

THE MANUFACTURING INSTITUTE

The Facts About Modern Manufacturing

8TH EDITION

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Table of Contents

INTRODUCTION

i

SECTION 1. IMPORTANCE OF MANUFACTURING IN DOMESTIC AND INTERNATIONAL ECONOMIES

1

U.S. Manufacturing Sector Is the Eighth Largest Economy	2
Manufacturing Keeps Up with Overall Economy	3
Top Manufacturing Industries	4
Small Companies Dominate Industrial Landscape	5
Manufacturing Supports State Economies	6
Manufacturing Employs Sizable Workforces in the States	7
Business Is Largest Source of State and Local Funding	8
Manufacturing Supports Millions of U.S. Jobs in Other Sectors	9
Manufacturing's Multiplier Effect Is Stronger than Other Sectors'	10
Manufacturing Pays Premium Compensation	11
Manufacturers Support Health Care Insurance for Workers and Families	12
Manufacturing Improved Living Standards	13
U.S. Share of Global Manufacturing Holds Steady	14
Manufacturing Dominates U.S. Exports	15
United States Is the Number Three Manufacturing Exporter	16
U.S. Manufacturing Unit Labor Costs Relative to 14 Other Countries	17
The Bulk of Trade in Manufactured Goods Spans Just a Few Core Industries	18
Trade-Engagement Pays with Higher Wages	19
Importance of Exports Resumes for Small Manufacturers	20
Trade Agreements Do Not Drive the U.S. Trade Deficit	21
U.S. Attracts More Investment than Other Countries	22
Foreign Investment in U.S. Manufacturing Grows	23
U.S. Exports in Goods Associated with Non-Bank Foreign Affiliates	24
U.S. Manufacturers Invest Primarily in High-Wage Countries	24

SECTION 2. INNOVATION DRIVES U.S. MANUFACTURING STRENGTH **27**

Manufacturing Drives Productivity Growth	28
The United States Leads the Way in Innovation	29
U.S. Industrial R&D Outpaces Global Rivals	30
Manufacturers Are Technology Leaders	31
Technology Leads to a Cleaner (Greener) Environment	32
Energy Efficiency Among Developed Countries	33
Technical Innovation Addresses Global Climate Change	34
Technology Transforms Safety in the Workplace	35
The Manufacturing Workforce Has Become More Skilled	36

SECTION 3. CHALLENGES FACED BY U.S. MANUFACTURING **39****Challenge: External Costs**

External Costs Hamper U.S. Manufacturing Competitiveness	40
U.S. Does Not Keep Pace with Falling Corporate Tax Rates	41
High Health Care Costs Hamstring Competitiveness	42
Energy Is Critical to the Industrial Sector	43
Pollution Abatement Costs Are Large and Growing	44
Tort Costs Continue to Rise	45

Challenge: R&D Investment

R&D Investments: Fastest Growing Economies Gaining Rapidly on United States	46
Federal Funding for Physical Sciences Declines	47

Challenge: Skilled Workforce

The United States Is Falling Behind in Engineering	48
The U.S. Workforce Suffers from a Math and Science Skills Deficit	49

Challenge: A Level Playing Field for Trade

Trade Gap Widens for Manufacturers	50
The United States Is Losing Import Market Share in China	51
Competitive Exchange Rates Are Critical to U.S. Exporters	52

MANUFACTURING RESOURCES **54****COMPANY INDEX** **55**

U.S. Manufacturing: An Industry in Transition

The 8th edition of the Facts gives a snapshot of the state of U.S. manufacturing, and exhibits its strengths and challenges. The Facts clearly show that manufacturing continues to play a vital role in the U.S. economy.

This edition illustrates that the quantity of manufactured goods produced in the United States has kept pace with overall economic growth since 1947, as both GDP and manufacturing have grown by about seven times (Figure 2). The United States still has the largest manufacturing sector in the world, and its market share (around 20 percent) has held steady for 30 years (Figure 13). One in six private sector jobs is still in or directly tied to manufacturing (Figure 8). Moreover, productivity growth is higher in manufacturing than in other sectors of the economy (Figure 25). Due largely to outstanding productivity growth, the prices of manufactured goods have declined since 1995 in contrast to inflation in most other sectors, with the result that manufacturers are contributing to a higher standard of living for U.S. consumers (Figure 12). Manufacturing still pays premium wages and benefits, and supports much more economic activity per dollar of production than other sectors (Figure 9).

Another major indicator of the importance of manufacturing to the strength of the economy is its key role in driving innovation and technology. These are crucial components of a productivity-driven, global competitiveness agenda, and also help explain the steady rise in our standard of living. U.S. manufacturing accounts for 35 percent of value added in all of the world's high technology production, and enjoys a trade surplus in revenues from royalties from production processes and technology. U.S. inventors still account for more than one-half of all patents granted in the United States (Figure 26), and the nation outpaces its rivals in terms of industrial research and development. Technology has aided U.S. manufacturers to use less energy per unit or dollar of production (Figure 30) and to lead all other sectors in reducing CO2 emissions in the last two decades (Figure 29). Finally, the technology and advanced processes developed in manufacturing consistently spill over into productivity growth in the service and agriculture sectors. For this reason, it is important to consider innovation in terms of processes as well as technologies.

U.S. manufacturing is much more engaged than other sectors in global trade. Fifty-seven percent of all U.S. exports are in manufactured goods (Figure 14). Since 2000, the trend toward higher exports of goods has been pronounced, as U.S. firms, led by capital goods firms, increased their sales abroad by 65 percent (Figure 17). Many foreign

firms also use the United States as an export platform (Figures 22 and 23) as well as an entry point to its domestic economy. Over \$350 billion in goods exports in 2007 were sourced from American affiliates of foreign firms.

Capital goods industries export as much as they import, and the value of open trade is shown by the fact that we enjoy a trade surplus with the countries with which we have free trade agreements (Figure 20). The United States is still the largest destination for foreign direct investment (Figure 21). Foreign affiliates of U.S. firms sell nearly \$4.7 trillion of products abroad, compared to only \$3 trillion in sales by foreign affiliates operating in the United States. The competitive advantage of U.S. multinationals is thus often implemented by investing locally for sale into foreign markets. At least three quarters of all U.S. foreign direct investment in manufacturing is in high-wage countries (Figure 24), helping belie the notion that all manufacturing is destined to move to low-cost locations. This reflects manufacturers' active participation in the global economy.

Because of the increasingly sophisticated technologies and processes it employs, U.S. manufacturing increasingly relies on a more educated workforce (Figure 33) and pays higher wages and better benefits than other sectors (Figures 10 and 11). The application of modern management practices and cutting-edge technology has steadily improved safety in the workplace (Figure 32).

The Facts clearly illustrate that U.S. manufacturing plays a critical role in our economic future. Still, that future is not without its challenges, also outlined in this edition. Rising external costs faced by U.S. manufacturers represent a fundamental challenge in a global, interconnected and competitive marketplace (Figure 34). Corporate tax rates continue to be a critical concern for manufacturing cost competitiveness (Figure 35). The U.S. corporate tax rate has been essentially unchanged for the past two decades, while all of our major competitors have been lowering theirs. Rising health care costs remain one of the most challenging pressures for manufacturers (Figure 36). Some firms have been able to remain competitive by trimming benefits or increasing employers' share of premium payments, but many others, particularly small- and medium-sized firms, have been forced to scale back on benefits. Compliance can also have implications for U.S. manufacturing competitiveness. For example, U.S. industry is faced with the highest pollution abatement costs compared to its major trading partners—even higher than the

so-called “green economies” of Western Europe (Figure 38). Tort costs represent yet another challenge (Figure 39). The total cost of U.S. tort claims exceeds \$250 billion a year, or over 2 percent of GDP. Even though this has leveled off in recent years, the fact remains that, scaled to GDP, the U.S. tort system is more than twice as expensive as its major competitors such as Japan, France, Canada, and the United Kingdom.

Despite the rise in the value of U.S. exports in recent years, the U.S. share of global exports of manufactured goods declined from 19 percent in 2000 to 14 percent in 2007. The most dramatic change was the rise of China to overtake the United States as a leading exporter of manufactured goods. The United States is losing import market share to both Asian and European competitors in the fast growing Asian market (Figure 45). Even more disturbing is the sustained large U.S. trade deficit in manufactured goods, which rose from \$319 billion in 2000 to \$500 billion in 2007, although it did fall back to \$458 billion in the recession year 2008 (Figure 44). A sustained deficit at these levels means several million less manufacturing jobs than would be achieved with a balanced trade picture.

The United States is also not keeping pace with global competitors in the development of the human capital or skills needed to maintain leadership in the global economy. Many analysts have noted that the United States is not producing enough numerate workers, much less the more highly skilled engineers and scientific researchers required to be the foundation of advanced, technology-intensive manufacturing. The realities of this assertion are at least partly borne out by international comparisons of skill levels in K-12 education (Figure 43) and at the higher levels of university-level training (Figure 42). There has been some growth in the number of PhDs granted in computer and physical sciences, but international comparisons still do not favor the United States in relative terms. Additionally, over 52 percent of these computer science and over 58 percent of engineering degrees were granted to foreign students in 2005, and studies show that more and more of these foreign students are returning home—to China, India, Korea—to build their careers.

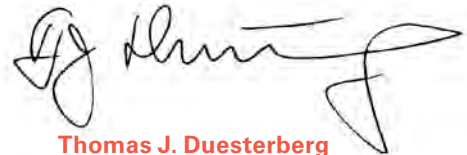
This eighth edition of the Facts presents a picture of the current state of U.S. manufacturing, but also suggests we need to pay attention to key areas that support manufacturing competitiveness.



Emily Stover DeRocco

President

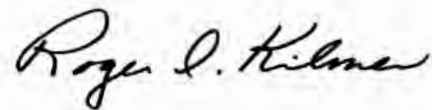
The Manufacturing Institute



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National Institute of Standards and Technology
U.S. Department of Commerce

The background is a solid red color with a complex, abstract wireframe design in white. The design consists of numerous overlapping circles, arcs, and straight lines that create a sense of depth and movement. Some elements resemble technical drawings or architectural plans. The overall aesthetic is modern and industrial.

SECTION 1.

Importance of Manufacturing in Domestic and International Economies

When assessing the size and importance of the U.S. manufacturing sector, it is vital to recognize that many other sectors, such as finance, telecommunications, wholesale and retail trade, and accounting, depend on a strong manufacturing base. While U.S. manufacturing itself is the eighth largest economy in the world, its impact on the overall U.S. economy is much larger when this “multiplier effect” is taken into account. And reports of the demise of the manufacturing economy in the 21st century are clearly premature. While the general public perceives a manufacturing sector marked primarily by a loss of jobs, the facts about the industry paint a different picture.

In this section, the manufacturing landscape in the United States is examined, highlighting a strong position that too few Americans understand and which is often masked by looking at a few data points and not the complete picture. Explaining these apparent contradictions with conventional wisdom is the purpose of this section. The story of U.S. manufacturing is that it remains vital to our economic security and standard of living. The U.S. presence in the global economy is also growing. It is often said today that “nothing is made in America anymore,” or that “we can no longer compete with low wage countries.” While manufacturing has become a smaller share of gross domestic product (GDP), the data presented in this section show a strong and more vibrant picture:

The U.S. share of global value added in manufacturing has remained relatively steady at around 22 percent since 1980.

Manufacturing production is now at the highest point in its history and is keeping pace with that of the overall economy in terms of physical output.

Manufacturing pays higher wages and has a higher multiplier effect than other economic sectors.

It competes effectively in advanced sectors of the global economy by focusing on technology-based industries and effectively managing its costs.

Manufacturing continues to generate more economic activity per dollar of production than any other business sector in the country.

U.S. investments abroad and foreign direct investments in the United States help strengthen U.S. competitiveness.

Manufacturing helps improve living standards by keeping product prices low.

During the recessions that began in 2001, and then with greater intensity in 2008, U.S. manufacturing was dramatically affected, losing millions of jobs due to a large drop in exports, a steep decline in business investment, rising input, health and energy costs, and greater import competition. The resiliency of manufacturers reversed the first downturn, and this experience with the power of improving production efficiency, leading in advanced industries, and managing the production process to keep total production costs under control, gives confidence that the downturn will reverse.

This section gives an overview of U.S. manufacturing, highlighting:

The global market share of U.S.-based manufacturing.

The top manufacturing industries.

The quantity of output in manufacturing has kept pace with the overall economy.

The importance of manufacturing to state and local economies.

The factors behind the premium paid in wages and benefits to manufacturing employees.

The growth in exports of manufactured goods.

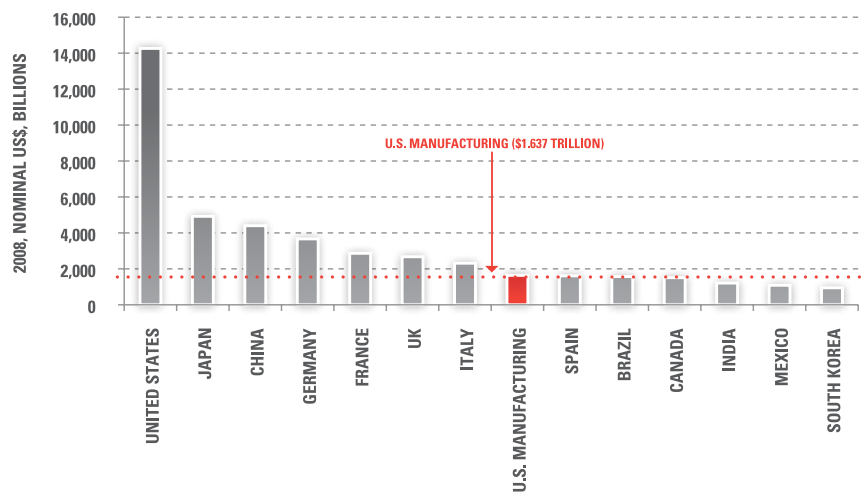
The role of free trade agreements in helping U.S. manufacturing level the playing field.

We also provide state-by-state analysis of manufacturing’s economic strength and employment record that shows California and Texas as the largest U.S. manufacturing states.

U.S. Manufacturing Sector Is the Eighth Largest Economy

If U.S. manufacturing were a country by itself, it would be the eighth largest economy in the world.

FIGURE 1.



Sources: International Monetary Fund and U.S. Bureau of Economic Analysis

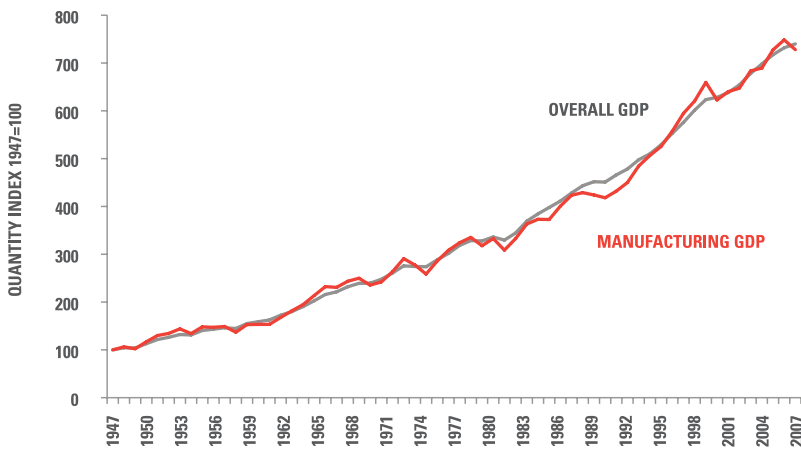
A common misconception is making the rounds: that domestic manufacturing is vanishing. This misperception is based on consumers' daily observation of foreign-made products visible on store shelves and the media's focus on the loss of jobs in the sector. But the facts do not support this pessimistic view. Manufacturing in the United States remains vital and important to the U.S. economy and is globally competitive.

The U.S. manufacturing sector is large and its output is growing. In 2008, it generated \$1.64 trillion worth of goods. Not only is manufacturing large, its industrial output has risen steadily over time. Over the last ten years ending in 2008, manufacturing value added has increased 22 percent. In fact, if U.S. manufacturing were a country by itself, it would rank as the eighth largest economy in the world. The United States is, of course, the largest economy in the world when measured by total GDP (value of all goods and services produced, see figure). As in the recent past, it is followed by Japan. But China has recently moved into the third place, displacing Germany. France, the United Kingdom, and Italy occupy the next three spots, followed by U.S. manufacturing.

The Chinese economy is growing briskly and its industrial sector is large relative to GDP. But the overall industrial output of China is significantly smaller than its U.S. counterpart.

Manufacturing Keeps Up with Overall Economy

FIGURE 2.



Source: U.S. Bureau of Economic Analysis

Between 1947 and 2008, both manufacturing GDP and overall GDP rose over 7 times.

Manufacturing is often compared to agriculture in terms of a slow decline in its share of employment and national output. However, after adjusting for price changes, the quantity of manufacturing value added (GDP) has generally kept pace with the overall economy during the past 61 years, taking into account both recessions and expansions. Manufacturing GDP does fall faster during recessions (like the current recession), but it also grows faster in expansions.

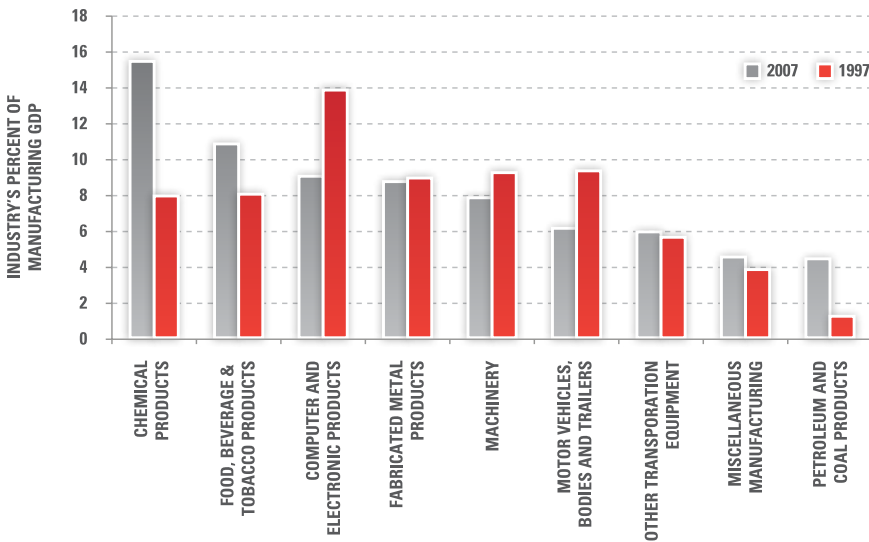
Between 1947 and 2008, both manufacturing GDP and overall GDP rose over sevenfold. It is generally unnoticed that the quantity of manufactured goods has continued to grow, leaving many people with the incorrect notion that little domestic value is produced in the United States anymore. In current dollars, manufacturing GDP made up 11.5 percent of total GDP in 2008.

