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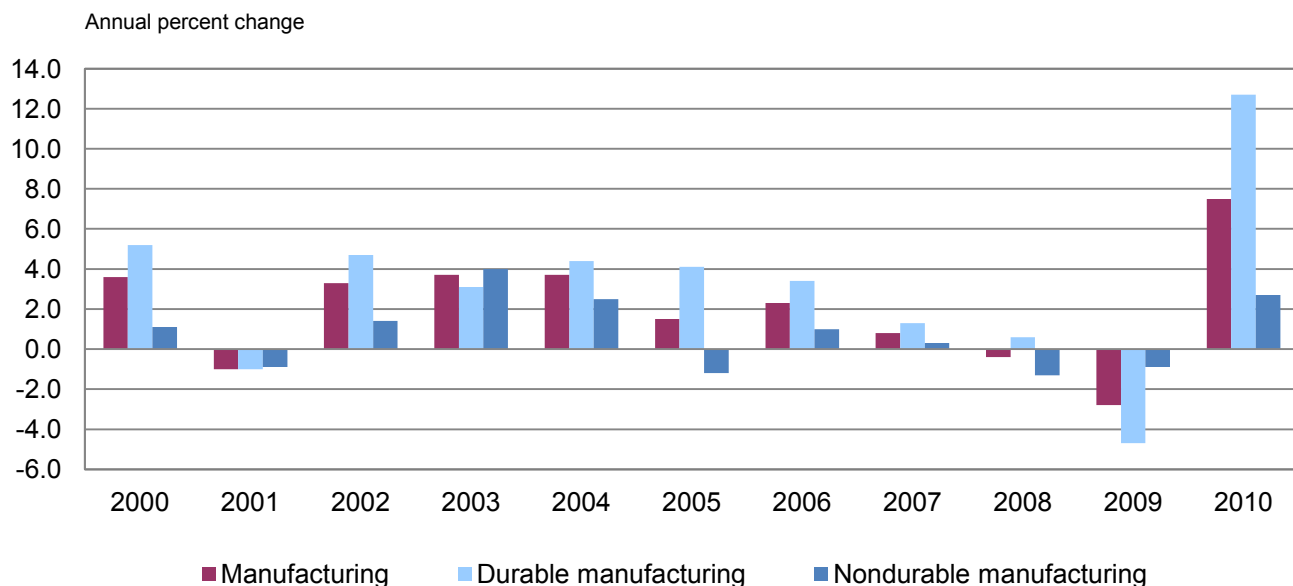
MULTIFACTOR PRODUCTIVITY TRENDS IN MANUFACTURING - 2010

Manufacturing sector multifactor productivity increased at an annual rate of 7.5 percent in 2010, the U.S. Bureau of Labor Statistics reported today. This was the largest increase recorded in the series, which began in 1987. (See chart 1, table A.) The multifactor productivity gain in 2010 reflected a 6.4 percent increase in output and a 1.1 percent decrease in combined inputs.

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 12.7 percent in 2010, following a decline of 4.7 percent in 2009. This was the largest increase recorded in the series, which began in 1987. **Nondurable manufacturing sector** multifactor productivity increased 2.7 percent in 2010, following a 0.9 percent decrease in 2009. The gain in 2010 was the largest increase since 2003. (See table C, table 3.)

Chart 1. Multifactor productivity for the manufacturing, durable manufacturing, and nondurable manufacturing sectors, 2000-2010



