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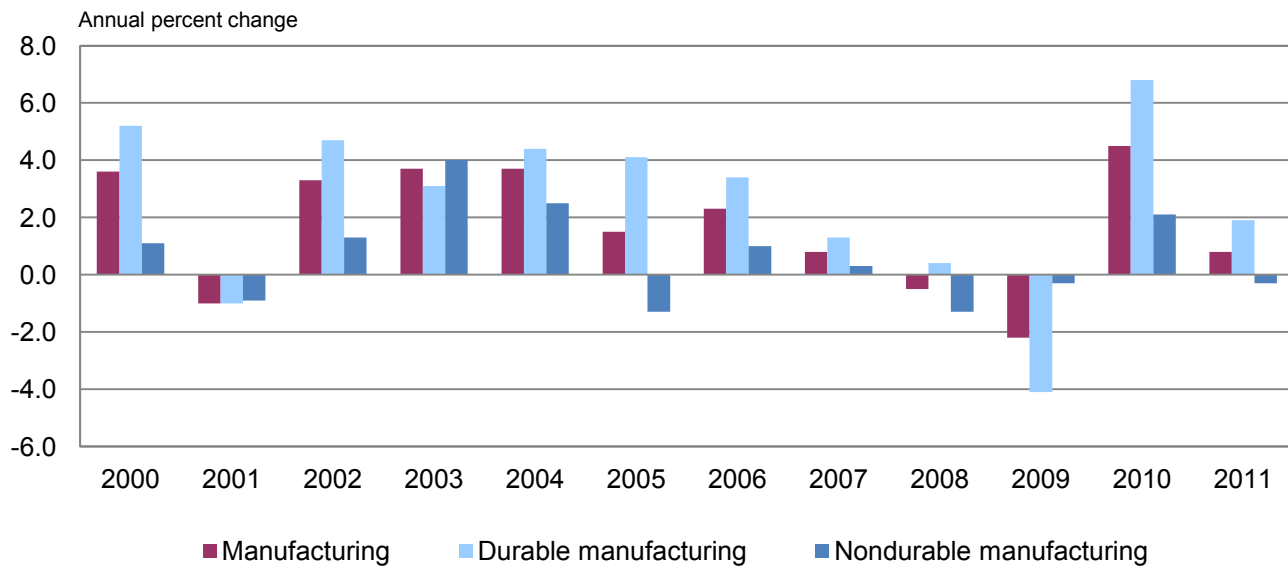
MULTIFACTOR PRODUCTIVITY TRENDS IN MANUFACTURING - 2011

Manufacturing sector multifactor productivity increased at a 0.8 percent annual rate in 2011, the U.S. Bureau of Labor Statistics reported today. This increase was considerably smaller than the 4.5 percent gain in 2010, the largest gain in the series which began in 1987. The multifactor productivity gain in 2011 reflected a 3.1 percent increase in output and a 2.3 percent increase in combined inputs. (See table A.)

Multifactor productivity measures the change in output per unit of combined inputs. Multifactor productivity in manufacturing is designed to measure the joint influences on economic growth of technological change, efficiency improvements, returns to scale, reallocation of resources, and other factors, allowing for the effects of capital, labor and intermediate inputs (energy, materials, purchased business services). Multifactor productivity measures differ from labor productivity (output per hour worked) measures that are published quarterly by BLS because multifactor productivity measures include information on capital services and intermediate inputs. Also, data needed to construct multifactor productivity are not available on a quarterly basis.

Durable manufacturing sector multifactor productivity increased 1.9 percent in 2011, following a 6.8 percent increase in 2010. **Nondurable manufacturing sector multifactor productivity** declined 0.3 percent in 2011, following a 2.1 percent increase in 2010. (See table C, table 3.)

