,944)	201 (340,279)	665 (1,154,680)
All children ages 12 to 17	316 (540,438)	258 (429,887)	914 (1,602,407)

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

## Employment-status proportions

CE data show that, among U.S. households, dual-income households have been a majority for at least the last two decades. The percentage of dual-income households was fairly stable between 1998 and 2017, ranging from 52 to 58 percent. (See figure 1.) In this article, a dual-income household is defined as one in which one spouse works full time and the other works at least part time. From 2007 to 2011, there was a steady decrease in the percentage of dual-income households (from 58 to 53 percent for couples who had some kind of dual income), and this decrease coincided with the Great Recession of 2007–09.<sup>8</sup> In those years, the percentage of single-income households increased, as did the percentage of households of other employment types (e.g., those in which both spouses are not working or those in which one spouse is working part time).<sup>9</sup>



But what about families with children? Based on 2015–17 CE data (used in the rest of the analysis) for married couples with children under age 18, the proportion of “one full time, one not working” households is 30 percent; the proportion of “one full time, one part time” households is 14 percent; and the proportion of “both full time” households is 52 percent. So, even among households with children, dual-income households make up two-thirds (66 percent) of the total. This percentage is higher than that for the overall population (52 to 58 percent), partly because retired couples (in which both spouses are considered not working) are more prevalent in the overall population than among households with children.

Table 2 shows household proportions by both employment status and age of children. One can see that, as the age of children increases from under age 6 to ages 6 to 11, the proportion of “one full time, one not working” households decreases by 10 percentage points, and the proportion of “both full time” households increases by 8 percentage points.

**Table 2. Percentage of households, by employment status and age of children, 2015–17**

Age of children	Employment status			
	One full time, one not working	One full time, one part time	Both full time	Other
All children under age 6	33.4	13.2	49.9	3.5
All children ages 6 to 11	23.0	17.0	57.6	2.4
All children ages 12 to 17	19.6	15.6	58.0	6.8

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

## Characteristics

Besides collecting expenditure data, the CE program collects demographic data from survey respondents. To get a profile of single- and dual-income households, the analysis compares their average age, number of children, race, income, and outlays across sample groups. This comparison is important because demographic characteristics may affect household expenditures even within the same employment-status group. As shown in table 3, the age of a household's reference person<sup>10</sup> varies little across employment types when the age range of children is held constant. The average age of parents within each column follows a natural lifecycle function, increasing with children's age. As shown in table 4, the number of children in a household varies little across children age groups. The largest difference (0.22) is again between "one full time, one not working" and "both full time" households, this time for households in which all children are under age 6. For households in which all children are ages 12 to 17, the difference is roughly halved (0.13).

**Table 3. Average age of reference person in household, by employment status and age of children, 2015–17**

Age of children	Employment status		
	One full time, one not working	One full time, one part time	Both full time
All children under age 6	33	33	34
All children ages 6 to 11	41	40	40
All children ages 12 to 17	48	48	47

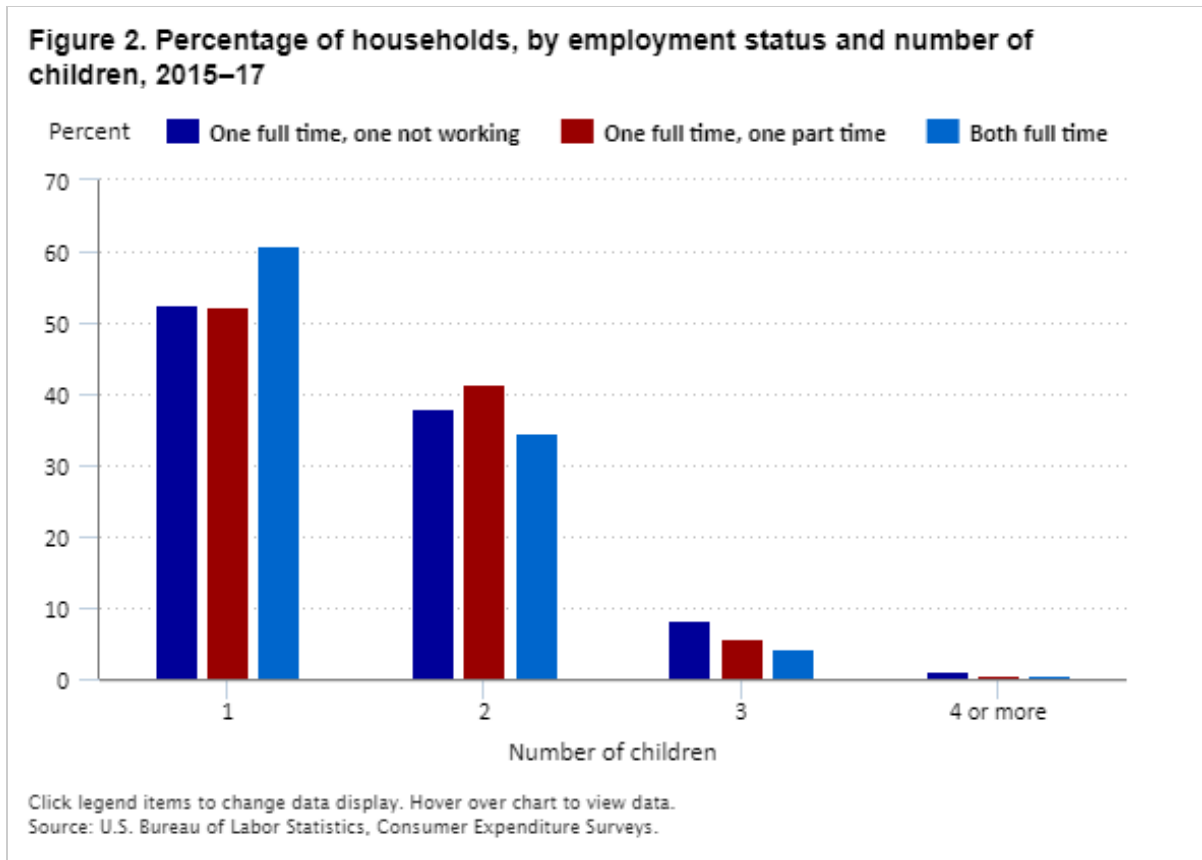
Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

**Table 4. Average number of children in household, by employment status and age of children, 2015–17**

Age of children	Employment status		
	One full time, one not working	One full time, one part time	Both full time
All children under age 6	1.61	1.55	1.39
All children ages 6 to 11	1.70	1.64	1.49
All children ages 12 to 17	1.57	1.48	1.44

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

Figure 2 compares the distributions of households by employment status and number of children. (Again, this comparison is for the sample restricted to households in which all children are under age 18.) As shown in the figure, 61 percent of households in which both spouses work full time have just one child. This percentage compares with about 53 percent of households with one spouse working full time and the other not working. Therefore, a higher percentage of households in the latter group have two or more children. Comparing the distributions shows that households with only one spouse working are more likely to have more children or that the more children a household has, the less likely that both of its spouses will be working.



Lastly, table 5 shows household distributions by employment status and race (White, Black, and Asian).<sup>11</sup> The race designations are based on the race of the reference person, not necessarily of both spouses. Whites and Blacks have similar distributions by household employment status. Asians exhibit a somewhat different pattern in that, compared with Whites and Blacks, they have a higher percentage of “one full time, one not working” households and, therefore, a lower percentage of households in the other two employment categories. A question worth further investigation is whether families have a dual income because of necessity or personal preference. For example, although the proportion of Black households in the “both full time” category is roughly the same as that for Whites, the average income of these Black households is lower than the average income of their White counterparts. (See table 6.) In fact, the average income of a “one full time, one not working” Black household is just under 60 percent of that of a White or Asian household in the same employment category. However, because the CE do not ask about the reasons for having a dual- or single-income status, the question cannot be answered with CE data.

**Table 5. Percentage of households, by employment status and race of reference person, 2015–17**

Race	Employment status		
	One full time, one not working	One full time, one part time	Both full time
White	27	16	58
Black	23	17	61
Asian	39	10	51

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

**Table 6. Average annual household income, by employment status and race of reference person, 2015–17**

Race	Employment status		
	One full time, one not working	One full time, one part time	Both full time
White	\$79,374	\$109,184	\$121,550
Black	46,950	67,397	92,180
Asian	81,798	76,182	163,518

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

## Income and outlays

In considering income before taxes (hereafter referred to simply as “income”), one could reasonably expect that, on average, dual-income households will have higher income than single-income households. But how much higher? Table 7 shows the difference in income for the three analysis groups. As expected, compared with “one full time, one not working” households, “both full time” and “one full time, one part time” households have higher average annual incomes. However, the disparity across groups decreases with children’s age. For households in which all children are under age 6, the income difference between “one full time, one not working” and “both full time” households is \$53,873. This difference drops to \$19,718 for households in which all children are ages 12 to 17.

**Table 7. Average annual total household income, by employment status and age of children, 2015–17**

Age of children	Employment status		
	One full time, one not working	One full time, one part time	Both full time
All children under age 6	\$63,507	\$92,319	\$117,380
All children ages 6 to 11	78,975	109,403	117,023
All children ages 12 to 17	103,564	113,192	123,282

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

There is a noticeable shift in the age of employed spouses across employment-status groups. (See table 8.) This shift is relevant to the analysis of average annual total income because, using age as a proxy for work experience, one might expect that “one full time, one not working” households have a spouse with more work experience than the spouses in “both full time” households. Among households in which all children are under age 6, “both full time” households have a higher average age of employed spouses (34 years) than do “one full time, one not working” households (33 years). However, among households in which all children are ages 12 to 17, “one full time, one not working” households have the highest average age for the employed spouse. At the same time, although “both full time” households have working spouses whose average age increases with children’s age, they are the only group for which income does not rise as children’s age increases from less than 6 years to 6–11 years. Therefore, it is unlikely that age, used as a proxy for work experience, is the only factor accounting for differences in total income.

**Table 8. Age of full-time employed spouse and average age of both full-time employed spouses, by employment status and age of children, 2015–17**

Age of children	Employment status		
	One full time, one not working	One full time, one part time	Both full time
All children under age 6	33	34	34
All children ages 6 to 11	42	41	40
All children ages 12 to 17	49	49	47

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

Table 9 presents total outlays,<sup>12</sup> which serve as a proxy for permanent income.<sup>13</sup> The figure shows that, compared with income, total outlays vary less across analysis groups. It is interesting that, among households in which all children are ages 6 to 11 or 12 to 17, “one full time, one part time” households have the highest average outlays. The differences between the three groups decrease with children’s age. For households in which all children are under age 6, the largest difference in outlays (\$24,260) is between “one full time, one not working” and “both full time” households. For households in which all children are ages 12 to 17, the largest difference (\$11,976) is between “one full time, one not working” and “one full time, one part time” households. In part, this decrease in outlay disparities is presumably a function of the decrease in income disparities as children’s ages increase. Another contributing factor is the decline in childcare expenditures for children older than age 6 (see childcare expenditure analysis below).

**Table 9. Average annual total household outlays, by employment status and age of children, 2015–17**

Age of children	Employment status		
	One full time, one not working	One full time, one part time	Both full time
All children under age 6	\$57,760	\$73,764	\$82,020
All children ages 6 to 11	77,524	94,940	84,308
All children ages 12 to 17	83,104	95,080	94,116

Note: In the Consumer Expenditure Interview Survey internal and microdata files, outlays are a quarterly amount. Because total income is often thought of as an annual amount, the outlay variable was multiplied by 4.

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

## Food expenditures

Families face a tradeoff between spending time and spending money. Dual-income families forgo extra time on meal preparation for the potential benefit of having higher total income, while single-income families forgo extra income for the potential benefit of spending less money on childcare and food away from home. According to the American Time Use Survey (ATUS), the time mothers spend on food preparation and cleanup is 0.8 hours per day in “both full time” households and about twice that in households in which only one spouse (the father) works full time.<sup>14</sup> This section analyzes average weekly spending for food at home and food away from home for the three types of employed households. Food at home is defined as food purchased from grocery or similar stores (convenience stores, farmers’ markets, etc.), and food away from home is defined as food purchased at

restaurants, employer cafeterias, vending machines, or similar venues. The analysis examines weekly average expenditures based on data from the CE Diary Survey, both because these data describe a person's weekly spending and because groceries and restaurant expenditures are often thought of in terms of weekly amounts.

Table 10 compares the food-at-home expenditures of the three analysis groups. The differences between the groups are not statistically significant.<sup>15</sup> This result may be partly due to the variety of frozen meals and prepared foods that can be purchased at grocery stores. In fact, the data show that, compared with single-income households, dual-income households spend consistently more on convenience foods (e.g., canned, prepared, or frozen foods).<sup>16</sup> On average, "both full time" households spend \$2.36 more per week on convenience foods than do "one full time, one not working" households. This spending difference is statistically significant for households in which all children are under age 6.

**Table 10. Average weekly household expenditures for food at home, by employment status and age of children, 2015–17**

Age of children	Employment status		
	One full time, one not working	One full time, one part time	Both full time
All children under age 6	\$92.78 (\$5.57)	\$110.20 (\$11.23)	\$104.04 (\$5.59)
All children ages 6 to 11	113.40 (8.62)	103.70 (10.34)	117.57 (7.06)
All children ages 12 to 17	124.04 (9.46)	139.82 (9.98)	129.87 (6.63)

Note: Estimates represent mean expenditures. Standard errors are shown in parentheses.

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

Furthermore, in terms of all food at home, the largest difference across groups is again observed for households in which all children are under age 6. Among these households, "one full time, one part time" households spend about \$17 more per week, on average, than do "one full time, one not working" households. Similarly, the difference between these two groups is \$16 for households in which all children are ages 12 to 17.

Table 11 presents group comparisons for food-away-from-home weekly expenditures. Some of the differences in this expenditure category are statistically significant. For example, among households in which all children are under age 6, "one full time, one not working" households spend significantly less, on average, than do "one full time, one part time" and "both full time" households.

**Table 11. Average weekly household expenditures for food away from home, by employment status and age of children, 2015–17**

Age of children	Employment status			t-values		
	One full time, one not working (A)	One full time, one part time (B)	Both full time (C)	t(A,B)	t(A,C)	t(B,C)
All children under age 6	\$53.89 <sup>B,C</sup> (\$5.38)	\$86.36 <sup>A</sup> (\$17.70)	\$82.89 <sup>A</sup> (\$6.36)	1.74	3.21	-0.18
All children ages 6 to 11	75.15 (12.15)	70.49 (12.54)	94.00 (7.26)	-0.27	1.30	1.62

See footnotes at end of table.

**Table 11. Average weekly household expenditures for food away from home, by employment status and age of children, 2015–17**

Age of children	Employment status			t-values		
	One full time, one not working (A)	One full time, one part time (B)	Both full time (C)	t(A,B)	t(A,C)	t(B,C)
All children ages 12 to 17	89.98 (10.83)	92.81 (11.01)	100.53 (6.72)	0.21	0.89	0.59

Note: Superscripts indicate statistically significant differences between specific groups. For example, in column C, an “A” superscript indicates that the mean for “both full time” households is significantly different from the mean for “one full time, one not working” households. Two superscripts in any column indicate that the mean therein is significantly different from the means for the other two groups. Standard errors are shown in parentheses.

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

## Transportation expenditures

This section tests the hypothesis that, because of potentially higher commuting costs for two workers, dual-income households would spend more on transportation than single-income households. This hypothesis is tested by comparing monthly expenditures for public transportation (intercity bus, mass transit, and train) and gasoline, both sourced from the CE Interview Survey.<sup>17</sup>

Contrary to the hypothesis, the results presented in table 12 show that the only significant difference in public transportation expenditures is that between “one full time, one part time” and “both full time” households with children ages 6 to 11. Intriguingly, for families with children ages 6 to 11, the difference does not appear to be due to a difference in ownership of commuting vehicles (cars and trucks). According to data from the CE Interview Survey, “one full time, one part time” households own about the same number of such vehicles (1.8, on average) as do “both full time” households (1.9).

**Table 12. Average monthly household expenditures for public transportation, by employment status and age of children, 2015–17**

Age of children	Employment status			t-values		
	One full time, one not working (A)	One full time, one part time (B)	Both full time (C)	t(A,B)	t(A,C)	t(B,C)
All children under age 6	\$6.68 (\$1.93)	\$11.64 (\$5.17)	\$9.41 (\$1.65)	0.88	0.92	-0.43
All children ages 6 to 11	12.04 (5.04)	15.19 <sup>C</sup> (3.73)	7.85 <sup>B</sup> (1.54)	0.46	-0.79	-1.85
All children ages 12 to 17	10.77 (3.98)	15.93 (5.19)	10.78 (2.34)	0.68	0.00	-0.91

Note: Superscripts indicate statistically significant differences between specific groups. For example, in column C, a “B” superscript indicates that the mean for “both full time” households is significantly different from the mean for “one full time, one part time” households. Standard errors are shown in parentheses.

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

Table 13 shows the results for gasoline expenditures, the second component of transportation expenditures. For households in which all children are under age 6 or between the ages of 6 and 11, one finds a statistically significant difference between “one full time, one not working” households and “both full time” households, with the latter group spending more on gasoline than the former. This pattern shifts for households in which all children are ages 12 to 17; here, “one full time, one not working” households spend the same, on average, as do “both full time” households. Finally, regardless of household employment status, average expenditures on gasoline increase with children’s age.

**Table 13. Average monthly household expenditures for gasoline, by employment status and age of children, 2015–17**

Age of children	Employment status			t-values		
	One full time, one not working (A)	One full time, one part time (B)	Both full time (C)	t(A,B)	t(A,C)	t(B,C)
All children under age 6	\$152.24 <sup>C</sup> (\$7.90)	\$169.63 (\$14.22)	\$177.72 <sup>A</sup> (\$5.99)	1.07	2.23	0.56
All children ages 6 to 11	177.62 <sup>C</sup> (9.21)	193.70 (13.32)	200.83 <sup>A</sup> (6.03)	0.94	2.07	0.53
All children ages 12 to 17	220.97 <sup>B</sup> (7.46)	201.46 <sup>A</sup> (8.26)	217.21 (7.21)	-1.76	-0.38	1.46

Note: Superscripts indicate statistically significant differences between specific groups. For example, in column C, an “A” superscript indicates that the mean for “both full time” households is significantly different from the mean for “one full time, one not working” households. Standard errors are shown in parentheses.

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

## Childcare expenditures

Many married couples with young children face the tradeoff between a second income and time spent with children, particularly when considering the monthly cost of childcare. According to ATUS data, mothers in “both full time” households spend 2.30 hours per day on caring for and helping household children. (See table 14.) This figure is much higher (3.49 hours per day) for households in which the father is employed full time and the mother is not employed. It is important to note that the ATUS data are categorized by the youngest, not the oldest, child in the household. Therefore, the ATUS data are not directly comparable with CE data.

**Table 14. Hours per day spent caring for and helping household children, by employment status and age of children, 2015–17**

Age of children	Employment status					
	Mother not employed, father employed full time		Mother employed part time, father employed full time		Both employed full time	
	Mother	Father	Mother	Father	Mother	Father
Youngest child under age 6	3.49	1.13	2.78	1.33	2.30	1.54
Youngest child age 6 to 17	1.56	0.52	1.18	0.57	0.76	0.50

Source: U.S. Bureau of Labor Statistics, American Time Use Survey.

Table 15 shows the childcare expenses of households with children under age 6 and households with children ages 6 to 11.<sup>18</sup> These expenditures differ significantly—at the 90-percent confidence level—across employment statuses within each children’s age category. For all employment statuses, the childcare expenditures of households in which all children are ages 6 to 11 are substantially lower than the childcare expenditures of households in which all children are under age 6. In fact, the average childcare expenditures for “one full time, one not working” households in the former group drop to only \$7, because children reaching school age no longer need all-day daycare during the academic year.

**Table 15. Average monthly childcare expenditures, by employment status and age of children, 2015–17**

Age of children	Employment status		
	One full time, one not working	One full time, one part time	Both full time
All children under age 6	\$60.51	\$252.85	\$508.22
All children ages 6 to 11	6.74	33.11	135.31

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

## Education expenditures

Unlike childcare expenditures, private education expenditures presumably reflect the personal preferences of parents, because households have access to free public education. This section examines whether “both full time” households spend more on private education than the other two employment-status groups. The comparison is based on a variable that captures monthly expenditures on private tuition for elementary through high school.<sup>19</sup> Because children under age 6 generally do not attend elementary school, the analysis is restricted to households in which all children are ages 6 to 11 or ages 12 to 17.

Surprisingly, the spending differences across groups are not statistically significant. (See table 16.) Therefore, on average, private school spending does not appear to differ between dual- and single-income households.

**Table 16. Average monthly expenditures on private tuition for elementary through high school, by employment status and age of children, 2015–17**

Age of children	Employment status		
	One full time, one not working	One full time, one part time	Both full time
All children ages 6 to 11	\$68.26	\$229.41	\$75.54
All children ages 12 to 17	110.67	158.37	101.53

Source: U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys.

## Summary and conclusion

In summary, the food, transportation, and education expenditures of dual- and single-income households depend on the ages of household children. Childcare is the one expenditure category for which dual-income households (“both full time” or “one full time, one part time” households) spend the most, regardless of children’s ages. As expected, and again regardless of children’s ages, dual-income households have higher total incomes and total

outlays than single-income households. An interesting area for further research is the finding that “one full time, one part time” households have the highest total outlays and the highest public transportation and private education expenditures. This result may be due to these households being less time constrained than “both full time” households and having higher incomes than “one full time, one not working” households. However, testing this hypothesis would require a regression or another complex analysis that is beyond the scope of this article.

The present research is important for parents engaged in family planning or making career choices. By identifying differences in the food, transportation, and childcare expenditures of dual- and single-income households, it can help couples with children anticipate spending increases or decreases as they change their employment status or as their children get older. In addition, the research can help retailers understand what goods and services are in demand by dual-income families, which have represented most households in the last 20 years. Monitoring the percentage of households in this category can facilitate market planning in the food, childcare, and private education industries.

## Appendix: About the data

CE data are collected by the U.S. Census Bureau for the U.S. Bureau of Labor Statistics in two component surveys: the Diary Survey and the quarterly Interview Survey. The Diary Survey captures small expenditures, such as those for groceries, personal care items, and housekeeping supplies, with respondents recording all purchases over a 2-week period. The Interview Survey captures larger and/or recurring expenditures, such as those for automobiles, major appliances, and rent and utilities. This survey is conducted every 3 months, for a total of four in-person visits per year, asking respondents to recall items purchased in the previous 3 months.

According to the CE, “A consumer unit comprises either: (1) all members of a particular household who are related by blood, marriage, adoption, or other legal arrangements; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in permanent living quarters in a hotel or motel, but who is financially independent; or (3) two or more persons living together who use their income to make joint expenditure decisions. Financial independence is determined by the three major expense categories: housing, food, and other living expenses. To be considered financially independent, at least two of the three major expense categories have to be provided entirely, or in part, by the respondent.”<sup>20</sup> Two roommates who share an apartment but are otherwise financially independent are considered two consumer units within a household. Although some married couples with young children may rent out a portion of their home, this article assumes that most of them form a single consumer unit. For this reason, the discussion uses the terms “family” and “household” interchangeably.

To be nationally representative, the data used in the analysis are weighted. Comparison statistics are derived from a method called Balanced Repeated Replication, which estimates standard errors used in calculating *t*-statistics and, hence, in significance testing. The data are divided into 43 groups, and each group is used to create a randomly selected half-sample. From the resulting half-samples, 44 mean estimates are computed, and then the standard error is calculated as the average of the difference between the half-sample estimates and the population estimate.<sup>21</sup>

### SUGGESTED CITATION

Julie Sullivan, "Comparing characteristics and selected expenditures of dual- and single-income households with children," *Monthly Labor Review*, U.S. Bureau of Labor Statistics, September 2020, <https://doi.org/10.21916/mlr.2020.19>.

## NOTES

- <sup>1</sup> Gretchen Livingston and Kim Parker, "8 facts about American dads," *Fact Tank: News in the Numbers* (Washington, DC: Pew Research Center, June 2019), <https://www.pewresearch.org/fact-tank/2019/06/12/fathers-day-facts/>.
- <sup>2</sup> Mitra Toossi and Teresa L. Morisi, "Women in the workforce before, during, and after the Great Recession," *Spotlight on Statistics* (U.S. Bureau of Labor Statistics, June 2017), <https://www.bls.gov/spotlight/2017/women-in-the-workforce-before-during-and-after-the-great-recession/pdf/women-in-the-workforce-before-during-and-after-the-great-recession.pdf>.
- <sup>3</sup> For further information on CE data, see "Consumer expenditures and income," *Handbook of Methods* (U.S. Bureau of Labor Statistics), <https://www.bls.gov/opub/hom/cex/home.htm>.
- <sup>4</sup> Although the present analysis uses internal data, researchers can find BLS public-use microdata at [https://www.bls.gov/cex/pumd\\_data.htm](https://www.bls.gov/cex/pumd_data.htm).
- <sup>5</sup> For more information on consumer units and households, see appendix.
- <sup>6</sup> The CE data capture the main reason that a respondent did not work during the previous 12 months, such as unemployment, retirement, or school attendance. For "one full time, one not working" households, this reason was "taking care of home/family."
- <sup>7</sup> Each spouse must have reported working at least 50 weeks (full or part time) during the previous year.
- <sup>8</sup> According to the National Bureau of Economic Research, the recession began in December 2007 and ended in June 2009. See "U.S. business cycle expansions and contractions" (Cambridge, MA: National Bureau of Economic Research), <http://www.nber.org/cycles.html>.
- <sup>9</sup> According to labor force statistics from the Current Population Survey, the annual unemployment rate for people ages 16 and older was 4.6 percent in 2007 and 8.9 percent in 2011, down from a peak of 9.6 percent in 2010. The annual data used here are not seasonally adjusted and are obtained from <https://data.bls.gov/PDQWeb/In>.
- <sup>10</sup> In the CE, the term "reference person" is defined as "the first member mentioned by the respondent when asked to 'Start with the name of the person or one of the persons who owns or rents the home.'" See "Consumer expenditures and income," *Handbook of Methods* (U.S. Bureau of Labor Statistics), p. 3.
- <sup>11</sup> People of other races, including multirace, are excluded from this analysis, because they constitute less than 1 percent of the estimated population.
- <sup>12</sup> In the CE, expenditures on property include only mortgage interest, and expenditures on vehicles include the full value of the purchased vehicle, whether or not the vehicle was financed. By contrast, outlays include both the principal and interest portions of property mortgages and vehicle loans. The purchase price of vehicles bought outright and not financed also is included in outlays.
- <sup>13</sup> According to the "permanent income hypothesis," first proposed by Milton Friedman in 1957, consumer expenditure decisions are based not only on income received today but also on expectations of future income. See Friedman, "The permanent income hypothesis," in *A theory of the consumption function* (Cambridge, MA: National Bureau of Economic Research, 1957), pp. 20–37, <https://www.nber.org/chapters/c4405.pdf>.
- <sup>14</sup> See table A-7A, "Time spent in primary activities by married mothers and fathers by employment status of self and spouse, average for the combined years 2013–17, own household child under age 18," *American Time Use Survey* (U.S. Bureau of Labor Statistics), <https://www.bls.gov/tus/tables/a7-1317.pdf>.
- <sup>15</sup> The *t*-values for this analysis are derived by using the Balanced Repeated Replication method. For more information on this method, see appendix and Kirk M. Wolter, *Introduction to variance estimation*, 2nd ed. (Chicago: Springer, 2007), p. 142.

[16](#) The items considered in this analysis include frozen vegetables, canned beans, canned corn, other canned vegetables, soup, frozen meals, other frozen food, prepared salads, and miscellaneous prepared foods.

[17](#) The CE Interview Survey collects quarterly data, but because transportation expenditures are often thought of in terms of monthly amounts, the variables used in calculating public transportation and gas expenditures were divided by 3 for this analysis.

[18](#) Like transportation expenditures, childcare expenditures are often thought of in terms of monthly amounts, so the variables used in calculating childcare expenditures were divided by 3 for this analysis. Children ages 12 and 17 usually do not need “childcare,” which, according to the CE, includes babysitting, daycare, nursery, and preschool; the childcare expenditures for children in this age group are at or near \$0 for all three household employment statuses.

[19](#) Private school tuition is also collected in the CE Interview Survey. Although tuition is often thought of in terms of annual amounts, households often budget in terms of monthly amounts. The variables used in calculating education expenditures were divided by 3 for this analysis.

[20](#) See “Glossary,” *Consumer Expenditure Surveys* (U.S. Bureau of Labor Statistics), <https://www.bls.gov/cex/csxgloss.htm>.

[21](#) For further information on this methodology, see “Consumer expenditures and income,” *Handbook of Methods* (U.S. Bureau of Labor Statistics), section “Calculation precision,” <https://www.bls.gov/opub/hom/cex/pdf/cex.pdf>. For an explanation of the Balanced Repeated Replication method, see “Balanced Repeated Replication (BRR) method,” *SAS/STAT(R) 9.2 user’s guide*, 2nd ed. (SAS), [https://support.sas.com/documentation/cdl/en/statug/63033/HTML/default/viewer.htm#statug\\_surveymeans\\_a0000000225.htm](https://support.sas.com/documentation/cdl/en/statug/63033/HTML/default/viewer.htm#statug_surveymeans_a0000000225.htm).

