



Job Creation in the Manufacturing Revival

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Summary

The health of the U.S. manufacturing sector is of intense interest to Congress. Numerous bills aimed at promoting manufacturing have been introduced in Congress, often with the stated goal of creating jobs. Implicit in many of these bills is the assumption that the manufacturing sector is uniquely able to provide well-paid employment for workers who have not pursued advanced education.

U.S. manufacturing output has risen significantly over the past four years as the economy has recovered from recession. This upswing in manufacturing activity, however, has resulted in negligible employment growth. Although a variety of forces seem likely to support further growth in domestic manufacturing output over the next few years, including higher labor costs in the emerging economies of Asia, higher international freight transportation costs, and increased concern about disruptions to transoceanic supply chains, evidence suggests that such a resurgence would lead to relatively small job gains within the manufacturing sector.

The past few years have seen important changes in the nature of manufacturing work. A steadily smaller proportion of manufacturing workers is involved in physical production processes, while larger shares are engaged in managerial and professional work. These changes are reflected in increasing skill requirements for manufacturing workers and severely diminished opportunities for workers without education beyond high school. Even if increased manufacturing output leads to additional employment in the manufacturing sector, it is likely to generate little of the routine production work historically performed by workers with low education levels.

As manufacturing processes have changed, factories with large numbers of workers have become much less common than they once were. This suggests that promotion of manufacturing as a tool to stimulate local economies is likely to meet with limited success; even if newly established factories prosper, few are likely to require large amounts of labor.

Contents

Introduction.....	1
Employment in the Manufacturing Sector.....	1
The Changing Character of Manufacturing Work	4
The Disappearance of the Large Factory	8
Start-Ups and Shutdowns.....	10
Selected Policy Issues for Congress	12

Figures

Figure 1. Manufacturing Output and Employment.....	2
Figure 2. Growth in Manufacturing Since Cyclical Trough	2
Figure 3. Manufacturing Employment by Occupation	5
Figure 4. Manufacturing Employment by Worker Education.....	7
Figure 5. Manufacturing Employment by Gender	8
Figure 6. Jobs Created by Establishment Openings.....	11
Figure 7. Jobs Lost Due to Establishment Closings	11

Tables

Table 1. Manufacturing Employment by Industry, 2001-2012.....	4
Table 2. The Size Distribution of Factories	9
Table 3. Factories with More Than 1,000 Workers by Industry	9
Table 4. Manufacturing Employment by Establishment Size.....	10

Contacts

Author Contact Information.....	14
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Introduction

After a prolonged slump, the U.S. manufacturing sector is showing notable signs of revival. In part, the upturn in manufacturing output is cyclical, as global economic growth recovers following the downturn in 2008-2009. At the same time, however, there are indications that other forces may be contributing to the revival of U.S. manufacturing. Higher labor costs in the emerging economies of Asia, higher international freight transportation costs, and heightened concern about the risk of disruptions to long, complex supply chains all increase the relative attractiveness of the United States as a location for factory production.

The strengthening of U.S. manufacturing is a subject of intense interest in Congress. In the 113th Congress, Members have introduced bills intended to improve vocational training in manufacturing skills (H.R. 803); mandate that federally assisted infrastructure projects be constructed with steel, iron, and manufactured goods produced in the United States (H.R. 949); require the President to develop a comprehensive national manufacturing strategy (H.R. 1127); provide financial support for domestic production of clean energy technology (H.R. 400, H.R. 1524); repeal the excise tax on medical devices (H.R. 523); provide grants for state and local governments to install U.S.-made solar energy systems (H.R. 1107); offer tax credits for manufacturers to hire unemployed workers (H.R. 1522); and support manufacturing activity in a variety of other ways.

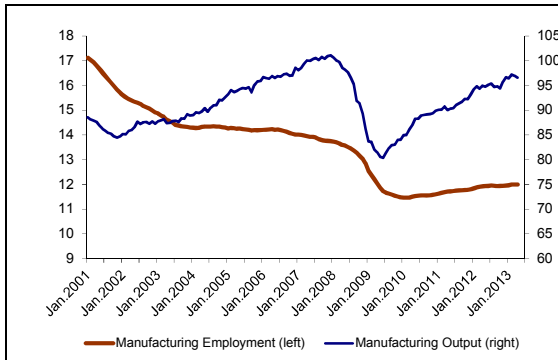
In public discourse, the revival of manufacturing is often associated with a variety of policy objectives, particularly with respect to employment. Most notably, proponents of support for the manufacturing sector often associate increased manufacturing activity with the creation of jobs for workers without higher education. Evidence suggests, however, that even strong growth in manufacturing output could well have only modest impact on job creation, and is unlikely to reverse the declining demand for workers with low levels of education.

Employment in the Manufacturing Sector

At the start of the 21st century, 17.1 million Americans worked in the manufacturing sector. This number declined during the recession that began in March 2001, in line with the historic pattern. In a departure from past patterns, however, manufacturing employment failed to recover after that recession ended in November 2001 (see **Figure 1**), even though U.S. manufacturing output increased over the next seven years. By the time the most recent recession began, in December 2007, the number of manufacturing jobs in the United States had fallen to 13.7 million. Currently, 12.0 million workers are employed in the manufacturing sector.

