Chapter 3
Effects of Tariffs and of Customs and Border Procedures on Global Supply Chains

Introduction

The effects of tariffs and of customs and border procedures on global supply chains (GSCs) are addressed in three sections in this chapter. The first section reviews the current literature on tariffs and on customs and border procedures, and examines the implications of these border costs within GSCs. The second section provides a quantitative assessment of the effects of tariffs on GSCs.[277] The third section presents three case studies that give examples of the types of inefficiencies in customs and border procedures that firms often encounter when they operate through GSCs. Two of the case studies focus on the automotive and semiconductor industries in South America and Southeast Asia, respectively. The third case study concerns logistics services in sub-Saharan Africa (SSA), an activity that is both an input to and a facilitator of GSC activity. Such services are especially critical to the transport of intermediate goods in GSCs.[278] Together these case studies illustrate the range of customs and border procedures that affect goods and services throughout the supply chain.

Overall, the chapter identifies two important effects that firms face when operating through GSCs. First, although tariffs on imported goods have largely decreased over time for a range of countries and products, goods that are produced in GSCs continue to face both direct and indirect tariffs that accumulate along the supply chain. Second, because they make multiple border crossings, goods produced in GSCs are subject far more often than other goods to customs and border procedures such as document preparation, goods inspection, the payment of customs duties and fees, and standards certification. When administered in an inefficient,

[277] Because data on customs and border procedures are not available on a level comparable to tariff data, this report does not include the effects of these procedures in its quantitative analysis.
[278] Government of Sweden, Kommerskollegium National Board of Trade, "Global Value Chains and Services," January 2013, 10.

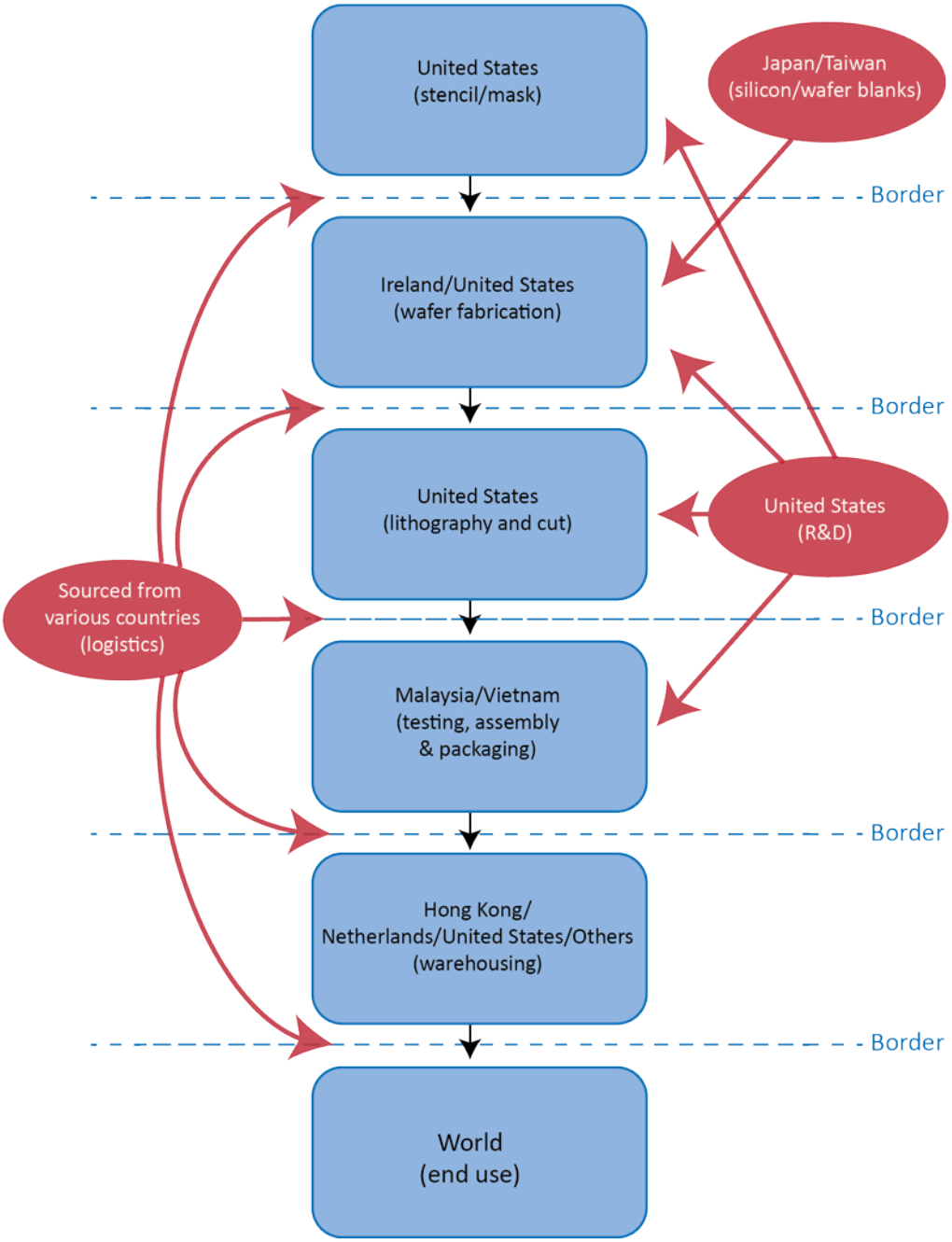
discriminatory, or burdensome way, these procedures serve as nontariff measures (NTMs) that drive up the costs and time of producing goods in a GSC.[279] Together, these two effects suggest that the trade costs associated with goods made in GSCs may be much higher than for their non-GSC counterparts.

The Rise of Global Supply Chains

A GSC is a process in which multiple firms or establishments undertake various stages of production in multiple countries. Figure 3.1 depicts a basic example of a GSC for a microprocessor as it is designed, produced, and assembled into a working chip. The initial design and fabrication occurs in the United States and Ireland; the chip is assembled, tested, and packaged in Malaysia or Vietnam; and it is eventually warehoused at routing points all around the world, including Hong Kong and Amsterdam. The microprocessors' production incorporates materials from countries such as Japan and Taiwan, as well as various services inputs ranging from research and development (R&D) services supplied in the United States to logistics and warehousing services supplied in Germany and the Netherlands. The finished product—a microprocessor—is itself often used as an intermediate input for other electronic goods within their respective GSCs.[280] Similar studies that focus on the supply chains of individual products have become quite common, including work that has examined the production of Barbie dolls,[281] T-shirts,[282] and computer hard drives.[283]

[279] In some cases, NTMs are intended to protect social interests, such as those concerning food safety and energy efficiency. In other cases, they exist principally to protect the domestic industry from foreign competition and, as such, are often referred to as nontariff barriers (NTBs) to trade. The WTO has established guidelines to identify NTMs that are designed to promote social interests rather than to inhibit trade; these guidelines state that the former should be transparent, nondiscriminatory, and scientifically based, and that better alternatives should be lacking. See, for example, Carrère and De Melo, "Non-Tariff Measures: What Do We Know?" December 2009, 21; Fontagné, von Kirchbach, and Mimouni, "An Assessment of Environmentally-Related Non-Tariff Measures," October 2005.
[280] Industry representative, interview by USITC staff, Washington, DC, March 10, 2017.
[281] Feenstra, "Integration of Trade and Disintegration of Production," 1998, 35.
[282] Planet Money, "Planet Money's T-shirt Project," 2013.
[283] Dedrick and Kraemer, "Who Captures Value from Science Based Innovation?" 2015.

Figure 3.1: A sample supply chain for a microprocessor



Source: Compiled by USITC.

The emergence of GSCs as a standard method of production is due to a variety of factors. On the demand side, there has been growth in consumer markets abroad. On the supply side, factors include (1) the lowering of average tariffs through trade liberalization; (2) advances in technology, such as those related to telecommunications, digital information, and transportation; (3) the harmonization of standards, such as sanitary, phytosanitary, and other

technical requirements; (4) the increasing availability of high-skilled, low-wage workers in developing countries; and (5) reductions in many other forms of NTMs.[284] In each case, improvements to production efficiency have increased the length and fragmentation of supply chains and have lowered the barriers faced within them.

While product-level studies of GSCs are informative, the level of detail required to conduct such a study is a major limitation. As an alternative, much research has turned instead to less granular studies of GSCs that focus on the extent to which countries combine foreign inputs with domestic value around the world (box 3.1). This type of aggregate analysis is typically done at an industry or sector level and therefore lacks many of the details present in a product-level study. Nonetheless, it can still provide valuable insight into the nature of GSCs and the barriers they face.[285] Such research has found, for example, that production in GSCs has grown considerably over the last half century.[286] In particular, since the 1970s, the use of foreign inputs in production has increased from about 15 percent of gross export value to between 25 and 30 percent.[287] In recent years, more than half of global manufacturing imports, and 70 percent of services imports, are used as intermediate inputs in the production of other goods.[288] Given this increased use of GSCs, the inefficiencies experienced between each stage of the supply chain have become increasingly important.

[284] Organisation for Economic Co-operation and Development (OECD), *Interconnected Economies*, 2013, 9–10; Timmer et al., "Slicing Up Global Value Chains," 2004; USITC, hearing transcript, February 9, 2017, 24–28 (testimony of Ed Brzytha, Information Technology Industry Council). Some of the same factors that have enabled the expansion of GSCs have also hindered their growth. For example, while advancements in information technology make it easier for companies to establish supply chain activity in foreign markets, server localization requirements and other restrictions on cross-border data flows may hamper such expansion.

[285] For a fuller discussion of this methodology, see Koopman et al., "Give Credit Where Credit Is Due," 2010; Powers, "The Value of Value Added," 2012.

[286] Yi, "Can Vertical Specialization Explain the Growth of World Trade?" 2003, 55.

[287] Johnson, "Five Facts about Value-Added Exports," Spring 2014, 123.

[288] OECD, *Interconnected Economies*, 2013, 8. Similarly, Johnson and Noguera find that foreign-sourced inputs account for as much as two-thirds of trade. Johnson and Noguera, "Accounting for Intermediates," March 2012, 1.

Box 3.1: Industry-level Findings about Global Supply Chains

Industry-level analysis of global supply chains (GSCs) has become popular in economic research and has led to a better understanding of GSCs and their role in international trade. This research has found that, as noted elsewhere in this report, 25 to 30 percent of the value of exported goods reflects foreign inputs that are used in their production. This share differs substantially across industries. Manufacturing, for example, exhibits a much higher ratio of foreign inputs than do services or agriculture. Similarly, these ratios differ across countries as well. Foreign content may range from 49 percent in exports from Taiwan to only 8 percent in exports from Russia.[a]

Analyses of foreign inputs and the various sources of these inputs are also useful in characterizing the position of a country in supply chains and the extent to which the country participates. Upstream countries tend to exhibit relatively low foreign content in their exports, while downstream countries exhibit much more.[b] Similarly, relatively large ratios of foreign inputs within a sector or a country are indicative of its extensive participation in GSCs.[c]

[a] Johnson, "Five Facts about Value-Added Exports," Spring 2014, 123–27.
[b] Upstream countries are those that provide primary inputs early in the production process, while downstream countries combine inputs at the end of the supply chain.
[c] Koopman et al., "Give Credit Where Credit Is Due," 2010, 20–21.

Tariffs and Customs and Border Procedures

As the manufacture of goods increasingly moves towards GSCs, the costs and inefficiencies associated with trade become more important. Each time a good crosses a border, it is subject to an array of barriers consisting of tariffs and nontariff customs and border procedures. Passing each of these barriers represents a cost, both monetary and nonmonetary, that some party must bear during the production or sale of the good. These procedures have become especially significant in recent years, because while tariffs have generally fallen over time, the number and relative effects of NTMs have largely increased.[289]

Tariffs, which typically consist of either ad valorem or unit-based charges on the importation of a good, are an explicit cost of a good crossing a border. Despite considerable trade liberalization, as well as global reductions in tariff rates, free-trade zones, and duty-drawback programs which eliminate some of these charges, tariffs continue to represent a significant friction to trade. As the following section will show in more detail, tariffs on GSC goods accumulate and compound at each stage of production, magnifying their costs relative to non-GSC goods. Given, however, that the nature of tariffs is generally well understood, the remainder of this section will focus primarily on the less transparent NTMs faced by goods at the border.

[289] Ferrantino, "Using Supply Chain Analysis to Examine the Costs," February 2012, 2–3; Beghin, Maertens, and Swinnen, "Non-Tariff Measures and Standards," 2015, 2–4.