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# COVID-19, educational attainment, and the impact on American workers

*Cody Parkinson*

The coronavirus disease 2019 (COVID-19) has disrupted the U.S. labor market in many ways. Early data indicate that American workers without a college degree have experienced the most severe impact. In [“The unequal impact of COVID-19: why education matters”](#) (*FRBSF Economic Letter*, Federal Reserve Bank of San Francisco, June 29, 2020), Mary C. Daly, Shelby R. Buckman, and Lily M. Seitelman examine how American workers with different levels of education have fared since the start of the pandemic.

With employment levels falling by more than 20 million from March through May 2020 and the unemployment rate rising to its highest level since 1938, many people are feeling the economic impact of COVID-19. As of May 2020, 53 percent of Americans were working, compared with 61 percent at the start of the year. While people are losing their jobs, many are also leaving the labor force. Other factors that contributed to the disproportionate impact include occupation, industry, social distancing, and shelter-in-place measures.

During the period of expansion before COVID-19, many long-standing economic gaps between more and less advantaged groups narrowed. For example, the difference between the unemployment rate for those with a high school diploma or less and a bachelor's degree or more was 2.2 percentage points. The gap increased to 8.8 percentage points in May 2020. The unemployment rate for people with a high school diploma or less rose more than 12.0 percentage points between February and May 2020. The rate rose 5.5 percentage points during the same period for those with a bachelor's degree or more. People with a high school diploma or less also experienced a larger decline in labor force participation, decreasing 4.0 percentage points to 51.8 percent from February to May 2020. Those with a bachelor's degree or more had a labor force participation rate of 71.9 percent at the end of the period, declining 1.2 percentage points. The proportion of job loss relative to working-age population share was also higher among those with a high school diploma or less.

The authors examined other factors potentially contributing to the disproportionate impact of COVID-19 on workers with different levels of education. Approximately 65 percent of workers with a bachelor's degree or more teleworked during COVID-19. In contrast, 22 percent of workers with a high school diploma or less teleworked, reflecting structural job vulnerabilities to mandated changes in work environments for workers with lower levels of education. Data also show that workers with higher levels of education are more likely to hold jobs that involve less interpersonal contact. Many workers at nonessential businesses—hospitality, personal care, and restaurants—were affected by the pandemic more than essential businesses because of social distancing and other health precautions.

Daly, Buckman, and Seitelman close by noting that these discrepancies were not created during this COVID-19 pandemic, rather the inequalities were deepened. In addition, they note that access to education is not equal and that greater access to higher education may ensure better economic resiliency in the future for the country and its people.

# Exploring changes in real average hourly earnings, June 2009 to December 2019

*This article examines trends in real average hourly earnings (1982–84 dollars) for all employees from June 2009, the trough of the 2007–09 recession, to December 2019. It looks at real earnings at the total private and major industry levels, with more detailed analysis for select industries. The article analyzes what drove the postrecession growth in real hourly earnings. In particular, it identifies which industries contributed the most to overall earnings growth during the period.*

The U.S. Bureau of Labor Statistics produces several measures of pay and benefits.<sup>[1]</sup> This article focuses on one of the timeliest measures: real average hourly earnings (1982–84 dollars) from the Current Employment Statistics (CES) survey, also known as the establishment or payroll survey.<sup>[2]</sup> Every month, the CES survey produces detailed estimates of industry employment, hours, and earnings of workers on nonfarm payrolls.<sup>[3]</sup> The economy added millions of jobs during the economic expansion that began in June 2009, but whether or not these are “good” jobs remains an open question.

In this article, we examine trends in real (inflation-adjusted) average hourly earnings of all employees from June 2009, the trough of the 2007–09 recession as determined by the National Bureau of Economic Research, to December 2019.<sup>[4]</sup> We look at hourly earnings at the total private and major industry levels, with a more detailed analysis for select industries.<sup>[5]</sup> Our goal is to analyze what drove the postrecession growth in real hourly earnings. That is, we identify which industries contributed the most—or the least—to earnings growth at the highest level and how these sectors affected the labor market as a whole.



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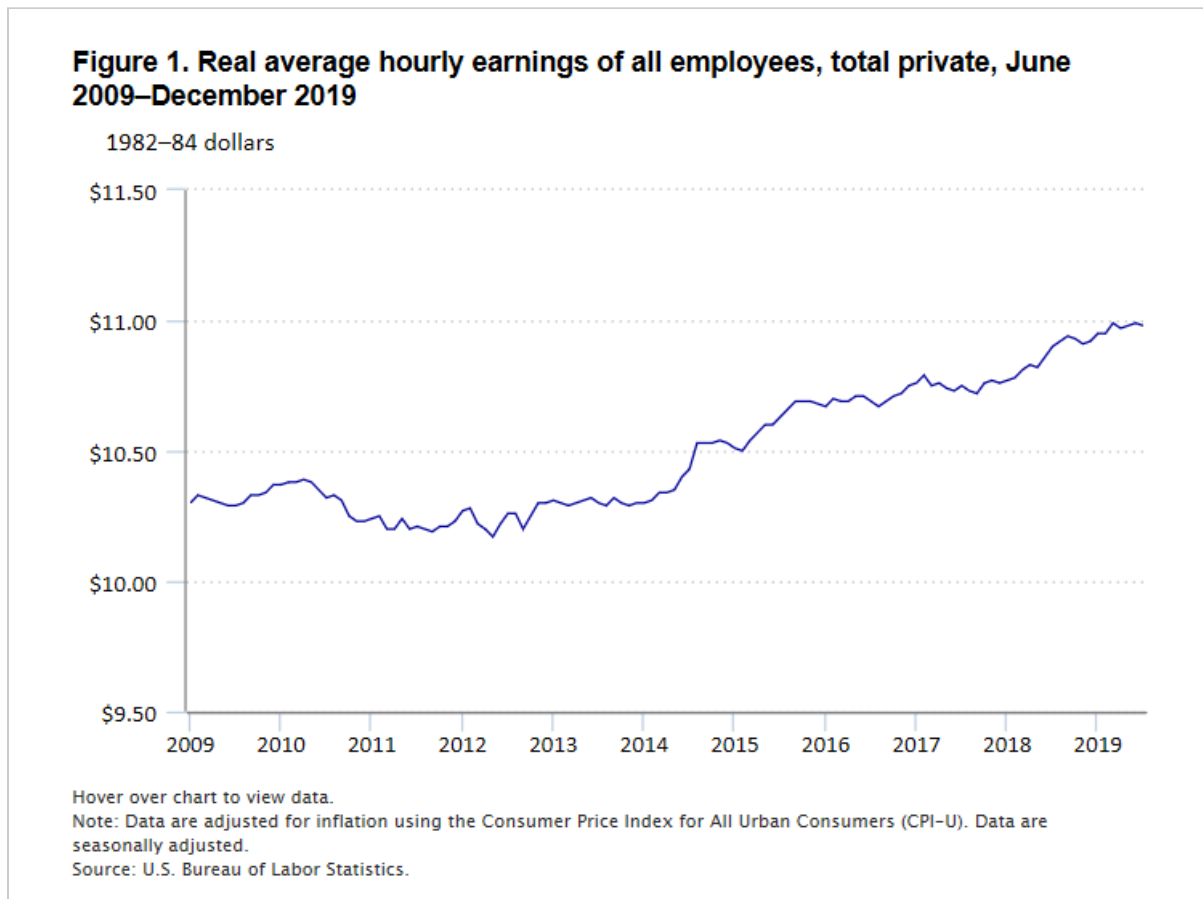
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## Basis and scope

Average hourly earnings from the CES survey are a measure of gross payrolls divided by total hours for which employees receive pay—including sick pay or vacation pay—during the pay period that includes the 12th of the month. They do not represent employers’ total compensation costs because they exclude items such as employee benefits, irregular bonuses and commissions, retroactive payments, and the employer’s share of payroll taxes.<sup>[6]</sup>

How have earnings changed since the end of the 2007–09 recession? Figure 1 illustrates the rise in total private real average hourly earnings, with a notable uptick in earnings beginning in 2014. Real hourly earnings rose by 68 cents, from \$10.30 in June 2009 to \$10.98 in December 2019, for a 6.6-percent total increase. Real earnings also increased over the 2009–19 period for every major industry group.

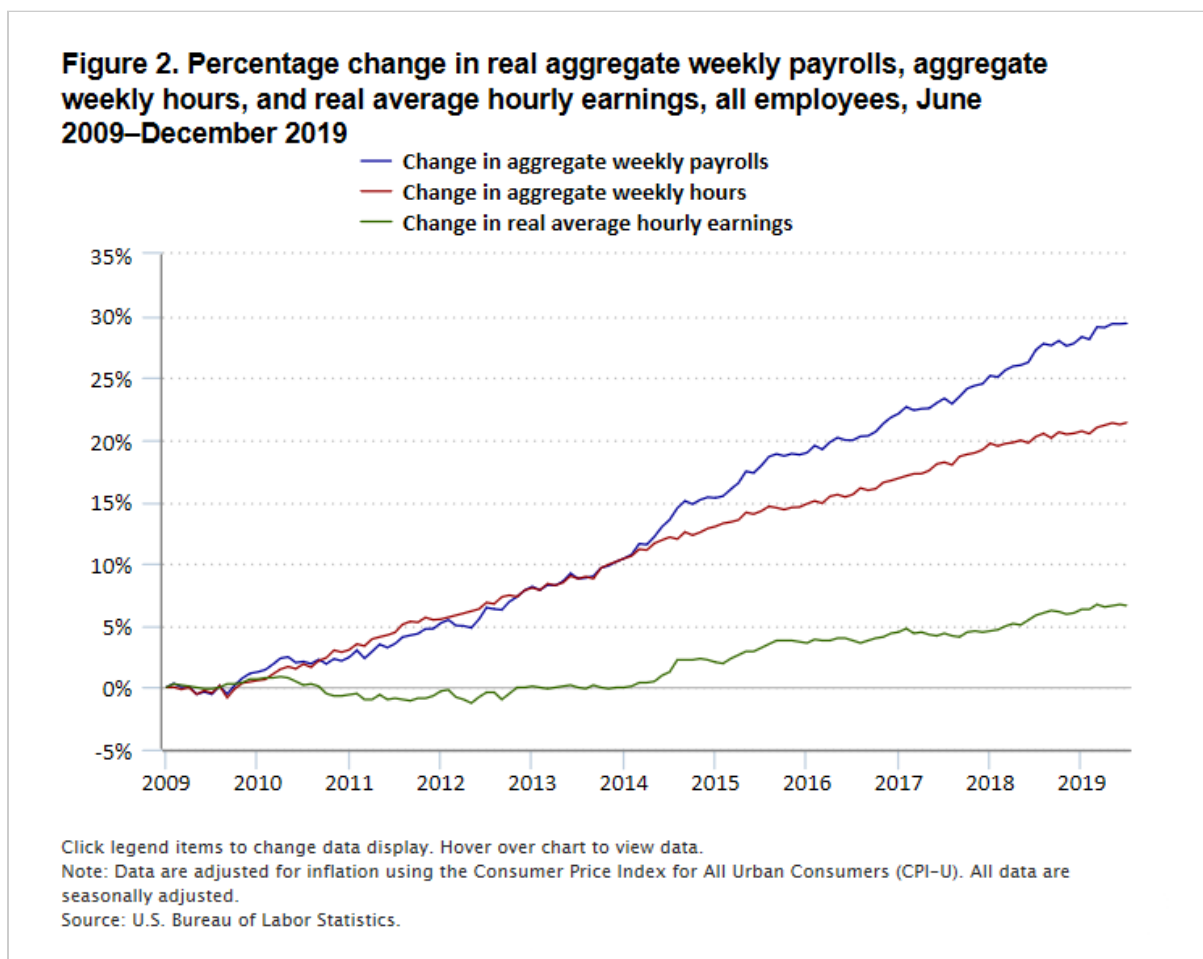


Several key components factor into total private earnings growth. Nominal average hourly earnings for all employees from the CES survey are calculated as follows: Aggregate weekly payrolls of all employees divided by aggregate weekly hours of all employees. This formula represents earnings at the nominal level. However, in this article, we use “real” or inflation-adjusted hourly earnings to compare earnings in 2009 with earnings in 2019 by removing the inflation factor. Real earnings are a better reflection of purchasing power and provide a more accurate comparison of earnings at different points in time. Using current-dollar values—as opposed to real or “constant-dollar” values—would show large increases in earnings across all industries, which would overstate earnings growth by not accounting for inflation.

We use a deflator to calculate real earnings from the nominal values. For all employees, the deflator is the Consumer Price Index for All Urban Consumers (CPI-U).<sup>[7]</sup> Therefore, real average hourly earnings for all employees are calculated as follows: Real aggregate weekly payrolls of all employees divided by aggregate weekly hours of all employees.

## Real earnings as a function of the payroll-to-hours relationship

At its most basic level, the growth in real earnings stems from real aggregate payrolls increasing at a faster rate than total hours worked. Therefore, mathematically, both the numerator and the denominator in the real earnings formula play a key role in the direction of the data series. That is, if the numerator increases more quickly than the denominator, then earnings *must* increase. The opposite holds true as well—if the denominator increases at a faster rate than the numerator, then earnings must decrease. Figure 2 illustrates this relationship clearly.



Payrolls and hours increased at almost the same rate from June 2009 until the middle of 2014, with real earnings growth hovering around 0 percent. At some points during the early part of the recovery, aggregate hours (denominator) were even growing slightly faster than aggregate payrolls (numerator), yielding a decline in real earnings. When payrolls began to increase faster than hours, as we see beginning in the second half of 2014, real earnings grew and continued to do so through 2019.

Total private real average hourly earnings have been rising since 2014, so which industries are driving this growth? Table 1 shows the percentage change in real total payrolls and aggregate weekly hours at the major industry level over the June 2009–December 2019 period. It thus shows the payroll-to-hours relationship, with the most relevant information being the *difference* between payroll and hours growth. If payrolls increase quickly and hours increase at a similar rate, then they will cancel each other out and real earnings growth will be stagnant. From 2009 to 2019, payrolls increased more than hours in all major industries, leading to an increase in total private real average hourly earnings over the period.

**Table 1. Percentage change in real aggregate weekly payrolls and aggregate weekly hours for all employees, by major industry, June 2009–December 2019**

Industry	Change in aggregate weekly payrolls	Change in aggregate weekly hours	Difference, in percentage points
Total private	29.4%	21.4%	8.0
Mining and logging	19.8	14.2	5.6
Construction	37.3	31.8	5.5
Manufacturing	16.4	14.5	1.8
Durable goods	18.8	18.4	0.4
Nondurable goods	12.1	8.7	3.4
Trade, transportation, and utilities	19.1	12.3	6.8
Wholesale trade	14.9	10.5	4.4
Retail trade	14.6	5.7	8.9
Transportation and warehousing	38.2	35.4	2.7
Utilities	9.7	2.7	7.1
Information	23.8	2.8	21.0
Financial activities	32.7	15.8	16.9
Professional and business services	41.3	34.4	6.8
Education and health services	32.1	26.3	5.9
Health care and social assistance	32.3	26.5	5.7
Leisure and hospitality	40.0	29.9	10.1
Other services	21.5	12.1	9.5

Note: Payroll data are adjusted for inflation using the Consumer Price Index for All Urban Consumers (CPI-U). Data are seasonally adjusted.

Source: U.S. Bureau of Labor Statistics.

Table 2 shows the percentage change in real earnings from June 2009 to December 2019. As can be seen in the table, real earnings increased in all of the major industry groups, which indicates that payrolls increased at a faster rate than hours for each of the groups during the postrecession period. Transportation and warehousing experienced very high payroll and hours growth over the period (as shown in table 1), but because pay and hours increased at almost the same rate, real earnings rose by only 2.0 percent.

**Table 2. Real average hourly earnings (1982–84 dollars) and percentage change, all employees, by major industry, June 2009–December 2019**

Industry	Real average hourly earnings, June 2009	Real average hourly earnings, December 2019	Percentage change
Total private	\$10.30	\$10.98	6.6%
Mining and logging	12.75	13.38	4.9
Construction	11.57	12.05	4.1
Manufacturing	10.72	10.89	1.6
Durable goods	11.42	11.46	0.4
Nondurable goods	9.60	9.90	3.1
Trade, transportation, and utilities	8.94	9.48	6.0
Wholesale trade	11.76	12.23	4.0
Retail trade	7.15	7.75	8.4
Transportation and warehousing	9.45	9.64	2.0
Utilities	15.26	16.31	6.9
Information	13.68	16.47	20.4
Financial activities	12.33	14.13	14.6
Professional and business services	12.60	13.24	5.1
Education and health services	10.30	10.78	4.7
Health care and social assistance	10.39	10.86	4.5
Leisure and hospitality	6.02	6.49	7.8
Other services	9.12	9.89	8.4

Note: Data are adjusted for inflation using the Consumer Price Index for All Urban Consumers (CPI-U). Data are seasonally adjusted.

Source: U.S. Bureau of Labor Statistics.

On the other end of the spectrum, the rate of payroll growth in the information industry (23.8 percent) was about average relative to other industries, yet real earnings increased by a substantial 20.4 percent, as aggregate hours in the industry increased by only 2.8 percent. (See table 1.) As a result, information had the largest percentage change in real earnings of all major industries over the period; at \$16.47 per hour, information also had the highest earnings rate, surpassing that of utilities (\$16.31), which had the highest rate (\$15.26) in June 2009. (See table 2.) This large earnings growth occurred because information had the largest difference between payroll growth (23.8 percent) and hours growth (2.8 percent). Hence, although information had relatively little increase in total hours worked between 2009 and 2019, establishments in the industry were paying their employees nearly 24 percent more by the end of the period.

## Employment

At first glance, information, financial activities, and utilities industries might appear to have performed the best during the postrecession period, because they make up the top three industries in terms of real earnings growth and they are the highest paying industries overall. On the basis of these data alone, one might assume that the three industries together represent one of the driving forces of the strong economy during the 2009–19 period.

This assumption ignores a major factor, though—employment. Table 3 shows the number of employees added to each major industry from June 2009 to December 2019. Over that period, total private employment increased by about 20.9 million, with some industries adding many more jobs than others.

**Table 3. Change in employment and percentage change, all employees, by major industry, June 2009–December 2019**

Industry	Change in employment	Percentage change
Total private	20,887,000	19.3%
Mining and logging	29,000	4.2
Construction	1,545,000	25.7
Manufacturing	1,140,000	9.7
Durable goods	882,000	12.3
Nondurable goods	258,000	5.7
Trade, transportation, and utilities	2,974,000	12.0
Wholesale trade	420,000	7.6
Retail trade	1,131,000	7.8
Transportation and warehousing	1,436,000	34.0
Utilities	–12,000	–2.2
Information	87,000	3.1
Financial activities	994,000	12.7
Professional and business services	5,006,000	30.3
Education and health services	4,851,000	24.7
Health care and social assistance	4,133,000	25.0
Leisure and hospitality	3,708,000	28.4
Other services	553,000	10.3

Note: Data are seasonally adjusted.

Source: U.S. Bureau of Labor Statistics.

The professional and business services industry added the most jobs over the 2009–19 period—about 5 million, or nearly 24 percent of the total jobs gained—with education and health services close behind. Interestingly, employment in utilities actually declined over the 10-year span. Although utilities had the highest real average hourly earnings level as well as positive earnings growth over the period, the industry had fewer employees in December 2019 than it had in June 2009.

Therefore, it is difficult to argue that an industry is driving real earnings growth when it has been losing workers. One job added to the economy increases both payrolls and hours. In order to boost total private earnings, that job must pay enough so that the marginal added payroll-to-hours ratio exceeds the total private average. In other words, employment growth in industries such as utilities, information, and professional and business services will more likely put upward pressure on the total private earnings average because these industries have a higher earnings rate than the total private average. One job added to leisure and hospitality, on the other hand, will likely decrease the total private average because the industry’s hourly earnings rate is lower than the total private rate.

The opposite holds true as well. Although adding one job to utilities would put upward pressure on total private earnings, eliminating one job in the industry would have a negative impact on total private earnings—which is what actually happened in the industry, as utilities employment declined slightly (–12,000) over the period. In this regard, employment acts as a weight on that upward or downward pressure on total private earnings. Because pressure

on total private earnings is affected by scale, a small industry such as utilities does not have as much impact on overall earnings as a large industry such as professional business services.

For example, we can compare the information industry, which is similar to utilities in terms of employment size and earnings level, to professional and business services. Although information had a higher real earnings level in December 2019 (\$16.47) than professional and business services (\$13.24), the latter added 5 million jobs to the economy, while the former added only 87,000. Generally speaking, because information had a higher earnings rate than professional and business services, adding one job to that industry would increase real earnings at the total private level more than adding one job to professional and business services.

A perfectly efficient labor market never exists in reality. Both industries contributed in a positive way to total private earnings. But because professional and business services added many more jobs than information, it had a stronger positive effect on the labor market than information did over the 10-year period. To summarize this effect, table 4 displays the ratio of real earnings in each industry group to total private earnings. A ratio above 1 signifies that the industry had a higher real earnings level than the total private average and thus any jobs added would put upward pressure on the total private earnings average. Similarly, ratios below 1 indicate that added jobs would put downward pressure on the total private average. Industries with decreasing employment have the opposite effect: a ratio greater than 1 will negatively affect the total private earnings level, while a ratio of less than 1 will positively affect the total private earnings level.

**Table 4. Ratio of real average hourly earnings in specific industries to total private level, all employees, June 2009 and December 2019**

Industry	June 2009	December 2019
Total private	1.00	1.00
Mining and logging	1.24	1.22
Construction	1.12	1.10
Manufacturing	1.04	0.99
Durable goods	1.11	1.04
Nondurable goods	0.93	0.90
Trade, transportation, and utilities	0.87	0.86
Wholesale trade	1.14	1.11
Retail trade	0.69	0.71
Transportation and warehousing	0.92	0.88
Utilities	1.48	1.49
Information	1.33	1.50
Financial activities	1.20	1.29
Professional and business services	1.22	1.21
Education and health services	1.00	0.98
Health care and social assistance	1.01	0.99
Leisure and hospitality	0.58	0.59
Other services	0.89	0.90

Source: U.S. Bureau of Labor Statistics.

The dynamic relationships between the earnings levels in individual industries and the total private level are evident in table 4. Some sectors, such as information, utilities, and financial activities, experienced high wage growth relative to the total private average, indicated by a higher ratio in December 2019 than in June 2009.

Others, such as durable goods manufacturing and transportation and warehousing, experienced diminished relative wage growth, represented by their lower ratios. The ratios in manufacturing and education and health services went below 1 over the period, meaning that, on average, adding one job would likely have exerted upward pressure in 2009 but downward pressure in 2019.

As mentioned previously, employment acts as a weight for both payrolls and hours and therefore indirectly affects total private earnings. Differences in weekly hours across industries complicate this issue further. Some industries carry more part-time workers, while others are more likely to have overtime. Also, some industries pay higher wages, on average, which can be attributed to a variety of factors not limited to productivity, education, labor demand, and so on.

To help us visualize the weights by industry, figure 3 illustrates what happened over the 2007–09 period in the major industry groups. The sizes of the bubbles in figure 3 represent the total employment in each of the industries in December 2019, the y-axis represents real average hourly earnings in December 2019, and the x-axis represents the number of jobs added from June 2009 to December 2019. The horizontal dotted line represents the total private real average hourly earnings level of \$10.98 in December 2019, and the vertical dotted line represents the average added employment across all 14 industry groups over the period, which is about 1.5 million jobs. From there, we assigned quadrants as follows: Quadrant I contains the industries with above-average earnings and below-average employment gains, quadrant II contains the industries with above-average earnings and above-average employment gains, quadrant III contains the industries with below-average earnings and above-average employment gains, and quadrant IV contains the industries with below-average earnings and below-average employment gains.

**Figure 3. Change in employment, June 2009 to December 2019, and real average hourly earnings, by industry, for all employees, December 2019**

Bubble sizes represent December 2019 employment



Click legend items to change data display. Hover over chart to view data.

Note: Data are adjusted for inflation using the Consumer Price Index for All Urban Consumers (CPI-U). All data are seasonally adjusted. The vertical dotted line represents the average employment change (1.5 million) across all industries from June 2009 to December 2019; the horizontal dotted line is the total private real hourly earnings level (\$10.98) in December 2019. Quadrant I = above-average earnings and below-average employment gains, quadrant II = above-average earnings and above-average employment gains, quadrant III = below-average earnings and above-average employment gains, and quadrant IV = below-average earnings and below-average employment gains.

Source: U.S. Bureau of Labor Statistics.

As long as the industry is in quadrants I or II with positive employment, it puts upward pressure on total private earnings. Industries in quadrant II are more impactful than those in quadrant I in that regard because they had above-average earnings and added an above-average amount of employment. Industries in quadrants III and IV negatively affect the total private earnings level when they add employment. Therefore, the leisure and hospitality industry, which is in quadrant III, puts strong downward pressure on average earnings at the total private level.

However, recall from table 2 that leisure and hospitality experienced a 7.8-percent increase in real average hourly earnings over the 2009–19 period. Although the industry still put downward pressure on total private earnings growth, it is not as much as it was in the earlier part of the study period. From Figure 3, we see that professional and business services was the most impactful major industry for increases in total private real earnings because it

had higher-than-average earnings and added a very large amount of employment over the period. The education and health services industry had a relatively neutral impact because its earnings were roughly in line with the total private average.

## Detailed industry analysis

Because employment acts as a weight for both the numerator and the denominator in the average hourly earnings equation, the results can sometimes be surprising. In a 2018 article, Angela Clinton discusses the math behind counterintuitive scenarios such as when earnings increase in the component industries but decrease at the more aggregate level.<sup>[8]</sup> The interactions of payrolls, hours, and employment occasionally lead to statistical anomalies such as Simpson's Paradox.<sup>[9]</sup> Thus, it can be difficult to determine which industries are performing the best, which are having the heaviest impact on total private trends, and the reasons why.

To understand the total private trends, we analyzed the major industry groups. A natural response to viewing the major industries is to ask, Why are some sectors doing well and others lagging behind? We can attempt to answer this question by examining the data at a more detailed industry level. As an example, we take a more detailed look at the information sector.

As shown in table 2, the information industry posted the highest growth in real average hourly earnings over the 2009–19 period. We saw that payrolls increased modestly, but hours and employment had only minor gains. So what is happening in the information industry that is causing its earnings to increase more than those of other industries? The hours and employment relationship makes sense, because small gains in employment tend to lead to small increases in total hours worked. From an economist's perspective, if labor demand is high and labor supply is low, then wages could increase while employment remains flat.

The information industry has six component industries: publishing industries, except Internet; motion picture and sound recording industries; broadcasting, except Internet; telecommunications; data processing, hosting and related services; and other information services. Table 5 shows the percentage change in real hourly earnings for the information industry and each of its components over the period from June 2009 to December 2019. Looking at the table, we can see why information is the leading sector in terms of earnings growth—each of its components shows above-average earnings gains. All components except motion picture and sound recording industries and telecommunications experienced earnings growth rates of more than 20 percent.

**Table 5. Percentage change in real average hourly earnings (1982–84 dollars) for the information industry and its components, all employees, June 2009–December 2019**

Industry	June 2009	December 2019	Percentage change
Information	\$13.68	\$16.47	20.4%
Publishing industries, except Internet	15.03	18.21	21.2
Motion picture and sound recording industries	13.04	15.05	15.4
Broadcasting, except Internet	12.81	15.95	24.5
Telecommunications	13.07	15.19	16.2
Data processing, hosting, and related services	13.70	16.73	22.1

See footnotes at end of table.

**Table 5. Percentage change in real average hourly earnings (1982–84 dollars) for the information industry and its components, all employees, June 2009–December 2019**

Industry	June 2009	December 2019	Percentage change
Other information services	14.04	16.96	20.8

Note: Data are adjusted for inflation using the Consumer Price Index for All Urban Consumers (CPI-U). Data are seasonally adjusted.

Source: U.S. Bureau of Labor Statistics.

The largest component within the information industry—publishing industries, except Internet—provides an interesting story. The industry consists of two component industries, newspaper, book, and directory publishers; and software publishers. Table 6, shows that in June 2009, two-thirds of employment in publishing industries, except Internet, was in newspaper, book, and directory publishers, with 536,800 employees and real average hourly earnings of \$11.66. The software publishing industry had only 257,800 employees in June 2009, but its hourly earnings level was more impressive, at \$21.40.

**Table 6. Employment and real average hourly earnings (1982–84 dollars) in publishing industries, except Internet, all employees, June 2009 and December 2019**

Industry	June 2009		December 2019	
	Employment	Average hourly earnings	Employment	Average hourly earnings
Publishing industries, except Internet	794,700	\$15.03	764,400	\$18.21
Newspaper, book, and directory publishers	536,800	11.66	287,700	11.75
Software publishers	257,800	21.40	477,100	21.85

Note: Data are adjusted for inflation using the Consumer Price Index for All Urban Consumers (CPI-U). Data are seasonally adjusted.

Source: U.S. Bureau of Labor Statistics.

By the end of 2019, employment in newspaper, book, and directory publishers had declined to 287,700 and hourly earnings had increased to \$11.75, whereas employment in software publishers had expanded to 477,100 and earnings had increased to \$21.85. Those changes represent an 85-percent increase in employment for software publishers and a 46-percent decrease in employment for newspaper, book, and directory publishers. As noted previously, increasing employment in industries with above-average earnings increases total private earnings, while declining employment in industries with below-average earnings also increases total private earnings. Thus, the increase in real earnings in publishing industries, except Internet, resulted from its lower paying component industry losing employment and its higher paying component industry gaining employment.