Figure 1. Manufacturing Output and Employment

Employment in million; output indexed, 2007=100

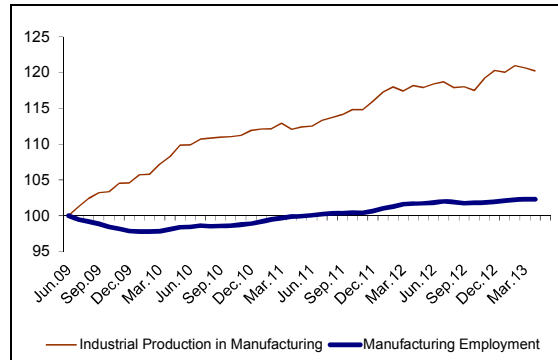


Source: Bureau of Labor Statistics, Current Employment Survey, and Federal Reserve Board, Industrial Production Index.

Note: Data are seasonally adjusted.

Figure 2. Growth in Manufacturing Since Cyclical Trough

Index, June 2009=100



Source: Bureau of Labor Statistics, Current Employment Survey, and Federal Reserve Board, Industrial Production Index.

Note: Data are seasonally adjusted.

The output of U.S. manufacturers hit a cyclical bottom in June 2009. Since that time, a 20% increase in manufacturing output has been accompanied by only a 2% increase in manufacturing employment (see **Figure 2**). The low point in manufacturing employment was reached in January 2010, but since that time the manufacturing job count has risen only 4.4%.¹ The employment recovery in manufacturing lags far behind the cyclical norm following past recessions.

There is no single cause of the weakness in manufacturing employment. A sharp increase in the bilateral U.S. trade deficit with China following that country’s accession to the World Trade Organization in 2001 contributed importantly to manufacturing job loss in the first half of the last decade, but the stabilization of the bilateral trade balance since 2006 has had minimal impact on hiring of factory workers in the United States.² Cyclical forces aside, there are at least three distinct factors that limit the prospects for job creation in the manufacturing sector, even if domestic production gains market share from imports.

- Some manufacturing industries, notably apparel and footwear, are tied to labor-intensive production methods that have proven difficult to automate. With labor costs accounting for a much higher share of value than in manufacturing as a whole, declining import barriers allowed imports from low-wage countries to displace domestic production. From 1.3 million workers as recently as 1980, U.S.

¹ Manufacturing output, as discussed in this section, is derived from the Federal Reserve Board Industrial Production Indexes for manufacturing and for various manufacturing industries, seasonally adjusted, <http://www.federalreserve.gov/releases/g17/Current/default.htm>. Employment figures used in this section are from the Bureau of Labor Statistics’ monthly Current Employment Statistics database, <http://www.bls.gov/data/>, and are based on seasonally adjusted data.

² On the impact of China on manufacturing employment, see Justin R. Pierce and Peter K. Schott, *The Surprisingly Swift Decline of U.S. Manufacturing Employment*, working paper 18655, National Bureau of Economic Research, December 2012, and David H. Autor, David Dorn, and Gordon H. Hanson, “The China Syndrome: Local Labor Market Effects of Import Competition in the United States,” *American Economic Review*, forthcoming. On U.S.-China trade more generally, see CRS Report RL33536, *China-U.S. Trade Issues*, by Wayne M. Morrison, and CRS Report RL33577, *U.S. International Trade: Trends and Forecasts*, by Brock R. Williams and J. Michael Donnelly.

employment in apparel manufacturing has fallen to 143,000. Leather manufacturing has seen an even steeper employment decline. Over the same period, U.S. output of apparel fell by 83%, and output of leather products fell by 73%.

- In other industries, technological improvements have led to large increases in labor productivity that have reduced the need for workers. Steelmaking offers such an example: the 94,000 people working in the industry in 2012 produced 14% more steel than nearly 400,000 workers did in 1980.³
- Secular shifts in demand have dimmed employment prospects in some industries despite the general recovery in manufacturing output. Paper consumption, for example, was once closely associated with economic growth, but no longer; as electronic communication supplants print in many uses, paper output is down 30% from its peak in 1999, contributing to a 38% drop in industry employment over the same period. As cigarette consumption has waned, output in tobacco products manufacturing is down by 51% since the most recent peak in 1996, while employment has fallen by nearly two-thirds. Neither sector shows signs of a production upturn.

These changes have resulted in a significant shift in the composition of manufacturing employment as well as in the level of employment. Food manufacturing, which two decades ago accounted for one in 11 manufacturing jobs, now accounts for one in eight. Fabricated metal products, machinery, and chemicals manufacturing have become more important parts of manufacturing—although these sectors have not been immune from the decline in employment. Apparel, textiles, furniture, and computers and electronic products now account for substantially smaller shares of manufacturing employment than was formerly the case (see **Table 1**).

³ In 1980, an average of 398,829 employees produced 83.9 million tons of steel; see American Iron and Steel Institute, *Annual Statistical Report 1980* (Washington, DC, 1981), pp. 8, 21. U.S. steel shipments in 2012 were 95.9 million tons, according to the Institute; see [http://www.steel.org/sitecore/content/Global/Document%20Types/News/2013/December Steel Shipments Up 1 Point 2 Percent From November.aspx](http://www.steel.org/sitecore/content/Global/Document%20Types/News/2013/December%20Steel%20Shipments%20Up%201%20Point%202%20Percent%20From%20November.aspx). BLS gives average industry employment in 2012 as 93,600.

Table I. Manufacturing Employment by Industry, 2001-2012

Shares of total manufacturing employment and thousands of workers

Industry	2001 Share	2001 Employment	2012 Share	2012 Employment
Food	9.08%	1,554	12.20%	1,447
Transportation Equipment	11.64%	1,992	12.01%	1,424
Fabricated Metal Products	10.28%	1,759	11.61%	1,377
Computers and Electronic Products	10.93%	1,871	9.34%	1,108
Machinery	8.49%	1,453	9.17%	1,088
Chemicals	5.71%	977	6.72%	797
Plastics and Rubber	5.45%	932	5.40%	640
Miscellaneous Manufacturing	4.25%	728	4.87%	577
Printing	4.66%	798	3.89%	461
Primary Metals	3.55%	608	3.40%	403
Paper	3.50%	599	3.31%	393
Electrical Equipment	3.41%	583	3.13%	371
Nonmetallic Mineral Products	3.25%	556	3.12%	370
Furniture	3.96%	677	2.95%	350
Apparel	2.67%	457	1.26%	158

Source: Bureau of Labor Statistics, Current Employment Statistics.

