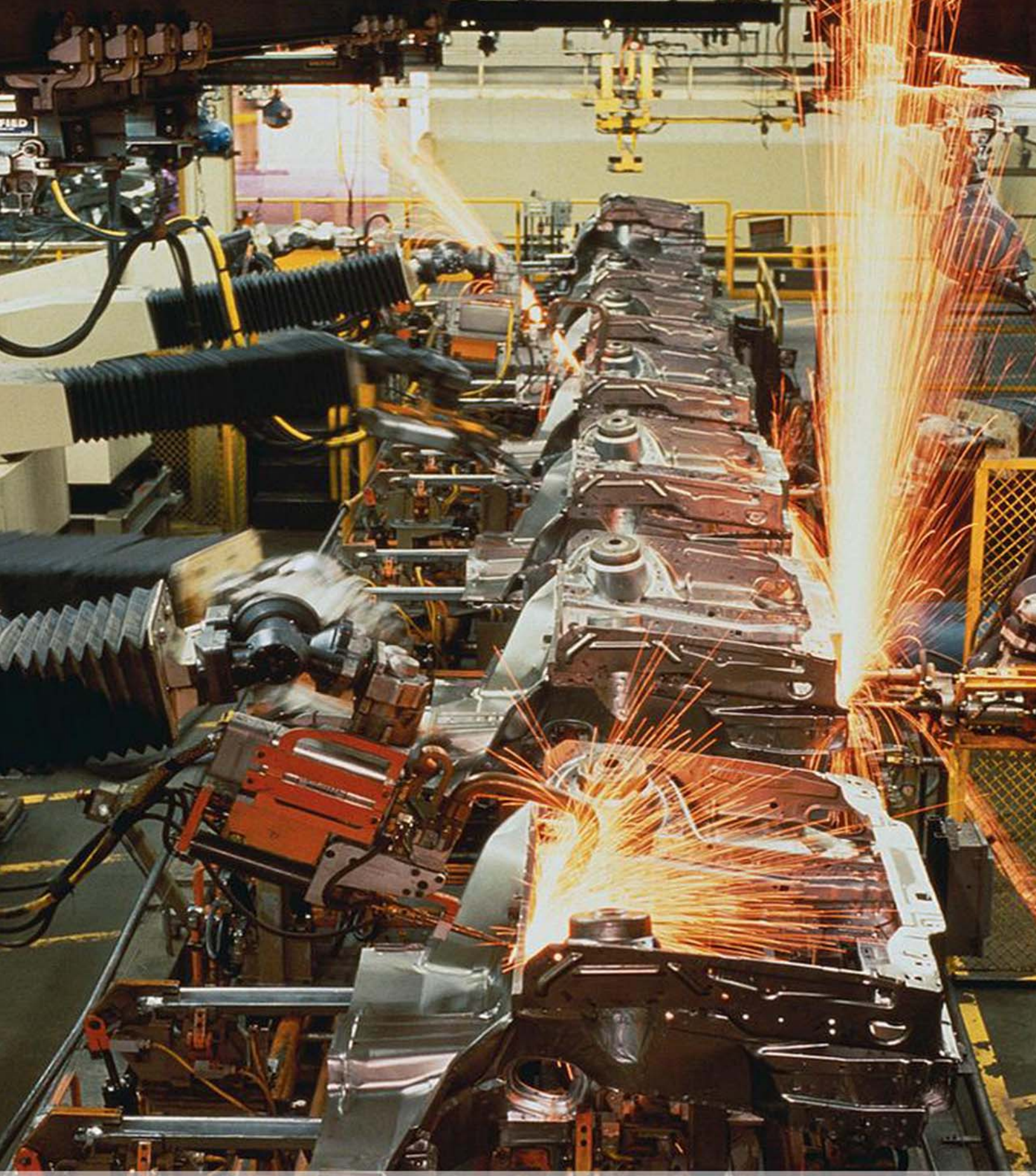


Revitalizing Manufacturing

6 Revitalizing Manufacturing

"Build it here. Sell it everywhere."
— *John E. Bryson, Secretary of Commerce, December 15, 2011*

A Strong Manufacturing Sector is Uniquely Important to the U.S. Economy

A flourishing manufacturing sector in the United States is crucial to its future competitive strength. Throughout its history, manufacturing has been a source of prosperity, innovation, and pride for the United States. Manufacturing pays higher than average wages, provides the bulk of U.S. exports, contributes substantially to U.S. R&D, and protects national security.

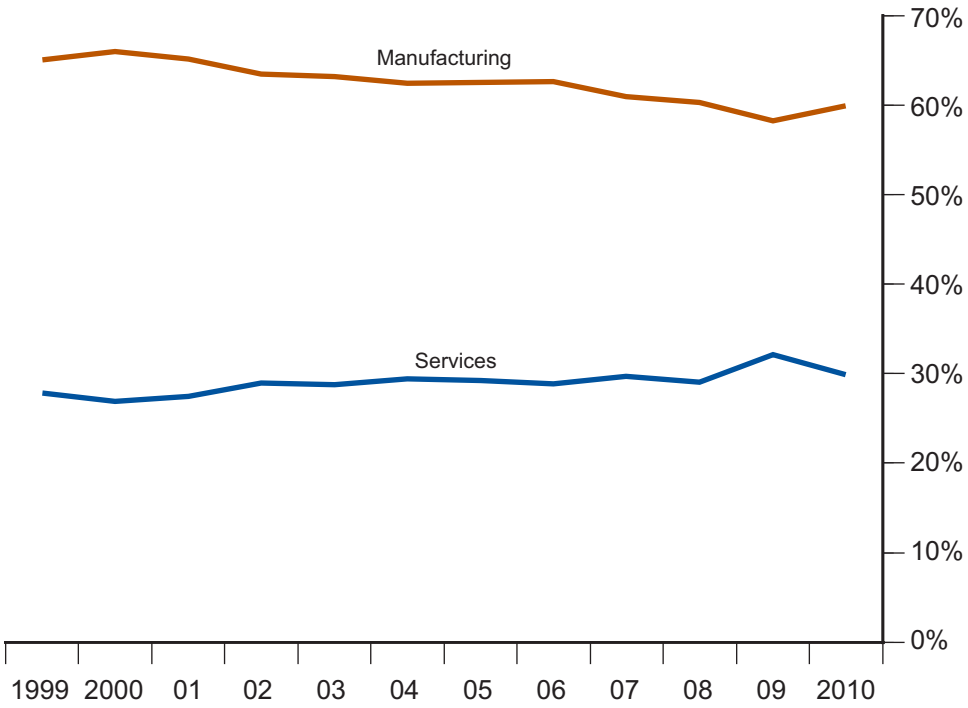
Manufacturing remains a vital part of the U.S. economy. In 2009, manufacturing made up 11.2 percent of gross domestic product (GDP)[1] and 9.1 percent of total U.S. employment,[2] directly employing almost 12 million workers. This sector also has indirect employment effects on other sectors of the U.S. economy when it purchases inputs for production such as raw materials (such as from the agricultural and mining sectors), buildings (from the construction and real estate sectors), and services (including warehousing and transportation; professional, scientific, and technical services; and financial services). In these ways, manufacturing supports millions of additional supply chain jobs across the economy.