Industry value added can be broken down into its underlying composition of the factors of production and into price and quantity. The figure shows that the quantity of manufacturing GDP keeps up with the change in total economic output. Manufacturing price changes, however, have not kept pace with general inflation (Figure 12). Price increases for manufacturing factors of production have grown less rapidly than in the general economy since 1947, and, in fact, the manufacturing price level has actually been falling since 1995 (price cuts are concentrated in computers and electronic products and motor vehicles industries). Consequently, manufacturing creates tremendous value for its customers by allowing them to use a smaller proportion of their budget to buy more and higher quality items.



Top Manufacturing Industries

FIGURE 3.



Source: NAM/MAPI Calculations from U.S. Department of Commerce data, 2009

The four largest manufacturing industries—food, chemicals, computers and electronic products and fabricated metal products—account for about 44 percent of manufacturing GDP.

Total manufacturing activity in the United States—measured in terms of physical output—continues to grow (Figure 2). The composition and relative importance of different industries within the manufacturing sector continue to shift due to technological change, shifting demand patterns, and international competition.

The four largest manufacturing industries—food, chemicals, computers and electronic products and fabricated metal products—account for about 44 percent of manufacturing GDP. The top nine sectors shown in this chart account for about 73 percent of manufacturing GDP and include both durable and non-durable sectors.

Federal and state regulatory initiatives and tax policies will affect the future of the manufacturing sector's footprint in the United States. Changes in energy prices can also affect the performance of energy-intensive industries like chemicals, metals, and machinery.



Small Companies Dominate Industrial Landscape

Smaller companies are nimbler in managing their business and may offer better opportunities for internal advancement for their workforce.

The industrial landscape is made up of mostly small- and medium-sized firms. This is one consistent sign of innovation, dynamism, and change that characterizes the American economy. A large number of small establishments means that entrepreneurship is alive and well. Small companies naturally grow in heft over time, swelling the ranks of medium-sized entities.

The largest cohort, with a count of over 100,000, is made up of the smallest firms, that is, those employing up to four workers. Industrial companies employing between 20 and 99 people are the second largest one. By far, the smallest cohort is made up of the largest companies, e.g., those employing over 500 people.

Small size does have its downsides. Undersized companies tend to offer fewer benefits to workers and are less likely to export than larger firms.

FIGURE 4.



Source: U.S. Census Bureau

D&S Manufacturing

A strong relationship with an original equipment manufacturer (OEM) customer can lead to a more secure market position and new opportunities for small manufacturers, as was the case with D&S Manufacturing. D&S, based in Black River Falls, WI, is a custom manufacturer of large-scale components, assemblies and weldments for several large companies. Looking to enhance its supply chain, Oshkosh Corporation chose a number of their suppliers, including D&S, to participate in the Wisconsin Manufacturing Extension Partnership's (WMEP) "Accelerate" program.

Through "Accelerate," D&S implemented lean manufacturing tools and techniques to reduce their Manufacturing Critical-path Time (MCT) by identifying improvement opportunities from the office to the plant floor. Through their dedication and hard work, D&S was able to reduce

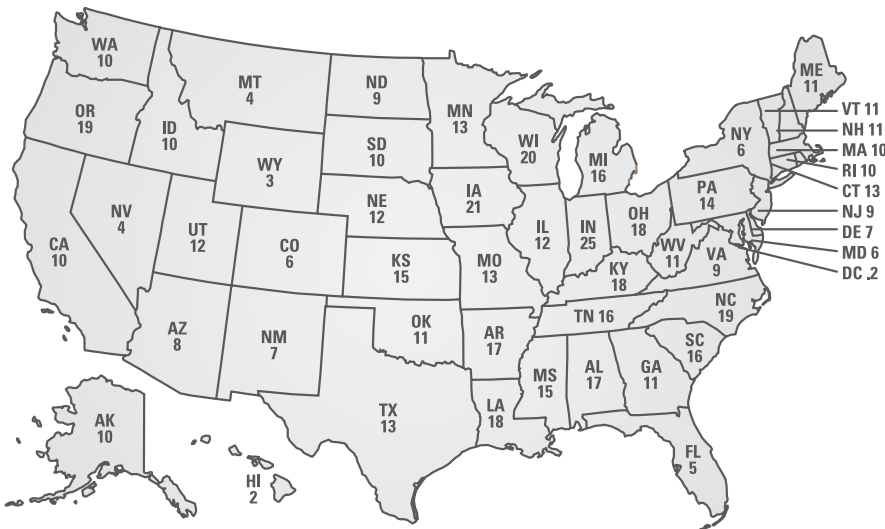
their MCT by 30%, late shipments by 26%, and customer defects by 32%. With the subsequent freed-up capacity, they increased their sales and created 15 new jobs.

Perhaps more importantly, D&S enhanced their credibility with Oshkosh, proving to them that they had the agility and commitment to successfully implement and build on continuous improvement initiatives, making them a stronger and more reliable supplier.

With the economic downturn, D&S has seen business from several of their OEMs drop dramatically. However, their relationship with Oshkosh and other core customers remains so strong that they felt confident completing a facility expansion that will better position the company when the economy begins to rebound.

Manufacturing Supports State Economies

FIGURE 5. MANUFACTURING AS PERCENT OF GROSS STATE PRODUCT



Source: U.S. Bureau of Economic Analysis, 2008

Although manufacturing constitutes a less significant share of U.S. economic activity than it has in previous eras, it contributes importantly to state and local economies across the country.

In the past quarter century, the geographic distribution of manufacturing has shifted—in some cases quite dramatically. Where it was once concentrated in the Northeast and Midwest, today, manufacturing is more broadly distributed and plays a significant role in the economic life of every region.

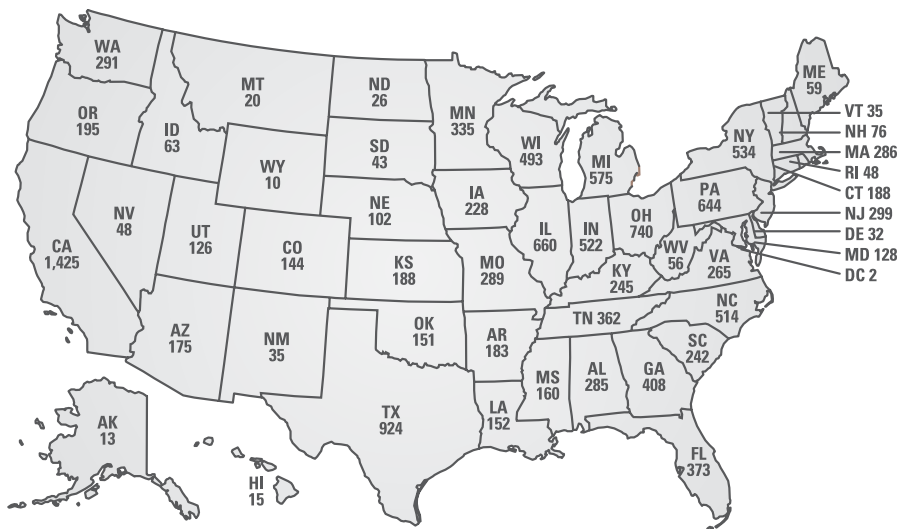
Manufacturing in just five states (California, Texas, Michigan, Ohio, and Pennsylvania) adds over half a trillion dollars to the national economy. And as the figure above shows, 14 states rely on manufacturing to generate more than 15 percent of their overall economic activity. States as disparate as Alabama, Indiana, Iowa, Kentucky, North Carolina, Oregon, and Wisconsin depend on a healthy manufacturing sector to support their local economies.

MANUFACTURING CONTRIBUTION TO STATE ECONOMIES

STATE	\$ BILLIONS
Alabama	29
Alaska	1
Arizona	20
Arkansas	17
California	181
Colorado	16
Connecticut	29
Delaware	5
District of Columbia	0.2
Florida	36
Georgia	43
Hawaii	1
Idaho	5
Illinois	79
Indiana	64
Iowa	28
Kansas	19
Kentucky	29
Louisiana	41
Maine	5
Maryland	15
Massachusetts	35
Michigan	62
Minnesota	34
Mississippi	14
Missouri	32
Montana	1
Nebraska	10
Nevada	6
New Hampshire	7
New Jersey	44
New Mexico	5
New York	69
North Carolina	78
North Dakota	3
Ohio	84
Oklahoma	16
Oregon	30
Pennsylvania	75
Rhode Island	5
South Carolina	25
South Dakota	4
Tennessee	41
Texas	159
Utah	13
Vermont	3
Virginia	34
Washington	32
West Virginia	7
Wisconsin	49
Wyoming	1

Manufacturing Employs Sizable Workforces in the States

FIGURE 6. MANUFACTURING EMPLOYS SIZABLE WORKFORCES IN THE STATES (THOUSANDS OF WORKERS)



Source: U.S. Bureau of Labor Statistics, 2008

Rising capital investment and widespread adoption of new manufacturing techniques demonstrated industry's willingness to adapt to changing circumstances.

The strong job growth observed in most sectors of the U.S. economy following the 2001 recession was not mirrored in manufacturing. The U.S. trade deficit, which cut into the manufacturing base in the United States, played a part, but so did increasing productivity. Rising capital investment and widespread adoption of new manufacturing techniques demonstrated industry's willingness to adapt to changing circumstances. "Lean" manufacturing and "Six Sigma" quality programs created demand for a smaller, but more highly skilled workforce.

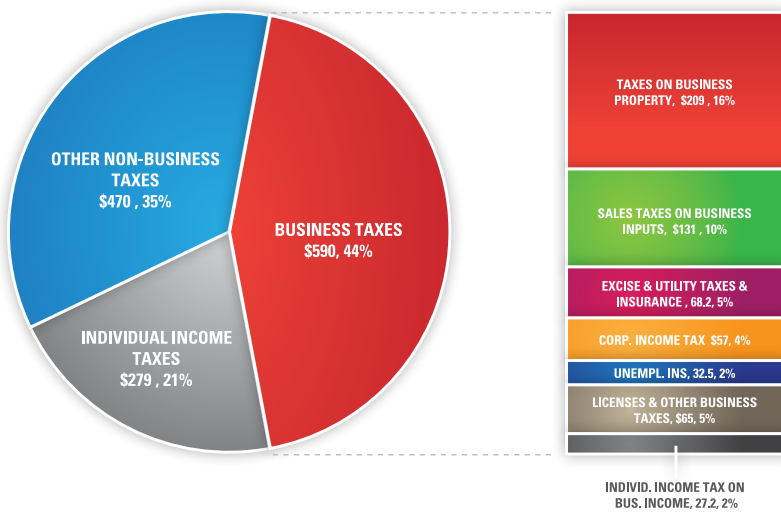
The global economic crisis of 2008 further reduced manufacturing employment, particularly in the Midwest, where the share of manufacturing employment is highest and where the troubled automotive sector is most concentrated. Some analysts believe that lean manufacturing, with its emphasis on training and retaining skilled workers, may have made manufacturing employment relatively less vulnerable to a downturn than in past recessions.

Although, as noted, manufacturing employment is highest in the Midwest, the two states with the largest manufacturing workforces are California and Texas. Together they accounted for better than 17 percent of the entire U.S. manufacturing workforce in 2008 and, with 2.35 million manufacturing workers, the two Sun Belt states actually exceeded the combined total of Ohio, Michigan, Indiana, and Wisconsin.



Business Is Largest Source of State and Local Funding

FIGURE 7. TOTAL STATE AND LOCAL TAXES FY 2008 (BILLIONS OF DOLLARS)



Businesses pay the bulk of all state and local taxes, and, among major industries, the tax payments of manufacturers rank a close second behind the much larger services sector. Of the more than \$580 billion in business tax revenues collected by local and state governments in Fiscal Year 2008, nearly \$90 billion was derived from manufacturing firms. That is more than the tax revenues collected from the retail trade and communications sector combined.

Between Fiscal Year 2005 and Fiscal Year 2008, total state and local taxes paid by manufacturers rose 29 percent. Corporate income tax payments alone rose 52 percent.

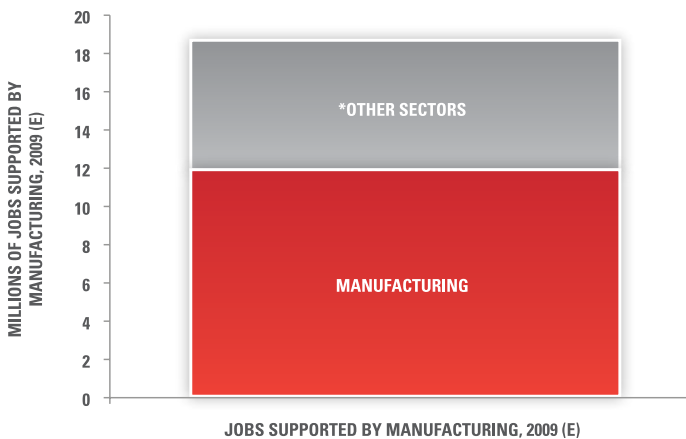
Source: Ernst & Young at Council of State Taxation

Of the more than \$580 billion in business tax revenues collected by local and state governments in Fiscal Year 2008, nearly \$90 billion was derived from manufacturing firms.



Manufacturing Supports Millions of U.S. Jobs in Other Sectors

FIGURE 8.



Source: Estimated (E) from the U.S. Bureau of Economic Analysis, 2007 Annual Input-Output Tables

About one in six U.S. private sector jobs depends on the U.S. manufacturing base. The manufacturing sector supports millions of employees who make things in America and a large number of employees in other sectors of the economy.

Specifically, manufacturing supported an estimated 18.6 million jobs in the United States in 2009: 11.8 million jobs directly within manufacturing and more than 6.8 million jobs in sectors outside of manufacturing such as professional services (accounting, legal, consulting, etc.), wholesaling, transportation, agriculture, and F.I.R.E. (finance, insurance, and real estate).

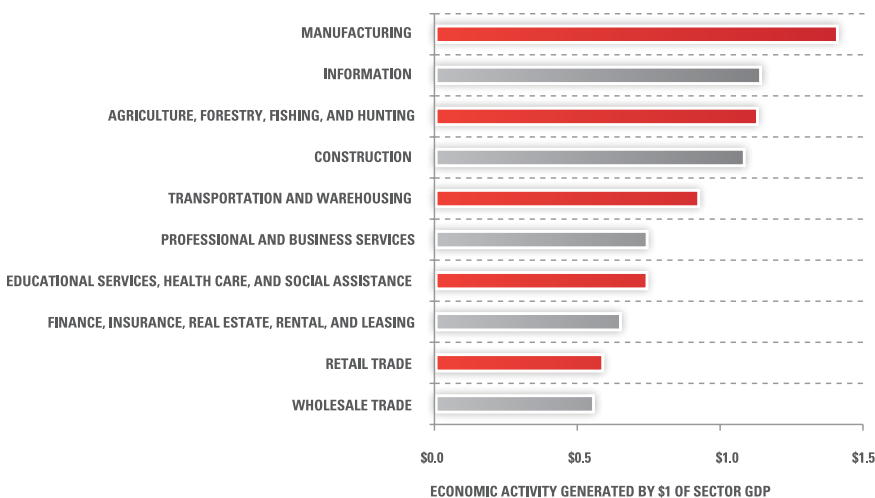
Vermeer

Vermeer Corporation, an international manufacturer of agricultural, construction, environmental and industrial equipment based in Pella, Iowa, has been on the “lean” journey for over 10 years. In the current economic climate, Vermeer has extended lean practices to their network of industrial dealers in order to keep them healthy as well. The company established an innovative inventory auto-replenishment system based on a daily electronic download of their dealers’ inventory footprints. The system captures daily floor vacancies and efficiently triggers replacements. While Vermeer previously restocked vendor inventory every month with lead time of nearly two months, they can now supply product in two days. This “just-in-time” system decreases dealer inventory by 50%, thereby reducing overhead costs of floor plans and space use. It avoids the wasteful practice of inventory forecasting, which can lead to overstocking and eventual product depreciation.

Working with their dealers, Vermeer developed and honed this “pull” inventory system with one product line and has now extended it to 20 products. With the ability to supply product—raw steel to out-the-door—in two days on select models, Vermeer has cut internal costs of inventory and is able to focus investments on research and development.

Manufacturing's Multiplier Effect Is Stronger than Other Sectors'

FIGURE 9.



Source: U.S. Bureau of Economic Analysis, 2007 Annual Input-Output Tables

The mapping of economic relationships in the economy finds that manufacturing has the highest backward linkage among the major sectors.

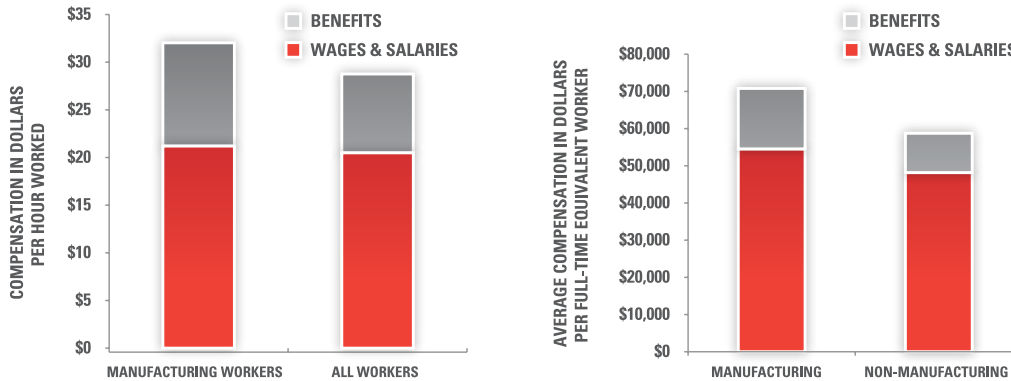
Manufacturing is complex and its production processes increase demand for raw materials, energy, construction, and services from a broad array of supplying industries in the economy. Additionally many functions previously done within manufacturing companies—from back-office and accounting to some types of logistics—are now contracted out to other service providers and hence not counted as part of the manufacturing sector itself. A measure of the breadth of the supply chain is the backward linkage in the input-output structure of the economy. An industry with a larger backward linkage than another industry means that growth in its output induces more production, both directly and indirectly, from the other sectors of the economy. The mapping of economic relationships in the economy finds that manufacturing has the highest backward linkage among the major sectors. As the demand for manufacturing grows, it in turn spurs the creation of jobs, investments, and innovations across many other sectors.