Note: Not all manufacturing industries are included.

The Changing Character of Manufacturing Work

In the public mind, the word “factory” is associated with the concept of mass production, in which large numbers of workers perform repetitive tasks. While mass production is still an important aspect of manufacturing, routine production functions, from welding joints in truck bodies to removing plastic parts from a molding machine, have proven susceptible to automation. This has had important consequences for the nature of work in manufacturing establishments and for the skill requirements of manufacturing workers.⁴

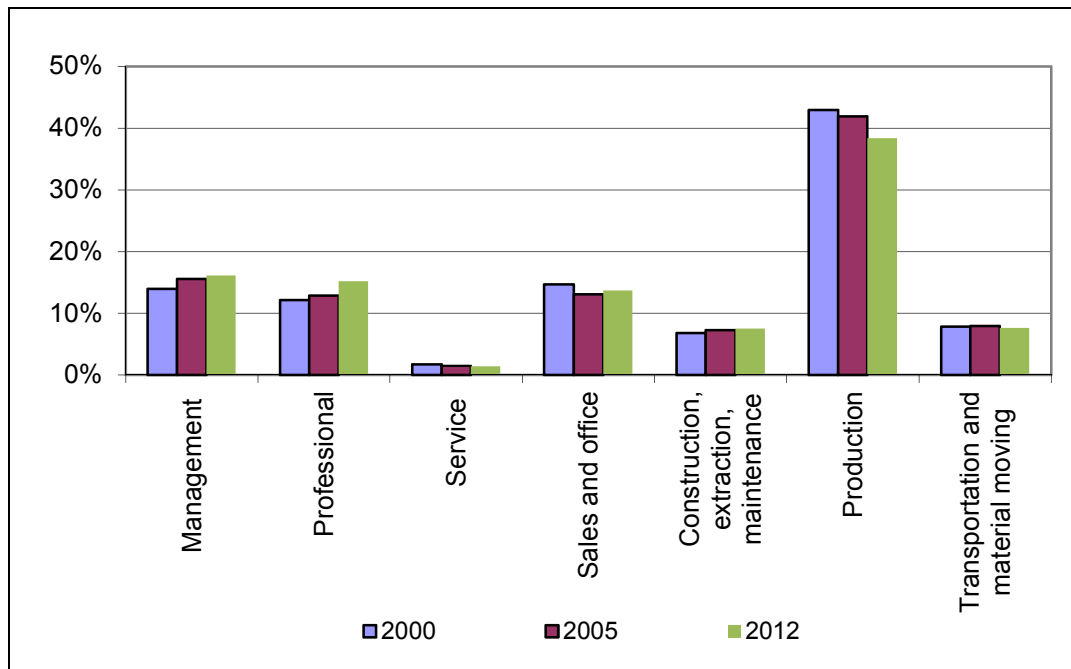
Goods production is no longer the principal occupation of workers in the manufacturing sector. Fewer than 39% of manufacturing employees are directly involved in making things. That proportion fell 4.5 percentage points between 2000 and 2012 (see **Figure 3**), and continues to decline. Some 31% of all manufacturing workers now hold management and professional jobs.⁵

⁴ On the changing sources of value in U.S. manufacturing, CRS Report R41712, “*Hollowing Out*” in U.S. Manufacturing: Analysis and Issues for Congress, by Marc Levinson.

⁵ Bureau of Labor Statistics, Current Population Survey for 2012 and previous years, Table 17.

Figure 3. Manufacturing Employment by Occupation

Percentage of manufacturing workforce



Source: Bureau of Labor Statistics, Current Population Survey, Table 17.

In many manufacturing sectors, the shift to higher skill requirements is even more pronounced. Total employment in the U.S. computer and electronic product manufacturing sector has declined due to automation, sharp falls in demand for certain products once produced in the United States (notably television tubes and audio equipment), and changed production economies that cause manufacturers to concentrate worldwide production in a small number of locations. Of the 1.1 million people employed in this sector in 2012, 28% were engaged in production work, for which a high school education may be sufficient and for which workers received mean annual pay of \$34,860. Some 22% of the industry's workers were in architecture and engineering occupations paying a mean annual wage of \$83,160, and another 13% were in computer and mathematical occupations with a mean annual wage of \$95,310; the latter two occupational categories required much higher education levels than production work. Similarly, some 31% of the workers in the pharmaceutical manufacturing subsector are involved with production. Many of the rest have scientific skills associated with higher education levels.⁶

The increasing demand for skills in manufacturing is most visible in the diminished use of “team assemblers”—essentially, line workers in factories and warehouses. In 2000, 1.3 million people were employed as team assemblers. In 2012, employment in this occupation, which typically requires little training and no academic qualifications, was 1,006,980. Of those, 742,040 worked in manufacturing, representing 6% of manufacturing jobs. This type of job, once the core of manufacturing, has become so unimportant to many manufacturers and warehouse operators that one-sixth of all team assemblers work for employment agencies, which furnish workers to other companies on an as-needed basis. Team assemblers working for employment agencies earn an