In addition, many of the jobs provided by this sector are high quality. Total hourly compensation in the manufacturing sector is, on average, 22 percent higher than that in the services sector and about 91 percent of factory workers have employer-provided benefits compared to about 71 percent of workers across all private sector firms.[3]

Manufacturing is also the largest contributor to U.S. exports. In 2010, the United States exported over $1.1 trillion of manufactured goods, which accounted for 86 percent of all U.S. goods exports and 60 percent of U.S. total exports (see figure 6.1). In order to support millions more jobs, President Obama's National Export Initiative set the ambitious goal of doubling U.S. exports by the end of 2014. Moreover, the United States runs a trade surplus in the services sector, a surplus that has tripled since 2003[4]; however, though the services sector will continue to be important, increases in services alone will not likely double U.S. exports by

Figure 6.1

U.S. Exports by Sector, Share of Total, 1991–2010



Source: Bureau of Economic Analysis and Census, U.S. International Trade in Goods and Services; excluding Agriculture and Non-agriculture/Non-Manufacturing goods.

2014. Indeed, without a strong manufacturing sector, the U.S. trade surplus in services may erode (see box 6.1).

A strong manufacturing sector is also crucial because successful innovation in many sectors is closely linked to the ability to manufacture products as innovative methods and ideas are generated and perfected through the process of making things. In the recent *Report to the President on Ensuring American Leadership in Advanced Manufacturing,*[5] the President's Council of Advisors on Science and Technology (PCAST) and the President's Innovation and Technology Advisory Committee (PITAC) emphasize the critical importance of advanced manufacturing in driving knowledge production and innovation in the United States. The PCAST researched the current state of manufacturing and concluded that U.S. leadership in manufacturing is declining and that this is detrimental to the well-being of the nation overall. Manufacturing companies in the United States are responsible for over two-thirds of the industrial R&D[6] and employ the majority of domestic scientists and engineers.[7] Furthermore, manufacturing R&D is the dominant

Box 6.1

Tradable Sectors: A Source of Good Jobs

Manufacturing is generally a "tradable" sector; that is, an activity that can be "transacted across distances" thus making it vulnerable to import competition. Since the jobs in manufacturing generally pay well, the loss of these jobs due to import competition can have severe negative effects on the well-being of the U.S. workforce.

Service activities at one time were not considered tradable, but some service industries have become an important and expanding component of U.S. trade. Tradable service jobs are also high-quality, with higher education and wage levels than jobs in non-tradable services.[1]

Given the recent decline in U.S. manufacturing, in part due to off-shoring, a concern is whether this will happen to the service sector. In fact, it could be argued that many of the current tradable services exist because various firms had a strong manufacturing capability that also provided a source of highly-trained engineers and technical staff that could export these services. Without a core manufacturing capability feeding that engineering base it could be argued that long-term growth in tradable services is not sustainable.

On the other hand, rather than lose jobs, the comparative advantage of the United States in high-skill, high-wage service jobs such as engineering and business services points to potential opportunities to expand services exports and increase jobs in these areas.

1. Jensen, J. Bradford. August 2011. "Global Trade in Services: Fear, Facts, and Offshoring." Peterson Institute for International Economics, Washington, DC. bookstore.piie.com/book-store//6017.html.

source of innovative new service-sector technologies,[8] hence its benefits reach beyond the manufacturing arena.

The colocation of manufacturing, research, and other sectors can also be important. In its recent report the PCAST states: "Proximity is important in fostering innovation. When different aspects of manufacturing—from R&D to production to customer delivery—are located in the same region, they breed efficiencies in knowledge transfer that allow new technologies to develop and businesses to innovate."[9] Thus, even if R&D facilities are kept in the United States, the relocation of manufacturing facilities overseas may limit the United States' ability to innovate.

Finally, an innovative and secure domestic manufacturing base is critical to national security. An inability to produce domestically the advanced defense

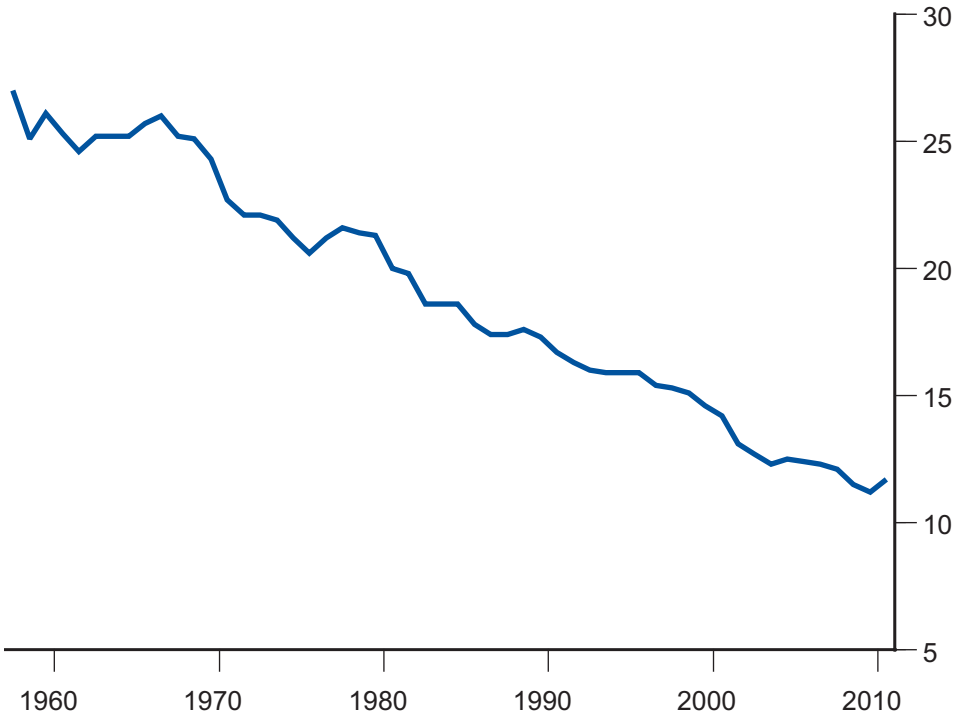
systems of the modern military would put the national security of the United States at risk. As its military comes to rely more heavily on complex and advanced technology systems, it is important that the United States retain the manufacturing capacity and knowledge necessary to produce these goods. Our continued security not only rests on the ability to produce military products, but we must also consider how the sourcing of all critical infrastructure components, from communications equipment to power generation, affects our ability to protect against potentially catastrophic supply chain disruptions.