Customs and Border Procedures

Customs and border procedures, which encompass the administrative requirements that firms must fulfill in order for their goods to clear customs, represent a less explicit but equally important cost of trade. The number of hurdles a shipment faces when entering or exiting a country is substantial, and to clear them often requires activities that include:[290]

- Preparing and submitting documents;
- Customs and pre-shipment inspections;
- Transit clearance, transportation delays, and congestion at the border;
- Payment of fees, such as duties and other taxes;
- Certification, which verifies the trader has fulfilled requirements such as technical, sanitary, and phytosanitary standards or import and export licenses;[291]
- Customs classification procedures;
- Customs valuation procedures, which occur when administering countries use nonstandard methods of assessing the value of the shipment; and
- Theft, bribes, and other forms of corruption.

The time and costs associated with customs and border procedures may, in some cases, be considerable. A 2014 study by the WTO found that border procedures remain cumbersome worldwide. According to this study, globally, each customs transaction requires on average 40 separate documents; calls for the submission (and often multiple resubmissions) of 200 data elements; and involves 20 to 30 different parties.[292] Other recent research, however, has found that just 2 to 5 documents are required to export on average, suggesting that the true extent of customs inefficiencies is still not well understood.[293] An older survey conducted by the World Bank in 2005 that focuses on exports provides some of the most detailed information available on border crossing requirements. The survey asked exporters in 146 countries to document all the procedures required to transport export goods from a factory to a ship, including the time, documents, and signatures required for each activity. Respondents indicated that that while in some countries these activities entailed relatively modest delays of only a few days, in many others these activities resulted in substantially longer delays, often in excess of 60 days.[294]

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[290] For further discussion of at-the-border procedures, see Arvis et al., "Connecting to Compete: Trade Logistics," 2016, 18–23; Deardorff and Stern, *Measurement of Nontariff Barriers*, 1998, 4, 57; Djankov, Freund, and Pham, "Trading on Time," 2010, 168.
[291] Examples of these types of requirements are safety standards, environmental protections, food and drug testing requirements, invasive species precautions, and quality standards, among others.
[292] WTO, "Briefing Note: Trade Facilitation," 2014.
[293] Arvis et al., "Connecting to Compete: Trade Logistics," 2016, 21.
[294] Djankov, Freund, and Pham, "Trading on Time," 2010, 167–68.

However, many countries have improved their procedures. For example, according to the aforementioned 2005 World Bank survey, to export a shipment from Burundi at that time required an average of 67 days, 29 signatures, and 17 visits to various offices to fulfill all customs-related requirements and move products from the factory to a ship.[295] More recent World Bank data concerning Burundi indicate that by 2014 export shipments took 32 days and import shipments took 43 days. These data indicate that the associated border procedures have been reduced and made more efficient, though delays still exist.[296]

When surveyed about barriers faced by exporters from the European Union (EU), firms reported that at-the-border NTMs were the most common hurdle they faced in their operations. Almost 32 percent of the issues faced by exporters related to conformity assessments at the border. In many cases, the difficulty of obtaining the proper certification for various standards represented a greater hurdle than satisfying the standard itself.[297] Recent World Bank data from 2016 confirm that these inefficiencies are still prevalent worldwide, with delays for the importation of goods for all countries averaging about 79 days. For some countries, they run as high as 588 days.[298] Similarly, documentary compliance costs were found to be $180 on average, and as high as $1,025 in some countries. It is clear that complying with customs-related requirements imposes significant costs on firms engaged in international trade.[299]

Delays in border clearance may also add costs to importers and exporters. For example, delays in the clearance of goods may require importers to pay for extra storage and security. Furthermore, the goods themselves may lose value through depreciation, technological obsolescence, quality degradation, or decay.[300] Moreover, efficient inventory management becomes difficult when shipment times are long and uncertain. The cost of time delays can be so significant that they have extensive impacts on trade behavior. Some research has found that reducing the shipment time of a good from 58 to 27 days could result in an increase in trade of 31 percent between the two parties.[301]

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[295] Ibid., 2010, 168.
[296] World Bank, World Development Indicators database (accessed August 18, 2017).
[297] International Trade Center and EC, "Navigating Non-Tariff Measures," 2016, 6–9.
[298] World Bank, "Doing Business DataBank," 2017.
[299] Several trade restrictiveness indexes, such as the World Bank's Logistics Performance Index (LPI) and the World Economic Forum's Trade Facilitation Index (TFI), include the customs and border procedures described here among the measures they track. See Arvis et al., "Connecting to Compete," 2016, and Geiger et al., *The Global Enabling Trade Report 2016*, 2016.
[300] For example, some parts for cell phones and other electronic parts have short life spans.
[301] Djankov, Freund, and Pham, "Trading on Time," 2010, 167. For similar results, see also Moïsé and Sorescu, *Contribution of Trade Facilitation Measures*, May 29, 2015.

The effect of reducing shipping times is larger for some industries than others. Automotive parts and other intermediate inputs, for example, are more sensitive to time delays than consumer or capital goods. This is likely due to the reliance on carefully managed inventories and just-in-time manufacturing in handling these goods. In such cases, producers keep limited inventories of inputs on hand at any given point and instead rely on their regular and timely delivery. Thus, the prevention of delays is especially important in the case of intermediate inputs, which are used to complete one production phase and move the good toward the next. Food is another type of good that is often highly time sensitive, given that delays in shipment can often cause serious quality degradation.[302]

The Effects of Trade Costs on Supply Chains

The presence of tariffs and customs and border procedures takes on increasing importance when goods are produced within GSCs. This is because a good that incorporates foreign inputs and services may cross many borders during its manufacture. As a result, both the relative and absolute costs associated with trade are generally higher for GSC goods than for goods produced within a single country. This cost magnification largely occurs as a result of three effects: (1) high costs relative to domestic content, (2) high costs due to accumulation, and (3) high costs due to shipment delays.

First, when goods face tariffs and other costs at the border, these costs are typically levied according to the total value of the exported good rather than the relative share of the value that was added domestically. When a good has been produced in a GSC, this total value consists of both domestic value and foreign value. In general, however, the costs charged at the border do not differentiate between the domestic value and the foreign value embodied in a good. As a result, the magnitude of the border costs can be significant relative to the value added by domestic producers, particularly when domestic value represents a small share of the total value of the good.[303] Economic research has been unable to establish whether this magnification of tariff rates relative to value added influences the behavior of traders or the production of goods in GSCs.

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[302] Hummels and Schaur, "Time As a Trade Barrier," January 2012, 30–32. In recent years, the WTO has made the reduction of unnecessarily burdensome NTMs a high priority among its member countries. In addition to commitments made by signatories to the WTO's Trade Facilitation Agreement, which entered into force on February 22, 2017, countries have pursued unilateral efforts to reduce customs and border NTMs by including trade facilitation principles in their bilateral and multilateral trade agreements. In fact, these agreements increasingly seek to address NTMs rather than traditional tariff barriers, which have fallen over time. Neufeld, "The Long and Winding Road," April 2014; WTO, "Trade Facilitation" (accessed May 19, 2017); Neufeld, "Trade Facilitation in Regional Trade Agreements," January 2014; Peterson, "An Overview of Customs Reforms to Facilitate Trade," August 2017.

[303] Koopman et al., "Give Credit Where Credit is Due," September 2010, 24–28; Rouzet and Miroudot, "The Cumulative Impact of Trade Barriers," 2013, 2–3.

Second, the absolute cost of trading a GSC-produced good increases because trade costs, including tariffs and other border costs, are paid each time intermediate inputs cross a border. Tariffs are applied on the total value of a good when it enters the customs territory of another country, not just on the value that was added at the most recent stage of production. Downstream tariffs are levied on goods that already embody upstream trade costs, resulting in the further compounding of costs upon costs—a phenomenon known as the magnification effect.[304] Higher tariffs or a longer GSC with more border crossings typically increases the magnification effect. In these instances, the cumulative tariff could be significant despite low individual tariffs.[305]

Attempts to quantify the absolute increase have largely found that the accumulation and compounding of costs significantly raises trade costs in GSCs. These studies have found that in the United States, about 87 percent of the tariffs paid on imports from China represent direct tariffs on Chinese value added, while 13 percent represent indirect tariffs paid on upstream inputs and their border costs. At the same time, 47 percent of tariffs paid on U.S. imports from South Korea have been found to represent direct tariffs, while 53 percent represent indirect tariffs.[306]

Third, delays in the transportation of goods often result in increased costs. However, these costs are generally much higher for products supplied through GSCs. Because the production process within GSCs is highly fragmented, each stage of the chain relies heavily on the timely arrival of upstream inputs. Delays at any border make manufacturing slow, unpredictable, and expensive. This risk has become increasingly significant given the widespread emergence of just-in-time manufacturing processes. Long or unpredictable delays for a single input can result in costly disruptions that also affect downstream manufacturers, raising costs and increasing the likelihood of delays at each step along the chain. Estimates suggest that the costs of adding an extra day to import inputs used within a supply chain are as much as 60 percent higher than for the costs of adding an extra day to import final goods.[307]

The Consequence of Higher Trade Costs in GSCs

As just noted, a good produced in a GSC will incur significantly higher costs from tariffs and from customs and border procedures than one produced without imported inputs. This fact implies that a reduction in trade costs would both lower the cost of foreign inputs and

[304] Yi, "Can Vertical Specialization Explain the Growth of World Trade?" 2003, 55–56.
[305] Koopman et al., "Give Credit Where Credit is Due," September 2010, 24–28; Rouzet and Miroudot, "The Cumulative Impact of Trade Barriers," 2013, 2–3.
[306] Rouzet and Miroudot, "The Cumulative Impact of Trade Barriers," 2013, 2–3.
[307] Hummels and Schaur, "Time as a Trade Barrier," January 2012, 1–2; Moïsé and Sorescu, "Contribution of Trade Facilitation Measures," May 29, 2015.

stimulate the exportation of goods to downstream parties or consumers. Policy makers appear to have recognized this implication, as many countries tend to set tariff rates and other economic policies with GSCs in mind.[308] For example, many nations have introduced special economic zones offering firms advantages beneficial to manufacturing in GSCs, such as duty-free importing of production inputs or logistical benefits. As of 2015, there were 186 free trade zones in the United States that exist to promote U.S. production and value added over foreign alternatives.[309] In China, similar free trade zones appear to have been successful in improving economic factors such as foreign direct investment, technological progress, and wages.[310] Alternatively, many policy makers have also enacted duty-drawback programs in which exporters are allowed to redeem the value of duties paid on imported inputs, thereby lessening the cumulative tariff for those exports.[311]

Firms are also well aware of and actively seek to mitigate the costs associated with multiple border crossings and cumulative tariffs. During the Commission's public hearing for this report, several industry participants including representatives from the Intel Corporation, the Footwear Distributors and Retailers of America, and the Information Technology Industry Council expressed concerns related to these costs and noted the efforts they put forth to reduce them.[312] In fact, improving supply chain efficiency and reducing costs has become a large standalone industry, as evidenced by the numerous third-party logistics firms that provide GSC expertise to firms and the many universities offering degrees in supply chain management.[313]

[308] Blanchard, Bown, and Johnson, "Global Supply Chains and Policy," January 2016, 4.
[309] U.S. Foreign-Trade Zones Board, *77th Annual Report of the Foreign-Trade Zones Board*, September 2016, inside front cover (U.S. Foreign-Trade Zones"), 1.
[310] Wang, "The Economic Impact of Special Economic Zones," March 2013, 135–36.
[311] International Bank for Reconstruction and Development and The World Bank, "Measuring and Analyzing the Impact of GVCs on Economic Development," 2017, 102.
[312] USITC, hearing transcript, February 9, 2017, 36–42 (testimony of Mario R. Palacios, Intel Corporation); USITC, hearing transcript, February 9, 2017, 15–21, 56–60 (testimony of Thomas Crocket, Footwear Distributers and Retailers of America); and USITC, hearing transcript, February 9, 2017, 22–28, 61–64 (testimony of Ed Brzytwa, Information Technology Industry Council).
[313] For example, companies such as UPS (https://www.ups-scs.com/logistics/), FedEx (http://supplychain.fedex.com/), and DHL (http://www.dhl.com/en/logistics.html) offer extensive global logistics services. Related programs are also offered by many schools, including MIT (http://scm.mit.edu/), Michigan State University (https://www.michiganstateuniversityonline.com/programs/certificate/supply-chain-management/), and Indiana University (https://kelley.iu.edu/programs/undergrad/academics/curriculum/supply-chain-management-curriculum.cshtml) (accessed August 21, 2017).

Quantitative Assessment of Tariffs on GSCs

Introduction

Within GSCs, intermediate components as well as final products cross national borders. This section presents estimates of the tariffs that accumulate from each border crossing. In contrast to the industry-specific information presented in the case studies, this section takes a broader view and uses multicountry data on production relationships and trade statistics for approximately 35 aggregated sectors and 60 countries (including a region that represents "the rest of the world") to estimate the total or cumulative effects of tariffs imposed throughout the entire supply chain. The estimates reflect actual paths taken by components and finished goods as they cross multiple borders, and so incorporate the extensive efforts made by firms to minimize tariff and border costs. Calculations show that the textiles and apparel sector has the highest cumulative tariffs.