⁶ Data from Bureau of Labor Statistics Occupational Employment Statistics database, <http://data.bls.gov/oes/>.

average of \$11.25 per hour, some 26% less than those employed directly by manufacturing companies.⁷

There are also far fewer manufacturing workers performing individual tasks on a piecework basis. Piecework compensation used to be the norm in industries such as apparel and shoe manufacturing, as each worker was responsible for a specific step in the production process and was paid according to the number of units he or she processed. In recent years, however, many of the surviving U.S. apparel plants have reorganized production workers into groups that are collectively responsible for multiple aspects of production. According to the Bureau of Labor Statistics (BLS), “many companies are changing to incentive systems based on group performance that considers both the quantity and quality of the goods produced.”⁸ A similar change appears to be occurring in other sectors, as firms seek to move away from pay systems that reward workers simply for the quantity of goods produced rather than for quality and problem-solving.⁹

The changing occupational mix within the manufacturing sector is mirrored by changing educational requirements. In 2000, 53% of all workers in manufacturing had no education beyond high school. Between 2000 and 2012, that share dropped by seven percentage points, even as the proportion of manufacturing workers with college or graduate degrees rose by more than six percentage points. Given that college-educated workers generally command significantly higher pay in the labor market than high-school dropouts and high-school graduates, it is unlikely that manufacturers would willingly hire more-educated workers unless there were a payoff in terms of greater productivity.

It is noteworthy that, despite the loss of 4.1 million manufacturing jobs between 2000 and 2012, the number of manufacturing workers with graduate degrees increased by 19% (see **Figure 4**). Demand for workers with associate (community college or proprietary school) degrees in academic fields, which qualify the recipient to pursue education to the bachelor’s degree level, rose 7%, even as the number of manufacturing workers without degrees beyond high school fell by one-third. Workers with academic-track associate degrees fared much better than those with associate degrees in occupational fields, which prepare students for immediate vocational entry and typically require less coursework in English, mathematics, and science. As manufacturing employment has recovered from its cyclical low in January 2010, manufacturers have shown a strong preference for workers with academic-track associate degrees; from 2010 to 2012, the manufacturing sector added 90,000 workers with academic-track associate degrees, while the number of manufacturing jobs held by workers with occupational degrees rose by 10,000.¹⁰

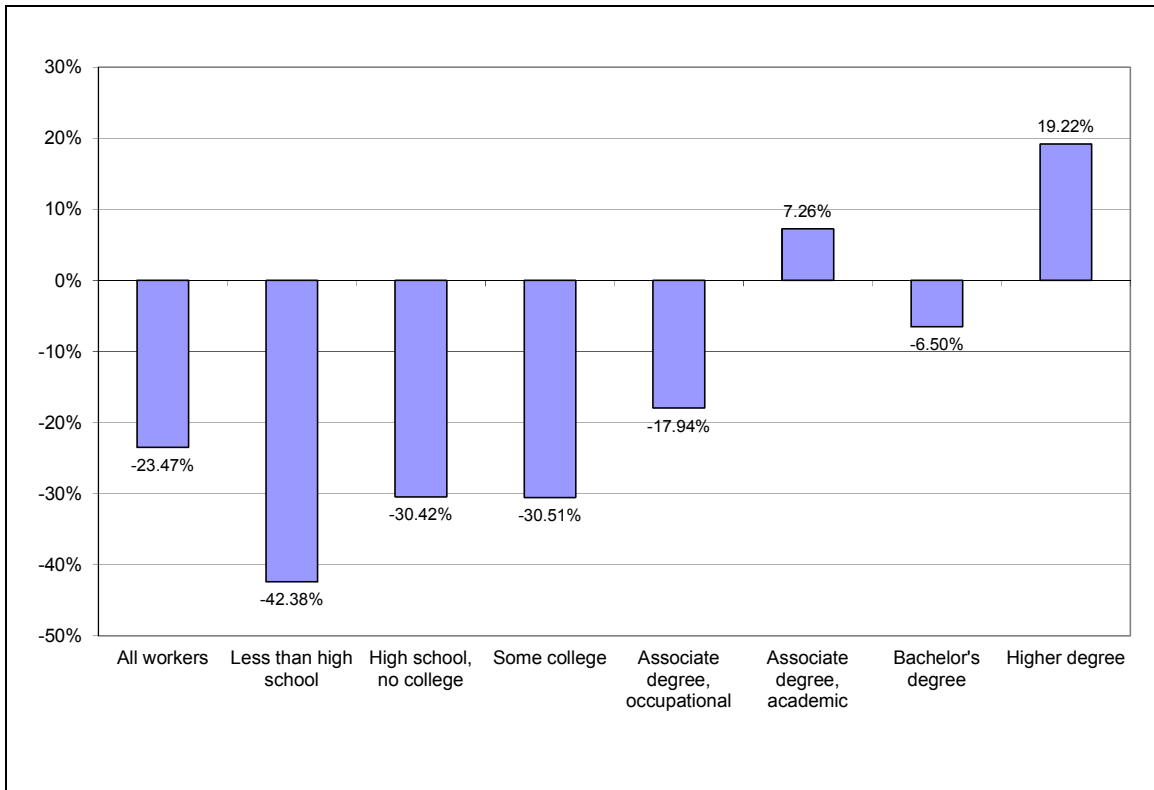
⁷ Ibid.

⁸ Bureau of Labor Statistics, “Textile, Textile Product, and Apparel Manufacturing,” *Career Guide to Industries*, 2010-11 edition, <http://www.bls.gov/oco/cg/cgs015.htm>.

