Bureau of Labor Statistics
Multifactor Productivity
March 24, 2016

CHANGES IN THE COMPOSITION OF LABOR FOR BLS MULTIFACTOR PRODUCTIVITY
MEASURES, 2014

Labor is an important input into the production process, but calculating MFP using only the total number of labor hours implies that every hour worked is equally productive and ignores the fact that labor input is composed of different types of labor. Demographic trends, such as increasing educational attainment and the aging of the population, have changed the composition of the workforce in ways that impact the productivity of an hour of labor. Other influences, such as business cycles, bring about more transient changes. For example, the workforce tends to become more experienced in recessions because older and more experienced workers are less likely to lose their jobs than younger and less experienced workers.[1] The effect of these underlying trends on labor composition and ultimately multifactor productivity are described below.

Ideally MFP would be calculated using numerous labor inputs, one for each type of worker. However, the BLS's primary source of hours data for productivity measurement, the Current Employment Statistics (CES) survey, does not include any demographic information and cannot distinguish hours by type of worker. Therefore, the BLS uses data from the Current Population Survey (CPS)—Outgoing Rotation Group (ORG), which includes demographic details in addition to information on hours worked and earnings, to adjust private business labor hours for changes in the composition of the workforce. In March 26, 2015, the BLS changed its source data from the March CPS Income Supplement to the CPS ORG, going back to 2004. CPS ORG data have more than twice the number of observations as compared to the March CPS and the ORG data are more current. Labor composition for the previous year can be computed as early as February using the CPS ORG, while measures using the March CPS couldn't be computed until October. In March 24, 2016, the BLS expanded its estimates of labor composition using CPS ORG to reflect the entire published time series, which begins in 1987.

Changes in labor input in the private business and private nonfarm business sectors are equal to the changes in labor hours plus the changes in labor composition. Labor hours for all employees are estimated by combining CES production and nonsupervisory worker employment and hours paid data, with an hours-worked adjustment from the BLS National Compensation Survey, and information on hours worked by nonproduction and supervisory workers from the CPS.[2] The changes in labor composition are estimated using CPS-ORG data as the difference between the weighted sum of changes in the hours of each type of worker and the un-weighted total change in the hours of all workers combined. The weights are the relative cost shares that more heavily weight the hours worked by more productive workers, i.e. those whose marginal product is estimated by their higher wage. To compute the change in labor composition, two consecutive years of CPS-ORG data are sorted into types of workers, defined by combinations of age, education and gender. For each of these worker types, "cells", total hours worked and median hourly wage are calculated in each year. The hours and wage data are used to calculate each type of worker's share of total wages, averaged over the two years; the weight for each type of worker. Next, the year-to-year percentage change in hours worked is computed for each type of worker, as well as for all workers combined. The labor composition adjustment that is used to adjust total hours is calculated as the difference between the percent change in total hours worked and the weighted sum of the percent changes of hours worked by each age/education/gender worker type. The labor composition index reported in the following section is computed by selecting a base year and computing the compound growth of labor composition between the base year and the current year.

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[1] BLS implicitly measures potential experience by age and education.

[2] See "Technical Information About the BLS Major Sector Productivity Measures", pp 2-4.,

Recent Changes in Labor Composition

Between 2013 and 2014, labor composition grew by 0.1 percent in both the private business and the private nonfarm business sectors.

Sector	2013-2014
Private business sector	0.1%
Private nonfarm business sector	0.1%

Because the two sectors are similar—the only difference in coverage is the farm sector, which made up 2.2 percent of private business sector hours worked in 2014—subsequent estimates will be presented only for the private business sector. Data for the private nonfarm business sector are available on request.[3]

Chart 1 shows the annual percent changes in labor input, hours worked, and the labor composition index in the private business sector for the 1987-2014 period. The effect of labor composition on labor input has increased over the period shown, as evident by the positive growth rates in all but two years.