The publishing industry itself has shifted from a paper-based industry to a largely electronic industry, shedding jobs in the former and gaining them in the latter. The diverging employment trends between software publishers and newspaper, book, and directory publishers are not visible at the aggregate level of publishing industries, except Internet, let alone at the information-sector level. The trends at the detailed level remind us that these are what drive the higher level industry trends. Major industries are not monolithic entities in which employment levels move in one direction. Some specific industries, such as software publishers, had substantial increases in employment

over the 2009–19 period, while others, such as newspaper, book, and directory publishers, had substantial declines.

## Conclusion

Although the question of which industries are driving real average hourly earnings growth is nuanced, other factors are clear. Adding employment to a relatively high-earning industry will drive overall earnings up; in that sense, professional and business services was the most successful industry because it added about 5 million jobs, or nearly a fourth of the 20.9 million total jobs added since the end of the 2007–09 recession. Employment in other industries, such as utilities and information, changed little, while real earnings grew rapidly. Even relatively low-paying industries, such as leisure and hospitality, had improvement in their real earnings. Substantial employment gains in leisure and hospitality lowered total private average earnings but not as much as occurred during the last recession.

The monthly CES survey data during the period of expansion from June 2009 to December 2019 raise the question, Is the economy adding good jobs? That question has always been difficult to answer. Although every major industry experienced real earnings growth over the period, detailed industry analysis reveals more nuanced trends. The real earnings gap between certain industries has grown as well, as high-earning industries such as information and utilities have seen their earnings increase at a faster rate than low-earning industries. As this article demonstrates, real average hourly earnings can be a complex statistic.

### SUGGESTED CITATION

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### NOTES

<sup>1</sup> The U.S. Bureau of Labor Statistics (BLS) has 12 surveys or programs that provide information on pay and benefits. For more information, see "Overview of BLS statistics on pay and benefits," <https://www.bls.gov/bls/wages.htm>.

<sup>2</sup> For the latest issue of the real earnings news release, see <https://www.bls.gov/news.release/realer.toc.htm>. For technical information about the real earnings data, see "Real earnings technical note" (part of the news release), <https://www.bls.gov/news.release/realer.tn.htm>.

<sup>3</sup> The Current Employment Statistics (CES) program surveys about 145,000 private businesses and government establishments each month, representing approximately 697,000 individual worksites. For more information, see "Current Employment Statistics—CES (national)," <https://www.bls.gov/ces>.

<sup>4</sup> The starting and ending dates of recessions are determined by the National Bureau of Economic Research (NBER). NBER determined that the peak of the most recent expansion occurred in February 2020. For more information, see "U.S. business cycle expansions and contractions" (National Bureau of Economic Research, June 8, 2020), <http://www.nber.org/cycles.html>.

<sup>5</sup> Throughout this article, "average hourly earnings," "earnings," and "hourly earnings" are used interchangeably. All data discussed in this article are seasonally adjusted and adjusted for inflation using the Consumer Price Index for All Urban Consumers (CPI-U).

<sup>6</sup> For more information about CES survey earnings and other concepts, see "Current Employment Statistics—CES (national): technical notes for the Current Employment Statistics survey," <https://www.bls.gov/web/empsit/cestn.htm>.

<sup>7</sup> BLS does not produce real aggregate weekly payrolls of all employees as a distinct time series; however, historical real aggregate payrolls can be derived from other existing data series.

<sup>8</sup> Angela Clinton, “An average mystery in hours and earnings data entails a weighty explanation,” *Beyond the Numbers: Employment and Unemployment*, vol. 7, no. 9, June 2018, <https://www.bls.gov/opub/btn/volume-7/mystery-in-average-of-hours-and-earnings.htm>.

<sup>9</sup> For more information, see “Simpson’s Paradox,” *Stanford Encyclopedia of Philosophy* (Stanford University, 2020), <https://plato.stanford.edu/entries/paradox-simpson/>.

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# How did the 2005 hurricanes affect individuals' long-term earnings?

*Jeffrey A. Groen, Mark J. Kutzbach, Anne E. Polivka*

Major disasters, such as hurricanes, typically reduce labor market activity in the affected area during the immediate aftermath. The physical damage and evacuations caused by these disasters can stop some businesses from operating and some individuals from working or getting to their jobs. As a result, individuals who reside in a disaster area often experience declines in their employment and earnings in the short term. But what happens over the long term?

In “[Storms and jobs: the effect of hurricanes on individuals' employment and earnings over the long term](#)” (*Journal of Labor Economics*, July 2020), we examine the effects of Hurricanes Katrina and Rita, which devastated the U.S. Gulf Coast in 2005. We estimate effects on the earnings of affected workers over the short and long term. To explain the pace of the recovery of a worker's earnings, we demonstrate the importance of two factors: damage to the worker's home and workplace and the worker's prestorm industry of employment. We combine Federal Emergency Management Agency damage data with U.S. Census Bureau data from household surveys and longitudinal administrative data on jobs and places of residence. From these combined individual-level data, we construct treatment and control samples, which we compare to estimate the effect of the storms on earnings. Our treatment sample consists of individuals who resided (at the time of the storms) in storm-affected areas in four states (Louisiana, Mississippi, Texas, and Alabama). Our control sample consists of individuals who resided in similar unaffected areas elsewhere in the United States. The populations and economies of these areas were similar to those of the storm-affected areas. In our job-level data, which are compiled from the Longitudinal Employer-Household Dynamics program, we track a worker's quarterly earnings from 2 years before the storms to 7 years after the storms.

We find that over the first year after the storms, the earnings of individuals affected by the hurricane were reduced. The earnings losses, which were due primarily to job loss, reflect various short-term disruptions caused by the hurricanes. Individuals whose home or workplace was damaged experienced larger earnings losses in the short term. These losses may be attributed to workers moving out of the affected area or to businesses closing down. In the medium and long term, affected individuals experienced earnings gains, primarily because of earnings gains within employment. Over the entire poststorm period covered by our data, the storms led to a net increase in the average quarterly earnings of affected individuals. Although earnings increased overall, they varied widely across individuals, depending on their industry and the degree of damage to their home or workplace.

We show that the long-term earnings gains of affected individuals were the result of differences in local labor market dynamics between the affected areas and the control areas. In the affected areas, labor supply decreased and labor demand increased—producing an increase in relative wages. Our results show substantial differences in

the trajectory of earnings by industry: those employed in sectors related to rebuilding had some of the largest gains, while those employed in local services, education, and healthcare had modest gains (or even losses).

Construction expenditures may have contributed to the recovery of other sectors. By generating demand for local products and services and providing earnings to local construction workers, construction spending may have boosted labor demand in other sectors. We find that workers in manufacturing; local services; and trade, transportation, and utilities had medium-term earnings gains. In contrast, we find no such gains for workers in the leisure and accommodations, healthcare, and professional services sectors. These sectors are more closely tied to tourism or the size of the local population.

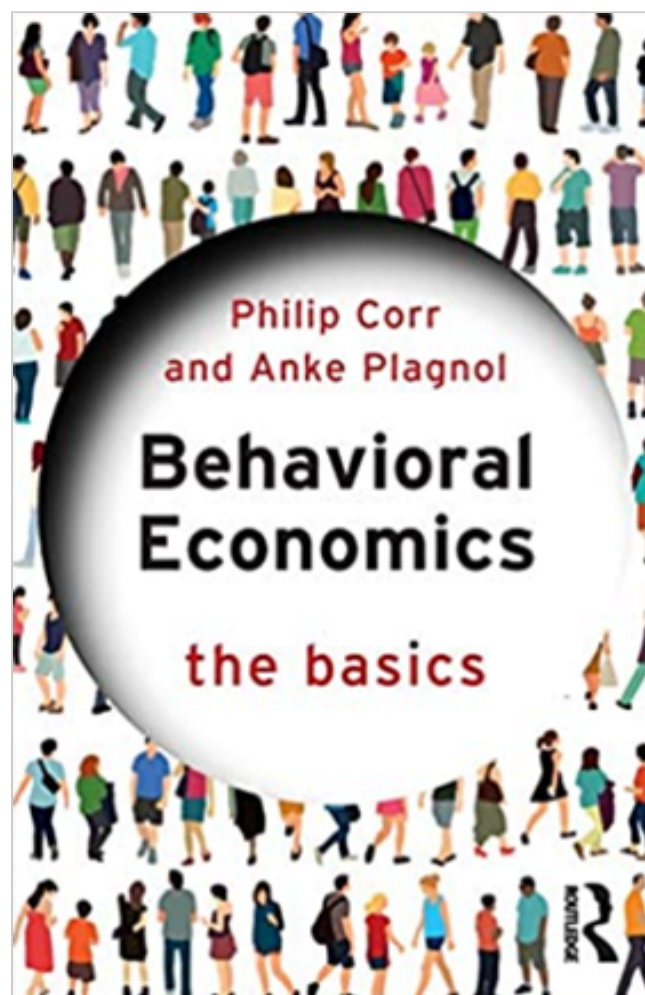
# An introduction to behavioral economics: using psychology to explain economic behavior

*Behavioral Economics: The Basics.* By Philip Corr and Anke Plagnol. London and New York: Routledge, 2019, 250 pp., \$25.95 paperback.

In this book, authors Philip Corr and Anke Plagnol provide an introduction to behavioral economics, a relatively new field of study that uses insights from psychology to understand economic behavior. Books in behavioral economics are plentiful and growing in number, ranging from rigorous and highly technical treatments of various topics in the field to accessible general-audience popular books telling stories about how people sometimes don't behave as predicted by standard economic models.

*Behavioral Economics: The Basics* falls within these two extremes: it summarizes the academic literature related to behavioral economics and provides a large number of examples drawing from case studies and anecdotal evidence.

The book is organized in seven chapters. Chapter 1 introduces the basic concepts of behavioral economics and explains why this new field is important. The chapter discusses how behavioral economics uses ideas from psychology to study economic behavior and argues that standard economics often fails to explain how people behave. Corr and Plagnol mention the 2007–08 financial crisis, a macroeconomic event (at the level of the economy as a whole), as an example illustrating the limitations of standard economics, although the book focuses on microeconomics (how individuals make decisions). The authors go on to characterize standard economic theory, which is grounded in rational choice, as normative economics (making judgements on economic policy or economic behavior) and behavioral economics as positive



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economics (describing and explaining economic behavior without making judgements). While most economists won't agree with these characterizations, some behavioral economists, including Corr and Plagnol, have adopted this controversial interpretation of normative versus positive economics.

Chapter 1 also discusses the role of behavioral economics in the economics discipline. One view, which I believe is shared by most economists, is that behavioral economics should be used to complement standard economics. In that sense, behavioral economics can explain anomalous cases of individual economic behavior. Another view, and one the authors seem to adopt throughout the book, is that standard economic theory is not only incapable of explaining economic behavior, but also that economists have not taken the criticisms from behavioral economics seriously. As one example, the authors note that economists rarely take the results of laboratory studies, which often use small samples of undergraduate students, as reliable or generalizable. While these studies may provide some interesting findings, their tiny samples (the number of participants is limited by the size of a classroom or a computer lab) and the complexity of the decisions asked of students (many of whom are not majoring in economics) render their experimental results biased and unscientific.

Chapters 2 and 3 present a brief introduction to the history of economic thought. Chapter 2 focuses on selected ideas proposed by classical economists, such as Adam Smith, David Ricardo, and Thomas Malthus, while chapter 3 focuses on modern economic theory, which the authors refer to as neoclassical economics. While these two chapters are interesting and provide useful context for the average reader, the ideas discussed in them are well known and readily available in most introductory economics textbooks.

Chapter 4 is the most informative chapter of the book and presents an excellent summary of the field of behavioral economics. While the authors base their analysis mostly on anecdotal evidence and small-scale case studies, they identify and discuss possible explanations for why people misbehave or make mistakes. The chapter starts by explaining the concept of loss aversion, which can be described as a situation in which the pleasure of receiving, for example, \$100 is less than the displeasure of losing \$100. The chapter then describes the endowment effect, which is valuing something we own more than the things we don't own, and mental accounting, which refers to our tendency to assign certain amounts of money to specific uses (some money for food, some for college tuition, some for a vacation, etc.). The chapter also discusses heuristics, which the authors describe as mental shortcuts that people use to make quick decisions. One example is anchoring, or the overreliance on initial, incomplete information, such as a readily available number (the anchor), to estimate the value of an item. The chapter also describes framing effects, which refer to how people change their behavior on the basis of how information is presented to them. For example, some people may be more likely to buy ground meat if its packaging describes it as being 95 percent lean as opposed to containing 5 percent fat, even though the product purchased is identical in both cases.

In chapters 5, 6, and 7, the authors use ideas from psychology to explain human behavior. As such, these chapters have less to do with behavioral economics, because they try to explain human behavior in areas not always related to economics. Although many readers are likely to find this discussion interesting, those who are very busy may want to skim through it and select specific topics they want to explore in more detail.

Chapter 5 argues that people don't typically maximize their own objectives and that their behavior is highly influenced by psychological factors. To support this argument, the authors present a mix of theoretical results obtained from games such as the prisoner's dilemma and case-study evidence obtained from games such as the ultimatum game. One could argue, however, that the most likely reason why people do not always maximize their

objectives is lack of information rather than psychology. The chapter also summarizes findings from experiments using monkeys as subjects.

Chapter 6 discusses if nudges can help people make better decisions and whether governments should use them. The use of nudges is controversial, and the authors do an excellent job of explaining the different sides of the debate. Finally, chapter 7 reviews how psychology has influenced marketing and advertising. The book does not contain a concluding chapter summarizing the main arguments or discussing the policy implications of the research.

While the book is interesting and easy to read, one is left with the impression that its disapproval of standard economic theory is overdone. More effort could have been devoted to proposing a theoretical framework supporting the arguments of the book, rather than summarizing a collection of stories, anecdotal evidence, and case studies. Although the book is an engaging read, the most convincing modern economics books rely on persuasive empirical evidence, such as that obtained from large datasets and econometric techniques that can control for unobserved individual characteristics, and this is an area in which *Behavioral Economics: The Basics* slightly disappoints. Still, undergraduate students taking an introductory course in behavioral economics and casual readers interested in selected microeconomic applications of psychology may find this book interesting.

*Disclaimer: The views and opinions presented in this book review are those of the author and do not necessarily represent those of the Internal Revenue Service or the U.S. government.*

# Assessing multidimensional worker skill levels and their allocation in the U.S. labor market

*Lawrence H. Leith*

Economists traditionally viewed inequality in wages and employment primarily as a function of human capital. The traditional view held that a worker's education and skill level were the main factors in determining the kind of job that a worker could obtain. That view has slowly given way to one in which most economists now view workers as having multiple skills, with the labor market largely determining how those skills are allocated into jobs that require different kinds and combinations of skills. The broader view of labor markets has led to improved understanding of wage and employment inequality. Nevertheless, one limitation of the newer view is that economists still tend to model workers' skills in a one-dimensional way. In other words, their models include the assumption that each worker has one generalized skill (or set of skills) and that different jobs vary in their need for that skill. A second limitation of the newer view is that economists generally overlook or understate the way that most workers improve the skills they use frequently and lose the ones they seldom use. The standard scalar measures of human capital that most economists use do not account for these kinds of changes.

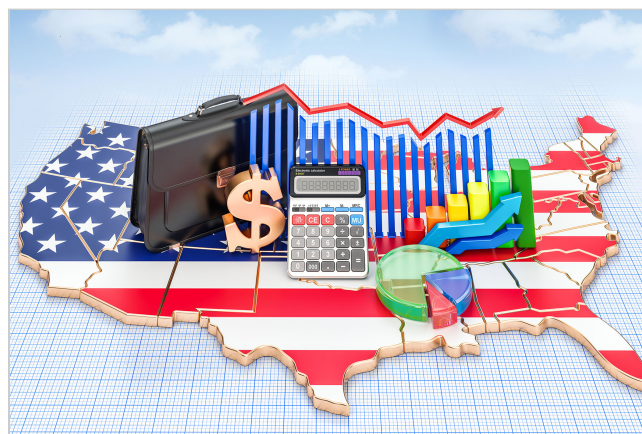
In their article, "[Multidimensional skills, sorting, and human capital accumulation](#)" (*American Economic Review*, August 2020), economists Jeremy Lise and Fabien Postel-Vinay try to help us better understand the matching process between workers' various skills and the demand for those skills in the U.S. labor market. The authors extend a well-known and widely used "search-theoretic model" that economists have traditionally applied under the one-dimensional view of worker skills and apply it to multidimensional skills. They use occupation-level measures of skill requirements from the U.S. Department of Labor Occupational Information Network and combine them with data from the National Longitudinal Survey of Youth 1979. Lise and Postel-Vinay examine three categories of skills—manual, cognitive, and interpersonal—and use their model to assess the economic costs of "mismatch" in the labor market.

In their model, the authors attempt to account for the fact that manual, cognitive, and interpersonal skills are very different kinds of productive qualities. Manual skills generally yield only modest returns and can be adjusted fairly quickly. Workers accumulate such skills rapidly on the job and lose them when they are not used. Cognitive skills yield much higher returns than manual skills, but they also take more time to adjust or alter than manual skills. Most workers acquire their cognitive skills through education, either before entering the workplace or by continuing their education after acquiring a particular job, especially one that highly values such skills. Interpersonal skills, which are sometimes referred to as noncognitive skills or even personality traits, are more difficult to measure. They yield modest returns—more than manual skills but less than cognitive skills—and are essentially fixed over a worker's lifetime. Although people can improve their interpersonal skills, for most workers, such skills tend to be relatively stable and unchanging over the course of their working lives.

Lise and Postel-Vinay find that the costs of mismatching are greatest for cognitive skills. In fact, they estimate that the costs are higher than those of mismatching for manual or interpersonal skills by an order of magnitude. Moreover, they find that such costs are unequal, in the sense that employing a worker who is underqualified in cognitive skills is more than twice as costly, in terms of lost surplus, as employing one who is overqualified. The authors point out that such subtleties and differences tend to be missed in models that assign a single scalar value to a worker's skill level. They compare their use of a multidimensional model with the more common one-dimensional model and show that the latter considerably overstates the importance of "unobserved heterogeneity" (diverse skills the worker has that are not immediately apparent) and understates the importance of "career shocks" (unexpected life-changing events that are out of the worker's control).

## Projections overview and highlights, 2019–29

*Employment and real output growth are projected to slow from 2019 to 2029. One in four people will be ages 65 and older in 2029, contributing to slower projected growth in the labor force and a continued decline in the labor force participation rate. The aging population is expected to continue to drive strong demand for a variety of healthcare services, with 3.1 million jobs projected to be added in the healthcare and social assistance sector through 2029.*



The U.S. Bureau of Labor Statistics (BLS) projects 0.4-percent annual growth in employment over the 2019–29 decade.<sup>[1]</sup> This projected growth is slower than the growth that occurred over the 2009–19 decade, which was marked by faster recovery growth following the trough of the 2007–09 Great Recession. The total economy will add about 6.0 million jobs, with employment reaching a level of 168.8 million in 2029. Various demographic trends, including an aging population, are expected to drive slow growth in the labor force and a lower labor force participation rate over the projections period. These demographic trends, combined with slower growth in the civilian noninstitutional population, will affect population and labor force, aggregate demand, industry output and employment, and occupational employment projections over the 2019–29 decade.

This article presents an overview of the 2019–29 projections. Highlights include the following:

- Labor force growth is projected to be slower (0.5-percent annual growth), in part, from an aging population and slower population growth among Hispanics.
- The labor force participation rate is projected to continue to decline from 63.1 percent in 2019 to 61.2 percent in 2029.
- Gross domestic product (GDP) is projected to continue to grow (1.8 percent annually), but at a slower rate than the historical pattern.
- Most employment gains over the 2019–29 period are expected to be in the service-providing sectors, led by strong growth in the healthcare and social assistance sector. The aging population will continue to create strong demand for industries and occupations that provide healthcare and related services.

Compared with the prior decade, population growth is expected to slow from 2019 to 2029, in part, because of the slowed growth among the Hispanic population. The median age of the population will continue to rise, with all baby boomers reaching ages 65 and older by 2029. This increase in median age and an increase in the number of

younger people choosing to pursue education before entering the labor force are expected to contribute to a decline in the labor force participation rate in 2029.

Real output is projected to increase by more than \$6.8 trillion from 2019 to 2029, with most growth expected to occur in the service-providing sectors. The 1.8-percent annual growth in output projected for the total economy is slower than the 2.2-percent annual growth from 2009 to 2019.

Total employment is projected to grow 0.4-percent annually from 2019 to 2029, slower than the 1.3-percent annual growth rate experienced from 2009 to 2019, following the trough of the 2007–09 recession.<sup>[2]</sup> By comparison, the average of the 10-year growth rates for each year over the period 2007 through 2019 was 0.5 percent. Service-providing sectors will account for most of the jobs added by 2029. Of the 6.0 million jobs projected to be added to the economy, about half (3.1 million) are expected to be in the healthcare and social assistance sector. Employment increases in this sector will stem from greater demand for a variety of healthcare services as the population continues to age and rates of chronic disease continue to increase.

Employment declines are expected in the goods-producing sectors, with the manufacturing sector leading the losses.

Increasing automation, combined with international competition, will lead to employment declines in the manufacturing sector and in many of the production occupations concentrated in this sector. Changing consumer preferences and the increase in the use of technology will lead to declines in employment in the postal service, retail trade, agriculture, and several information-related industries.

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### **Effects of the COVID-19 pandemic on the 2019–29 projections**

The 2019–29 projections do not include impacts of the coronavirus disease 2019 (COVID-19) pandemic and response efforts. BLS develops the BLS employment projections by using models based on historical data, which, in this set of projections, cover the period through 2019; therefore, all input data precede the pandemic. In addition, the 2019–29 projections were finalized in spring 2020 when substantial uncertainty about the duration and impacts of the pandemic still existed.

The BLS employment projections are long-term projections intended to capture structural change in the economy, not cyclical fluctuations. As such, they are not intended to capture the impacts of the recession that began in February 2020. However, besides the immediate recessionary impacts, the pandemic may cause new structural changes to the economy. BLS releases new employment projections annually, and

subsequent projections will incorporate new information on economic structural changes as it becomes available.

To provide more information about potential impacts before the release of the 2020–30 projections, BLS is developing alternate scenarios for the 2019–29 projections period that encompass possible impacts from the pandemic. Comparing these alternate scenarios with the baseline 2019–29 projections released here will demonstrate how changes in consumer behavior caused by the pandemic may alter the projections for detailed occupations and industries. An analysis of these scenarios will be released in a *Monthly Labor Review* article later in 2020.

## Preparing the projections—methodology overview

BLS prepares projections in four areas: population and labor force, aggregate demand, industry output and employment, and occupational employment. Each step in the projections process affects those that follow. The expectations for the population affect those for the labor force, which in turn affect the projections for productivity and GDP growth. These projections further affect output and employment at the industry level, which then limit occupational employment projections.

BLS makes labor force projections by incorporating U.S. Census Bureau population projections in BLS projections of the labor force participation rate. In the BLS labor force model, population growth and changes in participation rates are the main factors in labor force growth. However, most of the changes in labor force growth are due to changes in the population. The current BLS labor force projections to 2029 are based on the 2018 national population projections made by the U.S. Census Bureau. The projections include assumptions about future fertility and mortality rates of the U.S. population. Also included are assumptions about immigration, an important but uncertain factor affecting the size of the future labor force (immigration data are from the Census Bureau).

Because labor force growth is one of the major determinants of long-term economic growth, labor force projections describe the future path of the economy and its capacity to create goods and services. The long-term gradual slowdown in the labor force growth continues to be key in determining the growth of the economy and of employment.

BLS develops macroeconomic projections with a model licensed from Macroeconomic Advisers (MA) by IHS Markit.<sup>[3]</sup> The MA model includes an assumption of full employment in the target year, allowing the projections to underscore structural changes in the economy rather than cyclical movements in the business cycle. Energy prices come from the Energy Information Administration (EIA), and BLS determines other critical variables and supplies them to the MA model exogenously.<sup>[4]</sup> The MA model then projects economic aggregates, including total employment, output, productivity, prices, interest rates, and many other variables for the U.S. economy. These variables, most importantly nonfarm payroll employment, labor productivity, and GDP, serve as constraints for the industry output and employment projections. These critical variables set the parameters for the nation's economic growth and set the trend that GDP will follow and the number of jobs needed to support that trend.

BLS produces model-based projections for hundreds of detailed industries that are then summed to subsectors and sectors. Macroeconomic factors, such as the labor force, GDP and its components, and labor productivity, affect the growth in total employment. Along with projections models for the individual industries, these factors determine the final projections of industry employment and output.

BLS produces occupational employment projections by analyzing current and projected future staffing patterns (the distribution of occupations within an industry) in an industry–occupation matrix. Changes in the staffing pattern for each industry are projected and applied to the final industry projections, yielding detailed occupational projections by industry. This projected employment matrix includes estimates for 790 occupations across 295 industries.<sup>[5]</sup>

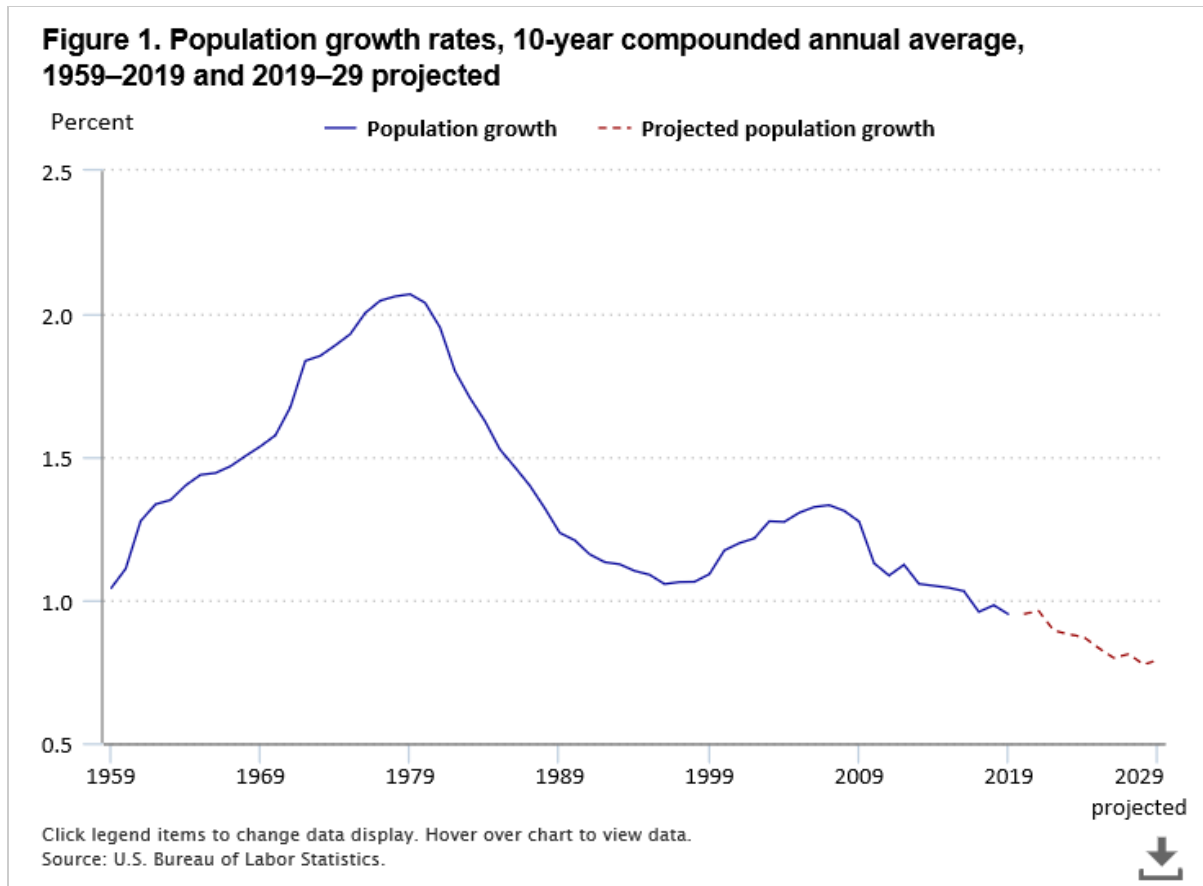
The current projections, for 2019–29, are the first set released annually. Prior projections were released every 2 years.