⁹ Susan Helper, Morris M. Kleiner, and Yingchun Wang, *Analyzing Compensation Methods in Manufacturing: Piece Rates, Time Rates, or Gain-Sharing?*, National Bureau of Economic Research working paper 16540, November 2010, <http://www.nber.org/papers/w16540>.

¹⁰ Unpublished data from Bureau of Labor Statistics, Current Population Survey, *Employed Persons by Intermediate Industry, education, sex, race, and Hispanic or Latino ethnicity (25 years and over)*, 2011 and prior years. It is unclear whether the higher demand for workers with academic associate degrees reflects higher skill levels among those workers or is a result of individuals with greater ability enrolling in the academic rather than occupational programs at community colleges.

Figure 4. Manufacturing Employment by Worker Education
 Percentage change, 2000-2012

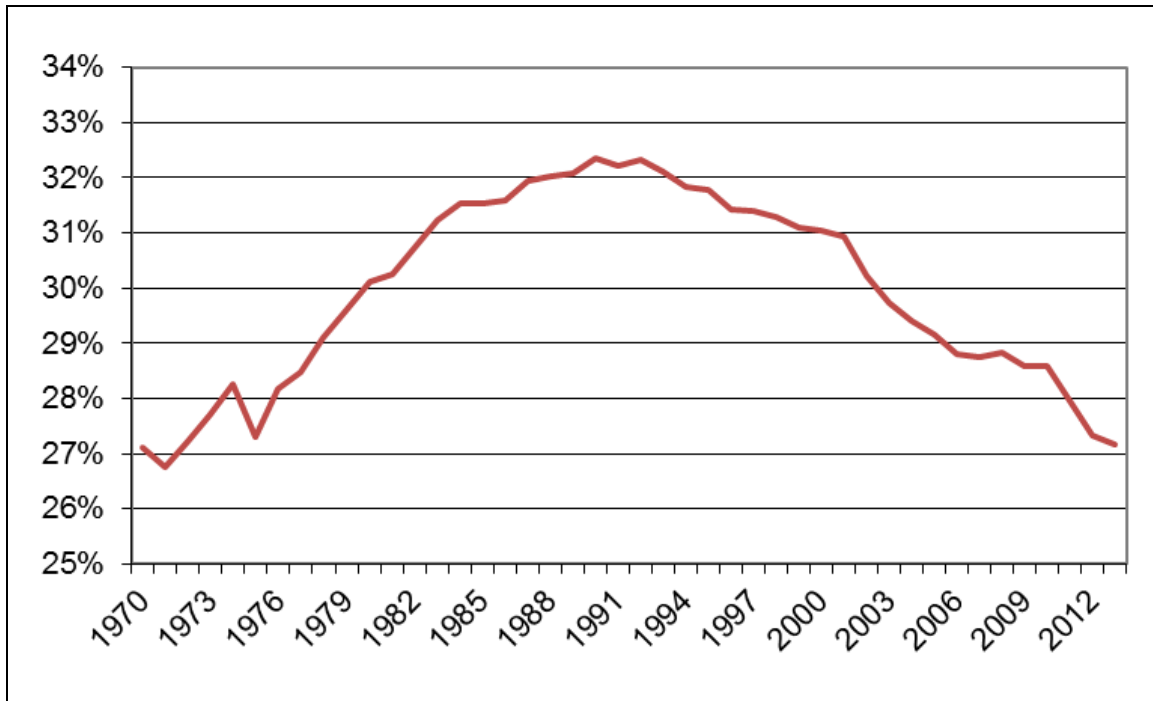


Source: Bureau of Labor Statistics, Current Population Survey.

Women now account for 27.2% of manufacturing workers, the smallest share since 1971 (see **Figure 5**). Women have long accounted for an unusually large share of employment in some of the industries that have experienced the steepest drops in employment, notably apparel, textiles, and electrical manufacturing. That workforce was significantly less educated than the male workforce in manufacturing: in 2000, 41% of female manufacturing workers had any education beyond high school, compared with 61% of their male counterparts.

This gender gap in education has closed since 2000, due largely to the departure of these less educated women from the manufacturing workforce. The number of female manufacturing workers with no education beyond high school fell 44% from 2000 to 2012. As a result, the number of years of schooling of female manufacturing workers is now very similar to that of males in manufacturing. Some 27% of women workers in manufacturing in 2012 held four-year college degrees or higher degrees, whereas 11% had failed to complete high school.

Figure 5. Manufacturing Employment by Gender
Percentage of manufacturing workforce that is female



Source: Bureau of Labor Statistics, Current Employment Statistics.

Note: Data are for January of each year and are not seasonally adjusted.

The Disappearance of the Large Factory

The stereotypic manufacturing plant has thousands of employees filling a cavernous factory hall. This stereotype is seriously outdated. The United States now has very few large factories: of more than 295,000 manufacturing establishments¹¹ counted by the Census Bureau in March 2011, only 815 employed more than 1,000 workers (see **Table 2**). The reported number increased slightly in 2011, marking the first time since at least 1998 that the number of large plants has shown an uptick.¹²

As the number of large factories has plummeted since the late 20th century, the number of small factories, those with fewer than 100 workers, has declined far more slowly. Most of the plants in the latter category are extremely small, with 60% of them having fewer than 10 workers. The growing prominence of small factories has contributed to a decline in mean employment in U.S. manufacturing establishments, from 46.3 workers in 1998 to 37.2 in 2011.

¹¹ An establishment is defined as “a single physical location where business is conducted or where services or industrial operations are performed.” In the manufacturing sector, an establishment is analogous to a factory, and the terms are used interchangeably in this section.