Cumulative Tariffs

Concept of a Cumulative Tariff

As discussed earlier, the cumulative tariff applied on a good is the sum of the **direct tariff**—the final tariff applied on a good as it crosses the last border in its production chain before it is consumed—and **indirect tariffs**. Indirect tariffs are tariffs applied on a good as it passes through each stage or tier of the supply chain and is transformed from raw materials into a finished product. Indirect tariffs include tariffs paid on intermediate inputs that are used in the production process. As discussed later, although services are not subject to direct tariffs, services firms that use imported intermediate inputs pay indirect tariffs, as well.

As a hypothetical example of the accumulation of tariffs, consider a T-shirt that is produced in stages in multiple countries.[314] Here, we assume that cotton is grown in India and exported to China, where it is ginned and spun into yarn, knitted into fabric, and then cut and sewn into a T-shirt. The T-shirt is exported to the United States, where a logo is screened onto it. The T-shirt with a logo is then exported to Germany and eventually sold to an end user. In this simple example, assume that the Indian cotton costs $4 to produce and transport to China, where a 25-percent tariff raises the cost to the Chinese importer to $5. Assume that, in China, the importer adds $3 of value in manufacturing the T-shirt and then exports it at a cost of $8 to the United States, where a 12.5-percent tariff raises the cost of the T-shirt to the U.S. importer to $9. Assume further that U.S. companies add $1 in value for the logo and export the $10 T-shirt

[314] Although this example is a consumer good, similar principles apply to industrial goods, as discussed in the case studies. See appendix G for a technical explanation of these calculations.

to Germany. There, a 10-percent tariff raises the cost of the finished T-shirt to the German importer to $11. In this case, the German importer pays a direct tariff of $1, but the cumulative tariff is $3, of which $1 was paid at the Chinese border and $1 was paid at the U.S. border. Hence, in this hypothetical example, the indirect tariff of $2 exceeds the direct tariff paid by the final importer.

Table 3.1 presents another version of the same example. In this report, cumulative tariffs are divided into tiers. Direct tariffs are ordinary tariffs applied on goods as they cross a border. From the perspective of a retailer in Germany, the direct tariff is the tariff on the finished T-shirt from the United States. First-tier tariffs are tariffs applied to intermediate inputs used to produce final goods. In the example, the first-tier tariff is applied to the blank T-shirt imported into the United States from China. Second-tier tariffs are tariffs that are applied to intermediate inputs used to make intermediate inputs, and so on. In this case, the second-tier tariff is applied to the cotton imported into China from India. In general, cumulative tariffs are composed of indirect tariffs (the first- through last-tier tariffs) and direct tariffs.

Table 3.1: Direct, indirect, and cumulative tariffs in hypothetical example

Product	Border	Value at border, $	Tariff rate, %	Direct tariff, $	Indirect tariff, $	Cumulative tariff, $
Cotton	India to China	4	25.0	1	0	1
Plain T-shirt	China to USA	8	12.5	1	1	2
T-shirt with logo	USA to Germany	10	10.0	1	2	3

Source: USITC calculations.

Note: Indirect tariffs are the sum of the direct tariffs in previous stages of production, as shown in the lines above any particular indirect tariff.

In most cases, the data show that the direct tariff on goods exceeds the indirect tariff because the direct tariff is applied to the full value of a higher-priced good at a later stage of production, and indirect tariffs are always applied to the inputs of upstream products. Tariff escalation, in which import duties are higher on processed goods and final products than on intermediate goods and inputs, can also contribute to the low indirect tariffs. Nevertheless, it is possible for indirect tariffs to add a significant cost to the final good, especially in long GSCs.

Services are included in the calculations of cumulative tariffs, even though direct tariffs are not imposed on them. While many services are not traded or are traded duty free, tariffs affect services because they use traded intermediate inputs that have tariffs applied to them. For example, U.S. transportation services, such as trucking, may use trucks built in Japan, or U.S. medical services may use magnetic resonance imaging (MRI) machines constructed with parts built overseas.

To estimate the cumulative tariffs for GSCs, two types of information are needed.[315] First, information is needed that shows how all industries in each country are linked to each other. For example, for each dollar of U.S. agricultural output, how many cents of German chemicals, Japanese tractors, and U.S. transportation services are used? This information represents the input cost shares of producing each good. Second, information is needed on the effective tariffs that each country applies to each good imported from each of its bilateral trading partners. Broadly speaking, the estimation technique involves multiplying the input shares for each sector by the tariffs applied to the traded inputs.

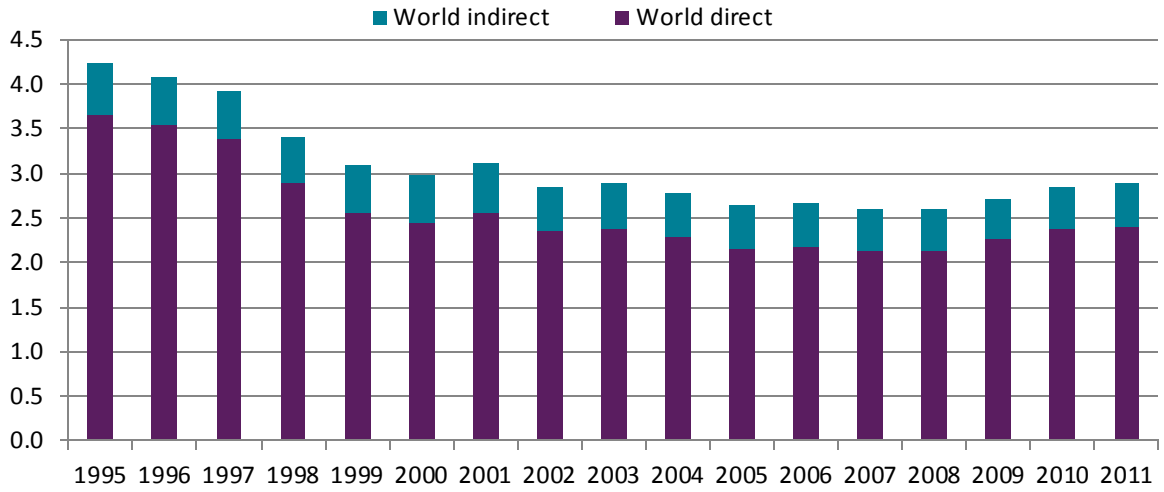
Estimation Results

Average direct import tariffs have decreased to the point where they are fairly low globally, especially for developed countries. Average indirect tariffs are low as well. Both tariffs contribute to low average cumulative tariffs. Average direct U.S. tariffs on all imports are lower than the average direct world tariffs, as the U.S. economy is among the world's most open (figures 3.2 and 3.3).[316] On the other hand, U.S. indirect tariffs are slightly higher than the world average, in part reflecting the fact that U.S. GSCs are longer than the global average. Since U.S. direct tariffs are lower than the world average, U.S. indirect tariffs constitute a more significant share of U.S. cumulative tariffs (about a third on average) than they do for the world (about a sixth on average).

[315] The approach used here is based on research by the OECD. See Rouzet and Miroudot, "The Cumulative Impact of Trade Barriers," 2013.

[316] Tariff data and information on industry interactions are needed to make these calculations. Tariffs are from the United Nations Conference on Trade and Development (UNCTAD) Trade Analysis Information System (TRAINS) database; information on industry interactions is based on intercountry input-output tables, available annually from the OECD for the years 1995–2011.

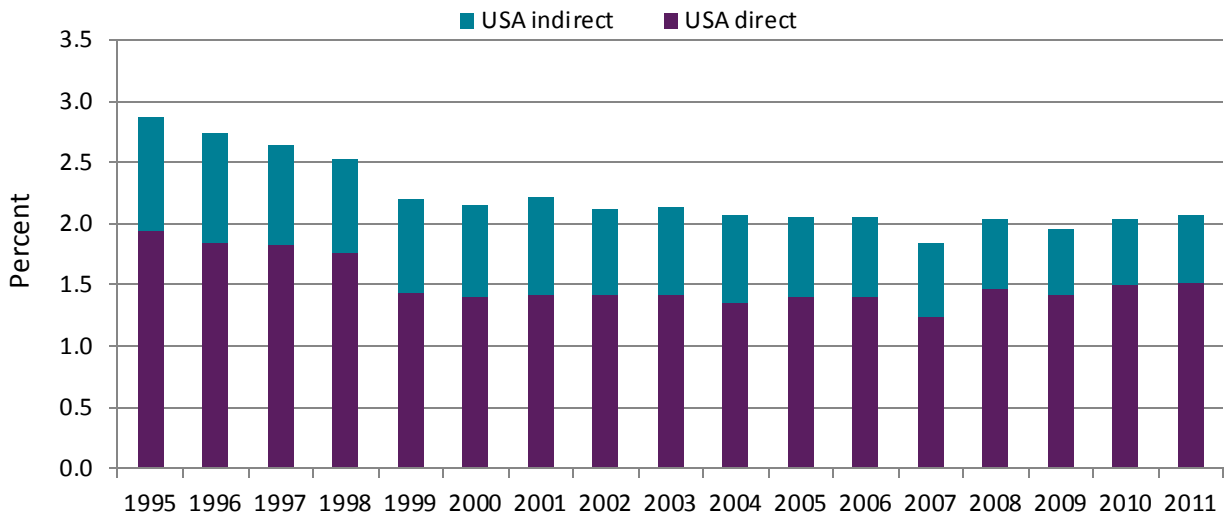
Figure 3.2: Direct and indirect tariffs on world imports, 1995–2011



Source: USITC estimates.

Globally, direct tariffs fell 34 percent over 1995–2011, while global indirect tariffs fell only 17 percent. Analysis indicates that, globally, supply chains have become more complex or longer, leading to a greater magnification effect. Indirect tariffs are affected by two contrary forces: (1) a general decline in direct tariff rates, and (2) an increase in length or complexity of the GSC. Consequently, indirect tariffs fall less than direct tariffs for the world. In contrast, when U.S. tariffs are examined, a different pattern emerges; direct tariffs fall by 22 percent but indirect tariffs fall by 41 percent, almost twice as much. Given the trend towards increased use of GSCs, there are two possible explanations for the precipitous decline in U.S. indirect tariffs: the United States may have shifted its GSCs to countries with which it has FTAs, or countries in the U.S. GSCs may have reduced their tariffs with each other.

