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Technical information: (202) 691-5606 • mfp@bls.gov • www.bls.gov/mfp
 Media contact: (202) 691-5902 • PressOffice@bls.gov

MULTIFACTOR PRODUCTIVITY TRENDS IN MANUFACTURING - 2017

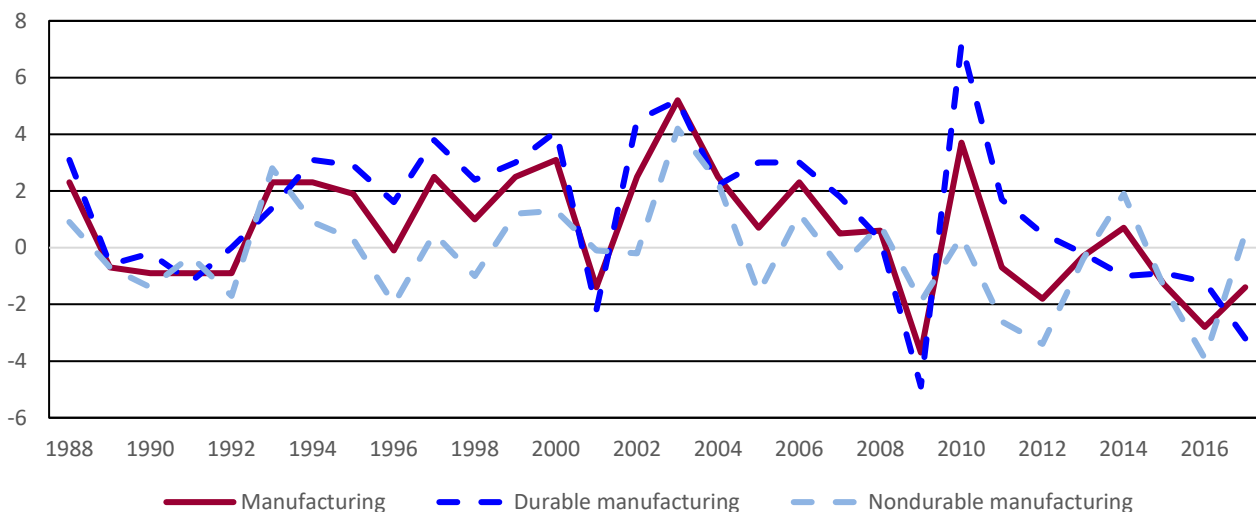
Manufacturing sector multifactor productivity declined 1.4 percent in 2017, the U.S. Bureau of Labor Statistics reported today. (See chart 1, table A.) The multifactor productivity decline in 2017 reflected a 0.4-percent increase in sectoral output and a 1.9-percent increase in combined inputs. The decrease in multifactor productivity followed a 2.8-percent decrease in 2016.

Multifactor productivity is calculated by dividing an index of real sectoral output by an index of combined units of labor input, capital services, and intermediate inputs. Multifactor productivity annual measures differ from BLS quarterly labor productivity or output per hour measures because the former also includes information on capital services, shifts in the composition of the workforce, and intermediate inputs.

Durable manufacturing sector multifactor productivity decreased 3.2 percent in 2017. The decline reflected a 0.3-percent increase in sectoral output and a 3.7-percent increase in combined inputs. **Nondurable manufacturing sector multifactor productivity** increased 0.5 percent in 2017. The increase reflected no change in sectoral output and a 0.5-percent decrease in combined inputs. (See table C, table 3.)

Chart 1. Multifactor productivity in the manufacturing, durable manufacturing, and nondurable manufacturing sectors, 1987-2017

Annual percent change



2012 NAICS Reclassification

All index series have been updated and reflect industry definitions consistent with the 2012 North American Industry Classification System (NAICS). As a result, all indexes for the manufacturing, durable, and nondurable measures are rebased to 2012=100 to reflect the new definitions.

Among the 18 manufacturing industries, 13 experienced declines in multifactor productivity in 2017. The largest declines in multifactor productivity were in the apparel, leather, and allied products industry and the transportation equipment industry. Printing and related support activities and petroleum and coal products industries showed the largest gains in multifactor productivity. Sectoral output increased in 5 industries and combined inputs increased in 9 industries in 2017. (See chart 2, table 3.)