The Current State of U.S. Manufacturing: A Crossroads for American Competitiveness

While manufacturing continues to play a vital role in the U.S. economy and provides millions of American jobs, the U.S. manufacturing sector has faced significant challenges in recent decades. As a fraction of U.S. GDP, manufacturing declined from 27 percent in 1957 to about 11 percent by 2009[10] (see figure 6.2).

Figure 6.2

Manufacturing Value Added as a Percentage of GDP, 1957–2010



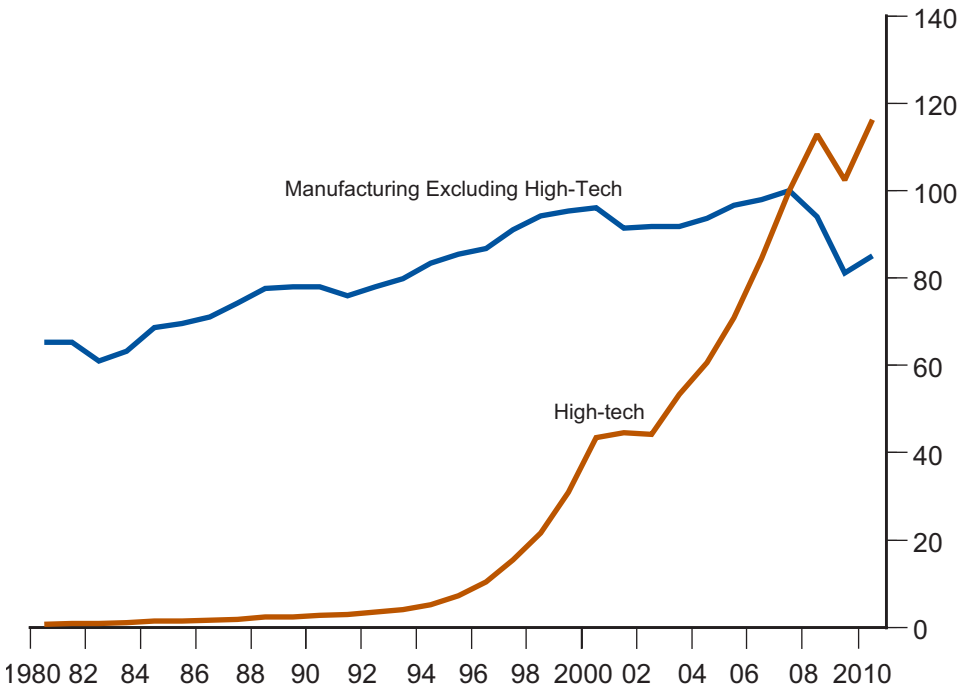
Source: Bureau of Economic Analysis, Gross Domestic Product-by-Industry Data

Since 2000, increases in the manufacturing of high tech equipment (semiconductors and related components, computers, and communications equipment) have hidden a slight decline in output of all other manufacturing sectors (see figure 6.3).[11] Manufacturing employment has seen dramatic declines; in the last decade alone, employment levels in manufacturing have declined by about a third (see figure 6.4), and the impact of this decline in manufacturing employment has been felt in many states across the country, with several states experiencing near collapse of their manufacturing sectors (see figure 6.5).

The reasons for the decline in manufacturing employment are varied and complex; the manufacturing sector is not monolithic and the reasons for the decline vary industry by industry. However, some common themes can be discerned. One likely factor is the large improvement in productivity in manufacturing. Between 1987 and 2010, labor productivity in manufacturing rose at a 3.4 percent annual rate, almost 50 percent higher than the 2.3 percent annual rate in the entire nonfarm business sector.[12] Though this increased productivity is critical in terms of

Figure 6.3

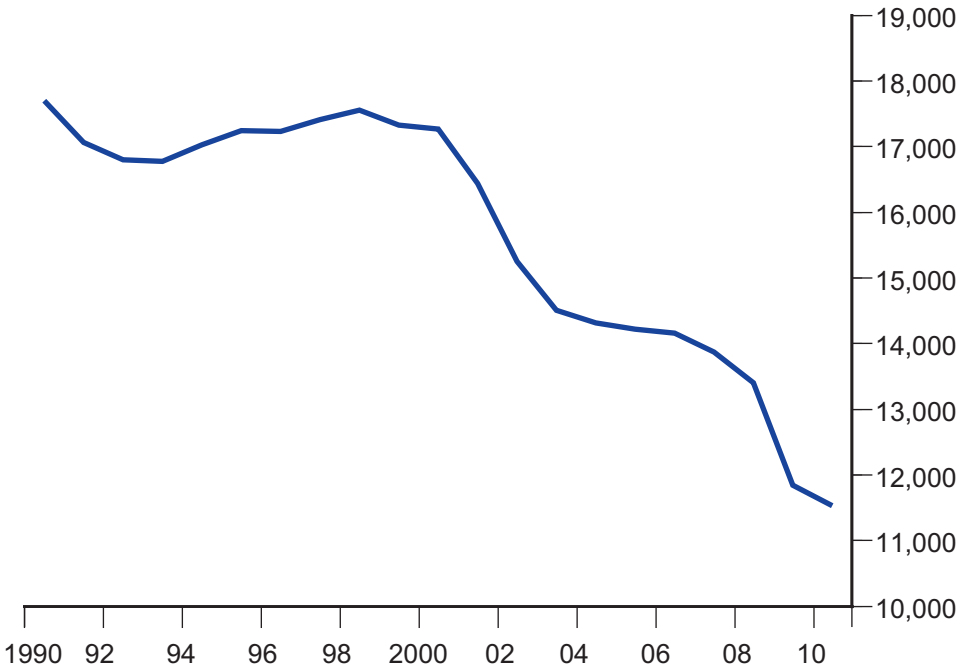
High-Tech Manufacturing Production Versus Manufacturing Production Excluding High-Tech, 1980–2010