## Population and labor force

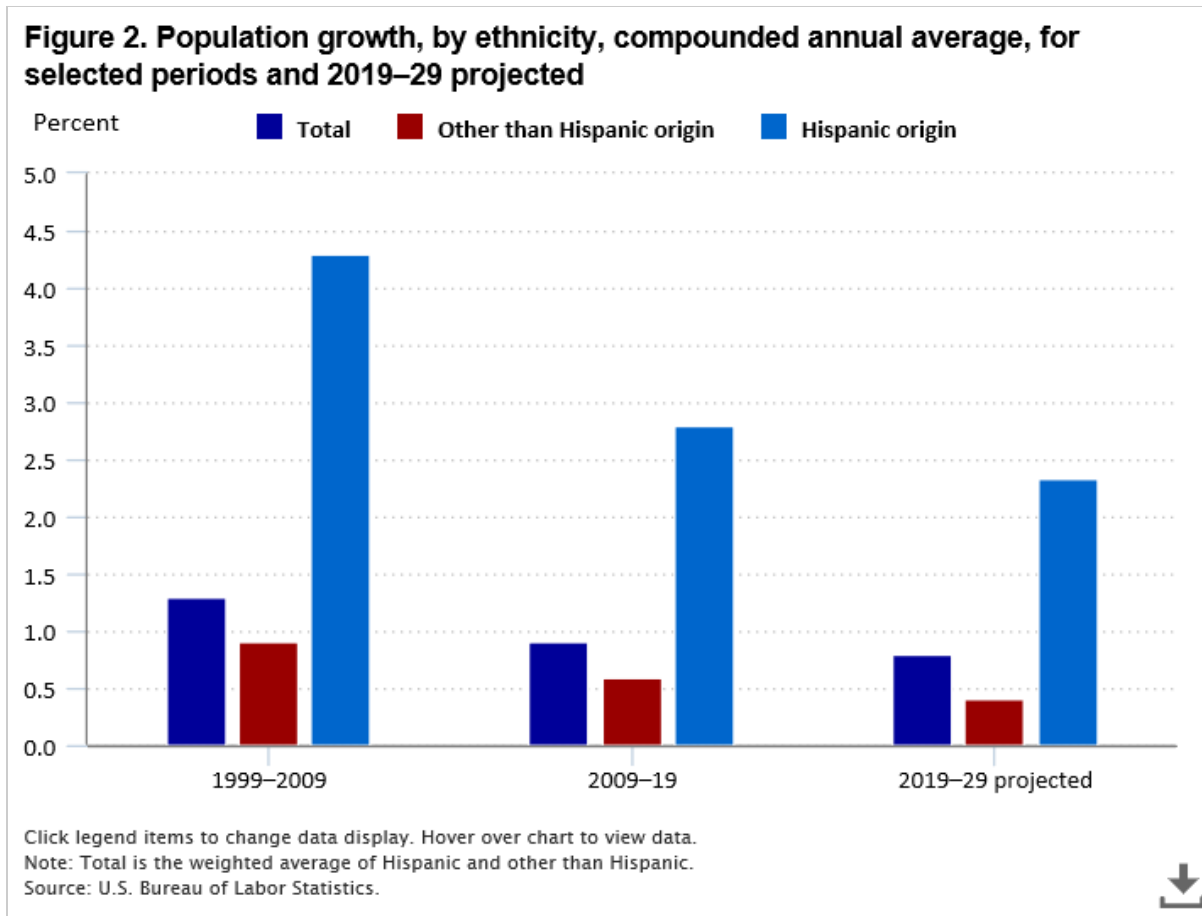
The population and labor force (the number of people ages 16 and older who are either working or actively looking for work) have been steadily growing over the span of U.S. history.<sup>[6]</sup> However, the growth for both has slowed over the last few decades and is expected to continue slowing over the 2019–29 decade. The labor force participation rate—the percentage of the civilian noninstitutional population in the labor force—has declined since the start of the 21st century because of the aging baby boom generation and other demographic trends. Slower growth of the population and the labor force and a continued decline in the participation rate are projected over the next decade.

### Population

Population growth has slowed substantially since the late 1970s, and this trend is projected to continue. (See figure 1.) The high growth rates in the late 1970s correspond with the start of the “echo boom,” when children of the baby boomers entered their prime childbearing years.<sup>[7]</sup> The smaller uptick in the 2000s can be partially attributed to increased immigration. Between 1999 and 2009, 3.8 percentage points of resident population growth were attributable to immigration. Immigration then slowed a bit during and after the 2007–09 recession, contributing only 3.0 percentage points between 2009 and 2019.<sup>[8]</sup>



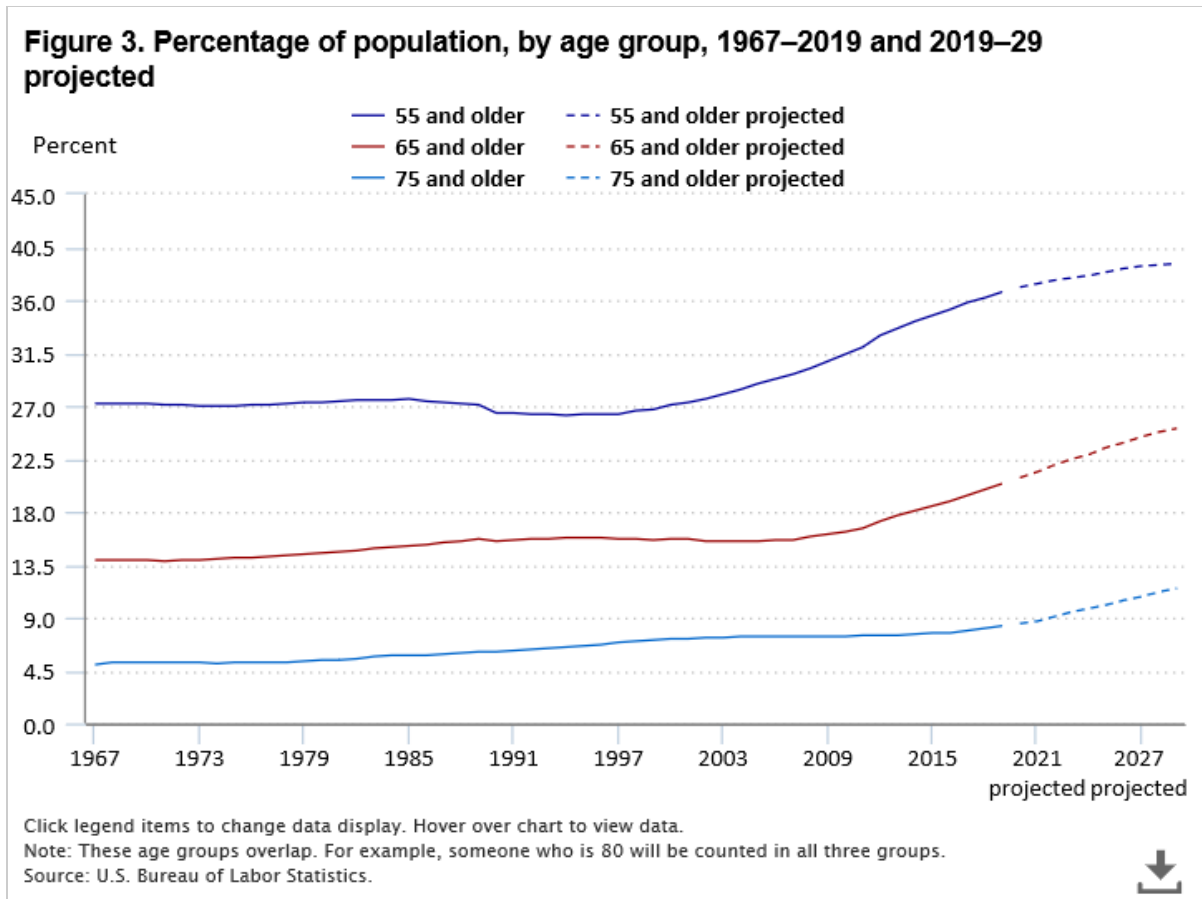
Over the 2000–10 decade, approximately half of all immigrants reported Hispanic ethnicity.<sup>[9]</sup> The Hispanic population grew 4.3 percent compounded annually between 1999 and 2009, faster than the 0.9-percent compounded annual growth in the non-Hispanic population. (See figure 2.) The high Hispanic growth rate was not strictly because of immigration. The birth rate amongst Hispanic individuals was higher than that of non-Hispanics.<sup>[10]</sup>



Between 2009 and 2019, the growth among foreign-born individuals living in the United States slowed.<sup>[11]</sup> Although the Hispanic population growth rate fell to 2.8 percent compounded annually, it was still significantly higher than that of the non-Hispanic population. In spite of the immigration slowdown, the Hispanic growth rate was still responsible for boosting the overall population growth rate by 0.4 percentage point over the same 2009–19 period.

Slowing immigration is expected to continue to affect overall population growth over the projections period. The overall population growth rate is projected to decline slightly to 0.8 percent compounded annually from 2019–29. The slowdown is because of continued decreases in both the rate of Hispanic growth and non-Hispanic growth, which are expected to fall to 2.4 percent and 0.4 percent compounded annually, respectively. (See figure 2.)

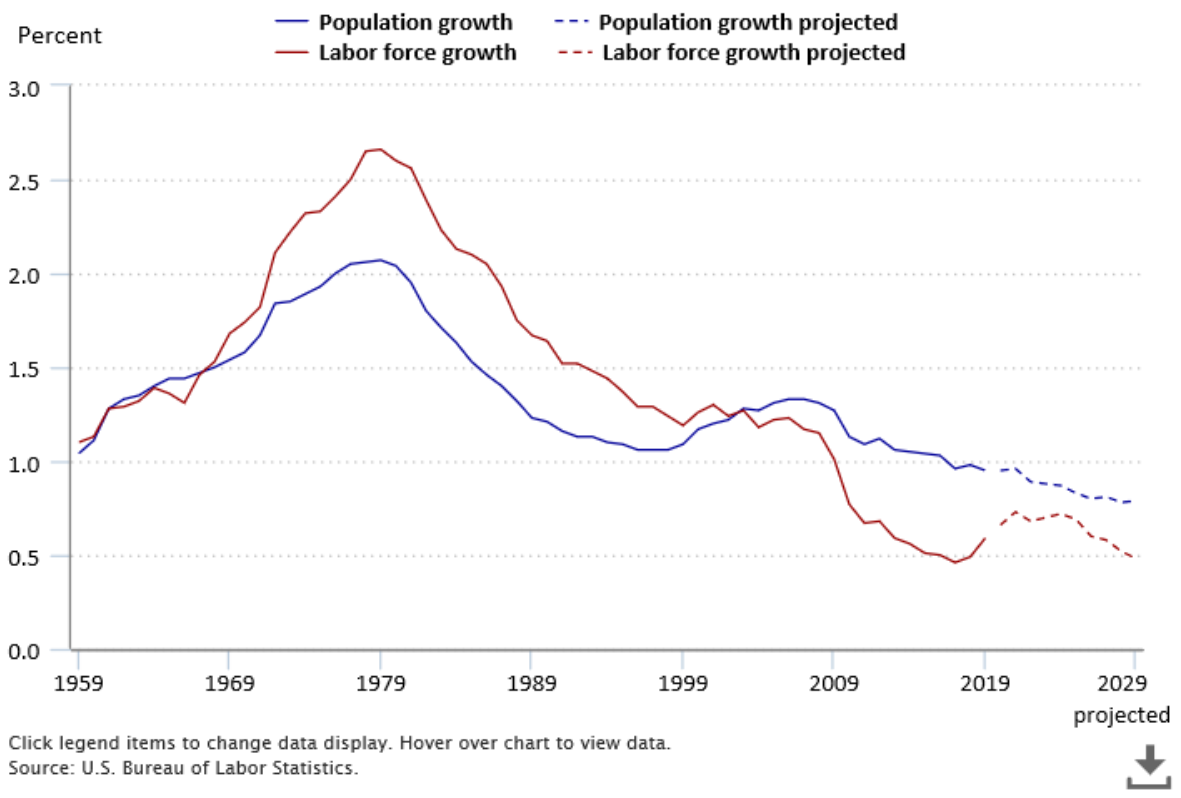
Other demographic shifts are also affecting the U.S. population. A growing percentage of the population is found in the higher age categories. Baby boomers began entering the 55-and-older cohort in 2001 and the 65-and-older cohort in 2011. These trends are particularly important for the labor force because older people are less likely to work than those ages 25 to 54. Through 2029, the growth of those ages 55 and older is expected to slow because all baby boomers are already in this group. However, the 65-and-older and 75-and-older groups are expected to continue to see their increased growth rates maintained. (See figure 3.) The growth among those ages 55 and older has contributed to a lower labor force participation rate and will continue to do so in the future.



## Labor force and participation rate

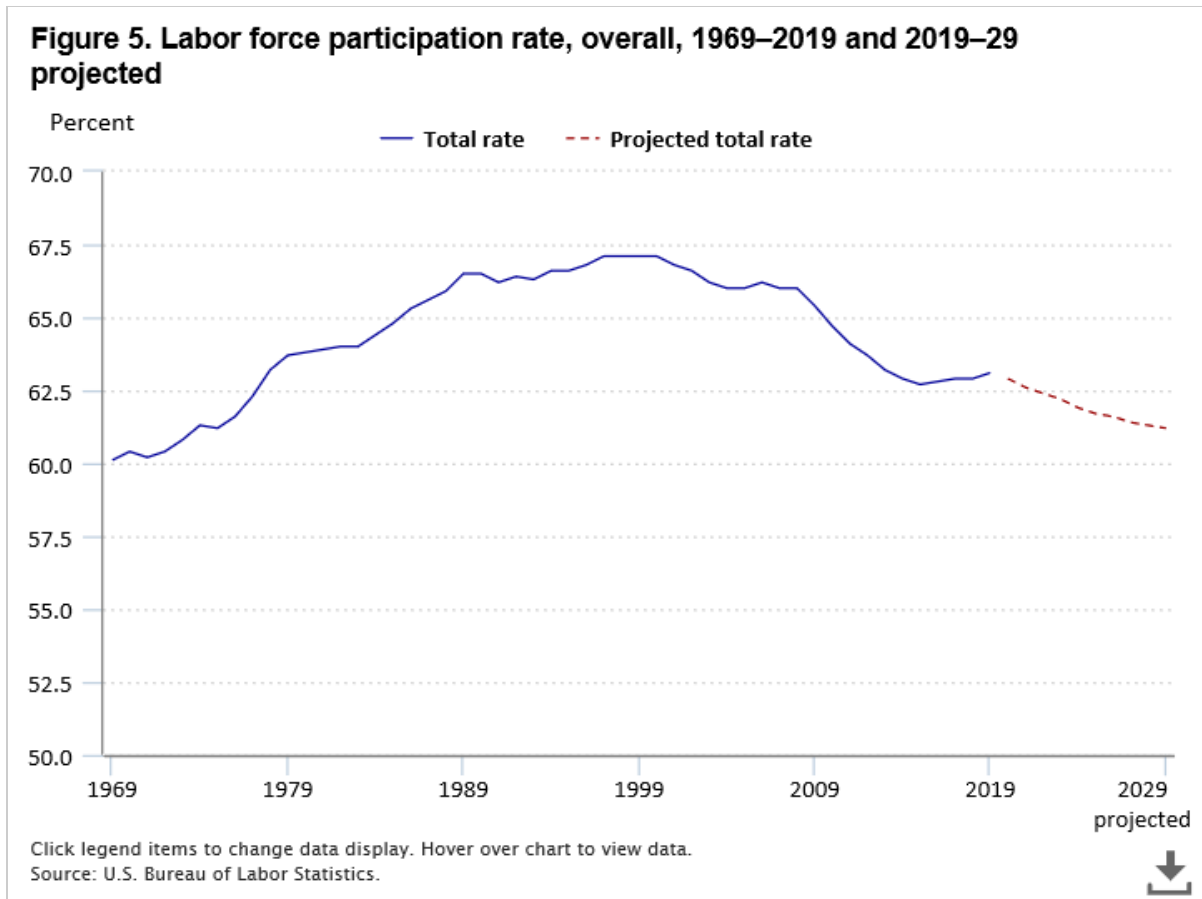
Growth of the labor force has slowed, in large part, because of the two previously discussed trends—the aging population and slower population growth. A large subset of the population is in the labor force; therefore, the labor force often takes a cue from population growth and behaves similarly. (See figure 4.)

**Figure 4. Population and labor force growth rates, 10-year compounded annual average, 1959–2019 and 2019–29 projected**

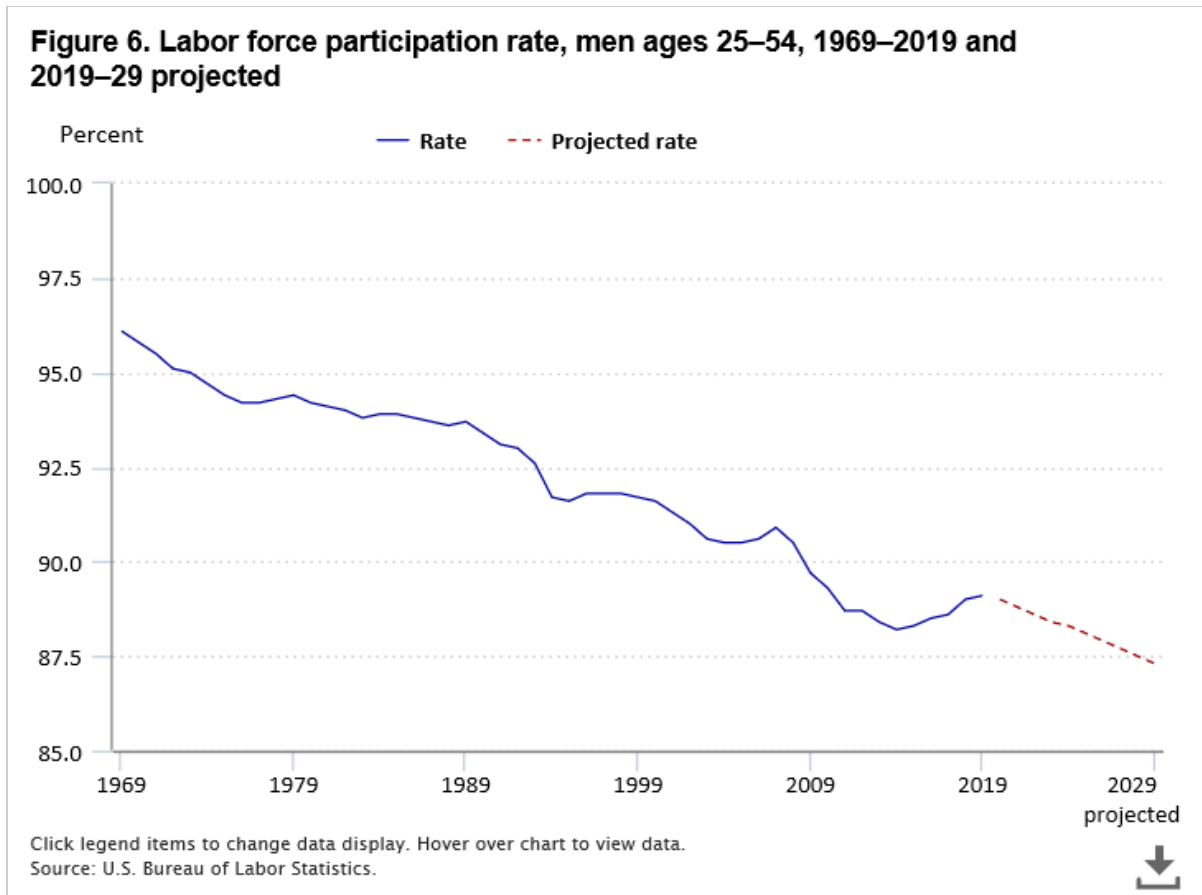


The percentage of the civilian noninstitutional population in the labor force is known as the labor force participation rate. The steady increase in the participation rate over the latter half of the 20th century was largely driven by women entering the labor force. Between 1997 and 2000, the overall participation rate peaked at 67.1 percent and has declined over most of the past two decades.

The participation rate fell steeply, well below potential growth,<sup>[12]</sup> between 2008 and 2015 in the aftermath of the 2007–09 recession. Since 2016, the participation rate has been edging up closer to, and possibly even surpassing, its 2019 potential, as estimated by the Congressional Budget Office.<sup>[13]</sup> Therefore, this uptick in the labor force participation rate between 2015 and 2019 appears to be due to cyclicalities and not a sustainable trend. (See figure 5.) The aging population is expected to be the largest driver of the projected decreasing participation rate because older individuals are less likely to be in the labor force.

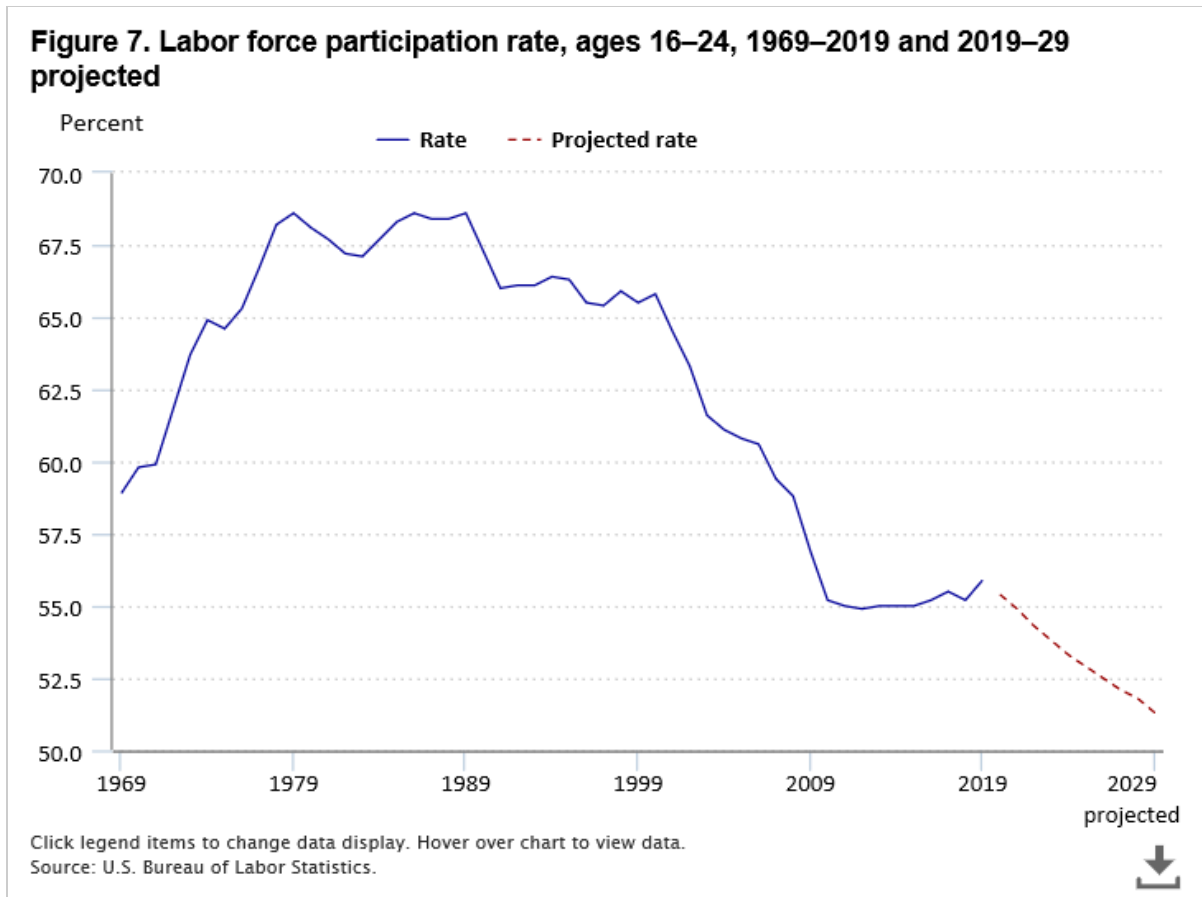


However, the aging population is not the only reason the overall participation rate is decreasing. The prime-age labor force participation rate for men ages 25 to 54 has steadily fallen, from 96.1 percent in 1969 to 89.1 percent in 2019, and is projected to continue to decline to 87.3 percent in 2029. (See figure 6.)



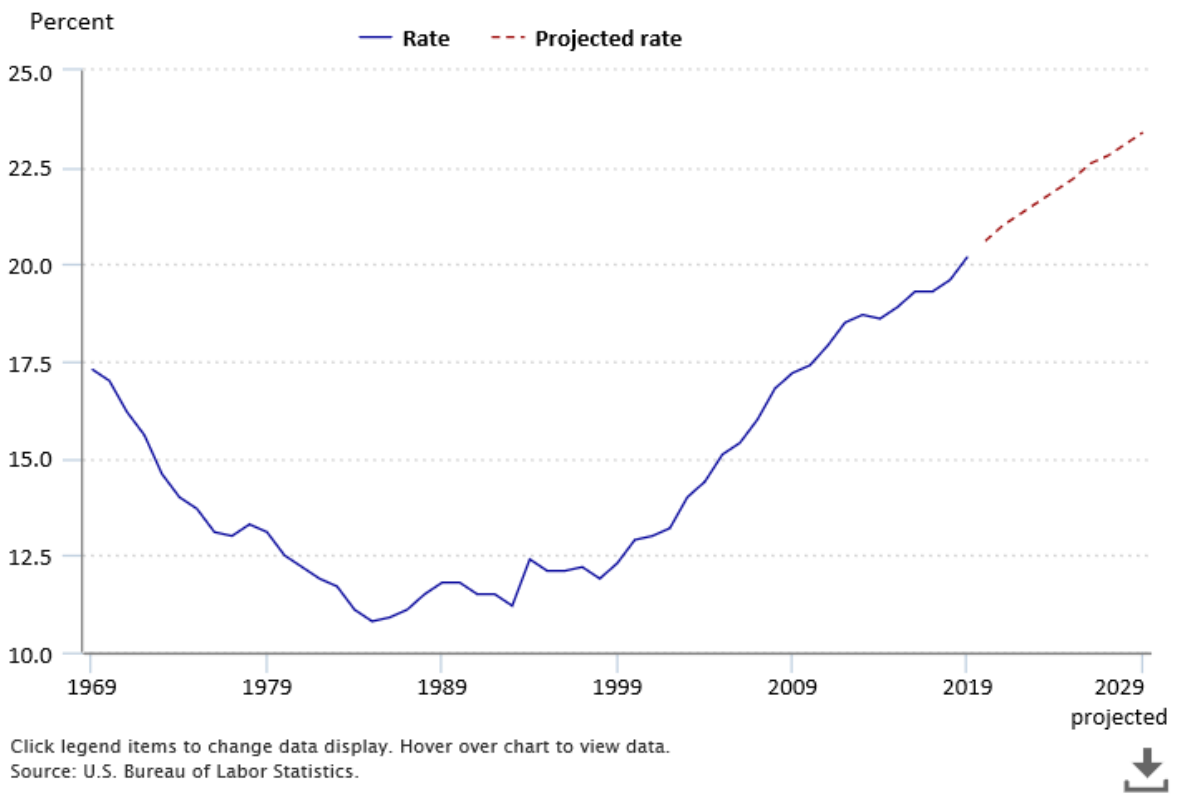
Historically, the participation rate fell the most for men with only a high school degree, some college, or an associate's degree and for men on the younger end of the prime-age range (ages 25 to 34). This group is most likely to be employed in middle-skill jobs, often considered “routine” occupations that have become automated by computers and machines. In addition, international trade and weakening unions have contributed to a decline in these middle-skill jobs.<sup>[14]</sup>

The participation rate of youths, ages 16 to 24, for both genders also has declined. The 16- to 24-year-old participation rate fell from 65.5 percent in 1999 to 55.9 percent in 2019. It is projected to decline still further, to 51.3 percent in 2029. (See figure 7.) The decline in labor force participation of youth corresponds to a higher fraction of young people attending school.<sup>[15]</sup>



While prime-age (25 to 54) individuals—particularly men—and youths are working less, older individuals are working more. The participation rate for the 65-and-older group has been rising since the 1990s and is projected to continue to rise. (See figure 8.) Several factors are driving this trend, including longer, healthier lifespans and shifts in retirement programs, which include changes to Social Security.<sup>[16]</sup> Despite these shifts, people ages 25 to 54 are projected to continue to have much higher participation rates than those ages 65 and older (81.8 percent and 23.4 percent, respectively).

**Figure 8. Labor force participation rate, ages 65 and older, 1969–2019 and 2019–29 projected**



## Macroeconomic projections

The U.S. economic output—which is associated with GDP—has grown throughout history. BLS projects output will continue growing; however, the 1.8-percent annual compounded growth through 2029 is slower than the rate seen in recent decades. (See figure 9.) The slower growth in the labor force will result in this slower GDP growth. However, the labor force is not the only contributor. BLS uses a potential output assumption in the target year (2029) to remove cyclicalities from projections. However, cyclicalities can remain in the base year. In 2019, the economy was at its full potential—so little to no cyclicalities existed. This situation is unusual; more often than not, the economy is below its potential, which gives it more room to grow. This constraint on growth is another reason GDP growth is expected to grow slower than it has historically.

