"Hollowing Out" in U.S. Manufacturing: Analysis and Issues for Congress

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Summary

The health of the U.S. manufacturing sector has been a long-standing concern of Congress. Although Congress has established a wide variety of tax preferences, direct subsidies, import restraints, and other federal programs with the goal of retaining or recapturing manufacturing jobs, only a small proportion of U.S. workers is now employed in factories. Meanwhile, U.S. factories have stepped up production of goods that require high technological sophistication but relatively little direct labor. Labor productivity in manufacturing, as measured by government data, has grown rapidly, suggesting that the manufacturing sector as a whole remains healthy.

Recent data, however, challenge the belief that the manufacturing sector, taken as a whole, will continue to flourish. Unlike previous expansions, the two most recent cyclical upturns in the U.S. economy have not generated jobs in manufacturing. Moreover, statistics suggest that domestic value represents a diminishing share of the value of U.S. factory output. One interpretation of these data is that manufacturing is "hollowing out" as companies undertake a larger proportion of their high-value work abroad. These developments raise the question of whether the United States will continue to generate highly skilled, high-wage jobs related to advanced manufacturing.

The evidence concerning "hollowing out" is ambiguous, as conceptual issues and statistical deficiencies make it difficult to determine whether the recent decline in manufacturing value added, relative to shipments, is a short-term phenomenon or a long-term trend. Despite improvements in recent years, U.S. statistical agencies still tend to treat manufacturing and services as unrelated economic activities, and it is not clear that existing data series on domestic economic activity, trade, and freight transportation adequately capture changes in the nature of manufacturing, the sources of employment, and the creation of value.

Nonetheless, evidence suggests strongly that physical production activities account for a diminishing share of the final value of manufactured products, with service-related inputs such as research, product design, and marketing becoming more important. Further, the production of many goods is dispersed across multiple locations along global supply chains, making it difficult to determine where value is added. Such shifts pose a challenge to efforts to capture economic value by promoting goods production in the United States.

In the context of national security, the fact that U.S. manufacturers of vital products are critically dependent upon inputs from abroad is frequently a subject of concern. International comparisons indicate that the United States is in no way unique in its dependence on foreign inputs to manufacturing. Although the output of U.S. factories contains a large proportion of foreign value added, many other countries appear to be even more dependent upon foreign value added than is the United States, at least with respect to goods traded in international markets.

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Introduction

The health of the U.S. manufacturing sector has been a major concern of Congress for more than three decades. Over the years, Congress has enacted a wide variety of tax preferences, direct subsidies, import restraints, and other federal programs intended to bolster the manufacturing sector, often with the goal of retaining or recapturing highly paid manufacturing jobs.

Only a small proportion of U.S. workers is now employed in factories, as manufacturers have shifted low-value, labor-intensive production, such as apparel and shoe manufacturing, to other countries. Meanwhile, U.S. factories have stepped up production of goods that require high technological sophistication but relatively little direct labor. Despite highly publicized factory closures, the good-producing capacity of the U.S. economy remains near its all-time peak, as measured by the Federal Reserve Board.

Recent data, however, challenge the belief that the manufacturing sector, taken as a whole, will continue to flourish. In particular, statistics showing that domestic value added represents a diminishing share of the value of U.S. factory output have been interpreted by many analysts as indicating that manufacturing is "hollowing out" as U.S. companies undertake more high-value work abroad. Economic data have been slow to take note of this development, which raises the question of whether the United States will continue to generate highly skilled, high-wage jobs related to advanced manufacturing.

This report discusses economic evidence related to the "hollowing out" thesis with respect to the manufacturing sector. It then considers the policy implications of the debate.

The Health of U.S. Manufacturing

The United States has a very large manufacturing sector. In 2010, manufacturers' shipments reached $5 trillion, equal to one-third of the gross domestic product. Although many factories closed or reduced production during the 2007-2009 recession, output has rebounded since the summer of 2009. In February 2011, the Federal Reserve Board's index of industrial production in manufacturing reached the highest seasonally adjusted level in two-and-a-half years, only 6% below the high recorded in July 2007.[1]

This cyclical recovery, however, has not stilled concerns about the sector's health. The number of U.S. manufacturing sites fell from 397,552 in 2001 to 344,352 as of June 2010, leaving many factories abandoned. Manufacturing employment, which peaked at 19.4 million in 1979, was 11.7 million in February 2011. Of those 11.7 million manufacturing workers, only 8.2 million, or 5.3% of the civilian labor force, are now engaged in factory production work.