Source: Federal Reserve and Haver Analytics
Note: 2007=100

Figure 6.4

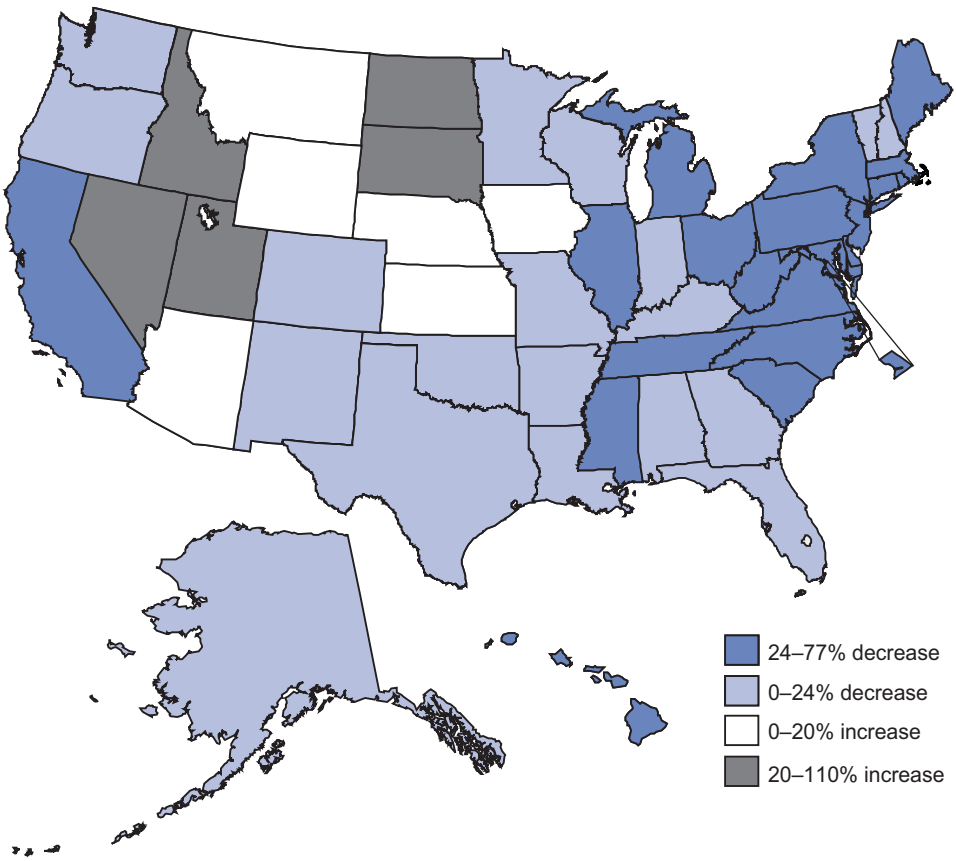
Manufacturing Employment, (Thousands) 1990–2010



Source: Bureau of Labor Statistics, Employment Nonfarm payrolls

Figure 6.5

Percent Change in Manufacturing Employment, 1990–2007



Note: Percent Change in Manufacturing Employment by state, 1990 (first year of data) to 2007.
Source: Bureau of Labor Statistics, Economics and Statistics Administration calculations.

maintaining the competitiveness of the manufacturing sector, it also has meant that companies can now do the same work with fewer workers and partially explains the drop in employment over the past two decades. However, given that employment in manufacturing held relatively steady during the 1990s while productivity was still high, other factors must also play a role in the decline of manufacturing since 2000. Further, a large portion of the overall gains in productivity are attributable to the production of computer and electronics products, so productivity gains are less likely to explain employment declines in other industries. In addition, this overall improvement in productivity may be slightly overstated due to the fact that low-cost foreign inputs are not adequately captured in existing price indices.[13]

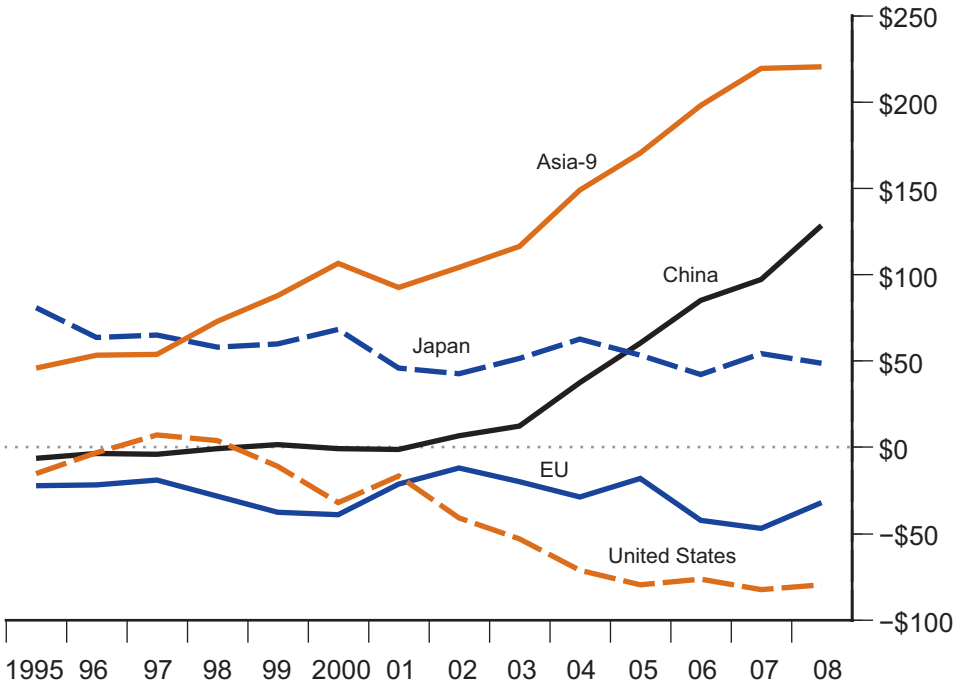
Another factor in the employment losses, particularly in some less efficient industries, is greater competition from low-wage countries, leading to the off-shoring of low-skilled jobs to lower cost locations. For example, one study has shown that between one-quarter to more than one-half of the lost manufacturing jobs in the 2000s was the result of import competition from China.[14] While there has been an overall decline in manufacturing employment, as stated above, there is evidence that the extent to which employment has fallen varies according to the amount of competition an industry faces from imports from low-wage countries. In fact, between 1972 and 2001, industries that faced the most import competition from low-wage countries saw an average decade-long decline in employment of 12.8 percent, while industries that faced little low-wage import competition saw an increase in average decade-long employment of 2.3 percent.[15]

While much has been written about the decline in jobs for unskilled labor within traditional manufacturing, this is only part of the story. The United States is also losing ground in the manufacture of high-tech goods that require skilled labor (see figure 6.6). PCAST notes, the United States has "not simply lost low-value jobs, such as assembly, in the high-tech sector, but also sophisticated engineering and advanced manufacturing activities."[16] This could be due to various factors; other countries may have relatively more skilled labor, may produce higher quality products, or have better customer service. The relative strength of the U.S. dollar can also play a role.