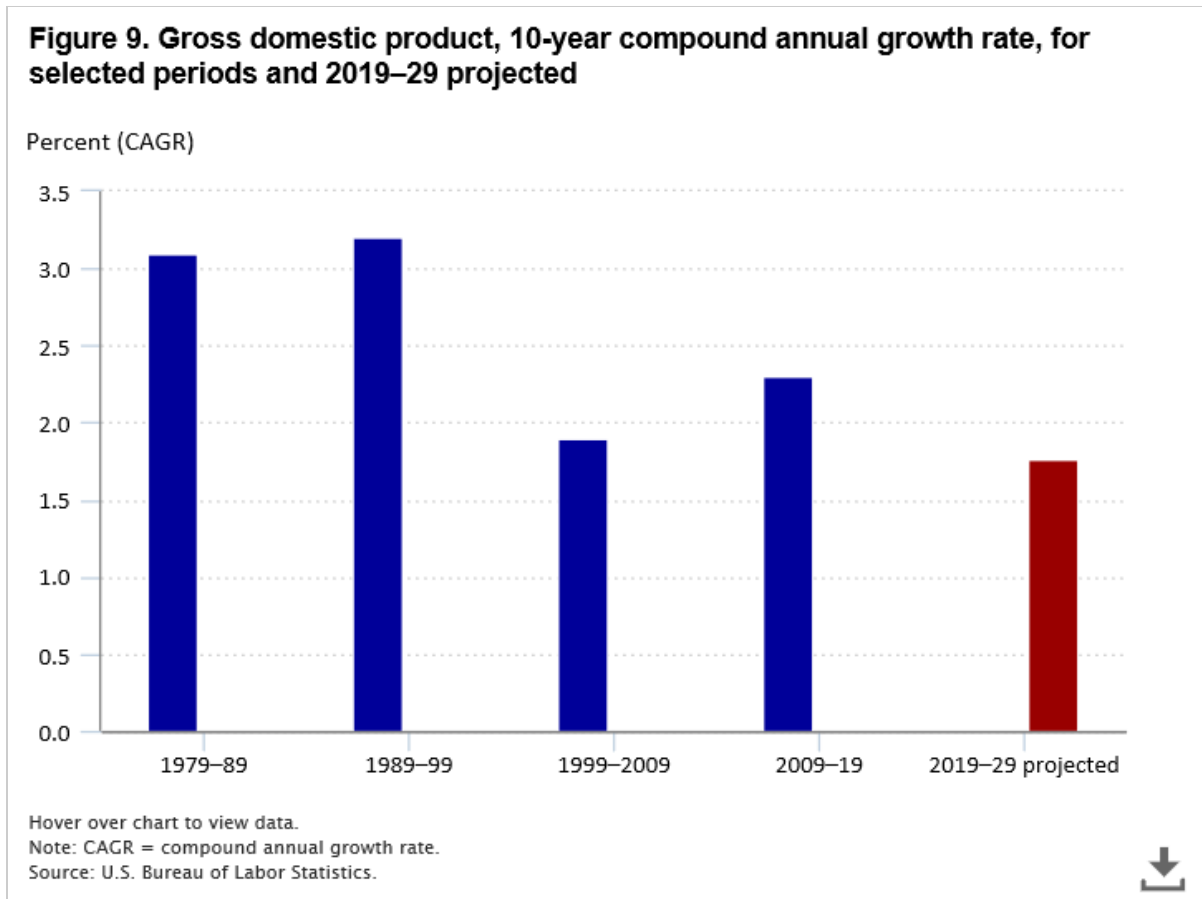
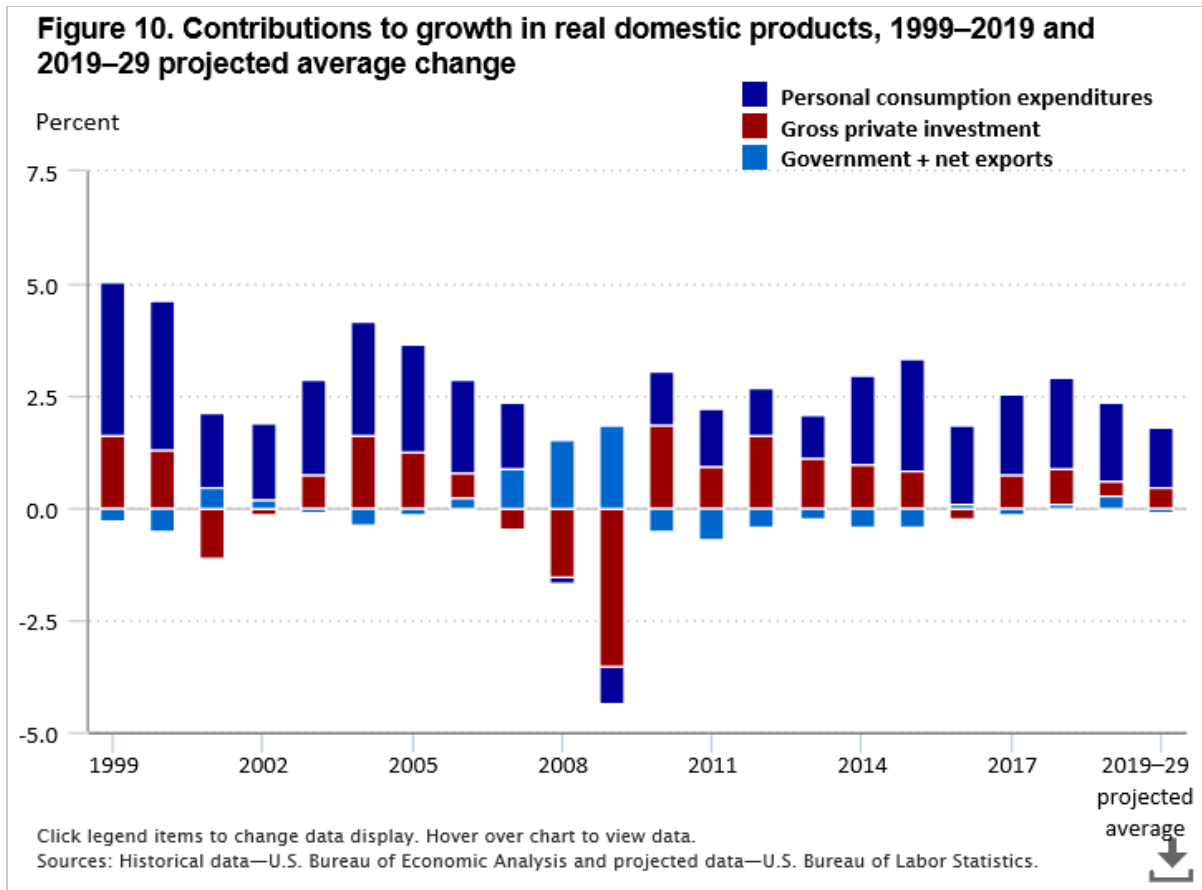


Figure 9 shows GDP growth over 10-year periods. Through the 1980s and 1990s, GDP growth hovered above 3-percent compound annual growth. During the 2007–09 recession, GDP growth plummeted, which is reflected in the slower growth over the 1999–2009 decade. The 2.3-percent compound annual growth from 2009–19 is not expected to be a new structural trend. The base year used for calculating this growth (2009) was one of the worst economic times in this country’s history. In addition, much of the recent 2018 and 2019 increase can be attributed to the 2017 Tax Cuts and Jobs Act, which is expected to result in a short-term boost, with little further effect on GDP growth in 2020 or beyond.<sup>[17]</sup>

Personal consumption expenditures are expected to be the primary driver of GDP growth over the next decade. This scenario is typical—consumption generally drives the majority of U.S. GDP growth. The exceptions are during a recession when government spending picks up slack from other sectors and sometimes after a recession when investment increases to make up for deferred investment during a recession. Over the next 10 years, 1.3 percentage points of annual compound growth are projected to be attributed to growth in consumption and 0.5 percentage point to investment. (See figure 10.)



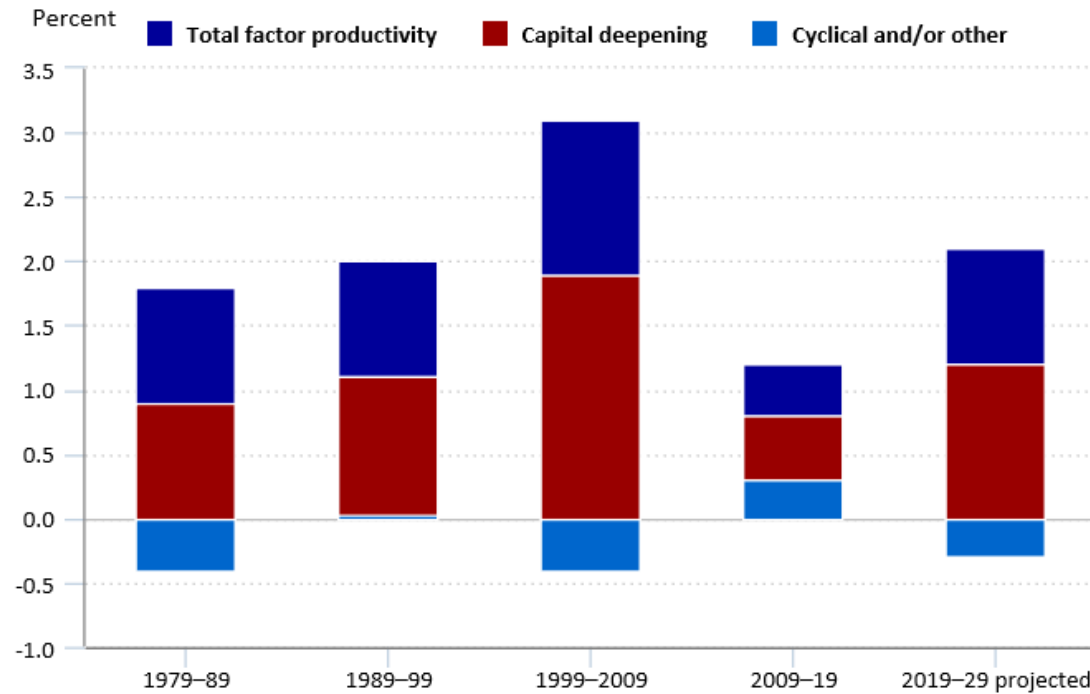
## Employment, nonaccelerating inflation rate of unemployment, and productivity

The labor force includes not only the employed but also the unemployed. At full employment, the rate of unemployment is relatively low. However, the unemployment rate never reaches zero—frictional unemployment will always exist as workers transfer between jobs and seek new jobs. The unemployment rate when the economy is at full employment is called nonaccelerating inflation rate of unemployment (NAIRU). The unemployment rate, at NAIRU, is set at 4.4 percent in 2029.<sup>[18]</sup>

NAIRU and the labor force have important implications for the projection of GDP. Labor productivity also affects GDP. Labor productivity is measured as the total output divided by hours worked in the economy. Productivity growth decreased in the wake of the 2007–09 recession. BLS projects productivity to return to a more normal pattern of growth over the next decade, 1.8-percent compound annual growth, compared with 1.1-percent compound annual growth in 2009–19. This percent growth is still significantly slower than the 2.7-percent compound annual growth experienced from 1999 to 2009.

Capital deepening, an increase in the capital to labor ratio, is the largest driver of productivity. Other drivers are lumped together and are called total factor productivity. These other drivers include technological advances, education or quality of the workforce, improvements in management practices, and economies of scale. Over the upcoming decade, capital deepening is projected to make up 1.2 percentage points of productivity compounded annual growth, compared with 0.9 percentage point for total factor productivity. (See figure 11.)

**Figure 11. Growth in labor productivity and its components, 10-year compound annual average rate, for selected periods and projected 2019–29**



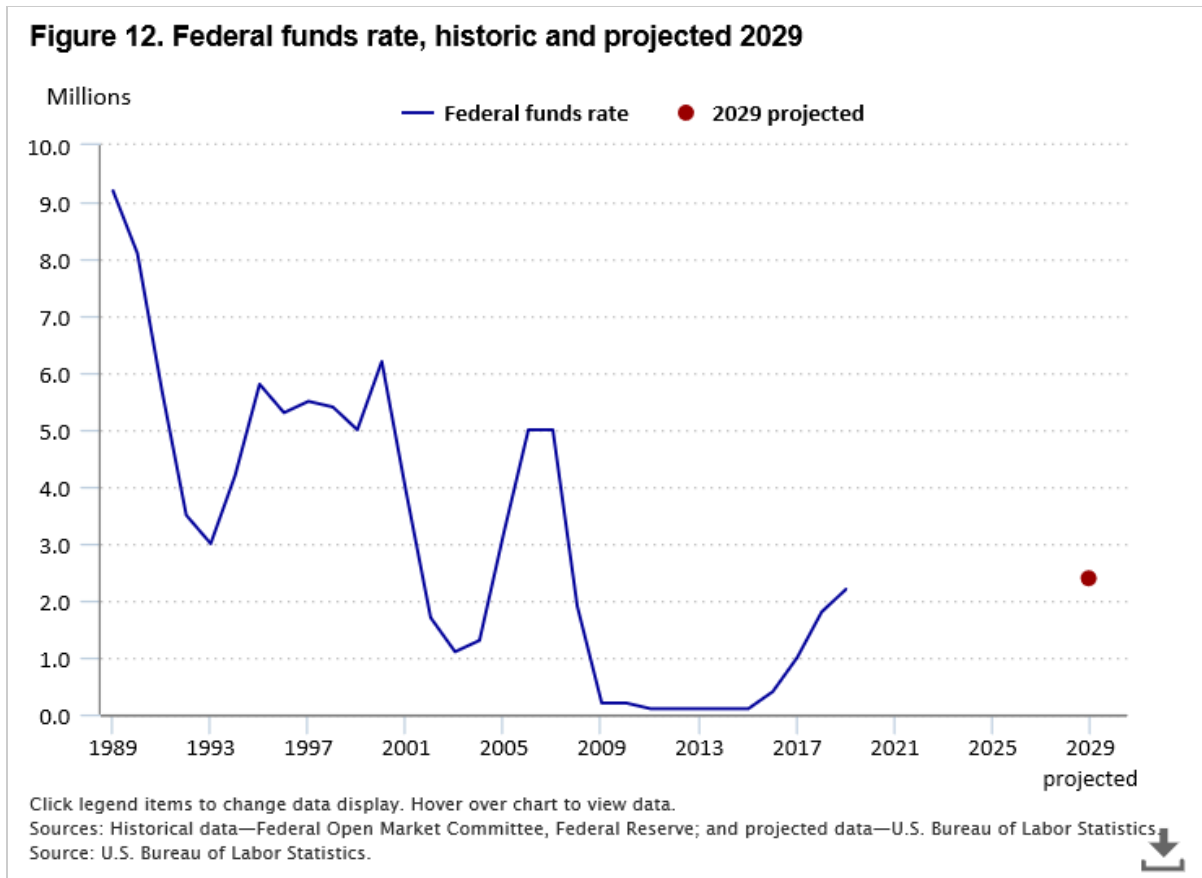
Click legend items to change data display. Hover over chart to view data.  
Source: U.S. Bureau of Labor Statistics.



## Fiscal and monetary policy

The monetary policy goal of the Federal Reserve is to foster economic conditions that achieve both stable prices and maximum sustainable employment.<sup>[19]</sup> The Federal Reserve targets 2-percent inflation to achieve its stable prices mandate.<sup>[20]</sup> In some environments, balancing these mandates may be challenging. Up to February 2020, however, the economy has managed to achieve full employment while inflation has been consistent, around 2.0 percent.<sup>[21]</sup>

The Federal Reserve's primary tool for managing this goal is through the federal funds rate. The federal funds rate is the rate at which banks lend money to each other. Consumer borrowing rates are higher than this rate, but they tend to move with it. The federal funds rate has been trending upward since it was lowered to 0.0 in the wake of the 2007–09 recession. In 2019, the federal funds rate was 2.2 percent, and it is projected to increase to 2.4 percent in 2029. (See figure 12.) This percentage is significantly below the federal funds rate for much of history—it reached 5.0 percent before the 2007–09 recession (in 2007) and above 6.0 percent before the 2001 recession (in 2000).

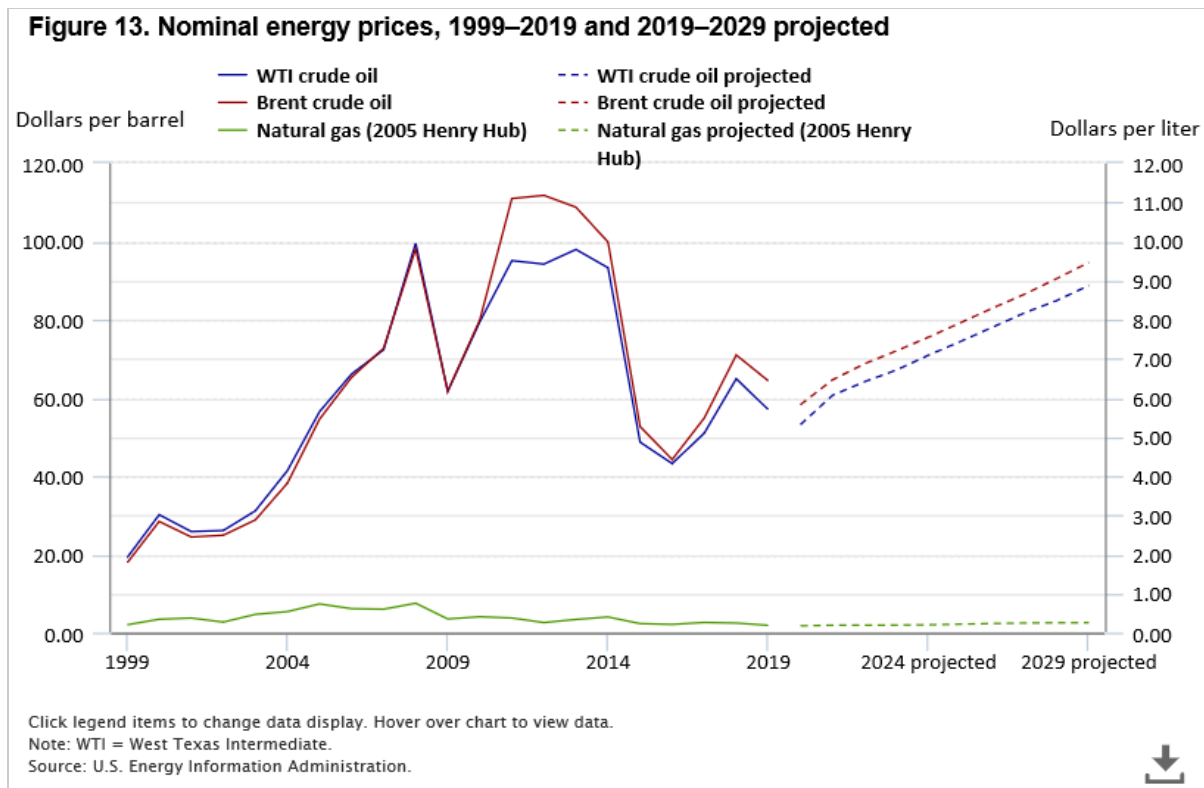


After the 2007–09 recession, there was some concern that low interest rates and an expanding money supply could cause excess inflation.<sup>[22]</sup> However, this worry turned out to be unfounded. Over time, the natural rate of interest can vary in response to shifts in preferences and technology. Evidence shows that such a shift to a lower natural rate may be occurring.<sup>[23]</sup> One reason that may explain the change is the aging of the population. As people live longer, they prefer to save more money to supplant a longer retirement period, which increases the supply of borrowable money and drives down interest rates.<sup>[24]</sup>

Assumptions about fiscal policy, including tax policies and government spending, substantially affect expectations for government revenue, national debt, and economic growth. BLS generally assumes no major changes to current tax laws over the projections decade. Effective marginal tax rates also are held constant at their current levels.

## Energy prices

Energy prices, particularly oil prices, are another macroeconomic variable of interest because of their influence on consumer spending. Lower prices are generally associated with more economic growth because they free up additional money for consumer discretionary spending. However, if prices fall exceptionally fast, the energy sector may contract, which negatively influences GDP. Energy prices used by BLS within the U.S. Macro Model (MA/ U.S.) from IHS Markit are supplied from the EIA's January 2020 Annual Energy Outlook.<sup>[25]</sup> From 2019 to 2029, oil prices are projected to rise approximately 50 percent, from \$57 to \$89 for West Texas Intermediate (WTI) and \$64 to \$95 for Brent. (See figure 13.)



## Industry output and employment projections to 2029

BLS projects real gross industry output will increase slightly more in the 2019–29 decade than it did during the previous decade, whereas employment growth will be slower. Industry output and employment projections were prepared with the use of the North American Industry Classification System (NAICS). Major sectors—hereafter referred to as “sectors”—are aggregations of NAICS industries.

### Industry output

BLS projects that real gross industry output will increase from just over \$34.0 trillion in 2019 to roughly \$40.9 trillion in 2029.<sup>[26]</sup> The more than \$6.8 trillion increase by 2029 is slightly larger than the increase during the previous decade. However, overall growth is projected to slow to a 1.8-percent rate over the 2019–29 period from a 2.2-percent rate over the 2009–19 recovery period. Most of the increase in real output (74.2 percent) is projected to come from service-providing sectors.

### Sector output

In line with projections for the 2018–28 period, output for service-providing sectors is projected to grow at an average rate of 2.0 percent per year from 2019 to 2029. (See table 1.) This rate is slower than the 2.3-percent growth experienced from 2009 to 2019. Over the 2019–29 decade, the projected 2.0-percent growth in output for service-providing sectors is slightly faster than the 1.8-percent projected growth for the entire U.S. economy. All service-providing sectors are projected to experience real-output growth over the 2019–29 projections period, except for the federal government sector, which is projected to decline slightly at a rate of 0.1 percent annually.

The healthcare and social assistance sector is projected to have the fastest growth rate among service-providing sectors in 2019–29, with a projected annual growth rate at 2.9 percent.

**Table 1. Output by major industry sector, 2009–29**

Industry sector	Billions of chained 2012 dollars			Compound annual rate of change		Billions of dollars			Percent distribution		
	2009	2019	2029	2009–19	2019–29	2009	2019	2029	2009	2019	2029
Total	\$27,293.3	\$34,049.9	\$40,867.6	2.2	1.8	\$25,021.9	\$37,733.5	\$53,862.7	100.0	100.0	100.0
Goods-producing, excluding agriculture	6,914.1	8,473.7	9,921.6	2.1	1.6	6,034.9	8,637.5	12,465.7	24.1	22.9	23.1
Mining	485.8	635.3	835.5	2.7	2.8	404.0	549.2	1,037.2	1.6	1.5	1.9
Construction	1,161.5	1,418.9	1,616.3	2.0	1.3	1,099.0	1,728.5	2,284.6	4.4	4.6	4.2
Manufacturing	5,261.6	6,384.1	7,434.0	2.0	1.5	4,532.0	6,359.8	9,143.9	18.1	16.9	17.0
Service-providing, excluding special industries	18,646.8	23,486.7	28,546.7	2.3	2.0	17,410.90	26,800.0	38,257.7	69.6	71.0	71.0
Utilities	443.6	458.6	534.5	0.3	1.5	436.5	505.7	718.6	1.7	1.3	1.3
Wholesale trade	1,223.5	1,885.8	2,440.7	4.4	2.6	1,154.8	2,051.6	3,207.1	4.6	5.4	6.0
Retail trade	1,271.2	1,842.1	2,339.3	3.8	2.4	1,207.7	1,936.3	2,678.5	4.8	5.1	5.0
Transportation and warehousing	940.4	1,128.4	1,327.9	1.8	1.6	782.0	1,274.7	1,900.2	3.1	3.4	3.5
Information	1,226.6	1,914.2	2,489.5	4.6	2.7	1,219.7	1,899.2	2,602.6	4.9	5.0	4.8
Financial activities	3,613.6	4,227.0	4,953.4	1.6	1.6	3,323.4	5,402.7	7,142.7	13.3	14.3	13.3
Professional and business services	2,750.9	3,763.7	4,720.1	3.2	2.3	2,610.2	4,266.1	6,039.6	10.4	11.3	11.2
Educational services	314.0	313.1	371.3	0.0	1.7	273.5	381.4	586.3	1.1	1.0	1.1
Health care and social assistance	1,829.6	2,402.3	3,201.2	2.8	2.9	1,724.1	2,641.2	4,271.0	6.9	7.0	7.9
Leisure and hospitality	1,013.8	1,347.3	1,662.8	2.9	2.1	955.2	1,581.3	2,491.5	3.8	4.2	4.6
Other services	563.9	651.6	773.6	1.5	1.7	526.5	765.4	1,111.0	2.1	2.0	2.1
Federal government	1,125.7	1,118.8	1,112.4	–0.1	–0.1	1,056.2	1,259.9	1,507.3	4.2	3.3	2.8
State and local government	2,333.5	2,475.1	2,754.4	0.6	1.1	2,141.3	2,834.4	4,001.4	8.6	7.5	7.4
Agriculture, forestry, fishing, and hunting	459.5	571.6	684.5	2.2	1.8	342.8	460.6	771.7	1.4	1.2	1.4
Special Industries <sup>(1)</sup>	1,273.7	1,505.5	1,671.1	1.7	1.0	1,233.1	1,835.5	2,367.6	4.9	4.9	4.4
Residual <sup>(2)</sup>	–0.7	12.4	43.7	—	—	—	—	—	—	—	—

Notes:

<sup>(1)</sup> Consists of nonproducing accounting categories to reconcile the input–output system with National Income and Product Accounts.

<sup>(2)</sup> Residual is shown for the first level only. Subcategories do not necessarily add to higher categories as a by-product of chain-weighting.

Source: U.S. Bureau of Labor Statistics.

Real output in the goods-producing sectors (excluding agriculture) is projected to grow at a rate of 1.6 percent per year from 2019 to 2029, which is slower than the expected growth rate of 1.8 percent for the overall economy. The 1.6-percent growth rate for the goods-producing sectors is slower than the 2.1-percent increase experienced a decade earlier, but roughly in line with the overall slowing of output growth. Within the nonagricultural goods-producing sectors, mining has the fastest projected growth rate—2.8 percent annually for the next 10 years.

The agricultural sector (including forestry, fishing, and hunting) is projected to grow at a rate of 1.8 percent per year for the 2019–29 projections period, the same as the projected rate for overall output growth. This rate is slower than the rate of 2.2-percent annual growth experienced a decade earlier by both the agricultural sector and total output.

## Fastest growing output

Within the service-providing sector, the information sector is projected to have 3 of the 20 fastest growing real-output industries from 2019 to 2029: software publishers; other information services; and data processing, hosting, and related services. The software publishers industry, in particular, continues to be the fastest growing real-output industry in the U.S. economy, as more consumers demand software to accommodate lifestyle needs, such as Internet of Things,<sup>[27]</sup> network integration, cloud computing, and web services. The software publishers industry is projected to grow at a rate of 4.8 percent annually over the 2019–29 projections period.

The healthcare and social assistance sector includes 10 of the 20 industries with the fastest growing real output for the 2019–29 projections period. Within healthcare and social assistance, offices of physicians, outpatient care centers, other ambulatory healthcare services, and medical and diagnostic laboratories industries are projected to grow the fastest. The aging of the population and the continued expected rise in chronic health conditions, such as diabetes, are expected to drive demand for healthcare services overall.

## Most rapidly declining output

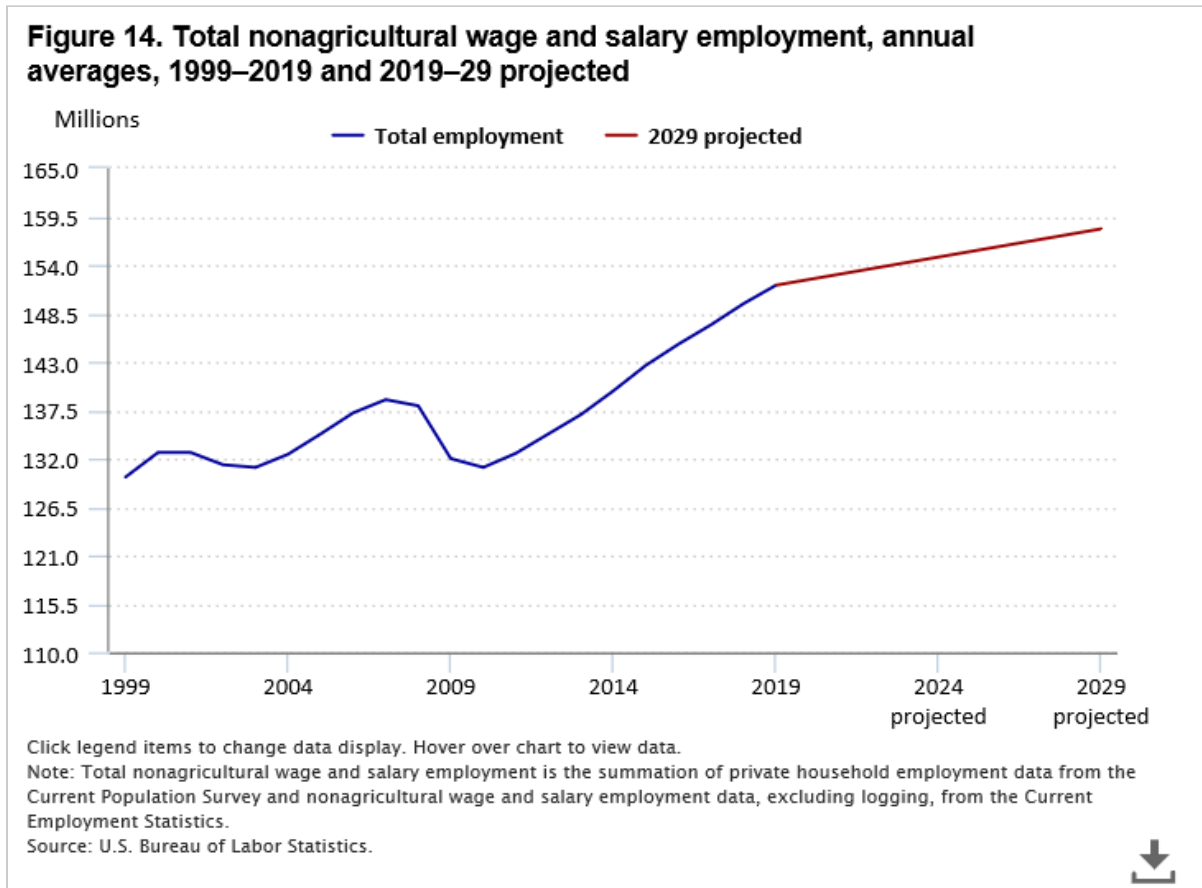
The manufacturing sector includes 3 of the 10 industries projected to decline in real output, with the tobacco manufacturing industry projected to have the fastest annual rate of decline over the next decade (–2.1 percent). The continued decline in the number of people who use tobacco products is one of the reasons for the industry’s drop in real output. The alumina and aluminum production and processing industry and the textile mills and textile product mills industry, both in the manufacturing sector, are the second- and fourth-fastest declining industries overall. Increased outsourcing to overseas production for lower labor costs contributes to the overall decline in manufacturing.