Chart 1. Labor input, hours worked, and the labor composition index in the private business sector, 1987-2014

Annual percent change
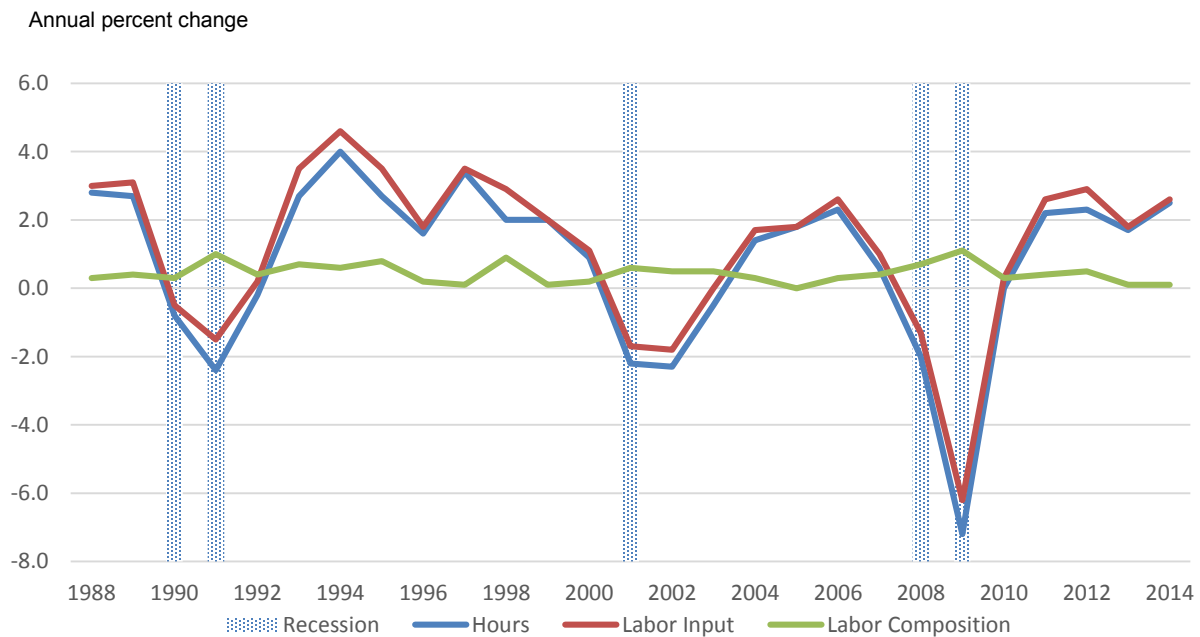
Note: Labor input in private business and private nonfarm business are obtained by chained superlative (Tornqvist) aggregation of the hours at work by all persons, classified by age, education, and gender with weights determined by each group's share of total wages. For more information see http://www.bls.gov/news.release/archives/prod3_03242016.pdf.

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[3] Labor composition measures are available for 1987-2014 using ORG Data for the current private business and private nonfarm business sectors. Multifactor productivity NAICS-based measures are only available for 1987-2014.

Changes in the labor composition index have a cyclical component. The labor composition index tends to increase faster during a recession and the early stages of the recovery, because younger and less-educated workers usually lose their jobs first, leaving an older and more-educated workforce. The labor composition index grew faster during the 1990-1992, 2000-2002, 2007-2009 periods. (See chart 1.) See the Bureau of Labor Statistics Employment and Earnings for more detailed data on worker characteristics. (Employment and Earnings are

Recent Changes in the Distribution of Hours Worked

Over the 2010-2014 period, the educational attainment of the work force continued to increase. (See table 1.)

Table 1 shows the distribution of hours worked by men and women in the private business sector by educational attainment. For both sexes, the share of total hours worked by those with college and advanced degrees increased. These increases were fairly evenly distributed over the 5-year period. Looking at all workers in the right hand panel, workers with 16 or more years of schooling saw the largest gain in their share of hours worked from 2010 to 2014.

The hours-weighted average level of educational attainment for men was 13.7 years in 2014, which was lower than women's level of 13.8 years. (See table 1.) The difference between the hours-weighted average level of educational attainment for men and women has remained 0.1 percent between 2010 and 2014. The hours-weighted average level of educational attainment for men and women combined was 13.8 years in 2014. The hours weights are the workers' shares of labor compensation, according to the relative size and hourly wages of the group of workers, with groups defined by age and education levels.