These broad trends—generally expanding manufacturing output coupled with declining employment—are of long standing. In combination, they are taken as indicators of rapidly rising productivity. Labor productivity in U.S. manufacturing, defined as output per work hour, has increased 13% since 2005 and 41% since 2000 as manufacturers have shifted away from labor-

[1] Industrial production and capacity data are published in the Federal Reserve Board's monthly G.17 release, available at http://www.federalreserve.gov/releases/G17/Current/default.htm.

intensive production. A rapid rise in productivity would be consistent with the belief that U.S. manufacturing is becoming more efficient and technologically sophisticated and therefore requires less labor; one analogy might be the farm sector, in which the labor force has shrunk to a small fraction of its size a century ago despite a vast increase in output.

The estimates of rising manufacturing output and capacity and of rapidly improving labor productivity, however, rely critically on price adjustments that attempt to account for improvements in the quality of computers and certain other high-technology products. Such adjustments are required because, for example, simply measuring changes in the quantity or value of the computers produced each year would have little economic meaning given the very rapid increase in a computer's capabilities.[2]

Government statistical agencies address this problem by making highly technical adjustments when measuring certain prices. These adjustments can affect prominent economic indicators, such as gross domestic product and labor productivity. The industries for which data are adjusted in this way, such as semiconductor manufacturing, are among the most vigorous in U.S. manufacturing, leading to questions about whether reported improvements in manufacturing represent real changes or merely the result of statistical adjustments.[3]

While some data thus indicate that U.S. manufacturing is resilient and recovering well from the 2007-2009 recession, two facts in particular support the argument that the manufacturing sector is more challenged than the government's output and productivity measures imply:

- Unlike previous expansions, the two most recent cyclical upturns in the U.S. economy have not brought more jobs in manufacturing. Factory output rose roughly 16% from the end of the 2001-2002 recession through 2007 without generating factory jobs. This pattern has repeated itself since June 2009; both total manufacturing employment and factory production employment are lower now than at the deepest point of the 2007-2009 recession, despite a 13.9% increase in factory output.
- Value added in U.S. factories appears to represent a declining share of the value of factory shipments. Although total output may still be rising, the measured contribution of U.S. factories to the value of the final products may not be keeping pace. Some commentators refer to this phenomenon as "hollowing out."

What Is Value Added?

Value added represents one measure of the health of manufacturing. Conceptually, value added equals the value of manufacturers' shipments less the value of purchased inputs. Employees' pay and benefits, depreciation of capital investment, business income taxes, and returns to business owners all are components of value added. In essence, value added is meant to capture the share

[2] For an explanation of this adjustment process, see Dave Wasshausen and Brent R. Moulton, "The Role of Hedonic Methods in Measuring Real GDP in the United States," October 12-13, 2006, http://www.bea.gov/papers/pdf/hedonicGDP.pdf.

[3] David Byrne, Brian K. Kovak, and Bryan Michaels, "Offshoring and Price Measurement in the Semiconductor Industry," in Susan N. Houseman and Kenneth F. Ryder, eds., *Measurement Issues Arising from the Growth of Globalization* (Washington, DC: National Academy of Public Administration, 2010), pp. 169-194.

of the value of final products that is being added "in house." Value added is typically assessed with two different metrics. One metric, the growth rate of "real" value added, provides information about the expansion of industrial output but is subject to the technology-related adjustment issues discussed above. The other metric, which avoids these adjustment issues, is the ratio of each year's manufacturing value added to that year's manufacturing shipments.

