21ST CENTURY MANUFACTURING

A WORLD OF DIFFERENCE

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The turn of the millennium twelve years ago was not just a chronological milestone. It coincided with a sea change in what economic globalization means for U.S. manufacturers.

Globalization, in the sense of imports and exports of manufactured goods, is nothing new—international trade has long been a significant engine of economic growth in the United States and around the world, with global trade growing twice as fast as overall output since 1990. What is new is that the information and communication revolution embodied in the commercial use of the Internet and dramatic declines in the cost of computing power, combined with declining transportation costs and improved ability to manage logistics, have enabled the fragmentation of global supply chains. This means companies are becoming less vertically integrated than ever before and have many more geographic choices with regard to sourcing production.

A second factor driving the New Globalization is China’s deliberate and sustained efforts to industrialize and become a major economic power. This culminated in its accession to the World Trade Organization in December 2001. Less than a decade later, China ascended to the top of the global manufacturing ranks. This has a number of consequences for U.S. manufacturers, among the most important of which are a potential source of relatively cheap labor on the supply side and a large potential market on the demand side. While China is the poster child of the New Globalization, it is by no means the only rising star—Brazil, India, Indonesia, and others are moving along similar trajectories, albeit at different speeds.

U.S. manufacturers are at the center of these tectonic shifts, which have forced them to rethink production strategies and intensify efforts to cut costs and improve productivity. By and large, they have been more successful than manufacturers in other industrial countries. At the same time, they face important structural obstacles to further enhancing their competitive position, largely because of government policies. These obstacles may also discourage foreign firms from locating here.

To set the context, Figures 1 and 2 show the increasing globalization of manufacturing through the evolution of U.S. imports and exports of manufactured goods since 1990. With regard to
exports, global growth is about the same on the business cycles on either side of the millennium: they doubled from 1990 to 2000 and then doubled again from 2001 to 2011. Underneath the top-line number is an increase in the share of exports going to emerging markets, starting with Mexico in the aftermath of the North American Free Trade Agreement in 1994 and spreading to China and other emerging markets starting in 2000. By 2011, the share of U.S. manufacturing exports to emerging economies (including Mexico) reached 34 percent, up from 25 percent in 1990.

The narrative for imports is qualitatively much the same, with a few important contrasts. First, growth of U.S. manufacturing imports actually slowed in the 2000s relative to the 1990s: top-line growth was 150 percent in 1990-2000 and 80 percent in 2000-2010. However, because imports are significantly larger in dollar terms than exports, the trade deficit in manufactured goods widened from $304 billion in 2001 to $449 billion in 2011, 70 percent of which is accounted for by China.

The other main difference is that the share of imports from emerging markets other than Mexico (which at 20 percent in 2000 was significantly larger than the share of exports at the time) increased to nearly 30 percent in 2011. As a result, the combined share of imports from emerging markets (including Mexico) increased to 43 percent in 2011, up from 26 percent in 1990.

Perhaps more indicative of the fragmentation of supply chains is the fact that a growing share of international trade is in intermediate rather than finished goods—an estimated two-thirds of the total in 2011. Countries no longer trade primarily final goods; rather, they move parts and components around the globe, adding value incrementally along the way. The automotive sector in North America is a perfect example, with components crossing the Canada-U.S. border multiple times before the finished car or truck rolls off the assembly line.

This ability to slice manufacturing supply chains into component parts is a paradigm shift in international trade, because it forces countries and businesses to think differently about the meaning of trade competitiveness. If we track the value-added

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**Figure 1: U.S. exports of manufactured goods, 1990-2011 (billions of dollars)**

![Figure 1](image1)

*Source: International Trade Administration*

**Figure 2: U.S. imports of manufactured goods, 1990-2011 (billions of dollars)**

![Figure 2](image2)

*Source: International Trade Administration*
of a given product, what forms is the so-called “smile of value creation,” as shown in Figure 3. A value chain for a product consists of a number of interlinked tasks extending from upstream R&D, prototyping, and commercial design, to manufacturing in the middle of the chain, and to downstream marketing, logistics, and after-sales service. Generally, the upstream stage R&D and downstream stage marketing are capital- and knowledge-intensive, while the manufacturing stages in the middle of the chain are labor-intensive. According to the framework, the tasks for R&D and marketing should therefore be located in capital-abundant developed countries with a highly skilled labor force, while manufacturing and especially assembly activities should be moved to labor-abundant developing countries.