Table 1. Distribution of hours worked and hours-weighted mean years of schooling in the private business sector by gender, 2010-2014

Percent

Years of school completed	Men					Women					All workers				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
0-4	0.5	0.5	0.5	0.5	0.5	0.2	0.2	0.2	0.2	0.2	0.7	0.7	0.7	0.7	0.7
5-8	1.9	1.8	1.8	1.7	1.8	0.7	0.7	0.7	0.7	0.7	2.6	2.5	2.5	2.4	2.4
9-11	3.4	3.4	3.2	3.1	3.0	1.9	1.7	1.7	1.6	1.5	5.2	5.1	4.9	4.7	4.5
12	19.5	19.4	19.3	18.9	19.2	12.2	11.8	11.4	11.3	11.4	31.7	31.2	30.7	30.2	30.6
13-15	15.7	16.1	16.1	16.1	16.1	13.4	13.3	13.4	13.4	13.2	29.1	29.4	29.5	29.5	29.3
16	12.5	12.6	12.7	12.9	12.7	8.8	8.9	9.2	9.5	9.5	21.3	21.5	21.9	22.4	22.3
17+	5.9	6.0	6.1	6.0	6.2	3.5	3.6	3.7	4.0	4.0	9.4	9.6	9.8	10.0	10.2
Sum	59.3	59.8	59.7	59.3	59.5	40.7	40.2	40.3	40.7	40.5	100.0	100.0	100.0	100.0	100.0
Mean years of schooling	13.6	13.6	13.7	13.7	13.7	13.7	13.8	13.9	13.9	13.8	13.6	13.7	13.7	13.7	13.8

Note: Only workers between 15 and 85 years old are represented.
Note: Hours worked are from Current Population Survey—Outgoing Rotation Group

Table 2 shows shares of hours worked for three broad categories of workers. The fraction of hours worked by those 31 to 55 has decreased from 59.5 percent in 2010 to 57.2 percent in 2014, while the fraction of hours worked by those over 55 has increased from 15.6 percent in 2010 to 17.7 percent in 2014. Movement towards an older age distribution of hours worked will tend to increase the labor composition index.

Table 2. Share of total hours worked by workers' age in the private business sector, 2010-2014

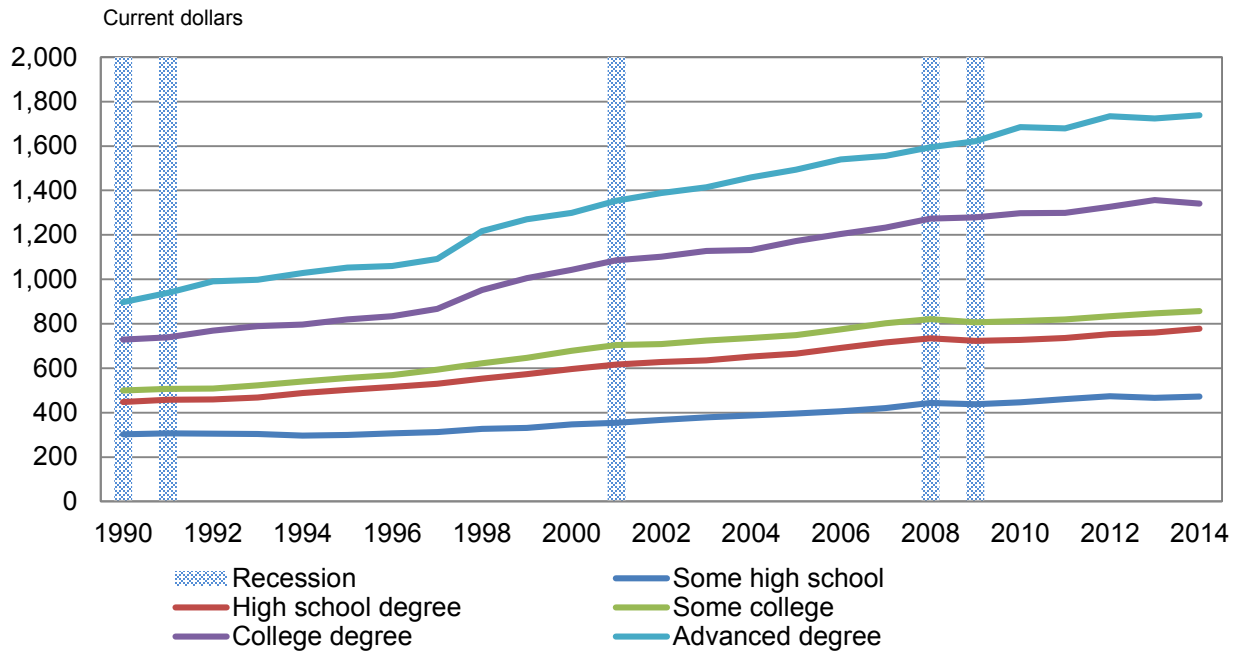|	Year				
Age	2010	2011	2012	2013	2014
15-30	24.9	25.1	24.7	24.9	25.0
31-55	59.5	58.9	58.5	57.8	57.2
56-70	15.6	16.0	16.8	17.3	17.7