Chart 2. Manufacturing industries' trends in multifactor productivity, sectoral output, and combined inputs, 2017

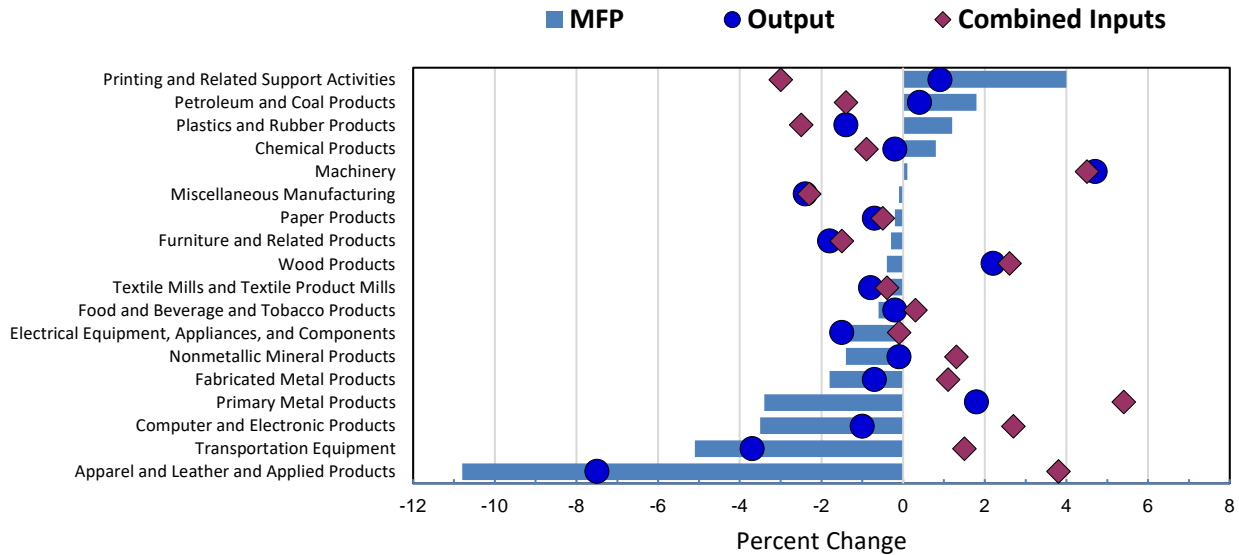
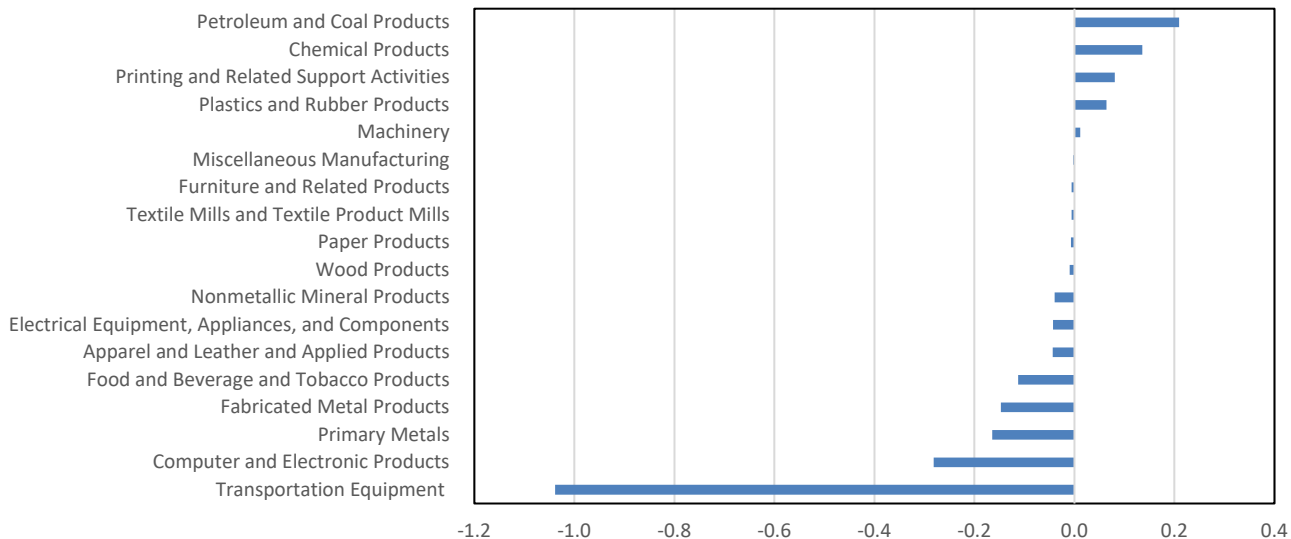


Chart 3 displays the contributions of three-digit manufacturing industries to manufacturing sector multifactor productivity. Contributions take into account the relative importance of each industry to the manufacturing sector multifactor productivity. Transportation equipment made the largest negative contribution to manufacturing multifactor productivity. Petroleum and coal products made the largest positive contribution to manufacturing multifactor productivity in 2017, partially offsetting the overall productivity decline.

Chart 3. Contributions of manufacturing industries to manufacturing sector multifactor productivity, 2017



Note: The contributions of manufacturing industries may not sum to manufacturing sector multifactor productivity due to independent rounding.

Trends in the manufacturing sector

Manufacturing sectoral output grew in 2017 with an annual increase of 0.4 percent compared to the 0.1-percent decline in 2016. The 1.9-percent increase in combined inputs was driven by a 1.1-percent growth in materials. (See table 1.)