The federal government sector includes 6 of the 10 industries that are projected to decline in real output, in part, because of continued pressure to reduce government spending.<sup>[28]</sup> Of all industries, the postal service is projected to have the third-largest decline in real output, decreasing by 0.8 percent annually over the next decade. The continued increase in the use of alternative methods of communication—such as email, electronic bill payment, and digital subscriptions, to name a few—contribute to the decline in real output.

## Industry employment projections

BLS uses projected output and labor force data to create projections of total employment by industry. BLS projects total employment in 2029 to reach 168.8 million, an increase from 2019 of about 6.0 million. This growth represents a 0.4-percent annual growth rate, which is lower than the 1.3-percent growth rate experienced from the

2009 recession trough to 2019. Most of the increase in employment stems from nonagricultural wage and salary workers: the number of nonagricultural wage and salary jobs is projected to rise from 151.7 million in 2019 to 158.1 million in 2029, an increase of about 6.4 million jobs.<sup>[29]</sup> (See figure 14.) This increase is less than the 19.7 million jobs that were added from 2009 to 2019. The 2019–29 employment increase for nonagricultural wage and salary workers, at a growth rate of 0.4 percent per year, is projected to be slower than the 1.4-percent annual growth rate experienced from 2009 to 2019.



## Sector employment

Employment in service-providing sectors is projected to increase by roughly 6.5 million jobs, reaching about 137.2 million by 2029. This projected increase represents most of the jobs to be added over the 2019–29 projections period. Employment in service-providing sectors is expected to grow by 0.5 percent annually over the next decade, slightly faster than the 0.4-percent annual growth for the overall economy. (See table 2.) This growth, however, is slower than the 1.4-percent annual growth rate experienced by the service-providing sectors from 2009 to 2019.

**Table 2. Employment by major industry sector, 2009–29**

Industry sector	Thousands of jobs			Change		Percent distribution			Compound annual rate of change	
	2009	2019	2029	2009–19	2019–29	2009	2019	2029	2009–19	2019–29
Total <sup>(1)</sup>	143,036.4	162,795.6	168,834.7	19,759.2	6,039.1	100.0	100.0	100.0	1.3	0.4
Nonagriculture wage and salary <sup>(2)</sup>	132,029.2	151,709.7	158,115.6	19,680.5	6,405.9	92.3	93.2	93.7	1.4	0.4
Goods-producing, excluding agriculture	18,507.7	21,016.3	20,964.9	2,508.6	–51.4	12.9	12.9	12.4	1.3	0.0
Mining	643.3	684.6	777.8	41.3	93.2	0.4	0.4	0.5	0.6	1.3
Construction	6,016.5	7,492.2	7,792.4	1,475.7	300.2	4.2	4.6	4.6	2.2	0.4
Manufacturing	11,847.9	12,839.5	12,394.7	991.6	–444.8	8.3	7.9	7.3	0.8	–0.4
Services-providing excluding special industries	113,521.5	130,693.4	137,150.7	17,171.9	6,457.3	79.4	80.3	81.2	1.4	0.5
Utilities	560.1	549.0	506.7	–11.1	–42.3	0.4	0.3	0.3	–0.2	–0.8
Wholesale trade	5,520.9	5,903.4	5,801.3	382.5	–102.1	3.9	3.6	3.4	0.7	–0.2
Retail trade	14,527.6	15,644.2	15,275.9	1,116.6	–368.3	10.2	9.6	9.0	0.7	–0.2
Transportation and warehousing	4,224.7	5,618.1	5,944.1	1,393.4	326.0	3.0	3.5	3.5	2.9	0.6
Information	2,803.8	2,859.4	2,853.2	55.6	–6.2	2.0	1.8	1.7	0.2	0.0
Financial activities	7,838.0	8,746.0	8,799.9	908.0	53.9	5.5	5.4	5.2	1.1	0.1
Professional and business services	16,633.8	21,313.1	22,831.4	4,679.3	1,518.3	11.6	13.1	13.5	2.5	0.7
Educational services	3,090.5	3,764.5	4,230.0	674.0	465.5	2.2	2.3	2.5	2.0	1.2
Health care and social assistance	16,539.8	20,412.6	23,491.7	3,872.8	3,079.1	11.6	12.5	13.9	2.1	1.4
Leisure and hospitality	13,077.5	16,575.9	17,691.5	3,498.4	1,115.6	9.1	10.2	10.5	2.4	0.7
Other services	6,150.1	6,713.8	6,994.7	563.7	280.9	4.3	4.1	4.1	0.9	0.4
Federal government	2,832.0	2,834.0	2,650.4	2.0	–183.6	2.0	1.7	1.6	0.0	–0.7
State and local government	19,722.7	19,759.4	20,080.0	36.7	320.6	13.8	12.1	11.9	0.0	0.2
Agriculture, forestry, fishing, and hunting <sup>(3)</sup>	2,011.9	2,303.6	2,265.1	291.7	–38.6	1.4	1.4	1.3	1.4	–0.2
Agriculture wage and salary	1,175.7	1,565.2	1,600.5	389.5	35.3	0.8	1.0	0.9	2.9	0.2
Agriculture self-employed	836.2	738.4	664.5	–97.8	–73.9	0.6	0.5	0.4	–1.2	–1.0
Nonagriculture self-employed	8,995.3	8,782.3	8,454.1	–213.0	–328.2	6.3	5.4	5.0	–0.2	–0.4

**Notes:**

<sup>(1)</sup> Employment data for wage and salary workers are from the BLS Current Employment Statistics survey, which counts jobs, whereas self-employed and agriculture, forestry, fishing, and hunting are from the Current Population Survey (household survey), which counts workers.

<sup>(2)</sup> Includes wage and salary data from the Current Employment Statistics survey, except private households, which is from the Current Populations Survey. Logging workers are excluded.

<sup>(3)</sup> Includes agriculture, forestry, fishing, and hunting data from the Current Population Survey, except logging, which is from Current Employment Statistics survey. Government wage and salary workers are excluded.

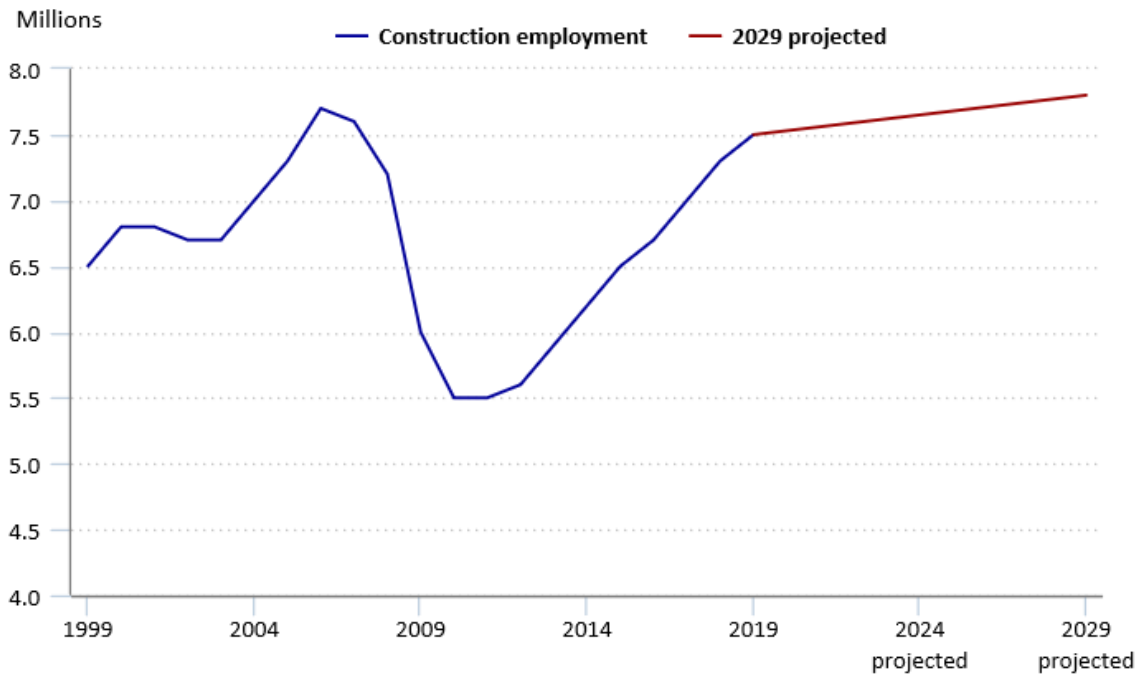
Source: U.S. Bureau of Labor Statistics.

In line with the last five sets of projections, the healthcare and social assistance sector is projected to have the most employment growth of any sector over the next decade. Employment in healthcare and social assistance is projected to add about 3.1 million jobs over the 2019–29 decade, reaching a level of 23.5 million by 2029. The sector is projected to grow at an annual rate of 1.4 percent, more than 3 times as fast as the annual growth for the overall economy. The projected growth for the healthcare and social assistance sector, however, is still slower than the 2.1-percent annual growth experienced during the 2009–19 period.

Conversely, the retail trade industry is projected to have the largest employment decline among all service-providing industries. Employment in the retail trade industry is projected to decline by 368,300 jobs from 2019 to 2029, a sharp contrast from the previous decade when it added 1.1 million jobs. The declining trend in retail trade employment is driven by several factors, including bankruptcy and consolidation of big box stores and the shift of consumer-spending behavior in favor of e-commerce shopping.<sup>[30]</sup>

Overall employment in the goods-producing sectors (excluding agriculture) is projected to decline over the 2019–29 projections period. These sectors experienced modest gains from 2009 to 2019 (+2.5 million jobs), offsetting larger losses experienced during the decade prior (1999–2009). Employment in the construction sector is projected to increase by 300,200 from 2019 to 2029, growing at an annual rate of 0.4 percent. This increase is much smaller than the job gains experienced during the previous decade, when construction added nearly 1.48 million jobs as the sector recovered following steep losses during the Great Recession. (See figure 15.) The manufacturing sector, the largest sector within the goods-producing sectors (excluding agriculture), accounts for over half of total employment in the goods-producing sectors. The manufacturing sector is projected to decline by 444,800 jobs over the next decade, overshadowing increases in the mining and construction industries. During the previous decade, manufacturing added 991,600 jobs. (See figure 16.)

**Figure 15. Construction wage and salary employment, annual averages, 1999–2019 and 2019–29 projected**



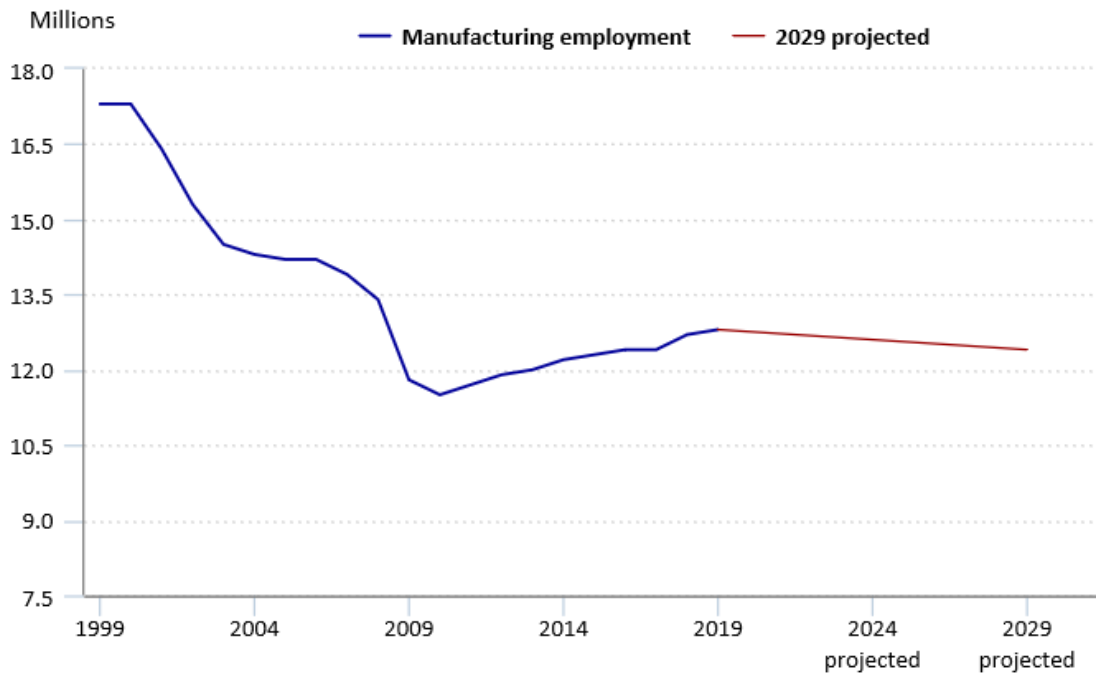
Click legend items to change data display. Hover over chart to view data.

Note: As designated by the National Bureau of Economic Research, the two most recent recessions occurred from December 2007 to June 2009 and March 2001 to November 2001.

Source: U.S. Bureau of Labor Statistics.



**Figure 16. Manufacturing wage and salary employment, annual averages, 1999–2019 and 2019–29 projected**



Click legend items to change data display. Hover over chart to view data.

Note: As designated by the National Bureau of Economic Research, the two most recent recessions occurred from December 2007 to June 2009 and March 2001 to November 2001.

Source: U.S. Bureau of Labor Statistics.



The agriculture, forestry, fishing, and hunting sector is projected to decline by 38,600 jobs from 2019 to 2029. During the previous 2009–19 decade, this sector added 291,700 jobs. The projected decline is largely due to a combination of the slowed employment growth in the crop production industry and a continued decline in the number of self-employed workers within the agriculture, forestry, fishing, and hunting sector. Employment in the crop production industry is projected to increase by 66,200 jobs for the 2019–29 decade, whereas 336,100 jobs were added to the industry during the previous decade. Along with employment growth in the crop production industry that is projected to slow, the number of self-employed workers in the agriculture, forestry, fishing, and hunting sector is projected to decline by 73,900 over the next decade, further exacerbating the loss of self-employed jobs that occurred in this industry during the last decade. This loss is due, in part, to the overall declining number of small farms, to the emergence of large farming operations, and to older workers being more likely to be self-employed than any other working age group in this industry.<sup>[31]</sup>

## Fastest growing industry employment

Although overall agriculture, forestry, fishing, and hunting sector employment is projected to decline from 2019 to 2029, employment in the forestry industry component is projected to grow the fastest among all industries for the 2019–29 projections period. The forestry industry is projected to grow at an annual rate of 3.7 percent. However, because of the industry’s small size, its fast projected growth does little to offset the declines expected in agriculture, forestry, fishing, and hunting sector employment. In the previous decade, the forestry industry declined at a rate of 2.4 percent annually.

Over the next decade, 5 out of the 20 fastest growing industries are in the healthcare and social assistance sector: individual and family services, home healthcare services, outpatient care centers, offices of other health practitioners, and other ambulatory healthcare services. Factors that contribute to the large projected increase in the number of healthcare and social assistance jobs include increased demand to care for the aging of the baby boom population, longer life expectancies, and continued growth in the number of patients with chronic conditions.<sup>32</sup> At an annual growth rate of 3.4 percent, employment in the individual and family services industry is projected to be the second-fastest growing industry overall.

For the 2019–29 projections period, three industries within the professional and business services sector are projected to be among the fastest growing industries overall. Within this sector, computer systems design and related services; management, scientific, and technical consulting services; and office administrative services are projected to experience fast job gains. Increased demand for technology and the growing complexity of business operations will contribute to the overall fast employment growth in professional and business services.<sup>[33]</sup>

## Most rapidly declining industry employment

The manufacturing sector is projected to lose the most jobs and have the most rapid employment decline of all sectors over the 2019–29 projections period. The manufacturing sector includes 12 of the 20 industries projected to have the largest job declines. Increased international competition and continued automation that increases overall production with fewer workers will continue to contribute to the loss of jobs for this sector.<sup>34</sup> The tobacco manufacturing industry is projected to have the most rapid declines in industry employment, falling by 5.2 percent annually.

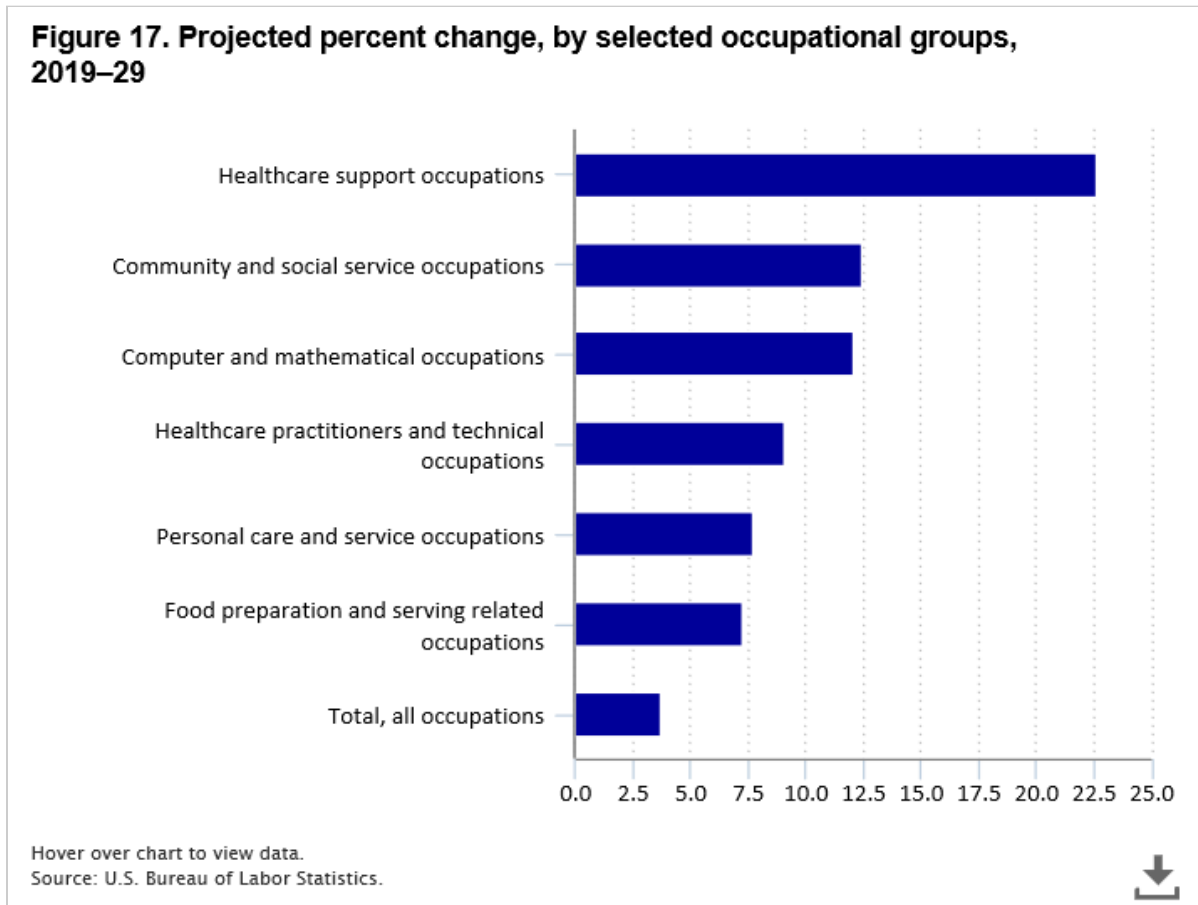
The information sector includes 3 of the 20 overall most rapidly declining industries for the 2019–29 decade. The first one is the cable and other subscription programming industry, which is the second-fastest declining industry within this sector for the projections period, and is projected to decline by 4.8 percent annually from 2019 to 2029. The second one is the newspaper, periodical, book, and directory publishers industry and is projected to decline by 4.0 percent annually. The wired telecommunications carriers, the third industry, is projected to lose jobs at an annual rate of 2.1 percent for the same period. The expectation of continued technological changes leading to fewer job opportunities, the continued trajectory toward digital readership versus print subscription, and a decline in the number of overall subscriptions will contribute to these employment declines.<sup>35</sup>

## Occupational projections of major groups

To construct projections by occupation, BLS combines the projected total industry employment with staffing-pattern information. BLS uses the Standard Occupational Classification (SOC) system to categorize occupations in 22 major groups.<sup>[36]</sup> Occupations are classified in the SOC system on the basis of the type of work performed, job tasks, and job duties. Examples include statisticians, mathematicians, computer programmers, and web developers, and all are in the broader computer and mathematical occupational group.

Healthcare support is the fastest growing occupational group, with a projected growth rate of 22.6 percent. (See figure 17.) Increased demand for healthcare and related employment is also reflected in the high projected growth rates for healthcare practitioners and technical occupations and community and social service occupations.

Healthcare support occupations include home health and personal care aides, the detailed occupation projected to add the most new jobs from 2019 to 2029.<sup>[37]</sup>



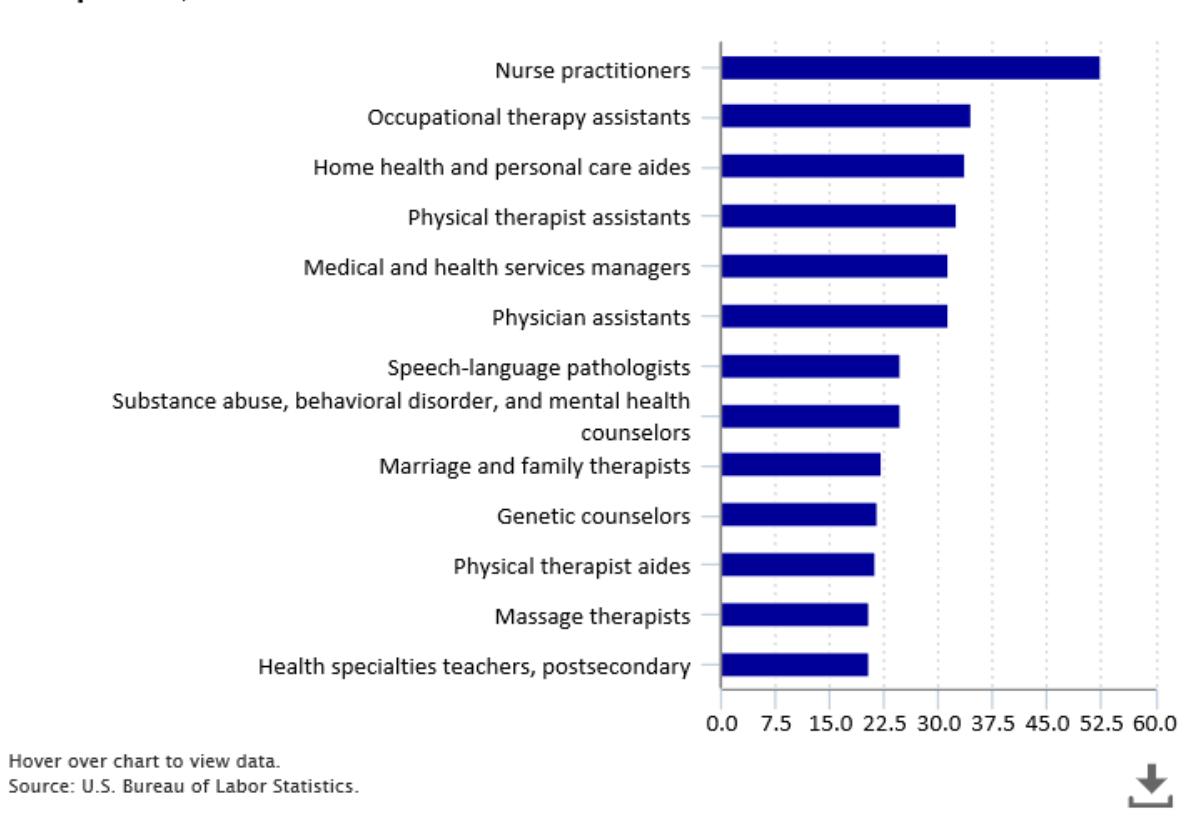
Other occupational groups in which employment is projected to grow markedly faster than the average for all occupations (3.7 percent) include computer and mathematical occupations, personal care and service occupations, and food preparation and serving related occupations. Computer occupations are expected to see job growth as strong demand is expected for IT (information technology) security and software development and as new products associated with the Internet of Things are developed. Rising incomes and a higher share of expenditures on food away from home are expected to drive growth for food preparation workers.<sup>[38]</sup>

Four major occupational groups are expected to lose employment: office and administrative support occupations, with a projected decline of 4.7 percent over the decade; production occupations, with a projected decline of 4.5 percent; sales and related occupations, with a projected decline of 2.0 percent; and farming, fishing, and forestry occupations, with a projected decline of 0.1 percent. Although employment declines among sales and related occupations will result from increasing competition from e-commerce, declines in the other groups reflect the increasing adoption of automation and productivity-enhancing technology in clerical and administrative work, manufacturing, and agriculture.

## Fastest growing occupational employment

The projected fast employment growth in the healthcare and social assistance sector is expected to increase employment substantially in many healthcare occupations from 2019 to 2029. (See figure 18.) Healthcare occupations and those associated with healthcare (including mental health) account for 13 of the 30 fastest growing occupations from 2019 to 2029. Increased demand for healthcare services by aging baby boomers and people with chronic conditions will drive the projected employment growth.<sup>[39]</sup> Several of the fastest growing healthcare occupations—including nurse practitioners, occupational therapy assistants, and physician assistants—are projected to be in greater demand because team-based healthcare models are increasingly used to deliver healthcare services.<sup>[40]</sup>

**Figure 18. Projected percent change, by selected healthcare and related occupations, 2019–29**



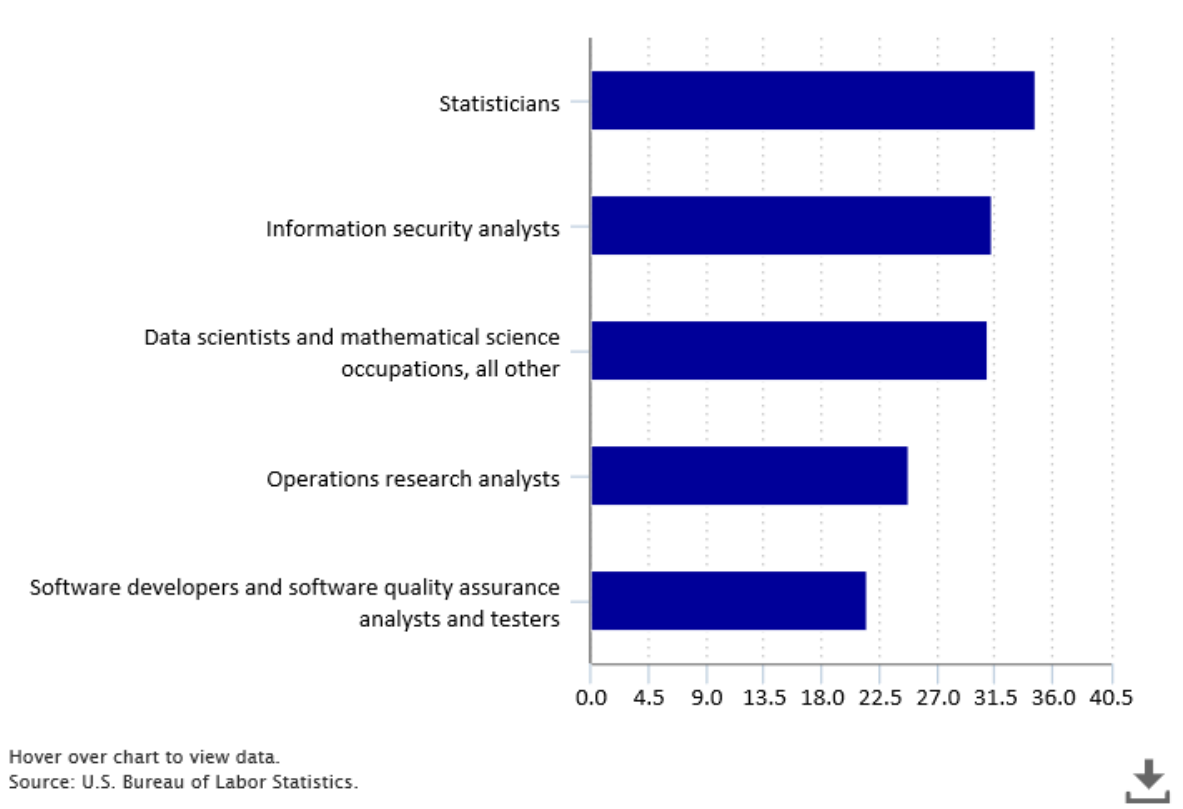
Within the community and social service occupational group, two healthcare-related counseling occupations are also projected to grow rapidly. Substance abuse, behavioral disorder, and mental health counselors and marriage and family therapists are projected to have fast employment growth because of increased demand for treatment of mental and behavioral issues, including opioid addiction. Healthcare-associated occupations from the management and education occupational groups—medical and health services managers and postsecondary health specialties teachers—are also expected to be among the fastest growing occupations.

Growth in information and related computer industries is expected to drive employment growth for several occupations in the computer and mathematical group. This group contains 5 of the 30 fastest growing occupations. As more devices are connected to the internet, the need to combat cybersecurity threats will increase. The risk of cyberattacks is expected to create demand for information security analysts, who will be needed to prevent the theft of critical information and to prevent service attacks on computer networks. Employment of these analysts is

projected to increase 31.2 percent from 2019 to 2029. The expected increased use of mobile devices and software to operate or manage everything from home appliances to medical devices will create demand for software developers and software quality assurance analysts and testers. Employment in this occupation is projected to grow 21.5 percent over the decade. Increased use of mobile devices will also drive demand for web-based and application-based video content, which in turn will lead to employment demand for film and video editors. This occupation's employment is projected to grow 21.6 percent from 2019 to 2029.

