

# CHAPTER 3

## Global Supply Chains

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### Development of Global Supply Chains

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From automobiles, electronics, and plastics, to software development or clothing, many goods and services today are provided via global supply chains (box 3.1). Instead of carrying out everything from research and development (R&D) to delivery and retail within a single country, many industries are dividing this process into stages or tasks (or “fragments”) that are then undertaken in many countries. The Apple iPod is a prominent example of a good produced via a global supply chain. Apple is headquartered in the United States and most of its R&D, marketing, top management, and corporate functions are located in the United States. The iPod’s hard drive, however, was designed in Japan by Toshiba and built in factories in China and the Philippines. The controller chip was designed by the U.S. firm Portal Player, but is produced by firms in either Taiwan or the United States. Other parts are manufactured in Japan, Thailand, Taiwan, Korea, and Singapore. Finally, the iPod is assembled by Taiwanese manufacturing firms in China.<sup>1</sup>

Global supply chains have spread widely across both industries and countries. The global restructuring of production has led to faster growth in trade, new patterns of trade, and new benefits from trade. It may also have introduced new risks, including exposure to foreign shocks<sup>2</sup> and negative effects for workers in certain industries and occupations. This chapter begins with an overview of the key elements of global supply chains, the major economic forces behind the emergence of these chains, and their significance for global trade and development. This is followed by an in-depth look at the evolution of U.S. participation in supply chains, and the policies, institutions, and characteristics that have affected that participation. The chapter then examines some of the effects of global supply chains on U.S. companies, consumers, and workers. The final section explores U.S. supply chains in three sectors (apparel, motor vehicles, and televisions) in which U.S. trade and production have been substantially integrated into global supply chains. The case studies also include U.S. logistics providers, which provide a service essential to the efficient operation of global supply chains.

### *Key Elements of Global Supply Chains*

#### **Structure**

The activities involved in a supply chain can be grouped into sequential or “vertical” stages. Figure 3.1 illustrates a simple supply chain, broken into broad stages from upstream R&D and design, through manufacturing, to downstream marketing, retail sales, delivery, and customer service. Each stage includes a large number of tasks. While many firms can carry out most stages or tasks internally, they often purchase raw materials and some service inputs from domestic or international suppliers. In a global

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<sup>1</sup> The example refers to the fifth-generation iPod. Linden et al., “Who Profits from Innovation in Global Value Chains?” 2010; Linden et al., “Innovation and Job Creation in a Global Economy,” 2011; Linden et al., “Who Captures Value in a Global Innovation System?” 2007.

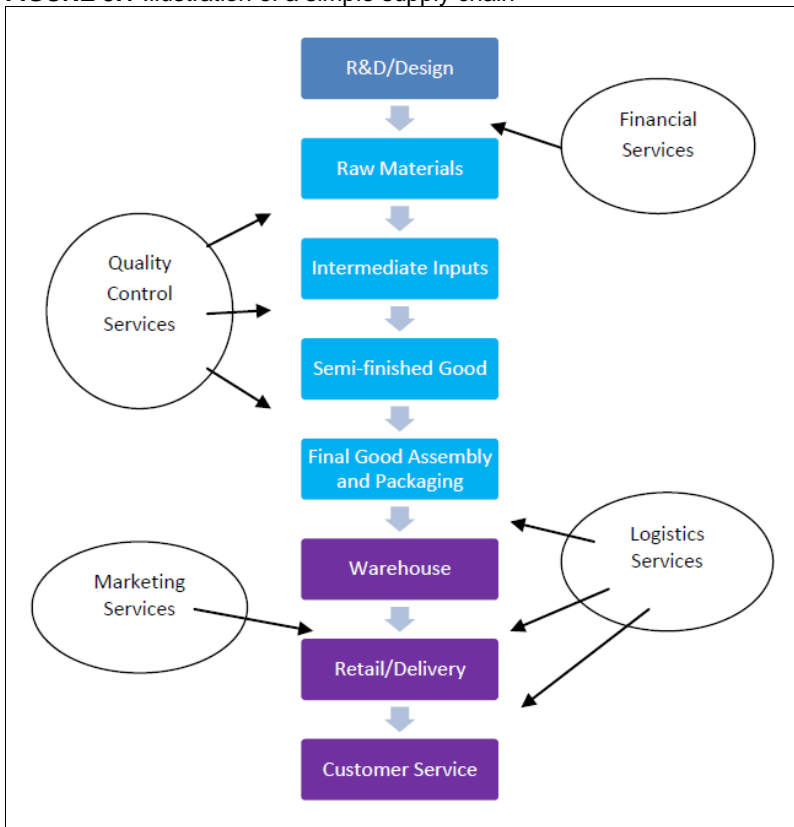
<sup>2</sup> Including economic and political shocks as well as natural disasters.

**BOX 3.1** Global supply chain fundamentals

A **supply chain** is a production network between multiple firms that supply interlinked economic activities toward the provision of a final good or service. Because the firms contribute economic value through these activities, the chains are often referred to as **value chains**. In general, supply chains encompass all activities necessary to bring a product from conception to consumption. To the extent that they involve suppliers located in different countries, the chains are **global supply chains**. For purposes of this discussion, a regional supply chain—e.g., one involving two or three NAFTA countries—is considered “global” based on this definition.

**Outsourcing** refers to service or manufacturing activities that are contracted out to unrelated firms located either in the home country or abroad. **Offshoring** originally referred to service or manufacturing activities within the supply chain that are carried out by affiliates located in foreign countries. However, **offshoring** is now commonly used more broadly to refer to activities done abroad through both foreign affiliates and independent contracts. The provision of service or manufacturing activities by a domestic firm to a firm abroad is known as **inshoring**.

**FIGURE 3.1** Illustration of a simple supply chain



Source: Commission compilation.

supply chain, many tasks are “offshored,”<sup>3</sup> either through the firm’s own subsidiaries abroad or through independent contracts.<sup>4</sup> For example, a domestic firm might provide the R&D and design of a product, and produce the initial intermediate inputs using local raw materials, as in figure 3.1. Then these intermediate inputs would be exported to a second country, where a firm would use them to produce a semifinished product. That

<sup>3</sup> Feenstra, “Integration of Trade and Disintegration of Global Production in the Global Economy,” 1998; Jones and Kierzkowski, “A Framework for Fragmentation,” 2001; Deardorff, “International Provision of Trade in Services, Trade, and Fragmentation,” 2001; Deardorff, “Fragmentation Across Cones,” 2001; Grossman and Rossi-Hansberg, “Trading Tasks,” 2008.

<sup>4</sup> Amiti and Wei, “Fear of Service Outsourcing,” 2005; Spencer, “International Outsourcing and Incomplete Contracts,” 2005.

firm would then export the semifinished good to a third country, where the final good is assembled and packaged. The third country would then export the good back to the domestic firm, which would oversee the marketing, retailing, and delivery of the product domestically and abroad. Supply chains like these require extensive organizational oversight. They also typically involve heavy reliance on telecommunications to ensure that different stages of the product are made to specification and on logistics to coordinate the movement of material across many firms and countries. As the case studies later in this chapter illustrate, global supply chains can involve complex interconnections between different tasks, as well as between domestic and foreign firms carrying out those tasks. This complexity is managed by lead firms in the chain that oversee production and make other key decisions (box 3.2).

Offshored tasks in a global chain can be done by independent foreign firms, by foreign affiliates, or both. Evidence from China, for example, indicates that most global supply chain manufacturing in China is done through foreign multinational subsidiaries or joint ventures.<sup>5</sup> The choice of affiliate versus independent firm is determined in part by the nature and maturity of the product, as well as the status of the intellectual property rights in the offshore site. If the product is new and embodies extensive R&D or intellectual property, firms may be less likely to offshore any tasks.<sup>6</sup> If they do offshore tasks, they may be more likely to use affiliates. This is due, in part, to the risk that intermediate goods may not be made to exact specifications if contracted to independent firms. It can also reflect concern about enforcement of contracts or property rights abroad.<sup>7</sup> Once a product is more standardized, firms are more likely both to offshore tasks and to do so using independent contractors.

## Trade

Global supply chains have produced important changes in the nature and volume of global trade. Modern complex supply chains generate more trade than traditional supply networks in which only raw materials or final goods might be sent across international borders. In the earlier example of a supply chain in which the stages in figure 3.1 were carried out in three countries, the product was exported three times before being sold in final form at home or abroad. Global chains can also generate new patterns of specialization, as firms in a particular country often specialize in a particular stage or task.<sup>8</sup> In electronics, for example, intermediate and semifinished goods are often produced in Japan, Hong Kong, South Korea, and Taiwan, while final assembly activities are often contracted to Chinese firms.<sup>9</sup> Finally, global chains can change the nature of a nation's trade. As countries become more vertically specialized, their imports and exports are increasingly composed of intermediate goods and services that are moving to the next stage in the chain.

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<sup>5</sup> Dean et al., "Decomposing China-Japan-U.S. Trade," 2009; Feenstra and Hanson, "Ownership and Control in Outsourcing to China," 2005.

<sup>6</sup> Antras, "Incomplete Contracts and the Product Cycle," 2005. For an examination of the potential increase in affiliate sales if intellectual property rights protection in China is improved, see USITC, "China: Effects of Intellectual Property Infringement and Indigenous Innovation Policies on the U.S. Economy," 2011.

<sup>7</sup> For example, American Tower, a provider of wireless network infrastructure and services, requires an extensive review of intellectual property rights protection before it will consider partnering with a firm in any foreign country. See Taiclet, "Keynote Address," April 5, 2011.

<sup>8</sup> Hummels et al., "The Nature and Growth of Vertical Specialization in World Trade," 2001.

<sup>9</sup> Dean et al., "Decomposing China-Japan-U.S. Trade," 2009.

### **BOX 3.2** Leadership of global chains

Supply chains are typically initiated and overseen by a limited number of lead firms. In a **producer-driven chain**, the lead firms are usually involved in R&D and design (the upstream end of the chain). These chains are most often found in high-tech goods that embody specialized design, complex production processes, and extensive R&D, such as electronics, semiconductors, computers, software development, and pharmaceuticals. In these types of chains, the production process itself is often fragmented, and the fragments are carried out in different countries. In one producer-driven chain, for example, U.S.-based lead firms design electronic products and component specifications. The components are produced in Asia and exported to Mexico, where affiliates of U.S. manufacturers use them to produce the electronic products. The finished products are then exported to the United States, where the U.S. lead firms carry out marketing and sales.<sup>a</sup>

**Buyer-driven chains** generally are led by firms involved in retail (the downstream end of the chain). These chains are more often associated with standardized, lower-tech goods such as apparel, which require less sophisticated capital equipment and fewer skilled workers. In these chains, the production process itself may not be fragmented, but may instead be done completely offshore. The apparel case study later in this chapter illustrates three types of buyer-driven supply chains, where the U.S. lead firms are branded marketers, large retailers, or branded manufacturers. These lead firms are involved (in varying degrees) in marketing and service activities, but contract out actual apparel production to foreign firms.<sup>b</sup>

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<sup>a</sup>Sturgeon and Kawakami, "Global Value Chains in the Electronics Industry," 2010.

<sup>b</sup>Gereffi, "International Trade and Industrial Upgrading in the Apparel Commodity Chain," 1999; Gereffi and Frederick, "The Global Apparel Value Chain, Trade, and the Crisis," 2010.

## ***Major Economic Forces Driving the Development of Chains***

### **Technological Change**

A key force behind the widespread development of global supply chains has been technological change. Over time, technological change has allowed more production processes to be fragmented—split into stages or tasks—and those stages or tasks to be carried out in new, often distant locations. For example, in the 1970s some apparel production for the U.S. market was offshored in nearby countries in the Caribbean region. But advances in telecommunications and in transport have allowed the industry to source from distant Asian suppliers and still meet the time-sensitive demands of the industry.<sup>10</sup> Since the introduction of just-in-time technologies in the 1980s, the automobile industry has been significantly restructured, enabling it to rely on complex global and regional networks with tiers of suppliers of parts and components. In the mid-1990s, the increased speed of communications via the Internet allowed the Indian software industry to become a key player in global chains. Swiss Airlines, American Airlines, and Singapore Airlines began contracting with Indian firms for flight scheduling, and Reebok and Nordstrom had their inventory software developed and supported by the Indian firm Infosys.<sup>11</sup>

### **International Cost Differences**

International cost differences have been another driving force behind the spread of global chains. Some tasks require higher skills or more complex equipment than other tasks, and a global chain allows a firm to reduce costs by locating activities in different countries based on their respective comparative advantages. Semiconductor production, for

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<sup>10</sup> David Hummels notes that faster delivery, including higher ship speeds and a shift to air transport, is "the most obvious quality improvement" in international transport. Hummels, "Have International Transport Costs Declined?" 1999, 21–22.

<sup>11</sup> Lateef, "Linking Up with the Global Economy," 1997.

example, can be broken into three stages: design, front-end fabrication, and back-end production. The majority of semiconductor producers, which carry out the design stage, are located in the United States, Japan, Taiwan, Korea, and the European Union (EU), where higher-skilled labor is relatively abundant and, thus, relatively less expensive. Front-end production, the stage requiring the most intensive use of capital and technology, also takes place in the EU, Japan, Taiwan, and the United States. Back-end testing, assembly, and production, which are relatively less skill-intensive, have generally been located in countries such as China, where lower-skilled labor is relatively more abundant and, thus, relatively less expensive.<sup>12</sup> The result is a more efficient, lower-cost production process.

## **Lower Trade and Transport Costs**

Two other important drivers in the development of global chains are the extensive global trade liberalization (e.g., reduction in tariff and nontariff barriers) and falling transportation costs that have occurred in the past quarter-century.<sup>13</sup> Because goods and services produced by global supply chains typically cross borders multiple times, they pass through multiple customs regimes and are affected by multiple tariffs and nontariff barriers. Thus, the benefits of trade liberalization can also be multiplied for goods and services produced in global supply chains. The Uruguay Round negotiations, a major multilateral trade liberalization completed in 1994,<sup>14</sup> resulted in average tariff reductions of 38 percent among industrialized nations, as well as liberalized trade in textiles and apparel and reductions to barriers in services trade. Created at the same time, the World Trade Organization (WTO) and its dispute settlement mechanism have contributed to a more open and orderly trading system.<sup>15</sup>

Bilateral and unilateral trade liberalization has also contributed to the formation of global supply chains, as have programs that encourage duty-free trade in parts and components. For example, the United States established programs as early as the 1950s to allow duty-free imports of U.S.-origin components contained in imported articles. This treatment has encouraged the use of U.S. components in foreign assembly operations and reduced the tariff costs associated with these supply chains. Other countries or regional blocs, such as the EU, have similar provisions.<sup>16</sup>

Similarly, falling transportation costs in the past three decades have significantly lowered the cost of shipping semifinished inputs between countries. These developments have reduced the obstacles to locating stages of production in different countries.

## **Improved International Logistics**

Logistics, the coordinated movement of goods and services, has become essential to the smooth flow of goods and services in many internationally fragmented supply chains. In fact, as discussed in the case study at the end of this chapter, the rise of low-cost, efficient, and globally integrated logistics firms is one factor that has spurred the creation of global chains. The development of logistics firms that offer multiple logistics services

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<sup>12</sup> Yinug, "Challenges to Foreign Investment in High-Tech Semiconductor Production in China," 2009.

<sup>13</sup> In some exceptional cases, trade restrictions may themselves have led to the break up of single-country production systems and the formation of global supply chains. For example, the voluntary export restraints under which Japanese automakers found themselves in the 1980s may have led them to invest in auto production in the United States and to form auto parts supply chains between the United States and Japan.

<sup>14</sup> Jackson, *The World Trading System*, 1997, 74.

<sup>15</sup> Additional accomplishments are noted in USITC, *Import Restraints, Sixth Update*, 2009, 83–87.

<sup>16</sup> USITC, *Production Sharing*, 1989, chap. 9 and app. A.

(such as warehousing, distribution, tracking, and customs brokerage) has enabled lead firms to manage larger and more complex chains. Technological advances, particularly via the Internet, have helped improve network communications and reduced logistics costs. Lowering the cost of logistics services can increase the number of suppliers and the complexity of the relationships that a lead firm can profitably incorporate in a supply chain.<sup>17</sup>

### **Improved Intellectual Property Rights Protection and Contract Enforcement**

Finally, improvements in intellectual property rights protection and contract enforcement in some countries may have facilitated the creation of global chains. From a lead firm's point of view, the prospect of overseeing contracts with independent firms, or setting up subsidiaries abroad to carry out offshored tasks, often implies additional risk. As noted earlier, this risk can both reduce the number of activities a firm offshores and determine whether or not the firm carries out those tasks via foreign investment or independent firms.<sup>18</sup> To the extent that countries have improved laws and regulations regarding intellectual property and contracts, their business environment will be more conducive to their participation in global chains.<sup>19</sup>

### ***Growth of Global Supply Chains in World Trade***

As global supply chains proliferate and expand, it is likely that they account for a growing share of world trade. However, because detailed trade data for such chains are not typically available, their share of world trade is difficult to measure. Researchers have turned instead to a variety of other methods to try to identify such trade (box 3.3). Evidence gathered from all these methods suggests that global supply chains are growing in importance in global trade.

### **Trade in Parts and Components**

Because supply chains involve extensive trade in intermediate and semifinished goods, some broad evidence of their importance can be found by measuring trade in parts and components. World trade in parts and components grew by about 9 percent per year from 1990 to 2000, outstripping total world trade growth of 6.5 percent per year.<sup>20</sup> There is also evidence of a strong network of Asian suppliers in parts and components. Estimates for 1984–96 showed that Asian global exports of parts and components grew by more than 500 percent, compared to Asian total export growth of 300 percent.<sup>21</sup> A similar analysis found that the share of East Asia in global exports of parts and components grew from 29.3 percent in 1992 to 39.2 percent in 2003.<sup>22</sup>

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<sup>17</sup> Jones et al., “What Does Evidence Tell Us about Fragmentation and Outsourcing?” 2005.

<sup>18</sup> Antras, “Incomplete Contracts and the Product Cycle,” 2005; Feenstra and Hanson, “Ownership and Control in Outsourcing to China,” 2005.

<sup>19</sup> In the plastics industry, for example, Gloucester Engineering has extended its chain to include Malaysia, in part because of Malaysia's improved property rights protection. See Johnson, “Doing Business in Malaysia,” April 5, 2011.

<sup>20</sup> Jones et al., “What Does Evidence Tell Us about Fragmentation and Outsourcing?” 2005.

<sup>21</sup> Ng and Yeats, “Major Trade Trends in East Asia,” 2003.

<sup>22</sup> Athukorala, “The Rise of China and East Asian Export Performance,” 2009; Athukorala and Yamashita, “Production Fragmentation and Trade Integration,” 2006. These authors also found evidence that the share of components in intra-regional trade was far higher than its share in extra-regional trade.