Multifactor productivity in the manufacturing sector grew at an average annual rate of 0.6 percent from 1987 to 2017 with sectoral output increasing at an average annual rate of 1.6 percent, faster than the 0.9-percent average annual rate of increase in combined inputs. During the same period, labor productivity grew at an average annual rate of 2.7 percent. (See table A.) Of the 2.7-percent average annual increase in labor productivity, multifactor productivity contributed 0.6 percentage points, capital intensity contributed 0.7 percentage points, intermediate inputs intensity contributed 1.1 percentage points, and labor composition contributed 0.2 percentage points. (See table B.)

For the most recent 2007-17 period, multifactor productivity declined at a 0.7-percent average annual rate as compared to an increase of 1.8 percent during the 2000-07 period. (See table A.) Sectoral output decreased at a 0.4-percent annual average rate and combined inputs rose at a 0.3-percent annual average rate over the 2007-17 period.

Revised measures

Annual rates of multifactor productivity and related series were revised historically for all three sectors. (See table D.) The revisions were a result of Comprehensive Update of the National Income and Product Accounts (NIPA) released on July 27, 2018 and the Gross Domestic Product by Industry data released on November 1, 2018.

Over the 1987-2016 period, manufacturing multifactor productivity growth was unrevised. It was previously reported as 0.7 percent. Revisions over the 1987-2016 period resulted in a 0.1-percentage point downward revision to multifactor productivity in nondurable manufacturing, with a 0.1-percentage point upward revision to multifactor productivity growth in durable manufacturing.

In 2016, multifactor productivity in the manufacturing sector was revised upward 0.4 percentage points, the upward revision was due to 0.8 percent and 0.5 percent downward revisions to combined inputs and sectoral output respectively. Multifactor productivity was revised upward 1.0 percent in the durable manufacturing sector and downward 0.3 percent in the nondurable manufacturing sector. Materials were revised downward 4.3 percent in manufacturing, 4.9 percent in durable manufacturing, and 1.4 percent in nondurable manufacturing. (See table D.)

Table A. Productivity, sectoral output, and inputs in the manufacturing sector for selected periods, 1987-2017

Average annual growth

	1987-2017	1987-1990	1990-1995	1995-2000	2000-2007	2007-2017	2016-2017
<u>Productivity</u>							
Multifactor Productivity ¹	0.6	0.2	0.9	1.8	1.8	-0.7	-1.4
Labor Productivity ²	2.7	1.7	3.3	4.6	4.3	0.5	-0.4
Output per unit of capital services	-0.7	-0.8	0.6	0.3	-0.4	-2.1	-1.0
<u>Sectoral Output</u>							
	1.6	1.8	3.2	4.5	1.1	-0.4	0.4
<u>Inputs</u>							
Combined Inputs ³	0.9	1.6	2.2	2.6	-0.6	0.3	1.9
Labor input ⁴	-0.5	0.5	0.6	0.4	-2.4	-0.5	1.1
Hours	-1.1	0.1	-0.1	-0.1	-3.1	-0.9	0.8
Labor composition ⁵	0.6	0.4	0.7	0.5	0.7	0.4	0.3
Capital services	2.3	2.7	2.6	4.2	1.5	1.8	1.5
Energy	-1.1	2.0	1.6	10.0	-5.6	-5.2	-15.3
Materials	1.5	0.5	3.3	3.8	0.2	0.6	1.1
Purchased business services	1.0	5.4	3.1	1.3	-0.5	-0.3	8.5

1 Output per combined units of labor input, capital services, energy, materials, and purchased business services.

2 Output per hour worked.

3 The growth rate of each input is weighted by its share of current dollar costs.

4 Hours at work by age, education, and gender group are weighted by each group's share of total wages.

5 Ratio of labor input to hours.

Table B. Labor productivity and contributions of capital intensity, intermediate inputs intensity, labor composition, and multifactor productivity to labor productivity in the manufacturing sector for selected periods, 1987-2017

Average annual growth

	1987-2017	1987-1990	1990-1995	1995-2000	2000-2007	2007-2017	2016-2017
<u>Labor Productivity</u> ¹	2.7	1.7	3.3	4.6	4.3	0.5	-0.4
Contribution of capital intensity ²	0.7	0.5	0.5	0.9	1.0	0.6	0.2
Information processing equipment intensity ³	0.1	0.1	0.1	0.2	0.1	0.0	0.0
Research and Development intensity ⁴	0.3	0.2	0.1	0.3	0.4	0.3	0.2
All other intellectual property products intensity ⁵	0.1	0.1	0.1	0.1	0.0	0.0	0.0
All other capital services intensity	0.3	0.2	0.2	0.3	0.5	0.2	-0.1
Contribution of intermediate inputs intensity ⁶	1.1	0.9	1.6	1.7	1.3	0.5	0.8
Energy intensity ⁷	0.0	0.1	0.0	0.3	-0.1	-0.1	-0.3
Materials intensity ⁸	0.8	0.1	1.0	1.2	1.0	0.5	0.1
Purchased business services intensity ⁹	0.3	0.7	0.5	0.2	0.4	0.1	1.0
Contribution of labor composition ¹⁰	0.2	0.1	0.2	0.2	0.2	0.1	0.1
Multifactor productivity ¹¹	0.6	0.2	0.9	1.8	1.8	-0.7	-1.4