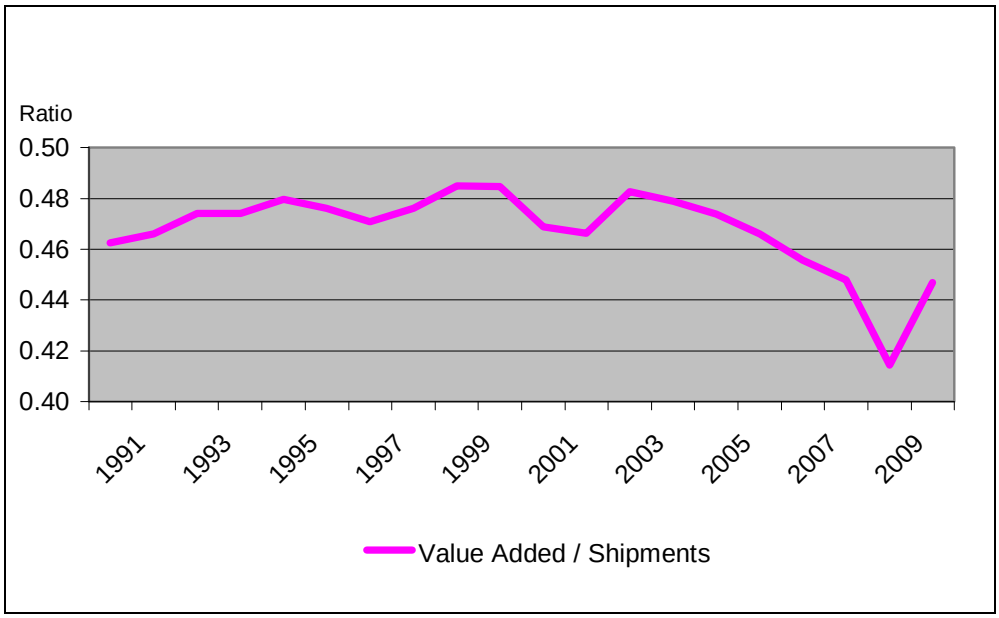
For an individual firm, a decline in the ratio of value added to shipments may not be meaningful. To see why, consider a firm that produces a component, uses the component to make another product, and sells that product. If the firm were to split itself in half, so that one entity makes the component and sells it to a separate entity that makes the finished product, manufacturers' total shipments would increase but total value added would not change. The resulting decline in the ratio of value added to shipments would have no economic significance.

The situation may be different, however, at the level of an industry or of the manufacturing sector as a whole. In these cases, a lower ratio of value added to shipments could reveal important changes. One might be diminished profitability. Another might be that manufacturers' costs for certain inputs, such as electricity or paperboard cartons, are rising faster than the prices manufacturers receive for their products. A third possibility could be that manufacturers are collectively making greater use of imported parts and components.

From 1990 through 2005, U.S. manufacturing value added fluctuated in a narrow range, between 46.3% and 48.5% of the value of manufacturers' shipments, according to Census Bureau estimates. From 2006 through 2008, however, the ratio fell to unusually low levels (see **Figure 1**). The decline, which began in 2003, predates the 2007-2009 recession.

Figure 1. Manufacturers' Value Added

(Ratio to Shipments)



Source: U.S. Census Bureau, Annual Survey of Manufactures.

Data compiled by the Bureau of Economic Analysis (BEA), using different methods, show similar trends over time. Both data series show the manufacturing value-added ratio rising in 2009, but as the figures are subject to large revisions, it is premature to conclude that the value-added ratio has returned to its previous range.

Whether the declining ratio of value added to shipments indicates deterioration in U.S. manufacturing is a matter of controversy among economists, as a number of conceptual issues and statistical deficiencies make this an imperfect gauge of economic activity. Among the most important of these problems are the following.

Accounting for purchased services. The Census Bureau *includes* manufacturers' outlays for telecommunications, advertising, transportation, and other services purchased from third parties in value added, but *excludes* outside purchases of materials, such as parts, packaging, and fuel. Conceptually, there is no reason to treat purchased services differently from purchased materials, but until recently the government lacked data on purchased services. According to BEA data, spending on purchased services consumed 16.2% of manufacturers' sales in 2006, up from 14.9% in 1997. This relative growth in the use of purchased services would have increased the reported growth rate of value added in manufacturing during that period, even if there were no actual change in physical manufacturing activity.[4]

Accounting for research and development. Government statistics include the costs of a manufacturer's research and development staff in value added in the same way as the costs of its production employees. Economists have long debated whether research and development should be treated instead as investment. BEA estimates that this accounting change would have raised the annual growth rate of value added in private industry slightly between 1995 and 2007, and that it would have caused value added in certain high-tech sectors, notably pharmaceutical, instrument, and aerospace manufacturing, to grow faster than official statistics indicate. BEA plans to revise the statistical treatment of corporate research and development spending in 2013.[5]

Intellectual property exports. Many companies conduct research and development in the United States and use or license the resulting designs, patents, and brand names for manufacturing abroad. In principle, if this intellectual property is licensed to a foreign producer, it appears in U.S. trade data as a services export. However, the measurement of value added can become blurred if the foreign-made product is then imported into the United States to be incorporated into other goods; U.S. data on manufacturing may not adequately correct for the fact that some of the import's value was originally created in the United States or may categorize that U.S. value added as a product of the service sector rather than the manufacturing sector. Moreover, if the intellectual property is licensed from a U.S. operation to a foreign operation of a multinational company, the licensing fee may not reflect the true economic value of the intellectual property. These complexities tend to make U.S. manufacturing value added appear smaller than it really is, and this bias may have increased over time as "offshoring" of assembly work has become more common.