### BOX 3.3 Measuring trade and value in global supply chains

Several methods have been used to measure the extent of global supply chain activity in world trade. Some methods rely only on trade data. One method uses detailed trade data to identify **trade in parts and components**. Another uses special customs data reported by some countries to measure **processing trade**, which includes imported goods used as inputs into products made solely for export (processing imports) and exports embodying processing imports (processing exports). China and Mexico account for a large portion of global processing trade, and both report such data.<sup>a</sup>

Other methods also incorporate input-output tables to measure the foreign content in domestic production or exports. Measures of **foreign content in intermediate use** (also known as offshoring intensity) examine the share of all intermediate inputs that come from abroad for use by domestic companies. Such inputs can include intermediate goods (e.g., hard drives) or intermediate services (e.g., accounting or information technology services) that firms use to produce goods for domestic use or exports. Measures of **foreign content in exports** (also known as vertical specialization) rely on estimates of the value of imported inputs used directly and indirectly in an exported good or service. If foreign content is high, this would suggest the country is extensively involved in global chains. If firms in the country lie far downstream in the chain, most of the value of the product will have been contributed by foreign countries at earlier stages in the chain. Thus, high foreign content might suggest that the country is specialized toward the downstream end of a global supply chain (e.g., in assembly, marketing, or sales).

A recent, more extensive approach uses global input-output data to track the sources and destination of value contributed by workers and companies in each country. Such databases capture value that flows directly between countries or through intermediate countries in the chain. This approach is based on **value added**, which is the difference between the cost of intermediate inputs a firm receives and the price paid by the next firm (or consumer) in the chain. This value includes workers' wages and company profits, and is tracked in input-output tables along with the value of intermediate inputs. The examination of U.S. participation later in the chapter measures value added in imports, value added in exports, and value added in absorption. **Absorption** is similar to demand and encompasses both intermediate inputs used by manufacturers and final goods and services used by consumers.

The copious data used in methods relying on input-output tables creates a tradeoff between timeliness and accuracy. Measures of foreign content generally employ data from a single country or a limited set of countries and are available on an annual basis up to 2008, but the more comprehensive value-added measures using worldwide data provide a snapshot of only a single year (currently only 2004 is available).

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<sup>a</sup>China reports processing trade using data on special customs regimes. Mexico reports export processing data for IMMEX, formerly the Maquiladora and PITEX programs. See USITC, *Production Sharing*, 1999.

## Processing Trade

Numerous countries have set up programs to encourage processing trade, which allow duty-free imports of components used in products made solely for export. Using data on these programs provides a more direct measure of global supply chain trade, since all of the trade in the components and products affected by the programs moves through a supply chain. China and Mexico are the two largest users of export processing regimes in the developing world, and together account for about 80–85 percent of such exports worldwide.<sup>23</sup> Chinese trade grew by more than 800 percent between 1995 and 2008—and about half of this growth is attributable to Chinese processing trade.<sup>24</sup> Mexico is also heavily reliant on processing trade; processing imports represented over 50 percent of total Mexican imports in 2006.<sup>25</sup>

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<sup>23</sup> Koopman et al., “Give Credit Where Credit Is Due,” 2010, 17.

<sup>24</sup> Dean et al., “Measuring Vertical Specialization,” 2011.

<sup>25</sup> De La Cruz et al., “Estimating Foreign Value-added in Mexico’s Manufacturing Exports,” 2010.

## **Foreign Content in Exports**

As discussed earlier in this chapter, firms in supply chains often import a semifinished product from the firm at the previous stage in the chain, add value, and then send that product to the country at the next stage in the chain. Measuring the share of imported inputs (foreign content) in the value of a country's exports might broadly indicate the extent of that country's participation in global chains and whether its firms are specialized upstream or downstream in the chain. Early evidence for countries belonging to the Organisation for Economic Co-operation and Development (OECD) showed that the foreign content of their exports was only about 16 percent in 1970, but grew to about 20 percent by 1990.<sup>26</sup> More recently, evidence for China indicated that in 2002, foreign content accounted for as much as 46 percent of China's total exports and 74 percent of its processing exports. For some products, like computers, the estimated foreign content in Chinese exports was as much as 95 percent.<sup>27</sup>

Evidence from recent studies measuring sources of value added in traded goods and services suggests that foreign content accounts for about one-quarter of global exports.<sup>28</sup> This share varies substantially by region, however. Emerging East Asian economies are the most integrated into global supply chains, with foreign content shares commonly exceeding 40 percent of export value. Major advanced economies (the United States, Japan, and the EU) have much lower foreign content shares of about 12 percent.<sup>29</sup>

## ***Significance of Global Supply Chains for World Trade and Economic Development***

### **Magnified Effect of Tariff Cuts**

Since the 1960s, the growth in global manufactured exports has been dramatic. Recent evidence suggests that global supply chains can explain a significant part of this growth.<sup>30</sup> As noted earlier, every time an intermediate good in a global chain crosses a border, it may incur a tariff. Thus, a reduction in tariffs is likely to cause a magnified cost reduction for a good produced in a global chain and a magnified increase in trade. In addition, new global chains may become cost-effective only when reductions in tariffs are sufficiently large.<sup>31</sup> If so, the extensive trade liberalization in the developing world, from the mid-1980s onward, may have stimulated new global chains by making it more profitable to offshore tasks to these countries.<sup>32</sup> The development of these new global chains would further magnify trade, compared to trade solely in final goods.

### **Changes in the Pattern of Trade**

The ability to split the production process into tasks that can be done in different locations implies at least three important changes in the pattern of global trade. First, it means a change in the nature of specialization. Traditionally, a country's production and

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<sup>26</sup> Hummels et al., "The Nature and Growth of Vertical Specialization in World Trade," 2001, 83.

<sup>27</sup> Dean et al., "Measuring Vertical Specialization," 2011; Koopman et al., "How Much of Chinese Exports Is Really Made in China?" 2008.

<sup>28</sup> Values reported here are from Koopman et al., "Give Credit Where Credit Is Due," 2010. See also Johnson and Noguera, "Accounting for Intermediates," 2010; Daudin et al., "Who Produces for Whom in the World Economy?" 2009.

<sup>29</sup> Koopman et al., "Give Credit Where Credit Is Due," 2010.

<sup>30</sup> Yi, "Can Vertical Specialization Explain the Growth of World Trade?" 2003.

<sup>31</sup> Ibid.

<sup>32</sup> Dean et al., "Trade Policy Reform in Developing Countries since 1985," 1994.



exports were concentrated in goods or services in which the country had a comparative advantage. Now specialization is more finely defined, with countries specializing in stages or tasks *within* products, based on comparative advantage. Second, this new pattern of specialization has generated a change in the nature of trade flows. The expansion of global supply chains is likely to increase the trade between industrial and developing countries, since the location of tasks depends upon differences in comparative advantage.<sup>33</sup> Third, the international fragmentation of production means the pattern of trade will be more sequential and more dominated by trade in intermediate goods.

Trade patterns in the semiconductor industry illustrate these three effects. In the past, the United States would have exported products like semiconductors to China. Now, the United States performs the R&D, design, and front-end fabrication of a semiconductor, and exports it to a Southeast Asian country that performs the back-end testing, assembly, and packaging of that semiconductor. The Southeast Asian country then exports the packaged semiconductor to China, where it is incorporated into various electronic products and then exported to customers globally.<sup>34</sup>

## Changes in the Benefits of Trade

### *Economy-wide benefits*

Freer trade tends to bring benefits to a country as a whole. These national gains occur through two channels: producers increase profits as they specialize more in goods in which the country has a comparative advantage; consumers are able to buy goods at lower prices. Both of these gains increase a country's global purchasing power. The possibility of participating in global supply chains strengthens these national gains, because it means a good can be produced more efficiently than if the entire process had to take place in a single location. It also means that trade liberalization yields larger increases in national purchasing power, due to its magnified impact on trade in global chains.<sup>35</sup>

Global supply chains may bring additional gains for developing countries, through opportunities to participate in one or more stages in the production of technology- or skill-intensive products, instead of having to achieve mastery over the entire production process first.<sup>36</sup> Firms initially performing the least-skilled tasks may learn through interaction with other firms in the chain and be able to move to higher-value activities. Indian software firms in the 1990s, for example, were largely in the middle to lower end of the software development chain, engaged in contract programming, coding, and testing.<sup>37</sup> Yet now, partly because of the learning process just described, Indian firms engage in business and technology consulting, systems integration, product engineering, custom software development, and other more skill-intensive activities.<sup>38</sup>

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<sup>33</sup> Arndt and Kierzkowski, *Fragmentation*, 2001.

<sup>34</sup> Evidence on this kind of change in trade patterns for China can be found in Dean et al., "Measuring Vertical Specialization," 2011, and Dean and Lovely, "Trade Growth, Production Fragmentation and China's Environment," 2010.

<sup>35</sup> Yi, "Can Vertical Specialization Explain the Growth of World Trade?" 2003.

<sup>36</sup> Arndt and Kierzkowski, "Fragmentation," 2001.

<sup>37</sup> Lateef, "Linking Up with the Global Economy," 1997.

<sup>38</sup> See Commander et al., "The Consequences of Globalisation," 2008; Infosys, "What We Do," <http://www.infosys.com/about/what-we-do/Pages/index.aspx>.

Small and medium-sized enterprises (SMEs) may see additional gains from global chains. Many SMEs are not able to obtain financing for exporting directly or to surmount other informational obstacles to participation in global markets.<sup>39</sup> However, these SMEs might be able to enter the global market indirectly, by contracting as a supplier in a global chain.<sup>40</sup> This is true for SMEs in both developing and industrial countries, but particularly so in developing countries, where business obstacles are larger.

### *Distributional benefits*

Evaluating the effect of global supply chains on the benefits of trade, as well as on the distribution of those benefits within an economy, is not simple. Freer trade typically generates winners and losers within a country. This occurs because productive resources move away from industries in which the country does not have a comparative advantage and into industries in which it does. In a country where capital and high-skilled labor are relatively abundant, for example, this typically means a shift of resources out of less skill-intensive industries and into those that are more capital- and skill-intensive. In this example, earnings of higher-skilled workers and capital owners tend to rise, while those of lower-skilled workers tend to fall throughout the economy.

In the presence of global supply chains, an industry would now have the opportunity and incentive to split off the most low-skilled, labor-intensive activities within the chain to locations offshore, specialize in the remaining activities, and continue producing the final good. One effect of this would be to create winners and losers, as described above. However, the global chain could reduce the adjustment costs of shifting resources across industries and soften the impacts on the “losers” from freer trade.<sup>41</sup> If a firm is already offshoring some of its less skill-intensive tasks, and the costs of offshoring fall, then the cost saving on the already offshored tasks has the same effect as an increase in productivity for the firm’s less-skilled workers. This provides an incentive to expand output. Thus, employment and/or wage losses might be mitigated, or even reversed.<sup>42</sup>

A number of studies have examined the effect of offshoring on relative wages or employment. The evidence on these issues is mixed. The evidence for the United States is discussed in detail later in this chapter.

### **New Concerns: Exposure to International Shocks**

While global chains introduce new benefits, there is also a potential negative side to greater international integration: global chains can increase exposure to global shocks. As international trade relationships deepen, domestic economies can become more sensitive to both positive and negative economic developments overseas. As a result, trade flows and economic growth may become more synchronized across countries. When a country grows rapidly, it trades more, thus aiding growth in other countries connected with it directly or indirectly through its supply chain. By the same token, if a country undergoes a recession, or experiences internal strife or natural disasters, other countries in the supply chain will feel the effects, even if they do not trade directly with the affected country. For example, a decline in U.S. demand for electronics imports from China

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<sup>39</sup> OECD, *Enhancing the Role of SMEs in Global Value Chains*, 2008.

<sup>40</sup> USITC, *Small and Medium-Sized Enterprises*, 2010.

<sup>41</sup> Arndt and Kierzkowski, *Fragmentation*, 2001; Jones and Kierzkowski, “A Framework for Fragmentation,” 2001; Deardorff, “International Provision of Trade in Services,” 2001.

<sup>42</sup> Grossman and Rossi-Hansberg, “Trading Tasks,” 2008.

would reduce Chinese demand for electronics parts and components from Asian suppliers. Asian suppliers' exports would fall even if they had no direct exports to the United States.<sup>43</sup>

Extensive integration into global supply chains may also make trade flows more volatile. This observation, while not universally accepted, accords with trade patterns in the recent global recession. The volume of global trade declined by 25 percent from October 2008 to May 2009, while global industrial production declined by only 13 percent in that period.<sup>44</sup> This contraction of trade was unusually large by recent historical standards.<sup>45</sup> In part, the large trade decline in global chains was due to the composition of products produced by those chains: in recessions, demand for consumer electronics, automobiles, consumer appliances, and even clothing can contract sharply, leading to lower trade. But some economists have argued that global supply chains themselves have increased trade volatility, implying that large positive or negative swings may be a new and permanent feature of the global trade environment.<sup>46</sup>

The increased interrelationships caused by global chains may also lead to speedier transmission of supply shocks as well as demand shocks. For example, the earthquake and tsunami that hit Japan in March 2011 have disrupted some global supply chains. In the case of the motor vehicle industry, for example, the single-sourcing of certain paint pigments from a Japanese plant affected by the earthquake and tsunami has limited the availability of some vehicle colors for automakers such as Chrysler and Ford.<sup>47</sup> On the other hand, Japanese firms may be better able to limit the negative effects of the disaster on the Japanese economy because of their increased ability to import supplies—an ability facilitated by global supply chains.<sup>48</sup>

## **Evolving U.S. Position in Global Supply Chains**

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U.S. manufacturers have substantially increased their participation in global supply chains during the last few decades, although this growth has differed by industry. U.S. companies engage more intensively in global supply chains to source inputs for domestic consumption than to obtain materials for exports. The United States exchanges the most value in global chains with Canada, Mexico, the EU, Japan, and China, in the electronics, chemicals, motor vehicles, and apparel industries. In addition, U.S. foreign investment has contributed to the development of global supply chains in China, Mexico, and elsewhere.

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<sup>43</sup> Bems et al., "The Collapse of Global Trade," 2009.

<sup>44</sup> Baldwin and Taglioni, "The Great Trade Collapse and Trade Imbalances," 2009, 48. See also Baldwin, *The Great Trade Collapse*, 2009.

<sup>45</sup> Levchenko et al., "The Collapse of International Trade," 2009. See also Bems et al., "The Collapse of Global Trade," 2009.

<sup>46</sup> No consensus has emerged on this topic. Brad Jensen noted that it is not yet known whether supply chains contributed to the trade decline "in a nefarious way." USITC, hearing transcript, December 16, 2010, 77–78 (testimony of J. Bradford Jensen, associate professor, Georgetown University). See also Altomonte and Ottaviano, "Resilient to the Crisis?" 2009; O'Rourke, "Collapsing Trade in a Barbie World," 2009.

<sup>47</sup> Just-auto.com, "Japan Quake," March 28, 2011.

<sup>48</sup> Escaith et al., "Japan's Earthquake and Tsunami," 2011.

## *U.S. Participation in Global Supply Chains Has Increased Since the 1980s*

### **Manufacturing**

Though it is not a new phenomenon,<sup>49</sup> U.S. manufacturers have become much more involved in global supply chains in recent decades. Estimates of a country's participation in global supply chains often examine the use of imported intermediate inputs in domestic production. A common approach measures a domestic industry's purchases of imported inputs relative to its total purchases of inputs.<sup>50</sup> This measure (foreign content in inputs used by domestic manufacturers) indicates that U.S. manufacturers' use of global supply chains grew about fourfold between 1980 and 2006 (figure 3.2).<sup>51</sup> Most of this increase has occurred since 1990, a period during which increased computer use and improved telecommunications facilitated global integration of operations. This was also a period of accelerated cross-border integration of manufacturing in North America under NAFTA. Industries with the largest shares of imported inputs in 2006 were apparel and leather products (25.7 percent); motor vehicles and parts (25.6 percent); and computers and electronics (20.8 percent).<sup>52</sup>

A related indicator of U.S. involvement in global supply chains is the amount of imported intermediate inputs embodied in U.S. exports (foreign content in exports).<sup>53</sup> An example of such an input would be a Mexican auto part used in a car assembled in the United States and exported to Canada. Imported inputs accounted for only 8.5 percent of the total value of U.S. merchandise exports in 1977.<sup>54</sup> This measure trended slowly upward and peaked at 15.9 percent in 2008.<sup>55</sup> Annual estimates available since 1998 show that foreign content in exports tends to decline during global trade downturns, as in 2001 and 2009, and then return to its generally upward trajectory.<sup>56</sup>

A comparison of the two measures shows that foreign content in inputs used by domestic U.S. manufacturers rose faster than foreign content in U.S. exports since the 1980s, and is

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<sup>49</sup> The United States has been involved in global supply chains since at least the 1800s, when it was a major exporter of cotton to Britain, which produced textiles and exported cotton fabrics and finished garments to the world. Robertson, *History of the American Economy*, 1973, 116–117, 252. Other examples include the sewing of brassieres and baseball gloves in the Philippines before 1950 using U.S.-origin fabric and leather. Motor vehicles is another sector in which the U.S. has long been involved in regional and global supply chains. The Canada-U.S. Automotive Products Agreement of 1965 fostered North American integration in the sector by removing tariffs on motor vehicles and parts traded between the two countries. See the motor vehicle case study at the end of the chapter for recent developments.

<sup>50</sup> The first use of this measure was in Feenstra, "U.S. Imports, 1972–1994," 1996.

<sup>51</sup> Feenstra and Jensen, "Evaluating Estimates of Materials Offshoring," 2009.

<sup>52</sup> Milberg, written submission to the USITC, December 20, 2010, figure 2a. For some products, however, a substantial share of import value consists of U.S. value returning home after processing abroad. The estimates in the following sections based on value-added flows are thus better estimates of foreign content in U.S. inputs and exports, although these estimates are available only for one year (2004).