The backward linkage or multiplier effect shows how much additional output is generated by a dollar's worth of final demand for each industry. Specifically, every dollar in final sales of manufactured products supports \$1.40 in output from other sectors of the economy. Manufacturing has the largest multiplier of all sectors, with only information; agriculture, forestry, fishing and hunting; and construction coming close. The wholesale and retail trade sectors have the lowest multipliers. Wholesale and retail trade sectors generate only 55 cents and 58 cents, respectively, in other additional inputs for every dollar of economic activity they generate themselves. Manufacturing plants, therefore, have a powerful positive impact on economic development.



Manufacturing Pays Premium Compensation

FIGURE 10.



Source: U.S. Bureau of Labor Statistics, March 2009

Source: U.S. Bureau of Economic Analysis, 2007

Between 2004 and 2009, the rise in benefits accounted for 28 percent of the increase in manufacturing compensation.

Today's manufacturing employees earn higher wages and receive more generous benefits than other working Americans. In March 2009, manufacturing employers paid \$32 per hour in wages and benefits, while all employers in the economy paid about \$29.39 per hour. That is a 9 percent premium for working in manufacturing.

Most of the difference in compensation is due to the fact that manufacturers provide a higher level of benefits for their workers than other industries. Manufacturing employers compensate workers better for paid leave, supplemental pay, and insurance

than in the general economy. Although manufacturing employers, like other industries, are making workers more responsible for their own health care costs, employer-provided health care payments continue to grow faster than wages and salaries. Health care contributions by manufacturing employers increased 5.9 percent a year over the last five years compared to a 3.8 percent a year gain in wage and salary costs per hour. Employer-provided health care imposes a significant burden on the manufacturing industries that have to compete internationally with countries where health care is paid for by general tax revenues.

Behlen Manufacturing

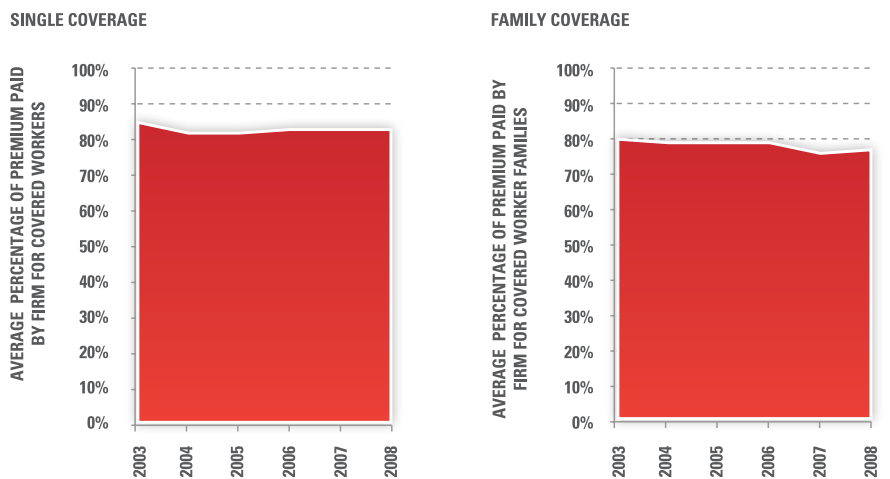
When Behlen Country, of Behlen Manufacturing in Columbus, NE, began their lean journey, they went far beyond just reworking their plant layout; they truly embraced and internalized the culture of lean throughout the company. Behlen enlisted the assistance of the Oregon Manufacturing Extension Partnership (OMEP) to perform a plant analysis and help them develop an action and implementation plan. While companies often start with the easiest implementation projects, the ones that create the least disturbance within their operation, Behlen took another approach. They wanted to create long-term change that would keep them at the forefront of their industry, and this required tackling their biggest roadblocks right from the start.

Behlen wanted all members of the workforce to work smarter, not harder, and they went straight to the source for recommendations. They not only listened, but also rewarded employees who came forth with new improvement ideas for their job or division. Soon, ideas were flying off the floor so fast that they couldn't implement them all. Behlen saw their lead time go from days to a matter of a few hours, their product changeover dropped from 27 minutes to under 50 seconds, and employee productivity increased by a minimum of 29%, which was rewarded by a 13% wage increase.

The successful implementation of true philosophical change keeps Behlen continuously growing and improving while their competitors struggle to keep up. Behlen Country quickly became the recognized lean leader for Behlen Manufacturing, and now helps other facilities internalize their own culture of lean.

Manufacturers Support Health Care Insurance for Workers and Families

FIGURE 11.



Sources: Employer Health Benefits Annual Survey, Kaiser Family Foundation.

Nearly three-quarters of all manufacturers provide health care coverage for their workers and more than 8 of every 10 employees participate in these employer-financed plans.

The rising cost of health care is a major concern and a significant cost for manufacturers. Yet nearly three-quarters of all manufacturers provide health care coverage for their workers and more than 8 of every 10 employees participate in these employer-financed plans. All large manufacturing companies with 1,000 or more employees provide coverage. Data from the Kaiser Family Foundation suggest that the share is nearly as high for companies with 200 to 999 employees. Almost 30 percent of manufacturers with 200 or more employees also offer healthcare coverage to their retirees.

In 1999 the premium for family coverage in the manufacturing sector averaged \$5,788. By 2008 family coverage premiums had risen to \$12,181. This 8.6 percent annual rate of increase over nine years was double the rate posted by the Producer Price Index, which reflects the change in prices manufacturers charge for their output.

In the face of rising health insurance premiums, manufacturers have held constant the share that they contribute for single coverage over the past five years and have reduced only slightly their contributions for family coverage. The average contribution for premiums made by manufacturers in 2008 was \$3,670 for single coverage and \$9,258 for family coverage. Thus, an average company that provides coverage for the families of 1,000 employees would pay premiums in excess of \$9 million annually.

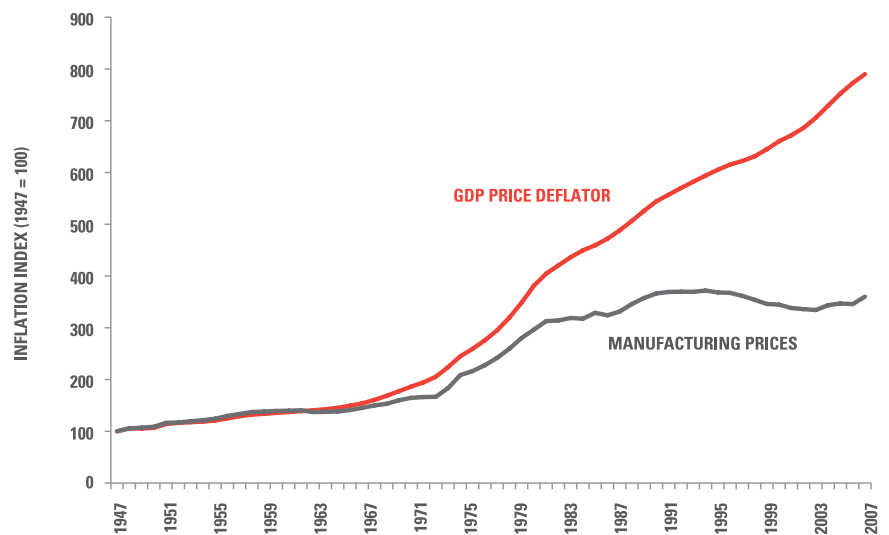
Manufacturing Improved Living Standards

Manufacturing has substantially increased American consumers' standard of living. Strong productivity gains, rapid advances in innovation, and increases in international competition has led to deflation in prices of manufactured goods as opposed to the inflation pushed through by services industries in the economy. Between 1995 and 2008, manufacturing prices decreased by 3 percent, while the overall price level increased by 33 percent. Falling prices for high-quality manufactured goods stand in sharp contrast to the runaway inflation in such industries as healthcare services and education.

The value that manufacturing provides to American consumers is that prices for goods have declined as consumer budgets continued to grow. For example, the producer price index for passenger cars in 2008 was 3.9 percent less than cars in 1995. The most dramatic deflation, though, has occurred in the electronics industry. Prices for personal computers and workstations were 98.3 percent less in 2008 than a decade earlier on a quality adjusted basis—computer prices declined 33 percent a year. The practical impact is that manufacturing provides consumers with more goods for less of their financial resources.

Deflation in manufactured goods also explains why manufacturing's share of GDP continues to fall over time. The value of manufacturing output is the product of the price of manufactured goods times the physical quantity of goods manufactured. Although the physical units of manufactured goods have increased at about the same rate as overall GDP, dollar prices of manufactured goods have not kept pace with overall inflation so mathematically manufacturers' share of the total economy must fall.

FIGURE 12.



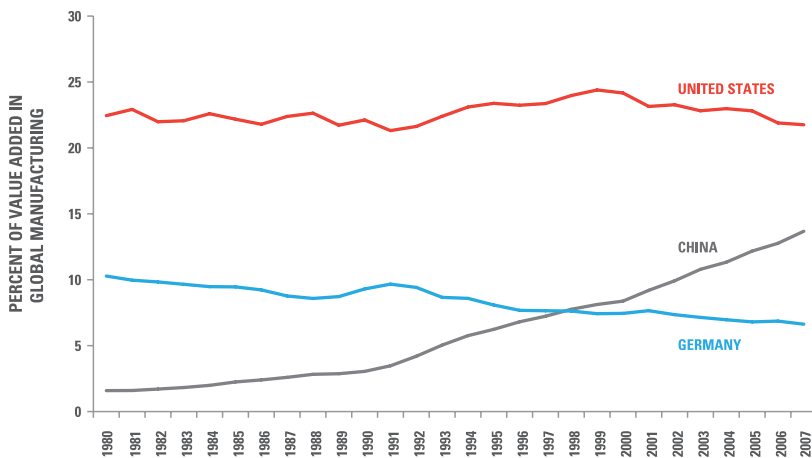
Source: U.S. Bureau of Economic Analysis

Between 1995 and 2008, manufacturing prices decreased by 3 percent, while the overall price level increased by 33 percent.



U.S. Share of Global Manufacturing Holds Steady

FIGURE 13.



Sources: United Nations, Statistics Division, and MAPI Calculations

U.S. manufacturing share of global manufacturing value added has barely budged from its 1980 level of 22 percent.

Rapid growth of the manufacturing sector in low-cost emerging market economies continues to present substantial challenges and opportunities for U.S. industry. As shown, between 1980 and 2007, China's share of global manufacturing value-added increased from less than 2 percent to nearly 14 percent.

Nonetheless, while U.S. manufacturing value added has fallen as a share of the total U.S. economy from 20 percent in 1980 to 11.5 percent in 2008, the data on this figure show that the U.S. manufacturing share of global manufacturing value added has barely budged from its 1980 level of 22 percent. Other industrialized powers such as Germany have not fared as well.

But the modest slippage since 2000 in the U.S. global manufacturing share from 24 percent to 22 percent does suggest that this dominant position may be less than stable in today's highly competitive business environment. As the world emerges from an historic financial and economic crisis, pro-growth trade policy in the form of low trade barriers, as well as competitive tax and regulatory costs, will be important to the future of the U.S. manufacturing sector in the emerging international economic order.



Manufacturing Dominates U.S. Exports

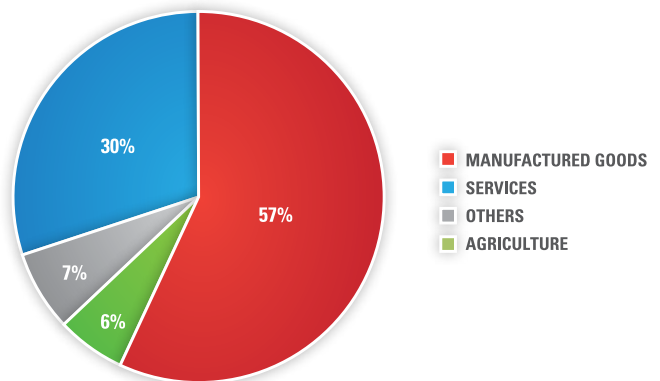
U.S. manufacturers exported \$88 billion per month in 2008, and exports increased from \$649 billion in 2000 to \$1,039 billion in 2008, or by 60 percent. In 2008, manufactured goods exports accounted for 57 percent of total exports, compared with only 6 percent in agriculture.

Breaking down the composition of manufactured goods exports further, we find that in 2008, capital goods represented 43 percent of exports, while consumer goods represented only 14 percent.

Advanced technology products, such as aerospace equipment (\$31 billion in exports in 2008), semiconductors (\$51 billion), and scientific instruments (\$21 billion), accounted for 23 percent of total goods exports.

U.S. exports of manufactured goods were down sharply during the first half of 2009 compared with 2008, as a result of the global recession. They will undoubtedly rise as global recovery begins, but the pace of export growth is uncertain. A delayed recovery in Europe, Japan, and some other Asian trading partners, and slower growth in China could hamper export growth.

FIGURE 14.



Source: U.S. Bureau of the Census, 2008

Rising capital investment and widespread adoption of new manufacturing techniques demonstrated industry's willingness to adapt to changing circumstances.

Maritime Applied Physics Corporation

Before 2000, Maritime Applied Physics Corporation (MAPC) had never considered international sales. But that year, the small Maryland-based R&D service provider and manufacturer of advanced vehicles and marine systems received an inquiry from a South Korean shipyard that learned via the Internet about MAPC's work for the U.S. Navy.

Three trips to South Korea later, MAPC returned with a new contract, albeit one it did not know how to finance. With help from SBA, the U.S. Export Assistance Center, local banks—and the patience of a client that looked past novice “cultural mistakes” made by the company—MAPC secured financing, letters of credit, and export licenses required for the \$2.3M contract. Fifteen months later, MAPC had delivered 100 tons of steel, hydraulics, and electronics to South Korea.

MAPC has realized the competitive advantage in technology and new products that U.S. firms offer in global markets, and is optimizing that growth potential. Today, exporting averages 15% of company revenue and is growing, and the company is exploring joint ventures with foreign companies for U.S. manufacturing that could bring foreign capital and new jobs to Maryland.

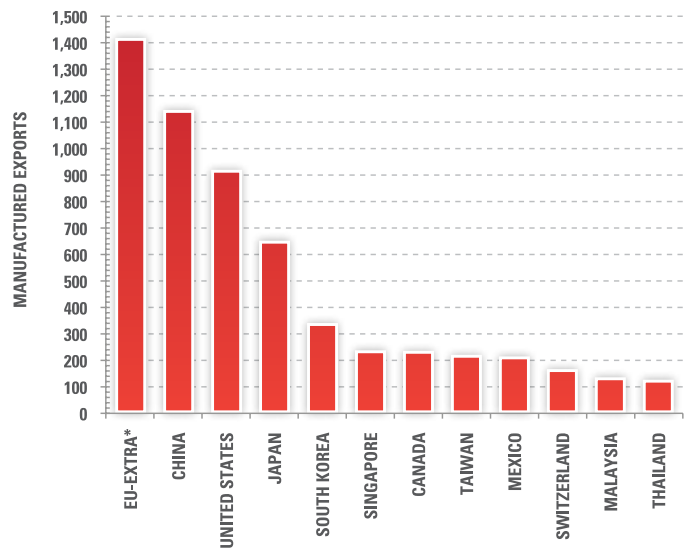
MAPC's experience contributed to the creation of ExporTech, a partnership of the Manufacturing Extension Partnership and U.S. Export Assistance Centers guiding manufacturers through the complexities of global sales.

United States Is the Number Three Manufacturing Exporter

In terms of global market share of manufactured exports, the U.S. share declined from 19 percent in 2000 to 14 percent in 2007, while the Chinese share rose from 7 percent to 17 percent.

FIGURE 15.

(2007, \$BILLIONS)



*"Extra" means exports to nonmembers.

Total EU exports, including to other members, was \$4,249 billion.

Source: WTO, International Trade Statistics

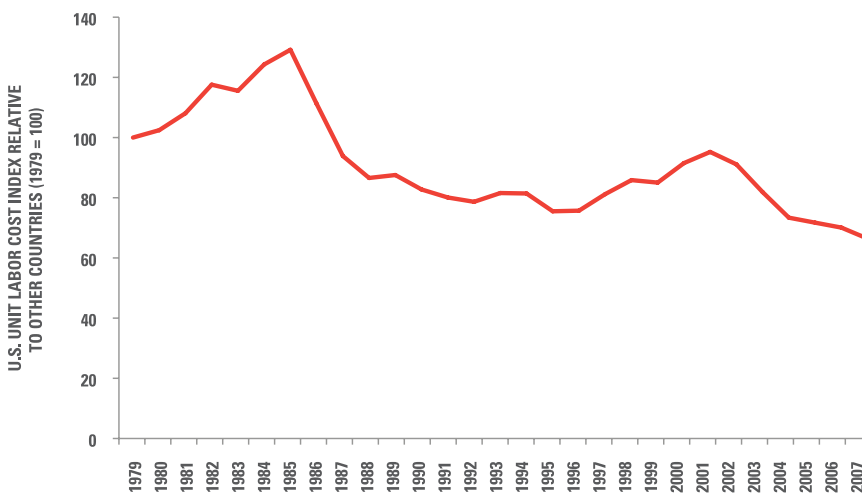


The United States is the third largest exporter of manufactured goods, after the European Union (EU) and China, and well ahead of fourth place Japan. The most dramatic shift in recent years has been the rapid rise of China to pass the United States. In 2000, U.S. manufacturing exports were more than three times larger than those of China, while in 2008 Chinese exports were 28 percent higher than those of the United States.

In terms of global market share of manufactured exports, the U.S. share declined from 19 percent in 2000 to 14 percent in 2007, while the Chinese share rose from 7 percent to 17 percent. These percentages in this figure are based on extra-EU exports, that is, exports to nonmembers. If we include all EU exports, including among members, the U.S. share of global exports declined from 14 percent in 2000 to 10 percent in 2007, while the Chinese share rose from 5 percent to 12 percent. Thus, even though goods exports from the United States have grown steadily in recent years, we have lost market share to even more rapidly growing exporters in China, Southeast Asia, and India.

U.S. Manufacturing Unit Labor Costs Relative to 14 Other Countries

FIGURE 16.



Since 1986, unit labor costs of U.S. manufacturers have declined by 40 percent relative to the average unit labor cost of 14 countries that are major competitors in global markets.