1 Output per hour worked.

2 Capital intensity multiplied by capital's share of current dollar costs.

3 Information processing equipment per hour multiplied by its share of current dollar costs.

4 Research and development per hour multiplied by its share of current dollar costs.

5 Software and artistic originals per hour multiplied by their share of current dollar costs.

6 Intermediate inputs per hour multiplied by intermediate inputs' share of current dollar costs.

7 Energy per hour multiplied by energy's share of current dollar costs.

8 Materials per hour multiplied by materials' share of current dollar costs.

9 Purchased business services per hour multiplied by purchased business services' share of current dollar costs.

10 Labor composition multiplied by labor's share of current dollar costs.

11 Output per combined units of labor input, capital services, energy, materials, and purchased business services.

Table C. Multifactor productivity and related measures in the total, durable and nondurable manufacturing sectors, for selected periods, 1987-2017

Average annual growth

	1987-2017	1987-1990	1990-1995	1995-2000	2000-2007	2007-2017	2016-2017
Manufacturing							
Multifactor productivity ¹	0.6	0.2	0.9	1.8	1.8	-0.7	-1.4
Labor productivity	2.7	1.7	3.3	4.6	4.3	0.5	-0.4
Sectoral Output	1.6	1.8	3.2	4.5	1.1	-0.4	0.4
Combined Inputs ²	0.9	1.6	2.2	2.6	-0.6	0.3	1.9
Capital Services	2.3	2.7	2.6	4.2	1.5	1.8	1.5
Labor Input ³	-0.5	0.5	0.6	0.4	-2.4	-0.5	1.1
Energy	-1.1	2.0	1.6	10.0	-5.6	-5.2	-15.3
Materials	1.5	0.5	3.3	3.8	0.2	0.6	1.1
Purchased Business Services	1.0	5.4	3.1	1.3	-0.5	-0.3	8.5
Durable Manufacturing							
Multifactor productivity ¹	1.3	0.7	1.2	3.0	2.5	-0.2	-3.2
Labor productivity	3.1	2.0	4.4	6.0	4.5	0.4	-0.1
Sectoral Output	2.1	1.9	4.2	6.7	1.3	-0.6	0.3
Combined Inputs ²	0.8	1.1	3.0	3.7	-1.2	-0.4	3.7
Capital Services	2.1	2.5	2.2	5.3	1.1	1.2	0.9
Labor Input ³	-0.5	0.3	0.5	1.2	-2.4	-0.7	0.7
Energy	-2.1	1.3	0.8	10.3	-5.7	-7.7	-13.8
Materials	1.6	1.1	6.1	5.3	-1.2	-0.2	6.2
Purchased Business Services	0.8	1.8	3.7	2.7	0.0	-1.4	11.1
Nondurable Manufacturing							
Multifactor productivity ¹	-0.1	-0.4	0.4	0.0	0.7	-1.0	0.5
Labor productivity	1.9	1.2	1.9	2.9	3.7	0.4	-1.6
Sectoral Output	0.7	1.6	1.9	1.4	0.6	-0.3	0.0
Combined Inputs ²	0.9	2.1	1.5	1.4	-0.1	0.7	-0.5
Capital Services	2.5	2.8	3.0	3.1	1.8	2.2	2.0
Labor Input ³	-0.6	0.9	0.8	-0.9	-2.4	-0.2	1.9
Energy	-0.4	2.6	2.2	9.9	-5.4	-3.9	-16.0
Materials	0.8	0.6	0.8	1.6	0.8	0.5	-3.4
Purchased Business Services	1.3	10.0	2.5	-0.4	-1.2	1.0	5.9

1 Output per combined units of hours, capital services, energy, materials, and purchased business services.

2 The growth rate of each input is weighted by its share of current dollar costs.

3 Hours at work by age, education, and gender group, weighted by each group's share of total wages.

Table D. Difference between revised and previous multifactor productivity and related measures, for selected periods 1987-2016