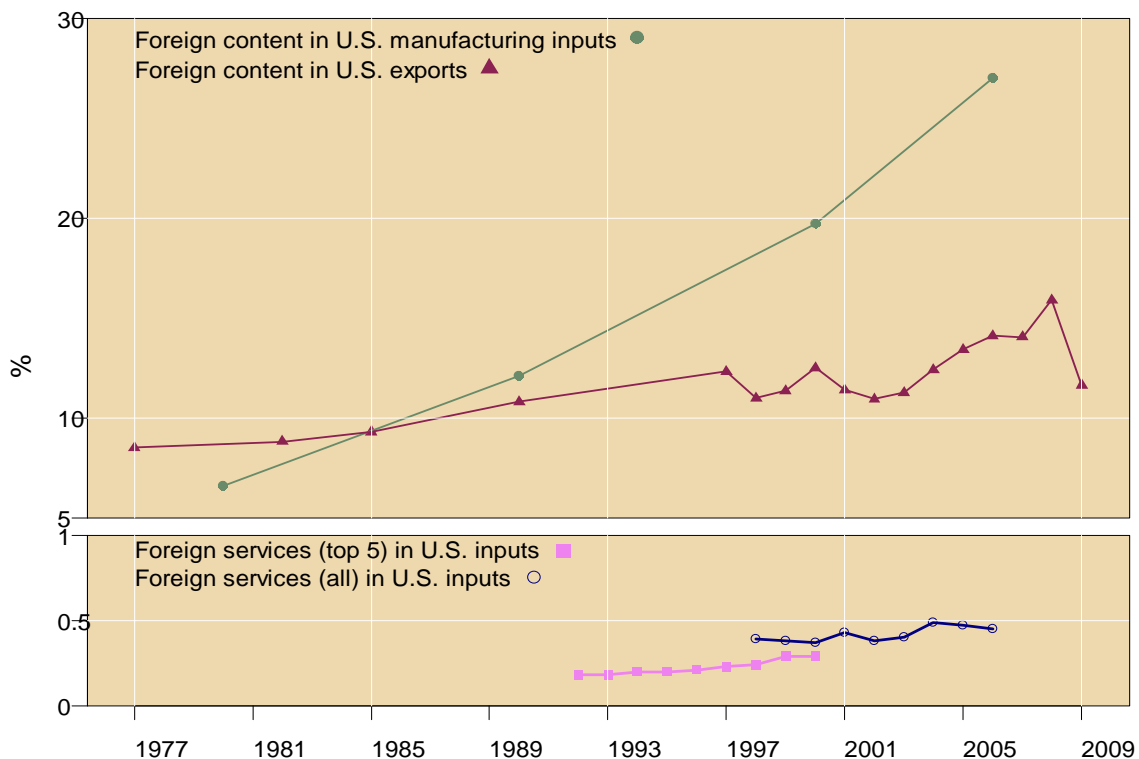
<sup>53</sup> This indicator is commonly called vertical specialization. Hummels et al., "The Nature and Growth of Vertical Specialization in World Trade," 2001, 77. Global use of imported intermediate inputs has risen since the 1980s, indicating increasing use of global supply chains. This measure has not increased markedly for the United States in this period, however, so the discussion in this section focuses on foreign content in U.S. trade. See Chen et al., "Vertical Specialization and Three Facts about U.S. International Trade," 2005, 41; Miroudot et al., "Trade in Intermediate Goods and Services," 2009, 51.

<sup>54</sup> Chen et al., "Vertical Specialization and Three Facts about U.S. International Trade," 2005, 42; Bridgman, "The Rise of Vertical Specialization Trade," 2010, 20.

<sup>55</sup> Commission estimates for 1998 to 2009 using annual BEA input-output tables.

<sup>56</sup> This decline reflects the overall drop in trade in global supply chains during recessions. See section on "new concerns" above for discussion of potential causes.

**FIGURE 3.2** Measures of U.S. participation in global supply chains, 1977–2009



Sources: Feenstra and Jenson, “Evaluating Estimates of Materials,” 2009; Chen et al., “Vertical Specialization,” 2005; Amiti and Wei, “Fear of Service Outsourcing,” 2005; Milberg, written submission to the USITC, December 20, 2010; and Commission estimates.

now substantially higher. Hence, the United States has increased its use of imported intermediate inputs, but these imports have largely been consumed at home and not been used as extensively by U.S. exporters. In contrast, the most active countries in global supply chains, such as Mexico and emerging Asian economies, incorporate a much higher share (often greater than 40 percent) of foreign inputs into their exports.<sup>57</sup>

## Services

U.S. services trade (both imports and exports) in global supply chains has increased over time and is likely to continue to grow rapidly in the future. However, services are less integrated than goods into global supply chains; for example, U.S. companies currently use substantially fewer imported services inputs than imported goods inputs. One reason for this disparity is that as a practical matter, some services can only be provided locally or through direct personal contact. Similarly, although services accounted for 82 percent of U.S. GDP in 2010, they only accounted for 17 percent of U.S. imports and 30 percent of U.S. exports in the same year.

The value of imported services (such as communications, information technology [IT], accounting, and financial services) used by U.S. industry is reportedly quite limited, although studies have not examined the most recent data. One study showed that U.S. manufacturers’ purchases of imported services increased as a share of their total

<sup>57</sup> Koopman et al., “Give Credit Where Credit Is Due,” 2010, 36–37. In fact, as noted earlier for Chinese processing trade, exports from these countries may include more foreign inputs than the goods and services they consume domestically.

purchases of inputs between 1992 and 2000 (figure 3.2), though from a very small base.<sup>58</sup> Thus, the value of imported services, such as accounting services provided by a company in India, made up considerably less than 0.5 percent of the total value of all inputs to manufacturing (including domestic services inputs and manufactured inputs such as the auto parts mentioned above). Other work showed that this measure (use of imported services as a share of total inputs) continued to increase between 1998 and 2006, but that imported services still accounted for less than 0.5 percent of total input purchases in 2006.<sup>59</sup> Another study examined the shares of imported services used by both manufacturers and services providers. Of the two groups, U.S. manufacturers buy more inputs of services from providers overseas than do U.S. service providers. Even in detailed industry categories, services offshoring rarely represents more than 2 percent of total purchases of inputs.<sup>60</sup>

Evidence from specific firms in professional services industries supports these findings. A study of 200 U.S. firms in architecture, engineering, computer systems design, and business support services found little services offshoring: less than 20 percent of all U.S. multinational companies (MNCs) imported services from 1999 to 2003.<sup>61</sup> Moreover, there was little consistent growth in services offshoring for these MNCs during that period.

Although U.S. firms have not substantially increased their offshoring of services, some researchers have focused on identifying which services could potentially be offshored. Services that do not require face-to-face contact have the potential to move overseas.<sup>62</sup> Services that are traded domestically across different parts of the United States also provide some insight into which services could be offshored. By this measure, studies have found that a significant portion of the overall services sector could be traded abroad. Professional services are viewed as especially tradable: about 70 percent of workers in the sector are deemed to perform a tradable activity.<sup>63</sup>

The United States also contributes substantial exports of services in global supply chains. As noted in chapter 2, the United States is a net exporter of services and has a comparative advantage in many services sectors.<sup>64</sup> U.S. workers in many tradable services sectors have more education and higher skill levels than in the lower-paying nontradable service sectors.<sup>65</sup> These facts imply that the United States may gain good jobs in tradable services as services exports grow and become more integrated into global supply chains, although some services are at risk of being offshored to low-wage labor-abundant countries like India and China.<sup>66</sup>

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<sup>58</sup> Amiti and Wei, “Services Offshoring and Productivity,” 2006, 8. Amiti and Wei examined imports of the top five services used by U.S. manufacturers as a share of their total input use. The five services were communications, financial services, insurance, business services, and computers and information services.

<sup>59</sup> Milberg, written submission to the USITC, December 20, 2010, figure 1; Milberg and Winkler, “Financialisation and the Dynamics of Offshoring in the USA,” 2010, 281. Milberg and Winkler looked at a broader measure of services use than Amiti and Wei. They examined imports of all types of services used as inputs by both manufacturers and services firms.

<sup>60</sup> National Academy of Public Administration Panel, *Offshoring: How Big Is It*, 2006, chap. 3.

<sup>61</sup> Including imports from affiliated and unaffiliated sources. *Ibid.*, chap. 6.

<sup>62</sup> Blinder, “Offshoring,” 2006, 113–28.

<sup>63</sup> Jensen and Kletzer, “Tradable Services,” 2005, 10, 30.

<sup>64</sup> For example, in 2009, the United States recorded large trade surpluses in financial services, travel services, and education services. USITC, *Recent Trends in U.S. Services Trade*, 2011, xiv–xv. See the section on the effects of these surpluses on the U.S. economy below.

<sup>65</sup> Jensen and Kletzer, “Tradable Services,” 2005, 12.

<sup>66</sup> Jensen and Kletzer, “‘Fear’ and Offshoring,” 2008, 1. Jensen and Kletzer estimate that 15–20 million jobs are at risk, with about half in the manufacturing sector. Liu and Trefler, “Much Ado about Nothing,” 2008, 31–33, estimate that the effects of inshoring (the opposite of offshoring) are likely to be larger than offshoring, although both effects were small.

While statistics suggest that growth has been slow, offshoring of services is relatively new and has substantial growth potential. Global supply chains are likely to provide more services as companies seek to reduce costs by splitting apart such functions as human resources management, customer support, accounting and finance, and procurement and outsourcing those functions that can be done more efficiently or less expensively by others.<sup>67</sup> Also, R&D and knowledge-intensive services are increasingly being offshored. Many leading services providers are large global firms with headquarters in the United States (table 3.1). These firms have large worldwide workforces. For example, of Accenture's total employees, more were in India than anywhere else in 2007, and 60,000 of IBM's almost 400,000 total employees were in India in 2006. These firms employ their global workforce to supply a wide variety of services, including IT and business consulting, to U.S. firms and to other firms throughout the world.<sup>68</sup>

### ***Information on Value Added Shows That the United States Participates in Supply Chains with a Variety of Countries***<sup>69</sup>

When a good or service is produced in several different countries, official government trade statistics, which are based on the total value of the traded good, can inaccurately represent each country's contribution. As noted in the introduction to this chapter, the Apple iPod is composed of value created in many different countries, only a small share of which is produced in China, the exporter of the final good. The value contributed by each source country, both directly and through intermediate countries, reflects how deeply it is integrated into U.S. supply chains (refer to box 3.3 for details and definitions).<sup>70</sup> This section examines the contributors of value to U.S. imports, absorption, and exports.

#### **Value Added in U.S. Imports**

Although U.S. imports from China and Mexico are considerable, these countries contribute less value added to U.S. imports than Europe,<sup>71</sup> Canada, and Japan, the three largest contributors to value added (table 3.2). Remarkably, U.S. value added that returns home after receiving further processing elsewhere ranks fourth at 8.3 percent. Among all countries, the United States has the highest share of its own value-added exports returned home in its imports.<sup>72</sup> This high share reflects both the large size of the U.S. market and its tight integration with Canada and Mexico.

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<sup>67</sup> Gereffi and Fernandez-Stark, "The Offshore Services Value Chain," 2010, 11–12. This view is also supported by the data on intermediate services trade, which now accounts for a substantial share of total services trade. The ratio of intermediate services trade to total services trade (54 percent) was higher than the comparable ratio for goods trade (52 percent) for the United States in 2005 (Miroudot et al., "Trade in Intermediate Goods and Services," 2009, 48).

<sup>68</sup> Gereffi and Fernandez-Stark, "The Offshore Services Value Chain," 2010, 10, 12.

<sup>69</sup> Value added is the value of output less the value of all intermediate inputs and therefore represents the contribution of labor and capital to the final product. See box 3.3.

<sup>70</sup> This section is based on the database detailed in Koopman et al. "Give Credit Where Credit Is Due," 2010. It is perhaps the most comprehensive attempt to trace value added in trade, but the data to meet its stringent requirements are currently only available for 2004.

<sup>71</sup> Europe refers to the entire EU (EU-27) plus the countries in the European Free Trade Association. The combined GDP of this region is very large and contributes to its prominence in tables in this section.

<sup>72</sup> The world average is 4.0 percent. Other economies with high shares include the EU (7.2 percent) and Japan (3.4 percent). Koopman et al., "Give Credit Where Credit Is Due," 2010, 36.

**TABLE 3.1** Top 10 offshore services providers, 2008

Name	Home country	Employees	Services sales (millions of \$)	Main activities
IBM	U.S.	398,455	58,892	Consulting, IT services
Accenture	U.S.	177,000	23,171	Consulting, IT services
HP Enterprise Services US (formerly EDS)	U.S.	139,500	22,100	IT, applications and business consulting
Computer Sciences Corp.	U.S.	92,000	16,740	Software management, customer relations management
Capgemini	France	89,453	12,740	Consulting, IT services
Automatic Data Processing	U.S.	45,000	8,867	Human resources, payroll, tax, and benefits
Affiliated Computer Services	U.S.	76,000	6,523	IT services, customer relations, human resources, e-government
Logica	UK	39,525	6,320	Business consulting, IT services
Tata Consultancy Services	India	111,407	5,824	Consulting, IT, engineering services
Infosys Technologies	India	105,453	4,533	IT, engineering, consulting, knowledge, and legal services

Source: Gereffi and Fernandez-Stark, "The Offshore Services Value Chain," 2010, 9.

**TABLE 3.2** U.S. imports and value-added shares in U.S. imports, 2004, by source

Region	Total imports Millions of \$	Share of general imports	Share of value-added imports	Share of value added passing through a third country before entering the United States
		Percent		
Europe	393,301	24.7	26.1	17.6
Canada	242,170	15.2	11.0	3.2
Japan	138,417	8.7	10.4	26.0
United States	—	0.0	8.3	100.0
China	176,879	11.1	7.7	14.8
Mexico	154,571	9.7	4.9	4.0
Rest of Americas <sup>a</sup>	76,183	4.8	4.7	13.2
Developing East Asia	79,250	5.0	4.5	32.4
Taiwan, Singapore, Hong Kong	73,066	4.6	4.3	36.7
Korea	51,707	3.3	3.3	31.8
Brazil	23,662	1.5	1.6	20.3
Australia and New Zealand	15,717	1.0	1.3	33.6
Russia	12,003	0.8	1.3	46.4
India	17,486	1.1	1.1	22.0
South Asia	9,557	0.6	0.5	10.2
Rest of world	120,320	7.6	8.5	23.5
Total	1,590,124	100.0	100.0	25.8 <sup>b</sup>

Source: Commission estimates.

<sup>a</sup>Including South American, Central American, and Caribbean countries other than Mexico and Brazil.

<sup>b</sup>U.S. average, weighted by U.S. imports from all sources.

The value-added approach more accurately portrays the origin of the value in U.S. imports than officially reported import data can. For example, Japan has an 8.7 percent share of total U.S. imports, but accounts for 10.4 percent of the value added in U.S. imports (hereafter "U.S. value-added imports"). Japan's higher share of value-added imports indicates that a substantial share of its exports (26 percent) first journey to other countries and undergo additional processing before being exported to the United States. Specifically, Japan produces a large volume of high-value components that are shipped to other Asian countries, particularly China, where they are assembled into consumer goods



and then exported.<sup>73</sup> In contrast, China's share of U.S. value-added imports (7.7 percent) is less than its share of total U.S. imports (11.1 percent). China is the final assembler in a number of supply chains in which Japan and other countries in East Asia supply parts. Similarly, exports from many smaller East Asian countries pass through third countries, such as China, before entering the United States. Canada and Mexico also have lower shares of U.S. value-added imports than their total U.S. imports. U.S. imports from Canada and Mexico contain many U.S.-produced components, which contribute to the large share of U.S. exported value that returns home.

Various countries and regions contribute value to U.S. imports in different sectors (table 3.3). Europe is the largest source of value added for many sectors, particularly business services. U.S. returned value added is most significant in motor vehicles and parts (19.1 percent); much of this represents value added returned home from other NAFTA countries, as the United States is heavily involved in auto supply chains in this region.<sup>74</sup> Europe and Japan also contribute significant amounts of value added to U.S. imports of motor vehicles and parts. U.S. returned value added is also fairly high for apparel (11.0 percent), since some rules of origin provide for duty-free imports of apparel made from U.S. yarns and fabrics (as discussed in the case study on apparel). East Asia,<sup>75</sup> which has abundant low-cost labor and is well integrated into supply chains with China, contributed the most value added to U.S. imports of apparel (27.8 percent).<sup>76</sup>

**TABLE 3.3** Country or regional sources of value added in U.S. imports, selected sectors, 2004, percent

Sector	U.S.		East			Latin		Europe	Others	Total
	returned	China	Japan	Asia	Canada	Mexico	America			
<i>Total</i>	8.3	7.7	10.4	12.0	11.0	4.9	6.3	26.1	13.2	100.0
<i>Selected Sectors</i>										
Apparel	11.0	11.2	2.4	27.8	2.4	2.0	10.4	11.4	21.4	100.0
Chemicals, rubber and plastics	6.3	5.0	9.7	8.7	12.0	2.5	3.6	42.8	9.4	100.0
Motor vehicles and parts	19.1	2.5	23.0	7.2	16.0	3.8	1.9	23.1	3.4	100.0
Electronic equipment	8.6	14.4	19.0	29.6	2.4	9.3	1.3	11.4	3.9	100.0
Machinery and equipment	11.3	10.1	17.2	9.7	6.9	4.7	2.9	32.1	5.1	100.0
Business services	1.5	1.3	6.2	12.7	8.8	0.2	2.7	55.5	11.3	100.0

Source: Commission estimates.

### Value Added in U.S. Absorption

The value-added shares of U.S. absorption (i.e., use of intermediate inputs plus consumption of final products, or equivalently total domestic expenditures on goods and services) provide another view of the sectors and regions where global value chains are important to the U.S. economy. Absorption can distinguish the relative U.S. and foreign value-added shares in products consumed in the United States. Overall, the United States itself generates a large share (89 percent) of the value of final and intermediate goods that it uses (table 3.4). This share is on a par with those of Japan (90 percent) and the EU-15

<sup>73</sup> Dean et al., "Decomposing China-Japan-U.S. Trade," 2009. Japan is also a leading supplier of components to Mexico's export processing industry, particularly for television and vehicle assembly.

<sup>74</sup> See the case study on autos and parts later in this chapter.

<sup>75</sup> East Asia includes Brunei, Cambodia, Timor-Leste, Korea, Hong Kong, Indonesia, Laos, Malaysia, Burma (Myanmar), the Philippines, Singapore, Taiwan, and Vietnam.

<sup>76</sup> Major changes have occurred in global supply chains involving textiles and apparel since 2004, and China's prominence in U.S. imports has increased. See the case study on apparel later in this chapter.

**TABLE 3.4** Country or regional sources of value added in U.S. absorption, selected sectors, 2004, percent

Sector	U.S.	China	Japan	East			Latin		Europe	Others	Total
				Asia	Canada	Mexico	America				
<i>Total</i>	89.0	0.9	1.3	1.5	1.3	0.6	0.7	3.2	1.4	100.0	
<i>Selected sectors</i>											
Apparel	54.3	4.1	0.6	18.3	2.1	1.8	5.7	2.9	8.6	100.0	
Chemicals, rubber and plastics	69.1	3.1	4.2	4.2	3.4	0.8	1.4	11.9	1.5	100.0	
Motor vehicles and parts	57.3	1.5	11.3	3.4	10.1	4.6	0.6	10.6	0.5	100.0	
Electronic equipment	33.3	9.3	12.7	23.3	1.8	10.9	0.8	7.0	0.8	100.0	
Machinery and equipment	76.1	2.7	4.5	3.1	2.2	1.6	0.7	8.4	0.6	100.0	
Business services	88.5	0.3	1.4	1.1	1.4	0.0	0.5	5.9	0.8	100.0	

Source: Commission estimates.

(88 percent), and is higher than those of most developing countries.<sup>77</sup> The many goods and services produced and consumed in the United States and the large portion of U.S. value returned in imports contribute to the high share.