Employment is projected to grow for statisticians, data scientists, and operations research analysts because of the increasing widespread use of statistical analysis to make informed business, healthcare, and policy decisions. (See figure 19.) In addition, the growing amount of data available online ("big data") will open new areas for analysis for these occupations.

**Figure 19. Projected percent change, by selected computer and mathematical occupations, 2019–29**



Two of the top three projected fastest growing occupations—wind turbine service technicians and solar photovoltaic (PV) installers—are involved in alternative energy production. Employment for wind turbine service technicians is expected to grow extremely fast (60.7 percent) from 2019 to 2029 as the expansion and adoption of wind turbines and their installation create new jobs. However, because this occupation is relatively small, with a 2019 employment level of 7,000, the fast growth will account for only about 4,300 new jobs over the next 10 years. In addition, developments in solar energy generation have made solar energy increasingly competitive with traditional power generation sources, such as coal and natural gas, and are expected to drive employment growth

for PV installers. Employment of these workers is projected to grow 50.5 percent over the next 10 years. Like wind turbine service technicians, this occupation is small and its rapid growth will account for only about 6,100 new jobs.

## Most rapidly declining occupational employment

As noted earlier, the manufacturing sector is projected to lose the most jobs and has one of the most rapid employment declines of any sector over the projections decade. The decline in employment in the manufacturing sector is expected to decrease employment over the projections decade in several occupations concentrated in manufacturing. Production occupations are projected to experience the second-strongest employment decline of any occupational group, because of a combination of productivity-enhancing technologies, such as robotics, and international competition.<sup>[41]</sup> Of the 30 occupations with the fastest employment declines, 12 are in the production occupational group and include various machine and tool setters, assemblers, and operators. Although their employment is projected to decline rapidly, they are relatively small occupations and are projected to lose 45,800 jobs, in total.

Similarly, technological changes are expected to continue to negatively affect the employment of several office and administrative support occupations. For example, software tools can help schedule meetings and appointments (replacing secretaries and administrative assistants), and digital data collection and handwriting recognition software can perform work previously done by data entry keyers. Of the 30 occupations with the fastest declining employment, 8 are office and administrative support occupations. Collectively, these 8 occupations are projected to lose about 257,400 jobs from 2019 to 2029.

Sales and related occupations are also expected to decline in employment over the next decade, largely because of competition from e-commerce activity and automation of checkout positions. Cashiers, retail salespersons, and first-line supervisors of retail sales workers are each projected to see employment declines from 2019 to 2029, for a combined loss of 371,600 jobs, as online shopping displaces brick-and-mortar retail employment.<sup>[42]</sup>

Farming, fishing, and forestry occupations are also projected to decline, by 0.1 percent from 2019 to 2029. Consolidation in the agricultural industry—a greater share of farming output moving from small to large farms—is allowing more agricultural output to be produced with fewer workers. In addition, automating technology, such as robotics, is reducing employment demand for farm laborers.<sup>[43]</sup>

## Conclusions

An aging population and slower population growth will result in slower growth in the labor force from 2019 to 2029 than in prior decades. Older people participate in the labor force less than younger people do, so fewer people are available to be employed. As a result, the projected growth for all jobs, at 3.7 percent, is slower than it was during the prior projections decade. In addition, since the base year of the projections (2019) is after a long economic expansion, economic growth rates are expected to be lower than rates in previous projection cycles.

From 2019 to 2029, employment in the service-providing sectors is projected to grow while that in the goods-producing sector is projected to decline. Occupations that provide healthcare or services related to healthcare are projected to be the most represented among the fastest growing occupations. An aging population is projected to demand more healthcare and related services. In addition, the number of people with chronic conditions is

projected to continue to grow, adding to the demand for healthcare-related occupations. Other occupations projected to grow rapidly include those involved with computers, math, and alternative energy.

#### SUGGESTED CITATION

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#### NOTES

<sup>1</sup> Annual growth refers to a compounded annual growth rate.

<sup>2</sup> Total employment is the summation of the employment figures for nonagricultural wage and salary workers; agricultural, forestry, fishing, and hunting workers; and self-employed workers. Nonagricultural wage and salary employment data are from the U.S. Bureau of Labor Statistics (BLS) Current Employment Statistics (CES) survey, excluding data for logging, and include private household employment data, which are provided by the Current Population Survey (CPS). The CPS also provides data for self-employed workers and agricultural, forestry, fishing, and hunting workers, except data for logging workers, which are provided by the CES survey.

<sup>3</sup> BLS develops macroeconomic projections with the Macroeconomic Advisers (MA) model, a structural econometric model of the U.S. economy. The model, licensed from MA by IHS Markit, comprises more than 1,000 variables, behavioral equations, and identities. Central characteristics of the MA model are a life-cycle model of consumption, a neoclassical view of investment, and a vector autoregression for the monetary policy sector of the economy. The full-employment foundation of the model is the most critical characteristic for the BLS outlook. Within MA, a submodel calculates an estimate of potential output from the nonfarm business sector. The calculation is based on full-employment estimates of the sector's hours worked and output per hour. Error-correction models are embedded in the MA model so that the model's solution is aligned with the full-employment submodel. MA does not forecast sharp cyclical movements in the economy over the 10-year projection horizon. "Add-factors" are either left unchanged after the first couple of years of the solution or returned to historical norms. Add-factors represent changes made to the base result of a forecast or projection equation; see "Glossary of statistical terms" (Paris: Organisation for Economic Co-operation and Development, September 25, 2001, updated March 28, 2014), <https://stats.oecd.org/glossary/detail.asp?ID=44>. The structure of the model, exogenous assumptions, and MA's view of the Federal Reserve's long-term policy objective largely determine the characteristics of the model's long-term outlook for the economy. For more information, see <http://www.macroadvisers.com/>.

<sup>4</sup> Energy Information Administration (EIA) estimates include prices for West Texas Intermediate crude oil, Brent crude oil, and natural gas and assume current energy regulations will remain unchanged. For more information, see *Annual energy outlook 2020* (U.S. Energy Information Administration, January 29, 2020, released annually), <https://www.eia.gov/outlooks/aeo/>.

<sup>5</sup> Visit our "Employment projections methods overview" page for a detailed description of the projections process at <https://www.bls.gov/emp/documentation/projections-methods.htm>.

<sup>6</sup> For pre-1946 data, see [https://www2.census.gov/library/publications/1949/compendia/hist\\_stats\\_1789-1945/hist\\_stats\\_1789-1945-chD.pdf](https://www2.census.gov/library/publications/1949/compendia/hist_stats_1789-1945/hist_stats_1789-1945-chD.pdf), and for post-1946 data, see <https://www.bls.gov/cps/>.

<sup>7</sup> Population Research Institute staff, "U.S. birth 'echo boom' fades away" (Population Research Institute, September 1, 1995), <https://www.pop.org/u-s-birth-echo-boom-fades-away/>.

<sup>8</sup> "Foreign born CPS data tables," table 1.1 for 1999, 2009, and 2019 (U.S. Census Bureau), <https://www.census.gov/topics/population/foreign-born/data/tables/cps-tables.html>. Note that these U.S. Census Bureau data encompass the resident population. The percentage points attributed to noninstitutional population growth are higher because few immigrants are children (ages 0–15), of whom are included in the resident population.

- <sup>9</sup> Eileen Patten, “2010, foreign-born population in the United States statistical portrait,” “Table 6. Population, by nativity, race and ethnicity: 2010,” *Hispanic Trends*, February 21, 2012, <https://www.pewresearch.org/hispanic/2012/02/21/2010-statistical-information-on-immigrants-in-united-states/>.
- <sup>10</sup> “U.S. fertility rates higher among minorities” (Washington, DC: Population Reference Bureau, January 1, 2003), <https://www.prb.org/usfertilityrateshigheramongminorities/>.
- <sup>11</sup> Sandra Leigh Johnson, “Drops in natural increase, net international migration resulted in 0.5% annual growth to 328.2M,” *Population* (U.S. Census Bureau, December 30, 2019), <https://www.census.gov/library/stories/2019/12/new-estimates-show-us-population-growth-continues-to-slow.html>.
- <sup>12</sup> For a more nuanced discussion on potential growth and its reflection in BLS projections, see Kevin S. Dubina, “Full employment: an assumption within BLS projections,” *Monthly Labor Review*, November 2017, <https://www.bls.gov/opub/mlr/2017/article/full-employment-an-assumption-within-bls-projections.htm>.
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- <sup>14</sup> Didem Tüzemen, “Why are prime-age men vanishing from the labor force?” *Economic Review* (Federal Reserve Bank of Kansas City, first quarter 2018), <https://www.kansascityfed.org/~media/files/publicat/econrev/econrevarchive/2018/1q18tuzemen.pdf>.
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- <sup>16</sup> Martin Neil Baily and Benjamin H. Harris, “Working longer policies: framing the issues,” *Economic Studies at Brookings* (The Brookings Institution and Northwestern Kellogg School of Management, January 2019), [https://www.brookings.edu/wp-content/uploads/2019/01/ES\\_20180124\\_Harris-Baily-Retirement-Proposals1.pdf](https://www.brookings.edu/wp-content/uploads/2019/01/ES_20180124_Harris-Baily-Retirement-Proposals1.pdf).
- <sup>17</sup> Karel Mertens, “U.S. tax cuts boost economy—but for how long?” *Dallas Fed Economics* (Federal Reserve Bank of Dallas, June 4, 2019), <https://www.dallasfed.org/research/economics/2019/0604>.
- <sup>18</sup> BLS used the nonaccelerating inflation rate of unemployment estimate as published by the Congressional Budget Office at the time of our estimation.
- <sup>19</sup> “The Federal Reserve’s dual mandate” (Federal Reserve Bank of Chicago, updated August 10, 2020), <https://www.chicagofed.org/research/dual-mandate/dual-mandate>.
- <sup>20</sup> “Why does the Federal Reserve aim for inflation of 2 percent over the longer run?” FAQs (Board of Governors of the Federal Reserve System, Federal Reserve, updated August 27, 2020), [https://www.federalreserve.gov/faqs/economy\\_14400.htm](https://www.federalreserve.gov/faqs/economy_14400.htm).
- <sup>21</sup> A variety of inflation measures exist. BLS includes two of the more common measures, the Consumer Price Index and a GDP index (sometimes referred to as a deflator) in table 4.2. See table 4.2 on the employment projections public website at <https://www.bls.gov/emp/tables/real-gdp-major-demand-category.htm>.
- <sup>22</sup> Arthur B. Laffer, “Get ready for inflation and higher interest rates,” *The Wall Street Journal*, June 11, 2009, <https://www.wsj.com/articles/SB124458888993599879>.
- <sup>23</sup> For more information regarding the natural rate of interest, see Thomas Laubach and John C. Williams, “Measuring the natural rate of interest” (Board of Governors of the Federal Reserve System, November 2001), <https://www.federalreserve.gov/pubs/feds/2001/200156/200156pap.pdf>; and “Measuring the natural rate of interest” (Economic Research, Federal Reserve Bank of New York), <https://www.newyorkfed.org/research/policy/rstar>.

<sup>24</sup> Sungki Hong and Hannah G. Shell, “Factors behind the decline in the U.S. natural rate of interest,” *Economic Synopses* (Economic Research, Federal Reserve Bank of St. Louis, April 19, 2019) <https://research.stlouisfed.org/publications/economic-synopses/2019/04/19/factors-behind-the-decline-in-the-u-s-natural-rate-of-interest>.

<sup>25</sup> For more information, see “*Annual energy outlook 2020*,” <https://www.eia.gov/outlooks/aeo/>. This model was run in early 2020, before oil prices fell dramatically in the wake of the coronavirus disease 2019 stay-at-home order.

<sup>26</sup> Throughout this article, output refers to real output in chain-weighted 2012 dollars.

<sup>27</sup> “Internet of Things,” *Merriam-Webster*, <https://www.merriam-webster.com/dictionary/Internet%20of%20Things>.

<sup>28</sup> “Employment projections,” “Table 2.5 Industries with the fastest growing and most rapidly declining output” (U.S. Bureau of Labor Statistics, last modified September 1, 2020), <https://www.bls.gov/emp/tables/industries-fast-grow-decline-output.htm>.

<sup>29</sup> Nonagricultural wage and salary employment data are from the CES survey, except for private household employment data, which are from the CPS. Logging workers are excluded.

<sup>30</sup> Julia La Roche, “Here’s why the retail sector keeps bleeding jobs,” *Yahoo Finance*, October 4, 2019, <https://finance.yahoo.com/news/retail-loses-11000-jobs-in-september-145131614.html>; Nathaniel Popper, “Americans keep clicking to buy, minting new online shopping winners,” *The New York Times*, May 13, 2020, <https://www.nytimes.com/interactive/2020/05/13/technology/online-shopping-buying-sales-coronavirus.html>; and Austan Goolsbee, “Never mind the internet. Here’s what’s killing malls,” *The New York Times*, February 13, 2020, updated February 14, 2020, <https://www.nytimes.com/2020/02/13/business/not-internet-really-killing-malls.html>.

<sup>31</sup> Steven F. Hipple and Laurel A. Hammond, “Self-Employment in the United States,” *Spotlight on Statistics*, March 2016, <https://www.bls.gov/spotlight/2016/self-employment-in-the-united-states/pdf/self-employment-in-the-united-states.pdf>.

<sup>32</sup> Emily Richards Rolen, “Healthcare jobs you can get without a bachelor’s degree,” *Beyond the Numbers*, November 2016, <https://www.bls.gov/opub/btn/volume-5/pdf/healthcare-jobs-you-can-get-no-bachelors-degree.pdf>; and Lauren Medina, Shannon Sabo, and Jonathan Vespa, “Living longer: historical and projected life expectancy in the United States, 1960 to 2060” (U.S. Census Bureau, February 2020), <https://www.census.gov/content/dam/Census/library/publications/2020/demo/p25-1145.pdf>.

<sup>33</sup> Zach Lazzari, “What are the causes of rapid growth in the service industry?” *Chron*, January 22, 2019, <https://smallbusiness.chron.com/causes-rapid-growth-service-industry-16007.html>.

<sup>34</sup> Alexa Lardieri, “Robots will replace 20 million jobs by 2030, Oxford report finds,” *U.S. News and World Reports*, June 26, 2019, <https://www.usnews.com/news/economy/articles/2019-06-26/report-robots-will-replace-20-million-manufacturing-jobs-by-2030>.

<sup>35</sup> Joseph Ahrens, “The decline in newspapers: a closer look,” *Wake Review* (Raleigh, NC: Wake Review Literary Magazine & Club, Wake Tech Community College, November 2016), <https://clubs.waketech.edu/wake-review/magazine/creative-writing/non-fiction/the-decline-in-newspapers-a-closer-look-joseph-ahrens/>; and Michael Barthel, “Newspapers fact sheet,” *Journalism & Media* (Pew Research Center, July 9, 2019), <http://www.journalism.org/fact-sheet/newspapers/>.

<sup>36</sup> The 2019–29 National Employment Matrix is based off the hybrid structure between the 2010 and 2018 Standard Occupational Classification (SOC) systems developed for the Occupational Employment Statistics survey. For more information on the implementation of the 2018 SOC system, see [https://www.bls.gov/oes/soc\\_2018.htm](https://www.bls.gov/oes/soc_2018.htm).

<sup>37</sup> The occupation of personal care aides was formerly a separate occupation (code 39-9021) in the 2010 SOC system. In the 2018 SOC system, these workers share a combined code with home health aides and move from the “personal care and service” occupational group to the “healthcare support” occupational group.

<sup>38</sup> Allie Van Duyne, “More people are choosing to dine out. Here’s why,” *Toast*, <https://pos.toasttab.com/blog/why-more-people-are-choosing-to-eat-out>.

<sup>39</sup> For more information, see Rolen, “Healthcare jobs you can get without a bachelor’s degree.”

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# A new BLS satellite series of net inputs to industry price indexes: methodology and uses

*This article describes U.S. Bureau of Labor Statistics efforts to develop a new set of satellite net inputs to industry price indexes that capture price change for both domestically produced and imported inputs to production. In addition to detailing the methodology for constructing the new indexes, the article discusses their publication structure and potential uses.*

In September 2020, the U.S. Bureau of Labor Statistics (BLS) introduced a new set of satellite net inputs to industry price indexes.<sup>1</sup> These indexes measure price changes for both domestically produced and imported inputs (excluding capital investment and labor) consumed by most three-digit North American Industry Classification System (NAICS) industry groups.<sup>2</sup> The new indexes are calculated by using the detailed price indexes published with the BLS Principal Federal Economic Indicators of the Producer Price Index (PPI) program and the International Price Program (which produces the U.S. Import and Export Price Indexes).

The new satellite series, published on the [PPI webpage](#), is the culmination of a long-term BLS effort to develop a comprehensive set of net inputs to industry price indexes. BLS first proposed calculating such indexes in the late 1970s and published its first series in 1986. The scope of these indexes and the methodology for calculating them were relatively limited, because the indexes were only published for the construction sector of the economy and excluded input prices for services, imports, capital investment, and labor. In 2015, BLS improved the construction industry input indexes by adding prices for services inputs. At the same time, the input price index series was expanded with indexes for a small number of manufacturing and service industries. After 2015, BLS continued its improvement efforts, and, in September 2020, it introduced a new satellite series of input indexes. While the new satellite indexes complement official BLS indexes already in existence, they are produced and published separately from them. The new data series improves upon the existing input price indexes by adding prices for imported goods inputs. In addition, it



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represents a major coverage expansion, because the official input indexes are only available for construction industries and a limited number of manufacturing and service industries.

This article describes the methodology used to construct the new input indexes, explains their publication structure, and provides examples of their potential uses.

## Methodology

The BLS net inputs to industry price indexes presented in this article measure the average change in prices most domestic industries pay for nearly all inputs to production, excluding capital investment and labor. As noted previously, by tracking price changes for both domestically produced and imported inputs, these new indexes differ from currently published BLS net inputs to industry price indexes, which account only for prices of domestically produced inputs.

To construct an overall net inputs to industry price index, BLS calculates two separate indexes: one measuring price change for domestically produced inputs and the other measuring price change for imported goods inputs.<sup>3</sup> The two indexes are then aggregated into an overall input price index that measures price change for industry inputs regardless of their country of origin. PPI commodity indexes are used to construct the domestic portion of the overall index, and import price indexes (MPIs) are used to construct the imported portion of the index.

The first subsection below describes the use of U.S. Bureau of Economic Analysis (BEA) Input–Output (I–O) data in establishing the set of inputs consumed by an industry. The next two subsections explain the methodologies for calculating the price indexes for domestically produced and imported goods inputs. The final subsection presents the methodology for combining these indexes into an overall net inputs to industry price index.

## Determining inputs to an industry

To determine the set of inputs consumed by an industry, BLS relies on the BEA “Use of commodities by industries” table (hereafter referred to as the “use table”).<sup>4</sup> The use table provides, on an industry basis, the set and dollar value of products consumed by each domestic industry as inputs to production. The data in the use table are classified by I–O codes, which are very similar to NAICS codes. Importantly, the values included in the use table represent the combined value of domestic and foreign production of the product consumed by an industry. For this reason, the set of domestic inputs included in a given industry input index is the same as the set of imported inputs included in that index. However, as explained below, the weights assigned to the domestically produced commodity differ from those assigned to the imported commodity. The domestic weights reflect the relative value of the input commodity produced in the United States, whereas the imported weights reflect the relative value of the input commodity produced abroad.

## Domestic index

The domestic portion of a net inputs to industry price index is constructed from PPI commodity indexes, which measure price change for domestically produced goods, services, and construction products. In determining the appropriate set of PPI commodity indexes to be included in an input price index for an industry, the PPI program matches the industry’s use-table data to PPI codes.<sup>5</sup> This matching results in a set of PPIs that correspond with the products the industry consumes.

After the set of PPIs to be included in an industry's input price index is determined, it is necessary to construct weights for each component PPI. These weights reflect the value of an input relative to all inputs consumed by the industry. The gross weight for a component PPI equals the share of the total value of the commodity consumed by the industry multiplied by the U.S. Census Bureau wherever-made value of shipments for that commodity, which reflects the total value of the commodity's domestic production in a given year. Assuming there are  $n$  industries and  $m$  commodities, one can calculate the share of commodity  $c$  consumed by industry  $i$  in base period  $b$  as

$$(1) \quad S_{c,i,b}^u = \text{Use}_{c,i,b} / \left( \sum_{i=1}^n \text{Use}_{c,i,b} \right),$$

where  $\text{Use}_{c,i,b}$  denotes the use of commodity  $c$  by industry  $i$  in base period  $b$ ; and  $\sum_{i=1}^n \text{Use}_{c,i,b}$  is the total use of commodity  $c$  by all use-table industries in base period  $b$ .

The gross weight of commodity  $c$  in the input index for industry  $i$  at time  $b$  can then be written as

$$(2) \quad \text{GW}_{c,i,b} = S_{c,i,b}^u \times \text{VOS}_{c,b},$$

where  $\text{VOS}_{c,b}$  is the wherever-made value of shipments for commodity  $c$  in base period  $b$ .

After the gross weight of an input commodity is determined, it is converted to a net weight by removing the portion of the commodity's value that was produced within the industry. Net weighting removes multiple-counting bias from the overall input price index. This bias occurs when prices from several stages of production are included in an aggregate index.

A net weight is calculated by applying a net input ratio to the gross weight. The net input ratio is calculated by using data from the BEA "Make of commodities by industry" table, which provides the set and dollar value of products made by each domestic industry,<sup>6</sup> and represents the share of the commodity produced outside the consuming industry. The share of commodity  $c$  produced by industry  $i$  in base period  $b$  is given by

$$(3) \quad S_{c,i,b}^m = \text{Make}_{c,i,b} / \left( \sum_{i=1}^n \text{Make}_{c,i,b} \right),$$

where  $\text{Make}_{c,i,b}$  is the make of commodity  $c$  by industry  $i$  in base period  $b$ ; and  $\sum_{i=1}^n \text{Make}_{c,i,b}$  is the total make of commodity  $c$  by all industries in base period  $b$ .

The net input ratio of commodity  $c$  for industry  $i$  in base period  $b$  is the share of commodity  $c$  not made by industry  $i$  and is calculated as follows:

$$(4) \quad \text{NIR}_{c,i,b} = 1 - S_{c,i,b}^m.$$

The final net value weight for commodity  $c$  in the input index for industry  $i$  in base period  $b$  is calculated as

$$(5) \quad \text{NW}_{c,i,b} = (1 - S_{c,i,b}^m) \times S_{c,i,b}^u \times \text{VOS}_{c,b},$$

which can be rewritten as

$$(6) \quad \text{NW}_{c,i,b} = \text{NIR}_{c,i,b} \times \text{GW}_{c,i,b}.$$

Once the products and weights for a net inputs to industry price index are determined, the index is calculated with a modified Laspeyres formula based on standard PPI methodology.<sup>7</sup> An approximation of the PPI aggregate price index for month  $t$  is given by

$$(7) \quad I_{a,t} = I_{a,t-1} \times \left[ \sum_{c=1}^m (I_{c,t} / I_{c,b}) \times NW_{c,b} \right] / \left[ \sum_{c=1}^m (I_{c,t-1} / I_{c,b}) \times NW_{c,b} \right],$$

where  $I_{a,t-1}$  is the aggregate price index in period  $t-1$ ;  $I_{c,t}$  is the price index for commodity  $c$  in period  $t$ ;  $I_{c,t-1}$  is the price index for commodity  $c$  in period  $t-1$ ;  $I_{c,b}$  is the price index for commodity  $c$  in base period  $b$ ; and  $NW_{c,b}$  is the net weight for commodity  $c$  in base period  $b$ .

## Import index

The imported portion of an input price index is constructed from MPIs, which measure price change for imported commodities and are classified by NAICS codes. As was the case with domestic inputs, determining the set of MPIs to be included in an input price index for an industry requires converting the industry's use-table data from I-O codes to MPIs (based on NAICS codes). This concordance results in a set of MPIs that correspond with the products consumed by the industry, and these MPIs are the imported components of the input price index for the industry.

After the set of MPIs to be included in an input price index is determined, weights are constructed for the component MPIs. The gross weight for an MPI equals the share of the total value of the commodity consumed by the industry, as shown in equation (1), multiplied by the census import trade value of shipments for the commodity during the base period. This calculation results in weights reflecting only the foreign-produced portion of the input commodity's value. The gross weight of commodity  $c$  in the input index for industry  $i$  at time  $t$  can then be written as

$$(8) \quad GW_{c,i,b} = S_{c,i,b}^u \times VOI_{c,b},$$

where  $VOI_{c,b}$  is the value of imports for commodity  $c$  in base period  $b$ .

Unlike the domestic portion of the input index, the imported portion does not require net weighting. Because domestic industries cannot produce imports, the share of a domestic industry's production of the import commodity is 0 ( $S_{c,i,b}^m = 0$ ) and the net input ratio is 1. When all net input ratios equal 1, the net weights exactly equal the gross weights.

Once the products and weights for an inputs to industry price index are determined, the index is calculated with a modified Laspeyres formula, as shown in equation (7).

## Aggregating the domestic and import indexes

As noted previously, the domestic and imported input price indexes are aggregated into a total index.<sup>8</sup> The aggregate price index at time  $t$  is given by

$$(9) \quad I_{a,t} = I_{a,t-1} \times \left[ \sum_{c=1}^m (I_{cd,t} / I_{cd,b}) \times NW_{cd,b} + \sum_{c=1}^m (I_{cf,t} / I_{cf,b}) \times NW_{cf,b} \right] / \left[ \sum_{c=1}^m (I_{cd,t-1} / I_{cd,b}) \times NW_{cd,b} + \sum_{c=1}^m (I_{cf,t-1} / I_{cf,b}) \times NW_{cf,b} \right],$$

where  $I_{a,t-1}$  is the aggregate price index at time  $t-1$ ;  $I_{cd,t}$  is the domestic price index for commodity  $c$  in period  $t$ ;  $I_{cd,t-1}$  is the domestic price index for commodity  $c$  in period  $t-1$ ;  $I_{cd,b}$  is the domestic price index for commodity  $c$  in base period  $b$ ;  $NW_{cd,b}$  is the net weight for domestic commodity  $c$  in base period  $b$ ;  $I_{cf,t}$  is the foreign price index for commodity  $c$  in period  $t$ ;  $I_{cf,t-1}$  is the foreign price index for commodity  $c$  in period  $t-1$ ;  $I_{cf,b}$  is the foreign price index for commodity  $c$  in base period  $b$ ; and  $NW_{cf,b}$  is the net weight for foreign commodity  $c$  in base period  $b$ .

## Publication structure

For each three-digit NAICS industry group, BLS publishes an aggregate input index measuring price change for inputs (excluding capital investment and labor) consumed by the group.<sup>9</sup> BLS also publishes separate subaggregate indexes measuring price change for domestically produced and imported inputs consumed by the industry group. Final breakdowns under the domestic subaggregate are published for goods, services, and construction products. No index is produced for industry groups that do not consume a sufficient quantity of inputs in a specific goods or service category. An example of the publication structure is presented in table 1.

**Table 1. Example of a publication structure for satellite input price indexes for nonmetallic mineral product manufacturing (NAICS 327)**

Title	Code
Inputs to NAICS 327, nonmetallic mineral product manufacturing, excluding capital investment and labor	IN327
Inputs to NAICS 327, domestically produced products	IN3271
Inputs to NAICS 327, domestically produced goods	IN32711
Inputs to NAICS 327, domestically produced services	IN32712
Inputs to NAICS 327, domestically produced maintenance and repair construction	IN32713
Inputs to NAICS 327, imported goods	IN3272
Note: NAICS = North American Industry Classification System.	
Source: U.S. Bureau of Labor Statistics.	

The publication table includes historical index values from the first period of index calculation forward. (In most cases, the index calculation began in December 2018.) Each month, after the release of PPI and MPI data, data for the current period are added to the table, and data for the 4 months prior to the current period are revised. These published data are rounded to the third decimal place.<sup>10</sup>

## Data uses

This section describes four potential uses for the BLS satellite index series: industry cost analysis, price transmission analysis, contract escalation, and deflation.

### Industry cost analysis

The most straightforward use of the net inputs to industry price indexes is to measure changes in industry input costs over time. Calculating the percent change in index levels between two periods provides a measure of the change in an industry's input costs, excluding those for labor and capital investment. In addition, subaggregate indexes can be used to compare price trends for domestically produced and imported inputs. Finally, subaggregate

indexes within the index for domestically produced inputs can be used to compare price trends for domestically produced goods and services inputs.

As an example, figure 1 presents input price indexes for the transportation equipment manufacturing industry group (NAICS 336). From December 2018 through January 2020, the overall input price index rose 0.4 percent, the index for imported inputs fell 1.1 percent, and the index for domestically produced inputs increased 1.0 percent. The inclusion of prices for imported inputs is clearly important for this industry, causing a 0.6-percentage-point difference in the index movements over the sample period. (Without the inclusion, the index rose 1.0 percent.)