Note: Hours worked are from the Current Population Survey—Outgoing Rotation Group.

Wage Structure

Wage structure can affect the labor composition index when the hours worked by the different demographic groups change at different rates. To illustrate, suppose that the hours of college-educated workers increase at the same rate as the hours of high school educated workers decrease. Labor input can either increase or decrease depending on the relative weights of these two groups. The higher wages of college-educated workers tends to increase their relative weight in the labor composition index, while their smaller total number of hours worked tends to reduce their weight. Wage growth matters if growth rates differ across demographic groups. In the above example, faster wage growth among college graduates would increase their relative weight and cause labor input to increase at an even faster rate. It is important to note, however, that if the hours of all groups grow at the same rate then differences in wage levels and growth rates across demographic groups do not affect the growth of the labor input.

Earnings by educational attainment for men and women in the private business sector are shown in charts 2 and 3 respectively. Earnings for men with a college degree and women with an advanced degree decreased in 2014; the only two groups to see earnings decrease in 2014. However, all other groups for both men and women saw an increase in earnings in 2014.

Chart 2. Average weekly earnings by educational attainment for men in the private business sector, 1990-2014

Current dollars

Note: Relative earnings of employees in the private business sector are measured holding all characteristics constant. Data are based on the Current Population Survey—Outgoing Rotation Group.

Chart 3. Average weekly earnings by educational attainment for women in the private business sector, 1990-2014

Current dollars
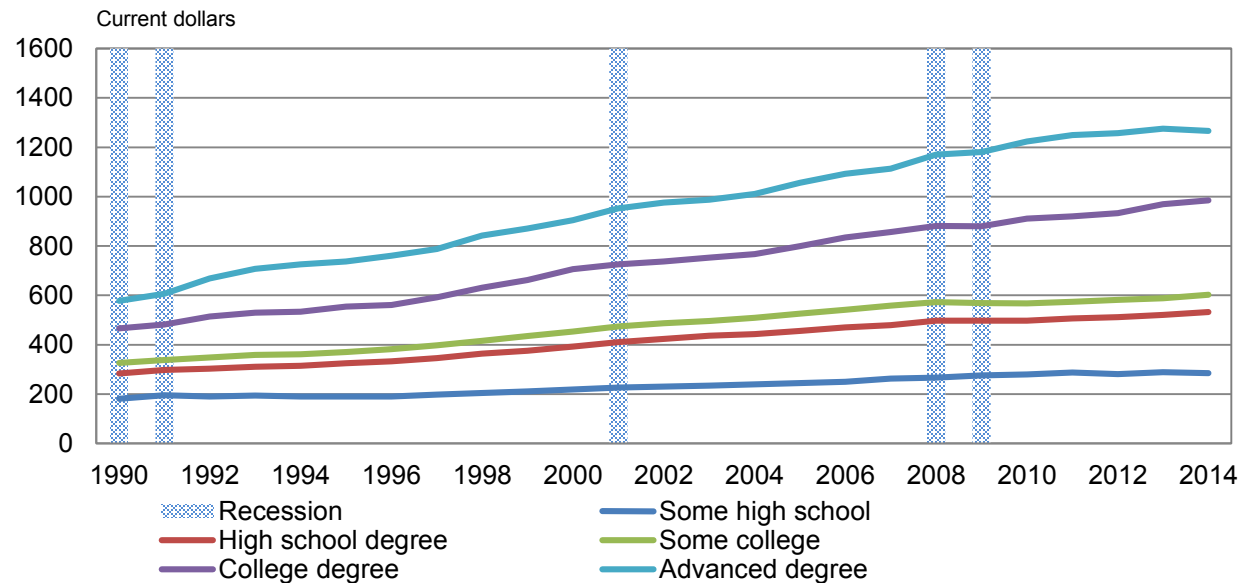
Note: Relative earnings of employees in the private business sector are measured holding characteristics constant. Data are based on the Current Population Survey—Outgoing Rotation Group.