Although overall U.S. value in absorption is high, the domestic value share is typically lower for sectors actively involved in global supply chains. There is substantial foreign content in electronic equipment, apparel, and motor vehicles. For apparel, consistent with value added in imports, China and East Asia contribute more value to U.S. absorption than Mexico and Latin America (largely from Central America).<sup>78</sup> As noted in the case study, Japan, Canada, and Europe are major participants in supply chains for motor vehicles and parts, and together account for almost one-third of the value added in U.S. absorption in the sector. Japan, East Asia, Mexico, and Europe participate in the supply chain for electronic equipment, which is one of the largest in terms of the number of countries contributing significant value added.<sup>79</sup> Electronics has the highest share of foreign content: fully two-thirds of the value of all electronics products used by U.S. industry and consumers originates abroad. Hence, foreign value in some U.S. industries may be substantially higher than estimates in previous studies based on gross input use or gross trade.<sup>80</sup>

In business services, a category that includes consulting and computer support, the United States provides a large portion (88.5 percent) of its absorbed value added, while Europe contributes 5.9 percent. Despite the high profile of India's consulting and computer services and the prominence of some large suppliers (table 3.2), India supplied only 0.1 percent of the value added in U.S. absorption of business services in 2004.

<sup>77</sup> EU-15 refers to the first 15 countries to join the EU. Domestic value-added shares for Japan, the EU-15, and other countries come from Koopman et al., "Give Credit Where Credit Is Due," 2010, 36.

<sup>78</sup> Given changes discussed in the apparel case study later in this chapter, China's contribution has likely grown since 2004.

<sup>79</sup> See the case study on televisions for an example of an electronic product in which Mexico is a major contributor.

<sup>80</sup> The Commission's estimate of foreign value in electronics is considerably higher than some previous estimates. For example, Professor William Milberg estimates that the share of foreign inputs in the electronics industry's use of intermediate inputs is about 20 percent. (Milberg, written submission to the USITC, December 20, 2010, 11.) Based on the Commission's data, the foreign value-added share in U.S. gross absorption of electronic equipment is 16 percent, which is similar to Milberg's estimate. These low values are based on gross input use, however. This report has argued that measures based solely on value added (such as the estimates in table 3.4) provide the most informative view on foreign content.

## Value Added in U.S. Exports

Value added in U.S. exports measures how much different countries contribute to the value of exported goods and services. The United States contributed a high share (87.1 percent) of total value added to its exports in 2004 (table 3.5). The domestic content of exports remains high even in sectors such as electronics, where various countries contribute value added. This is in sharp contrast to emerging markets such as China, Malaysia, and Mexico that have substantial foreign value in their exports. The United States does have slightly higher foreign value in its exports than the other major developed economies (Japan and the EU).<sup>81</sup>

Europe contributes the largest foreign share of value in total U.S. exports (3.3 percent) with significant shares in many sectors, namely, electronic equipment; motor vehicles and parts; and chemicals, rubber, and plastic products.<sup>82</sup> The United States participates in various value chains with its NAFTA partners, Canada and Mexico. Canada contributes the largest single-country share of foreign value added in U.S. exports (1.7 percent) and is a key supplier of foreign value added in motor vehicles and parts and chemical, rubber, and plastic products.<sup>83</sup> Mexico's overall share (0.9 percent) is small but its contribution is important in sectors such as electronics and motor vehicles. The U.S. share of value added in its own exports is highest for business services (95.6 percent) and lowest for electronic equipment (76.9 percent), where many other countries contribute value added.

Value-added calculations provide a more revealing look at the contributors to U.S. imports and exports than can be seen in officially reported gross trade statistics. Hence, these trade statistics can also provide new insight into bilateral trade deficits. Box 3.4 compares bilateral deficit measures in gross terms to those measured using the value-added decomposition in this chapter.

**TABLE 3.5** Country or regional sources of value added in U.S. exports, selected sectors, 2004, percent

Sector	U.S.	China	Japan	East		Mexico	Latin		Europe	Others	Total
				Asia	Canada		America				
<i>Total</i>	87.1	0.8	1.3	1.5	1.7	0.9	1.1	3.3	2.1	100.0	
<i>Selected sectors</i>											
Apparel	88.5	0.7	0.8	1.5	1.3	0.6	0.7	3.3	2.5	100.0	
Chemicals, rubber and plastics	85.5	0.5	1.0	1.1	2.2	0.7	1.5	4.4	3.0	100.0	
Motor vehicles and parts	81.5	1.3	3.0	1.9	3.0	1.3	1.3	4.7	2.0	100.0	
Electronic equipment	76.9	2.7	3.7	5.1	1.6	2.2	1.0	4.7	2.0	100.0	
Machinery and equipment	89.4	1.0	1.2	1.3	1.3	0.8	0.8	2.8	1.4	100.0	
Business services	95.6	0.2	0.6	0.7	0.5	0.2	0.2	1.4	0.6	100.0	

Source: Commission estimates.

<sup>81</sup> Koopman et al., "Give Credit Where Credit Is Due," 2010, 35.

<sup>82</sup> This region was the largest destination for U.S. exports, accounting for just over 27 percent of total U.S. exports.

<sup>83</sup> The United States exported over \$145 billion of chemical, rubber, and plastics products in 2004, about 14 percent of the global total.

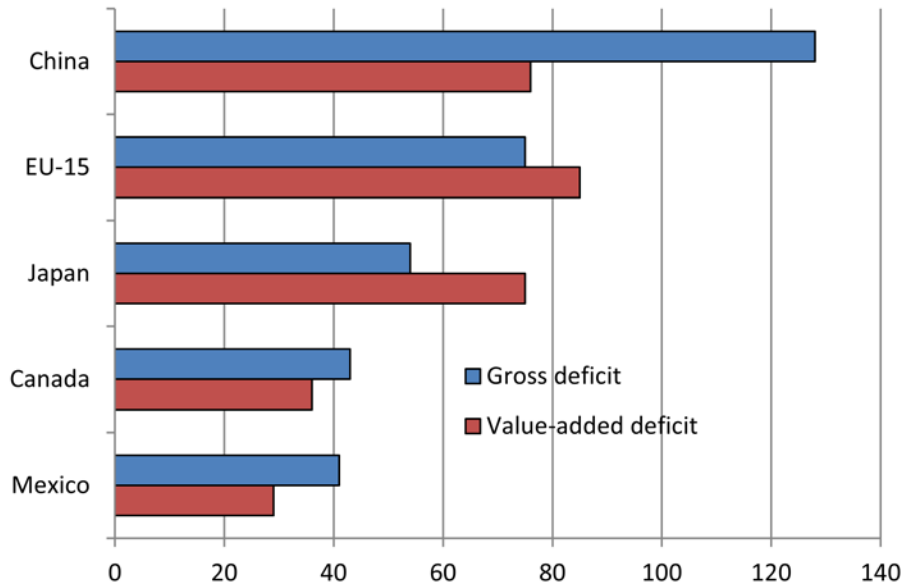
**BOX 3.4** The U.S. value-added trade deficit

The U.S. trade balance, or the difference between U.S. exports and imports, is a frequently discussed trade issue. The United States has had large trade deficits in recent years (e.g., \$500 billion in 2010), and it has also had substantial bilateral deficits with major trading partners.

This chapter shows repeatedly that many countries may add value to a particular good or service in a global supply chain, and that attributing the entire export value to the last exporting country can provide a misleading picture of the sources of value in U.S. trade. While the overall U.S. trade balance is not affected by any of the calculations in this chapter, examinations of bilateral trade balances on a value-added basis yield different conclusions about the extent to which specific foreign countries contribute to the U.S. deficit.<sup>a</sup>

The contribution of China to the U.S. trade deficit differs substantially depending on which of the two measures is used. As discussed in this chapter, China is the final assembler in a large number of global supply chains, and it uses components from many other countries to produce its exports. The figure below shows that the U.S.-China trade deficit on a value-added basis is considerably smaller (by about 40 percent in 2004) than on the commonly reported basis of official gross trade.<sup>b</sup> By contrast, Japan exports parts and components to countries throughout Asia; many of these components are eventually assembled into final products and exported to the United States. Thus the U.S.-Japan trade balance on a value-added basis is larger than the comparable gross trade deficit. The U.S. value-added trade deficits with other major trading partners (Canada, Mexico, and the EU-15) differ by smaller amounts from their corresponding gross trade deficits.

U.S. Bilateral Trade Deficits with Major Trading Partners, 2004 (billions of dollars)



Source: Commission estimates.

<sup>a</sup>USITC, hearing transcript, December 16, 2010, 12 (testimony of Kenneth Kraemer, professor, University of California, Irvine); Johnson and Noguera, "Accounting for Intermediates," 2010, 33.

<sup>b</sup>Using a slightly different method, a recent study found that this discrepancy was about 53 percent in 2005 and 42 percent in 2008. WTO, IDE-JETRO, *Trade Patterns and Global Value Chains in East Asia*, 2011, 104.

## ***Investment Abroad Has Increased U.S. Participation in Global Supply Chains***

U.S. investment abroad has contributed to the development of global supply chains.<sup>84</sup> For example, U.S. firms are key investors in Mexico's processing industry, which exports goods containing large shares of U.S. value added.<sup>85</sup> U.S. firms and other foreign firms also contributed to the growth of China's processing industry, which participates in supply chains with the United States and East Asia.<sup>86</sup> As previously noted, U.S. production is well integrated with that of Canada, a major recipient of U.S. foreign direct investment (FDI) in 2009.<sup>87</sup> About a third of U.S. manufacturing imports from Canada originate from U.S. firms operating in Canada, and many Canadian exports to the United States are intermediate products that contain a sizable component of U.S. value added and that are returning for further processing in the United States. Most U.S. FDI in 2009 was directed to Europe, a key U.S. supplier in global chains. U.S. investments abroad were primarily in the finance industry, the insurance industry, and a variety of manufacturing industries, including chemicals and machinery.

Investments by foreign firms in the United States similarly contribute to the growth of global supply chains. European countries, followed by Japan and Canada, were the primary sources of FDI into the United States in 2009.<sup>88</sup> Foreign multinationals investing in the United States commonly extend global supply chains from the parent firm to their affiliates. For example, Japanese automakers that manufacture cars in U.S. plants import some auto parts from Japan.<sup>89</sup> Such "vertical" FDI is particularly important for supply chains.

## ***Policies and Institutions Have Affected U.S. Participation in Global Chains***

U.S. government policies have neither directly promoted nor opposed the development of global supply chains. However, many policies and institutions, especially those concerning trade and foreign business conditions, indirectly affect the prevalence of supply chains. This section briefly surveys these factors.

### **Facilitating Factors**

Private entrepreneurs seeking innovative ways to access markets and to lower costs have been the principal force behind global supply chains, which have developed despite differences in culture, administration, geography, and level of development among participants in the value chain.<sup>90</sup> These entrepreneurs are attracted by institutions that

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<sup>84</sup> Gereffi, "Shifting Governance Structures in Global Commodity Chains," 2001, 1616. Along with increased use of the Internet, investment by multinational firms was a primary driver of the growth of global supply chains in the last part of the 20th century.

<sup>85</sup> The Mexican processing sector includes the IMMEX program (formerly the Maquiladora and PITEX programs), and is similar in nature to the Chinese processing regime discussed earlier in the chapter. In 2006, the United States supplied 51 percent of the value of Mexican processing imports, a high share but one that has declined from 81 percent in 2000 as Mexico has integrated into supply chains with other countries. See De La Cruz et al., "Estimating Foreign Value-added in Mexico's Manufacturing Exports," 2010, 4–6.

<sup>86</sup> Fung et al., *U.S. Direct Investment in China*, 2004, 5.

<sup>87</sup> Ibarra-Caton, "Direct Investment Positions for 2009," 2010, 32–33.

<sup>88</sup> *Ibid.*, 34–35.

<sup>89</sup> Blonigen, "In Search of Substitution between Foreign Production and Exports," 2001, 94. Economists commonly find a complementary relation between FDI and imports from the parent's country. In this case, Blonigen found a substitution relationship: fewer Japanese cars were imported.

<sup>90</sup> Ghemawat, *Redefining Global Strategy*, 2007.

support business growth by providing for secure property rights and contract enforcement. Some governments have sought to improve their investment climate, which indirectly contributes to the formation of global value chains. For example, the USDOC SelectUSA program<sup>91</sup> encourages foreign firms to invest in new U.S. businesses and contributes to the formation of supply chains between the United States and the country of the investing parent firm.<sup>92</sup> The business climate in foreign countries is an important determinant of where U.S. firms choose to invest.<sup>93</sup>

As noted, the effects of tariff and other trade restraints are magnified in the case of goods passing through multiple borders in global supply chains.<sup>94</sup> U.S. supply chain development has thus benefited from trade liberalization abroad and from lower U.S. import restraints. For example, average U.S. tariffs have fallen considerably, from 3.4 percent in 1989 to 1.3 percent in 2010.<sup>95</sup> Similarly, the barriers that U.S. exporters face abroad fell during the period; the average tariff on U.S. exports is now about 3.0 percent, although some high tariffs remain.<sup>96</sup> Still, despite shrinking trade barriers, multiple border crossings raised the cost of exporting U.S. final goods by 46 percent (from 1.3 to 1.9 percentage points) in 2004, the most recent year for which data are available.<sup>97</sup>

U.S. free trade agreements (FTAs) and preferential trade programs also contributed to the creation of global supply chains.<sup>98</sup> NAFTA phased out a number of tariffs and other trade restrictions, and promoted the integrated production of many commodities in Canada, Mexico, and the United States. Since NAFTA entered into force in 1994, U.S.-Mexico trade in goods has more than tripled, and as much as 85 percent of Mexico's exports result from global supply chains.<sup>99</sup> The United States and Canada have a large, highly integrated trading relationship that includes value chains in auto parts and other products. Likewise, the Caribbean Basin Trade and Partnership Act and the Central America-Dominican Republic Free Trade Agreement (CAFTA-DR) have led to increased U.S. integration with Caribbean and Central American countries. Although highly efficient apparel supply chains in East Asia (particularly China) have supplanted apparel chains in this region to a large extent, collectively the CAFTA-DR countries were the second largest supplier of textiles and apparel to the United States in 2010 after China.<sup>100</sup>

## Impeding Factors

Policies that limit trade tend to restrict the use of global supply chains, and many impediments to trade remain.<sup>101</sup> For example, customs procedures—both burdensome

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<sup>91</sup> SelectUSA incorporated the “Invest in America” program in June 2011.

<sup>92</sup> There is some evidence that such programs can increase investment; see Harding and Javorcik, “Developing Economies and International Investors” 2007, 21–22.

<sup>93</sup> The United States has over 40 bilateral investment treaties, mostly with smaller countries, that seek to protect U.S. investment abroad. USDOC, *Bilateral Investment Treaties and Related Agreements*, March 3, 2008.

<sup>94</sup> Yi, “Can Multistage Production Explain the Home Bias in Trade?” 2010, 365; Ma and Assche, “The Role of Trade Costs in Global Production Networks,” 2010.

<sup>95</sup> USITC, *Import Restraints, Sixth Update*, 2009, 1; this report, chap. 2.

<sup>96</sup> USITC, *Small and Medium-Sized Enterprises*, 2010, 6–15.

<sup>97</sup> Koopman et al., “Give Credit Where Credit Is Due,” 2010, table 7.

<sup>98</sup> ROO in these agreements, as well as earlier trade programs such as U.S. production sharing tariff provisions, have facilitated supply chains with U.S. trading partners.

<sup>99</sup> De La Cruz et al., “Estimating Foreign Value-added in Mexico’s Manufacturing Exports,” 2011, 18, 24.

<sup>100</sup> Despite lower tariffs offered by CAFTA-DR, inefficient port operations in Central America make it difficult for these countries to take advantage of this agreement. Londoño-Kent et al., “A Tale of Two Ports,” 2003, 20.

<sup>101</sup> See chap. 2 of this study for an analysis of significant U.S. restraints.

rules and inefficient port operations—often hinder the flow of goods.<sup>102</sup> Efficient operation of global supply chains requires adequate infrastructure at ports and airports, as well as speed and accuracy in the customs and security clearance process.<sup>103</sup> Extra time in transit, whether due to delays in customs clearance or transportation, raises trade costs and decreases the likelihood that trade will take place at all.<sup>104</sup>

Regulations that restrict foreign business practices also make it more difficult for global supply chains to flourish. These include policies that limit foreign investment, regulate the form that a foreign-owned establishment can take, restrict the hiring of personnel, and impose opaque and duplicative licensing requirements.<sup>105</sup> However, these restrictions do not necessarily make the operations of global supply chains impossible. In some cases, when faced with onerous regulations that may stifle foreign investment, foreign firms may still be able to contract local firms to complete tasks in a global supply chain; these firms may be more adept at dealing with (or exempt from) the local barriers.<sup>106</sup>

## **Effects of Global Supply Chains on the U.S. Economy**

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### ***Key Effects***

The expansion of global supply chains has had multifaceted and complex effects on the U.S. economy, which are challenging to quantify in terms of production, prices, and jobs. One reason it is difficult to measure these economic effects is that supply chains have rearranged the pattern of U.S. trade, increasingly concentrating the production and export of skill-intensive goods and services in the United States while relocating other, less skill-intensive activities to other countries. Global supply chains have induced many leading U.S. companies to change their business models, refocusing on coordinating the assets and expertise of their business partners, and placing less emphasis on owning all key technological and managerial assets. Advances in supply chain management by U.S. retailers have made it easier and cheaper to import an increasing variety of goods into the United States, with significant benefits to consumers. The effect of global supply chains on U.S. wages and employment varies for workers in different industries and occupations, and may also depend on the extent to which U.S. multinationals concentrate their activities in high-income or low-income countries.

The strength of the evidence linking global supply chains to the effects on companies, consumers, and workers varies, depending on the type of linkage being examined. Many of the observations in this section rely at least partly on indirect evidence and inference. There are several ways in which better measurement can aid further quantitative investigations on this topic; these possibilities are discussed at the end of this chapter.

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<sup>102</sup> International logistics firms encounter their most significant impediment at the border clearance process. USITC, *Logistic Services*,” 2005, 3-2.

<sup>103</sup> USITC, hearing transcript, December 16, 2010, 39–43 (testimony of Michael Mullen, Express Association of America).

<sup>104</sup> Studies on the importance of time in trade include Hummels, “Calculating Tariff Equivalents for Time in Trade,” 2007 and Djankov et al., “Trading on Time,” 2006. Londoño-Kent provided information of border crossing frictions at the U.S.-Mexican border; see USITC, hearing transcript, December 16, 2010, 31–38.

<sup>105</sup> USITC, *Logistic Services*, 2005, 3-2.

<sup>106</sup> A U.S. industry source noted that Haitian firms can perform such tasks as Haitian customs clearance more efficiently than U.S. firms and added that for this reason, it is more efficient to contract for services there than to invest directly. USITC, *Textiles and Apparel*, 2008, 1–12.