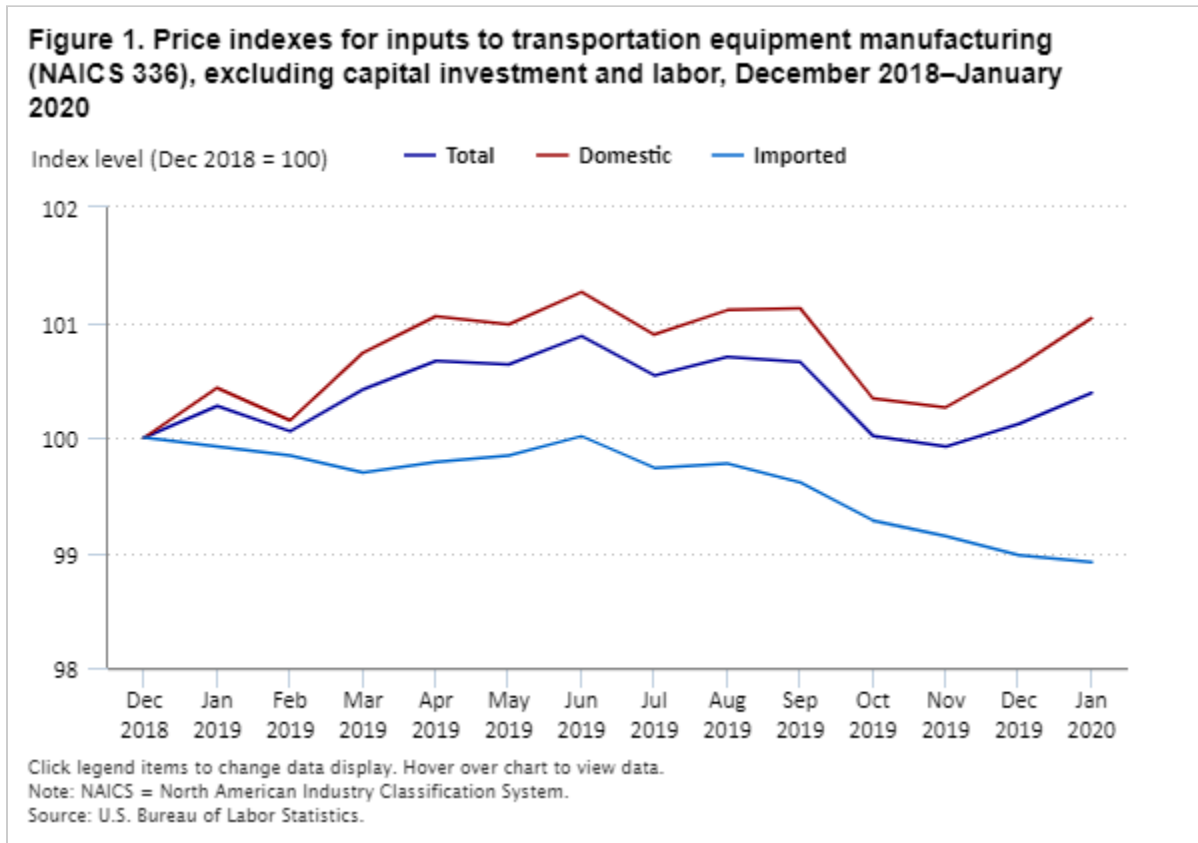
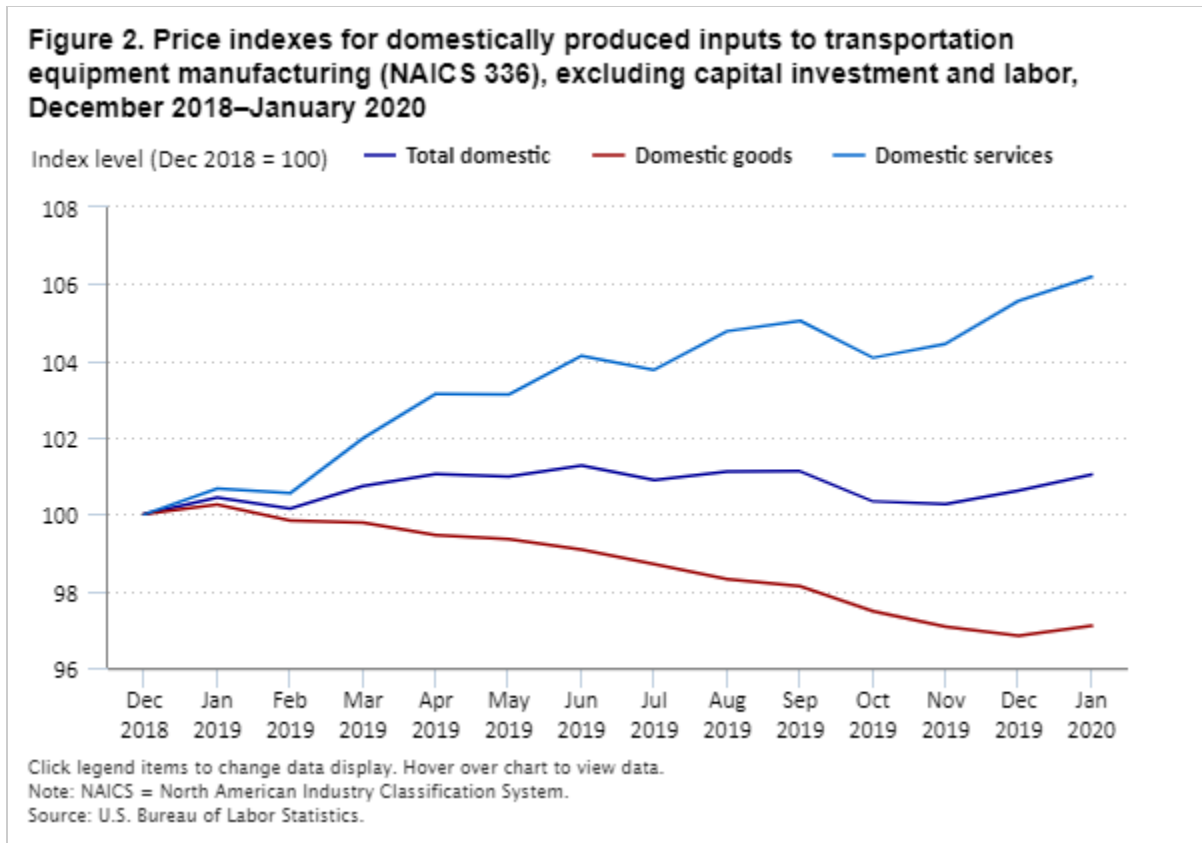


Figure 2 presents the subaggregate price index for domestically produced inputs, along with a further breakdown for domestically produced goods and services. For transportation equipment manufacturing, the input index for domestically produced goods fell 2.9 percent, while that for services rose 6.2 percent. Therefore, the increase in the overall input price index can be traced to prices for domestically produced services, because prices for both imported and domestically produced goods declined. (See figure 1.)



This subsection has illustrated that the new input price indexes provide a relatively detailed measure of changes in industry costs, allowing data users to compare price trends for domestically produced and imported inputs and for domestically produced goods and services inputs.

## Price adjustments for contracting parties

BLS price index data are widely recognized as useful in price adjustment clauses, because they provide an objective price-change measure free from possible manipulation by contracting parties. The satellite series of input price indexes offers a new set of data that contracting parties can use in price adjustment clauses. In some cases, contracting parties may want to make price adjustments based on either broad-level inflation or price change for a specific product. In other instances, the parties may prefer to adjust prices on the basis of changes in overall input costs. For these latter cases, the input price indexes may be useful by providing an objective measure of price change for inputs purchased by specific industry groups.

There are several methods of using BLS data in price adjustment, including the “simple percentage” method, the “adjusting a portion of the base price” method, the “index points” method, the “limits for price adjustment” method, and the “composite indexes” method.<sup>11</sup> An example using the composite indexes method, which is often implemented by parties that want to adjust prices on the basis of changes in input costs, is provided below. To implement this method, parties select a set of component price indexes that represent significant inputs and calculate a weighted average of price change for those indexes. The weighted average is then used to adjust the contract price. The composite indexes method often includes prices for goods inputs, services inputs, and labor. The benefit of using a new input index is that it incorporates the near-full set of material and services inputs consumed by an industry group. Without this index, parties would need to identify important material and services

inputs individually and then attempt to weight them properly, likely obtaining a less complete input measure than the one calculated by BLS.

Table 2 presents an example of a composite price adjustment for the sale of 500 plastic containers. The contracting parties agree to use the net inputs to industry price index for plastic and rubber products (NAICS 326), to account for price changes in material and services inputs, and the Employment Cost Index, to account for changes in labor input costs.<sup>12</sup>

**Table 2. Example of composite price adjustment for plastic containers (NAICS 326)**

Step	Inputs to NAICS 326	Employment Cost Index	Composite
1: Base price (December 2018) = \$1,000 per 500 plastic containers	—	—	—
2: 2018 index value	100.0	131.9	—
3: 2019 index value	95.4	135.8	—
4: Index relative = (2019 index)/(2018 index)	0.954	1.030	—
5: Assigned proportion	0.65	0.35	—
6: (Index relative) × (Assigned proportion)	0.620	0.360	—
7: Composite relative = Sum [(Index relative) × (Assigned proportion)]	—	—	0.980
8: Adjusted price = (Base price) × (Composite relative)	—	—	\$980

Note: NAICS = North American Industry Classification System.

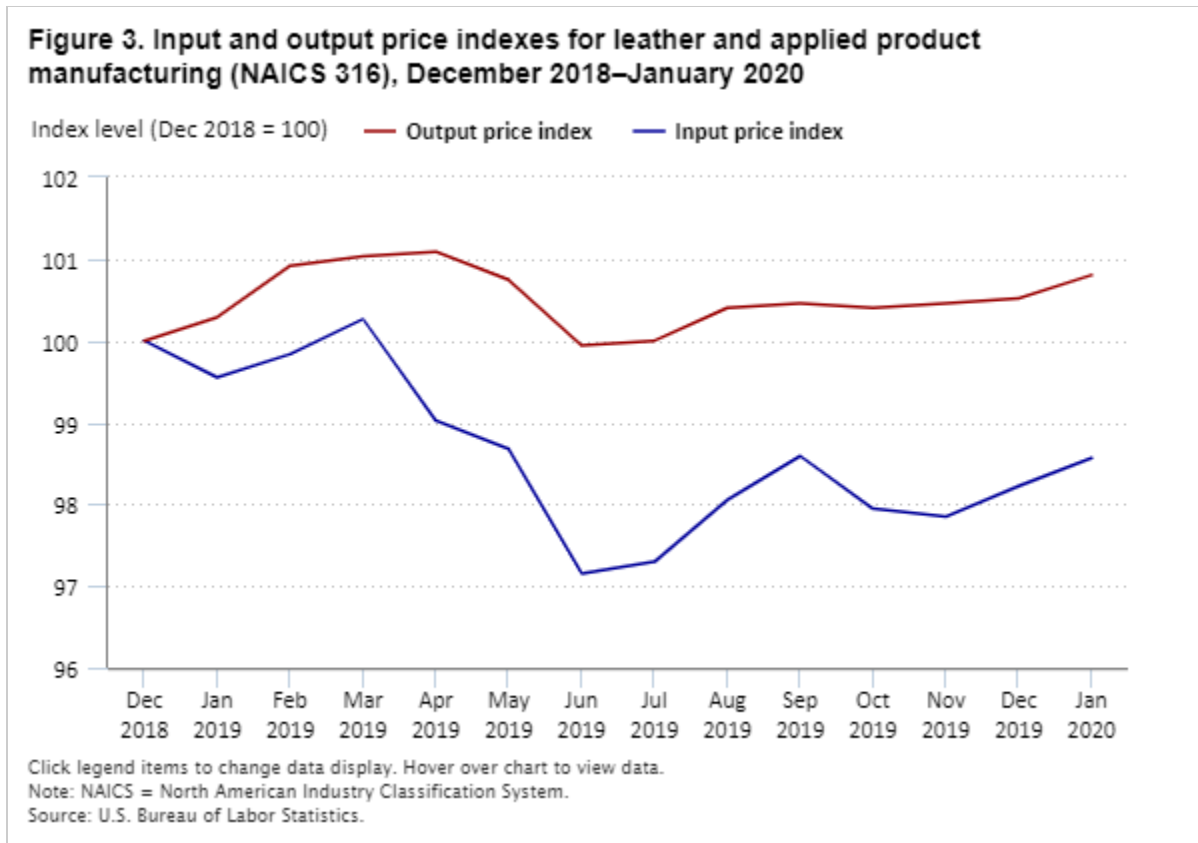
Source: Authors' calculations based on data from the U.S. Bureau of Labor Statistics.

As shown in row 1 of table 2, in the contract's base period (December 2018), the price of 500 plastic containers is set at \$1,000. To adjust the contract price from the base period to the current period, one begins by deriving relatives of the component indexes, dividing the 2019 index values by the 2018 index values.<sup>13</sup> (See row 4.) Then, the index relatives are multiplied by their respective proportions, which have been agreed to by the contracting parties. (See row 6.) The composite relative is then calculated by summing the values from step 6. (See row 7.) Finally, the adjusted price is calculated by multiplying the base period price by the composite relative. (See row 8.) In this example using the composite indexes method, the base-period price of \$1,000 is adjusted downward to a new price of \$980.

## Price transmission analysis

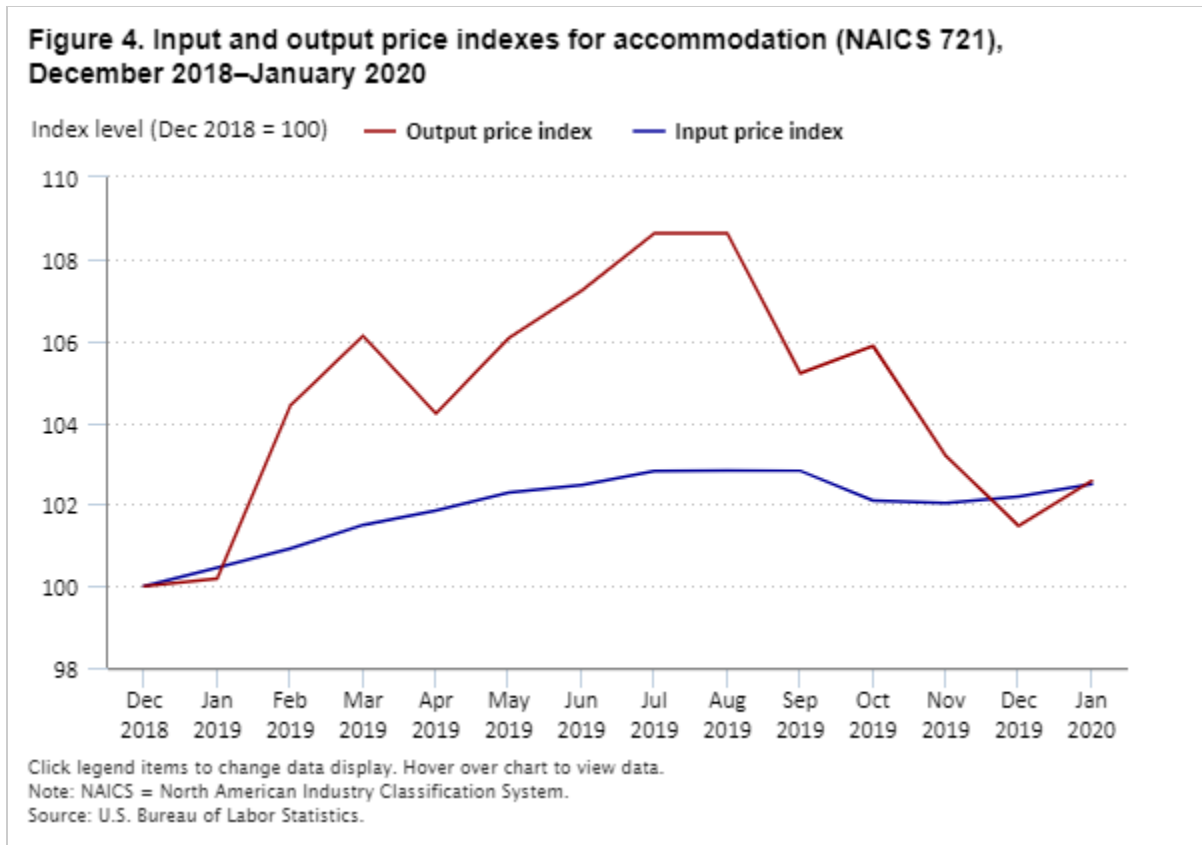
The analysis of price transmission involves estimating the causal relationships between prices in a supply chain. The new satellite net inputs to industry indexes provide data users with an opportunity to analyze price transmission between BLS input and output price indexes for industry groups.

A rigorous price transmission analysis uses econometric time-series models to estimate the causal relationships between prices in a supply chain.<sup>14</sup> To be accurately estimated, these econometric models require some minimum amount of data. In the case of the new net inputs to industry price indexes, for which most data begin in December 2018, the sample period is too short for a formal econometric analysis. For this reason, this subsection presents an informal comparison of prices. Figure 3 displays the input and output price indexes for leather and applied product manufacturing (NAICS 316). For comparison purposes, both indexes are rebased to equal 100 in December 2018.



The trends in the input and output price indexes presented in figure 3 are visually similar, suggesting price transmission between the indexes. After an initial drop in the input price index in January 2019, both the input and output price indexes trended upward during the first quarter of 2019, declined for most of the second quarter, and then turned up in July 2019, rising for several months. The trends diverged slightly in October 2019, as the input price index fell while the output price index remained flat. However, for most of the final quarter of 2019, and through January 2020, both indexes trended up. A relatively high correlation of 0.67 between the monthly percent changes in the input and output price indexes also suggests price transmission.

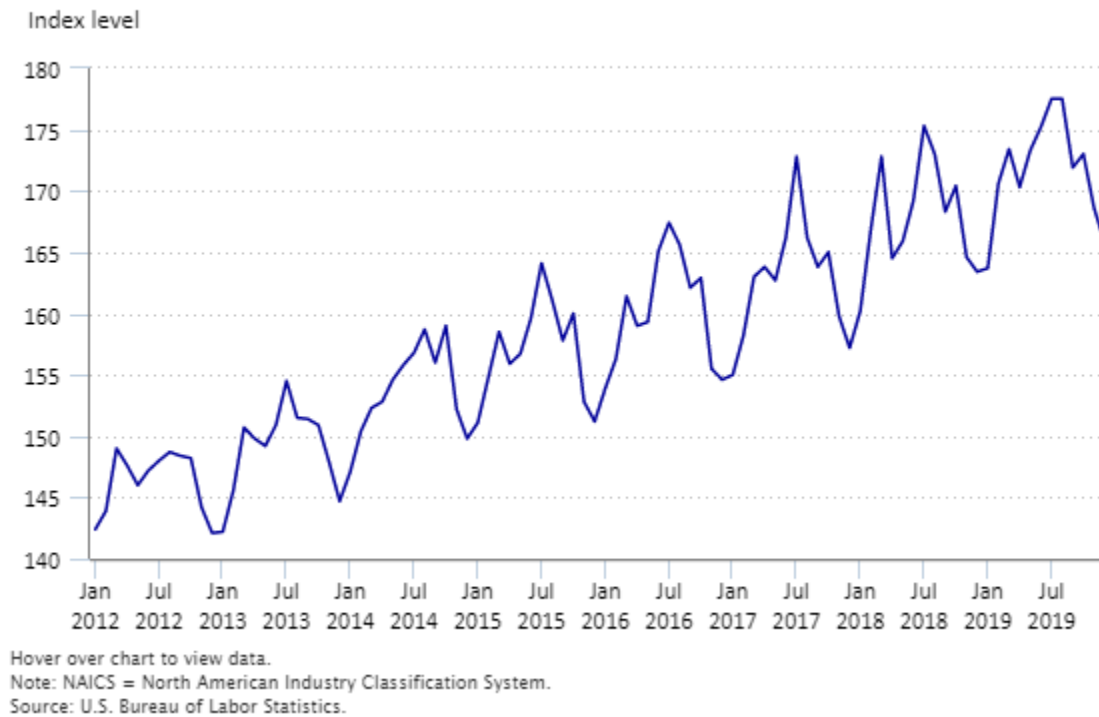
Although the price transmission relationship appears to be relatively strong in leather and applied product manufacturing, it may be weaker in other industries. This is particularly evident in cases in which wages account for a larger share of an industry's inputs or in which the industry is subject to frequent demand shocks. Figure 4 presents an example for a second industry, accommodation (NAICS 721), in which the relationship between input and output prices appears to be weaker.



While both the input and output price indexes for accommodation saw nearly identical increases over the sample period, they did not exhibit similar turning points, and the output price index displayed much more volatility. The output price index generally rose from December 2018 through the summer of 2019, except for a small downturn in April, and then fell for most of the remainder of 2019 before beginning to increase again in January 2020. In contrast, the input price index rose over almost the entire sample period, except for a small decline from September through November 2019. The substantial difference in trends between the input and output price indexes suggests that price transmission in accommodation is weaker than price transmission in leather and applied product manufacturing. The correlation in monthly percent changes between the input and output price indexes in accommodation is 0.37, which also indicates weak price transmission in that industry.

A closer examination of the output price index for accommodation over a longer period may partially explain the relatively weak price transmission in the industry. Figure 5 presents the output price index for accommodation from January 2012 to December 2019.

**Figure 5. Output price index for accommodation (NAICS 721), January 2012–December 2019**



The output price index for accommodation appears to exhibit a pronounced seasonal pattern, with a strong peak in the summer.<sup>15</sup> This seasonal pattern is likely due to an increase in demand for accommodation during the summer months. In contrast, the input index for accommodation does not appear to exhibit this type of seasonality. This difference in seasonal patterns partially explains the relatively weak price transmission between the input and output price indexes. Of course, the long-term trends of the indexes appear to be similar, but the available input price data are insufficient to make this determination.

For industries that consume a substantial amount of imports as inputs, the inclusion of both domestic and imported inputs is likely important for price transmission analysis. To illustrate this point, table 3 presents an example for apparel manufacturing (NAICS 315), showing correlations in 1-month percent index changes (from January 2019 through April 2020) between the industry's output price index and its input price indexes for total, domestic, and imported inputs.

**Table 3. Correlations in 1-month percent index changes between the output price index and input price indexes for apparel manufacturing (NAICS 315)**

Input price index	Relative importance	Correlation with output index
Total inputs	100.0	0.30
Domestic inputs	71.1	0.22
Imported inputs	28.9	0.24

Note: NAICS = North American Industry Classification System.

Source: Authors' calculations based on data from the U.S. Bureau of Labor Statistics

The correlation between the overall input price index (for both domestically produced and imported inputs) and the output price index is approximately 0.08 points (or 36 percent) higher than the correlation between the input index for domestically produced inputs and the output price index. Although this example is based on a short timeframe and a limited analysis method, it illustrates that, in cases in which imports account for a relatively large portion of industry inputs, the inclusion of imported inputs may be important for price transmission analysis.

## Deflation

Deflation entails removing the effect of price changes from a revenue stream in order to separate changes in revenue due to changes in product quantities sold from changes in revenue due to changes in prices. A revenue stream is deflated (i.e., converted from nominal to real) with the following formula:

$$(10) \quad \text{Real revenue} = \frac{\text{Nominal revenue}}{\text{Price index}} \times 100.$$

Applying equation (10) to a nominal revenue value converts it to a real revenue value expressed in constant dollars from the price index's base period. In the context of deflation, the base period is the period in which the index equals 100.

For most revenue streams, output price indexes or consumer price indexes that correspond with the industry or product whose revenue is being deflated are used as deflators. For some industries and products, however, corresponding price indexes are not available. BLS may not calculate a price index for an industry or product for two main reasons. First, the product or industry may be in scope for a BLS pricing program, but the program may lack the resources to produce the price index. For example, PPI does not currently publish price indexes for industries in the education sector (NAICS 611) and for the custom computer programming services industry (NAICS 541511). Second, the product or industry may be out of scope for BLS because it has no marketed output. For example, the temporary shelters industry (NAICS 624221), which provides short-term emergency shelter for victims of violence and child abuse, as well as for other people in need, does not typically sell its output. Therefore, BLS cannot calculate an output price index for temporary shelters, because there are no prices for that industry's output. In cases in which no output or consumer price index is available, an input index can be used as a deflator.

Table 4 presents an example of deflating U.S. Census Bureau revenue data for the social assistance industry group (NAICS 624) with the BLS input price index for that group. BLS does not currently publish an output price index for social assistance, because most industries within this three-digit NAICS group are out of scope for the PPI program. In the example presented in table 4, the net inputs to industry price index is first converted from a monthly index to a quarterly index by averaging the three monthly price indexes in each quarter. This step is necessary because the census revenue data are only available quarterly. Next, the quarterly price index data are rebased to equal 100 in the first quarter of 2019. This step ensures that, after the deflation is complete, the resulting revenue will be expressed in constant first-quarter-2019 dollar values. The nominal revenue (shown in the third data column of table 4) is then converted to real revenue with the use of equation (10).

**Table 4. Deflation of U.S. Census Bureau data for social assistance (NAICS 624) using an input price index, 2019**

Quarter	Price index	Price index rebased	Nominal revenue (millions of dollars)	Real revenue (millions of dollars)
First quarter	100.418	100.000	\$49,431	\$49,431
Second quarter	102.145	101.720	51,385	50,516
Third quarter	102.423	101.997	51,194	50,192
Fourth quarter	102.346	101.920	55,954	54,900

Note: NAICS = North American Industry Classification System.

Source: Authors' calculations based on data from the U.S. Bureau of Labor Statistics and the U.S. Census Bureau.

Finally, it should be noted that the example presented in table 4 is likely oversimplified. In practice, data users performing a deflation for social assistance may want to combine BLS input price index data with wage data, because wages represent a substantial portion of this industry group's inputs.<sup>16</sup>

## Conclusion

In September 2020, BLS introduced a new set of satellite net inputs to industry price indexes. These indexes measure price change for inputs (excluding capital investment and labor) consumed by most three-digit NAICS industries and are constructed by combining PPI commodity indexes and MPIS. This article has identified a number of potential uses for the new indexes, including industry cost analysis, contract escalation, price transmission analysis, and deflation. BLS will be further examining this satellite data series and soliciting user feedback on it, aiming to make it an official series in the future.

### SUGGESTED CITATION

Jayson Pollock and Jonathan C. Weinhagen, "A new BLS satellite series of net inputs to industry price indexes: methodology and uses," *Monthly Labor Review*, U.S. Bureau of Labor Statistics, September 2020, <https://doi.org/10.21916/mlr.2020.22>.

### NOTES

<sup>1</sup> As of this article's release, the term "satellite" is used to describe the new input price indexes because, while the indexes provide data that expand the analytical utility of the currently published input price indexes, they are not considered an official U.S. Bureau of Labor Statistics (BLS) output. Upon further review, BLS may release the new index series as an official output as early as 2021.

<sup>2</sup> Input components for which BLS does not calculate price indexes are also excluded from the satellite series. Most importantly, BLS does not calculate price indexes for approximately 28 percent of domestically produced services or any imported services. For cases in which coverage is missing for a substantial portion of an industry's inputs, a net input price index for that industry is not produced.

<sup>3</sup> BLS does not publish an overall services import price index; imported services account for one-fifth of U.S. imports. Import price index measures are available at <https://www.bls.gov/mxp/>.

<sup>4</sup> The BEA use table is available at [http://www.bea.gov/industry/io\\_annual.htm](http://www.bea.gov/industry/io_annual.htm).

<sup>5</sup> The industry input index excludes cases in which the I–O code is out of scope or not currently covered by the PPI program. BLS also implements a cutoff rule that removes commodities accounting for less than 0.5 percent of an industry's total inputs from the

industry's input indexes. The cutoff rule substantially reduces the work required to build and maintain the net inputs to industry price indexes, while having a negligible effect on index movements.

<sup>6</sup> The BEA "Make of commodities by industries" table is available at [http://www.bea.gov/industry/io\\_annual.htm](http://www.bea.gov/industry/io_annual.htm).

<sup>7</sup> For an overview of the PPI methodology, see chapter 14, "Producer prices," *Handbook of Methods* (U.S. Bureau of Labor Statistics), <https://www.bls.gov/opub/hom/pdf/homch14.pdf>.

<sup>8</sup> See *ibid.*

<sup>9</sup> The BLS satellite net inputs to industry price indexes for three-digit NAICS industry groups are published at <https://www.bls.gov/ppi/a-new-bls-satellite-series-inputs-to-industry-price-indexes.htm>. Input indexes were not calculated if prices for a substantial portion of an industry group's inputs were not available.

<sup>10</sup> Official PPIs are revised only once, 4 months after original publication. In addition, official PPI data are rounded to the first decimal place.

<sup>11</sup> For descriptions of these methods and for an overview of applying PPIs to price adjustment (escalation) clauses, see "Price adjustment guide for contracting parties," *Producer Price Indexes* (U.S. Bureau of Labor Statistics, 2017), <https://www.bls.gov/ppi/ppiescalation.htm>.

<sup>12</sup> The specific Employment Cost Index (ECI) used in the example is for total compensation (wages and benefits), private industry, and goods-producing industries (database code CIU201G000000000I, <https://www.bls.gov/ncs/ect/>). BLS does not directly assist in writing contracts and does not make recommendations about what data or indexes contracting parties should use.

<sup>13</sup> Because the ECI is published on a quarterly basis, fourth-quarter values are used for the price adjustment calculation. The input index is a monthly index, so December values are used for the calculation.

<sup>14</sup> See, for example, Jonathan C. Weinhaven, "Price transmission: from crude petroleum to plastics products," *Monthly Labor Review*, December 2006, <https://www.bls.gov/opub/mlr/2006/12/art4full.pdf>.

<sup>15</sup> Formal seasonality testing based on the U.S. Census Bureau X-12-ARIMA program indicates that this series exhibits statistically significant seasonality.

<sup>16</sup> The BLS ECI series is a potential source of data for measuring wages. These data can be found at <https://www.bls.gov/ncs/ect/>.

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