Published labor input measures

Labor composition growth generally provides a small but steady positive contribution to labor input. Within a growth accounting framework, an increase in the labor composition index, or workers' skill levels, has the same effect on output and productivity growth as an increase in hours worked. That is, a 1.0 percent increase in labor composition is equivalent to a 1.0 percent increase in hours worked.

Tables 3 and 4 present all three published measures for the private business sector. For the 1987-2014 period, labor input increased by 1.2 percent annually; labor composition increased 0.4 percent annually and hours worked increased 0.8 percent. For the 2007-2014 period, labor input increased 0.3 percent; labor composition increased 0.4 percent and hours worked declined at 0.1 percent. In 2014, labor composition increased 0.1 percent for the second year in a row. These two years showed the smallest increase since 2005, yet hours worked grew at 2.5 percent.

Table 3. Labor input, hours worked and labor composition in the private business sector, 1987-2014

Percent change

Year	Labor Input[1]	Hours Worked[2]	Labor Composition
1988	3.0	2.8	0.3
1989	3.1	2.7	0.4
1990	-0.5	-0.8	0.3
1991	-1.5	-2.4	1.0
1992	0.2	-0.2	0.4
1993	3.5	2.7	0.7
1994	4.6	4.0	0.6
1995	3.5	2.7	0.8
1996	1.8	1.6	0.2
1997	3.5	3.4	0.1
1998	2.9	2.0	0.9
1999	2.0	2.0	0.1
2000	1.1	0.9	0.2
2001	-1.7	-2.2	0.6
2002	-1.8	-2.3	0.5
2003	0.0	-0.5	0.5
2004	1.7	1.4	0.3
2005	1.8	1.8	0.0
2006	2.6	2.3	0.3
2007	1.0	0.6	0.4
2008	-1.3	-2.0	0.7
2009	-6.2	-7.2	1.1
2010	0.3	0.0	0.3
2011	2.6	2.2	0.4
2012	2.9	2.3	0.5
2013	1.8	1.7	0.1
2014	2.6	2.5	0.1
1987-2014	1.2	0.8	0.4
1987-1990	1.9	1.5	0.3
1990-1995	2.1	1.4	0.7
1995-2000	2.3	2.0	0.3
2000-2007	0.5	0.1	0.4
2007-2014	0.3	-0.1	0.4

1. Hours at work by age, education, and gender group are weighted by each group's share of total wages.
2. Hours at work are derived using data from the CPS, CES, and National Compensation Survey (NCS).

Table 4. Labor input, hours worked and labor composition in the private business sector, 1987-2014

Indexes 2009=100

Year	Labor Input[1]	Hours[2]	Labor Composition
1987	79.603	88.267	90.185
1988	82.025	90.700	90.436
1989	84.597	93.135	90.833
1990	84.180	92.433	91.072
1991	82.956	90.207	91.962
1992	83.160	90.047	92.352
1993	86.061	92.512	93.026
1994	90.041	96.228	93.571
1995	93.211	98.869	94.277
1996	94.887	100.428	94.482
1997	98.249	103.842	94.614
1998	101.054	105.875	95.447
1999	103.112	107.942	95.526
2000	104.247	108.918	95.712
2001	102.515	106.475	96.280
2002	100.633	103.987	96.774
2003	100.667	103.503	97.260
2004	102.346	104.917	97.550
2005	104.208	106.819	97.555
2006	106.887	109.245	97.841
2007	108.008	109.931	98.251
2008	106.606	107.757	98.931
2009	100.000	100.000	100.000
2010	100.287	100.033	100.254
2011	102.862	102.215	100.633
2012	105.794	104.605	101.136
2013	107.653	106.359	101.216
2014	110.446	109.029	101.300

1. Hours at work by age, education, and gender group are weighted by each group's share of total wages.
2. Hours at work are derived using data from the CPS, CES, and National Compensation Survey (NCS).