## *Effects on the Pattern of U.S. Production and Trade*

### **U.S. Multinational Firms, Now Acting as Coordinators of Networks**

As already mentioned, the advent of global supply chains has required major U.S. companies to revise their business models to become network facilitators, with successful firms acting as coordinators of capabilities among multiple strategic allies.<sup>107</sup> As firms expand their global supply chains, their ability to grow and remain profitable depends on managing their relationships with an ever-larger network of suppliers and customers.<sup>108</sup> It is less and less likely that a firm managing a global supply chain will own all of the assets needed to succeed in a single vertically integrated operation. Thus, the focus of multinational firms' strategy is increasingly on alliances. These alliances range in their degree of formality from turnkey operations to joint ventures. When a high degree of coordination is required, such alliances may result in mergers or acquisitions.<sup>109</sup>

The increasing reliance on strategic networks means that successful U.S. multinationals must operate very differently than they did in earlier decades, when there was a greater tendency for firms to control all phases of their operations directly. Today, personal computer companies such as Apple, Dell, and Hewlett-Packard (HP) specialize in consumer-oriented aspects of computer design, while Taiwan-based manufacturers are increasingly responsible for designing a computer's physical architecture, finding suppliers for subcomponents, and making sure the pieces fit.<sup>110</sup> Similarly, as discussed below in the apparel case study, U.S. retailers of apparel like Wal-Mart and Limited Brands are linked indirectly to a wide variety of textiles and apparel suppliers worldwide, often relying on specialized middlemen such as the Hong Kong-based Li & Fung.

The effect of these changes has been to enhance the leadership of U.S. multinationals in some industries, but not universally. Companies such as HP that successfully transitioned to a role as coordinator of networks thrive and remain global lead firms, while those that failed to do so have declined. For example, U.S. television producers did not adapt to technological changes as readily as other electronics firms, thus ceding their role as network coordinators to Japanese and Korean firms (see the television case study later in this chapter).

### **Relocation of Tasks**

As discussed above, the development of supply chains enables different parts of the production process to be carried out in various locations, allowing countries to specialize in tasks rather than in goods.<sup>111</sup> In general, as already noted, this industrial restructuring has led firms in the United States to increasingly specialize in mid- to high-skilled tasks; however, the stages of production that relocate, and the speed of this relocation, have varied by industry. The following sections discuss how this trend has affected U.S. manufacturing, services, and R&D activity.

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<sup>107</sup> For the concept of multinationals as manufacturing impresarios, see North, *Localizing Global Production*, 1997.

<sup>108</sup> Dunning and Lundan, *Multinational Enterprises and the Global Economy*, 2008, 260–94.

<sup>109</sup> Contractor and Lorange, "The Growth of Alliances in the Knowledge-Based Economy," 2002.

<sup>110</sup> Dedrick and Kraemer, "Offshoring and Outsourcing in the PC Industry," 2009.

<sup>111</sup> Grossman and Rossi-Hansberg, "Trading Tasks," 2008.



### *Relocation of tasks: Effects on U.S. manufacturing*

U.S. companies have moved their manufacturing operations abroad to capitalize on differences in comparative advantage. Companies in developing countries have focused on particular labor-intensive tasks, such as final assembly of computers and telecommunications equipment, while the United States and other high-income countries have retained certain technology-intensive parts of the supply chain.

The speed of this reorganization has differed by industry. In electronics, productive tasks have been offshored relatively rapidly to low-wage locations such as China. The most dramatic shift has been in the production and assembly of computers. Production of computer peripherals, photographic equipment, and telecommunications equipment such as cell phones has also relocated to lower-income countries. However, the United States and other high-income countries have retained a large share of the production and export of such technology-intensive products as doped wafers<sup>112</sup> and machinery used in manufacturing semiconductors. Figure 3.3 shows the average income in countries exporting electronics products relative to incomes in the United States.<sup>113</sup> For example, the average per capita income of producers of semiconductors and integrated circuits is less than 40 percent of U.S. income. This indicates that producers of these goods earn wages below those prevailing in, say, Taiwan (which has roughly half the per capita income of the United States), but above those of China, Malaysia, or the Philippines (which have per capita incomes less than one-fifth of the U.S. level). The decline in relative wages between 1997 and 2006 has been particularly rapid in computers and computer peripherals, reflecting the rapid offshoring of production from high-income countries in these products.

The offshoring of activity in most other industries has not been as extensive, nor the changes as rapid, as in the electronics industry. Chemicals provides an example of an industry with more modest movements in supply chains (figure 3.4). A comparison of electronics and chemicals offshoring also shows that globalization does not affect the same stage of production in every industry. The United States retains substantial production of upstream inputs and machinery in the electronics sector, which require much more technology and skill to produce than more finished goods in the sector such as computers. In chemicals, high-income countries retain most of the production of final goods such as cosmetics and personal care items, which are the most technologically complex products in the sector. Meanwhile, upstream inputs are composed mostly of raw materials and basic organic compounds, and sourcing of these inputs has moved rapidly to low-income countries.

### *Relocation of tasks: Effects on U.S. services*

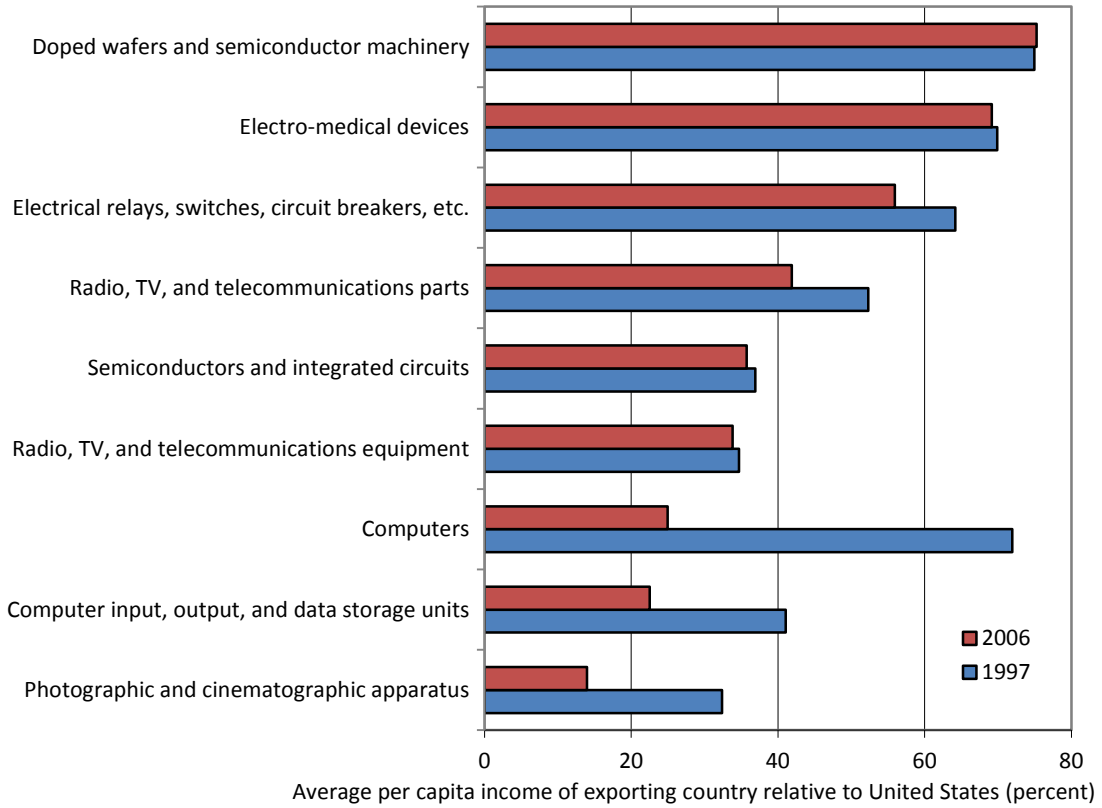
Globalization has caused relocation of services activities as well as goods production. The reorganization of supply chains for services has led to both offshoring (foreign provision of services used to produce goods and services in the United States, resulting in

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<sup>112</sup> Wafers are thin crystals of highly pure semiconductor material, usually silicon. They are doped by the deliberate introduction of impurities such as boron or antimony. The technology of this process is relatively more difficult than later stages of the assembly and testing of semiconductors.

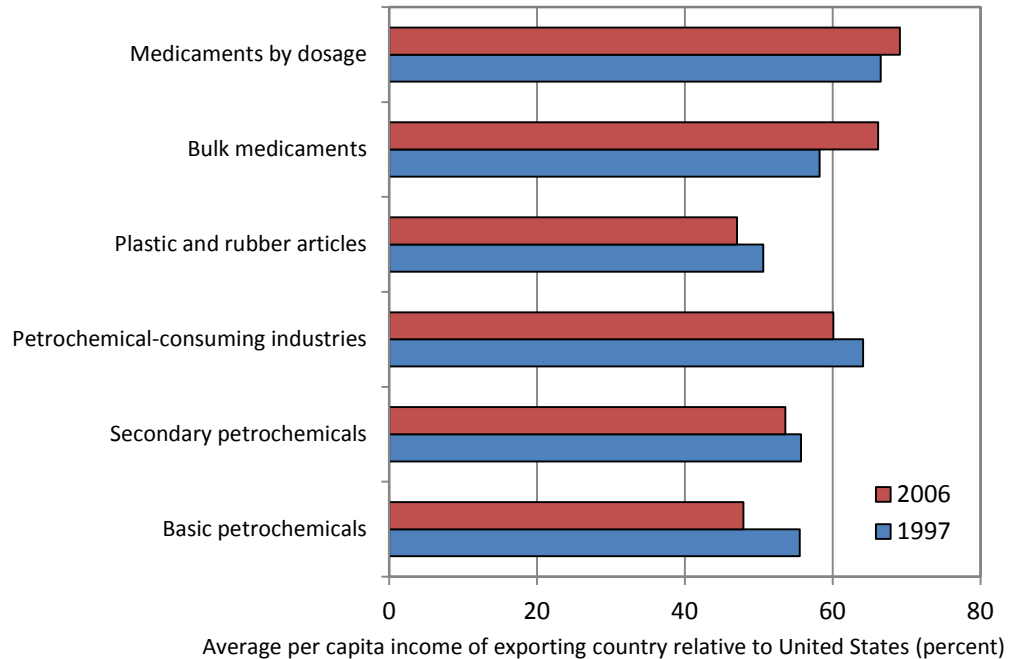
<sup>113</sup> The analysis in this section is based on Deason and Ferrantino, "Determinants of Diffusion and Downstreaming," 2009. This study looked at patterns of international trade in technology-intensive products for 15 countries making up the bulk of world trade in such products for the period 1997–2006.

**FIGURE 3.3** Some electronics and related products have moved rapidly to low-income countries; others have not



Source: Deason and Ferrantino, "Determinants of Diffusion and Downstreaming," 2009.

**FIGURE 3.4** Exports involving later stages of chemical processing are associated with higher income levels



Source: Deason and Ferrantino, "Determinants of Diffusion and Downstreaming," 2009.

U.S. services imports) and inshoring (U.S. provision of services to foreign producers, resulting in U.S. services exports). Firms in the United States specialize in many kinds of skilled labor-intensive services. Important components of the U.S. trade surplus in services include royalties and license fees; financial services; other business, professional, and technical services; and travel services. Firms around the world thus tend to source some of the skilled services they need in the United States. While some service activities, such as call centers, software design, and payroll processing, can be relocated to developing countries,<sup>114</sup> these remain the exception rather than the rule.<sup>115</sup> Consequently, for the United States, inshoring of services is a much larger phenomenon than offshoring. In 2009 the United States exported \$484 billion of services and imported \$335 billion, for a surplus of \$149 billion. The 2009 surplus is more than double its 2003 level of \$67 billion. During the same period, U.S. exports of business, professional, and technical services have grown by 85 percent, more rapidly than the 66 percent growth in U.S. exports of other services.<sup>116</sup>

#### *Relocation of tasks: Effects on U.S. R&D*

U.S. multinationals still perform most of their R&D activities at home; in 2007, for example, 85 percent of their R&D investment remained in the United States. Both economies of scale in R&D and the need to coordinate R&D with central headquarters management provide continuing incentives for firms to focus their R&D at home. However, it is becoming more common for U.S. firms to locate R&D outside the United States.<sup>117</sup> Although only 15 percent of U.S. multinationals' R&D investment went to their affiliates abroad in 2007, that share is up from 12 percent in 2001. Moreover, while most of the R&D carried out by U.S. affiliates occurs in other developed countries,<sup>118</sup> there have been a number of recent instances of U.S. firms increasing their R&D investment and employment in emerging markets, including Pfizer and Microsoft in China, Ford in Brazil, and Boeing in India.<sup>119</sup>

Multinationals' R&D in developing countries consists in large measure of adapting U.S. technologies. When multinationals use their foreign affiliates primarily for production and sales, as is common, it makes sense for their R&D in those countries to focus primarily on adapting technologies, processes, and strategies already developed in the United States to different local conditions.<sup>120</sup> The development of new technologies or management methods would require the affiliate to engage in a higher level of independent action than a typical affiliate focused on production and sales.<sup>121</sup>

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<sup>114</sup> The United States is also a net importer of insurance services and computer and data processing services. See Gereffi and Fernandez-Stark, "The Offshore Services Value Chain," 2010, for more examples of services that have been offshored to developing countries.

<sup>115</sup> This characterization is based on both recent case studies and U.S. trade data.

<sup>116</sup> BEA data and Commission calculations.

<sup>117</sup> Gilman, "The New Geography of Global Innovation," 2010, 7.

<sup>118</sup> In 2008, 70 percent of the \$37.0 billion of R&D performed by majority-owned U.S. affiliates abroad was located in Australia, Canada, the EU, and Japan. (BEA data and Commission calculations.)

<sup>119</sup> Gilman, "The New Geography of Global Innovation," 2010, 8, gives additional examples.

<sup>120</sup> Dunning and Lundan, *Multinational Enterprises and the Global Economy*, 370–1. See also USITC, hearing transcript, December 16, 2010, 131–2 (testimony of Kenneth Kraemer, professor, University of California, Irvine).

<sup>121</sup> Cantwell and Mudambi, "MNE Competence-Creating Subsidiary Mandates," 2005, 1109–28.

## *Effects on Consumers*

Retailers are major users of advanced supply chain management techniques, and the efficiencies gained from the use of such techniques impact consumers directly. For example, the United States' largest retailer, Wal-Mart, has pioneered a variety of techniques to track products, manage warehouse inventories, and guarantee that orders from suppliers are quickly and accurately filled.<sup>122</sup> These practices are increasingly being adopted by other retailers around the country, and integrated with strategies for overseas sourcing. U.S. consumers have benefited both from the lower prices in today's better-managed superstores and from an increasingly wide variety of imported and domestic goods.<sup>123</sup> Better supply chain management also contributed to lowering the retail prices of apparel, electronics, hardware, recreational goods, and other items that are frequently imported.

In addition to lowering costs, the availability of a wider range of imported goods in the U.S. market has also benefited consumers in terms of increased product variety. The number of imported product varieties in the United States increased by a factor of four from 1972 to 2001.<sup>124</sup> The benefit to consumers of this increase in variety is estimated to be equivalent to a 1.2 percentage point annual drop in import prices, or 2.6 percent of GDP over the entire time period. While there are multiple factors affecting the supply of new imported varieties into the United States, including economic development in other countries, improvements in supply chain efficiency have also played a role. It has been estimated that trade facilitation measures in developing countries, which would enhance these countries' integration into supply chains by cutting red tape at the border, could dramatically expand the variety of products they export to developed countries.<sup>125</sup> Thus, there is scope for further improvements in supply chains in developing countries that could yield substantial benefits for consumers in the United States and other markets.

## *Effects on Employment and Wages*

The effects of global supply chains on U.S. wages and employment are not well established in the economic literature, although empirical evidence suggests that effects vary by sector and by skill level of worker. Although studies suggest that, overall, U.S. workers are likely to benefit from global supply chains, there may be a negative effect on the relative wages of less-skilled workers. Offshoring low-skilled tasks to other countries has three potential effects on wages:<sup>126</sup>

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<sup>122</sup> These techniques include continuous replenishment programs, vendor-managed inventory, and the use of radio frequency identification (RFID) technologies. See Lummus and Vokurka, "Defining Supply Chain Management," 1999; Angeles, "RFID Technologies," 2005.

<sup>123</sup> One study found that Wal-Mart sells identical food items at prices 15 to 25 percent lower than traditional supermarkets. Hausman and Leibtag, "CPI Bias from Supercenters," 2004.

<sup>124</sup> Broda and Weinstein, "Globalization and the Gains from Variety," 2006.

<sup>125</sup> Persson, "Trade Facilitation and the Extensive Margin," 2010. This study finds that if all countries were as efficient at the border as the most efficient country at the same level of development, the number of product varieties exported to the EU would increase by 64 percent for more differentiated products, such as high-end manufactured goods, and 29 percent for more uniform products such as agricultural goods.

<sup>126</sup> Grossman and Rossi-Hansberg, "Trading Tasks," 2008; Baldwin, "Integration of the North American Economy," 2009.

- First, there is a *labor supply effect*, as low-skilled workers whose tasks have been offshored seek other jobs in the economy. This effect tends to push down the wages of less-skilled workers.<sup>127</sup>
- Second, offshoring can have a *terms-of-trade effect*, which can raise or lower wages by changing the relative prices of U.S. imports and exports. If offshoring increases the world supply of a good or service that the U.S. exports, its price will tend to decrease, while a relative decrease in the world supply of a good or service will increase the U.S. export's price. If the price shift leads to a decrease in U.S. export prices relative to U.S. import prices, this would tend to lower U.S. wages, while if U.S. export prices increase in relative terms, workers would benefit.
- Third, there is a *productivity effect*. When U.S. firms reduce costs by offshoring some tasks, the increased productivity could benefit all workers (both less-skilled and more-skilled) that remain employed. The widespread use of supply chains has generated economy-wide productivity gains, and thus potential increases in the wages of all kinds of workers.<sup>128</sup>

Studies conducted in the 1980s and 1990s often found at least some evidence for the labor supply effect. Increased imports of goods using less-skilled labor exerted downward pressure on the wages of less-skilled labor in the United States, though the effect of imports was often estimated to be modest compared to other factors affecting workers, such as technical change.<sup>129</sup> Since that time, global activities have been split into narrower tasks, and still more less-skilled activities have been sent to low-wage countries, while new high-skilled activities have migrated to the United States. Increased outsourcing can place additional downward pressure on the wages of less-skilled labor. One early study of this effect estimated that outsourcing accounted for 15 to 40 percent of the decline in the wages of production workers (such as assemblers, repair personnel, and maintenance workers) relative to nonproduction workers (such as managers, salespersons, and professionals) over 1979–90.<sup>130</sup>

The effect of global production fragmentation on wage inequality in the United States and elsewhere continues to be actively researched. Since the first intensive studies into the relationship between trade and wages in the 1990s, the share of U.S. imports from developing countries has expanded. One recent study, focusing on the impact of U.S. imports from China on U.S. local labor markets, found that increasing Chinese imports explain one-third of the aggregate decline in U.S. manufacturing employment between 1990 and 2007.<sup>131</sup> Another study found that average hourly compensation in the top 10 U.S. trading partners, weighted by trade, has fallen substantially: from 81 percent of the U.S. level in 1990, when China ranked 10th among U.S. trading partners, to 65 percent in

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<sup>127</sup> This effect is not specific to supply chains—imports from developing countries could exert downward pressure on the wages of less-skilled workers in the United States, even in a world in which production fragmentation did not exist.