While some might suggest that an advanced country, such as the United States, will inevitably lose manufacturing share as the country shifts towards a more services-oriented economy, this is not a foregone conclusion. As the *Economic*

Figure 6.6

Trade Balance of High-Tech Goods, 1995–2008



Source: IHS Global Insight, World Trade Service database (15 July 2009).
Note: Billions of dollars

Report of the President notes, "experience from other high-income countries shows that a shift in the world share of exported goods does not mean a shift entirely out of manufacturing and into a service-only economy. Germany, the second place goods exporter, maintains a substantial share of manufacturing in its economy and exports many of these products…manufacturing, especially of complex products, continues to play a substantial role in advanced economies."[17]

Economic Rationales for Federal Government Support for U.S. Manufacturing

An overarching U. S. manufacturing innovation policy should invest to overcome market failures and to ensure technology-based enterprises have the infrastructure needed to be successful. The Federal government can help facilitate this by supporting research programs in new technologies; supporting the creation and dissemination of powerful design methodologies that dramatically expand the ability of entrepreneurs to design products and processes which any given entrepreneur may not have the incentive to invest in on its own; and investing in

shared technology infrastructure that would help U.S. companies improve their manufacturing.

The manufactured goods market is global and companies from more and more countries are participating. It is not an option or desired outcome for the United States to close its borders to goods produced abroad; however, we must be conscious of the impacts that our government's actions and those of our trading partners have on the competitiveness of this sector. (The ways in which foreign governments support industry are discussed more in Chapter 7).

The Federal government has historically played an important supportive role in the manufacturing sector. As *A Framework for Revitalizing American Manufacturing* noted, "the key to success (in manufacturing) lies in American workers, businesses, and entrepreneurs—but the federal government can play a supportive role in providing a new foundation for American manufacturing."[18]

Just as there is no single explanation for why manufacturing has declined in the United States, no one policy prescription will reverse the decline. Successful manufacturing policy actions must reflect the diversity of the manufacturing sector while not creating an industrial policy that inefficiently seeks to pick winners and losers.

Longstanding Federal Government Support for U.S. Manufacturing

Trade Policies

The United States works to open markets for U.S. goods and services through free trade agreements and other activities. The Federal government also takes steps to enforce existing trade rules within the World Trade Organization framework. Unfair foreign pricing and government subsidies distort the free flow of goods and adversely affect some American businesses in the global marketplace. Free trade must be premised on fair trade.

Investments in Research and Development Infrastructure

As noted in Chapter 3, Federal support for R&D provides a vital and necessary public good that individual private companies may be unwilling or unable to undertake. Federal support for R&D, particularly support for long-term basic research, has helped the advancement of important innovative technologies that

have then spawned many successful companies and even entire industries (for an example, see box 6.2). In their *Report to the President,* PCAST notes, "The Federal Government has historically made visionary investments that have facilitated the birth of new technology-based industries and strengthened the development of existing industries. These investments have paid enormous financial and social returns to the Nation."[19]

The Federal government supports R&D through agencies such as NSF, DARPA, NIST, and the DOE's Office of Energy Efficiency and Renewable Energy (see box 6.3 for a detailed description of NIST's manufacturing-related activities and see box 6.4 for an example of a company that has benefitted from multiple Federal programs).

The Federal government also has played a role by helping to fund large-scale research labs as part of public-private partnerships. As noted by a recent PCAST report, in the past the Federal government "funded in part the major corporate laboratories that laid the foundations for the U.S. economic leadership and inno-

Box 6.2

A123 Systems: Supporting the Future of the Auto Industry

In 2001 Professor Yet-Ming Chiang of the Massachusetts Institute of Technology co-founded A123 Systems, a producer of rechargeable lithium-ion batteries that power hybrid and electric vehicles and other technologies. The firm's foundation was enabled by a Small Business Innovation Research grant from the Department of Energy. The firm subsequently raised more than $300 million in capital from investors like Sequoia Capital and corporations like GE and Motorola. It also received a $5 million loan from the Massachusetts Clean Energy Center.[1] It went public in September 2009.

In February 2010, it embarked on a $6.0 million research program, with funding from the NIST Technology Innovation Program (TIP), to develop a new nanocomposite material for lithium ion battery electrodes together with improved manufacturing process technologies to enable both significantly improved battery performance and lower manufacturing costs. With help from the Department of Energy it opened a manufacturing plant in Michigan in September 2010.[2] Today A123 Systems employs approximately 1,700 people.

---

1. National Economic Council and the Office of Science and Technology Policy. *A Strategy for American Innovation: Securing Our Economic Growth and Prosperity.* February 2011, 58. www.whitehouse.gov/sites/default/files/uploads/InnovationStrategy.pdf.

2. The Science Coalition, *Sparking Economic Growth: How federally funded university research creates innovation, new companies and jobs.* April 2010, 35. www.sciencecoalition.org/successstories/resources/pdf/Sparking%20Economic%20Growth%20Full%20Report%20FINAL%204-5-10.pdf.

Box 6.3

The National Institute of Standards and Technology (NIST)

The National Institute of Standards and Technology (NIST) helps manufacturers of all kinds—from shipbuilders to semiconductor makers—streamline their operations, improve quality, reduce environmental impacts, and develop innovative products and processes.

The NIST Laboratory programs also provide critical support for manufacturers through research, standards activities, and the development and delivery of measurement services. Efforts are underway in partnership with industry and academia, to produce measurement technologies, standards, and services in areas including nano- and biomanufacturing, advanced robotics, additive manufacturing, cyberphysical systems, advanced materials development, and a number of other areas that will broadly impact technologies that are critical to advanced manufacturing across industry sectors. NIST is committed to advancing the Administration's vision for advanced manufacturing and will continue to provide:

- Unique and enabling measurements to industry, particularly in support of emerging technologies. In the area of advanced materials NIST is working to develop modeling and characterization tools that will help reduce materials design time from the current 10 year timeframe to a timescale more compatible with the average 18 month product development cycle.
- Support to strategic standards development and adoption. In the area of robotics NIST is working to provide the measurement framework that will support the adoption of standards to enable safer, closer proximity human-robot interactions on the factory floor.
- Support to technology transfer and commercialization of technology. In the area of nanomanufacturing the NIST nano-fabrication facility provides a key facility for users to test new manufacturing methods and techniques that can help speed the introduction of new nanomaterials into new products.