[4] Robert E. Yuskavage, Eric H. Strassner, and Gabriel W. Medeiros, "Domestic Outsourcing and Imported Inputs in the U.S. Economy: Insights from Integrated Economic Accounts," May 15, 2008, http://www.bea.gov/papers/pdf/yuskavage_outsource.pdf, p. 40.

[5] Jennifer Lee and Andrew G. Schmidt, "Research and Development Satellite Account Update," *Survey of Current Business*, December 2010, pp. 16-27.

Factoryless manufacturing. A growing number of companies widely considered to be manufacturers—perhaps the best known is the electronics company Apple Inc.—specialize in certain processes, such as design, distribution, or service, but perform little or no physical production themselves.[6] The activities of such "factoryless manufacturers" may show up in government data as "wholesale trade" rather than as "manufacturing." As more companies embrace the factoryless model, it is possible that an increasing proportion of products with high U.S. value added are being omitted from the calculation of manufacturing output and value added, contributing to the measured decline in the value-added ratio through most of the past decade. The Census Bureau plans to address this issue by including factoryless manufacturers in the manufacturing sector starting in 2012, but this may cause other statistical distortions.[7]

Price biases. Import price indexes play a critical role in measuring value added in manufacturing. Around 40% of all imports are inputs for business use, such as parts and components, rather than consumer goods. Research suggests that import price indexes are slow to capture price changes when a manufacturer shifts from a domestic to a foreign supplier or from a supplier in one country to a supplier in another. These measurement problems may result in official data understating the use of imported components in U.S. factories, implying that value added in U.S. factories may be lower than statistics indicate.[8]

Table 1 summarizes the effects of these various measurement issues on reported value added in the manufacturing sector. The net effect is ambiguous. Although the statistical problems are serious, it is uncertain, on balance, whether they collectively make value added larger or smaller, relative to manufacturers' shipments, and whether they change the growth rate of value added in manufacturing.

Table 1. Summary of Measurement Issues Affecting Value Added in Manufacturing

Measurement Issue	Effect on Measured Value Added
Inclusion of Purchased Services in Value Added	Positive
Treatment of In-House Research and Development as Expense Rather Than Investment	Negative
Misattribution of Intellectual Property Exports	Negative
Misclassification of Some Factoryless Manufacturing	Negative
Import Price Overstatement	Positive

Source: Interviews and literature reviewed by CRS.

[6] Apple, Inc., Form 10-K for the fiscal year ended September 25, 2010, p. 13, states that "substantially all of the Company's components and products are manufactured in whole or in part by a few third-party manufacturers." The only company-owned factory mentioned is in Cork, Ireland.

[7] U.S. Census Bureau, "Economic Classification Policy Committee (ECPC) Recommendation for Classification of Outsourcing in North American Industry Classification System (NAICS) Revisions for 2012," May 12, 2010, http://www.census.gov/eos/www/naics/fr2010/ECPC%20Recommendation%20for%20Classification%20of%20Outsourcing.doc.

[8] Susan N. Houseman, "Offshoring and Import Price Measurement," *Survey of Current Business*, February 2011, pp. 7-11.

International Trade and Value Added

One possible reason for the decline in manufacturing value added, relative to sales, could be increased use of imported inputs—so-called "intermediate inputs"—by U.S. manufacturers. In 1998, 24% of intermediate inputs used in manufacturing were imported. According to one analysis, the figure started rising in 2003 and reached 34% in 2006. Moreover, U.S. factories' use of domestic components and other materials (excluding energy) is estimated to have declined at an annual rate of 3.9% between 1998 and 2006, while their use of imported components and materials is estimated to have risen at a 3.5% rate.[9]