<sup>128</sup> Some work has questioned the extent to which these gains have been transmitted to workers and the broader economy, however. One study associated offshoring with an increase in the share of corporate profits in value-added and a decrease in the share of labor, and argued that increased profits from offshoring have been largely invested in financial assets, rather than in assets that are more likely to raise productivity and employment. Milberg and Winkler. “Financialisation and the Dynamics of Offshoring in the USA,” 2010.

<sup>129</sup> USITC, *The Impact of Trade Agreements*, 2003.

<sup>130</sup> Feenstra and Hanson, “The Impact of Outsourcing,” 1999. According to this study, the effect of advances in technology on wages is substantially greater than the effect of outsourcing. The study estimated that expenditures on computers, a measure of technology upgrading, accounted for 35 to 70 percent of the falling relative wage of production workers.

<sup>131</sup> Autor et al., “The China Syndrome,” 2011.

2005, when China ranked 3rd.<sup>132</sup> This suggests at least the possibility that increasing production fragmentation in manufacturing may continue to place downward pressure on wages of less-skilled labor, and may also reduce employment of such workers. Future research may aid in disentangling the various ways in which global supply chains may have affected the structure of wages and employment in the U.S. economy and abroad. Box 3.5 discusses ways in which improved data could better show how participation in global chains affects the United States.

The effects of offshoring on U.S. manufacturing workers vary significantly for workers in different industries or occupations. Overall, U.S. multinationals tend to hire more workers in the United States when they are also expanding employment in high-income countries, and fewer U.S. workers when they are expanding employment in low-income countries in industries employing a high share of workers in routine occupations such as clerical work than in industries employing a high share of workers in nonroutine work such as management, communication, analytical reasoning, or skilled eye-hand coordination. Possibly as a result, workers in routine occupations experienced lower employment and wages when U.S. multinationals in their industries hired more workers in low-income countries, but higher employment and wages when U.S. multinationals in their industries hired more workers in high-income countries.<sup>133</sup>

Relatively few U.S. services jobs have been offshored so far. Researchers remain divided as to the potential effects of offshoring services on U.S. employment and wages, although the U.S. comparative advantage and trade surplus in services sectors are highlighted as reasons for positive effects on U.S. workers.

Some analysts believe the potential for future offshoring of such jobs is substantial. One study estimates that while the total number of U.S. services jobs offshored so far may be well less than a million, the total number of services jobs susceptible to offshoring is two to three times greater than the total number of manufacturing jobs.<sup>134</sup> However, another study argues that only “about one-third of tradable services activities are at risk of being offshored to low-wage labor-abundant countries like India and China,” noting that the United States appears to have a comparative advantage in services and is a net exporter of services.<sup>135</sup> The same study noted that U.S. workers in tradable services sectors have more education and higher skill levels than in the lower-paying nontradable service sectors, and argued that the United States will likely gain good jobs in tradable services as services exports grow and become more integrated into global supply chains.<sup>136</sup> Other studies also question the calculations indicating that very large numbers of service jobs are offshorable, stating that they do not always consider the possibility of increased U.S. services exports to developing countries and, again, do not take into account the substantial U.S. trade surplus in services.<sup>137</sup>

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<sup>132</sup> Krugman, “Trade and Wages, Reconsidered,” 2008.

<sup>133</sup> Ebenstein et al., “Estimating the Impact of Trade and Offshoring on American Workers,” 2009.

<sup>134</sup> There were 14 million U.S. manufacturing jobs in 2006, the year the study was published. Blinder, “Offshoring,” 2006.

<sup>135</sup> Jensen and Kletzer, “‘Fear’ and Offshoring,” 2008. Jensen and Kletzer estimate that 15–20 million jobs are at risk with about half in the manufacturing sector, which has long been at risk.

<sup>136</sup> U.S. workers may also benefit from exports of skill-intensive services such as engineering, design, and architecture as demand in developing countries grows for improved infrastructure such as airports, sea ports, and large construction projects. USITC, hearing transcript, December 16, 2010, 74–76 (testimony of J. Bradford Jensen, associate professor, Georgetown University).

<sup>137</sup> Baldwin, “Integration of the North American Economy,” 2009; Amiti and Wei, “Fear of Service Outsourcing,” 2005.

**BOX 3.5** Improved data would give a better picture of U.S. participation in global supply chains and its effects

There are several areas in which research into global supply chains could be enhanced by improved data and quantification. These include the tracking of intermediate goods and services trade on an industry-by-industry basis, the contribution of the logistics sector to economic activity, and the extent to which better global supply chain management has reduced transaction costs or may be expected to do so in the future.

In order to do the type of analysis of value added in U.S. trade presented earlier in this report it is necessary to have some idea of the amount of intermediate inputs used by particular U.S. industries that comes from specific exporting countries. At present there are no direct measures of such linkages, a lack that has been noted as a significant gap in available trade data.<sup>a</sup> Analyses of value-added trade must thus estimate these trade linkages, since they cannot be directly observed. Significant progress has been made in improving these estimates, but it is likely that they still fail to capture significant differences in the import sourcing patterns of different industries. Improvements in direct measurement of such linkages would help more precisely identify industry-specific connections to the global economy.

The contribution of the logistics industry to value chains is another area where improved data would further analysis. The activities of this industry generally do not appear as a coherent unit in statistical reporting systems but are broken up among a wide variety of areas, such as transport, warehousing, and business services. This reflects the industry's role in integrating a number of service sectors that used to be provided separately, or self-provided by manufacturing firms.<sup>b</sup>

Data on trade costs, by product and country, would help analysts estimate the effect of global supply chain management on these costs as well as assess its potential for reducing them further. Total trade costs include all transport and transaction costs linking the producer in the exporting country to the final consumer in the importing country. Some isolated estimates of total trade costs are available. For example, it has been estimated that the average retail markup for manufactured goods traded among developed countries is 170 percent, reflecting the difference between the price received by the producer in the exporting country and the retail price in the importing country.<sup>c</sup>

In a well-known example, the markup on Barbie dolls produced in China and sold in the United States is about 900 percent.<sup>d</sup> Case studies tracking price increases of particular products as they pass through global supply chains would be a useful first step in developing more comprehensive databases for the study of global trade costs.<sup>e</sup>

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<sup>a</sup>Feenstra et al., "Report on the State of Available Data," 2010, 5–8.

<sup>b</sup>USITC, *Logistic Services*, 2005, chap. 1.

<sup>c</sup>Anderson and van Wincoop, "Trade Costs," 2004.

<sup>d</sup>Feenstra, "Integration of Trade and Disintegration of Global Production in the Global Economy," 1998.

<sup>e</sup>Ferrantino, "Quantifying the Trade and Economic Effects of Non-Tariff Measures," 2006, 38–40.

In 2008, researchers examined the effects on U.S. workers of offshoring of services to China, as well as those of inshoring.<sup>138</sup> They found that small positive effects from inshoring outweighed smaller negative effects from offshoring, which were concentrated on less-skilled white collar workers.<sup>139</sup> On balance, according to this study, U.S. workers in occupations exposed to both offshoring and inshoring spent 0.1 percent less time unemployed, were 2 percent less likely to change occupations, and would earn 1.5 percent more than in the absence of such changes.<sup>140</sup>

## Industry Case Studies

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These case studies provide a detailed examination of the U.S. participation in three sectors in which U.S. trade and production have been substantially integrated into global supply chains. Supply chains in these industries differ considerably from one another, both in the activities performed by U.S. firms (figure 3.5) and the power that these firms have to set prices and other terms. In the first two case studies (apparel and motor vehicles), U.S. firms continue to hold dominant positions in supply chains, though they perform markedly different activities. In the third industry (televisions), the previous generation of dominant U.S. firms largely failed to transition to the world of global sourcing, though one U.S.-headquartered firm has grown to account for a substantial share of U.S. sales without being a dominant producer. Supply chains in these industries also differ considerably in their geographic extent and the factors important to their development. These characteristics are summarized below:

- **Apparel:** U.S. apparel firms engage in design, logistics, marketing, and sales activities. Almost all production is done abroad and, though they remain core activities of some U.S. firms, design and logistics are increasingly performed by foreign full-package suppliers as well. Asian countries have increasingly become the source of global apparel production, though U.S. firms continue to rely on suppliers in regions with U.S. FTAs and preferential trade agreements.
- **Motor vehicles and parts:** U.S. firms engage in nearly all supply chain activities, though specialized outside firms provide logistics and other services (except for financing). Auto manufacturers and their suppliers pursue a regional strategy, tailoring these activities to produce cars for local markets within regional supply chains. Europe, North America, and China are the major production locations.
- **Televisions:** U.S. production of televisions ended in 2009, and only one company (Vizio) is headquartered in the United States. This company engages in some design, but mainly provides distribution, marketing, and sales support to U.S. retailers. Globally, Japanese and Korean companies produce the major television components, while assembly occurs in China and Mexico.

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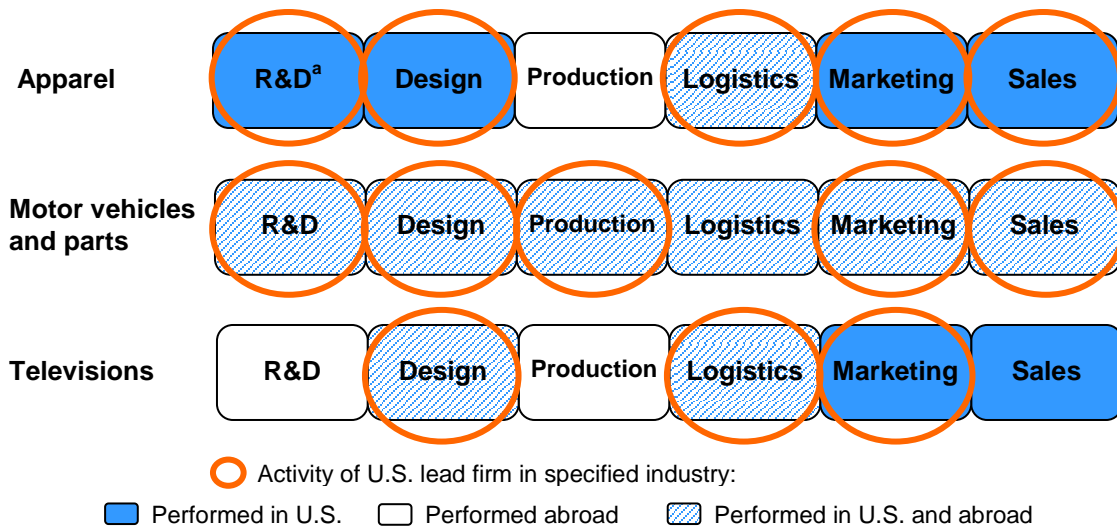
<sup>138</sup> Liu and Trefler, “Much Ado about Nothing,” 2008, 1. This study defined offshoring as sales of U.S.-produced services to unaffiliated buyers abroad.

<sup>139</sup> Including workers in occupations such as sales and office and administrative support. Liu and Trefler, “Much Ado about Nothing,” 2008, 32–34.

<sup>140</sup> Specifically, Liu and Trefler report estimated changes in unemployment duration, occupation switching, and wages for a scenario under which the rate of inshoring and offshoring in business, professional, and technical services grew at the same rate as that observed during 1996–2005 for the following nine-year period.



**FIGURE 3.5** Major activities of U.S. lead firms in global supply chains, at home and abroad



Source: Commission compilations; apparel based on Gereffi and Frederick, “The Global Apparel Value Chain, Trade, and the Crisis,” 2010.

<sup>a</sup>As noted in the apparel case study below, much of the R&D in the sector is provided by textile companies.

In addition to the three studies of industrial value chains, this section also examines the role of U.S. **logistics** firms. As noted earlier, logistics firms coordinate the movement of goods and services, an activity essential to the efficient operation of global supply chains. These firms have extended beyond the movement of freight, and now provide services such as customs brokerage, product repair, parts procurement, and distribution management. The case study discusses U.S. logistics providers’ activities and global reach, and also presents examples of their integration into supply chains in industries such as electronics.

## *Apparel*

### **Activities of U.S. Lead Firms at Home and Abroad**

Like many other labor-intensive industries, the apparel supply chain for the U.S. market has evolved from one in which most activities took place in the United States to one with an increasingly global profile. Today, many of the early and especially late supply chain activities take place in the United States, but a large share of the intermediate steps, particularly apparel production, occur in one or more countries overseas. In large part reflecting this shift, U.S. apparel employment in the United States has dropped; in 2010, it was only 17 percent of its 1990 level.<sup>141</sup> Despite the fact that more supply chain activities are taking place offshore, much of the value and decision-making in the supply chain is still associated with the lead firms.<sup>142</sup> Such firms own the brands, and include mass market retailers (e.g., Wal-Mart and Macy’s), specialty retailers (e.g., Gap and

<sup>141</sup> BLS, *Current Employment Statistics*, 1990–2009.

<sup>142</sup> Gereffi and Frederick, “The Global Apparel Value Chain, Trade, and the Crisis,” 2010, 11–12; Nathan Associates Inc., “Exporting Apparel to the United States,” 2009, 9–16.

Chico's FAS), and large apparel firms (e.g., VF Corporation, The Jones Group, and Hanesbrands).<sup>143</sup>

Figure 3.6 shows the basic steps of the global apparel supply chain (in blue). The top row indicates supply chain activities, which take products from research to sales. Most of the R&D takes place in the United States and abroad in the upstream product sectors—particularly in the development of new fibers, coatings, and fabric finishes—and so R&D is generally not included with the activities of apparel firms.<sup>144</sup> The bars below the supply chain illustrate three simplified examples of lead firm involvement (shown in green) in the global apparel supply chain. In all three examples, the lead firms are heavily involved in the branding and marketing of products (shown on the right side of the diagram). Although the lead firms typically employ several different combinations of supply chain sourcing, the trend has been to outsource more and more steps in the supply chain. As lead firms look for avenues to improve their competitiveness, many have shifted some or most of the supply functions offshore to other firms to manage for them.

In example 1, apparel firms control most or all of the activities in the global supply chain, from design through marketing. These firms own their own brands, design their products, select their raw materials, and maintain control of their production networks. They either own the production facilities themselves or supply the fabrics to a contractor who cuts the fabric, makes (sews) the garment, and trims it (trims the thread and packages the garment)—a process collectively known as cut, make, trim (CMT). This was a common form of apparel sourcing when domestic apparel manufacturing firms initially started moving production offshore to seek lower labor costs. Today, however, this is the least common form of sourcing for U.S. lead firms, although some U.S. apparel firms (e.g., Hanesbrands and VF Corporation) still operate at least part of their supply chain using this model, particularly for apparel manufactured in the CAFTA-DR region.<sup>145</sup>

In example 2, the U.S. lead firm designs the product, but outsources the procurement of raw materials and the manufacturing of the garment to a “package contractor.” The logistics and financing involved in procuring fabrics and other raw materials is shifted from the lead firm to the package contractor. Under this example, production also likely takes place offshore. Some lead firms have also moved their sourcing offices closer to their main apparel suppliers (mainly Asia), and some have moved the design process and materials selection offshore as well, though not to different companies.

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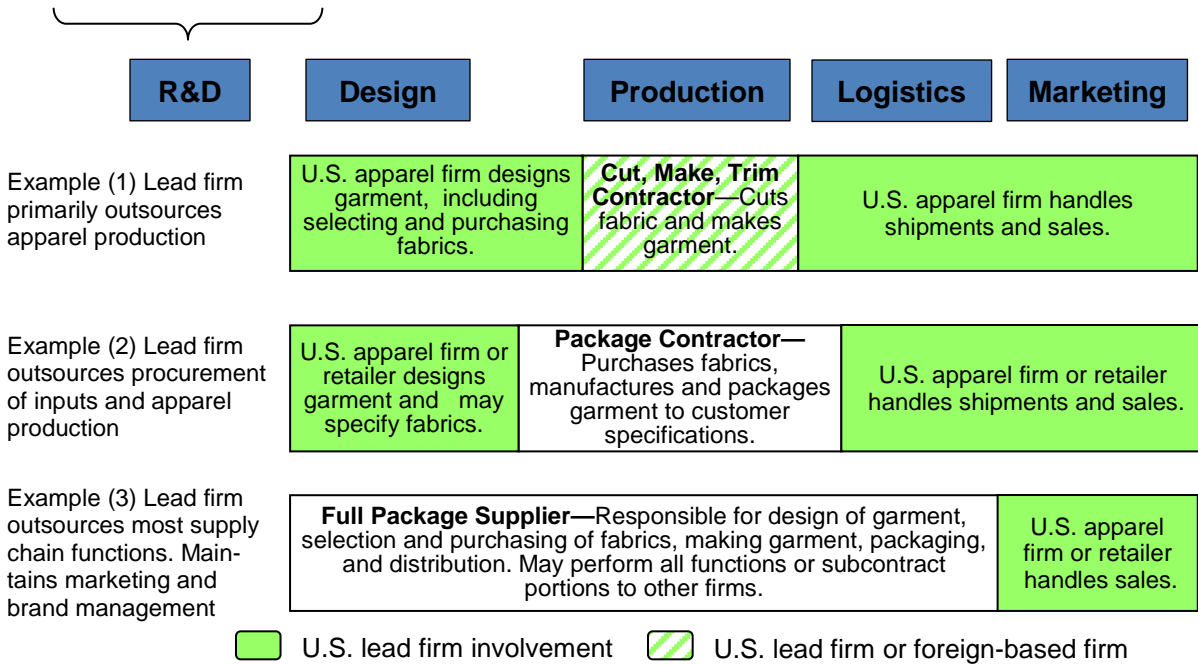
<sup>143</sup> Mass market retailers sell apparel under their own private-label brands, as well as international branded apparel. Specialty retailers sell apparel exclusively under their own brand names. The large apparel firms each control several different brands, and many have also entered the retail sector with their own specialty retail stores (e.g., Levi Strauss, Polo Ralph Lauren, and Nike).

<sup>144</sup> Examples of U.S. firms involved in such R&D include Invista (a subsidiary of Koch Industries, Inc.), International Textile Group, and Polartec. These firms have developed intermediate branded products that are inputs to apparel articles (e.g., fibers, fabrics, and finishes). For the purposes of this discussion, design of the garment is treated separately from R&D. Nevertheless, apparel firms are sometimes involved in R&D. For example, apparel firms making clothing for extreme weather or physical activities will likely go beyond design for an average garment and be involved in developing and testing the garment for specific applications. Apparel firms may also work with textile firms in the development of applications for new fibers, fabrics, and finishes.