Figure 3.3: Direct and indirect tariffs on U.S. imports, 1995–2011

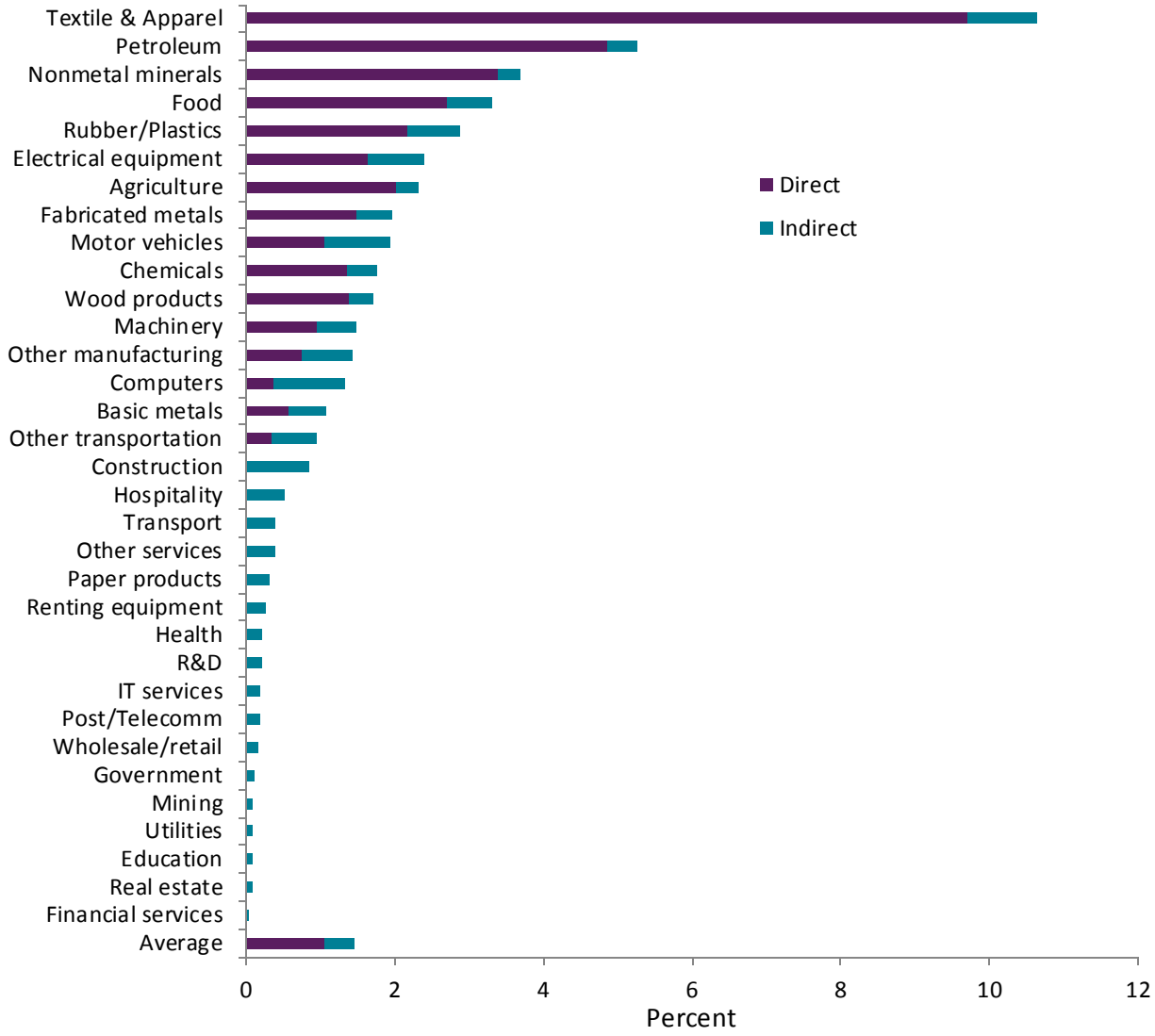


Source: USITC estimates.
Note: Import tariffs are weighted averages paid by the world and by the United States on imports from all countries and all sectors. The weights are based on total import expenditures by the world and the United States, respectively, from each exporting country and industry. For more details see Drenski, Hallren, and Powers, "A Guide to Calculating Cumulative Tariffs of Global Value Chains," forthcoming.

Although average cumulative tariffs on total U.S. imports are low, some sectors have large cumulative tariffs. The textile and apparel sector has the highest cumulative tariff (10.6 percent) due to its large direct tariff (9.7 percent) (figure 3.4). As a share of output value, the top imported intermediate inputs for U.S. textiles are textile inputs from China and wholesale services from China.[317] These represent about 5 percent of the value of output, so the relatively high cumulative tariff on textiles reflects the high rates applied to textile imports into the United States. The petroleum sector has the next-highest cumulative tariff followed by nonmetal minerals, owing to fairly large direct tariffs on both. As a share of output value, the top imported intermediate inputs for U.S. petroleum are inputs from the mining and quarrying industries in the "rest of the world" region, Canada, Saudi Arabia, Mexico, and Colombia. Together these constitute 20.5 percent of the value of petroleum output.

[317] Wholesale services involve purchasing and storing large quantities of goods and selling them in batches to resellers, such as retailers and professional groups.

Figure 3.4: Direct and indirect tariffs on U.S. imports by sector, 2011 percent



Source: USITC estimates.

Note: "Average" is the unweighted arithmetic mean of the industry cumulative tariffs.

The motor vehicle sector has a moderate cumulative tariff, with approximately equal direct and indirect tariffs. The services sectors have no direct tariffs but indirectly pay tariffs on imported intermediate goods. These indirect tariffs occur when service providers use equipment and capital that is imported from abroad or is made from imported components that are tariffed when they arrive in the U.S. Most U.S. services sectors primarily use value added and domestic intermediate inputs, so the portion of value that is dutiable is small. Among services, construction services and hospitality services have the largest indirect tariffs (0.9 percent and 0.5 percent, respectively). Of the services sector, construction uses the largest proportion of foreign intermediate inputs (8.9 percent). Of these, the top two are electrical equipment and

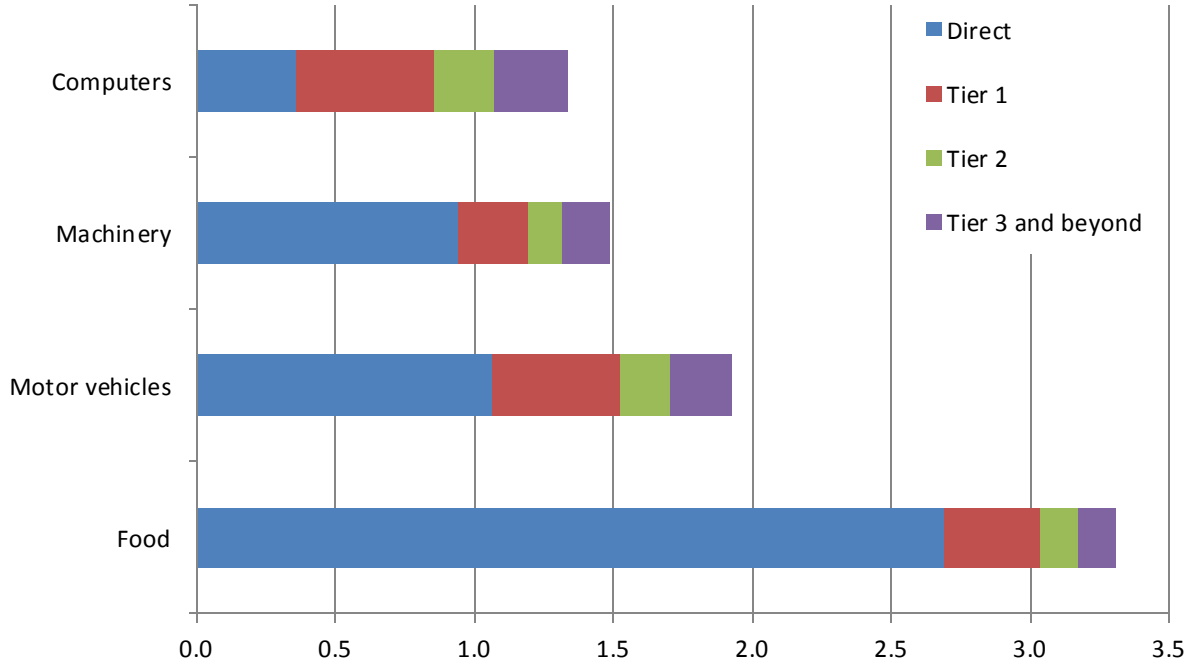
manufacturing equipment from China. The indirect tariffs reflect the duties applied to these products imported from China.

The cumulative tariff is low for computer and related products, consisting mainly of indirect tariffs. As discussed in the case study on semiconductors, signatories to the WTO Information Technology Agreement (ITA) pay no tariffs on their imports of semiconductors and various other electronic goods, which implies that direct tariffs are zero on many of these products. The low cumulative tariffs on these products likely contribute to this industry's broad use of GSCs. Other researchers using a related approach report that the length of the GSCs for computers and related industries increased more than those for other manufactured products between 1995 and 2009.[318] They also point out that developing countries that joined the ITA have higher average-participation rates in GSCs than members of the Organisation for Economic Co-operation and Development (OECD), and that these developing countries import inputs about as often as they export similar products to other countries.

Figure 3.5 breaks out U.S. cumulative tariffs into direct, first-, second-, and third-tier and beyond tariffs for selected industries in 2011. In three of the four cases, the direct tariffs constitute the largest share of the cumulative tariff. Moreover, the figure suggests that typically, the direct tariff accounts for more of the cumulative tariff than the tier-one tariff, while the tier-one tariff accounts for a greater proportion than the tier-two tariff and so on. However, this relationship does not always hold, as in the case of computers and related products, where the tier-one tariff (0.9 percent) is larger than the direct tariff (0.4 percent). This case arises in industries when final assembly is primarily done in the United States but relies on a large number of intermediate goods. It may also arise when the final good is imported at a low tariff rate, but the intermediate goods used in final assembly have higher tariffs levied on them.

[318] De Backer, Koen, and Miroudot, "Mapping Global Value Chains," December 19, 2013.

Figure 3.5: Upstream U.S. cumulative tariffs by direct suppliers and tier 1–3 suppliers and by tier 1–3 suppliers for selected sectors, 2011 (percent)



Source: USITC calculations.

The analysis also maps the tariffs paid by importing countries based on the source (exporting) country. Table 3.2 shows bilateral cumulative tariffs and the indirect share of cumulative tariffs from the source country (row) to the destination country (column); zeros (on the diagonal) occur because countries do not charge tariffs on themselves. For example, China's importers of goods from Korea pay an average cumulative tariff of 6.2 percent, and 24 percent of that is an indirect tariff. In general, it is expected that for products traded in regional trade blocs, the indirect tariff will be a high share of cumulative tariffs. The results presented in table 3.8 follow the expected pattern. For example, low cumulative tariffs and high indirect shares of the cumulative tariffs among Canada, Mexico, and the United States reflect the deep integration of these NAFTA countries in automotive supply chains and in other sectors.

Table 3.2: Bilateral cumulative tariffs and indirect tariffs share on imported goods in selected economies, 2011 (percent)

	Australia	Canada	China	Japan	S. Korea	Mexico	USA	EU	ROW
Panel A. Cumulative tariffs									
Australia	0	1.0	5.0	9.0	12.8	1.5	0.7	2.1	3.0
Canada	1.1	0	4.3	2.0	5.2	0.9	0.5	1.8	3.8
China	3.3	5.0	0	3.4	6.0	3.9	3.4	3.9	8.6
Japan	2.2	2.1	5.0	0	4.2	2.4	1.3	3.5	13.1
South Korea	4.1	4.8	6.2	4.1	0	8.2	3.1	5.1	9.1
Mexico	2.6	0.9	6.6	2.3	8.7	0	0.7	1.0	4.3
United States	0.2	1.1	4.7	1.4	16.6	0.5	0	1.6	4.1
EU	2.4	2.6	5.5	2.1	6.6	5.2	1.4	0	3.7
ROW	2.1	4.3	4.2	2.4	4.3	3.7	5.0	4.1	0
Panel B. Indirect share of cumulative tariff									
Australia	0	23	4	2	1	16	31	14	8
Canada	26	0	8	18	6	53	96	16	7
China	24	15	0	23	11	23	24	17	9
Japan	6	7	3	0	4	6	11	5	1
South Korea	43	39	24	56	0	18	50	31	16
Mexico	23	85	8	22	6	0	97	53	9
United States	92	24	5	12	1	57	0	12	5
EU	12	9	5	13	4	5	15	0	6
ROW	38	23	21	41	28	25	18	31	0

Source: USITC calculations.

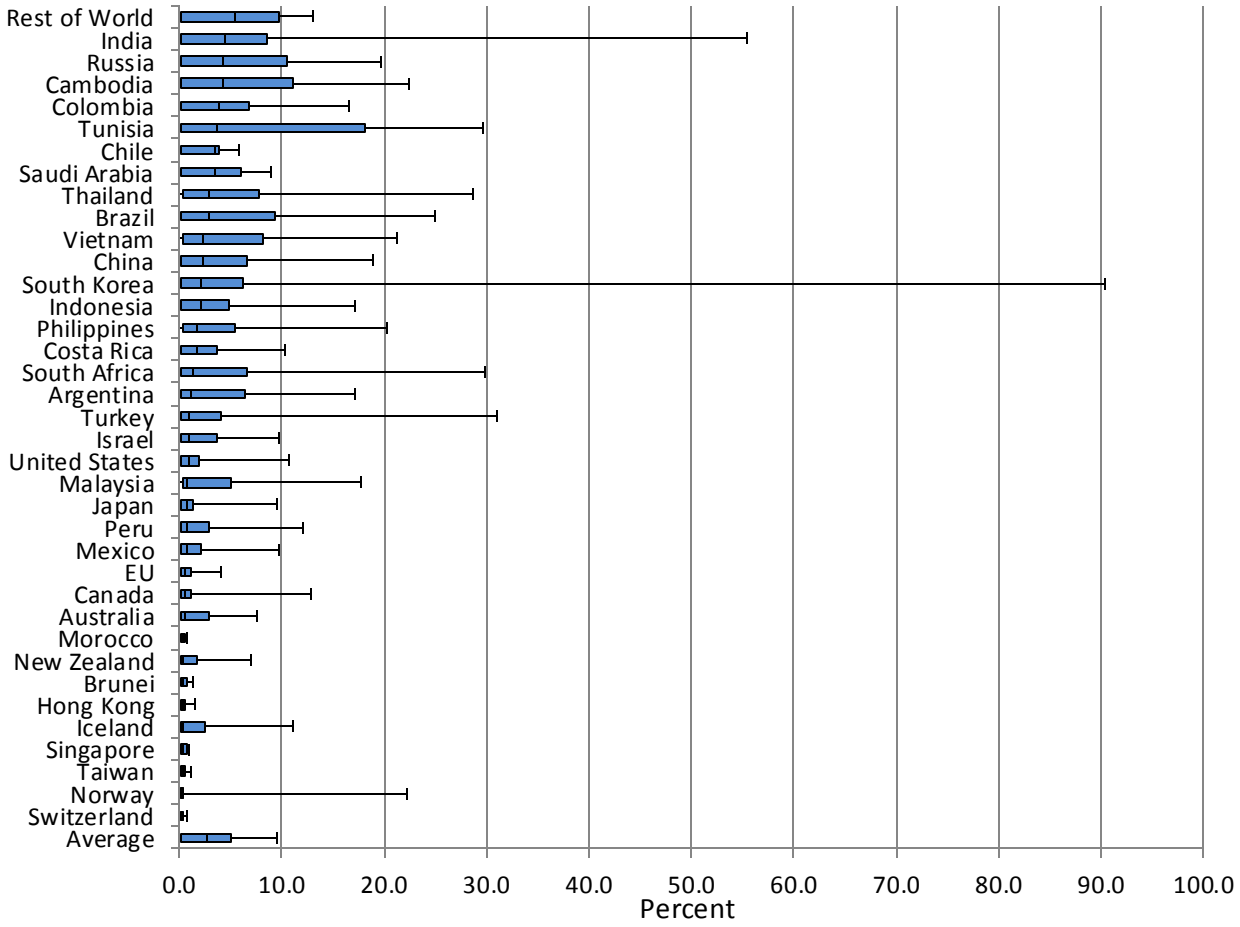
Note: Columns are destination countries or regions, and rows are source countries or regions. EU = the 28 EU economies; ROW = rest of the world.