Figure 3: The Smile of Value Creation


From a firm’s perspective, the new paradigm means rationalizing global supply networks to maximize the captured value from production of a given product. The offshoring phenomenon that dominated U.S. business headlines in the middle of the decade is largely consistent with such a shift. Indeed, many U.S. manufacturers began to offshore assembly activities to China and other countries whose labor costs are significantly lower, a practice that was subsequently condemned as “exporting jobs” and hollowing out U.S. manufacturing. Yet, the practice was much more about optimizing global supply networks than abandoning the United States as a high-value node in those networks. In the context of Figure 3, U.S. manufacturers began to focus their domestic activities on the two ends of the value chain—R&D/design and marketing/after-sales services—areas where the U.S. enjoys a strong comparative advantage relative to China and other emerging economies. If done intelligently, this will increase, not decrease, the value added to manufactured goods in the United States.

Statistical and anecdotal evidence demonstrate that U.S. manufacturers have adapted well to the New Globalization. From a cost-effectiveness standpoint, manufacturing productivity soared by 65 percent in the 2000s, far more rapidly than all other mature industrialized nations and an even faster pace than in the 1990s. Unit labor costs declined commensurately and, while total manufacturing employment stagnated or drifted downward during the 2000s expansion, inflation-adjusted output grew just as rapidly as the overall economy.

Behind the statistics, there has been a veritable renaissance of American manufacturing on the shop floor. U.S. manufacturers were pioneers in implementing enterprise resource planning systems such as SAP and Oracle beginning in the late 1990s, and within several years, they were delivering the improved coordination and planning that are the essential building blocks of efficient and far-flung supply chains. In addition, they responded nimbly to competitive pressures from China and elsewhere by implementing lean production techniques, just-in-time inventory management, and formalized business process improvement programs.
A crucial point regarding the establishment of production facilities in China and other emerging markets is that it is much more about gaining access to local markets than it is about re-exporting finished goods back to the United States. In the mid-2000s, the Bureau of Economic Analysis conducted an in-depth analysis of the four countries with the largest increase in employment of U.S.-based foreign affiliates of U.S. firms at the time—Mexico, China, India, and Poland. It found that less than 10 percent of sales from those countries were destined to the U.S. market. The only exception was Mexico, which benefits from geographic proximity to the United States. Even in that case, only 28 percent of sales of Mexican affiliates were to U.S. customers.

The smile of value creation also explains how offshoring certain parts of a firm’s supply chain can actually have positive implications. Establishment of facilities for lower-value assembly frees up domestic resources for higher-value activities at the upstream and downstream ends of the smile of value creation. To the extent foreign production facilities allow firms to grow overseas markets, domestic employment may increase. This is precisely the result of research done by Matthew Slaughter, former member of the Council of Economic Advisers for President George W. Bush, showing that every foreign job created by U.S. multinational corporations is associated with almost two new jobs here at home (although other researchers have noted that this job complementarity effect is stronger for retailing and services industries than it is for manufacturing).

New Globalization is not just about U.S. firms exploiting production and market opportunities overseas. The reverse is also true. Thousands of foreign manufacturing firms employ more than 2.2 million Americans in their U.S. operations, or 18 percent of total U.S. manufacturing employment. These companies pay higher wages on average than their U.S. counterparts, but more importantly, they have positive spillover effects on domestic firms via the R&D and innovation they invest in and the competitive pressures they bring to the marketplace. They locate here both to serve the large North American market and as a platform for export elsewhere in the world.