In addition, NIST's Hollings Manufacturing Extension Partnership (MEP) and its nationwide network of centers have a proven track record of helping manufacturers. According to NIST research "every $1 of Federal investment in MEP generates $32 of return in sales growth, a total of $3.6 billion in new sales nationally."[20] MEP centers offer access to market intelligence, trends, and data about manufacturing; outreach assistance to existing manufacturing firms in the region to get them involved in cluster initiatives (particularly small and medium sized manufacturers); technical assistance to companies in targeted clusters to enhance their competitiveness and accelerate growth opportunities (technology development, sustainability, etc.) leading to job creation; and tracking of performance measures (e.g., jobs created/retained, cost savings, new sales, new investments).

Box 6.4

West Paw Designs: Sustainable Manufacturing in Montana

West Paw Design is a small manufacturer based in Bozeman, MT that makes pet toys and beds.[1] West Paw uses IntelliLoft—a fiber created from 100 percent post-consumer recycled plastic soda bottles—to fill their stuffed pet beds and toys. Since 2006, the company has helped divert more than 5 million plastic bottles from landfills through this practice.

West Paw has taken advantage of Federal programs and services for small businesses, for sustainable manufacturing, and for exporting. They've been able to utilize the variety of services available to them, including SBA loans through the Recovery act, the Hollings Manufacturing Extension Partnership program at NIST, and some export assistance from the Department of Commerce's U.S. Commercial Service.[2] In 2010 West Paw doubled the size of its manufacturing facility by focusing on a green line of products and by looking to the international marketplace, with the help of various Federal government programs and services.

1. West Paw Design, "The West Paw Design Story." Accessed November 15, 2011 www.westpawdesign.com/articles/-west-paw-story/west-paw-design-story.

2. Williams, Spencer. Invited Testimony before the United States Senate Committee on Finance. February 23, 2010 finance.senate.gov/imo/media/doc/022310swtest.pdf.

vation in the 20th century, including Xerox PARC, RCA David Sarnoff Research Center, and AT&T Bell Labs."[21]

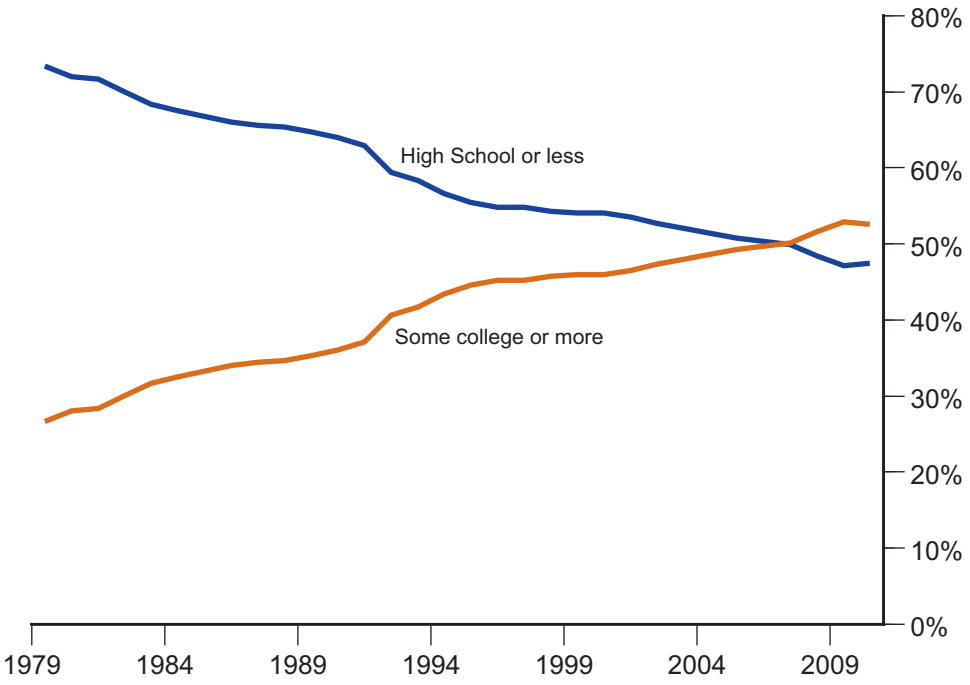
Investments in Education

As outlined in Chapter 4, investments in education, particularly STEM education, are critical to the future competitiveness of the United States. This is especially true for modern manufacturing, which requires an increasingly skilled workforce. Just as the manufacturing sector today is diverse and not a monolithic set of factories banging out widgets, today's manufacturing workforce is diverse, with a wide range of skills. The share of manufacturing employment accounted for by those with at least some college education has been increasing over time and exceeded half of the overall manufacturing labor force during the last few years (see figure 6.7).

Community colleges are educating many of these higher skilled manufacturing workers either as a continuation of their formal K–12 education or as part of the workforce development system. The United States' public, 2-year college system has more than 7.1 million students enrolled and awards 790,000 associate de-

Figure 6.7

Manufacturing Employment by Education Level, 1979–2010



Source: CPS public use Merged Outgoing Rotation Group files from NBER

grees annually.[22] Moreover, community colleges award huge numbers of non-degree certificates in specific scientific, technical, and computing skills. In addition, many of these institutions offer contract training for the public sector and employers, providing multiple opportunities for students and workers to gain skills that can facilitate their job search or allow them to become more productive in their current jobs. Students have been flocking to public 2-year colleges, with enrollment up by 75 percent between 1979 and 2009, and by 12 percent between December 2007 and June 2009.[23]

Employment projections through 2018 show that jobs that require at least some postsecondary education will be growing faster than those that require workers with just a high school diploma or less; however, the fastest growth will be in jobs for which an associate degree is the best pathway of entry.[24] Community colleges are also a needed nexus between industry and higher education, providing education in academic fields, including STEM, combined with vocational studies (see box 6.5 for an example of private-public partnership at community colleges).

Box 6.5

10,000 Small Businesses

This Goldman Sachs initiative is a $500 million, five-year program that aims to unlock the growth and job-creation potential of 10,000 small businesses across the United States. It provides access to business education, mentors, networks and financial capital. The program is anchored at local community colleges. At year end 2011, the program was operating in New York, Los Angeles, Chicago, New Orleans, Houston, and Long Beach, CA, and focused on historically underserved communities.

Economic development experts believe that a combination of education, capital and support services best address the barriers to growth for small businesses. The current environment of fiscal austerity is notably impeding the budgets of many public post-secondary school programs, including community colleges that often provide support to new business owners and vocational training to others.