Figure 3.6 summarizes the sectoral distribution of cumulative tariffs for selected countries for 2011; regions or countries are presented in descending order of the median cumulative tariff.[319] In this figure, the interquartile ranges—the distance between the 75th percentile and the 25th percentile appear as shaded boxes. The interquartile ranges indicate how a country's cumulative tariffs are dispersed by industry. For example, Tunisia has a large interquartile range, of between 0.2 percent and 18.1 percent, indicating that that its cumulative tariffs vary considerably by industry. By contrast, Canada has little variation by industry in its cumulative tariffs, as indicated by its small interquartile range, which lies between 0.1 percent and 1.1 percent. The five countries or regions with the highest median cumulative tariffs are the rest of

[319] The shaded boxes in figure 3.9 contain the middle half of the data, which is the interquartile range between the 75th percentile and the 25th percentile. The vertical line in the shaded box is the median. Maximum values are indicated by the "whisker," or extended line to the right.

the world, India, Russia, Cambodia, and Colombia. The medians fall within a fairly narrow range between 0.2 percent and 5.5 percent.

Figure 3.6: Sectoral distribution of cumulative tariff rates by country (2011), percent



Source: USITC calculations.

Note: "Average" is the unweighted arithmetic mean of the country cumulative tariffs; ROW = rest of the world.

Nevertheless, there is considerable variation in cumulative tariffs across industries within each country. This variation likely reflects differing degrees of international vertical specialization across industries. In addition, while most cumulative tariffs are relatively modest at the median, in some cases they can accumulate and magnify to more than three times the direct applied rate. For example, South Korea has a high cumulative tariff of 90.5 percent on agricultural imports.[320] By contrast, the cumulative tariffs on services and paper products are all less than 1 percent.

[320] The cumulative tariff rates for South Korea could be lower in later data from the period after the U.S.-Korea Free Trade Agreement went into effect in March 2012, although South Korea continues to have high direct tariffs on agricultural products with other countries as well.

Conclusion

Average cumulative tariffs are fairly low. The world average, weighted by expenditures on imports, is about 2.9 percent, with an average direct tariff of 2.4 percent and an average indirect tariff of 0.5 percent. The indirect tariff reflects the accumulated tariffs on upstream inputs resulting from multiple border crossings. Despite the low overall averages, there is considerable variability by sector. For example, the cumulative tariff faced by U.S. importers of textiles and apparel is almost 10 percent, and the cumulative tariff on agricultural imports into South Korea is over 90 percent. Although services are not subject to direct import tariffs, they are an important link in GSCs and are affected by indirect tariffs. For example, the indirect tariff for imports of construction services into the United States is nearly 1 percent, the largest of any U.S. services sector. Of the goods sectors, computers and related products have fairly high indirect tariffs reflecting lengthy GSCs.

Case Studies

Introduction

The following section presents three case studies illustrating how customs and border procedures affect goods that are produced through GSCs. The first case study examines the passenger vehicle supply chain in Argentina and Brazil, while the second looks at the manufacture of semiconductors in the Philippines and Vietnam. The third case study examines logistics services in sub-Saharan Africa (SSA). Since logistics services often facilitate GSC activity, customs and border procedures encountered by logistics firms may affect both the upstream production and the downstream distribution of GSC goods.

Each case study identifies specific customs and border procedures that serve as NTMs affecting supply chain activity because they increase the monetary costs and add to the time associated with moving goods through GSCs. Broadly, these NTMs fall into three categories: border procedures, document procedures, and measures concerning domestic transport and cross-border data flows (table 3.3). Border and document procedures generally affect the speed with which goods are cleared at customs checkpoints. Moreover, inadequate or poorly regulated information, technology, and communications and transport infrastructure may hamper the efficient flow of goods "behind the border" (i.e., after the goods have cleared customs), thus adding costs to firms' supply chain operations.[321] These "behind-the-border" measures may

[321] Sadikov, "Border and Behind-the-Border Trade Costs," December 2007, 4; USITC, hearing transcript in connection with *The Economic Effects of Significant U.S. Import Restraints: Ninth Update*, February 9, 2017, 24, 28.

also undermine the efficiency with which financial, logistics, and other services are supplied in GSCs.[322]

Table 3.3: Customs- and border-related nontariff measures (NTMs) identified in the literature and illustrated in case studies

NTM category	NTM	Passenger vehicles in Argentina and Brazil	Semiconductors in the Philippines and Vietnam	Logistics in SSA
Border procedures	Burdensome inspections		●	●
	Lack of transparency		●	●[a]
Document procedures	Preparing and submitting customs documents	●	●	●
	Payment of fees, duties, and taxes	●	●	●
	Customs classification			
	Customs valuation			
	Certification requirements, including export and/or import license	●	●	
Measures affecting domestic transport and cross-border data flows	Inadequate port, road, and/or rail infrastructure			●
	Inadequate information, communications, and technology infrastructure			●
	Regulations that limit or restrict the cross-border transmission of data, including server localization requirements			

Source: Adapted from the World Bank, "Doing Business: Trading Across Borders Methodology," 2016.
Note: All listed NTMs were identified in the literature.
[a] Includes inefficient or costly operations due to trucking cartels in sub-Saharan Africa (SSA).

Although the focus of this chapter is on customs and border procedures, the case studies illustrate how such measures are often linked to broader trade restrictions that have an adverse impact on firms' supply chain operations. For example, in Vietnam semiconductor production is hampered by inconsistent and burdensome licensing requirements for the importation of used equipment. In addition, some firms operating in Vietnam are prohibited from importing such equipment altogether, even if they have applied for an import license.

[322] In this case, services are viewed as what the Kommerskollegium (Swedish National Board of Trade) labels as "enablers" of GSC activity, facilitating the flow of goods from origin to end consumer. Such services include, for example, insurance, finance, telecommunications, transport, and logistics services. Government of Sweden, Kommerskollegium National Board of Trade, "Global Value Chains and Services," January 2013, 6. For further discussion of services' input into manufacturing and their role in GSCs, see also USITC, *The Economic Effects of U.S. Import Restraints: Eighth Update*, "The Role of Services in Manufacturing," December 2013.

Thus, semiconductor firms operating in Vietnam may encounter a related set of customs and trade barriers (i.e., nontransparent import licensing procedures for used equipment and a ban on such imports). Both types of measures increase the costs of semiconductor firms operating in that country.

Passenger Vehicle Supply Chain Case Study: Argentina and Brazil

Introduction

The first case study examines the effects of import licenses on the automotive supply chain in Argentina and Brazil. These two countries are the largest producers of passenger vehicles and auto parts in South America. They are both significant suppliers of passenger vehicles and, to a lesser extent, of parts to each other. However, relatively high trade costs, including those due to import licenses, appear to have hindered deeper integration of these countries' vehicle supply chains.[323] In particular, according to industry representatives, the approval process for Argentina's import licensing system historically has been nontransparent and inconsistent.[324] Thus, it was often difficult for Argentine auto manufacturers to learn why the issuance of an import license for a particular good was delayed, as well as if and when they could expect the arrival of the imported parts they need.[325] Recently, however, the new Argentine government has reformed the country's import licensing program, reducing the time and expense associated with importing parts used in vehicle manufacture.[326] These reforms may ultimately lower the costs of producing vehicles in Argentina and result in more trade in intermediate parts between Argentina and Brazil.

In addition to customs and border procedures, local content rules and trade-balancing requirements related to the Mercosur customs union may have hampered the integration of Argentina's and Brazil's automotive supply chains.[327] Both countries' tax incentives are aimed at

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[323] Industry representatives, interview by USITC staff, Buenos Aires, October 31 and November 1, 2016.
[324] Disciplines under the WTO indicate that a country's import licensing procedures should be "simple, transparent, and predictable." Where information about licensing procedures is not readily available to traders, or where the licensing process itself is unpredictable, import licensing may be considered as an NTM affecting trade. WTO, "Understanding the WTO: The Agreements: Import Licensing" (accessed April 4, 2017).
[325] Industry representatives, interview by USITC staff, Buenos Aires, October 31 and November 1, 2016.
[326] Mauricio Macri was elected president of Argentina in November 2015, and economic reform was a major part of his election platform.
[327] Argentina and Brazil are members of Mercosur (or Mercosul in Portuguese), a customs union which has helped facilitate the establishment of a regional automotive supply chain in South America. Argentina, Brazil, Paraguay, and Uruguay are full members of Mercosur. Bolivia is currently in the process of becoming a full member, and Chile, Colombia, Ecuador, Guyana, Peru, and Suriname are all associate members. Venezuela's membership was suspended on December 1, 2016.

increasing the local content of vehicles sold in the domestic market. Moreover, sales of both Brazilian-produced vehicles in Argentina and Argentine-produced vehicles in Brazil are required to be no more than half of total vehicle sales in either country due to the trade-balancing requirements. Together, these restrictions may limit trade, and hence supply chain activity, between the two countries.

Overview of the Passenger Vehicle Industry

Industry Description

Most passenger vehicle manufacturers produce a range of products, including passenger cars, sport-utility vehicles, minivans, work vans, and light trucks.[328] The passenger vehicle supply chain tends to be regional, with the majority of vehicles and parts sourced from nearby countries.[329] The regional nature of the automotive supply chain is partly motivated by the fact that vehicles are heavy, and thus expensive to transport, but it may also be influenced by government incentives for vehicles to be produced locally. In addition, many passenger vehicle manufacturers are attempting to use a larger share of common parts for their vehicles to achieve greater economies of scale. This focus has often led manufacturers to push their top suppliers to co-locate plants that produce parts close to each passenger vehicle assembly plant around the world.[330] By keeping their suppliers close to their production plants, automotive manufacturers minimize the need to maintain a large inventory of parts. At the same time, however, as more top suppliers locate facilities near assembly plants, less work goes to smaller local suppliers that could only supply assembly plants in a single market.[331]

[328] The passenger vehicle industry encompasses products under the following six-digit product classification codes within the global Harmonized System (HS) for classifying traded goods: 870321, 870322, 870323, 870324, 870331, 870332, 870333, 870390, 870421, and 870431.
[329] Klier and Rubenstein, *Who Really Made Your Car?* 2008, 3; Sturgeon and Van Biesebroeck, "Global Value Chains in the Automotive Industry," 2011.
[330] Klier and Rubenstein, *Who Really Made Your Car?* 2008, 133.
[331] Klier and Rubenstein, *Who Really Made Your Car?* 2008, 3; Sturgeon and Van Biesebroeck, "Global Value Chains in the Automotive Industry," 2011.

Primary U.S. and Global Participants in Argentina and Brazil

The top five global vehicle manufacturers are Volkswagen, General Motors, Toyota, Hyundai, and Ford. Each firm has a significant presence in Argentina and Brazil, as indicated by the number of assembly plants they have in those countries as well as their market share (table 3.4). Fiat Chrysler Automotive, another global automobile manufacturer, also has significant vehicle sales in Brazil.