Source: U.S. Bureau of Labor Statistics

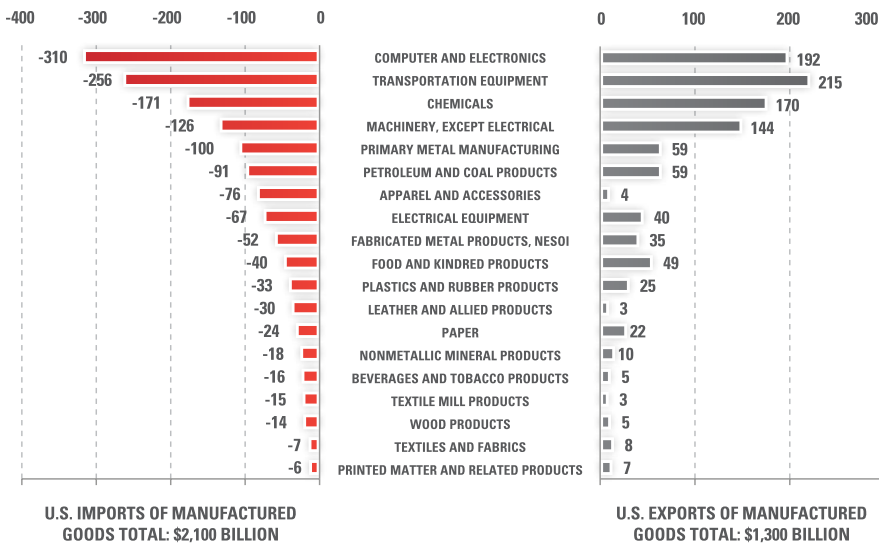
Productivity (measured by output per hour worked) in the United States has risen faster than in most of its major industrial competitors. This has enhanced the competitiveness of U.S. manufacturers by helping to reduce unit labor costs, despite the fact that compensation in the U.S. manufacturing sector exceeds that in other sectors of the economy. Since 1986, unit labor costs of U.S. manufacturers have declined by 40 percent relative to the average unit labor cost of 14 countries that are major competitors in global markets.¹

While the decline in U.S. manufacturing unit labor costs is a positive development, the competitiveness of U.S. companies relative to foreign companies is affected by other factors such as taxes, raw material costs, tort litigation, health care costs, and stricter environmental regulations. The combined impact of these factors offsets the reduction in unit labor costs (see Section 3 of this report).

¹The 14 countries included in the comparison are: Canada, Japan, Republic of Korea, Taiwan, Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, and the United Kingdom.

The Bulk of Trade in Manufactured Goods Spans Just a Few Core Industries

FIGURE 17.



Source: U.S. International Trade Commission, 2008

The trade deficit is driven by elevated imports of manufactured goods as well as by a persistent and growing imbalance with China.

The trade deficit is driven by manufactured goods and oil imports as well as a persistent and growing imbalance vis-à-vis China.

Measured by value, the ranks of major export and import categories roughly coincide. That is, the United States exports large quantities of the same types of goods that it imports (the exceptions being apparel and leather, whose imports dwarf exports). Likewise, product lines whose exports are relatively small also match product lines whose imports are insignificant.

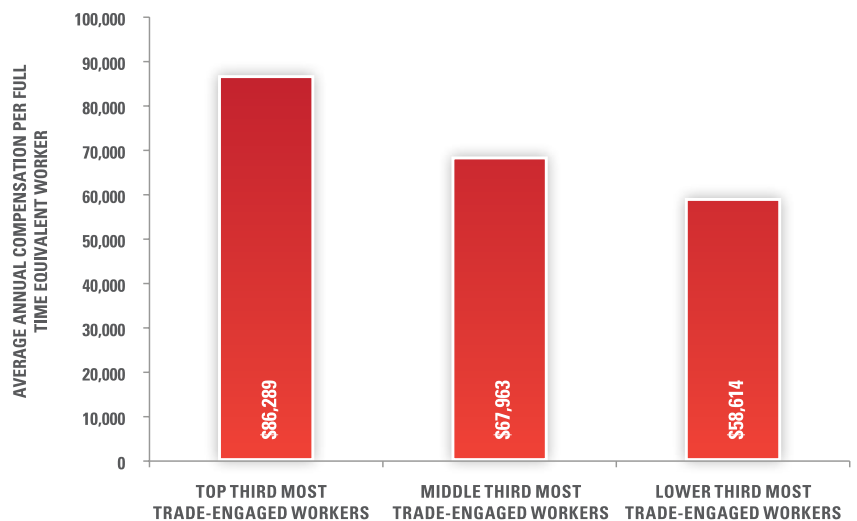
Four sectors account for two thirds of trade on the import side and one third on the export side. Computers and electronics top the list but transportation equipment (including aerospace equipment) is a close second. Chemicals and non-electrical machinery round out the roster which includes all highly processed products with relatively elevated value added.



Trade Engagement Pays with Higher Wages

Despite the commonly held view that global trade engagement leads to lower domestic wages, employees in the most trade-competitive industries earn an annual compensation package that averages about \$86,000. This is 47 percent more than average compensation in the least trade-competitive sectors of manufacturing.

FIGURE 18.



Source: U.S. Bureau of Economic Analysis, Estimated from the 2007 Annual Input-Output Tables

Higher employee compensation and trade intensity go hand-in-hand. Employees in the most trade-intensive industries—where combined exports and imports amount to at least 70 percent of their domestic industrial output—earn an annual compensation package that averages about \$86,000. This is 47 percent more than average compensation in the least trade-engaged sectors of manufacturing. Industries in this most trade-engaged category account for over half of U.S. manufacturing trade. The middle group of trade-engaged industries pays about \$68,000 a year in wages and benefits. Industries in this category account for a little more than one-third of U.S. manufacturing trade.

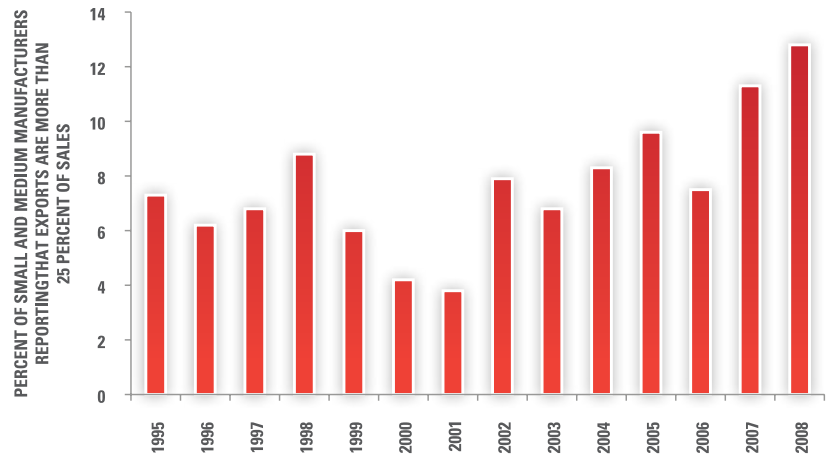
The industries with the least trade engagement pay nearly \$59,000 a year and account for only 14 percent of U.S. manufacturing trade. The premium pay of trade-engaged industries also extends to other manufacturing and service companies in the supply chain. Employers at these companies—where jobs are directly supported by exporting—also enjoy higher pay than their peers at domestic-only companies.

Importance of Exports Resumes for Small Manufacturers

Scale economies as well as the complexity and cost of selling goods and services overseas naturally give larger business establishments a competitive advantage in the exporting arena. In spite of the challenges, smaller manufacturing firms are gaining traction in global markets. The share of small and medium manufacturers reporting that exports account for more than one-quarter of their sales more than tripled from 3.8 percent during 2001 to 12.8 percent during 2008.

The Internet, as well as a variety of government programs, have lowered the barriers to export markets for smaller manufacturers. And technology has allowed for smaller scale production of commoditized products.

FIGURE 19.



Source: NAM Operating Survey on Small and Medium Manufacturers

Marlin Steel Wire Products



Marlin Steel Wire Products is a small manufacturer that has achieved global reach. Marlin produces wire baskets, shelves, wire forms and hooks that are used in the manufacturing processes of major companies like Caterpillar and Toyota.

Marlin does all of its manufacturing in Baltimore, MD, but has an export market that boasts 23 countries worldwide. President and Owner Drew Greenblatt brought Marlin to the forefront of process innovation and quality control with the recent purchase of a robot that makes wire forms at 492 feet per minute. An additional robot transports products to quality-control booths, where a vision system photographs and measures each part to validate conformity to the customer's needs.

Marlin couples the unique robotic quality-control system with the hands-on expertise of in-house engineers, creating a specialized process that enables Marlin to check every part it manufactures. This value-add process ensures precision, consistency and, inevitably, customer satisfaction.

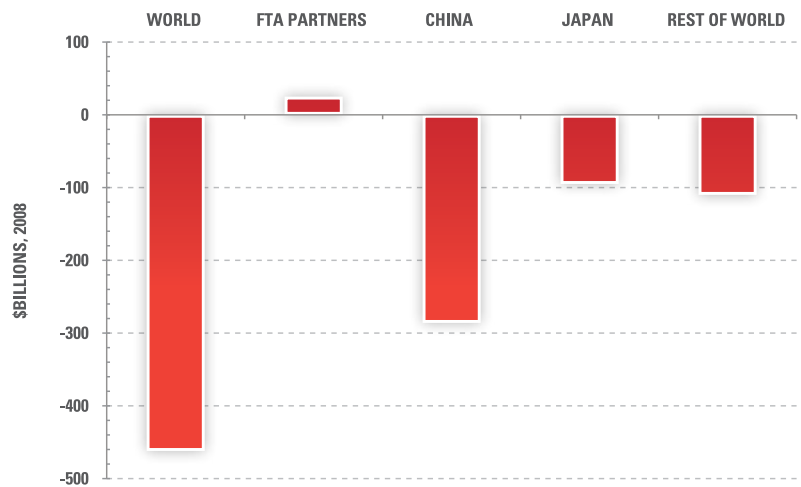
Two years ago, Marlin expanded its export market through the Export Import Bank, the official export credit agency of the United States that provides working capital guarantees of exported U.S. goods and services to international markets. This service gives Marlin the financial assurance it needs to confidently compete in foreign export markets. Today, exports make up 10-15% of Marlin's business.

Trade Agreements Do Not Drive the U.S. Trade Deficit

The U.S. manufacturing trade deficit is not with those countries where the United States has a free trade agreement (FTA). In 2008, the United States had a surplus of \$21 billion with FTA partners, including NAFTA. The deficit is almost entirely with Asia. In 2008, China accounted for 62 percent (\$282 billion) of the total deficit and Japan for 19 percent (\$85 billion). South Korea, Taiwan, and Malaysia accounted for an additional 13 percent.

FTAs help level the international playing field for manufacturers: U.S. tariffs on imported manufactured goods average less than 2 percent, while U.S. exports face an average of about 10 percent globally. U.S. exports gain when those higher tariff walls are reduced to zero through an FTA. The trade deficit is in part driven by artificially low exchange rates in some countries.

FIGURE 20.



Sources: U.S. Bureau of the Census and NAM press release, May 27, 2009

Lincoln Electric

In 2007, Lincoln Electric, the world's largest manufacturer in the arc welding and cutting industry, received the President's "E Star" Award for enhancing export growth in U.S. manufacturing. Headquartered in Cleveland, Ohio, Lincoln Electric continued its long-standing success as an export leader in 2008 when it received the Ohio Governor's Excellence in Exporting Award and was recognized as the state's Large Business Exporter of the Year. The company's export sales were more than \$350 million in 2008. While Lincoln's total corporate sales grew at a compound annual rate of 19% from 2003 to 2008, its export sales grew 23% (CAGR) the last five years.

Today, Lincoln Electric provides products and services through a global distribution and sales network covering more than 160 countries. Nearly half of its export business involves FTA countries. Because of FTAs, Lincoln Electric has become a more effective competitor in the global marketplace, which includes European competitors that also offer high-tech solutions. Favorable business conditions fostered by FTAs have enabled Lincoln Electric to support and create a significant number of jobs in U.S. export-based technologies.



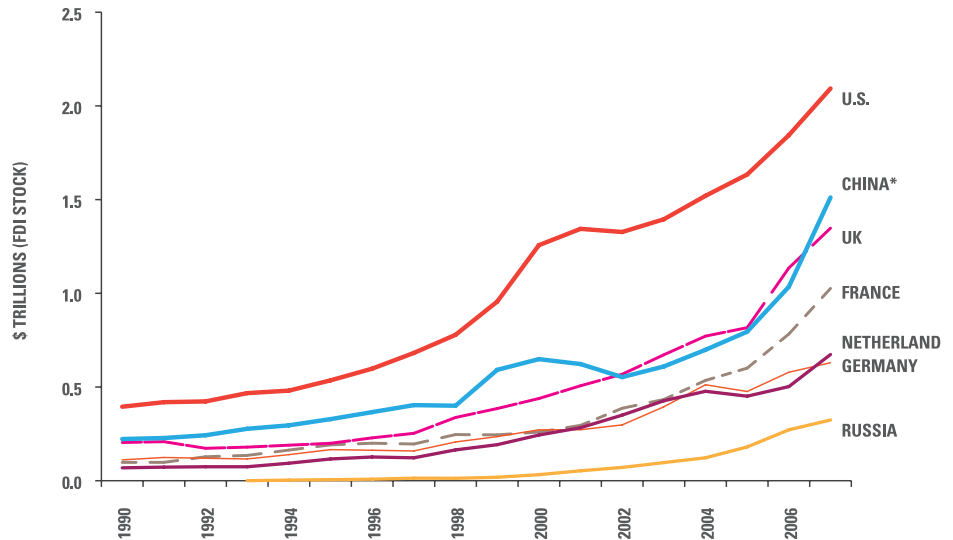
U.S. Attracts More Investment than Other Countries

The United States maintained its position as the world's largest recipient country of foreign direct investment (FDI) in 2007 as investors continued to be attracted by its large and open market, the quality of its infrastructure, high income levels and access to cutting-edge technology and research.

U.S. manufacturing affiliates of foreign firms, including international powerhouse companies like Honda, Siemens, and Saint Gobain, now employ about 2 million manufacturing workers and sell about \$1.1 trillion in goods each year, based on 2006 data. Following the United States, the United Kingdom, France, the Netherlands, and Germany are large recipients of FDI as well. China, including Hong Kong, and the Russian Federation are the largest recipients among developing and transition economies.

Although the weaker global economic growth and the dampening effects of the financial market turmoil may have a noticeable impact on FDI in the short run, global investment prospects remain positive in general due to the underlying long-term trend of the globalization of business. To continue to be an attractive destination for FDI, the United States must be able to compete with other countries in factors critical to foreign investors, such as an educated workforce, high-quality business environment, and a transparent regulatory process. However, as discussed in Section 3, a range of structural external costs, including energy and taxes, are raising the cost of producing in the United States and making this country a less attractive location for investment.

FIGURE 21.



* Includes Hong Kong

Source: UNCTAD World Investment Report, 2008

Honda

Honda has been investing in the United States for 50 years. Since establishing its first overseas operations in America in 1959, Honda has made more than \$12.1 billion total capital investment in U.S. operations. The company's first U.S. manufacturing plant began operations in Ohio in 1979, and during the past four years, Honda has broken ground on six new facilities while expanding four existing facilities—an investment totaling \$1.23 billion. The newest opening in the U.S. occurred in fall 2008 in Greensburg, Indiana, becoming the company's 11th major U.S. plant. Now, nearly 76 percent of Honda and Acura vehicles sold in the U.S. are manufactured in North America.

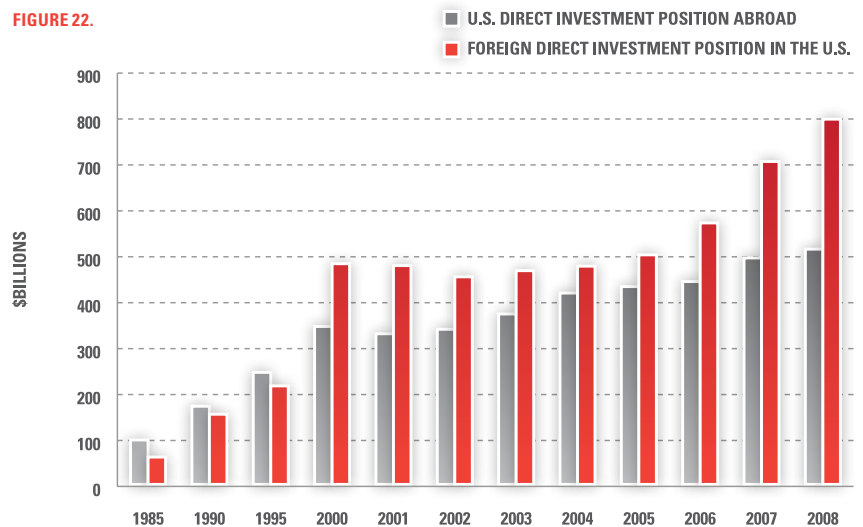
In addition to its localization of manufacturing plants in the United States, Honda allocates 5 percent of global revenues to U.S. research and development. With a particular focus on creating original technology, Honda's strong support of U.S. innovation has led U.S. R&D operations to be completely capable of researching, designing, and developing all-new vehicles.

In a study of the economic contribution made to America by Honda, its affiliated companies, its suppliers, and its associated retail operations, the Center for Automotive Research (CAR) in Ann Arbor, Michigan, evaluated direct employment and compensation data for calendar year 2007. CAR estimated that Honda's U.S. presence generated over 367,000 jobs and \$17 billion in annual compensation.

Foreign Investment in U.S. Manufacturing Grows

Foreign affiliates now manage fully half a trillion dollars worth of investments, with a rising trend over the past four years.

FIGURE 22.



Source: U.S. Bureau of Economic Analysis, Operations of Multinational Companies



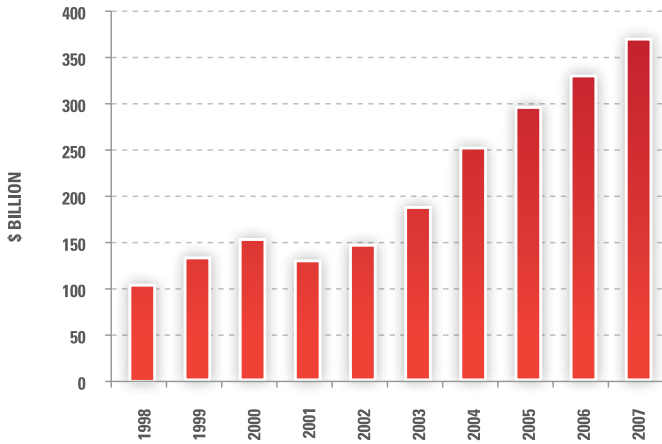
“Outsourcing” has a rather negative ring in popular parlance. But it has its counterpart in “insourcing,” a positive term that can describe foreign direct investment. As mentioned earlier, foreign capital creates wealth, employment, and exports. Thanks to insourcing, about 1 in 12 American manufacturing workers is now employed by a foreign-owned firm.