Average annual growth

	1987-2016	1987-1990	1990-1995	1995-2000	2000-2007	2007-2016	2014-2015	2015-2016
Manufacturing								
Multifactor productivity ¹	0.0	0.0	-0.1	0.0	0.1	0.2	0.2	0.4
Labor productivity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4
Sectoral Output	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5
Combined Inputs ²	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.8
Capital Services	0.1	0.0	-0.1	0.0	0.2	0.0	-0.2	-0.5
Labor Input ³	0.0	-0.1	0.0	0.1	0.0	0.1	0.0	0.1
Energy	0.4	0.1	0.0	3.4	-1.7	0.8	3.2	-1.7
Materials	0.1	0.1	0.1	-0.5	-0.1	0.4	1.6	-4.3
Purchased Business Services	-0.7	0.1	-0.1	0.0	0.0	-2.2	-3.8	2.8
Durable Manufacturing								
Multifactor productivity ¹	0.1	0.0	-0.1	-0.1	0.0	0.5	0.6	1.0
Labor productivity	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
Sectoral Output	0.0	0.0	-0.1	0.0	0.0	0.1	0.0	-0.4
Combined Inputs ²	-0.1	0.0	0.1	0.2	0.0	-0.4	-0.6	-1.4
Capital Services	0.1	-0.1	-0.1	-0.1	0.2	0.3	0.4	0.0
Labor Input ³	0.0	-0.1	0.0	0.1	0.0	0.1	-0.1	-0.1
Energy	-0.1	0.1	-0.1	3.9	-1.1	-1.3	4.5	-10.5
Materials	-0.1	0.2	0.0	0.1	0.1	-0.5	1.2	-4.9
Purchased Business Services	-0.7	0.1	-0.1	0.2	0.4	-2.7	-7.5	0.6
Nondurable Manufacturing								
Multifactor productivity ¹	-0.1	0.0	0.0	0.2	0.1	-0.3	-0.2	-0.3
Labor productivity	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.6
Sectoral Output	0.0	-0.1	0.0	0.0	0.0	0.1	0.0	-0.2
Combined Inputs ²	0.0	0.0	0.1	-0.2	-0.1	0.3	0.3	0.1
Capital Services	0.1	0.0	0.0	0.1	0.3	-0.1	-0.6	-0.8
Labor Input ³	0.1	0.0	-0.1	0.0	0.1	0.2	0.2	0.4
Energy	0.6	0.1	0.0	3.1	-2.1	1.9	2.3	2.9
Materials	0.1	0.0	0.1	-0.9	0.0	0.9	1.1	-1.4
Purchased Business Services	-0.7	0.0	0.1	-0.3	-0.5	-1.6	1.3	5.5

1 Output per combined units of hours, capital services, energy, materials, and purchased business services.

2 The growth rate of each input is weighted by its share of current dollar costs.

3 Hours at work by age, education, and gender group, weighted by each group's share of total wages.

Technical Notes

BLS includes a measure of the effects of changes in the composition of the work force for manufacturing sectors and industries. Labor input in manufacturing sectors and NAICS industry groups is obtained by chained superlative Tornqvist aggregation of the hours at work, classified by age, education, and gender with weights determined by each group's share of total wages. The labor composition index estimates the effect of shifts in the age, education, and gender composition of the work force on hours worked.

Capital Services

Capital services are the services derived from the stock of physical assets and intellectual property assets. There are 90 asset types for fixed business equipment, structures, inventories, land, and intellectual property products. The aggregate capital services measures are obtained by Tornqvist aggregation of the capital stocks for each asset type within each of the eighteen manufacturing NAICS industry groupings using estimated rental prices for each asset type. Each rental price reflects the nominal rate of return to all assets within the industry and rates of economic depreciation and revaluation for the specific asset; rental prices are adjusted for the effects of taxes. Data on investment for fixed assets are obtained from BEA. Data on inventories are estimated using data from BEA and additional information from IRS Corporation Income Returns. Data for land in the farm sector are obtained from USDA. Nonfarm industry detail for land is based on IRS book value data. Current-dollar value-added data, obtained from BEA, are used in estimating capital rental prices.

Labor Input

Labor input in manufacturing sectors and industries is obtained by chained superlative Tornqvist aggregation of the hours at work, classified by age, education, and gender with weights determined by each group's share of total wages. The labor composition index estimates the effect of shifts in the age, education, and gender composition of the work force on hours worked. Hours at work data reflect Productivity and Costs data as of the February 6, 2019 "Productivity and Costs" news release (USDL-19-0188). The growth rate of labor composition is defined as the difference between the growth rate of weighted labor input and the growth rate of the hours.

The growth rate of labor composition in manufacturing may be underestimated due to limitations in the source data. The education proxy does not include training certifications and licensing. The proxy only includes number of years of schooling.

Additional information concerning data sources and methods of measuring labor composition can be found in "Changes in the Composition of Labor for BLS Multifactor Productivity Measures, 2014" (www.bls.gov/mfp/mprlabor.pdf).

Intermediate Inputs

In manufacturing, intermediate inputs consist of energy, materials, and purchased business services, and represent a large share of production costs. Research has shown that substitution among inputs, including intermediate inputs, affects productivity change. Therefore, it is important to account for intermediate inputs in productivity measures at the industry level. In contrast, the more aggregate productivity measures compare "value-added" output with two classes of inputs, capital and labor. Because of these differences in concepts and methodology, productivity change in manufacturing cannot be directly compared with changes in private business or private nonfarm business.

Data on intermediate inputs are obtained from BEA based on BEA annual input-output tables. Tornqvist indexes of each of these three input classes are derived at the three-digit NAICS level and then aggregated to the manufacturing sectors. Materials inputs are adjusted to exclude transactions between establishments within the same sector.