Table 3.4: Top global vehicle manufacturers in Argentina and Brazil

Group	Headquarters	2016 global sales (millions of units)	Assembly plants in Argentina and Brazil	2015 market share by volume of sales in Argentina and Brazil, %
Volkswagen	Germany	10.4	4	15.4
General Motors	United States	10.0	4	14.8
Toyota[a]	Japan	8.9	3	7.5
Hyundai[b]	South Korea	7.7	1	7.0
Ford	United States	6.7	3	11.2
Fiat Chrysler	Italy	4.4	2	17.3
Subtotal		48.1	17	73.4
Other		44.8	15	26.6
Total		92.9	32	100.0

Source: Fiat Chrysler, *Fiat Chrysler Automobiles Annual Report 2016*, February 9, 2017, 14; Ford, *Ford Motor Company 2016 Annual Report*, 2; General Motors, *General Motors Company Annual Report 2016,* April 2017, 2; Hyundai, *Hyundai Motor Company Annual Report 2015*, January 26, 2016, 16; Kia, *Kia Motors Corporation Annual Report 2015*, 2016, 8; Toyota, *Toyota Motor Corporation Form 20-F: Annual Report*, June 24, 2016, 2; Volkswagen, *Volkswagen Annual Report 2016*, 2017, 2; Binder, *Ward's Automotive Yearbook 2016*, 2016, 75–76; ANFAVEA, *Brazilian Automotive Industry Yearbook 2017*, 2017, 30.

[a] All Toyota data are from the fiscal year ending on March 31, 2017.

[b] Global sales represent a combination of Hyundai and Kia sales in 2015.

Overall, automotive supply chains have changed in recent years as top global manufacturers have upgraded vehicles to increase their fuel efficiency, their use of common parts, and their use of technology for safety and entertainment. Firms such as Fiat Chrysler, for example, have made significant investments in powertrain technology, as well as in new engine technologies (e.g., hybrid, electric, and hydrogen) aimed at increasing fuel efficiency.[332] These trends have helped nontraditional automotive suppliers gain entry into the supply chain, strengthened large multinational vehicle suppliers, and increased competitive pressures on smaller national suppliers.

[332] In 2015, Fiat Chrysler invested $53 million in a R&D center in northeastern Brazil for the production of powertrain technology, or engine and transmission-controlling software. Mari, "Fiat Chrysler Invests $53M in Brazil R&D Center," December 7, 2015.

The Passenger Vehicle Supply Chain in Argentina and Brazil

Overview

Argentina and Brazil are the top two suppliers of passenger vehicles for the South American market. In 2015, these two countries accounted for 98 percent (2.95 million) of vehicles produced in South America (3.02 million).[333] In addition, Argentina and Brazil accounted for 95 percent of the region's passenger vehicle exports in 2015.[334] In the same year, vehicle sales for all countries in South America totaled 3.9 million units, with Argentina and Brazil supplying 3.2 million of those sales.[335]

Passenger vehicles produced in Argentina have approximately 30 percent Argentine content, but some vehicles have as much as 40 percent.[336] Brazil produces more vehicles than Argentina, and passenger vehicles produced in Brazil tend to have higher levels of Brazilian content, as there is more R&D and parts production in Brazil than in Argentina. Also, Brazil's domestic content program has been in place for a longer time.[337] Brazil was South America's largest importer of vehicles and parts in 2015, as well as the region's largest exporter of parts (it was second in passenger vehicle exports to Argentina).[338]

Vehicle Trade between Argentina and Brazil

Argentina and Brazil trade significantly more finished vehicles than vehicle parts.[339] In 2016, Argentina accounted for two-thirds of Brazil's passenger vehicle imports ($2.8 billion) and Brazil was Argentina's top market for vehicle exports (figure 3.7).[340] On an average annual basis, 55.5 percent (or $5.1 billion) of Brazil's passenger vehicle imports were from Argentina during the period 2012–16.[341] Many of these imports likely represented intracompany shipments by

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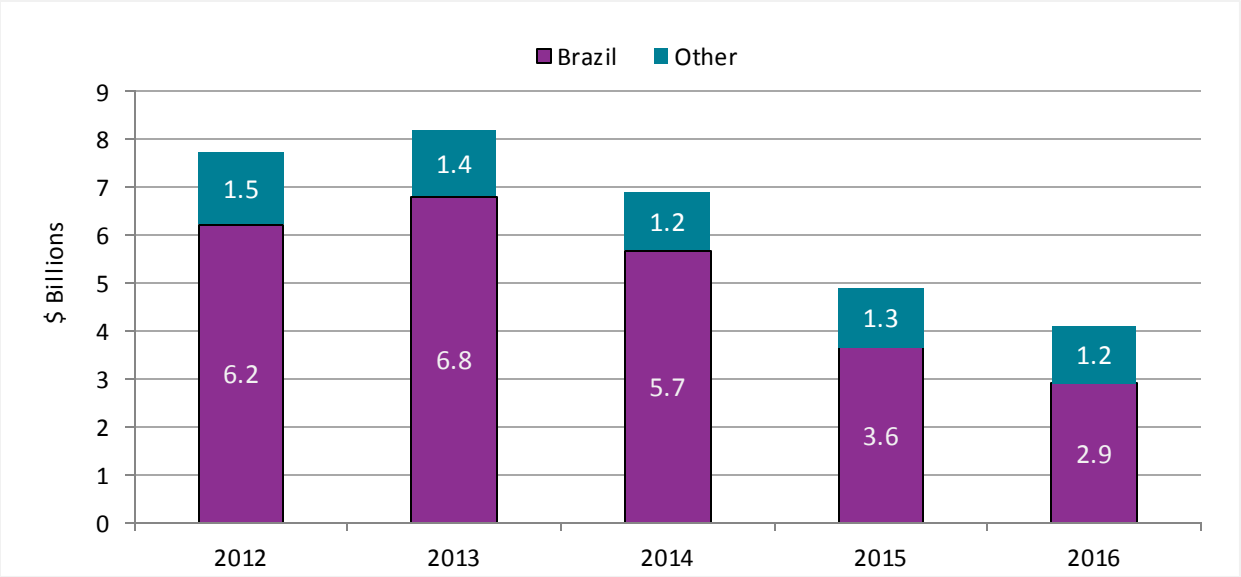
[333] OICA, "2015 Production Statistics," March 2, 2016.
[334] IHS Markit, GTA Database (accessed September 12, 2016).
[335] Binder, *Ward's Automotive Yearbook 2016*, 2016.
[336] Industry representative, interview by USITC staff, Buenos Aires, October 31, 2016.
[337] Domestic parts account for as much as 80 percent of parts in some vehicles produced in Brazil. Michaud, "Driving Up the Local Content of Brazilian Cars," September 2015, 4.
[338] IHS Markit, GTA Database (accessed February 3, 2017).
[339] In other regional markets (e.g., North America or Europe), parts trade can be significantly higher than it is in South America.
[340] IHS Markit, GTA database (accessed June 28, 2017).
[341] Declining exports to Brazil was the primary factor accounting for a 40 percent drop in Argentina's passenger vehicle exports during 2011–15. This decline was due to a recession and decreasing demand for vehicles in Brazil. No other country accounted for more than 5 percent of Argentina's passenger vehicle exports in 2015, with Australia accounting for 4.7 percent ($230 million) in that year. IHS Markit, GTA database (accessed June 28, 2017).

foreign vehicle manufacturers in Brazil. Domestically produced vehicles made up 82 percent of Brazil's new-vehicle registrations from 2012 to 2016.[342]

Figure 3.7: Argentina's passenger vehicle exports, 2012–16

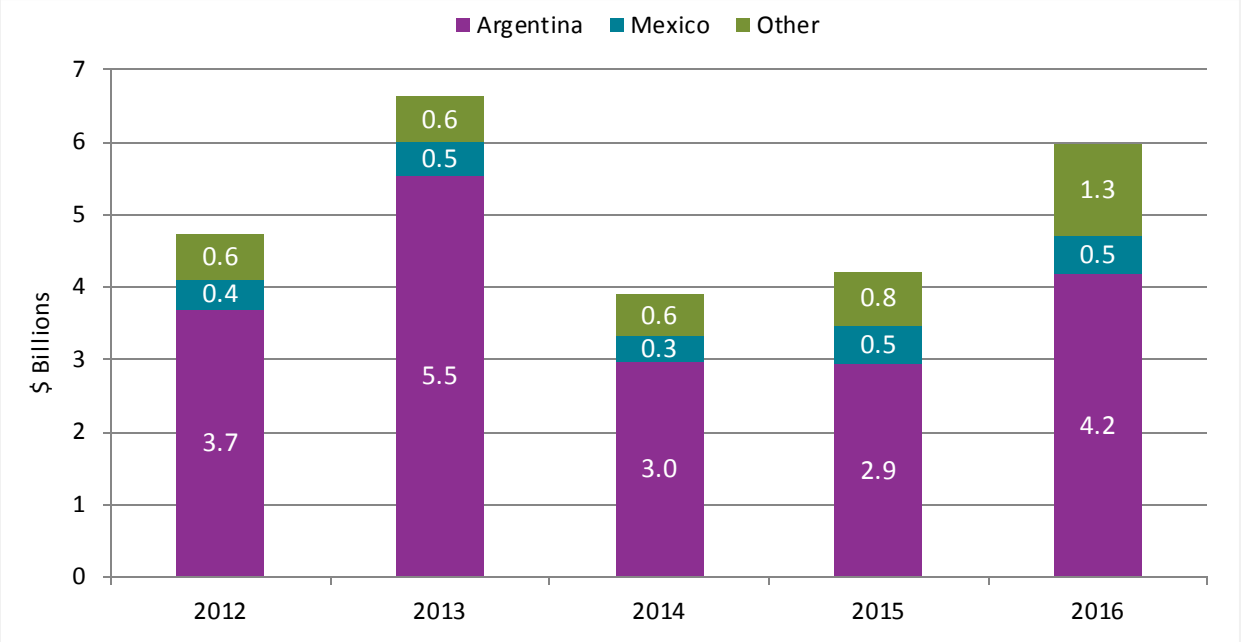


Source: IHS Markit, GTA Database (accessed June 28, 2017).

At the same time, between 2012 and 2016, Brazil was Argentina's top passenger vehicle supplier, as well as the top destination for Brazilian passenger vehicle exports (figure 3.8). Total Argentine passenger vehicle imports ranged from a high of $7.9 billion in 2013 to a low of $3.8 billion in 2015. However, during 2016, Brazil was the source of 78 percent of Argentina's passenger vehicle imports.[343] Domestically produced vehicles made up 45 percent of Argentina's vehicle sales from 2011 to 2015.[344]

[342] ANFAVEA, "Series Historicas [Historical series]," 2016 (accessed June 29, 2017).
[343] IHS Markit, GTA Database (accessed June 28, 2017).
[344] Asociación de Fábricas de Automotores (ADEFA) [Association of Automobile Manufacturers], *Basic Automotive Statistics 2013*, 14, 20; ADEFA, *Basic Automotive Statistics 2015*, 69, 72.

Figure 3.8: Brazil's passenger vehicle exports during 2012–16



Source: IHS Markit, GTA Database (accessed June 28, 2017).

Parts Trade between Argentina and Brazil

As noted, Argentina and Brazil also supply each other with vehicle parts. However, while a large share of vehicle parts exports from Brazil are destined for Argentina, Brazil imports a much smaller share of its vehicle parts from Argentina. In 2016, Brazil was Argentina's top foreign supplier of automotive parts. During 2012–16, Brazil averaged $5.0 billion in parts exports, with over 39 percent ($2.0 billion) sent to Argentina. Such exports included a variety of different vehicle components.[345]

Customs Barriers and Efforts at Reform

Argentina and Brazil have made recent efforts to liberalize their trade regimes. Specifically, Argentina's implementation of a new import licensing program in 2015 is a positive step towards addressing a lack of transparency in the previous import licensing program that sometimes delayed the import of intermediate goods. This new import license program was partly in response to a WTO dispute between the United States and Argentina in which the United States claimed that some measures in Argentina's previous import licensing program were inconsistent with various WTO agreements.[346] The new program could be a significant step leading to enhanced integration of the Argentina-Brazil vehicle supply chain. In addition,

[345] IHS Markit, GTA Database (accessed August 19, 2016).
[346] WTO, "DS444: Argentina," January 26, 2015.

both countries recently have taken other bilateral trade liberalization measures. For example, they have worked to increase the flexibility of Mercosur's export-balancing requirements and have demonstrated greater openness to automotive trade.