A study by the Organization for International Investment finds that about 5.3 million Americans are directly employed by foreign-owned firms with wages averaging \$68,317 a year, which is 32 percent higher than compensation at all U.S. companies. And foreign affiliates heavily invest in the American manufacturing sector--30 percent of jobs at U.S. subsidiaries are in manufacturing industries.

In the 1990s, U.S. manufacturing companies invested more abroad than their counterparts did in the United States. But the trend has reversed, beginning early in this decade. Foreign affiliates now manage fully half a trillion dollars worth of investments, with a rising trend over the past four years.

U.S. Exports in Goods Associated with Non-Bank Foreign Affiliates

FIGURE 23.



Source: U.S. Bureau of Economic Analysis, Operations of U.S. and Foreign Multinational Companies

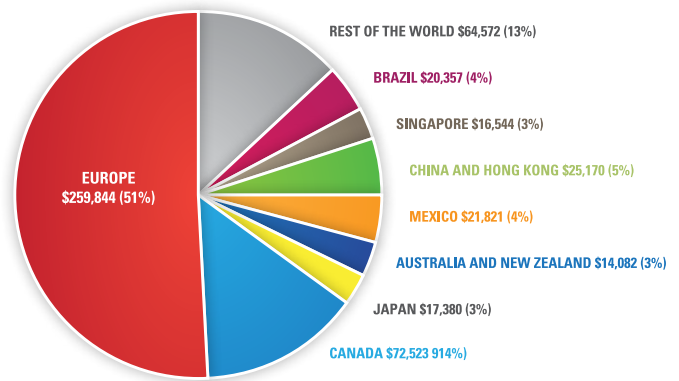
Foreign firms operating their U.S. subsidiaries are important players in the domestic market. They bring in capital, industrial know-how, and employ millions of Americans. They also export.

Exports of these domestic affiliates of foreign firms, measured by their net receipts from sales abroad, have grown steadily over the past decade. The ten years can be divided into two parts. The period from 1998 until 2002 included a recession as well as the continuous rise of the dollar against America's major trading partners. It also coincided with exports by foreign affiliates oscillating around the \$100-\$150 billion mark. The period from 2003 until 2007 was characterized by a steady depreciation of the dollar vis-à-vis other currencies and by a surge of exports. Sales abroad more than doubled and reached almost \$370 billion by 2007.

U.S. Manufacturers Invest Primarily in High-Wage Countries

FIGURE 24.

U.S. MANUFACTURING FOREIGN DIRECT INVESTMENT POSITION (MILLIONS OF DOLLARS, PERCENT OF FDI)



Source: U.S. Bureau of Economic Analysis, Investment Position on an Historical Cost Basis, 2008

A very large share of U.S. foreign direct investment (FDI) in manufacturing is in developed, high wage countries. Seventy-two percent of the investment dollars in manufacturing affiliates abroad were in Europe, Canada, Japan, Australia, and New Zealand, and this percentage share is unchanged from ten years ago. Cheap labor is thus clearly not the driving force behind FDI. It is the access to large and growing markets, rather than inexpensive labor, which attracts long-term investment. Businesses can easily import products into the United States from low-wage countries if they want; they do not have to make foreign investments in order to take advantage of low labor costs. The motivation for taking ownership positions in a foreign firm is to establish a presence and commitment to participate in the regional market.

China is the fastest growing marketplace for industrial products in the world. For this reason, it is not surprising that U.S. firms are eager to participate in the Chinese market. U.S. FDI in manufacturing within China has grown at a 12 percent annual rate in the last decade versus 7 percent growth in total manufacturing FDI. Nevertheless, U.S. FDI in China remains a small proportion of the overall investment mix. U.S. FDI in Chinese manufacturing was only 3.5 percent of total U.S. manufacturing FDI in 2007, although up from only 2 percent of FDI ten years ago.



SECTION 2.

Innovation Drives U.S. Manufacturing Strength



The many wonderful products that make our lives easier and more productive did not just appear by chance. Someone invented them and someone found a way to produce them at a price most of us could afford. Overwhelmingly, these inventions are a product of U.S. innovation and the engine for innovation is U.S. manufacturing.

This section discusses the ways in which U.S. manufacturing creates the bulk of technology and innovation in the economy and how this translates into higher productivity and competitiveness in global markets. The United States accounts for 40 percent of all research and development (R&D) spending in the industrial world. The United States remains a world leader in R&D as a proportion of GDP, and manufacturers are the clear leaders in developing new products to drive productivity. These innovations are extremely important to other industries. For example, the Internet began as a project to link communication among defense contractors; electronic computers and telecommunications equipment have revolutionized business practices across every business sector; and the large majority of capital equipment produced by manufacturers is purchased and used in non-manufacturing industries.

Many factors will determine whether the United States remains the foremost innovation leader, as it is today. There are various ways to measure that leadership. Patents are one way; U.S. inventors continue to be awarded about half of all U.S. utility patent grants. These patents are the result of extensive private sector and federally supported spending on R&D. The United States spends almost twice as much on R&D—over \$200 billion—than the next highest spender, the European Union. Manufacturers represent 45 percent of all private sector companies performing R&D in the United States.

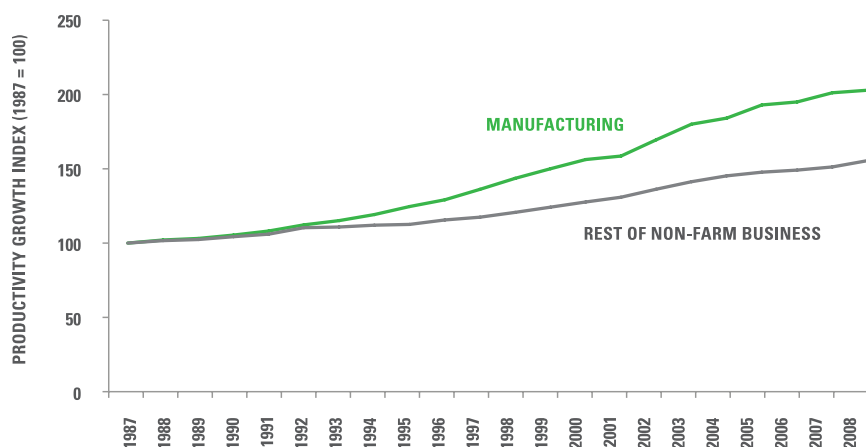
Technology leadership is also measured in the ways in which technology is deployed. Manufacturers' investments have paid off in a cleaner environment; today's industry generates fewer metric tons of carbon dioxide than in 1980. Spurred by innovative products and processes, the real value of industrial output per unit of energy consumed increased by 43 percent between 1987 and 2007. In other words, American manufacturers are producing more with significantly less energy. Improved technology and processes also result in a safer and more sustainable workplace.



Finally, an innovation leader needs highly trained workers and researchers; data show that the manufacturing workplace is relying more and more on high skill levels on both the shop floor and in research labs.

Manufacturing Drives Productivity Growth

FIGURE 25.



Between 1987 and 2008, manufacturing productivity grew by 103 percent, almost double the 56 percent increase in productivity in the rest of the business sector.

Source: U.S. Bureau of Labor Statistics

Federal Reserve Chairman Ben Bernanke has said that productivity growth is “perhaps the single most important determinant of living standards.”¹ Manufacturing productivity consistently outpaces productivity growth in other sectors. Between 1987 and 2008, manufacturing productivity grew by 103 percent, almost double the 56 percent increase in productivity in the rest of the business sector. Higher productivity means that we can produce more with our stock of resources (labor and capital) and thus is the basis for higher wages and living standards.

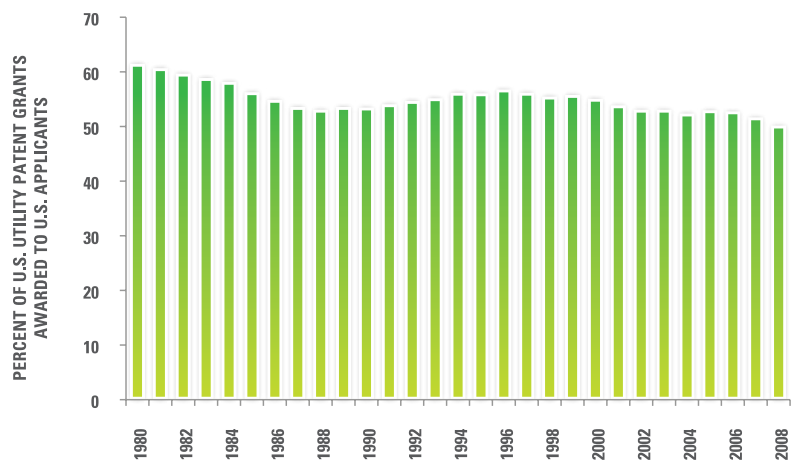
While manufacturing accounted for an average of 15 percent of GDP during this time, it was responsible for approximately 22 percent of overall productivity growth between 1987 and 2008. Rising productivity is one major reason the prices of manufactured goods have risen at a slower rate than the overall price level.

Sustainable long-term economic growth is the result of increases in and quality of the labor force, investment in capital equipment, and technological improvements. The trend in the labor force is largely determined by demographic forces. Investments in capital equipment and technology, however, are sensitive to economic policy. The manufacturing sector is the most intensive user of capital equipment and technology in the economy, which explains why manufacturing is the nation’s productivity powerhouse. A strong and vibrant manufacturing sector is critical for long-term economic growth and our country’s future.

¹Federal Reserve Board Chairman Ben Bernanke’s commencement address at MIT, 2006.

The United States Leads the Way in Innovation

FIGURE 26.



Source: U.S. Patent and Trademark Office

U.S. manufacturing has long been a leader in bringing innovative new products to market. Policies that continue to stimulate innovation will be critical to U.S. manufacturing success in a post-crisis global economy. Increasing investment focused on new technologies will improve U.S. manufacturing's competitiveness in a rapidly changing and increasingly competitive global business environment.

U.S. inventors continue to be awarded about half of all U.S. utility patent grants. However, this is down from about 60 percent in 1980.

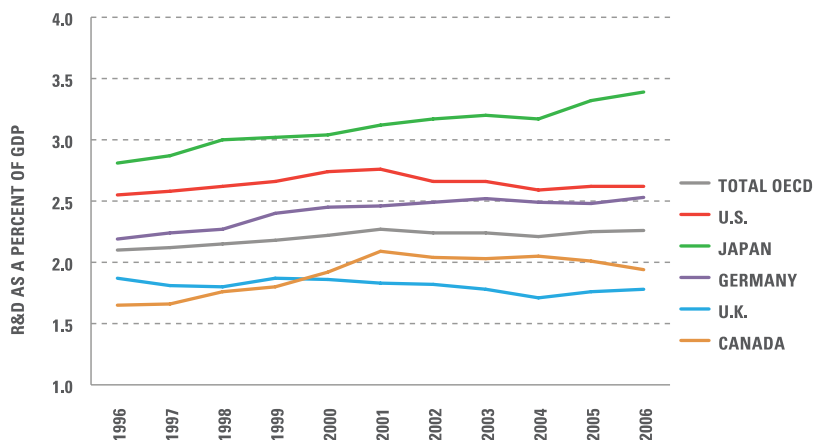
Key emerging market nations, while still relatively small players in global innovation, have experienced significant upswings in innovative performance. For example, U.S. utility patent grants to Chinese inventors rose from 119 in 2000 to 1,225 in 2008 and from 3,314 to 7,549 over the same period to residents of South Korea. Clearly, the United States must continue to influence and develop the latent talents of the science and engineering workforce (see Section 3) and provide them with the resources to spur scientific discovery and innovation.

U.S. Industrial R&D Outpaces Global Rivals

While concerns about the U.S. R&D workforce have been growing in recent years, U.S. investment in R&D remains competitive. The latest data for 2006 show that the United States invested approximately 2.6 percent of GDP in R&D, which is modestly above the 30 nations of the Organization for Economic Cooperation and Development (OECD) average of 2.3 percent. Among key industrialized country competitors, only Japan, which invests 3.4 percent of its GDP in R&D, exceeds the United States' investment level. Federal government support for basic research, a key element in innovation, has declined from a height of nearly 2.5 percent of GDP in the heyday of the Apollo program to only about 0.3 percent in recent years.

But R&D investment is not the only component of a successful innovation strategy. Research has revealed the importance of cutting-edge scientific output from academic institutions, capital investment, and the growth of the science and engineering workforce. All of these elements, not just R&D, must be considered in the formulation of a national productivity strategy. Indicators of innovation output, developed by Manufacturers Alliance/MAPI economists, show a dramatic improvement in both product and process innovation performance since the 1970s in spite of declining federal funding for basic research. Total academic research expenditures accelerated from the 1970s to the 1980s and international competition motivated stronger private R&D commitment in the manufacturing sector, as well as a greater focus on business process improvement. Company and non-federal sources now account for about 90 percent of all funds expended for R&D in the manufacturing sector.

FIGURE 27.



Source: OECD, *Main Science and Technology Indicators*

Dowding Industries

Michigan-based Dowding Industries looks at economic downturns as opportunities to innovate and expand its core business. Even at a time when the company's core business—progressive die stampings, metal fabrications, and welded assemblies—dropped by half and the number of employees decreased from 250 to 147 in six months, Dowding continues to reinvent itself.

Seeing a growth opportunity when many companies were struggling, Dowding invested \$10 million in a facility dedicated to renewable energy, and three years ago specifically focused its attention to manufacturing parts for the wind turbine industry. To find the workers with the experience and expertise to operate the massive new machinery and meet the high levels of precision required, the company turned to the auto industry for its skilled workforce as well as its processes and standards.

In doing so, the company expects to modernize the machining of metal components, decrease the machine time of wind turbine hubs by 70%, and cut production costs by 50%.

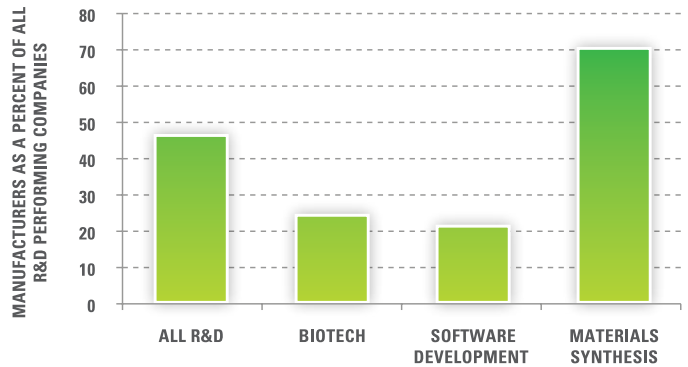
By applying the entrepreneurial vision, knowledge, and engineering techniques of the best of American manufacturing, Dowding and its partners are addressing an array of production challenges that could have otherwise stymied U.S. wind turbine output required to meet the country's long-term energy goals.

Manufacturers Are Technology Leaders

The highly competitive nature of the global economy and the growing complexity of manufacturing supply chains increase the incentive for technology development and implementation in the manufacturing sector. An array of environmental technologies, material sciences, computer-related and just-in-time production infrastructures, as well as the growing world of nanotechnology, are among those advances that have expanded product and process innovation and have kept U.S. manufacturing globally competitive.

The figure shows that manufacturing firms account for more than 45 percent of all R&D-performing companies in the United States. More recent data for 2007 show that the manufacturing sector continues to account for about half of all public and private R&D performance in the United States. Between 20 and 25 percent of all firms in leading-edge biotech and software development are manufacturers. And the industrial sector still dominates materials synthesis development, accounting for 70 percent of all U.S. firms engaged in this area of technological development. Further anecdotal evidence has shown that other sectors of the economy have successfully adopted lean production techniques created in the industrial sector with positive implications for service performance and profitability.

FIGURE 28.



Source: National Science Foundation, Survey of Industrial R&D, 2004



ACE Clearwater

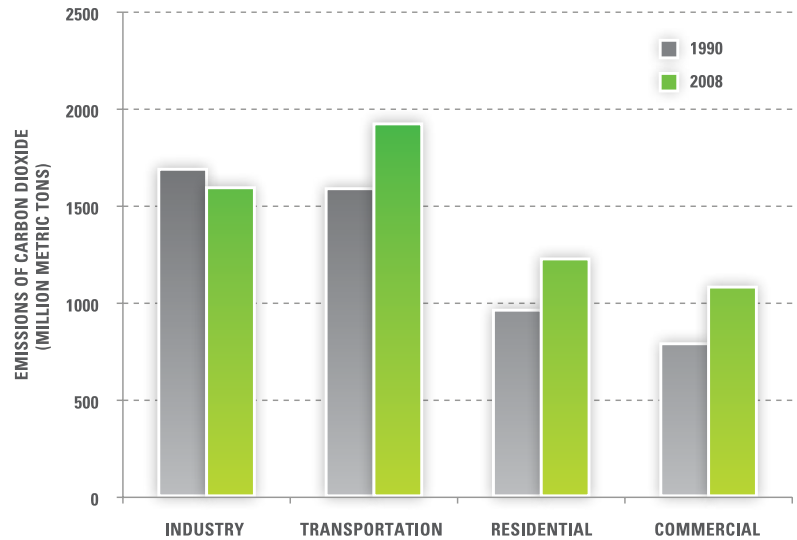
ACE Clearwater, based in Torrance, CA, is at the cutting edge of mass customization. The family-owned manufacturer of complex formed and welded sheet metal components for the aerospace and power generation industries is beginning to use High Performance Computing (HPC) technology to increase product quality and efficiency. With the development of a computer simulation model of formed sheet metal and aerospace parts using the HPC technology, ACE Clearwater will be able to create a virtual, optimized design for forming tools and dies.

The virtual design reduces physical prototyping by 50%. Because ACE Clearwater specializes in producing short-run, low-volume products, the accuracy attained prior to the physical production is critical to achieving customization. The automation achieved through HPC technology will reduce both lead time and manual labor by taking the guesswork out of the production phase. The company will be able to make new products right the first time. By increasing the quality and precision of their products, ACE Clearwater will meet high standards of customer satisfaction and maintain profitability. This kind of technological innovation drives a steady growth of productivity.

Technology Leads to a Cleaner (Greener) Environment

When it comes to cleaning up the environment, U.S. industry leads the way. During the 2008 election campaign, President Barack Obama advocated reducing U.S. greenhouse gas emissions down to 1990 levels by 2020, a metric that the U.S. industrial sector had already met by 2008 for carbon dioxide (CO₂)—the most important greenhouse gas directly resulting from human activity. Even as U.S. industrial production has risen, the amount of CO₂ emissions generated by U.S. factories actually declined by 6 percent. By contrast, CO₂ emissions from the transportation, residential, and commercial sectors have all increased since 1990. Collectively, CO₂ emissions from those sectors rose by 27 percent through 2008. Manufacturing is a leader in this area due to its relentless attention to leaner and more efficient production, through continuous improvements in productivity, and through changes in production processes to achieve more sustainable business models.