The Goldman Sachs program has thus far targeted disadvantaged urban areas. The board of 10,000 Small Businesses, which includes Warren Buffet and Professor Michael Porter, has laid out the mandate for the initiative which is to meet the vital need for training, tools and relationships to help local entrepreneurs create a self-reinforcing cycle of economic opportunity.

Community colleges depend much more than 4-year public universities on state and local government appropriations. In the 2008–2009 school year, 47 percent of total revenues of public 2-year schools came from these appropriations, compared with 24 percent for public 4-year schools.[25] Given their dependence on state and local budgets, community colleges are especially vulnerable to government cutbacks. The Obama Administration recognized early on the essential role played by community colleges, and the $2 billion Health Care Reform Act investment in community colleges is one essential and timely investment that will help strengthen not just the colleges themselves, but also their ties to local industries. While community colleges by definition operate at a local level, these needed Federal government investments support workers, their communities, and the nation's industrial base.

Investments in Transportation, Energy, and Communications Infrastructure

Finally, the Federal government can support American manufacturers by investing in a 21st century infrastructure, as outlined in Chapter 5. This is because the "cost to move goods from one factory to another and to their final destination,

the cost to move energy from where it is created to where it is used, the cost of moving people and the cost to transport information are all significant factors in the manufacturing process" notes the Administration's *A Framework for Revitalizing American Manufacturing*.[26] Also, PCAST notes that small-and medium-sized firms "would benefit from readily accessible shared infrastructure, providing both equipment and expertise. Infrastructure currently provided at Federal laboratories, for example, for the fabrication of micro-electromechanical systems, has allowed for new products to be developed."[27]

In addition to programs that are strictly Federal, partnerships and coordination with governments at the state and local level have also proved effective. For example, Commerce's NIST MEP, along with the Economic Development Administration (EDA), recently partnered with the National Governors Association (NGA) to launch a Policy Academy that will encourage the growth of advanced manufacturing industries (see box 6.6).

These examples clearly illustrate the important role of the Federal government in supporting U.S. manufacturing. This support has been important in the past and will likely be even more important in the increasingly competitive marketplace of the future.

Box 6.6

EDA, NIST, NGA Collaborate To Form a Policy Academy

The U.S. Commerce Department's NIST Manufacturing Extension Partnership (MEP), in collaboration with EDA, have partnered with the National Governors Association (NGA) to launch a Policy Academy to encourage coordination amongst stakeholders in both Federal and state government along with leaders in industry and academia, to spur the growth of advanced manufacturing industries and support American jobs.

The states will receive guidance and technical assistance from NGA staff, experts from MEP, EDA and the State Science and Technology Institute, as well as consultants from the private sector, research organizations and academia. Colorado, Connecticut, Illinois, Kansas, Massachusetts, New York and Pennsylvania have been selected to participate, and the strategies and policies that are developed at the Policy Academy are intended to benefit all states.

For more information, visit www.nga.org/cms/center/ehsw.

Federal Initiatives to Revive Manufacturing

Many initiatives are underway to revitalize the U.S. manufacturing sector. They include:

- *The White House Office of Manufacturing Policy*. To improve the coordination of manufacturing policy across the Federal government, President Obama announced on December 12, 2011 that Commerce Secretary John Bryson and National Economic Council Director Gene Sperling will be co-chairs of the White House Office of Manufacturing Policy. The office will convene cabinet-level meetings to implement and coordinate priority manufacturing initiatives.

- *The Advanced Manufacturing Partnership (AMP).* Launched in June 2011, AMP identifies opportunities for industry, academia, and government to collaborate in order to accelerate the development and deployment of emerging technologies with the potential to transform and reinvigorate advanced manufacturing in the United States.

  - The AMP Steering Committee (AMP-SC) is co-chaired by Susan Hockfield of the Massachusetts Institute of Technology and Andrew Liveris of Dow Chemical and includes leading experts from industry and academia, including CEOs of major manufacturing firms and presidents of leading universities. The AMP-SC conducted four regional meetings from October to December of 2011, and will be issuing a final report in the spring of 2012.

  - In addition, to support the rapidly advancing work of the AMP, the Administration is establishing a National Program Office (NPO) that will reside at Commerce's NIST and will be staffed by a broad representation from several key Federal agencies involved in U.S. manufacturing in order to provide a coordinated "whole-of-government" response. The AMP NPO will support the ongoing work of the AMP partners, support interagency coordination of advanced manufacturing programs, and provide a link to the growing private sector partnerships between manufacturers, universities, state and local governments, and other manufacturing-related organizations.

- *The Materials Genome Initiative*. This program modeled on the Human Genome project that deciphered the building blocks of human genetics, will speed understanding of fundamental issues related to materials science by investing in research, training and infrastructure to enable U.S. companies to discover, develop, manufacture, and deploy advanced materials. For example, the initiative will fund various computational tools and software to help understand the properties of these materials and open standards and databases to help facilitate the sharing of knowledge.

- *SelectUSA* was established by Executive Order on June 15, 2011. It is the first Federal effort designed with executive authority to support foreign and domestic business investment in the United States. It showcases the United States as the world's premier business location, complementing the activities of states and regions—the primary drivers of economic development—to spur economic growth and job creation. SelectUSA coordinates existing resources and functions across all Federal agencies that have operations relevant to business investment decisions.

  SelectUSA encourages business investment by conducting four critical, inherently governmental functions:

  - **Outreach and engagement.** Leading and coordinating outreach and engagement by the Federal government to promote the United States as the best market for business operations in the world;

  - **Ombudsman.** Serving as ombudsman to facilitate the resolution of specific issues involving Federal programs or activities related to pending investments and addressing the Federal regulatory climate through an interagency investment facilitation task force;

  - **Information clearing house.** Providing information to firms regarding items such as Federal programs and incentives available to investors and state and local economic development points of contact; and,

  - **Policy advisement and engagement.** Advising the White House, Federal agencies, and the U.S. economic development community on business

investment policy issues based on feedback, solicited and unsolicited, that is received from investors and stakeholders.

- *New Federal support for R&D*. Initiatives the Obama Administration is championing include funding for DOE to support R&D in areas such as flexible electronics for components like batteries and solar cells and ultra-light materials for cars and funding for NSF to support research in advanced manufacturing areas such as nano-manufacturing, next-generation robotics and "smart" buildings and bridges.

- *The National Nanotechnology Initiative (NNI)*. The NNI is the U.S. Federal government's interagency program for coordinating R&D and enhancing communication and collaborative activities in nanoscale science, engineering and technology.

- *National Digital Engineering and Manufacturing Consortium (NDEMC).* NDEMC is a public-private partnership launched in March 2011 that brings together manufacturers, industry associations, Federal agencies, national labs, and research universities to make modeling and simulation capabilities available to small-and medium-sized manufacturers.