Fragmentation of supply chains also causes severe distortions in the trade data that inform our understanding of national competitiveness. A useful illustrative example is the Apple iPod and iPhone, since their supply chains have been studied in great detail. Because both finished products are assembled in and shipped from China, for the purposes of trade statistics, they are considered to be “made in China.” Yet, the actual process of assembling iPods and iPhones in China adds less than 1 percent to their wholesale value. For units sold in the United States, 75 percent of the value-added throughout the products’ global supply chain journey is captured by the United States (both by Apple, who designs, brands, and markets the products, and by distributors, wholesalers, and retailers), and most of the remainder accrues to Japan, which manufactures the hard drives and display modules. So paradoxically, an increase in iPod and iPhone sales, which clearly benefit Apple and the American economy, actually increases the measured trade deficit with China.

A more systematic look at China’s trade shows that its supposedly meteoric increase in competitiveness with regard to high-technology goods is largely a statistical illusion. It is commonly noted that China’s exports of high-technology equipment have grown rapidly—by some measures, they are approaching one-third of total exports. However, the Chinese content of high-technology manufacturing done in China is less than 20 percent. Correcting for this drastically reduces China’s high-tech exports on a value-added basis to less than 10 percent, which is lower than high-tech exports’ share of
global trade. This implies that China is currently at a comparative global disadvantage with regard to high-tech exports, though it is effective at assembling them.

Even though China’s trade penetration in many markets may be overstated, there is little reason for complacency. China’s desire to move up the value chain is evidenced by its heavy investment in research. China’s R&D as a share of GDP has doubled in the past decade to 1.7 percent of GDP, while the U.S. share has remained in the 2.6 to 2.9 percent range. Also, the number of science and engineering graduates exceeds the U.S. level by a factor of two. Anecdotally, U.S. manufacturers are reporting that product quality in many industries traditionally dominated by the United States, Japan, and Germany is improving rapidly in China and other emerging economies.

Policymakers must ensure that the business environment in the United States is conducive to establishing high value-added manufacturing activities. Unfortunately, they have fallen short on several key fronts. Unlike manufacturers, who have done their part in cutting costs, streamlining operations, and aligning products with ever-increasing customer demands, governments are in large part responsible for a number of obstacles to growth for U.S. manufacturers and instead discourage foreign firms from locating here. As noted, a highly skilled labor force is essential for capturing the upstream and downstream pieces of the smile of value creation, but the U.S. primary and secondary education system leaves much to be desired. Manufacturers report as many as 600,000 jobs that they cannot fill even in the context of 8–9 percent national unemployment.

Furthermore, in the latest in a series of studies tracking structural costs facing U.S. manufacturers, MAPI reported that structural costs add a 20 percent burden to total U.S. manufacturing costs relative to our nine largest trading partners, an increase relative to 2008. Eighty-five percent of this burden is caused by two factors: high corporate tax rates and healthcare costs that are growing more rapidly than elsewhere in the world. The remainder is due to relatively onerous compliance costs for business regulation and tort litigation. Reducing these obstacles is essential for forward-looking U.S. manufacturing strength.

In short, the New Globalization is more than just lower trade barriers and higher trade flows; it is a battle to capture the economic value of production. In a world where physical and financial capital is mobile and human capital can make the difference, winning this battle requires three things: a policy environment that attracts and rewards investment; a strong national innovation effort; and a workforce that is educated, skilled, and motivated to be the best.

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1. A recent report by the Boston Consulting Group indicates U.S. companies who sought to reduce costs by moving operations to China and re-exporting back to the U.S. are beginning to come back to the United States in response to rising Chinese labor costs as well as problems with transportation and inventory management. See www.bcg.com/media/pressreleasedetails.aspx?id=tcn:12-75973.
4. “High-technology” industries as defined here include aircraft, pharmaceuticals, information and communication equipment, office machinery and computers, and precision medical and optical instruments.
5. Perhaps not surprisingly, the industry in which China has the largest comparative advantage when measured by trade data corrected for re-exports of imported content is apparel.