FIGURE 29.



Source: U.S. Energy Information Administration

The Road To Sustainable Automobile Manufacturing

Toyota Motor Engineering & Manufacturing North America, Inc. (TEMA)

With nearly 17,000 team members at ten vehicle, engine and parts plants throughout the U.S., Toyota recognizes the importance of sustainable manufacturing and minimizing their impact on the ecosystems upon which they rely.

This is why the 5 Rs – refine, reduce, reuse, recycle, recover energy – have been the key to waste reduction efforts in their manufacturing plants. They have reduced non-saleable waste (waste Toyota pays to have disposed of or pays to have recycled) to just under 20 kilograms per vehicle, a 46 percent reduction since Fiscal Year 2006.



Through the innovative efforts of their team members, all of Toyota's plants in North America have achieved and maintain near-zero waste to landfill – defined as a 95 percent or greater reduction in waste to landfill from 1999 levels. In fact, eight of their ten U.S. plants are operating at 100 percent landfill-free status.

In addition to their sustainability gains in manufacturing, many of Toyota's on-site cafeterias have replaced plastic tableware, plates and bowls with compostable materials.

Toyota is committed to the sustainable manufacturing goal. And, according to Toyota leadership, the best resource to achieve their vision is team members who are innovating the way to a sustainable future.

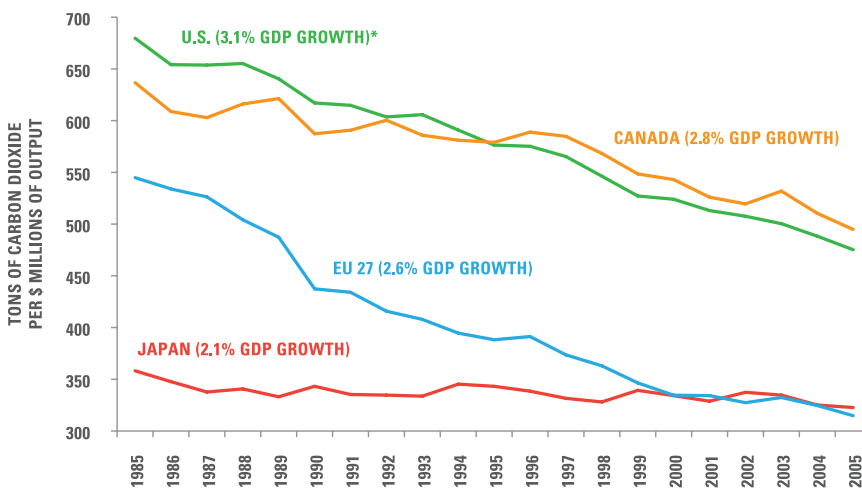
By collecting compostable waste throughout the facility, Toyota Motor Manufacturing, Kentucky (TMMK) generates fresh topsoil to grow vegetables and pumpkins at an on-site garden. The vegetables are donated to a local food pantry for needy families and pumpkins are handed out to team members' children at Toyota's on-site daycare facility at Halloween.

Energy Efficiency Among Developed Countries

Staying competitive in the global marketplace requires continual progress in both using energy more efficiently and protecting the environment. The use of energy and carbon emissions obviously go hand-in-hand. U.S. manufacturers have responded by introducing a variety of innovative technologies, new business processes and enlightened management techniques.

The energy efficiency of U.S. industry has improved remarkably. By 2005, the United States used 23 percent less energy to produce a dollar of goods than in 1990, the reference year of the Kyoto climate treaty. During the most recent 20 years for which data are currently available, the United States reduced its energy-related CO₂ emissions at a rate that compares favorably with the rates achieved by other industrialized countries, while also achieving a higher average annual rate of economic growth. Faster economic growth means more rapid improvement in family incomes and the standard of living.

FIGURE 30.



* Growth measured at average annual rate of change

Source: World Resources Institute



Orion Energy

As manufacturers nationwide seek alternatives to increasing energy costs, Orion Energy Systems' vertically integrated manufacturing process is quickly delivering guaranteed energy savings to its customers and quickly reducing its customers' carbon footprint.

Orion Energy Systems, of Manitowoc, Wis., is a leading power technology enterprise that designs, manufactures and implements energy management systems, consisting primarily of high-performance, energy-efficient lighting systems, controls and direct renewable products for commercial and industrial customers.

Its high-intensity fluorescent lighting platform is guaranteed to reduce light-related energy costs 50 percent or more when replacing high-intensity discharge lighting.

Orion produces its own materials, providing the flexibility and speed needed for companies that can't afford to wait to install cost-saving technology. As a result of its vertically integrated manufacturing, Orion can often have product in the hands of its customers within two weeks.

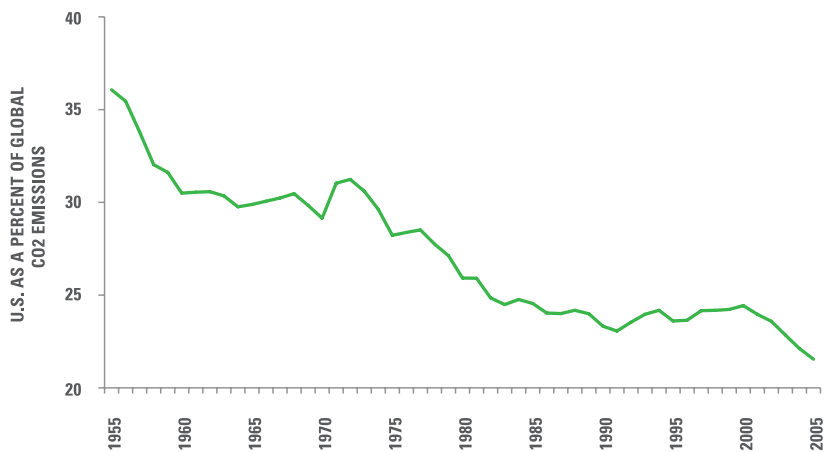
Orion buys raw material and manufactures it as needed. For example, the company buys aluminum coils for its light reflector and powder coats its own parts.

"By vertically integrating our process, we don't have to rely on transportation or production of parts from a vendor," said Steve Wronkowski, Orion's vice president of operations. "As a result, we're significantly reducing wait time for our customers, who are wasting money every minute they use an HID."

Technical Innovation Addresses Global Climate Change

Continued technical innovation by U.S. manufacturers will be one of the keys for a successful global response to the problem of climate change.

FIGURE 31.



Source: World Resources Institute



Over the last half century, the United States has accounted for a declining share of global CO₂ emissions. In particular, the economies of developing countries, such as China and India, have been increasing their share of global CO₂ emissions. During the 15 years between 1990 and 2005, China and India increased their combined share of global CO₂ emissions by 11 percentage points, while the United States decreased its share by 2 percentage points. Adequately addressing the problem of global climate change will require participation by all nations. No single country can reach a solution by itself.

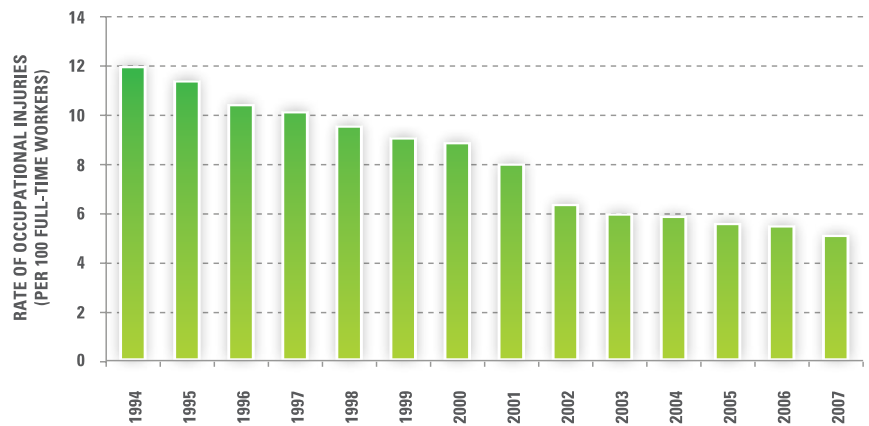
U.S. companies are among the global leaders in developing the technical innovations that can enable countries to become more energy efficient while also achieving the economic growth so essential to improving the living standards of their citizens. Continued technical innovation by U.S. manufacturers will be one of the keys for a successful global response to the problem of climate change.

Technology Transforms Safety in the Workplace

Manufacturers see workplace safety as an important business tool. Rather than being a cost of doing business, safety programs reduce costs and contribute to the bottom line. As a consequence, many companies have incorporated safety into their lean manufacturing culture. Safe practices reduce absenteeism, increase productivity, and improve efficiency, quality, and morale.

Between 1994 and 2007, the rate of occupational injuries in manufacturing facilities has been cut in half, from just over 12 injuries per 100 workers to barely more than 5. This is a substantially faster rate of improvement than that of the overall private sector.

FIGURE 32.



Source: U.S. Bureau of Labor Statistics

Notes: Industry classification changed from SIC to NAICS in 2002. Changes in some OSHA definitions occurred in 2003

Smithfield Foods

Smithfield Foods, headquartered in Smithfield, Virginia, is the world's largest producer and processor of pork, and a leader in turkey processing. Smithfield employs more than 57,000 people globally in the production of more than 50 brands of pork and turkey products and more than 200 gourmet foods.

As an integral component of all business operations, Smithfield is committed to Corporate Social Responsibility (CSR) that upholds five tenets, including environmental protection, employee safety, animal welfare, community involvement, and food safety.

In order to continuously improve its employee safety practices, Smithfield focused high-tech manufacturing processes on employee safety by deploying an Employee Injury Prevention Management System (EIPMS). EIPMS incorporates a comprehensive strategy that requires each of its facilities to map the risks associated with processes and the specific preventative actions taken against them. At its core, the EIPMS requires frequent and transparent communication documented

between all involved staff. Implementation of the system has driven a reduction of work-related injuries by 31% between 2004 and 2008.

Smithfield Foods' CSR achievements have received various recognitions including being named the first recipient of McDonald's new Supplier Sustainability Award. In 2009, Smithfield Foods was included for the first time among CRO (Corporate Responsibility Officer) magazine's list of 100 Best Corporate Citizens.





Schweitzer Engineering Laboratories (SEL)

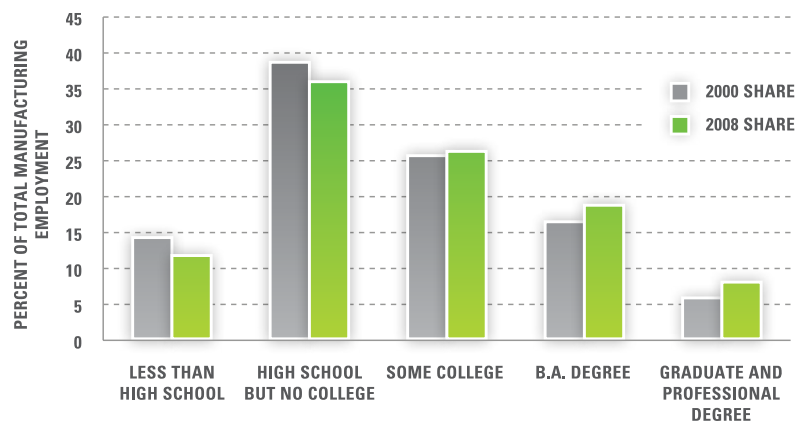
Schweitzer Engineering Laboratories (SEL) understands the value of an educated, highly skilled workforce. The power protection systems manufacturer out of Pullman, Washington, has been investing in education within their community and building on a stalwart commitment to the “lifelong learning” of its employees for thirteen years. SEL provides an eighty-dollar education benefit attached to monthly paychecks that encourages employees of over six months to engage in any education-based learning. After one year, all employees are eligible for the Path To Your Future program, which gives qualified employees financial support to pursue an accredited degree that helps develop their careers at SEL. On campus, SEL developed SEL University, a division that provides courses for customers and employees focused on a comprehensive understanding of the power industries, as well as basic electronic and technical skills.

SEL also values high-quality education within its community as a driver of economic prosperity. By paying the salary of an acclaimed science and electronics teacher in a local classroom, SEL is stimulating the young minds in the community to get excited about high-tech manufacturing and ultimately feeding a pipeline of qualified, well-educated individuals to enter valuable careers at SEL.

SEL has proven that investing in education creates well-rounded, skilled employees and inevitably leads to productivity and profitability.

The Manufacturing Workforce Has Become More Skilled

FIGURE 33.



Source: U.S. Bureau of Labor Statistics, Current Population Survey

The manufacturing workforce is becoming more highly skilled as manufacturing has evolved into a more technology intensive sector. The general education level of the manufacturing workforce has continued to improve in recent years. Most notably, between 2000 and 2008, the share of the total manufacturing workforce with B.A. degrees increased from 16 percent to nearly 19 percent, and the share with graduate and professional degrees increased from 5.7 percent to nearly 8 percent. The share of manufacturing employees with less than a high school diploma fell from 14 percent to just under 12 percent during the same period. These data are one factor underlying the higher wages paid to manufacturing workers.

But, we need to ensure that we continue to train workers with the right skills to keep pace with the increasingly technical demands of the productivity-oriented manufacturing sector. By creating more pathways for post-secondary education, aligning education with industry-recognized skills credentials, and developing standardized measures for teacher and school performance, the United States can create the kind of manufacturing workforce that will facilitate ever-needed product and process innovations in an evolving global business climate.



The background of the page is a solid blue color with a white technical drawing overlaid. The drawing consists of various geometric shapes, including circles, arcs, and lines, which are typical of a mechanical or architectural blueprint. The drawing is positioned in the upper right and lower right areas of the page, with some lines extending towards the center.

SECTION 3.

Challenges Faced by U.S. Manufacturing

Rising external costs faced by U.S. manufacturers represent a fundamental challenge in a global, interconnected and competitive marketplace. These costs for corporate taxes, health care and pensions, regulation, natural gas and tort litigation add almost 18 percent to manufacturers' costs relative to our major trading partners. Additionally, we are not equipping American students and workers with the right skills and in the right disciplines needed to compete in the modern global manufacturing economy. Finally, we are seeing our global market share eroded, even in high technology areas where we have been dominant.

Recent analyses by The Manufacturing Institute, the National Association of Manufacturers (NAM), and the Manufacturers Alliance/MAPI (MAPI) show that external or "structural" costs resulted in a 17.6 percent disadvantage for U.S. manufacturers when compared with similar costs for our nine major trading partners. While this is a marked improvement from the 31.7 percent cost disadvantage in 2006, there are still several major cost drivers that continue to impact U.S. manufacturing:

Taxes:

Corporate tax rates continue to be a critical concern for manufacturing cost competitiveness. The U.S. corporate tax rate has been essentially unchanged for the past two decades, while all of our major competitors have been lowering theirs.

Health Care:

Rising health care costs remain one of the most challenging pressures for manufacturers. Some firms have been able to remain competitive by trimming benefits or increasing employees' share of premium payments, but many others, particularly small- and medium-sized firms, have been forced to scale back on benefits.

Compliance:

Compliance can have implications for U.S. manufacturing competitiveness. For example, U.S. industry is faced with the highest pollution abatement costs compared to its major trading partners—even higher than the so-called "green economies" of Western Europe.

Litigation:

The total cost of U.S. tort claims exceeds \$250 billion a year, or over 2 percent of GDP. Even though this has leveled off in recent years, the fact remains that, scaled to GDP, the U.S. tort system is more than twice as expensive as its major competitors such as Japan, France, Canada, and the United Kingdom.

Despite the rise in the value of U.S. exports in recent years, the U.S. share of global exports of manufactured goods declined from 19 percent in 2000 to 14 percent in 2007. The most dramatic change was the rise of China to overtake the United States as a leading exporter of manufactured goods. The United States is losing import market share to both Asian and European competitors in the fast growing Asian market. Even more disturbing is the sustained large U.S. trade deficit in manufactured goods, which rose from \$319 billion in 2000 to \$500 billion in 2007, although it did fall back to \$458 billion in the recession year 2008. A sustained deficit at these levels means several million less manufacturing jobs than would be achieved with a balanced trade picture.

As a result of these escalating costs, slowing investment in research, loss of skills leadership, and loss of global market:

The United States manufacturing sector has become less competitive.

2.7 million manufacturing jobs were lost between 2000 and 2003.

Manufacturers have cut back investments in R&D and worker training.

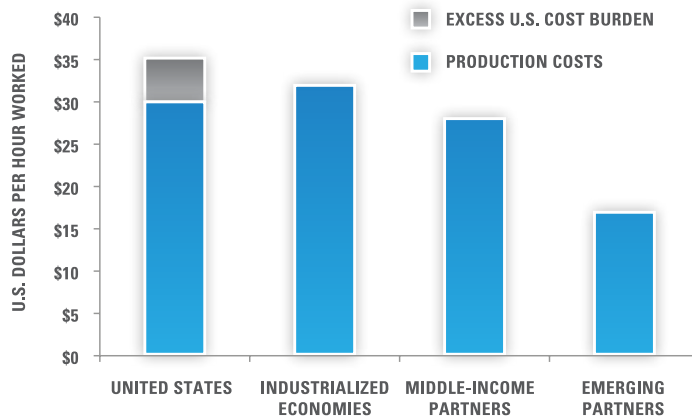
In terms of the domestic environment supporting innovation, recent years have seen a dramatic falloff in U.S. investment in education and the physics, engineering, and computer sciences, so vital to our ability to remain a global technology and manufacturing process leader.

CHALLENGE: EXTERNAL COSTS

External Costs Hamper U.S. Manufacturing Competitiveness

Compared to our nine largest trading partners, U.S. manufacturers face higher costs in the areas of taxation, employee benefits, tort claims, and government regulation.

FIGURE 34.



Source: The Tide Is Turning, The Manufacturing Institute, National Association of Manufacturers, and the Manufacturers Alliance/MAPI, 2008



While it is well known that Mexico and China have lower labor costs, it is generally not recognized that external structural costs put U.S. manufacturers at a competitive disadvantage, even with our industrialized trading partners. Compared to our nine largest trading partners, U.S. manufacturers face higher costs in the areas of taxation, employee benefits, tort claims, and government regulation.