The rapidly increasing use of imported inputs may inflate labor productivity growth in manufacturing, as measured by government data. The reason for this is that government statistics may understate the declines in input prices if manufacturers are shifting quickly from using a domestic input to a competing foreign-made input that is lower in cost. If this is occurring, it would mean that U.S. factories are using a greater quantity of the foreign input than assumed, and less of the domestically made alternative. In that case, the output of U.S. manufacturing workers, and hence their productivity, would be lower than believed.[10]

Industry-level data suggest that increased use of imported components may be occurring in some manufacturing industries that traditionally have high value added relative to shipments. These industries typically are intensive users of scientific research and advanced technology, and are often regarded as industries in which the United States should have an international competitive advantage. While some such industries have shown little change in the domestic value added ratio, others have exhibited marked declines in value added relative to shipments in the last four or five years (see **Table 2**). For example, value added in the computer and electronics industry, with shipments of $328 billion in 2009, declined from 65% of shipments in 2005 to 59% in 2009.

Table 2. Value Added in Five High-Value-Added Industries

(Percent of Value of Industry's Shipments)

Industry	2009 Shipments ($bn)	2000	2005	2008	2009 (prelim.)
Pharmaceuticals	$142	70.3%	82.4%	74.6%	74.8%
Medical Instruments	$35	74.8%	77.0%	72.4%	72.0%
Semiconductors	$59	74.7%	80.7%	74.6%	69.9%
Navigational & Control Instruments	$125	62.3%	71.0%	61.5%	63.5%
Dies and Tools	$6	69.3%	69.7%	62.1%	60.9%

Source: U.S. Census Bureau, Annual Survey of Manufactures.

[9] Lucy P. Eldridge and Michael J. Harper, "Effects of imported intermediate inputs on productivity," *Monthly Labor Review*, June 2006, pp. 6, 12.

[10] Susan Houseman, Christopher Kurz, Paul Lengerman, and Benjamin Mandel, "Offshoring Bias in U.S. Manufacturing," *Journal of Economic Perspectives*, forthcoming.

The declining share of domestic value added in particular industries is related to a broad change in businesses' strategies that emphasizes the use of global supply chains.[11] In such arrangements, made possible by low freight transportation and communication costs, a retailer or manufacturer organizes its production on a worldwide basis rather than on a country-by-country basis. It may then obtain economies of scale in manufacturing by using a factory in one country to supply most or all of its need for a particular product worldwide, shipping intermediate inputs from place to place for additional processing in order to deliver the final product at the lowest total cost.

Global supply chains have enabled U.S. manufacturers to make greater use of imported intermediate inputs from low-wage countries, notably China. The trade patterns can be difficult to trace, because it may not be clear which domestic manufacturing industry makes use of a particular import. One recent study illustrates the complexities. Imports of automobile seats have declined since 1994, suggesting, at first glance, that auto manufacturers are making greater use of U.S. content. More detailed analysis, however, shows that imports of seat parts, mainly from Mexico, have increased sharply. These imports consist of items such as fabrics and temperature-control devices that may not be readily identified as auto-related.[12] Collectively, such imports reduce the amount of U.S. content in the seat and in the vehicle in which the seat is installed.[13]

The extent to which inputs imported into the United States contain value added in the exporting country, the United States, or third countries is uncertain due to the same conceptual factors that complicate analysis of U.S. value added in manufacturing. Nor are there reliable data on how the amount of U.S. content embedded in imported products has changed over time. However, one recent study estimated that 8.3% of the gross value of U.S. imports in 2004 originated in the United States. Among the world's major economies, only the European Union approached the United States in terms of domestic value embedded in imports. Developing economies usually add little value to exports that are subsequently incorporated into their imports (see **Table 3**).[14]

Table 3. Domestic Value Added Included in Imported Goods, 2004

(Percent of Each Country's Imports by Value)

United States	8.3%
European Union	7.2%
Japan	3.4%
South Korea	1.1%
China	0.9%
Brazil	0.4%

Source: Koopman et al., p. 43. See note 14.

[11] CRS Report R40167, *Globalized Supply Chains and U.S. Policy*, by Dick K. Nanto. A growing academic literature examines global supply chains. Among the early examples is Gary Gereffi and Miguel Korzeniewicz, eds., *Commodity Chains and Global Capitalism* (Westport, CT: Greenwood Press, 1994).

[12] Thomas H. Klier and James R. Rubenstein, "Imports of Intermediate Parts in the Auto Industry—A Case Study," in Houseman and Ryder, eds., *Measurement Issues Arising from the Growth of Globalization*, pp. 226, 231.