Import License Barriers in Argentina

Argentina still imposes some restrictions on vehicles and parts and uses import licenses to enforce these measures. Argentina requires import licenses for the import of vehicles and some parts, and also has import quotas for vehicles that do not have a domestic equivalent.[347] While nearly 87 percent of goods are governed by automatic import licenses, which are granted upon completion of the import license application, passenger vehicles and many vehicle parts can only be imported under non-automatic licenses, which are reviewed by Argentina's Federal Administration of Public Revenues (AFIP).[348] Nonautomatic licenses are only valid for 90 days, and approval time for these licenses can vary significantly.[349] According to U.S. industry representatives in Argentina, non-automatic licenses for parts used in vehicle assembly are approved rapidly (often in less than 48 hours).[350] Rapid approval of import licenses increases certainty for manufacturers, and reduces the time it takes to import inputs, which may make it more competitive to produce vehicles using inputs from GSCs in Argentina. By contrast, licenses for the import of parts that will be sold in the aftermarket tend to take longer, though usually no more than 60 days. Industry sources indicate that the longer approval times for aftermarket parts may potentially be used to increase the costs and time it takes for importers to receive such parts relative to domestic producers. However, industry representatives also acknowledge that the reasons for approval delays are often unclear.[351]

Efforts to Improve Argentina's Import Licensing Regime

In December 2015, Argentina's AFIP established a single window for the management of import licenses, both automatic and non-automatic. This new import licensing system is an attempt to increase clarity and reduce the extent to which Argentina's import license system acts as a barrier to trade. Industry representatives report that this new system represents a significant improvement over the old one, and that even when problems arise, it is much easier to

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[347] USDOC, ITA, Office of Transportation and Machinery, *Compilation of Foreign Motor Vehicle Import Requirements*, December 2015, 16–17. The quotas are designed to limit the share of vehicles imported into Argentina to a fraction of domestically produced vehicles.

[348] Administración Federal de Ingresos Públicos (AFIP) is Argentina's tax-collecting body under its Ministry of Treasury and Public Finances. Government of Argentina, Ministry of Justice and Human Rights, "Transaction of Automatic and Non-Automatic Import Licenses," Ministry of Production, Resolution 5, 2015, Annexes XVI and XVII, December 22, 2015.

[349] U.S. Embassy in Argentina, "Trade Barriers," August 2016, 28–29.

[350] Industry representative, interview by USITC staff, Buenos Aires, October 31, 2016 and November 1, 2016.

[351] Ibid., November 1, 2016.

communicate with Argentine customs officials to resolve issues.[352] However, customs officials in Argentina are still sensitive to imports of parts and components that compete directly with domestically produced parts and components. Those parts and components typically receive import licenses, but they may take the full 60 days to gain approval.[353]

Local Content Rules and Export-Balancing Requirements

As mentioned, the local content rules and Mercosur-related trade-balancing requirements may limit the integration of Argentina and Brazil's automotive supply chains through two specific measures. First, Brazil's "Inovar Auto" program, established in 2012, is a system of tax incentives aimed at motivating the assembly of vehicles in Brazil and encouraging firms to engage in other high-value-added activities in Brazil. Argentina has drafted a similar law.[354] These laws each encourage the use of domestic (Argentine or Brazilian) content, but not content sourced from either trade partner. Thus, they reduce the incentive to strengthen the supply chain between Argentina and Brazil. Second, according to the current automotive agreement between Argentina and Brazil under Mercosur, Brazilian auto manufacturers may export only 50 percent more vehicles (by value) to Argentina than they import from Argentina. In total, Brazilian-produced vehicle sales in Argentina cannot account for more than 44 percent of total vehicle sales. However, Argentine-produced vehicle sales in Brazil cannot account for more than 11 percent of total vehicle sales.[355] The goal of the Mercosur-related requirements is to encourage development of vehicle manufacturing industries in both Argentina and Brazil. The automotive agreement was extended in June 2015 and June 2016.[356] The June 2016 extension will last until 2020, with the possibility of expanding the ratio to 70 percent for Mercosur countries if certain conditions are met.[357]

Conclusion and Outlook

According to industry sources, changes to Argentina's import licensing program may reflect a desire to work more closely with global trade partners, as the new program appears to meet

[352] Industry representative, interview by USITC staff, Buenos Aires, October 31, 2016.
[353] Ibid., November 1, 2016.
[354] Government of Argentina, *Boletín Oficial de la República Argentina* [Official Journal of the Republic of Argentina], Régimen de Desarrollo y Fortalecimiento del Autopartismo Argentino [Plan for Developing and Strengthening the Argentine Auto Parts Industry], August 1, 2016; Façanha, "Brazil's Inovar Auto-Incentive Program," February 2013, 1–3; industry representatives, interviews by USITC staff, Buenos Aires, October 31 and November 1, 2016. The EU has filed a complaint regarding the Inovar Auto program with the dispute settlement body of the WTO, "Brazil—Certain Measures Concerning Taxation and Charges," March 26, 2015.
[355] Marsh, "Argentina, Brazil Sign New Car Trade Pact," June 11, 2014; Invest In Brazil, "Brazil and Argentina Renew Automotive Agreement by 2020" (accessed August 31, 2016).
[356] Invest In Brazil, "Brazil and Argentina Renew Automotive Agreement by 2020" (accessed August 31, 2016).
[357] Industry representative, interview by USITC staff, Buenos Aires, October 31, 2016.

the standards of the WTO's Trade Facilitation Agreement.[358] While industry representatives indicate that import licenses, local content rules, and export-balancing requirements still have an impact on the automotive supply chain between Argentina and Brazil, they maintain that the negative effect of such policies is much less than it was in previous years, and it may decline further in light of the economic reforms promised by President's Macri's administration. This, in turn, may increase the efficiency with which vehicles and vehicle parts are traded between the two countries. Despite progress in addressing these issues, the auto supply chains in Argentina and Brazil remain much less integrated than the North American auto supply chain.

Semiconductor Supply Chain Case Study: The Philippines and Vietnam

Introduction

The second case study examines the semiconductor supply chain in the Philippines and Vietnam. In general, semiconductor supply chains have undergone a significant transformation since their development in the 1960s, primarily as a result of the elimination of tariffs and lower border costs.[359] In particular, the WTO Information Technology Agreement (ITA) eliminated tariffs on semiconductors and various electronics goods among all signatories, which in turn facilitated the development of GSCs for these products.[360] Semiconductor firms are careful to select countries with low tariffs and without other trade barriers affecting their supply chains.[361] Modern semiconductor supply chains take advantage of increased specialization in various locations with large increases of intermediate-goods trade among ITA participants. In 2016, the semiconductor industry estimated that a typical semiconductor product travels through a supply chain across at least four national borders and 25,000 miles before being inserted into a final good.[362]

Southeast Asian countries, including the Philippines and Vietnam, are among the top importers and exporters of semiconductor products. Intermediate and final semiconductor products are imported and exported during the "assembly, test, and packaging" portion of the supply

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[358] Ibid, October 31 and November 1, 2016.
[359] USITC, hearing transcript, February 9, 2017, 30–32 (testimony of Devi Keller, Semiconductor Industry Association).
[360] WTO, "15 Years of the Information Technology Agreement," May 2012, 43. As of May 2017, there were 82 participants in the ITA. These countries account for approximately 97 percent of international trade in information technology products. WTO, "Information Technology Agreement" (accessed May 19, 2017).
[361] Multinational semiconductor firms also choose Southeast Asian countries like the Philippines and Vietnam for their production activities due to relatively low-wage labor, high productivity yield, and proximity to final semiconductor purchasers.
[362] SIA and Nathan Associates, *Beyond Borders: The Global Semiconductor Value Chain*, May 2016, 10.

chain.[363] These countries also import finished semiconductors as intermediate parts for electronics goods (such as mobile phones and computers). In recent years, both the Philippines and Vietnam have made improvements to their respective customs agencies and introduced government certification programs to speed customs processes for approved firms. These improvements have reduced clearance times for imports. However, some customs barriers remain, as explored in this case study. Foremost among these are inconsistent import licensing enforcement on used equipment, import and export licensing procedures on cryptographic goods, and inadequate infrastructure that hinders the efficient border clearance of intermediate and finished semiconductors.

Overview of the Semiconductor Industry

Industry Description

Pioneered by U.S. engineers in the late 1940s and 1950s, semiconductors are small electronic goods, based primarily on silicon materials that enable all modern electronics. The computing and data processing facilitated by semiconductors has played a crucial role in the development of information and communications technology and related industries since the 1960s.[364] Semiconductor products include integrated circuits, memories, microprocessors, and analog devices. The semiconductor industry is a supplier to almost all manufacturing industries that use electronic components, including, for example, computers, mobile phones, industrial machinery, and transportation equipment. Semiconductor research and design, as well as front-end manufacturing, take place in both developed and developing economies, while back-end manufacturing usually takes place in developing countries to leverage low labor costs and proximity to end-markets.[365]

In 2016, global semiconductor sales reached $357 billion.[366] Firms headquartered in the United States accounted for 50 percent of global sales, followed by South Korea (17 percent), Japan (11 percent), and Taiwan (6 percent).[367] The 5 five global semiconductor firms accounted for 41 percent of the market share, while the top 10 firms' market share was 56 percent (table 3.5).[368] In 2016, 4 firms from the United States were among the top 10 global suppliers of semiconductors and accounted for 27 percent of global semiconductor sales. China is the

[363] Intermediate semiconductors include cut and uncut wafers. Final, or finished, semiconductors include microprocessors that have undergone the "assembly, testing, and packaging" stage of production.
[364] CRS, *U.S. Semiconductor Manufacturing*, 2016, 1–2.
[365] Front-end manufacturing primarily consists of wafer production that is highly technical and machinery intensive, requiring accuracy at nanometer levels. Back-end manufacturing adds relatively low value and includes assembly, testing, and packaging that is both machine- and labor-intensive.
[366] IC Insights, "Five Suppliers Hold 41% of Global Semiconductor Market," December 6, 2016.
[367] SIA, *Semiconductor Industry Association 2016 Factbook*, 2016, 3.
[368] IC Insights, "Five Suppliers Hold 41% of Global Semiconductor Market," December 6, 2016.

leading producer of electronic and industrial goods requiring semiconductor components and consumes as much as 59 percent of global semiconductors.[369]

Table 3.5: Top 10 global semiconductor firms by sales revenue, 2016

	Company	Location of headquarters	2016 revenue (billion $)
1	Intel	United States	56.3
2	Samsung	South Korea	43.5
3	TSMC (foundry)	Taiwan	29.3
4	Qualcomm (fabless)	United States	15.4
5	Broadcom (fabless)	Singapore	15.3
6	SK Hynix	South Korea	14.2
7	Micron	United States	12.8
8	Texas Instruments	United States	12.3
9	Toshiba	Japan	10.9
10	NXP	Netherlands	9.5

Source: IC Insights, "Five Top-20 Semiconductor Suppliers," November 15, 2016.
Note: Fabless firms provide only semiconductor design, with no manufacturing capacity.

The costs of producing cutting-edge semiconductor devices have increased dramatically in recent years, even as prices of semiconductors have fallen, leading to a period of accelerated industry consolidation.[370] In addition, these costs, along with the increasing complexity of semiconductor manufacturing, have led to the fragmentation of tasks and the proliferation of GSCs to leverage efficiencies.[371] As a result, most semiconductor firms with manufacturing capabilities operate production facilities in multiple countries. Intel, for example, runs design facilities in California and Oregon; front-end manufacturing facilities (i.e., for the manufacture of semiconductor wafers) in Arizona, New Mexico, and Oregon, as well as in China and Israel; and back-end manufacturing facilities (i.e., for assembly, testing, and packaging) in China, Malaysia, and Vietnam.[372] At the same time, Texas Instruments maintains facilities in Arizona, California, and Texas, in addition to overseas locations in Germany, Japan, Malaysia, Mexico, the Philippines, Scotland, and Taiwan.[373]

Semiconductor Manufacturing and Trade

Because semiconductors are produced in several steps that cross multiple borders before they become finished products, the value of total global imports of semiconductors is more than double the value of global semiconductor sales. In 2015, global imports of semiconductors

[369] PwC, *China's Impact on the Semiconductor Industry*, January 2017, 4.
[370] The pace of industry innovation so far accords with Moore's law, a prediction by Gordon Moore, a co-founder of Intel, that the industry would be able to double the number of transistors within the same amount of space every 18 months. While that pace of innovation continues, the costs are reportedly becoming prohibitive. SIA and Nathan Associates, *Beyond Borders: The Global Semiconductor Value Chain*, 2016, 5.
[371] SIA and Nathan Associates, Beyond Borders: *The Global Semiconductor Value Chain*, May 2016, 15.
[372] Intel, *Intel 2016 Annual 10K Report*, 2017, 9.
[373] Texas Instruments, *Texas Instruments 2016 Annual 10K Report*, February 2017, 14.

totaled $728 billion, compared to global semiconductor sales of $335 billion.[374] While U.S.-based firms account for a majority of global semiconductor sales, the United States ranks as only the fourth-largest importer and sixth-largest exporter of semiconductors (table 3.6).