¹² Census Bureau, 2011 County Business Patterns: Geography Area Series: County Business Patterns by Employment Size Class, <http://censtats.census.gov/cgi-bin/cbpnaic/cbpsect.pl>. Due to definitional changes, data for 1998 and subsequent years are not compatible with those for earlier years.

Table 2. The Size Distribution of Factories

Number of establishments by number of employees

	99 or less	100-249	250-499	500-999	1,000-2,499
1998	330,956	22,499	7,968	3,322	1,504
2001	319,058	21,744	7,433	3,011	1,373
2004	309,909	19,227	6,349	2,486	1,112
2007	302,836	18,943	6,172	2,384	1,020
2010	277,148	15,428	4,764	1,847	795
2011	272,396	15,575	4,986	1,871	815
Change, 1998-2011	-17.69%	-30.77%	-37.42%	-43.68%	-45.81%

Source: Census Bureau, County Business Patterns by Employment Size Class.

The decline in the number of large factories has been widespread across the manufacturing sector, with the exception of the food processing industry. According to the Census Bureau's annual *County Business Patterns* report, which captures data on enterprises from a variety of administrative records, four industries—chemicals, computers and electronic products, machinery, and transportation equipment—accounted for more than half the decline in the number of factories with more than 1,000 workers between 1998 and 2011 (see **Table 3**).¹³

Table 3. Factories with More Than 1,000 Workers by Industry

Number of establishments

Industry	1998	2003	2008	2010	2011
Food	169	179	171	167	168
Chemicals	107	81	71	60	57
Primary Metals	71	44	42	31	33
Computers and Electronic Products	269	168	140	122	123
Electrical Equipment	66	39	28	24	22
Machinery	122	82	86	63	71
Transportation Equipment	298	260	243	163	177

Source: Census Bureau, County Business Patterns, various years.

The recent economic literature on the causes of changes in factory size is scant, but evidence suggests two principal causes. One is automation: as firms substitute capital for labor, fewer workers are required to produce a given quantity of output. The other is the increase in what economists refer to as “vertical specialization,” with individual plants making a narrow range of the components required for a finished product, and those partially finished goods, known as “intermediate products,” being shipped from one location to another along a sometimes lengthy

¹³ Census Bureau, *County Business Patterns*, <http://www.census.gov/econ/cbp/>.

supply chain before the final good is manufactured.¹⁴ Much of the growth in international trade in recent years has involved intermediate products in international supply chains, and one logical—although undocumented—corollary of that growth would be that large factories reduce the scope of their activities and shed workers who formerly made inputs that are now obtained elsewhere.

Among the remaining factories with more than 1,000 workers, average employment size has held steady since 2004. In aggregate, however, large factories account for a diminishing share of manufacturing employment (see **Table 4**). In 2011, 15% of manufacturing workers were employed in plants with more than 1,000 workers, down from 19% in 1998.

Table 4. Manufacturing Employment by Establishment Size
Percentage of manufacturing employment in employment size category in given year

	99 or less	100-249	250-499	500-999	1,000 and over
1998	30.9%	20.5%	16.2%	13.3%	19.2%
2003	33.7%	21.2%	16.0%	12.1%	17.0%
2008	34.7%	21.9%	15.7%	12.1%	15.6%
2010	36.6%	21.7%	15.1%	11.4%	15.2%
2011	36.2%	21.6%	15.6%	11.4%	15.1%

Source: Census Bureau, County Business Patterns, various years.

Start-Ups and Shutdowns

The employment dynamics of the factory sector differ importantly from those in the rest of the economy. In other economic sectors, notably services, business start-ups and shutdowns account for a large proportion of job creation and job destruction. In manufacturing, by contrast, employment change appears to be driven largely by the expansion and contraction of existing firms, and entrepreneurship and failure play lesser roles. This may be due to obvious financial factors: the large amounts of capital needed for manufacturing equipment may serve as a deterrent to opening a factory, and the highly specialized nature of manufacturing capital may make it difficult for owners to recover their investment if an establishment shuts down entirely rather than reducing the scope of its production activities.

The dynamics of employment change in manufacturing can be seen in two different government databases. The Bureau of Labor Statistics’ Business Employment Dynamics database, which is based on firms’ unemployment insurance filings, offers a quarterly estimate of gross employment gains attributable to the opening of new establishments and to the expansion of existing ones, and of the gross job losses attributable to the contraction or closure of establishments.¹⁵ In

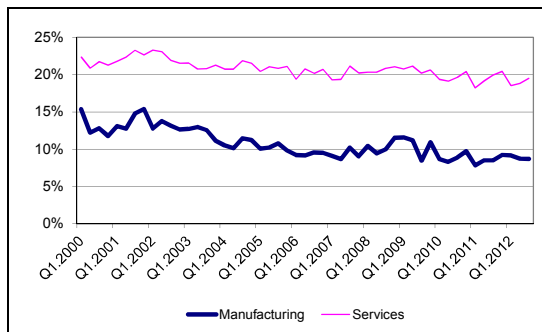
¹⁴ For a survey of the evidence on vertical specialization, see Gary Herrigel, *Manufacturing Possibilities: Creative Action and Industrial Recomposition in the United States, Germany, and Japan* (New York: Oxford University Press, 2010), ch. 4-6. The literature on the implications of vertical specialization for international trade flows, which stems from the observation that trade in manufactured goods has grown far more rapidly than global output of manufactured goods, is now quite large, but economists have paid much less attention to the implications of vertical specialization for the structure of the manufacturing sector.