[13] Value added in the motor vehicle parts sector, which averaged 41.4% of shipments from 1997 through 2006, averaged only 37.2% of shipments from 2007 through 2009, according to Census Bureau data.

[14] Robert Koopman, William Powers, Zhi Wang, and Shang-Jin Wei, "Giving Credit Where Credit Is Due: Tracing Value Added in Global Production Chains," Working Paper 16426, National Bureau of Economic Research, September 2010, revised March 2011, http://www.nber.org/papers/w16426.pdf.

One evidence of the tenuous link between output and value added can be seen in China's soaring exports of what U.S. trade data label "advanced technology products," or ATP, including specified electronic and biotechnology goods. While China's bilateral trade surplus with the United States in such products soared from 2002 through 2006, all of the increase was due to processing of foreign components in Chinese factories owned, at least in part, by foreign investors. Although U.S. exports to China were lower than Chinese exports to the United States, "It appears that ATP exports from the United States to China are dominated by large scale, sophisticated, high-valued equipment and devices at the high end of these industries' value-added chains, while ATP exports from China to the United States are mainly small scale final products or components in the low end of the ATP value-added chain," a recent study concluded.[15]

More generally, the so-called emerging economies tend to rely more heavily on foreign value added for export goods than do higher-income countries (see **Table 4**). The sources of that imported value added vary considerably among countries. The United States, for example, is estimated to have provided 37.1% of the value added in Mexican exports in 2004, whereas Japan provided only 2.7%. On the other hand, Japan was the largest source of foreign value in China's exports, providing 7.9% of total value added, while the United States provided only 3.7%.[16]

Table 4. Domestic Value Added in Final Goods Exports

(Percent of Export Value, 2004)

European Union (15 countries)	88.9%
Japan	88.8%
United States	88.4%
Korea	69.3%
China	64.1%
Mexico	56.5%

Source: Koopman et al., p. 45. See note 14.

These data shed light on a concern frequently raised in the context of national security, that U.S. manufacturers of vital products are critically dependent upon inputs from abroad. Evidence suggests that the output of U.S. factories contains a large proportion of foreign value added. However, many other countries are even more dependent upon foreign value added than is the United States, at least with respect to goods traded in international markets.

[15] Michael Ferrantino, Robert Koopman, Zhi Wang, Falan Yinug, Ling Chen, Fengjie Qu, and Haifeng Wang, "Classification and Statistical Reconciliation of Trade in Advanced Technology Products," May 2008, http://ssrn.com/abstract=1132748, pp. 38-43, 51. For a study reaching similar conclusions with respect to the sophistication of Chinese exports, see Mary Amiti and Caroline Freund, "The Anatomy of China's Export Growth," World Bank Development Research Group, Policy Research Working Paper 4628, May 2008, http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&theSitePK=523679&entityID=000158349_20080527092730&searchMenuPK=64187283&theSitePK=523679.

[16] Koopman et al., "Giving Credit Where Credit Is Due," p. 45.

Issues for Congress

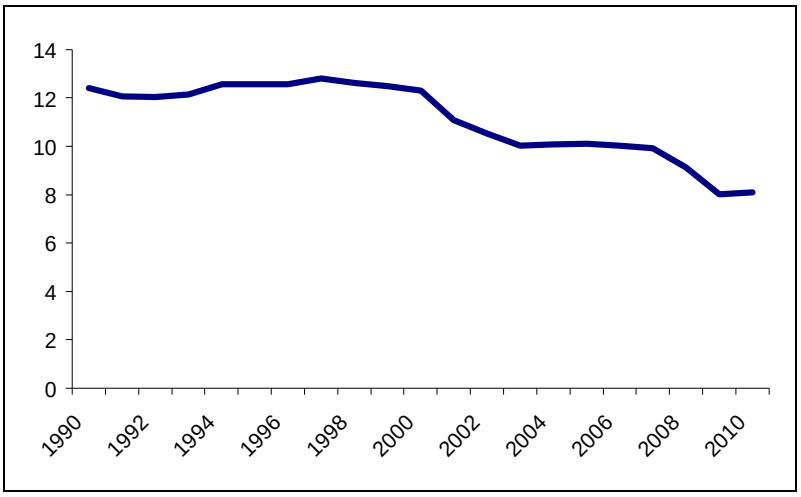
As the research surveyed in this report emphasizes, traditional understandings of "manufacturing" are inadequate to explain the process by which goods are produced in the modern world economy. For a large number of goods, physical production—activities such as stamping, molding, cutting, machining, welding, and assembly—is no longer the heart of the manufacturing process. The bulk of the value in many goods comes from ancillary activities, such as design, marketing, and distribution, which are not necessarily performed by the same enterprises, or at the same locations, as physical production.