Chart 1. Multifactor productivity for the manufacturing, durable manufacturing, and nondurable manufacturing sectors, 2000-2011



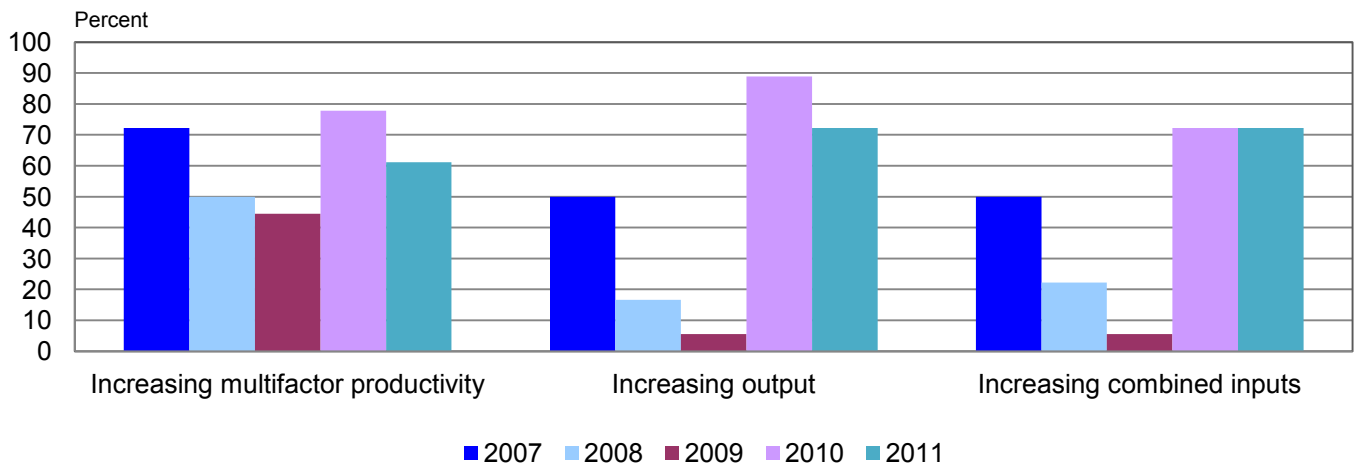
Historical trends in manufacturing

Multifactor productivity in manufacturing grew 1.3 percent annually from 1987 to 2011 with sectoral output increasing at an annual rate of 1.7 percent, faster than the 0.3 percent annual increase in combined inputs. During the same period, output per hour (labor productivity) increased 3.3 percent annually. (See table A.) Of the 3.3 percent growth rate in labor productivity, multifactor productivity added 1.3 percent, capital intensity contributed 0.6 percent, materials intensity added 0.9 percent, and purchased business services intensity added a 0.4 percent increase. The contribution of energy intensity was unchanged. (See table B.)

For the 2007-2011 period, multifactor productivity rose at a 0.6 percent annual rate compared to a larger 2.0 percent annual growth rate in the 2000-2007 period. (See table A.) Sectoral output declined 2.3 percent and combined inputs declined 2.9 percent over the 2007-2011 period.

In 2011, fewer NAICS three-digit manufacturing industries exhibited an increase in multifactor productivity growth and sectoral output growth compared to the previous year. The number of industries exhibiting an increase in combined inputs remained steady at 13, the same number as in 2010. Eleven out of 18 manufacturing industries exhibited an increase in multifactor productivity. Thirteen industries showed increasing output. (See chart 2.) Seven industries experienced a decline in multifactor productivity growth. Of these seven industries, two were durable manufacturing industries: primary metals and miscellaneous manufacturing. The remaining five industries were in the nondurable manufacturing sector: food, beverage, and tobacco products; textile mills and textile product mills; apparel, leather, and allied products; petroleum and coal products; and plastics and rubber products. (See table 3.)

Chart 2. Percent of manufacturing industries with increases in multifactor productivity, output, and combined inputs, 2007-2011



Revised measures

Previous and revised productivity measures and related data for 2009 and 2010 for the manufacturing, durable manufacturing, and nondurable manufacturing sectors are displayed in table C. In 2010, multifactor productivity growth in the manufacturing sector was 4.5 percent, a downward revision from the previously reported 7.5 percent. Multifactor productivity in the durable manufacturing sector was 6.8 percent, down from the previously reported 12.7 percent. In the nondurable manufacturing sector, multifactor productivity was 2.1 percent, a slight downward revision. The downward revision of multifactor productivity in all three sectors was largely the result of an upward revision in the growth of combined inputs in all three sectors. In 2009, multifactor productivity in all three sectors was revised slightly upward. The revisions in both years were due to the annual revision of the National Income and Product Accounts (NIPA) released on November 13, 2012.