¹⁵ “Gross” job gains and losses refer to the number of positions created and eliminated, respectively; the net change in (continued...)

manufacturing, BLS finds, less than 10% of gross job creation since 2005 is attributable to new establishments, and more than 90% to the expansion of existing establishments. This is quite a different picture than that offered by the service sector, in which openings routinely account for more than 20% of all new jobs (see **Figure 6**).

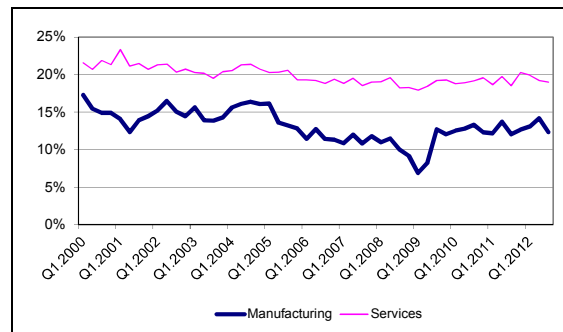
Similarly, while plant closings are frequently in the headlines, closings are responsible for less than 12% of the manufacturing jobs lost since 2005, according to BLS data. The vast bulk of manufacturing job losses occur at establishments that remain in operation. Closure is far less likely to be the cause of job loss in the manufacturing sector than in the service sector, where 19% of job losses are due to establishments closing (see **Figure 7**).¹⁶

Figure 6. Jobs Created by Establishment Openings
Percentage of New Jobs



Source: Bureau of Labor Statistics.

Figure 7. Jobs Lost Due to Establishment Closings
Percentage of Jobs Lost



Source: Bureau of Labor Statistics.

The other source of data on the connection between new factories and manufacturing job creation is the longitudinal business database maintained by the Census Bureau’s Center for Economic Studies. This database, which contains data since 1976, covers some establishments (notably certain public sector employers) not included in the BLS database and links individual firms’ records from year to year in an attempt to filter out spurious firm openings and closings.¹⁷ The Census database has different figures than the BLS database, but identifies similar trends, in particular that establishments are born and die at far lower rates in the manufacturing sector than in other sectors of the economy.

The Census Bureau data make clear that the rate at which new business establishments of all sorts were created fell significantly during the 2007-09 recession.¹⁸ Yet they also show that, within the manufacturing sector, the decline in the rate at which new factories are opened has persisted for at least three decades.

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employment can be calculated by subtracting gross job losses from gross job gains. For technical details on this database, see <http://www.bls.gov/news.release/cewbd.tn.htm>.

¹⁶ Bureau of Labor Statistics Business Employment Dynamics database, http://www.bls.gov/web/cewbd/table1_5.txt and http://www.bls.gov/web/cewbd/table1_6.txt.

¹⁷ For information about this database, see http://www.ces.census.gov/index.php/ces/researchdata?detail_key=10.

¹⁸ John Haltiwanger, Ron Jarmin, and Javier Miranda, *Historically Large Decline in Job Creation from Startup and Existing Firms in the 2008-09 Recession*, March 2011, http://www.ces.census.gov/docs/bds/plugin-BDS%20March%202011%20single_0322_FINAL.pdf.

The new manufacturing establishments that have been created in recent years have accounted for relatively few jobs, the Census data suggest. In 2011, less than 10% of all manufacturing jobs were located at establishments in operation for five years or less. Economy-wide, by contrast, 24% of all jobs were at establishments operating for five years or less. The average new manufacturing establishment provides 13 jobs during its first year in operation.¹⁹ The Census data also indicate that from 2009 to 2011, the most recent year for which data are available, 25% of the job loss in manufacturing was related to the closure of a plant, well below the 30% of job loss that was due to establishment closure across the entire economy.

These two data sources on business dynamics thus support similar conclusions about the role of plant openings and closings in manufacturing employment. Only a small share of the jobs that are created in the manufacturing sector comes from new factories, largely because factories typically expand slowly in their early years.²⁰ Conversely, a minority of the jobs lost come from the closure of existing factories. These facts indicate that marginal employment change in manufacturing depends more heavily on staffing decisions at existing factories than on the creation of new factories.

Selected Policy Issues for Congress

In recent years, Congress has considered a large amount of legislation intended to revive the manufacturing sector. Bills introduced in the 113th Congress take extremely diverse approaches, ranging from establishing tax-exempt manufacturing reinvestment accounts (H.R. 1737, the Manufacturing Reinvestment Account Act of 2013) to encouraging relocation of foreign business operations to the United States (S. 337, the Bring Jobs Home Act) to creating a revolving loan fund to assist U.S. manufacturers with retooling or retraining (H.R. 375, the Make It In America Manufacturing Act of 2013) to requiring that only “green technologies” that are 85% manufactured in the United States may be acquired by the federal government (H.R. 1524, the Make it in America: Create Clean Energy Manufacturing Jobs in America Act) to supporting worker training related to targeted “industry clusters” (H.R. 919, the Strengthening Employment Clusters to Organize Regional Success (SECTORS) Act of 2013).

These proposals, and many others, are typically advanced with the stated goal of job creation, and often with the subsidiary goals of improving employment opportunities for less educated workers or reversing employment decline in communities particularly affected by the loss of manufacturing jobs. The available data suggest, however, that these goals may be difficult to achieve. In particular:

- Even large increases in manufacturing activity are likely to translate into only modest gains in manufacturing employment due to firms’ preference to use U.S. facilities for highly capital-intensive production. After adjusting for inflation, U.S. manufacturers’ fixed assets per full-time-equivalent employee rose 26% from 2006 to 2011.²¹ Examples of the heavy use of capital can be seen in recent

¹⁹ Census Bureau, Longitudinal Business Database, http://www.census.gov/ces/dataproducts/bds/data_firm.html.