The manufacturing sector would also greatly benefit from some of the policies outlined elsewhere in this report, such as robust basic research funding, an expanded and enhanced corporate R&D tax credit, and accelerated R&D, specifically in biotechnology, nanotechnology, clean energy and advanced manufacturing (Chapter 3); initiatives to support STEM education, such as the Skills for America's Future Initiative and the Department of Education's "Race to the Top Initiative" (Chapter 4); infrastructure investments (Chapters 5 and 7); and supporting Regional Innovation Clusters, the National Export Initiative, corporate tax reform, and an effective intellectual property regime (domestically and abroad) (Chapter 7).

Endnotes

1. Bureau of Economic Analysis, Survey of Current Business January 2011, Table 2.
2. Bureau of Labor Statistics, 1961 to 2011, Table B–1.
3. Executive Office of the President of the United States 2009, 7.
4. Bureau of Economic Analysis, Trade in Goods and Services.
5. PCAST *Report on Advanced Manufacturing* 2011.
6. National Science Foundation, 2011. Detailed Statistical Tables NSF 11–301.
7. Wolfe, Raymond M. 2009. Table 3. As cited by Tassey, 290.
8. Tassey, 2010, 283–333.
9. PCAST *Report on Advanced Manufacturing* 2011, 11.
10. Bureau of Economic Analysis, GDP-by-Industry Data 2011.
11. Board of Governors of the Federal Reserve System, Industrial Production and Capacity Utilization-G17 2011.
12. Bureau of Labor Statistics, Labor Productivity and Costs, as cited by Executive Office of the President 2009, 6.
13. Houseman, et. al. 2011, 115.
14. Autor, Dorn and Hansen, 2011, 21.
15. Bernard, Jensen and Schott 2004, 9.
16. PCAST *Report on Advanced Manufacturing* 2011, 3.
17. Council of Economic Advisers 2011, 95.
18. Executive Office of the President of the United States 2009, 11.
19. PCAST *Report on Advanced Manufacturing* 2011, 24.
20. National Institutes of Standards and Technology, 2011, 1.
21. PCAST *Report on Advanced Manufacturing* 2011, 17.
22. National Center for Education Statistics 2010, Tables 196 and 198.
23. National Center for Education Statistics 2010, Table 198.
24. Lacey and Wright 2009, 88, Table 3.
25. National Center for Education Statistics, IPEDS, 2010, Table 362.
26. Executive Office of the President of the United States 2009, 3.
27. PCAST *Report on Advanced Manufacturing* 2011, 20.

References

Autor, David, David Dorn, and Gordon Hansen. 2011. "The China Syndrome: The Local Labor Market Effects of Import Competition" MIT Working Paper; econ-www.mit.edu/files/6613.

Bernard, Andrew B., J. Bradford Jensen and Peter K. Schott. 2004. "Facing the Dragon: Prospects for U.S. Manufacturers in the Coming Decade." Yale School of Management Working Paper, faculty.som.yale.edu/peterschott/files /research/papers/dragon.pdf.

Board of Governors of the Federal Reserve System, (Accessed December 2011) Industrial Production and Capacity Utilization-G17, Industrial Production: Market, Industry Groups, and Individual Series, Data from January 1986 to present (Tables 1, 2, and 10); www.federalreserve.gov/releases/g17/table1_2.htm.

Bureau of Labor Statistics. (Accessed November 2011) Table B–1. Employees on nonfarm payrolls by major industry sector, 1961 to date; ftp://ftp.bls.gov/pub/suppl/empsit.ceseeb1.txt.

Bureau of Labor Statistics. (Accessed December 2011) Labor Productivity and Costs Data, Industry Labor Productivity and Costs: Indexes; www.bls.gov/lpc/iprprodydata.htm.

Bureau of Economic Analysis. 2011. *Survey of Current Business 2006–2009*. January; www.bea.gov/scb/pdf/2011/01January/0111_indy_accts_tables.pdf.

Bureau of Economic Analysis. (Accessed December 2011). GDP-by-Industry Data. www.bea.gov/industry/gdpbyind_data.htm.

Bureau of Economic Analysis. (Accessed December 2011). International Economic Accounts, Trade in Goods and Services 1992–Present; www.bea.gov/international/index.htm.

Council of Economic Advisers. 2011. *Economic Report of the President*. Washington, DC: U.S. Government Printing Office. February. www.gpoaccess.gov/eop/2011/pdf/ERP-2011.pdf.

Executive Office of the President of the United States. 2009. *A Framework for Revitalizing American Manufacturing*. December; www.whitehouse.gov/sites/default/files/microsites/20091216-manufacturing-framework.pdf.

Houseman, Susan, Christopher Kurz, Paul Lengermann and Benjamin Mandel. 2011. "Offshoring Bias in U.S. Manufacturing," *Journal of Economic Perspectives*. Vol. 25, no. 2. Spring; pubs.aeaweb.org/doi/pdfplus/10.1257/jep. 25.2.111.

Lacey, T. Alan, and Benjamin Wright. 2009. "Occupational Employment Projections to 2018." *Monthly Labor Review* (November): 82–123, Table 3.

National Center for Education Statistics. 2010. *2010 Digest of Education Statistics;* nces.ed.gov/programs/digest/2010menu_tables.asp.

National Center for Education Statistics. Integrated Postsecondary Education Data System (IPEDS). Spring 2006 to Spring 2010; nces.ed.gov/programs/digest/d10/tables/dt10_362.asp.

National Institutes of Standards and Technology. 2011. The Manufacturing Extension Partnership: Partnering for Manufacturing Innovation and Growth 2011, www.nist.gov/mep/upload/MEP-PARTNERING- IMPACTS-FEB2011.pdf.

National Science Foundation, National Center for Science and Engineering Statistics. 2011. *Research and Development in Industry: 2006–07*. Detailed Statistical Tables NSF 11–301. Arlington, VA. Available at www.nsf.gov/statistics/nsf11301/.

President's Council of Advisors on Science and Technology. 2011. "Report to the President on Ensuring American Leadership in Advanced Manufacturing." June; www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-advanced-manufacturing-june2011.pdf.

Tassey, Gregory. 2010. "Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies." *Journal of Technology Transfer 35*: 283–333.

Wolfe, Raymond M. 2009. "U.S. Business R&D Expenditures Increase in 2007; Small Companies Perform 19% of Nation's Business R&D." *InfoBrief NSF 09–316*. Washington, DC: National Science Foundation; www.nsf.gov/statistics/infbrief/nsf09316/.