A recent study by The Manufacturing Institute, NAM, and MAPI shows that these costs add nearly 18 percent to the cost of doing business in the United States. Without this cost disadvantage, the United States would be a lower-cost platform to manufacture than Germany, the United Kingdom, France or Canada, and roughly on par with South Korea. Together, these external costs have offset a large part of the growth in manufacturing productivity which has occurred since 1990.

U.S. Does Not Keep Pace with Falling Corporate Tax Rates

FIGURE 35.

COUNTRY	STATUTORY TAX RATE	EFFECTIVE MARGINAL TAX RATE (SMALL BUSINESS)	EFFECTIVE MARGINAL TAX RATE (OVERALL)
UNITED STATES	40.0%	32.0%	37.8%
JAPAN	42.0%	31.6%	31.6%
GERMANY	39.6%	25.9%	35.7%
CANADA	36.6%	25.9%	30.9%
FRANCE	34.3%	14.4%	31.9%
MEXICO	34.0%	22.5%	13.1%
UNITED KINGDOM	30.0%	21.4%	28.8%
SOUTH KOREA	29.7%	18.4%	31.5%
CHINA	25.0%	15.7%	19.1%

The United States now has the second highest corporate tax rate among our major trading partners, trailing only slightly behind Japan.

Source: *A Closer Look at the U.S. Corporate Tax Burden*, Manufacturers Alliance/MAPI, 2008.

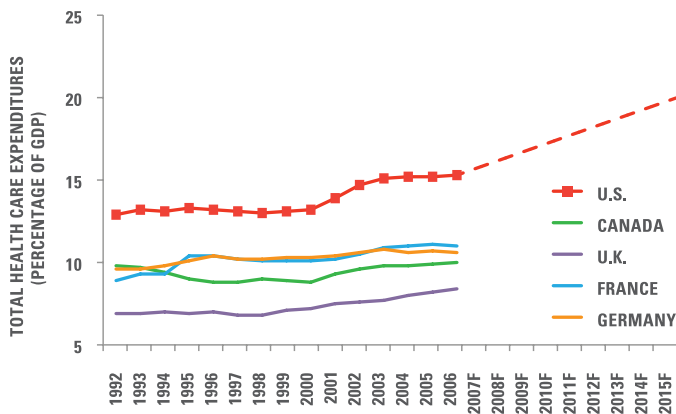
The United States now has the second highest corporate tax rate among our major trading partners, trailing only slightly behind Japan. The rate cuts in 1986 brought the United States below the Organization for Economic Cooperation and Development (OECD) average at that time. Since then, other countries have cut tax rates aggressively while the United States has stood still, and the U.S. rate now exceeds the OECD average by more than 10 percentage points. While depreciation allowances, deductions and exclusions make the U.S. burden less severe than statutory rates would suggest, an analysis by MAPI shows that effective marginal tax rates in our major trading partners exhibit roughly the same pattern.

There is wide agreement among economists and policy makers that corporate income taxes distort business decision making, discourage capital investment, reduce hiring, and cause firms to invest billions of dollars in tax planning, compliance, and dispute resolution that could otherwise be put to more productive uses.

Economic simulations by MAPI indicate that cutting the U.S. statutory corporate tax rate by five percentage points would increase manufacturing output by \$156 billion over ten years and create 500,000 manufacturing jobs.

High Health Care Costs Hamstring Competitiveness

FIGURE 36.



The United States has by far the most expensive health care in the world relative to the size of its economy.

Source: OECD System of Health Accounts; U.S. forecast based on C. Borger et al., "Health Spending Projections Through 2015: Changes on the Horizon," Health Affairs volume 25, February 2006

Health care costs, one of the most difficult challenges facing manufacturers, continue their steady upward path, growing from 7.2 percent of manufacturing compensation in 2001 to nearly 10 percent today. While all countries are grappling with rising health care costs, the effect on manufacturing competitiveness is most pronounced in the United States, where there is a disproportionate reliance on employer financing. A 2006 NAM survey of small- and medium-sized manufacturers showed that 69 percent of these firms were raising the employee's share of premium payments, and the proportion of small firms offering health care coverage at all dropped from 68 percent in 2001 to 59 percent in 2007.

Larger firms have reacted to cost pressures by experimenting with consumer-directed health care plans, which are designed to increase the individual's financial contribution for routine medical care in return for full coverage of major unexpected health problems. As of 2007, 20 percent of large firms offered such plans, twice the percentage in 2005.

As shown in the figure, the United States has by far the most expensive health care in the world relative to the size of its economy, and the aging of the population coupled with continued health-care inflation could mean that 1 in every 5 dollars in the economy will be spent on health care by 2015 if no action is taken to make health care services more accessible, efficient, and cost-effective.

Manufacturers want to continue their proud commitment to providing health benefits through affordable health coverage by creating electronic health records to improve cost-effectiveness and quality of health care, preventing and managing chronic care of workers through education, and encouraging consumer-directed health care options.

Energy Is Critical to the Industrial Sector

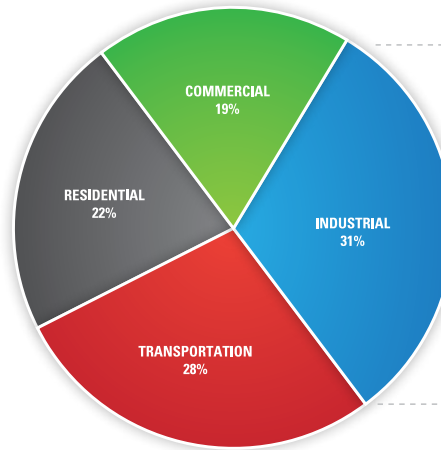
The manufacturing sector has a huge stake in ensuring that the United States has a dependable supply of affordable energy. The industrial sector, which includes mining, agriculture, fishing, and manufacturing, accounts for 31 percent of total U.S. energy consumption, the largest share of any sector. Manufacturing alone accounts for 65 percent or two thirds of the industrial sector's energy consumption.

Most of the manufacturing sector's energy comes from fossil fuels, and raw inputs such as oil or natural gas for chemicals or coke for steelmaking have no substitutes from other fuel sources. The rise in fossil fuel prices since 2002 has raised production costs as well as concerns about the availability of energy at a time when world energy consumption is growing, and it is becoming increasingly difficult to find and develop new energy sources.

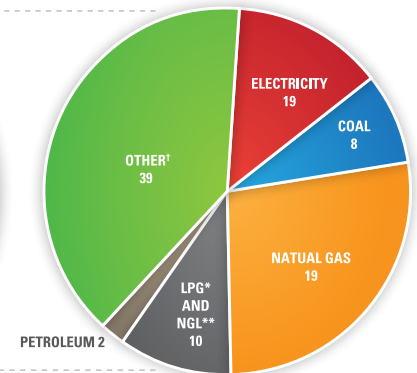
Manufacturers are looking to diversify their energy supplies, including expanding their use of renewable energy. As shown previously in figure 30, manufacturers are also working hard to improve the efficiency with which they use energy.

FIGURE 37.

INDUSTRY ACCOUNTS FOR CLOSE TO 1/3 OF TOTAL END-USE ENERGY CONSUMPTION



MOST OF THE MANUFACTURING SECTORS' ENERGY COMES FROM FOSSIL FUELS WITH NATURAL GAS REPRESENTING THE SINGLE MOST IMPORTANT ENERGY SOURCE



*Liquefied Petroleum Gases

**Natural Gas Liquids

†Other energy includes a mix of energy types (petroleum, natural gas, coal, nuclear power and renewables). This energy is used to produce heat and power or used as feedstock/raw material inputs. For the petroleum refining industry, the feedstocks and raw material inputs for the production of non-energy products and feedstock consumption at adjoining petrochemical plants are included as 'Other' regardless of type of energy.

Sources: U.S. Bureau of the Census and NAM press release, May 27, 2009

Cascade Engineering

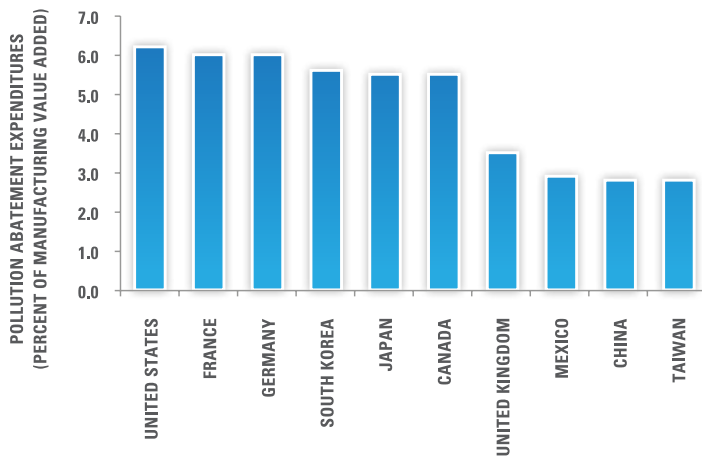
Michigan-based Cascade Engineering has evolved in 36 years from a process-focused manufacturer to a multi-business manufacturer today with more than 900 employees. Each evolution of the company was the result of market demand, market opportunity, and plenty of innovation, but primarily the company's goal has been sustainability: finding ways to embrace the Triple Bottom Line and keep Cascade relevant, needed, and at the forefront of what industry, consumers, and the economy is—or will be—pursuing.

Today the company has forged into renewable energy products, focusing on distributed energy for residential and commercial customers. By applying its high tech injection molding expertise, Cascade has developed the rotor for the Scottish patented Swift 1kW Wind Turbine that is quiet and vibration-free, making it flexible for mounting on buildings as well as towers.

For Cascade, the move to green opportunities was both philosophical and economic. Committed to finding ways for the world to consume less without reducing quality of life, Cascade gambled a several million-dollar investment over the past few years on the hope and vision of where the U.S should turn. Today, Cascade forecasts its renewable energy product line will grow from 1% to potentially 25% of its revenue by 2013.

Pollution Abatement Costs Are Large and Growing

FIGURE 38.



Source: *The Tide is Turning*, The Manufacturing Institute, National Association of Manufacturers, and the Manufacturers Alliance/MAPI, 2008.

Manufacturers spend an estimated \$162 billion annually to comply with economic, environmental, and workplace safety regulations as well as tax compliance—equivalent to a 12 percent value added tax.

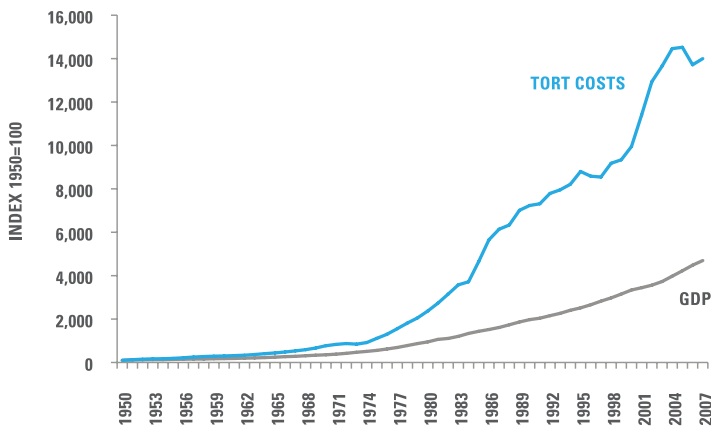
More than any other sector, manufacturers bear the highest share of the cost of regulatory compliance. Many regulations have positive benefits for the economy and society. For example, workplace safety and air quality have improved steadily for the past three decades. Yet few understand the cost of these regulations and their impact on companies that face intense global competition with overseas firms that often do not have similar costs.

The cost of complying with federal regulations is steep. Manufacturers spend an estimated \$162 billion annually to comply with economic, environmental, and workplace safety regulations as well as tax compliance—equivalent to a 12 percent value added tax. As an example, U.S. industry is faced with the highest pollution abatement costs compared to its major trading partners—even higher than the so-called “green economies” of Western Europe. In 2007, U.S. manufacturers spent an estimated 6.2 percent of value added complying with air and water emissions standards (which are among the strictest in the world), compared to 6 percent in France and Germany, 5.5 percent in Canada, and 3.5 percent in the United Kingdom. Regulatory costs impact the global competitiveness of manufacturers, constrain the demand for employees in U.S. facilities, and further encourage firms to locate production abroad.



Tort Costs Continue to Rise

FIGURE 39.



Sources: U.S. Bureau of Economic Analysis and Tillinghast-Towers Perrin

Even though the explosive growth of tort claims in the past 10 years has subsided, the fact remains that, scaled to GDP, the U.S. tort system is more than twice as expensive as its major competitors such as Japan, France, Canada, and the UK.

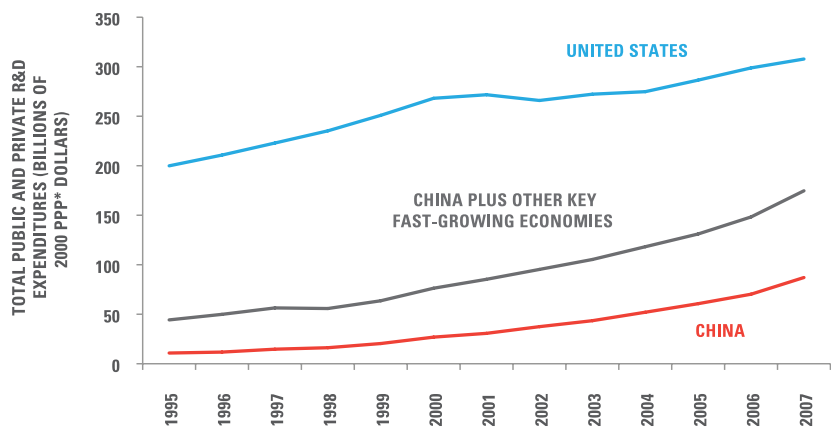
Another impediment to U.S. manufacturing competitiveness is the price of defending against tort claims. Overall, tort claims and the attendant litigation cost more than \$250 billion a year, or over 2 percent of GDP. Almost two-thirds of this amount is for commercial tort claims (such as product liability and business-related property losses) and medical malpractice claims. Even though the explosive growth of tort claims in the past 10 years has subsided, the fact remains that, scaled to GDP, the U.S. tort system is more than twice as expensive as its major competitors such as Japan, France, Canada, and the United Kingdom. Everyone pays as a result of these costs: health care costs rise, investment and new product development is deferred, and, in some extreme cases, plants are closed when insurance fees jump. The U.S. tort system is unique in the industrialized world in that each party is responsible for all of its legal costs. This fact, combined with large potential costs for punitive damages and compensatory awards, means that plaintiffs have strong financial incentives to use (or abuse) the tort system for frivolous or unfounded lawsuits. In addition, class-action lawsuits can inflate damages awarded, even if the majority of affected individuals never claim their share. In nearly all other countries, plaintiffs are required to pay for all or part of the defendant's legal costs if the judgement is in the defendant's favor.

Legislation in recent years has limited some of the more problematic areas of the U.S. tort system (such as linking attorney compensation to amounts claimed rather than amounts awarded in class action suits and preventing "jurisdiction shopping" to plaintiff-friendly courts), but the fact remains that manufacturers are diverting too many resources to both actual and potential legal action.

CHALLENGE: R&D INVESTMENT

R&D Investments: Fastest Growing Economies Gaining Rapidly on United States

FIGURE 40.



Source: OECD Main Science and Technology Indicators

Note: Emerging non-OECD includes Business Employment Dynamics

*PPP = Purchasing Power Parity

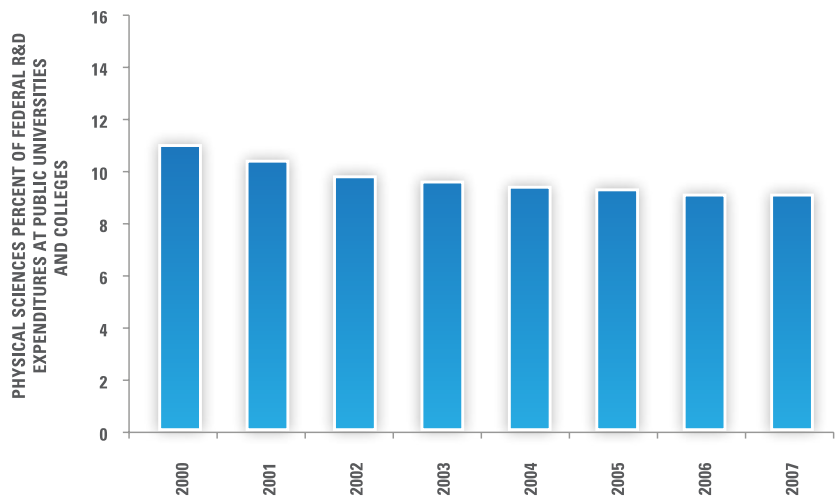
While U.S. R&D investment has increased by 54 percent since 1995, fast-growing emerging economies have nearly tripled R&D spending over that period.

For more than half a century, the United States has led the world in science and innovation. In today's competitive world, the United States can no longer take its supremacy for granted. Aggregate R&D spending by seven large and fast-growing economies (China, Ireland, Israel, Singapore, South Korea, Russia, and Taiwan) has reached nearly 60 percent of the U.S. level, and significant R&D investment by India and Brazil pushed this share closer to 70 percent. If current trends continue, R&D spending in these key emerging markets may exceed U.S. levels in a few years.

The United States remains the largest R&D investor followed by Japan and other developed OECD countries. While U.S. R&D investment has increased by 54 percent since 1995, fast-growing emerging economies have nearly tripled R&D spending over that period. China's R&D spending has increased a whopping seven-fold. Without significant additional R&D, the United States is at risk of squandering its longstanding innovation leadership position, and recent federal commitments to bolster such investments must be honored.

Federal Funding for Physical Sciences Declines

FIGURE 41.



Source: National Science Foundation, Survey of Research and Development Expenditures at Universities and Colleges

The share of federal academic R&D monies awarded for basic research in the physical sciences, which includes physics and chemistry, has been falling in recent years from 11 percent in 2000 to 9 percent in 2007. This has an important impact on materials synthesis technology that manufacturing dominates. Federal research investment monies for the life sciences that grew from about 57 percent in 2000 to about 60 percent in 2007 is a positive for the development of such areas as pharmaceuticals. And many industries such as medical equipment benefit from research in both areas. But federal policy makers must consider the capital goods industries for which U.S. manufacturing has a competitive advantage. These industries require physical science research to support the highly specialized engineering that is needed for innovations in high-tech capital goods production such as motion control technology used in industrial processes.

CHALLENGE: SKILLED WORKFORCE

The United States Is Falling Behind in Engineering

The United States lags the world in engineering human capital but sees an encouraging trend in the share of doctorates related to manufacturing.