Combined Inputs

The five input indexes (capital services, labor, energy, materials, and purchased business services) are combined using chained superlative Tornqvist aggregation, applying weights that represent each component's share of total costs. Total costs are defined as the current dollar value of manufacturing sectoral output. Most taxes on production and imports, such as excise taxes, are excluded from costs; however, property and motor vehicle taxes remain in total costs.

Capital Intensity

Capital intensity is the ratio of capital services to hours worked in the production process. The higher the capital to hours ratio, the more capital intensive the production process is.

In a production process, profit maximizing/cost-minimizing firms adjust the factor proportions of capital and labor if the price of one factor falls relative to the price of the other factor; there would be a tendency for the firms to substitute the less expensive factor for the more expensive one. In the short run, changes in hours worked are more variable than changes in capital services. Changes in hours worked in business cycles can result in volatility of the capital intensity ratio over short periods of time. In the long run an increase in wages relative to the price of capital will induce the firm to substitute capital for labor, resulting in an increase in capital intensity.

Rising labor costs are, in fact, an incentive for firms to introduce automated production processes. Industry estimates of capital to hours ratios can be obtained at <http://www.bls.gov/mfp/mprdownload.htm>.

Sectoral Output

The output concept used for multifactor productivity in manufacturing is “sectoral output”. Sectoral output equals gross output (sales, receipts, and other operating income, plus commodity taxes plus changes in inventories), excluding transactions between establishments within the same sector. In contrast, the output concept used for private business and private nonfarm business is “real value-added”. Real value-added output in private business equals gross domestic product less general government, government enterprises, private households (including the rental value of owner-occupied real estate), and non-profit institutions. Real value-added output excludes intermediate transactions between businesses.

The output index for manufacturing is constructed using a chained superlative index (Tornqvist) of three-digit NAICS industry outputs. Industry output is measured as sectoral output, the total value of goods and services leaving the industry. The indexes of industry output are calculated with the Tornqvist index formula. This index formula aggregates the growth rates of the various industry outputs between two periods, using their relative shares in industry value of production averaged over the two periods as weights.

Manufacturing industry output measures for 2016 and earlier years are constructed primarily using data from the economic censuses and annual surveys of the U.S. Census Bureau together with data on price changes primarily from BLS. These measures have been revised due to new and revised data from the Bureau of Economic Analysis, used in part to construct intra-industry transactions. Manufacturing industry output for 2017 is estimated based on historical relationships between BLS sectoral output, BLS price indexes, and data on industrial production from the Federal Reserve Board.

Multifactor Productivity

The manufacturing multifactor productivity measures describe the relationship between output in real terms and the inputs involved in its production. Multifactor productivity measures are not intended to capture the specific contributions of labor, capital, or intermediate inputs. Rather, they are designed to measure the joint influences on economic growth of technological change, efficiency improvements, returns to scale, reallocation of resources and other factors of economic growth, allowing for the effects of capital, labor, and intermediate inputs. The

multifactor productivity indexes are derived by dividing an output index by an index of the combined inputs of labor, capital services, energy, non-energy materials, and purchased business services.

Other information

Comprehensive tables containing more detailed data than that which is published in this press release are available upon request at 202-691-5606 or at <http://www.bls.gov/mfp/mprdload.htm>. More detailed information on methods, limitations, and data sources of capital and labor are provided in BLS Bulletin 2178 (September 1983), *Trends in Multifactor Productivity, 1948-81* and on the BLS Multifactor Productivity website under the title "Technical Information About the BLS Multifactor Productivity Measures" for Major Sectors and 18 NAICS 3-digit Manufacturing Industries at <http://www.bls.gov/mfp/mprtech.pdf>. General information is available on the BLS Multifactor Productivity website at <http://www.bls.gov/mfp/mprover.htm>. Additional data not contained in the release can be obtained in print or at <http://www.bls.gov/mfp>. A number of comprehensive tables set up as zip files can be obtained at <http://www.bls.gov/mfp/mprdload.htm>. Methods for measuring manufacturing multifactor productivity are discussed in the July 1995 issue of the *Monthly Labor Review*, "Measurement of productivity growth in U.S. manufacturing". See <http://www.bls.gov/mfp/mprgul95.pdf>.