Table A. Compound annual growth rates for productivity, sectoral output, and inputs in the manufacturing sector for selected periods, 1987-2011

In percent

	1987-2011	1987-1990	1990-1995	1995-2000	2000-2007	2007-2011	2010-2011
<u>Productivity</u>							
Multifactor productivity ¹	1.3	0.3	1.2	1.8	2.0	0.6	0.8
Output per hour of all persons	3.3	1.8	3.4	4.8	3.9	1.6	0.8
Output per unit of capital services	-0.1	-0.1	0.7	0.8	0.3	-2.8	3.0
<u>Sectoral Output</u>							
	1.7	2.1	3.3	4.6	0.7	-2.3	3.1
<u>Inputs</u>							
Combined inputs ²	0.3	1.9	2.1	2.8	-1.3	-2.9	2.3
Labor hours ³	-1.6	0.4	-0.1	-0.1	-3.1	-3.9	2.3
Capital services	1.8	2.3	2.6	3.8	0.4	0.5	0.1
Energy	-0.3	1.9	1.7	5.9	-3.9	-5.3	2.0
Materials	1.4	1.6	3.7	5.9	-1.1	-2.3	6.3
Purchased business services	0.7	5.3	3.2	1.3	0.2	-5.6	-3.1

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 of all persons.

Table B. Compound annual growth rates in output per hour of all persons and the contributions of capital intensity, intermediate inputs intensity, and multifactor productivity in the manufacturing sector for selected periods, 1987-2011

In percent

	1987-2011	1987-1990	1990-1995	1995-2000	2000-2007	2007-2011	2010-2011
<u>Manufacturing</u>							
Output per hour of all persons	3.3	1.8	3.4	4.8	3.9	1.6	0.8
Contribution of capital intensity ¹	0.6	0.3	0.4	0.7	0.6	0.8	-0.4
Contribution of information processing equipment and software ²	0.2	0.2	0.2	0.3	0.1	0.2	0.0
Contribution of all other capital services	0.4	0.2	0.2	0.3	0.5	0.7	-0.4
Contribution of intermediate inputs ³	1.3	1.2	1.8	2.2	1.2	0.2	0.5
Contribution of energy intensity ⁴	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Contribution of materials intensity ⁵	0.9	0.4	1.1	1.8	0.6	0.5	1.4
Contribution of purchased business services intensity ⁶	0.4	0.8	0.6	0.3	0.6	-0.3	-0.9
Multifactor productivity ⁷	1.3	0.3	1.2	1.8	2.0	0.6	0.8

¹Capital services per hour multiplied by capital's share of current dollar costs.

²Information processing equipment and software per hour multiplied by its share of current dollar costs.

³Intermediate inputs per hour multiplied by intermediate inputs' share of current dollar costs.

⁴Energy per hour multiplied by energy's share of current dollar costs.

⁵Materials per hour multiplied by materials' share of current dollar costs.

⁶Purchased business services per hour multiplied by purchased business services' share of current dollar costs.

⁷Output per combined units of hours, capital services, energy, materials, and purchased business services.

Table C. Previous and revised multifactor productivity and related measures for the 2009-2010 and 2008-2009 periods