<sup>145</sup> VF Corporation, for example, states on its Web site that it manufactures products in its own or contract facilities in Nicaragua, Honduras, and Mexico, though it has extensive operations elsewhere. It also states that it oversees production at more than 1,400 owned or sourced facilities around the world. VF Corporation Web site, <http://www.vfc.com/about/global-presence> (accessed February 24, 2011); Gereffi and Frederick, “The Global Apparel Value Chain, Trade, and the Crisis,” 2010, 16.

**FIGURE 3.6** Apparel global supply chain: Selected examples

U.S. and foreign firms in sectors upstream from apparel are most involved in R&D



Source: Commission compilation based on Gereffi and Frederick, “The Global Apparel Value Chain, Trade, and the Crisis,” 2010, and industry sources.

In example 3, most of the steps in the supply chain are undertaken offshore, including design, production, and logistics. The lead firm relies on a full-package supplier to perform all the elements of the supply chain except marketing and perhaps shipping.<sup>146</sup> Some of the larger full-package suppliers have factories located around the world, which allows them to offer lead firms a greater diversity of products as well as more options to balance costs, lead times, and order quantities.

In addition to working directly with package contractors or full-package suppliers, large U.S. apparel companies and retailers are increasingly working with intermediary sourcing agents who provide a link between themselves and the manufacturer. In the case of examples 2 and 3 in figure 3.3 above, the sourcing agent assumes the responsibilities of the foreign manufacturer (shown in white). The sourcing agents may perform some of the functions themselves (such as raw materials selection), but generally source the production of the garment itself to another firm. Since sourcing agents often have access to a large network of fabric suppliers and apparel manufacturers around the world, they can also help retailers and apparel firms have more flexibility about order quantities and lead times, as well as save on costs.

Li & Fung Limited, based in Hong Kong, is an example of a large sourcing firm that offers a wide range of services to lead firms, including product design and development, raw material sourcing, factory sourcing (for production of the apparel articles), and logistics. In 2010, Wal-Mart signed a non-exclusive strategic alliance with Li & Fung for

<sup>146</sup> Sometimes the full package supplier will ship the goods directly to the lead firm’s distribution center or even its customer. However, U.S. lead firms may also arrange for their own shipping from the factory or port, particularly if they have negotiated good rates with the shipping firms.

sourcing some of its goods, including apparel items.<sup>147</sup> Liz Claiborne also has a sourcing agreement with Li & Fung that provides everything except design and marketing.<sup>148</sup>

### **Important Drivers Affecting U.S. Participation**

One of the most important drivers shaping U.S. participation in the global apparel supply chain in recent years has been the expiration in 2005 of U.S. and EU textile and apparel import quotas under the WTO Agreement on Textiles and Clothing (ATC).<sup>149</sup> Because the quotas no longer limited quantities that could be obtained from a single country, U.S. retailers and apparel companies consolidated their supply bases and developed new supply chains to reduce lead times and costs.<sup>150</sup> At the same time, there was extensive consolidation in the retail and branded sectors: the number of department store chains in the United States dropped from 50 in 1990 to 17 in 2008.<sup>151</sup> This trend has greatly expanded U.S. lead firms' purchasing power.<sup>152</sup> Since 2004, the year before the ATC expired, the consumer price index (CPI) for apparel has remained relatively flat; it actually declined 0.7 percent between 2004 and 2010, whereas the CPI for all products increased by 15.5 percent during the same period.<sup>153</sup>

Although the quotas are gone, the rules of origin under U.S. FTAs and preferential trade arrangements have also influenced U.S. firms' involvement in global apparel supply chains. For example, the rules of origin for most apparel under NAFTA and CAFTA-DR require the apparel to be made from yarns and fabrics produced in the United States or an FTA partner country for it to enter the United States duty free. In 2010, these FTA partner countries accounted for 72 percent of the value of U.S. yarn and fabric exports.<sup>154</sup> Nevertheless, U.S. yarn and fabric exports to these countries have declined in recent years—down by 15 percent from 2004 levels—in part because U.S. lead firms have shifted their sourcing strategies (box 3.6). Asian manufacturers have been able to provide more services at overall lower costs, despite having to pay tariffs on imported goods (as in examples 2 and 3).

In addition, U.S. retailers and branded apparel firms are looking to expand their global presence by opening new retail outlets and/or selling their merchandise in established

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<sup>147</sup> Just-Style.com, “Wal-Mart Deal ‘tip of the iceberg’ for Li & Fung,” February 1, 2010; Walmart, “Walmart Leverages Global Scale to Lower Costs,” news release, January 28, 2010 (accessed February 28, 2011).

<sup>148</sup> Einhorn, “Li & Fung: A Factory Source Shines,” May 14, 2009; Li & Fung Limited, “Liz Claiborne Inc. and Li & Fung,” news release, February 23, 2009 (accessed February 28, 2011).

<sup>149</sup> The ATC entered into force in 1995 and mandated the gradual elimination of quotas that had been in place under the Multifiber Arrangement (MFA) since the 1970s. All MFA quotas were eliminated after a 10-year transition period that ended on January 1, 2005. Some quantitative restraints on Chinese apparel remained in place after this date, as permitted under the China WTO accession protocol. These safeguard quotas were also eliminated by the end of 2008. USITC, *Import Restraints, Fifth Update 2007*, 2007, 58–62.

<sup>150</sup> USA-ITA, written submission to the USITC, January 6, 2011.

<sup>151</sup> Barrie, “Brand Bias Drives New Retail Strategies,” April 17, 2008.

<sup>152</sup> David Birnbaum described the increase in power as an “oligopsony where a small number of customers control entire retail markets.” Birnbaum, “Comment: The Changing Value of the Garment Worker,” October 18, 2010.

<sup>153</sup> Based on BLS, “Consumer Price Index for All Urban Consumers,” 2004, 2006, 2008, and 2010.

<sup>154</sup> Based on exports under NAICS code 313 (textile mills) from USITC DataWeb/USDOC (accessed March 3, 2011).

**BOX 3.6** Recent shifts in sources of global value in textiles and apparel

As reported earlier in chapter 3, China's share of the valued added in U.S. apparel imports was 11 percent in 2004 (table 3.3), but it is likely that China's share has increased significantly since then. China's share of total U.S. apparel imports has more than doubled since 2004, growing from 19 percent in 2004 to 41 percent in 2010. China is also a large supplier of textile inputs to other major Asian apparel-producing countries, such as Vietnam, which also ship large quantities of apparel to the United States. Recent reports reveal, however, that some U.S. apparel firms and retailers are starting to move some of their apparel sourcing back to the Western Hemisphere to help diversify their supply base and minimize their risk, such as unexpected delivery delays.<sup>a</sup>

<sup>a</sup>Freeman, "Apparel Firms Eye Central America Sourcing," March 24, 2011.

retail outlets in international markets.<sup>155</sup> Using full package suppliers (example 3) and/or sourcing agents gives branded apparel firms and retailers greater flexibility in supplying different markets, for more cost-effective results. For example, such arrangements may offer U.S. retailers and apparel firms access to a wider selection of fabrics and manufacturing bases, as well as duty-free access to certain markets under other countries' bilateral or regional trade agreements and preferential trade arrangements.<sup>156</sup>

Most recently, another driver affecting U.S. participation in the global supply chain has been shrinking consumer expenditures on apparel. During 2007–09, average annual consumer expenditures on apparel declined by 8 percent,<sup>157</sup> putting added pressure on retailers to cut costs and minimize excess inventory. In response, retailers have shifted additional sourcing functions offshore to other firms, allowing lead firms to reduce lead times while ordering fewer garments in greater assortments.

### ***Autos and Parts***

The motor vehicle industry<sup>158</sup> manages a large, diversified set of suppliers in nearly every region of the world, making for a complex supply chain with global, regional, and local characteristics. Although a completely global car or platform is an attractive concept to automakers because of the potential for scale economies and reduced design and engineering costs, the most prevalent manufacturing strategy employs a regional supply chain. With this approach, automakers and suppliers are better able to meet local pricing and consumer preferences, reduce inventory costs, and manage currency fluctuations. Motor vehicle companies perform nearly all supply chain activities within these regions, with the exception of logistics services, which are largely provided by specialized firms.

<sup>155</sup> For example, VF Corporation, which describes itself as world's largest apparel company, states that its brands are sold in 150 countries through 47,000 retailers. VF Corporation Web site. <http://www.vfc.com/about/global-presence> (accessed February 24, 2011). See also Driscoll, *Standard & Poor's Industry Surveys*, 6; Just-Style.com, "US: Aeropostale Inks Deal to Expand into Asia," March 9, 2011; Juststyle.com, "US: A&F to Expand Global Reach," February 17, 2011.

<sup>156</sup> For example, access to the Japanese market under the Association of Southeast Asian Nations-Japan FTA. USITC, *ASEAN: Regional Trends in Economic Integrations*, 2010, 4-10 to 4-11.

<sup>157</sup> BLS, *Consumer Expenditures–2009*, October 5, 2010, 1, table A.

<sup>158</sup> The motor vehicle industry includes firms that assemble vehicles, such as passenger cars and light trucks, as well as those that produce vehicle components, such as gearboxes and braking systems.

## Regional Manufacturing Approach

Regional manufacturing is common to most of the world's leading automakers and to tier one (large multinational) parts makers,<sup>159</sup> including those in the United States. These firms manufacture vehicles and parts throughout the world, and although they are considered global in terms of their footprint and reach, they typically organize their manufacturing activities within high-demand regions, such as Europe, North America, and China.<sup>160</sup> The level of demand in these regions is high enough to support volume production of vehicles and parts, a leading prerequisite for firms when deciding where to locate manufacturing. Countries within these regions also share certain common features, such as regionwide safety standards in Europe, which make local production more attractive. Taken in combination, these factors often encourage vehicle and parts makers to establish regional or local R&D and design centers to tailor vehicles and components to local preferences, standards, and pricing and technology levels, although global headquarters may remain in the home country. Logistics services for the industry, on the other hand, are usually handled by globally established firms with local operations and specialized expertise.<sup>161</sup>

The NAFTA region is a notable example of regional automotive industry integration. Regional integration began in the mid-1960s, when the Automotive Products Trade Agreement between the United States and Canada eliminated tariffs on imports of motor vehicles and parts between the two countries. This agreement is considered by some to be the initial model for regional integration in the motor vehicle industry. North American integration took an additional step with the ratification of NAFTA, drawing Mexico further into the regional automotive industry. For example, automakers Ford, General Motors, Chrysler, and Toyota manufacture in all three NAFTA countries, as do tier one suppliers such as Visteon (United States) and Denso (Japan).

As noted in the section on U.S. supply chain participation earlier in this chapter, U.S. imports in the motor vehicles and parts sector have a substantial share of value (19.1 percent) that consists of U.S. value returned home from abroad. This largely represents U.S. value returned home from NAFTA member countries, as the U.S. industry sources heavily from the region's supply chains. In terms of value added, North American sources account for 72 percent of the content of the U.S. motor vehicles and parts sector.

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<sup>159</sup> Motor vehicle parts makers are commonly referenced by their position in a particular industry "tier." Tier one producers are generally large multinationals that supply components, systems, and modules directly to automakers. These firms may also undertake supply chain management, systems integration, foreign investment, and extensive design and R&D. Tier two and tier three suppliers, which number in the tens of thousands, are generally smaller in size and product/function scope and are less likely to have the financial resources and customer base to support significant foreign investment. Tier two suppliers generally provide parts and materials to tier one producers, whereas tier three suppliers often provide raw materials or parts to a wide variety of industries, including the motor vehicle sector.

<sup>160</sup> Sturgeon et al., "Value Chains, Networks, and Clusters," 2008, 9.

<sup>161</sup> Logistics activities in the automotive supply chain are often complex. A single automaker, for example, may source from a global supply base of over 10,000 firms. Deloitte Research and Stanford Global Supply Chain Management Forum, *Integrating Demand and Supply Chains*, 2009, 10. Logistics firms not only transport, warehouse, and inventory parts and vehicles, but they also perform other services, such as sequencing and assembly of parts at vehicle assembly plants. With sequencing, the firms deliver the parts or systems to the automaker in the order in which assembly occurs as part of the just-in-time inventory process. Team 3 Logistics, for example, indicates that it provides services such as materials procurement, warehousing, inventory control, sequencing and kitting of parts, and forwarding. Team 3 Logistics Web site, <http://www.team3logistics.com/services.html> (accessed March 7, 2011).

## Regional Structure Factors

### *Market factors*

Because different motor vehicle markets often have different requirements, automakers and their suppliers often find that regional production best enables them to satisfy these criteria. For example, the type of vehicles demanded in a given region may be determined by income, vehicle standards and regulations (e.g., emissions and safety), consumer preferences, and driving conditions.<sup>162</sup> A regional strategy allows automakers and their suppliers to offer vehicles that meet local price ranges and are tailored to the market, often while employing just-in-time inventory practices. Transportation costs, although important, appear to be less of a contributing factor in the development of regional production arrangements for higher-value goods such as motor vehicles. Automakers also control retailing in local operations to manage vehicle sales and provide aftermarket support.

### *Government policies*

Several types of government policies have influenced the manufacturing structure of the automotive industry, with local-content requirements being the most notable. These requirements mandate that a specific share of a locally assembled vehicle's value must come from locally produced components for the vehicle to benefit from certain incentives, such as reduced tariffs. These policies have been a significant growth driver for regional motor vehicle and parts production. By stipulating a designated content level, governments aim to develop their domestic industry, increase local production, and encourage foreign suppliers to form joint ventures or set up shop locally to supply their automotive customers.<sup>163</sup> The industries in China, Thailand, Australia, and Indonesia, for example, have at various times been subject to these requirements.

Beyond local-content requirements, political considerations also weigh into decisions to produce and source locally. The automotive industry is often a leading source of economic growth for countries or regions, and may be supported to some degree by national governments. Political pressure on automakers and their suppliers to establish or retain local production facilities has also contributed to this regional production pattern.<sup>164</sup>

Regional trade arrangements, such as NAFTA and the Association of Southeast Asian Nations (ASEAN), provide trade and investment preferences to member countries, which may serve as a lure for foreign investment from manufacturers that want to benefit from those policies. Automakers also use regional production to cushion the effects of currency fluctuations.<sup>165</sup> By spreading production in different regions, automakers and suppliers try to lessen the financial impact of a strong (or weak) home currency.

### *Supply chain relationships between automakers and suppliers*

The supply chain activities undertaken by the motor vehicle industry are less concentrated globally than those of other industries, as motor vehicle companies perform many supply chain activities in all regions. In fact, automakers and component manufacturers perform several of the same functions on a regional basis. R&D and

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<sup>162</sup> Humphrey and Memedovic, "The Global Automotive Industry Value Chain," 2003, 18.

<sup>163</sup> Ibid., 19.

<sup>164</sup> Sturgeon et al., "Value Chains, Networks, and Clusters," 2008, 9.

<sup>165</sup> Kitamura, "Toyota President Says He May Move More Production," January 14, 2011.

design work are performed by both automakers (vehicles) and suppliers (parts). They work closely together to ensure vehicle fit and finish, quality, and safety. Automakers procure most parts from suppliers, but generally retain manufacture of signature systems—typically, engines and transmissions.<sup>166</sup> This supply chain approach allows automakers to lower costs by taking advantage of parts suppliers with their own core competencies, product expertise, and volume production.<sup>167</sup> Honda, for example, reportedly relies on suppliers for more than 80 percent of the components for its passenger cars, with in-house production focused on engines, transmissions, and bulky, capital-intensive parts such as stampings.<sup>168</sup>

Leading parts suppliers are often expected to invest globally to supply their auto customers, and they may also manage the upstream supply chain (tier two and three suppliers).<sup>169</sup> In a recent survey of automotive suppliers, 52 percent of tier one respondents indicated that their customers exerted pressure on them to manufacture nearby.<sup>170</sup> Suppliers for both Toyota and Honda, for example, followed their automotive customers to the United States to supply their U.S.-based vehicle assembly facilities. These suppliers include Denso Corp., Nippon Seiki Co., and Stanley Electric Co.<sup>171</sup> A similar movement has occurred as U.S. automakers moved into China, where 26 percent of China's parts producers are reportedly owned by U.S. suppliers.<sup>172</sup>

With respect to vehicle sales outlets, automakers typically control operations. In the United States, for example, automakers contract with one or more franchise dealers to represent their vehicles. The automakers then provide financing for dealerships to purchase vehicles (called floorplan financing) and also offer an avenue for customer financing (dealer-arranged financing). The dealer, however, takes on most of the investment risk in providing dealership services.<sup>173</sup>

## *Televisions*

The U.S. supply chain for televisions, like that of many other products in the electronics sector, has migrated from a pattern in which a high concentration of activities, including production, occurs in the United States to one in which production is exclusively offshore. Unlike some other U.S. consumer electronics firms, however, U.S. television producers failed to adapt swiftly enough to technological change and lost their former position as global industry leaders. In 2011, U.S. supply chain activity by the sole remaining U.S. firm is limited to design, marketing, and to a lesser extent, logistics (figure 3.5).

While the United States developed color televisions, and was a significant producer of televisions for decades, U.S. production ended in 2009.<sup>174</sup> The primary factors contributing to the loss of U.S. production were superior technology and marketing strategies employed by Japanese firms;<sup>175</sup> competitive, and in some cases, unfair pricing

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<sup>166</sup> One industry source estimates that automakers add less than 25 percent to a vehicle's value, with the remainder (over 75 percent) added by suppliers. A.T. Kearney, "Automotive Suppliers: Management Strategies & Value Enhancement" (accessed April 1, 2011).

<sup>167</sup> Furtado and Andrade, "Outsourcing In Different Production Models," 2005, 2.

<sup>168</sup> SupplierBusiness Ltd., "Honda Purchasing Strategy and Relationship with Suppliers," 2009, 21.

<sup>169</sup> See, for example, Sedgwick, "Toyota Expects Tier 1s to Check on Subsuppliers," January 17, 2011.

<sup>170</sup> KPMG International, "Global Location Strategy for Automotive Suppliers," 2009, 10.

<sup>171</sup> SupplierBusiness, Ltd., "Honda Purchasing Strategy and Relationship with Suppliers," 2009, 21.

<sup>172</sup> KPMG International, "Global Location Strategy for Automotive Suppliers," 2009, 11.

<sup>173</sup> Canis and Platzer, "U.S. Motor Vehicle Industry Restructuring and Dealership Terminations," 2009.

<sup>174</sup> Zacks Investment Service, "Sony Partially Exits LCD Plant," 2010.

<sup>175</sup> Hart, "The Consumer-Electronics Industry in the United States," 1991.



of televisions and parts over a period extending back into the 1960s by producers in China, Korea, Japan, and Taiwan;<sup>176</sup> and, more recently, the shift in display technology from cathode ray tubes (CRTs) to flat panel displays (FPDs) such as liquid crystal and plasma displays.<sup>177</sup> Rules of origin provisions for CRTs under NAFTA were unsuccessful in maintaining U.S. production and jobs after the industry switched to FPDs.