Table 1. Manufacturing sector: productivity and related measures for the 1987-2017 period

Annual percent change from previous year

	Productivity			Sectoral Output	Inputs					
	Labor Productivity ¹	Output per unit of capital services	Multifactor Productivity ²		Labor ³	Capital Services	Energy	Materials	Purchased business services	Combined Inputs ⁴
1988	2.0	1.8	2.3	4.1	2.3	2.3	4.4	-1.9	8.7	1.8
1989	-0.3	-1.6	-0.7	1.0	1.7	2.7	-0.5	-0.2	6.0	1.8
1990	3.3	-2.6	-0.9	0.3	-2.3	2.9	2.1	3.7	1.6	1.2
1991	1.9	-4.2	-0.9	-1.8	-3.0	2.6	-0.3	-0.9	-0.7	-0.9
1992	5.9	2.4	-0.9	4.9	-0.1	2.4	-0.9	14.9	7.4	5.9
1993	2.4	1.3	2.3	3.6	2.1	2.3	3.2	-0.1	0.7	1.3
1994	2.8	2.8	2.3	5.3	3.2	2.4	3.5	2.4	3.7	2.9
1995	3.5	0.8	1.9	4.1	1.1	3.3	2.5	1.2	4.6	2.1
1996	4.2	0.1	-0.1	4.2	0.5	4.1	-2.8	11.3	-0.7	4.2
1997	4.8	2.1	2.5	6.9	2.5	4.7	-2.2	6.3	3.8	4.2
1998	4.4	-0.2	1.0	4.7	0.9	4.9	0.3	5.4	4.8	3.7
1999	5.6	-0.1	2.5	3.9	-1.2	4.0	44.0	-0.2	0.5	1.4
2000	4.1	-0.5	3.1	2.8	-0.6	3.3	17.6	-3.3	-1.9	-0.3
2001	2.5	-6.4	-1.4	-4.2	-6.0	2.3	16.7	-8.4	2.4	-2.8
2002	8.0	-1.0	2.5	0.4	-6.0	1.5	-34.2	8.6	-6.1	-2.0
2003	6.2	0.1	5.2	1.0	-4.0	0.8	-17.9	-9.0	1.0	-4.1
2004	2.9	1.7	2.5	2.2	-0.1	0.5	0.5	6.5	-13.8	-0.3
2005	5.0	2.7	0.7	4.0	-0.5	1.3	18.1	4.9	7.1	3.2
2006	1.2	0.0	2.3	1.7	0.8	1.7	-19.0	-3.5	5.3	-0.6
2007	4.6	0.7	0.5	3.0	-0.7	2.4	10.4	4.4	2.2	2.5
2008	-0.6	-7.6	0.6	-4.7	-3.0	3.2	4.7	-7.8	-17.1	-5.3
2009	1.8	-12.8	-3.7	-11.6	-12.3	1.5	-25.5	-11.8	-1.2	-8.2
2010	5.7	5.1	3.7	6.1	0.9	0.9	-4.3	4.5	2.9	2.2
2011	0.7	1.5	-0.7	2.8	2.1	1.2	9.9	8.0	-4.0	3.5
2012	-1.0	-0.3	-1.8	1.2	2.6	1.5	1.1	4.0	4.2	3.1
2013	1.4	0.2	-0.3	2.2	1.0	2.1	4.2	4.2	0.8	2.6
2014	-0.3	-0.9	0.7	1.3	1.9	2.2	-10.3	0.3	-1.0	0.6
2015	-1.5	-2.4	-1.3	-0.6	1.1	1.9	-8.6	-0.1	1.7	0.7
2016	-0.2	-1.8	-2.8	-0.1	0.6	1.8	-2.5	5.1	4.1	2.8
2017	-0.4	-1.0	-1.4	0.4	1.1	1.5	-15.3	1.1	8.5	1.9

1 Output per hour worked.

2 Output per combined units of labor input, capital services, energy, materials, and purchased business services.

3 Hours at work by age, education, and gender group, weighted by each group's share of total wages.

4 The growth rate of each input is weighted by its share of current dollar costs.

Source: The Bureau of Labor Statistics (BLS) develops productivity measures using output data published by the Bureau of the Census, U.S. Department of Commerce, and modified by BLS. Compensation and hours data are from the BLS. Capital measures are based on data supplied by the BEA, U.S. Department of Commerce. See Technical Notes in this release.

Table 2. Manufacturing sector: indexes of productivity and related measures, 1987-2017 period