²⁰ Lucia Foster, John Haltiwanger, and Chad Syverson, *The Slow Growth of New Plants: Learning About Demand?*, working paper 12-06, Census Bureau Center for Economic Studies, March, 2012, <ftp://ftp2.census.gov/ces/wp/2012/CES-WP-12-06.pdf>.

²¹ The increase in fixed assets per employee is calculated from Bureau of Economic Analysis (BEA) fixed assets accounts tables 3.1ES and 3.2ES and the BEA measure of full-time-equivalent employees by industry. The underlying (continued...)

- announcements by manufacturers. A \$200 million yogurt plant that opened June 3, 2013, in Batavia, NY, is expected to employ 180 workers, an investment of \$1.1 million per worker. A “multibillion-dollar expansion” under way at a large chemical plant in Baytown, TX, is expected to provide 350 permanent jobs, implying a capital investment of several million dollars per worker. Such ventures may create demand for workers in other sectors, notably construction, but the effect on employment in the manufacturing sector is likely to be small.
- The decline in energy costs due to the development of shale gas, strongly encouraged by federal policy, is stimulating energy-intensive manufacturing in the United States.²² The three sectors that jointly account for about 65% of natural gas consumption in manufacturing—chemicals, petroleum refining, and primary metals—are the three most capital-intensive sectors of U.S. manufacturing and provide relatively little employment.²³ To the extent that expansion in these industries creates jobs, those are more likely to be in ancillary sectors rather than directly in chemical and steel plants and oil refineries.²⁴
 - Changes in methods, products, and materials may transform some manufacturing industries over the next few years. Some of these changes have been supported by the federal government. For example, in 2012 five federal agencies jointly invested \$30 million to help establish the National Additive Manufacturing Innovation Institute to develop and disseminate methods of producing goods by using printer-like equipment to deposit thin layers of liquefied material, one atop the other, following a digital blueprint. Although still in its infancy, additive manufacturing is expected to provide a cost-effective means of making items with relatively short production runs, such as components for industrial machinery or aircraft. Federal research grants have been important in the growth of nanotechnology, which involves the creation of materials and products using components just a few billionths of a meter in size and is now widely used in pharmaceutical and semiconductor manufacturing. Such innovations may increase demand for engineers and scientists, but they may further reduce the need for production workers, as equipment will be almost entirely automated.
 - Increases in manufacturing employment are unlikely to result in significant employment opportunities for workers who have not continued their educations

(...continued)

data are available on the BEA website, <http://www.bea.gov>.

²² See CRS Report R42814, *Natural Gas in the U.S. Economy: Opportunities for Growth*, by Robert Pirog and Michael Ratner.

²³ For example, in 2011, the chemicals sector had \$390,000 of structures, equipment, and software per full-time employee, implying that even very large investments will lead to little direct demand for additional labor; see Bureau of Economic Analysis, Fixed Assets Accounts Table 3.1ES, Current-Cost Net Stock of Private Fixed Assets by Industry, and Industry Economic Accounts, Full-Time Equivalent Employees by Industry, both accessible from <http://www.bea.gov>.

²⁴ “New yogurt plant hungry to grow,” *Buffalo News*, June 3, 2012, http://www.buffalonews.com/apps/pbcs.dll/article?AID=/20130603/BUSINESS/130609732/1005;_r_company/news_and_media/press_releases/2012/corporate/2012jun04_corporaterelase.page?; ExxonMobil Chemical Co., “U.S. Petrochemical Production, Exports to Expand, says ExxonMobil Chemical President,” March 5, 2013, <http://news.exxonmobilchemical.com/press-release/english/us-petrochemical-production-exports-expand-says-exxonmobil-chemical-president>; “Exxon doubles down in multibillion-dollar Baytown plant expansion,” *Houston Chronicle*, March 5, 2013, <http://www.chron.com/business/energy/article/Exxon-doubles-down-in-multibillion-dollar-Baytown-4331134.php>.

beyond high school, as the sorts of tasks performed by manufacturing workers increasingly require higher levels of education and training. Although manufacturers report shortages of certain manufacturing skills, the average hourly wage in manufacturing rose only 1% in the year to March 2013, implying weak demand for additional labor in the manufacturing sector. This suggests that government-supported training efforts, while potentially helpful in preparing individuals for specific manufacturing jobs, should not be expected to lead to an increase in total manufacturing employment.

- To the extent that federal policies lead to the establishment of new manufacturing facilities in the United States, those facilities are likely to provide only limited employment opportunities in the locations where they are built, as plants with more than 1,000 workers are now rare. Well over half of all manufacturing workers are employed in establishments with fewer than 250 workers. This suggests that there will be relatively few instances in which the siting of a new plant, by itself, will suffice to revitalize a community with a struggling economy.
- Policies that promote construction of new facilities for manufacturing may be less effective ways of preserving or creating jobs than policies aimed at existing facilities, as new establishments are relatively unimportant as drivers of employment in manufacturing.

It is important to note that increased manufacturing activity may lead to job creation in economic sectors other than manufacturing. For example, professional and business services provide about 9% of all inputs into manufacturing, and the transportation and warehousing industry furnishes about 3%, so expansion of manufacturing is likely to stimulate employment in those sectors.²⁵ To the extent that increased domestic production of manufactured goods supplants imports, however, any increases in ancillary employment related to domestic manufacturing may be counterbalanced by reduced employment related to the transportation and processing of imported goods, leaving the net employment effect uncertain.

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²⁵ Estimates taken from Bureau of Economic Analysis, "Use of Commodities by Industries before Redefinitions," 2011, http://www.bea.gov/iTable/index_industry.cfm.