## Global Supply Chains for Televisions

There are two key components for FPD televisions, the display panel and the chipset, which together account for 94 percent of the costs.<sup>178</sup> The global supply chain for FPD televisions uses glass produced in Japan and Korea; displays incorporating the glass, assembled in Japan, Korea, and Taiwan; and semiconductor chip sets designed in the United States and elsewhere and produced in China, Korea, Singapore, and Taiwan. Assembly occurs principally in China, the world's largest television producer, although most sets destined for the U.S. market are assembled in Mexico.<sup>179</sup> These sourcing patterns are consistent with tables 3.2 to 3.5 above, which illustrate the significant value added by East Asia, Japan, and China in U.S. imports of electronic equipment.

An investment in the hundreds of millions of dollars is required to be in the vanguard of glass production for FPD televisions.<sup>180</sup> The need for such investment has led to collaboration by multinational corporations. The biggest investment for production is in the tooling to produce the glass for the displays, followed by the production of the display itself, and then by the assembly into the finished consumer good. Investments in FPD technology have been concentrated in Asia, reflecting Asia's increasing importance as a global production center for televisions and other electronics.

## U.S. Participation in the Global Supply Chain

U.S. participation in the global supply chain is now limited to the design of chips, some product development, distribution, marketing, and customer service. The last U.S. television factory (owned by Sony) closed in 2009. All televisions sold in the United States now are imported from original equipment manufacturers (OEMs)<sup>181</sup> with factories outside the United States (principally in Mexico) or from contract manufacturers with factories principally in Mexico and China.<sup>182</sup>

The sole remaining U.S.-headquartered television brand, Vizio, entered the U.S. market in 2002. Vizio has no factories of its own, but rather uses contract manufacturers in

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<sup>176</sup> For example, see USITC, *Certain Color Television Receivers from China*, May 2004; USITC, *Television Receiving Sets from Japan*, June 1981; U.S. Tariff Commission, *Television Receiving Sets from Japan*, March 1971.

<sup>177</sup> FPD technology was largely developed in American laboratories. However, U.S. companies capable of manufacturing FPDs either decided not to do so or were unable to obtain funding for their efforts. U.S. Congress, Office of Technology Assessment, *Flat Panel Displays in Perspective*, 1995.

<sup>178</sup> Palepu and Kind, "Vizio Inc.," 2009, 7.

<sup>179</sup> China Economic Net, "3D TV Sets Booming in China" (accessed May 18, 2011).

<sup>180</sup> Corning Display Technologies, "Corning Announces Investment in Gen 10 LCD Glass Substrates," December 5, 2007.

<sup>181</sup> An OEM is an organization that makes the products it sells under its own brand name or buys products and resells them under its own brand name. The OEM typically designs the product and owns the intellectual property for the product, which is made to order. A contract manufacturer is an organization that makes products under contract for resale by the OEM, using the OEM's design.

<sup>182</sup> In 2010, Mexico and China accounted for 70 percent and 29 percent, respectively, of the value of U.S. imports of televisions.

China, Taiwan, and Mexico to produce goods to Vizio's specifications.<sup>183</sup> Although Vizio builds products that incorporate current technology, it does no R&D; instead, it purchases patents or licenses the technology from other patent owners. Vizio has also acquired other patents, which it licenses to other television manufacturers.<sup>184</sup> The principal suppliers of finished televisions to Vizio are two contract manufacturers in Taiwan, Foxconn and Amtran. These companies are also part owners of Vizio.<sup>185</sup>

### **Policies and Institutions That Affected the U.S. Industry**

Most of U.S. television production, which then used CRT technology, gradually moved to Mexico in the late 1990s. NAFTA included provisions that allowed televisions to enter the United States duty free if specific rules of origin were followed. These rules required that either of the two major glass parts of a tube be of North American origin for NAFTA origin to be conferred on the finished tube.<sup>186</sup> In addition, the rules of origin for televisions virtually required the inclusion of a picture tube of NAFTA origin in order for NAFTA origin to be conferred on the television itself. Because of the sizable U.S. investment in tube and glass factories, those goods continued to be produced in the United States for some time even after CRT-based television assembly moved to Mexico. However, new display technology made those NAFTA provisions irrelevant when FPDs became affordable alternatives to CRTs in televisions.<sup>187</sup> In addition to being price-competitive, televisions incorporating FPDs could have much larger screens than televisions incorporating CRTs, take up less space, consume less energy, and be more easily moved around. The switch to FPDs accelerated in 2009, when the United States adopted a digital broadcast standard such that signals could only be received by televisions incorporating a digital tuner or connected to a digital-to-analog converter. As consumers bought new televisions with digital tuners, many opted to buy televisions with FPDs rather than CRTs. As a result, demand for CRT-type sets (which constituted the majority of U.S. production) fell and production in the United States declined, from \$4.0 billion in 2000 to \$127 million in 2009.<sup>188</sup> The value of imports grew as demand for televisions with FPDs grew, from \$245 million (4 percent of the value of television imports in 2001) to \$19.2 billion in 2010, or 100 percent of the value of imports.

Although the North American industry producing televisions with FPDs survives, in part the result of NAFTA rules of origin, the largest part of what survives is in Mexico, and consists of assembling mostly imported components of Asian origin. Like contract manufacturers in China, the factories in Mexico (some of which are themselves contract manufacturers) take advantage of lower labor costs. Meanwhile, some higher-value activities (such as R&D) occur overseas, while others (including design and marketing) remain in either the country where headquarters are housed or the United States.

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<sup>183</sup> Vizio also markets other consumer electronic products, including Blu-ray players and home theater systems.

<sup>184</sup> Vizio, "Sony, Vizio Reach DTV Patent Agreements," 2009.

<sup>185</sup> As of 2008, Amtran reportedly owned 23 percent of Vizio. Flannery, "Vizio's Flat-Screen Burst," 2008.

<sup>186</sup> North American Free Trade Agreement, Annex 401; Jensen-Moran, "Trade Battles as Investment Wars," 1996.

<sup>187</sup> Although liquid crystal display displays were invented in the United States, there has been only limited commercial production of such displays in the United States.

<sup>188</sup> U.S. Census Bureau, Annual Survey of Manufactures, various years.

## Effects on U.S. Companies and Employment

The number of companies producing televisions in the United States declined from seven in 2003<sup>189</sup> to one in 2009, which closed its plant that year. U.S. television production declined as manufacturers (mostly headquartered in Japan) moved U.S. production to Mexico, which had lower-cost labor.<sup>190</sup> In 2010, Vizio had 196 employees, with 76 in South Dakota, 3 outside the United States, and the remainder in California. None of the Vizio employees, however, either in the United States or elsewhere, would be considered production workers.

## Logistics

U.S. firms are among the leading logistics providers worldwide and hence have become essential participants in global supply chains.<sup>191</sup> Logistics, the coordinated movement of goods and services, encompasses diverse activities that oversee the end-to-end transport of raw, intermediate, and final goods between suppliers, producers, and consumers.<sup>192</sup> As noted above, improvements in logistics services—both in-house and third-party—have promoted the growth of global supply chains.<sup>193</sup> Manufacturing firms, for example, increasingly outsource certain logistics activities to third-party logistics service providers (3PLs) in order to focus on their core competencies and avoid or minimize the costs of developing in-house logistics capacity (table 3.6).<sup>194</sup>

The ability of firms to move materials faster and over greater distances has become key, if not critical, to maintaining competitive advantage.<sup>195</sup> New sourcing arrangements with 3PLs help manufacturers achieve these goals. As discussed below, the benefits of integrating fully with 3PLs often exceed what those companies could obtain under traditional contractual arrangements where the 3PL performs discrete functions, but has limited knowledge of a company's internal operations.<sup>196</sup> In addition, where companies' sourcing, production, and distribution activities are spread across multiple countries, procuring services from 3PLs permits the manufacturers to take advantage of the 3PLs' transportation and supply chain networks.<sup>197</sup>

## Leading Logistics Firms

The largest and most diversified U.S. logistics firms are FedEx and UPS, although for both firms, primary revenues are derived from the express delivery of letters and small

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<sup>189</sup> USITC, *Certain Color Television Receivers from China*, May 2004.

<sup>190</sup> Contreras and Carrillo, "E-commerce and Regional Integration," July 2002.

<sup>191</sup> Mullen, written testimony to the USITC, December 16, 2010.

<sup>192</sup> Logistics most commonly include freight forwarding; multimodal transport (i.e., transport by air, ship, truck, or rail); warehousing and storage; tracking; and customs brokerage. They may also encompass other services such as order fulfillment, product repair, and supply chain management. Supply chain management refers to the design and management of transportation and distribution networks. Along with goods, certain services may also be transported by logistics firms, for example, in the forms of architectural plans, legal briefs, and franchising materials. USITC, *Logistic Services: An Overview*, May 2005, 2-1.

<sup>193</sup> Mullen, written testimony to the USITC, December 16, 2010.

<sup>194</sup> Bolumole, "The Supply Chain Role of Third-Party Logistics Providers," 2001, 90.

<sup>195</sup> Bhatnagar and Viswanathan, "Re-engineering Global Supply Chains," 2000, 13-34.

<sup>196</sup> Global 3PLs have developed areas of competency that are based on the industries of their largest customers, including, for example, healthcare and high-tech manufacturing. As 3PL firms accumulate knowledge of these industries, they can more effectively serve their customers. See, for example, UPS, "Industry Solutions" (accessed March 16, 2011).

<sup>197</sup> Bhatnagar and Viswanathan, "Re-engineering Global Supply Chains," 2000, 22-27.

**TABLE 3.6** Examples of services supplied by U.S. 3PL firms to global clients

U.S. 3PL firm	Client and industry	Services	Location(s) served
Caterpillar Logistics	Caterpillar, heavy equipment	Warehousing and distribution	Dubai
FedEx	Philips Semiconductor, high-tech equipment	Transportation, warehousing and distribution, customs brokerage	United States and Asia
Menlo Worldwide	Maastricht, high-tech equipment	Warehousing and distribution for service parts	Europe, Russia, the Middle East, and Africa
Penske Logistics	General Motors, automotive	Transportation, distribution, supply chain management	Mexico
Penske Logistics	Continental Tire, transportation equipment	Warehousing and distribution, customs brokerage	China
Ryder	Boeing, aerospace	Transportation (by truck or by air and rail, using third-party providers), parts procurement, supply chain management	United States and Asia
UPS	Genzyme, biotechnology	Warehousing and storage, tracking and tracing, distribution	United States, Puerto Rico, and the Netherlands
UPS	Samsung America, healthcare equipment	Transportation management, customs brokerage	United States and Asia

*Source:* Commission compilation from Armstrong & Associates Web site and company Web sites.

packages (table 3.7).<sup>198</sup> Some other large U.S.-based logistics firms include C.H. Robinson Worldwide, Expeditors International of Washington, Caterpillar Logistics Services, and Penske Logistics. All of these firms operate globally and typically have hundreds of offices worldwide. Like FedEx and UPS, these firms have added logistics and supply chain capabilities to their main lines of business which, for example, include the transportation of heavy freight (Caterpillar) and the arrangement of transportation services (C.H. Robinson and Expeditors). For all firms, supply chain management is a fast-growing business segment, with U.S. revenues for supply chain services having grown by about 20 percent during 2004–09.<sup>199</sup>

### Examples of Logistics Firms' Participation in Supply Chains

Two examples drawn from the global operations of U.S. firm Penske illustrate how deeply logistics firms have become integrated into their customer's supply chains and highlight their growing importance in maintaining their clients' competitiveness. In Brazil, Penske manages distribution operations for the large Korean electronics manufacturer Samsung, which produces appliances, computer monitors, and televisions. Penske has set up a large warehouse outside of São Paulo, Brazil, near Samsung's manufacturing facility. Samsung products that are manufactured both in Brazil and in foreign markets are received and stored in Penske's São Paulo warehouse. Penske also

<sup>198</sup> In the United States, as in the global market, leading 3PLs are composed principally of transportation services firms that, over time, have added logistics and supply chain management capabilities to their core business.

<sup>199</sup> Armstrong & Associates, "Bigger and Better: 3PL Financial Results, 2004," 2004; Armstrong & Associates, "U.S. 3PL Market Size Estimates," 2009. Estimates are based on four services: non-asset-based domestic transportation management, international transportation management, warehousing and distribution, and software services.

**TABLE 3.7** Top 10 U.S. 3PL firms by logistics revenues, 2009

Company	Core business of parent	Logistics revenues (Millions of \$)
C.H. Robinson	Freight forwarding	7,577
UPS Supply Chain Solutions <sup>a</sup>	Express delivery	7,516
Expeditors International of Washington	Freight forwarding	4,092
Caterpillar Logistics	Heavy equipment manufacturing	3,119
Penske Logistics	Truck rental and leasing	2,387
Schneider Logistics	Truck transport	2,200
Ryder Supply Chain Solutions	Truck rental and leasing	1,611
FedEx Supply Chain Services <sup>b</sup>	Express delivery	1,501
Menlo Worldwide Logistics	Freight forwarding	1,326

*Source:* Armstrong & Associates, “A&A’s Top 50 Global Third-Party Logistics Provider (3PL) List”; Armstrong & Associates’ Top 40 North American 3PLs List” (accessed February 24, 2011); company Web sites.

<sup>a</sup>In 2009, total revenues for UPS were \$45.3 billion.

<sup>b</sup>In fiscal year 2009, total revenues for FedEx were \$34.7 billion.

prepares orders for outbound distribution to Samsung’s commercial customers in Brazil, which include large retail outlets such as Carrefour and Wal-Mart. Other services provided by Penske to Samsung include processing returns, repairing products, checking product quality, and repackaging.<sup>200</sup>

In China, Penske has operated three warehousing facilities outside of Shanghai since acquiring a local logistics firm in 2006. The acquisition enabled Penske to receive three separate licenses from the Chinese government permitting Penske to function simultaneously as an international trading company, a freight forwarder, and a customs broker. Penske now performs a variety of logistics services for companies operating in China. For instance, the company manages import and domestic distribution for BMW; customs clearance and distribution for General Electric (GE); and export consolidation and international transportation for a furniture manufacturer, Knoll.<sup>201</sup>

## Transportation Networks

The transportation networks of large logistics service providers, such as FedEx and UPS, are organized around primary air hubs that connect to smaller, regional hubs (or spokes). Each hub has a sorting, warehousing, and storage facility, as well as access to nearby road and rail transport.<sup>202</sup> 3PLs’ hub-and-spoke network saves costs for manufacturing firms by centralizing the inbound and outbound distribution of raw materials and finished goods. Electronic data interchange systems, which allow 3PLs to “plug into” the operations of their clients, let both sides track inventory and shipments in real time.<sup>203</sup> The networks of large logistics firms are global in scope, with each firm’s primary U.S. hub connecting to several hubs located abroad. The location of these hubs in Europe, North America, and Asia coincides with regions of major supply chain activity.

<sup>200</sup> Armstrong, “Penske Logistics Leverages Local Expertise,” 2007.

<sup>201</sup> Armstrong, “Penske Logistics Leverages Multinational Relationships in Expanding Asian Operations,” 2007.

<sup>202</sup> Konrad, “Louisville Flies High,” 2010.

<sup>203</sup> Bhatnagar and Viswanathan, “Re-engineering Global Supply Chains,” 2000, 13–34; FedEx, “FedEx Introduces Worldwide Technology Enhancements” (accessed February 22, 2011). Electronic data interchange refers to the “computer-to-computer” exchange of data that is delivered in standardized formats. More recently, FedEx has introduced Web-based software that enables its customers to track and manage inventory directly via the Internet.

Logistics service providers set up their hubs where commercial and industrial activity is likely to flourish; 3PL customers often locate their operations near such hubs, creating the so-called logistics “corridors” that are a combination of manufacturing, transportation, distribution, and customs processing facilities. These operations centralize activities essential to the smooth flow of goods within global supply chains. For example, UPS’s air hub in Louisville, Kentucky, covers more than 600,000 square feet of warehousing and distribution space, with connections to road, rail, and water transportation. The hub also includes a foreign trade zone for customs processing that employs 750 people providing customs brokerage services.<sup>204</sup> More than 100 firms have chosen sites close to UPS’ Louisville hub to take advantage of the latter’s transportation and distribution network.<sup>205</sup> Such companies include online footwear vendor Zappos and biotechnology firm Genentech.<sup>206</sup>

Similarly, numerous U.S. firms have set up distribution operations near the FedEx air hub facility in Memphis, Tennessee, including HP, Nike, Pfizer, and GlaxoSmithKline.<sup>207</sup> The FedEx hub has also attracted more than 130 firms from 22 foreign countries to Memphis. Together, these firms employ roughly 17,000 workers in the Memphis area<sup>208</sup>—nearly half again as many as the approximately 12,000 FedEx employees in the company’s Memphis hub.<sup>209</sup>

### **Policies That Affect Logistics Service Providers**

Logistics and supply chain service providers are subject to a range of government policies that influence where they establish, how they operate, and what services they provide. These policies most commonly pertain to FDI, licensing, customs procedures, cargo security, and air traffic rights. Unfavorable policies on air transportation rights or FDI, in particular, prevent logistics firms from serving new markets or from expanding service in countries where they are already located.<sup>210</sup> Logistics service providers may also be hampered by poor transportation infrastructure in host countries, including limited capacity at airports and seaports, insufficient road and rail networks, and inadequate customs processing facilities.<sup>211</sup> Deficient infrastructure reduces both the speed and the reliability with which logistics firms deliver their services and may undermine the ability of these firms, as well as their customers, to compete.<sup>212</sup> One study estimates that removing such obstacles—both infrastructure and policy-related—would boost global GDP and employment, substantially increasing economic welfare overall.<sup>213</sup>

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<sup>204</sup> Armstrong & Associates, “UPS Revamps Supply Chain Service Offering,” April 8, 2008; Armstrong & Associates, “A&A’s Top 40 North American 3PLs List” (accessed April 28, 2011).

<sup>205</sup> Oxford Economics, “The Impact of the Express Delivery Industry,” 2009, 32.

<sup>206</sup> Konrad, “Louisville Flies High,” 2010.

<sup>207</sup> Inbound Logistics, “Memphis: North America’s Logistics Center,” October 2010, 3.

<sup>208</sup> Oxford Economics, “The Impact of the Express Delivery Industry,” 2009, 31.

<sup>209</sup> FedEx, “Video: Inside the Memphis Superhub” (accessed April 1, 2011).

<sup>210</sup> Oxford Economics, “The Impact of the Express Delivery Industry,” 2009, 41–42.

<sup>211</sup> Air traffic rights refer to the permission granted to airlines of countries that are signatories to air transport agreements to carry passengers and cargo to, from, or within each other’s air transport markets.

<sup>212</sup> Nordas et al., “Logistics and Time as a Trade Barrier,” 2006, 16, 19.

<sup>213</sup> Oxford Economics, “The Impact of the Express Delivery Industry,” 2009, 40. In China, for example, the removal of restrictions on express delivery (and logistics service) providers were estimated to result in an increase in output of \$180 billion over a five-year period, as well as the creation of 700,000 jobs.

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