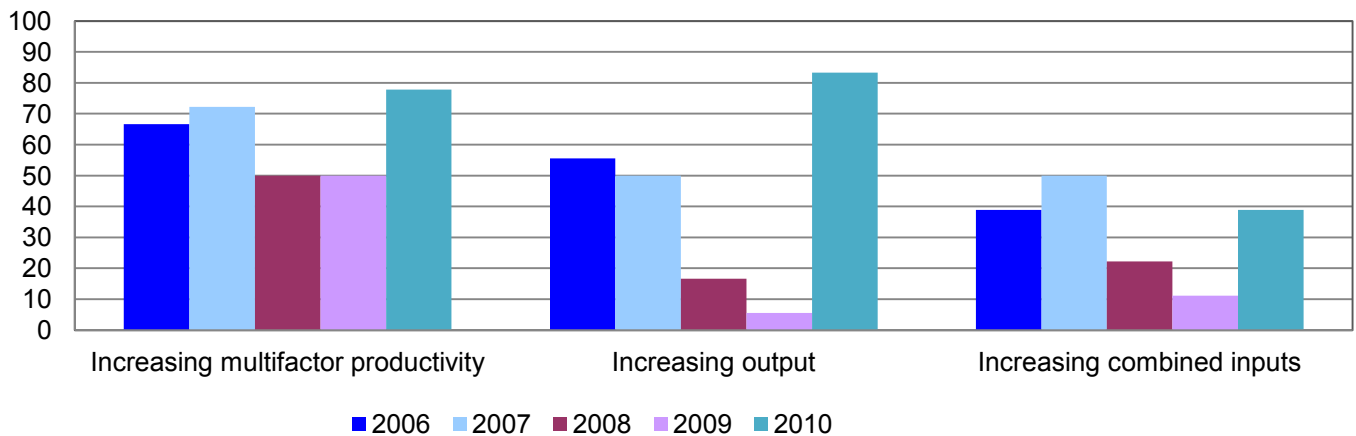
Historical trends in manufacturing

Multifactor productivity in manufacturing grew 1.5 percent annually from 1987 to 2010 as sectoral output increased at a faster rate, 1.7 percent, than combined inputs, 0.2 percent. During the same period, output per hour (labor productivity) increased 3.4 percent. (See table A.) Of the 3.4 percent growth rate in labor productivity, multifactor productivity added 1.5 percent, capital intensity contributed 0.6 percent, materials intensity added 0.8 percent, and purchased business services intensity added a 0.5 percent increase. The contribution of energy intensity was unchanged. (See table B.)

For the 2007-2010 period, multifactor productivity rose at an annual rate of 1.3 percent compared to a 2.0 percent annual growth rate in the 2000-2007 period. The multifactor productivity average annual growth rate in 2007-2010 would have been significantly lower had it not been buoyed by the sharp increase of 7.5 percent in 2010.

In 2010, the number of manufacturing industries that exhibited increasing multifactor productivity, output, and combined inputs grew from the previous year. Fourteen out of eighteen manufacturing industries exhibited increases in multifactor productivity, fifteen showed increasing output, and seven showed increasing combined inputs. (See chart 2.) Only four manufacturing industries exhibited a decrease in multifactor productivity in 2010: textile mills and textile product mills, paper products, primary metals, and electrical equipment, appliances, and components. (See table 3.)

Chart 2. Percent of manufacturing industries with increases in multifactor productivity, output, and combined inputs, 2006-2010



Revised measures

Previous and revised productivity measures and related data for 2008 and 2009 for the manufacturing, durable manufacturing, and nondurable manufacturing sectors are displayed in table C. In 2009, multifactor productivity in manufacturing was revised to a decline of 2.8 percent compared to a decline of 5.7 percent as previously reported. In the nondurable manufacturing sector, multifactor productivity fell 0.9 percent compared to the previously reported decline of 3.1 percent. Multifactor productivity in the durable manufacturing sector was revised to a decline of 4.7 percent instead of a decline of 8.0 percent. The upward revision of multifactor productivity in all three sectors was largely the result of a downward revision in the growth of combined inputs in all three sectors. The revisions in both years were due to the annual revision of the National Income and Product Accounts (NIPA) released on December 13, 2011.

Table A. Compound annual growth rates for productivity, sectoral output, and inputs in the manufacturing sector for selected periods, 1987-2010

In percent

	1987-2010	1987-1990	1990-1995	1995-2000	2000-2007	2007-2010	2009-2010
<u>Productivity</u>							
Multifactor productivity ¹	1.5	0.3	1.2	1.8	2.0	1.3	7.5
Output per hour of all persons	3.4	1.8	3.4	4.8	3.9	1.9	6.5
Output per unit of capital services	-0.2	-0.1	0.7	0.8	0.3	-4.7	6.7
<u>Sectoral Output</u>							
	1.7	2.1	3.3	4.6	0.7	-4.0	6.4
<u>Inputs</u>							
Combined inputs ²	0.2	1.9	2.1	2.8	-1.3	-5.3	-1.1
Labor hours ³	-1.7	0.4	-0.1	-0.1	-3.1	-5.8	-0.1
Capital services	1.9	2.3	2.6	3.8	0.4	0.7	-0.3
Energy	-0.4	1.9	1.7	5.9	-3.9	-7.7	2.9
Materials	0.9	1.6	3.7	5.9	-1.1	-7.4	-3.7
Purchased business services	0.9	5.3	3.2	1.3	0.2	-6.2	0.4