Sector	Multifactor productivity ¹	Sectoral output	Inputs					Purchased business services
			Combined inputs ²	Hours ³	Capital services	Energy	Materials	
Annual percent change, 2009-2010								
<u>Manufacturing</u>								
Previous	7.5	6.4	-1.1	-0.1	-0.3	2.9	-3.7	0.4
Revised	4.5	6.3	1.7	0.0	-0.5	1.6	5.0	1.3
<u>Durable manufacturing</u>								
Previous	12.7	10.5	-1.9	-0.1	-1.8	6.1	-4.3	-3.4
Revised	6.8	10.0	3.0	-0.1	-1.6	12.8	14.2	-1.3
<u>Nondurable manufacturing</u>								
Previous	2.7	3.2	0.4	0.0	0.6	1.0	-1.1	5.7
Revised	2.1	3.3	1.1	0.1	0.1	-5.1	1.4	4.9
Annual percent change, 2008-2009								
<u>Manufacturing</u>								
Previous	-2.8	-12.9	-10.4	-13.0	0.1	-24.1	-13.1	-9.1
Revised	-2.2	-12.9	-10.9	-13.0	0.1	-22.8	-14.2	-10.6
<u>Durable manufacturing</u>								
Previous	-4.7	-20.3	-16.3	-15.4	-0.1	-28.0	-26.8	-13.4
Revised	-4.1	-20.3	-16.9	-15.5	-0.2	-28.9	-27.1	-15.1
<u>Nondurable manufacturing</u>								
Previous	-0.9	-6.4	-5.6	-8.6	0.2	-21.4	-6.6	-2.4
Revised	-0.3	-6.4	-6.2	-8.7	0.3	-18.8	-7.8	-3.4

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

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

³Hours at work of all persons.

Technical Notes

Capital Services

Capital services are the services derived from the stock of physical assets and software. There are 86 asset types for fixed business equipment and software, structures, inventories, and land. 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 investments in physical assets and software are obtained from the Bureau of Economic Analysis (BEA). Data on inventories are estimated using BEA and additional information from IRS Corporation Income Returns. Nonfarm industry detail for land is based on IRS book value data.

Labor Hours

The construction of the hours measures follows the methodology described in USDL 13-0626, *Multifactor Productivity Trends, 2011*, http://www.bls.gov/news.release/archives/prod3_04092013.pdf. Hours in manufacturing are directly aggregated and do not include the effects of labor composition. Hours data for the manufacturing multifactor productivity measures include hours for all persons working in the manufacturing sector – wage and salary workers, the self-employed and unpaid family workers. The primary source of hours data is the BLS Current Employment Statistics (CES) survey. Hours paid of production workers are also obtained primarily from the CES survey. The hours of these employees are then converted to an at-work basis by using information from the Employment Cost Index (ECI) of the National Compensation Survey (NCS) and the BLS Hours at Work Survey. Hours at work for nonproduction workers are derived using data from the Current Population Survey (CPS), the CES, and the NCS. The hours at work of proprietors are derived from the CPS.

Hours at work data are based on underlying hours data published in the February 7, 2013, USDL-13-0192, *Productivity and Costs*, http://www.bls.gov/news.release/archives/prod2_02072013.pdf. Therefore, the data do not reflect the benchmark revisions to the CES and other revisions to hours released on March 7, 2013.

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 level of manufacturing. 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 3-digit NAICS level and then aggregated to total manufacturing. Materials inputs are adjusted to exclude transactions between establishments within the same sector.

Combined Inputs

The five input indexes (capital services, hours, 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.

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. BLS industry output measures for manufacturing industries are constructed using data from the economic censuses and annual surveys of the Bureau of the Census, U.S. Department of Commerce, together with information on price changes, primarily from BLS.

Multifactor Productivity

The manufacturing multifactor productivity measures describe the relationship between output in real terms and the inputs involved in its production. Manufacturing multifactor productivity measures exclude intermediate inputs between manufacturing establishments from both output and inputs. Multifactor productivity measures are not intended to measure 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 hours, 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 "Measurement of productivity growth in U.S. manufacturing" in the July 1995 issue of the *Monthly Labor Review*. See <http://www.bls.gov/mfp/mprgul95.pdf>.

Table 1. Manufacturing sector: productivity and related measures for the 1987-2011 period