The shift to global supply chains has had both positive and negative effects on the U.S. economy. There is no doubt that it has contributed to reduced U.S. consumer prices for many manufactured products. The availability of imported intermediate inputs has probably preserved some manufacturing within the United States, as reliance on higher-cost domestic inputs might well make related U.S. final-goods manufacturing uncompetitive. Additionally, the supply chains themselves support U.S. jobs in transportation, logistics management, and other fields.

At the same time, there is widespread agreement that "offshoring" has played a major role in loss of factory production work (see **Figure 2**), leading to higher unemployment and reduced incomes for some groups of workers and some communities where import-sensitive manufacturing is located.[17] One forthcoming study estimates that the rapid growth of manufactured imports from China accounted for a quarter or more of the decline in U.S. manufacturing employment since 1990, and may have adversely affected employment and wages in other sectors as well.[18]

Figure 2. U.S. Production Employment in Manufacturing

(Million Workers)



Source: Bureau of Labor Statistics, Current Employment Statistics.

Note: Data are for December of each year, seasonally adjusted.

[17] For a summary of relevant research on employment and "offshoring," see CRS Report RL32292, *Offshoring (or Offshore Outsourcing) and Job Loss Among U.S. Workers*, by Linda Levine.

[18] David Autor, David Dorn, and Gordon H. Hanson, "The China Syndrome: Local Labor Market Effects of Import Competition in the U.S.," National Bureau of Economic Research, Working Paper, March 2011.

The broader impact on the U.S. labor market, however, remains a matter of considerable debate. One recent study of the growth of Chinese exports to the European Union between 1999 and 2007, directly applicable to the United States, concludes that "trade drives out low-tech firms … and increases the incentives of incumbents to speed up technical change."[19] This finding, if confirmed in other research, may require reevaluation of the many economic studies that attribute declining factory employment to technological change, as it emphasizes that the rate of technological change is itself affected by increased trade with low-wage countries. It also suggests that declines in manufacturing production employment may go hand in hand with increased demand for workers with skills that are in some way related to goods production and distribution, but may not fall within the traditional definition of "manufacturing" work.

The transformation of manufacturing poses novel issues for public policies aimed at the manufacturing sector. A variety of federal programs, from the Hollings Manufacturing Extension Partnership administered by the National Institute of Standards and Technology[20] to the National Nanotechnology Initiative[21] to the Small Business Administration's 504/CDC Loan Guaranty Program,[22] are designed, in part, to help manufacturers upgrade technology, replace capital stock, and compete more effectively in global markets. The extent to which such efforts lead private-sector firms to select U.S. locations for high-value activities within their supply chains, and the degree to which those activities create employment, are unclear.

More broadly, shifts in the nature of value added in manufacturing put into question the efficacy of policies designed to promote factory production within the United States, such as tax policies favoring investment in manufacturing equipment and "Buy American" rules requiring certain goods financed by the federal government to be produced domestically. Given that employment and economic growth are increasingly decoupled from production, it is uncertain whether policies oriented to physical manufacturing activity are best suited to achieve desired economic goals.

Finally, the changes described in this report raise questions about the adequacy of government statistics. U.S. statistical agencies have made significant efforts in recent years to improve the collection of data on the service sector, corporate spending on research and development, and international trade in intangible products. Nonetheless, available data still tend to treat manufacturing and services as unrelated economic activities, and it is not clear that existing data series on domestic economic activity, trade, and freight transportation completely capture changes in the nature of manufacturing, the sources of employment, and the creation of value.

[19] Nicholas Bloom, Mirko Draca, and John Van Reenen, "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity," National Bureau of Economic Research, Working Paper 16717, January 2011, p. 4.

[20] CRS Report 97-104, *Manufacturing Extension Partnership Program: An Overview*, by Wendy H. Schacht.

[21] CRS Report RL34401, *The National Nanotechnology Initiative: Overview, Reauthorization, and Appropriations Issues*, by John F. Sargent Jr.

[22] CRS Report R41184, *Small Business Administration 504/CDC Loan Guaranty Program*, by Robert Jay Dilger.

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