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, 1987-2010

In percent

	1987-2010	1987-1990	1990-1995	1995-2000	2000-2007	2007-2010	2009-2010
<u>Manufacturing</u>							
Output per hour of all persons	3.4	1.8	3.4	4.8	3.9	1.9	6.5
Contribution of capital intensity ¹	0.6	0.3	0.4	0.7	0.6	1.3	-0.1
Contribution of information processing equipment and software ²	0.2	0.2	0.2	0.3	0.1	0.3	0.0
Contribution of all other capital services	0.4	0.2	0.2	0.3	0.5	1.0	-0.1
Contribution of intermediate inputs ³	1.3	1.2	1.8	2.2	1.2	-0.7	-0.9
Contribution of energy intensity ⁴	0.0	0.0	0.0	0.2	0.0	-0.1	0.1
Contribution of materials intensity ⁵	0.8	0.4	1.1	1.8	0.6	-0.5	-1.1
Contribution of purchased business services intensity ⁶	0.5	0.8	0.6	0.3	0.6	-0.1	0.1
Multifactor productivity ⁷	1.5	0.3	1.2	1.8	2.0	1.3	7.5

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 2008-2009 and 2007-2008 periods

Sector	Multifactor productivity ¹	Sectoral output	Inputs					Purchased business services
			Combined inputs ²	Hours ³	Capital services	Energy	Materials	
Annual percent change, 2008-2009								
<u>Manufacturing</u>								
Previous	-5.7	-12.5	-7.2	-12.6	1.2	-11.4	-8.0	-5.3
Revised	-2.8	-12.9	-10.4	-13.0	0.1	-24.1	-13.1	-9.1
<u>Durable manufacturing</u>								
Previous	-8.0	-19.3	-12.3	-15.1	1.5	-22.3	-17.3	-9.8
Revised	-4.7	-20.3	-16.3	-15.4	-0.1	-28.0	-26.8	-13.4
<u>Nondurable manufacturing</u>								
Previous	-3.1	-6.6	-3.6	-8.3	1.1	-4.4	-4.8	0.4
Revised	-0.9	-6.4	-5.6	-8.6	0.2	-21.4	-6.6	-2.4
Annual percent change, 2007-2008								
<u>Manufacturing</u>								
Previous	-0.1	-4.4	-4.3	-4.0	2.8	3.9	-5.0	-11.9
Revised	-0.4	-4.5	-4.1	-4.0	2.4	0.7	-5.1	-9.6
<u>Durable manufacturing</u>								
Previous	2.2	-5.7	-7.7	-4.2	1.7	0.4	-12.6	-14.3
Revised	0.6	-5.8	-6.3	-4.2	1.3	-1.8	-11.1	-9.0
<u>Nondurable manufacturing</u>								
Previous	-2.2	-3.5	-1.3	-3.7	3.6	6.3	-0.9	-8.7
Revised	-1.3	-3.6	-2.3	-3.6	3.2	2.4	-2.1	-10.6

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 Bureau of Economic Analysis (BEA). 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 12-0494, *Multifactor Productivity Trends, 2010*, http://www.bls.gov/news.release/archives/prod3_03212012.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 2, 2012, USDL-12-0162, *Productivity and Costs*, http://www.bls.gov/news.release/archives/prod2_02022012.pdf. Therefore, the data do not reflect the benchmark revisions to the CES and other revisions to hours released on March 7, 2012.

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, employing weights that represent each component's share of total costs. Total costs are defined as the current dollar value of manufacturing sectoral output.