Annual percent change from previous year

Year	Productivity			Sectoral Output	Inputs					
	Output per hour of all persons	Output per unit of capital services	Multifactor Productivity ¹		Hours ²	Capital Services	Energy	Materials	Purchased business services	Combined units of all Inputs ³
1988	2.1	3.3	2.0	5.2	3.0	1.8	4.1	1.0	8.7	3.1
1989	1.0	-0.7	-0.5	1.6	0.6	2.4	-0.3	2.1	5.8	2.1
1990	2.2	-3.0	-0.7	-0.3	-2.5	2.7	1.9	1.7	1.5	0.4
1991	2.6	-3.9	-0.4	-1.7	-4.2	2.3	-0.3	-0.5	-0.8	-1.3
1992	3.8	1.0	-0.6	3.3	-0.5	2.2	-1.0	8.6	7.5	4.0
1993	2.6	1.5	2.6	3.9	1.3	2.4	3.4	0.8	0.8	1.3
1994	3.5	3.3	2.6	5.9	2.3	2.5	3.6	4.3	3.9	3.3
1995	4.5	1.7	1.8	5.2	0.7	3.5	2.9	5.4	4.9	3.4
1996	3.6	-0.6	0.3	3.4	-0.2	4.1	-2.7	9.0	-0.3	3.1
1997	5.4	2.8	2.7	7.3	1.8	4.5	-2.0	8.0	4.1	4.5
1998	5.5	0.7	1.3	5.2	-0.3	4.5	3.8	8.4	3.4	3.9
1999	4.8	0.6	1.2	4.1	-0.7	3.5	23.3	6.2	0.9	2.9
2000	4.4	0.5	3.6	3.0	-1.3	2.5	9.1	-1.9	-1.4	-0.6
2001	1.8	-5.8	-1.0	-4.8	-6.5	1.0	9.2	-6.4	-1.7	-3.8
2002	7.2	-0.6	3.3	-0.4	-7.1	0.2	-22.6	1.0	-3.2	-3.6
2003	6.3	1.3	3.7	1.1	-4.9	-0.3	-10.2	-1.6	-0.8	-2.5
2004	2.3	2.5	3.7	1.7	-0.5	-0.7	-6.3	-0.8	-6.3	-1.9
2005	4.7	3.2	1.5	3.6	-1.1	0.4	10.3	1.6	8.3	2.0
2006	0.9	0.9	2.3	1.6	0.7	0.7	-4.2	-1.1	-2.7	-0.7
2007	3.8	0.7	0.8	2.1	-1.6	1.4	0.6	-0.1	8.6	1.3
2008	-0.6	-6.8	-0.5	-4.5	-4.0	2.4	0.7	-5.0	-9.6	-4.1
2009	0.1	-13.0	-2.2	-12.9	-13.0	0.1	-22.8	-14.2	-10.6	-10.9
2010	6.3	6.8	4.5	6.3	0.0	-0.5	1.6	5.0	1.3	1.7
2011	0.8	3.0	0.8	3.1	2.3	0.1	2.0	6.3	-3.1	2.3

¹Output per combined units of hours, capital services, energy, materials, and purchased business services.²Hours at work of all persons.³Combined units of hours, capital services, energy, materials, and purchased business services, chained superlative index.

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 also Technical Notes in this release.

Table 2. Manufacturing sector: indexes of productivity and related measures, 1987-2011

Indexes 2005=100

Year	Productivity			Sectoral Output	Inputs					
	Output per hour of all persons	Output per unit of capital services	Multifactor Productivity ¹		Hours ²	Capital Services	Energy	Materials	Purchased business services	Combined units of all Inputs ³
1987	51.2	92.8	76.6	63.0	123.2	67.9	83.3	63.8	71.5	82.3
1988	52.2	95.9	78.2	66.3	126.9	69.1	86.8	64.5	77.7	84.8
1989	52.8	95.2	77.8	67.4	127.7	70.8	86.5	65.8	82.3	86.6
1990	53.9	92.4	77.2	67.2	124.5	72.7	88.1	66.9	83.5	87.0
1991	55.3	88.8	76.9	66.0	119.3	74.3	87.9	66.6	82.9	85.8
1992	57.5	89.7	76.4	68.2	118.7	76.0	87.0	72.4	89.0	89.2
1993	58.9	91.1	78.4	70.9	120.3	77.8	89.9	72.9	89.7	90.4
1994	61.0	94.1	80.4	75.1	123.1	79.8	93.1	76.1	93.2	93.3
1995	63.8	95.7	81.9	79.0	123.9	82.6	95.8	80.2	97.8	96.5
1996	66.1	95.1	82.1	81.7	123.6	85.9	93.3	87.4	97.4	99.5
1997	69.7	97.7	84.3	87.7	125.8	89.8	91.4	94.4	101.4	104.0
1998	73.5	98.4	85.4	92.3	125.5	93.8	94.9	102.3	104.9	108.1
1999	77.1	99.0	86.4	96.1	124.7	97.1	117.0	108.7	105.9	111.2
2000	80.5	99.5	89.5	99.0	123.1	99.5	127.6	106.6	104.4	110.6
2001	81.9	93.8	88.6	94.2	115.0	100.5	139.4	99.8	102.6	106.3
2002	87.9	93.3	91.5	93.9	106.9	100.7	107.8	100.8	99.3	102.6
2003	93.4	94.5	94.9	94.9	101.6	100.4	96.8	99.2	98.5	99.9
2004	95.5	96.9	98.5	96.5	101.1	99.6	90.7	98.4	92.4	98.0
2005	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2006	100.9	100.9	102.3	101.6	100.7	100.7	95.8	98.9	97.3	99.3
2007	104.8	101.6	103.2	103.8	99.0	102.1	96.4	98.8	105.7	100.6
2008	104.2	94.7	102.6	99.1	95.1	104.6	97.1	93.9	95.6	96.6
2009	104.3	82.4	100.4	86.3	82.7	104.8	74.9	80.6	85.4	86.0
2010	110.9	88.0	104.8	91.7	82.7	104.2	76.1	84.6	86.5	87.5
2011	111.8	90.6	105.6	94.5	84.6	104.3	77.6	90.0	83.8	89.5