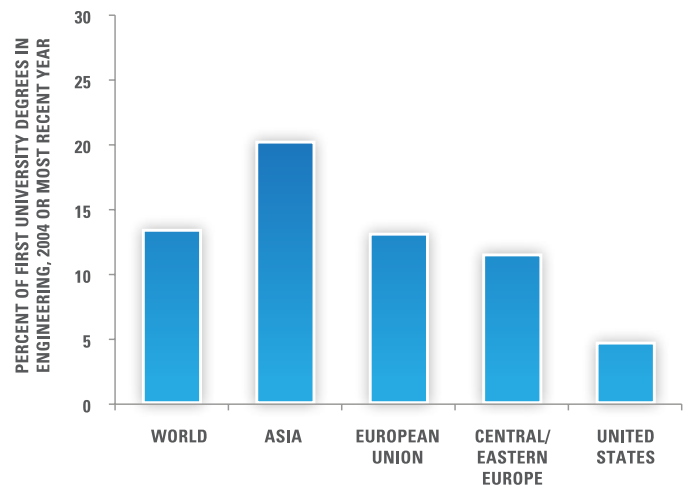
The figure shows the United States falling behind much of the world in providing engineers for its science and engineering workforce. The latest data show that engineering degrees as a share of total first university degrees are below 5 percent in the United States as compared to a world average of 13 percent and an Asian average of 20 percent. While the data must be interpreted in the light of skill differences among country engineering programs, the United States must clearly bridge this gap or risk losing a large share of its domestic innovation capacity.

Demographic trends augment concerns about the engineering workforce. As experienced engineers begin to retire from the labor force, a simple replacement from the current supply of engineers may be a problem. Many U.S. manufacturing firms, even in times of recession, report difficulties in finding the right mix of skilled engineers for their needs.

While the supply of engineers is a concern for U.S. manufacturing, the supply of researchers that are needed for manufacturing-related innovation is encouraging. The share of total U.S. doctorates awarded in key physical, environmental, life, and mathematical sciences rose from 43 percent in 2000 to 50 percent in 2007.

An effective policy regarding foreign students and adequate federal funding for frontier science will allow the domestic scientific infrastructure to grow in the United States. This will be much to the benefit of the manufacturing sector. Economic research has demonstrated the connections between frontier science, mostly conducted in academic institutions, and industrial productivity and long-term growth.

FIGURE 42.

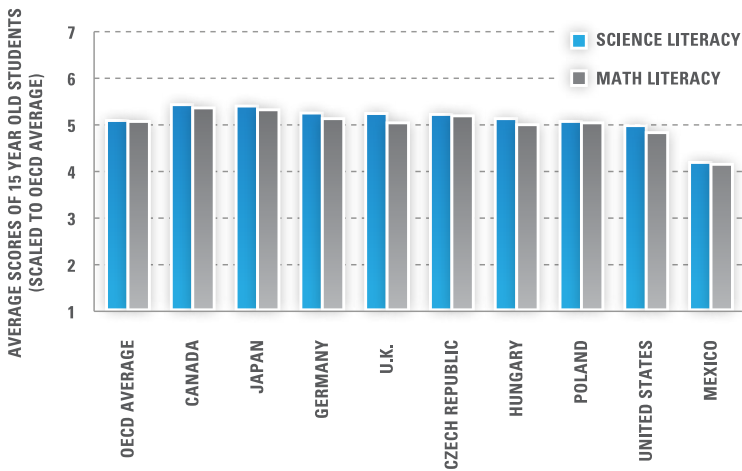


Source: National Science Foundation, *Science and Engineering Indicators*, 2008



The U.S. Workforce Suffers from a Math and Science Skills Deficit

FIGURE 43.



Source: U.S. National Center for Education Statistics, 2006

The new paradigm of lean manufacturing requires production workers with increased numeracy, team building, and problem solving abilities.

There is a disturbing gap in the math and science skills of U.S. students relative to those of key competitors. The figure shows the relative scores of U.S. students compared to students in a number of industrialized and developing countries from the Program for International Student Assessment (PISA). PISA is a system of international tests designed to measure the performance of 15-year-olds in important areas such as reading, literacy, math, and science. It is administered every three years. The data, which are scaled to an OECD average, show that the United States lags in both math and science against students in both advanced economies such as Germany, Japan, and the United Kingdom, and developing economies such as those in Hungary and Poland.

Today's advanced manufacturing requires a technical workforce with math and science skills. The new paradigm of lean manufacturing requires production workers with increased numeracy, team building, and problem solving abilities. The human capital challenge must be met as part of an effective innovation policy or the return on an otherwise competitive level of R&D investment will be weak.

Lodge Cast Iron

Lodge Cast Iron is a fourth generation, family owned and operated business that produces a broad array of cast iron cookware, including Dutch ovens, skillets, deep fryers, country kettles, and grills. Located at the base of the Appalachian Mountains in the small, rural town of South Pittsburg, Tennessee, Lodge has reached an extensive national market through its commitment to upgrading people skills and equipment, and to an "up-scale" marketing campaign.

Lodge has sustained its competitiveness as a foundry by focusing internal initiatives on the training and education of its employees. Lodge has drawn its workforce from a very small community of just over 3,000 people. As manufacturing at large is transforming, Lodge's manufacturing processes require a more technically-skilled workforce. In response to

increased demands for more educated employees, Lodge has adopted effective training strategies that marry the educational assets of their employees to job-specific skills required to run a productive and profitable company. From day one, Lodge matches each new employee with a mentor so that they learn the ins and outs of both the process and product. This hands-on approach to training creates an effective internal learning community that gives employees the skills and confidence to contribute to the high-quality output of the entire company.

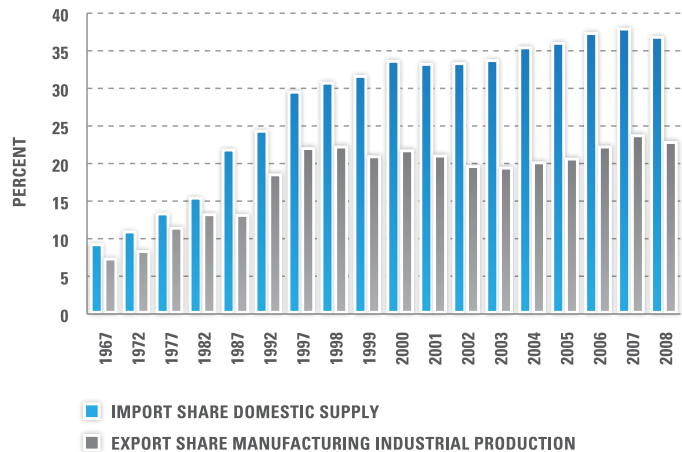
The key to Lodge's growing market is a contemporary and targeted marketing strategy. Lodge has recently been featured on the front pages of William Sonoma's catalogue, with the company's roots highlighted, and on The Food Network's series "Unwrapped."

CHALLENGE: A LEVEL PLAYING FIELD FOR TRADE

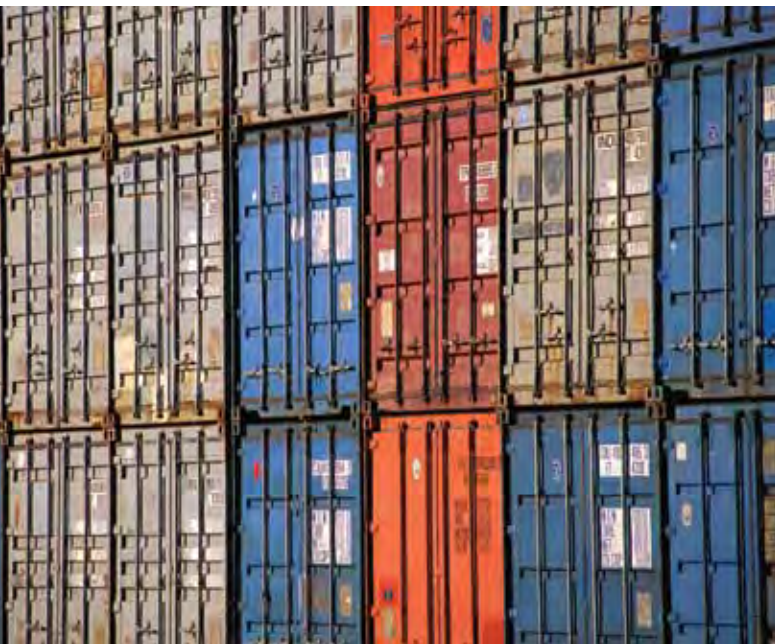
Trade Gap Widens for
Manufacturers

By 2008, almost 37 percent of all manufactured products bought in the United States were imported, compared to a third as recently as 2003 and less than a tenth in 1967.

FIGURE 44.



Source: U.S. Bureau of Economic Analysis, Input-Output Tables, and MAPI



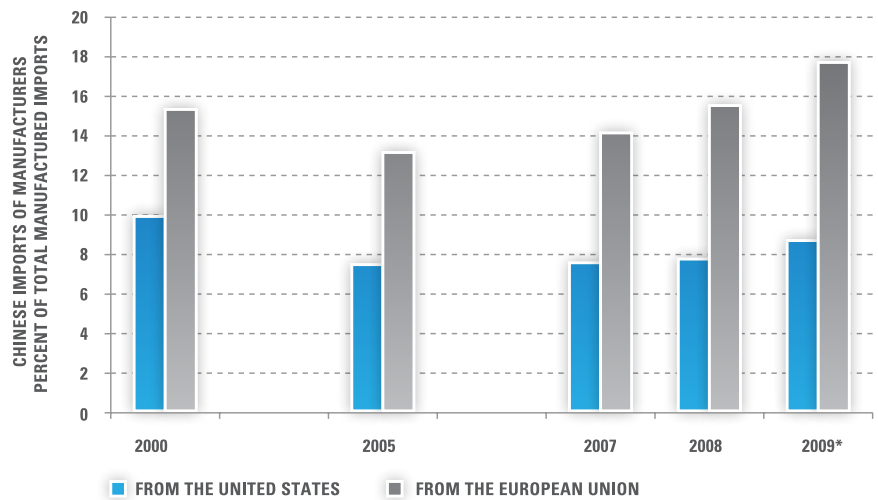
Since the early 1970s, manufacturing has become ever more engaged in international trade. While exports rose steadily and reached 22 percent of domestic manufacturing output by 1998, imports rose even faster.

Many factors influence the share of imports in domestic consumption or the percentage of domestic production that is exported. One is the absolute size of an economy and the attendant integration with foreign markets. Generally, the larger the economic size, the smaller the share of trade in GDP. The United States possesses a large internal market that is separated by great distances from key trading partners. But movements in exchange rates can also influence trade penetration in the short term.

The steady rise in the percentage of domestic production that is sold abroad during this decade can be traced to trends in exchange rates. From 2003 until 2008, the dollar depreciated continuously (Figure 46) while the share of manufacturing production exported rose from 19 percent to almost 23 percent.

The United States Is Losing Import Market Share in China

FIGURE 45.



Source: China's Customs Statistics

*January-June, 2009

U.S. exports of manufactured goods face strong competition in many markets and particularly from the Chinese. U.S. manufactured exports to high-growth Asian markets were almost twice those of China in 2000, while by 2008 Chinese exports were more than double U.S. exports. Bilaterally, U.S.-manufactured imports from China in 2008 were \$329 billion, or seven times larger than U.S. exports to China of \$48 billion.

U.S. manufactured exports have also been relatively weak in the Chinese market. In 2008, the U.S. share of total Chinese imports of manufactured goods was only 8.2 percent, far behind Japan (17.7 percent), the EU (15.6 percent), South Korea (12.4 percent), and Taiwan (12.1 percent). The relative loss of market share to the EU is particularly noteworthy, with the EU market share almost double that of the United States during the first half of 2009.

Competitive Exchange Rates Are Critical to U.S. Exporters

The accelerated rise in exports coincided with a gradual weakening of the U.S. dollar and the subsequent reversal spanning the 2008-2009 global recession.

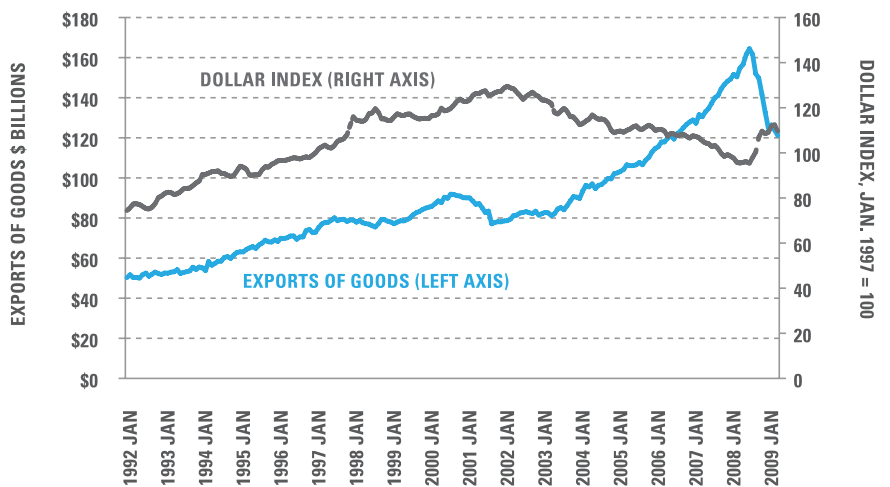
Recessions abroad can hobble performance of those U.S. firms that export heavily. Slower demand for goods and services in any economy dampens the appetite for products imported into that country. But flexible exchange rates also play a role, particularly in the short term.

Take the 2001 recession as an example. The global recovery that took off from 2003 coincided with a gradual weakening of the U.S. dollar. The cheaper currency helped to make U.S. goods more price-competitive internationally. At the same time, it made imported goods more expensive.

The gray line in the figure depicts a broad dollar index constructed by the Federal Reserve. It is a weighted average of the foreign exchange values of the U.S. dollar against the currencies of a large group of major U.S. trading partners. The blue line depicts the monthly value of exports of goods. Note how the accelerated rise in exports coincided with a gradual weakening of the currency and the subsequent reversal spanning the 2008-2009 global recession.

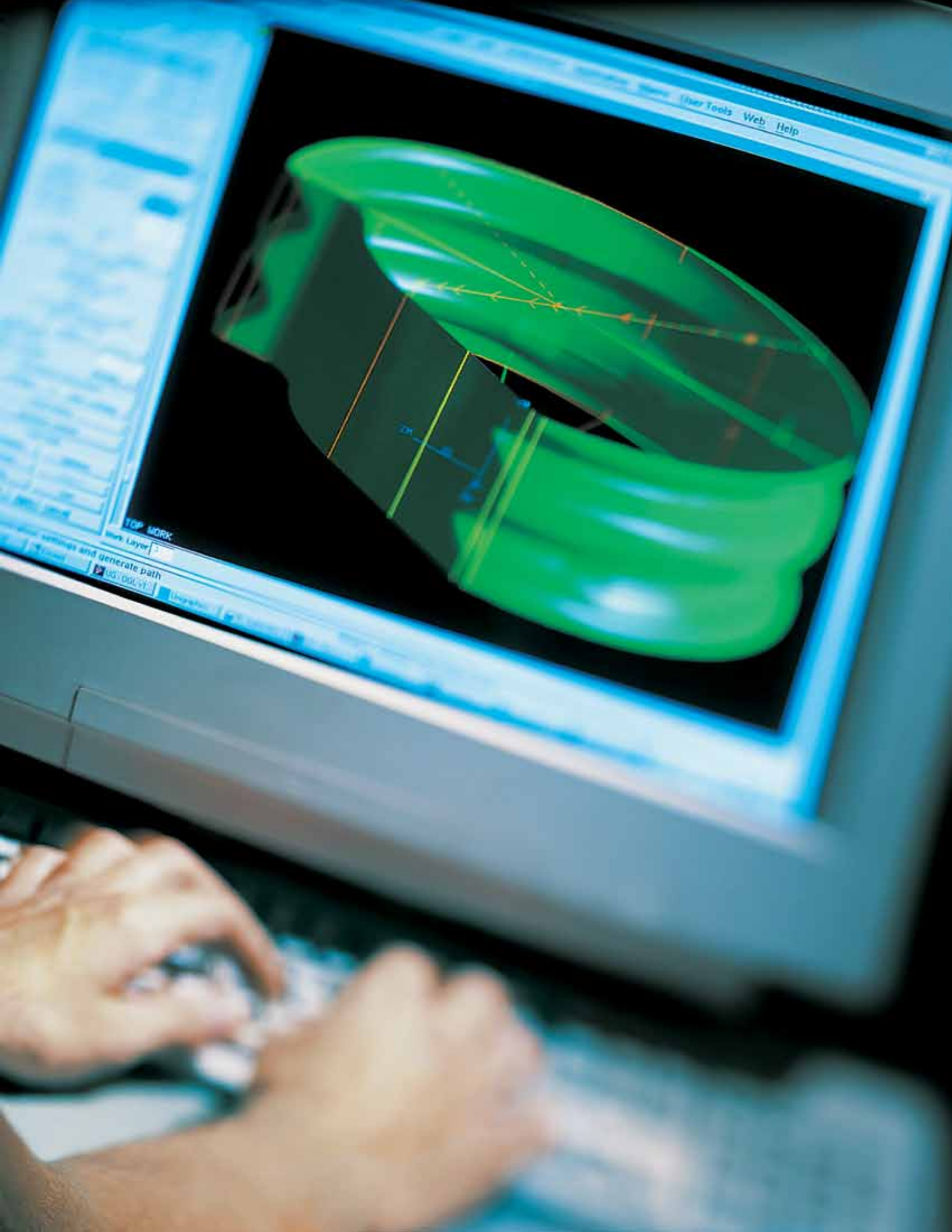
Some countries, such as China, intervene in the foreign exchange market to keep their currencies pegged to other currencies, such as the U.S. dollar. The Chinese renminbi remains undervalued against both the dollar and the euro, which has hampered European and U.S. exports to China.

FIGURE 46.



Sources: Federal Reserve Board and U.S. Bureau of Economic Analysis

The accelerated rise in exports coincided with a gradual weakening of the currency and the subsequent reversal spanning the 2008-2009 global recession.



Manufacturing Resources

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Company Index

ACE Clearwater	31
Behlen Manufacturing	11
Cascade Engineering	43
D&S Manufacturing	5
Dowding Industries	30
Honda	22
Lincoln Electric	21
Lodge Cast Iron	49
Maritime Applied Physics Corporation (MAPC)	15
Marlin Steel Wire Products	20
Orion Energy	33
Schweitzer Engineering Laboratories (SEL)	36
Smithfield Foods	35
Toyota	32
Vermeer	9

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