Indexes 2012=100

Year	Productivity			Sectoral Output	Inputs					
	Labor Productivity ¹	Output per unit of capital services	Multifactor Productivity ²		Labor ³	Capital Services	Energy	Materials	Purchased business services	Combined Inputs ⁴
1987	45.0	117.7	78.4	64.7	123.0	55.0	97.2	71.5	84.6	82.6
1988	45.9	119.8	80.2	67.4	125.9	56.2	101.5	70.2	91.9	84.0
1989	45.8	117.8	79.6	68.1	128.0	57.8	100.9	70.0	97.4	85.5
1990	47.3	114.8	78.9	68.3	125.0	59.5	103.1	72.6	99.0	86.5
1991	48.2	109.9	78.2	67.0	121.3	61.0	102.8	71.9	98.3	85.8
1992	51.1	112.6	77.4	70.3	121.2	62.5	101.9	82.7	105.6	90.8
1993	52.3	114.0	79.2	72.8	123.8	63.9	105.2	82.6	106.4	91.9
1994	53.7	117.2	81.1	76.7	127.7	65.5	108.8	84.6	110.4	94.6
1995	55.6	118.1	82.6	79.8	129.1	67.6	111.6	85.6	115.4	96.6
1996	57.9	118.1	82.6	83.2	129.8	70.4	108.5	95.2	114.7	100.7
1997	60.7	120.6	84.7	88.9	133.0	73.7	106.1	101.2	119.0	105.0
1998	63.4	120.4	85.5	93.1	134.2	77.3	106.4	106.6	124.8	108.9
1999	67.0	120.2	87.6	96.7	132.7	80.5	153.2	106.4	125.4	110.4
2000	69.7	119.7	90.3	99.5	131.9	83.1	180.2	102.9	123.0	110.1
2001	71.5	112.0	89.1	95.3	124.0	85.1	210.2	94.2	125.9	107.0
2002	77.2	110.8	91.3	95.7	116.6	86.4	138.4	102.3	118.3	104.8
2003	81.9	111.0	96.1	96.6	111.9	87.1	113.6	93.1	119.4	100.6
2004	84.3	112.9	98.5	98.7	111.8	87.5	114.2	99.1	102.9	100.2
2005	88.6	115.9	99.2	102.7	111.2	88.6	134.9	104.0	110.1	103.5
2006	89.6	116.0	101.5	104.4	112.2	90.1	109.3	100.3	116.0	102.9
2007	93.8	116.7	102.1	107.6	111.3	92.2	120.7	104.7	118.5	105.4
2008	93.2	107.8	102.7	102.6	107.9	95.1	126.3	96.5	98.2	99.9
2009	94.9	94.0	98.9	90.7	94.6	96.5	94.1	85.2	97.1	91.7
2010	100.4	98.8	102.6	96.2	95.5	97.4	90.1	89.0	99.9	93.8
2011	101.0	100.3	101.9	98.8	97.5	98.5	99.0	96.1	95.9	97.0
2012	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2013	101.4	100.2	99.7	102.2	101.0	102.1	104.2	104.2	100.8	102.6
2014	101.0	99.3	100.3	103.6	102.9	104.3	93.5	104.5	99.8	103.3
2015	99.5	96.9	99.1	103.0	104.1	106.3	85.4	104.4	101.5	104.0
2016	99.3	95.2	96.3	102.9	104.7	108.2	83.4	109.8	105.7	106.9
2017	98.8	94.2	94.9	103.3	105.8	109.8	70.6	110.9	114.7	108.9

1 Output per hour worked.

2 Output per combined units of labor input, capital services, energy, materials, and purchased business services.

3 Hours at work by age, education, and gender group, weighted by each group's share of total wages.

4 The growth rate of each input is weighted by its share of current dollar costs.

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Table 3. Multifactor productivity measures for manufacturing industries in selected periods, 1987-2017

Average annual growth

	1987- 2017	1987-1990	1990-1995	1995- 2000	2000-2007	2007-2017	2016-2017
Manufacturing	0.6	0.2	0.9	1.8	1.8	-0.7	-1.4
<u>Nondurable manufacturing</u>	-0.1	-0.4	0.4	0.0	0.7	-1.0	0.5
Food, beverage, and tobacco products	-0.3	-1.4	1.3	-1.4	0.7	-0.9	-0.6
Textile mills and textile product mills	0.7	1.0	0.6	1.9	0.7	-0.1	-0.4
Apparel, leather, and allied products	-0.3	0.0	2.6	0.1	1.9	-3.6	-10.8
Paper products	0.1	-0.3	-0.1	0.2	0.8	-0.2	-0.2
Printing and related support activities	1.0	0.3	-0.6	0.9	2.7	0.8	4.0
Petroleum and coal products	0.5	-1.1	1.7	2.7	0.0	-0.3	1.8
Chemical products	-0.9	-0.8	-1.1	-0.2	0.9	-2.4	0.8
Plastics and rubber products	0.6	0.8	0.3	1.6	0.7	0.1	1.2
<u>Durable manufacturing</u>	1.3	0.7	1.2	3.0	2.5	-0.2	-3.2
Wood products	0.1	1.2	-1.6	-0.6	0.8	0.5	-0.4
Nonmetallic mineral products	0.1	0.1	0.4	-0.1	0.1	0.0	-1.4
Primary metals	0.5	0.9	-0.2	1.1	0.5	0.6	-3.4
Fabricated metal products	-0.2	-0.2	0.7	-0.1	0.6	-1.3	-1.8
Machinery	-0.4	1.0	-2.2	-1.3	1.5	-0.8	0.1
Computer and electronic products	6.4	4.9	9.1	13.1	6.6	2.3	-3.5
Electrical equipment, appliances, and components	-0.8	-1.9	-2.5	-2.8	1.8	-0.5	-1.4
Transportation equipment	0.0	-1.4	-0.4	0.5	1.7	-0.9	-5.1
Furniture and related products	-0.1	-0.8	0.2	0.2	0.1	-0.2	-0.3
Miscellaneous manufacturing	0.7	2.2	-0.5	1.2	1.6	-0.1	-0.1

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