¹Output per combined units of hours, capital services, energy, materials, and purchased business services.²Hours at work of all persons.³Combined units of hours, capital services, energy, materials, and purchased business services, chained superlative index.

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 also Technical Notes in this release.

Table 3. Multifactor productivity measures for manufacturing industries in selected periods, 1987-2011

Compound annual growth rates

	1987- 2011	1987- 1990	1990- 1995	1995- 2000	2000- 2007	2007- 2011	2010- 2011
Manufacturing	1.3	0.3	1.2	1.8	2.0	0.6	0.8
<u>Nondurable manufacturing</u>	0.3	-0.5	0.7	-0.2	1.0	0.1	-0.3
Food, beverage, and tobacco products	-0.1	-1.6	1.4	-1.7	0.7	-0.1	-0.8
Textile mills and textile product mills	1.1	1.1	0.7	1.5	1.6	0.2	-1.2
Apparel, leather, and allied products	1.4	0.0	2.9	0.6	4.2	-3.3	-2.1
Paper products	0.2	-0.2	-0.2	0.5	0.7	-0.4	2.9
Printing and related support activities	0.6	1.0	-0.2	-0.5	1.3	1.5	5.6
Petroleum and coal products	0.7	0.8	0.8	1.0	0.4	0.5	-2.7
Chemical products	0.1	-1.0	-0.7	-0.5	1.9	-0.5	1.6
Plastics and rubber products	0.7	0.8	0.5	1.2	0.6	0.2	-0.2
<u>Durable manufacturing</u>	2.1	0.9	1.5	3.3	2.8	1.2	1.9
Wood products	0.5	1.0	-1.3	-0.3	1.0	2.7	6.4
Nonmetallic mineral products	-0.1	0.2	0.8	0.1	-0.7	-0.6	1.5
Primary metals	-0.2	1.0	0.0	0.3	-0.4	-1.8	-8.5
Fabricated metal products	0.2	-0.1	1.0	-0.2	0.6	-0.6	3.7
Machinery	0.2	1.0	-1.9	-1.1	1.6	1.4	5.6
Computer and electronic products	9.7	5.5	9.3	14.4	9.9	7.6	3.1
Electrical equipment, appliances, and components	-0.7	-2.4	-2.4	-2.6	1.4	1.3	8.6
Transportation equipment	0.2	-1.6	-0.5	0.5	1.7	-0.7	1.0
Furniture and related products	0.2	-0.7	0.6	0.6	1.1	-1.7	0.8
Miscellaneous manufacturing	1.5	2.7	-0.1	2.4	2.0	0.5	-4.9

Note: Multifactor productivity measures by industry do not sum up to aggregate manufacturing measures because industry measures exclude transactions only within the specific industry while the aggregate manufacturing measures also exclude transactions between all manufacturing industries.