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 computed 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. Wherever possible, the indexes of industry output are calculated with a Tornqvist formula. This 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 do not account for 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 due to shifts in factor inputs across industries, and other factors. 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>. 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 1987-2010 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	6.2	1.3	3.7	1.0	-4.9	-0.3	-10.2	-1.6	-0.8	-2.5
2004	2.3	2.5	3.7	1.7	-0.5	-0.8	-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	1.0	0.9	2.3	1.7	0.7	0.7	-4.2	-1.1	-2.7	-0.7
2007	3.9	0.7	0.8	2.1	-1.6	1.4	0.6	-0.1	8.6	1.3
2008	-0.5	-6.8	-0.4	-4.5	-4.0	2.4	0.7	-5.1	-9.6	-4.1
2009	0.0	-13.0	-2.8	-12.9	-13.0	0.1	-24.1	-13.1	-9.1	-10.4
2010	6.5	6.7	7.5	6.4	-0.1	-0.3	2.9	-3.7	0.4	-1.1

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, 1987-2010

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	63.1	123.2	67.9	83.4	63.9	71.5	82.3
1988	52.3	95.9	78.2	66.3	126.9	69.1	86.8	64.5	77.8	84.8
1989	52.8	95.2	77.8	67.4	127.7	70.8	86.5	65.8	82.3	86.6
1990	54.0	92.4	77.2	67.2	124.5	72.7	88.1	66.9	83.5	87.0
1991	55.4	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	93.2	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	99.6
1997	69.7	97.7	84.3	87.7	125.8	89.8	91.4	94.4	101.5	104.0
1998	73.5	98.4	85.4	92.3	125.5	93.8	94.9	102.4	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	91.6	93.9	106.9	100.7	107.8	100.8	99.3	102.6
2003	93.3	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	101.0	100.9	102.3	101.7	100.7	100.7	95.8	98.9	97.3	99.3
2007	104.9	101.7	103.2	103.8	99.0	102.1	96.4	98.8	105.7	100.6
2008	104.3	94.8	102.7	99.1	95.1	104.6	97.1	93.7	95.6	96.5
2009	104.3	82.5	99.8	86.3	82.7	104.7	73.7	81.5	86.8	86.5
2010	111.1	88.0	107.4	91.9	82.7	104.4	75.9	78.5	87.2	85.6

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, 1987-2010

Compound annual growth rates

	1987-2010	1987-1990	1990-1995	1995-2000	2000-2007	2007-2010	2009-2010
Manufacturing	1.5	0.3	1.2	1.8	2.0	1.3	7.5
<u>Nondurable manufacturing</u>	0.4	-0.5	0.7	-0.2	1.0	0.2	2.7
Food, beverage, and tobacco products	-0.2	-1.6	1.4	-1.7	0.7	-0.8	0.3
Textile mills and textile product mills	0.9	1.1	0.7	1.5	1.6	-1.7	-4.0
Apparel, leather, and allied products	2.4	0.0	2.9	0.6	4.2	2.6	5.9
Paper products	0.1	-0.2	-0.2	0.5	0.7	-1.2	-2.2
Printing and related support activities	0.4	1.0	-0.2	-0.5	1.3	0.0	1.1
Petroleum and coal products	0.9	0.8	0.8	1.0	0.4	2.3	6.6
Chemical products	0.1	-1.0	-0.7	-0.5	1.9	-0.9	1.9
Plastics and rubber products	0.8	0.8	0.5	1.2	0.6	1.5	3.5
<u>Durable manufacturing</u>	2.3	0.9	1.5	3.3	2.8	2.6	12.7
Wood products	0.5	1.0	-1.3	-0.3	1.0	3.6	9.7
Nonmetallic mineral products	0.0	0.2	0.8	0.1	-0.7	-0.1	4.7
Primary metals	0.3	1.0	0.0	0.3	-0.4	1.7	-1.7
Fabricated metal products	0.4	-0.1	1.0	-0.2	0.6	0.1	9.9
Machinery	0.3	1.0	-1.9	-1.1	1.6	2.9	14.8
Computer and electronic products	10.4	5.5	9.3	14.4	9.9	11.7	24.3
Electrical equipment, appliances, and components	-1.2	-2.4	-2.4	-2.6	1.4	-1.6	-7.8
Transportation equipment	0.2	-1.6	-0.5	0.5	1.7	-0.9	12.6
Furniture and related products	0.4	-0.7	0.6	0.6	1.1	-0.9	12.0
Miscellaneous manufacturing	2.0	2.7	-0.1	2.4	2.0	4.1	8.7

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.