Table 3.6: Top 11 global importers and exporters of semiconductors in 2015

	Importer	2015 import value, billion $	Exporter	2015 export value, billion $
1	China	262.0	China	105.4
2	Hong Kong	115.4	Hong Kong	97.6
3	Singapore	59.2	Singapore	85.1
4	United States	42.1	Taiwan	72.6
5	South Korea	37.4	South Korea	58.0
6	Taiwan	37.4	United States	42.1
7	Malaysia	29.2	Malaysia	35.7
8	Japan	25.6	Japan	34.7
9	Germany	19.7	Germany	19.4
10	Mexico	18.3	Philippines	17.3
11	Vietnam	14.3	France	8.8

Source: IHS Markit, GTA database, 2016 (accessed January 24, 2017). Products are classified in HS 8541, 8542, 381800, 852352 (corresponds to NAICS 334413).
Note: Vietnam is the 13th-largest exporter, accounting for $4.7 billion in global semiconductor exports.

Even as firms based in the United States have maintained leadership in global semiconductor sales, a significant portion of front-end manufacturing capacity has shifted to Asia. In 2016, Taiwan accounted for 21 percent of semiconductor wafer manufacturing capacity, followed by South Korea (20.9 percent), Japan (17.1 percent), North America (13.4 percent), China (10.8 percent), and Europe (6.4 percent).[375] The Philippines and Vietnam do not currently have any front-end manufacturing capabilities. However, as participants in back-end manufacturing activities, such as assembly, testing, and packaging, the Philippines was the 10th-largest global exporter of semiconductors by value in 2015, and Vietnam was the 11th-largest global importer of semiconductors by value during that year.

Major Customs Barriers Encountered by the Semiconductor Industry in Vietnam and the Philippines

Semiconductors cross multiple borders; in many cases, a good may cross the same border multiple times before being sold. Hence, semiconductor firms choose markets where border

[374] IHS Markit, GTA Database, 2016 (accessed January 24, 2017); SIA, *Semiconductor Industry Association SIA 2016 Factbook*, 2016, 2.
[375] IC Insights, "Taiwan Maintains Largest Share," February 23, 2017. According to SIA, the United States accounts for nearly all of North America's semiconductor production. Industry representative, email message to USITC staff, April 6, 2017.

costs are low.[376] For example, Brazil and India are notably absent from semiconductor production chains, primarily due to the high costs of getting goods into and out of those markets.[377] In addition, because tariffs are rarely imposed on semiconductor products within a supply chain, customs barriers are mainly due to burdensome regulations (including regulatory uncertainty) and inadequate infrastructure.[378] Localization requirements, including data localization laws, have been also noted by the industry as a significant supply chain barrier, as GSCs rely heavily on cross-border data flows.[379]

In the Philippines and Vietnam, certain regulations limit the capacity of semiconductor and electronics firms to produce goods in these countries and clear them at border checkpoints. First, in Vietnam, the new Law on Information Security (LONIS) may impose significant customs delays if semiconductor companies and importers are required to submit extensive certification processes for imports of goods that use civil cryptography.[380] Second, Vietnam's inconsistent import licensing procedures and its restrictions on used equipment that is older than 10 years have made it harder for semiconductor firms to bring in necessary equipment and consolidate operations from other countries through intra-firm trade.[381] Separately, in the Philippines, burdensome customs procedures for importing specialized goods, including certain chemicals used to manufacture semiconductors, add to border costs for semiconductor firms. Overall, regulations in both the Philippines and Vietnam have increased the costs, time, and risks associated with clearing semiconductor goods through customs checkpoints in those two countries.

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[376] SIA and Nathan Associates, *Beyond Borders: The Global Semiconductor Value Chain, 2016*, 15.

[377] Most semiconductor products receive duty-free treatment among signatories of the Information Technology Agreement (ITA), and the agreement covers most of the semiconductor market. Countries that are not signatories to the ITA, or have not implemented the agreement completely, are usually absent from the supply chain. WTO, "Information Technology Agreement at 15," 2013; USITC hearing transcript, February 9, 2016, 25–26, 30–32 (testimonies of Devi Keller, Semiconductor Industry Association, and Ed Brzytwa, Information Technology Industry Council).

[378] Some tariff issues still exist due to a few countries within the supply chain that have not yet joined the WTO ITA expansion agreement or are implementing it only slowly. The expansion agreement includes duty-free treatment of newer generations of semiconductor products.

[379] Localization requirements stipulate that firms must include content made locally for imported products. USITC hearing transcript, February 9, 2016, 28 (testimony of Ed Brzytwa, Information Technology Industry Council). Other industry sources state that three types of data that need constant flows are: (1) technical data required for highly precise manufacturing that needs real-time monitoring, (2) R&D data that need real-time monitoring and updates, and (3) logistics data that require a firm to track supply-chain functionality in real time.

[380] Civil cryptography refers to cryptography functions used in nonmilitary applications to ensure privacy and deter theft of information. While cryptography restrictions are usually related to cross-border data flows, this section addresses trade restrictions on cryptographic goods.

[381] Semiconductor manufacturing equipment can have a lifespan of more than 30 years.

Vietnam's Law on Network Information Security (LONIS)

The Vietnam began implementing LONIS in July 2016, after it passed the National Assembly in May 2015.[382] LONIS requires import and export permits and licensing for all goods identified as "civil cryptographic products."[383] The Vietnamese government's list of civil cryptographic products includes semiconductors, as well as many electronic goods that contain semiconductors as key components.[384]

The Semiconductor Industry Association (SIA) estimates that about 90 percent of semiconductor products enable or use cryptographic functions, and states that as a result, such border procedures add significantly to the costs of the industry's participation in the supply chain.[385] Several semiconductor firms operating in Vietnam have argued that if customs agencies fully implement the rules as currently legislated, significant border costs will be imposed for both the export and import of semiconductor products.[386] Export and import licensing fees, and the required time-consuming permitting process, would have an adverse impact on the operations of firms that rely on efficient border procedures.

Inconsistent Import Licensing Procedures on Used Equipment in Vietnam

Industry representatives indicate that the customs administration in Vietnam is inconsistent in its enforcement of import licensing requirements. In particular, the government of Vietnam has issued a decree that places restrictions on the importation of used equipment, including machinery used in the production of semiconductors and semiconductor components. This law applies to all firms, whether domestic or foreign owned. Industry representatives report that customs officials in Vietnam enforce the law in an unpredictable, opaque manner, potentially

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[382] According to its preamble, LONIS is aimed at making certain that organizations and individuals are responsible for ensuring network information security. Government of Vietnam, National Assembly, "Law on Network and Information Security (LONIS)," Law 86 2015, QH13 (2015) paragraph 1 (accessed May 22, 2017); Tilleke and Gibbins, "New Law on Cyber Security in Vietnam," June 2016 (accessed August 2, 2017).

[383] The provisions indicate a requirement for both permits and licenses. The difference between the two is not yet clear and is pending further clarification through decrees. Government of Vietnam, National Assembly, "Law on Network and Information Security (LONIS)," Law 86 2015, QH13 (2015) paragraph 1 (accessed May 22, 2017).

[384] Includes all items in HS 8541 (transistors and unmounted semiconductor wafers) and in HS 8542 (processors and memories). Government of Vietnam, National Assembly, "Law on Network and Information Security (LONIS)," Law 86 2015, QH13 (2015) annex 1 (accessed May 22, 2017).

[385] Sashida, "Why Do We Need Encryption Rules in the TPP?" September 2013, 9. LONIS allows firms to obtain permits to import and export civil cryptographic products if they acquire a business license to trade in such goods and are able to verify that such imports do not damage national defense or security. Applications are processed by a government agency in Vietnam. However, significant uncertainties regarding permitting procedures remain. SIA, "Comments on Draft Vietnam Encryption Regulations," July 10, 2013.

[386] Industry representatives, interviews with USITC staff, Ho Chi Minh City, December 1 and 2, 2016. As of June 2017, the implementation of this law is still undergoing consideration by the government of Vietnam.

increasing costs for semiconductor firms importing used equipment from their affiliates.[387] According to industry sources, some firms in Vietnam can import used equipment with relatively simple and informal licensing procedures, without such equipment undergoing further inspections by customs authorities. By contrast, other firms can import used equipment only after a completing a lengthy import-licensing procedure of at least two months, with the possibility of facing further customs inspections.[388] Still other firms are not able to import any used equipment at all despite applying for licenses, and it is unclear what criteria Vietnamese customs officials use to make this determination.[389]

Inefficient Customs Procedures for Specialized Goods in the Philippines

Industry representatives state that certain specialized inputs needed for semiconductor manufacturing, especially chemicals, are often subject to inefficient customs procedures in the Philippines.[390] Industry representatives in the Philippines report that while significant improvements have been made to facilitate the importation of chemicals, customs procedures still impose costs. The importation of chemicals once required 64 signatures by various officials before goods could be imported and transported.[391] That has since been reduced to 30 signatures, and then further reduced to 5 signatures. If any of the 5 signatories are not available, however, the importer must wait.[392] Unfortunately, the chemical permitting process is not included in the Philippines' efforts to create a national single customs window, which is aimed at increasing the efficiency of customs processing and decreasing the potential for corruption by customs officials.[393]

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[387] Industry representatives, interviews with USITC staff, Ho Chi Minh City, December 1, 2016.
[388] Industry representatives, interviews with USITC staff, Ho Chi Minh City, December 1 and 2, and Hanoi, December 8, 2016.
[389] Ibid.
[390] Industry representatives, interviews with USITC staff, Manila, December 5 and 6, 2016.
[391] Ibid., December 6, 2016.
[392] Ibid.
[393] Single windows are efforts by customs and other government agencies to simplify border procedures so that importers and exporters can complete all customs-related documentation, including that required by other government agencies, through a single electronic interface. In the Philippines, the "Philippines National Single Window" is still in the process of being completed. In general, it is reported that the increased use of electronic interfaces in the Philippines for customs processing has lessened opportunities for corruption by customs officials and has reduced clearance time for imports into the country. However, industry representatives observed that, due to customs revenue targets imposed by the Philippines government, difficulties exist in implementing electronic customs systems. As a result, opportunities remain for corruption at ports through direct exchanges with customs officials. Industry representatives, interviews with USITC staff, Manila, December 6, 2016; World Bank, *Doing Business 2017: Trading Across Borders; Technology Gains*, 2017, 84–85.

Infrastructure Constraints near Manila

Inadequate infrastructure constrains the importation of certain chemicals at ports in Manila. Chemicals often require refrigeration to maintain specific temperatures, and they have a limited shelf life.[394] However, bottlenecks in Manila ports can sometimes lead to refrigerated cars losing power if kept idle for an extended period of time, or refrigerator doors may be kept open too long while awaiting outgoing inspection.[395] While the breakdown of these chemicals does not always hinder semiconductor manufacture, the need for firms to maintain reserves of supplies and, potentially, to reorder goods may affect their profitability and redirect resources away from production.[396]

Other infrastructure inadequacies at and near the border are also a major concern for semiconductor firms operating in the Philippines. The widely recognized road congestion in the Manila metro area has caused significant delays for importing and exporting firms, even as customs procedures are generally becoming more efficient.[397] Costs at the border, including customs clearance, documentation, and brokerage costs, account for 20 to 30 percent of logistics costs for semiconductor firms operating in the Philippines.[398] The remaining 70 to 80 percent of logistics costs are the costs of physical transportation. One semiconductor firm estimates that a one-day delay in clearing goods at customs checkpoints could cost the firm up to an additional $250,000 in daily logistics expenses.[399] To avoid such delays, firms maintain about a three-week inventory, despite the associated cargo and warehousing costs.[400]

Attempts to Remediate Customs Barriers

Both the Vietnamese and Philippine governments have engaged in efforts to streamline their customs and border processes to encourage participation in the semiconductor supply chain, including the expansion of specialized trade zones.

Streamlining Customs Procedures

Vietnam has worked closely with electronics and semiconductor firms to design and implement an electronic customs system to clear goods within 30 seconds of entering the port.[401] While not all goods are eligible, semiconductors and electronics supply chains are direct beneficiaries

[394] Industry representatives, interviews with USITC staff, Manila, December 6, 2016.
[395] Ibid.
[396] Ibid.
[397] Government of the Philippines, Philippine Institute for Development Studies, "A System-Wide Study of the Logistics Industry," March 2015.
[398] Ibid.
[399] Ibid.
[400] Industry representatives, interviews with USITC staff, Manila,, December 6, 2016.
[401] Vietnam Plus, "Intel Celebrates 10th Anniversary in Vietnam," December 10, 2016.

of speedy customs clearances. The Ho Chi Minh City customs office reports that only 18 percent of port clearance time is accounted for by customs, with the remaining 82 percent due to other government agencies requiring import or export licensing.[402] Similarly, in the Philippines, the customs bureau has designed an electronic-to-mobile automated customs system. While it is a significant improvement from a paper-based system, the electronic system is reportedly not modern and requires frequent maintenance. In addition, firms cited weekly power and communications blackouts that last from several hours to as long as three days.[403]

In Southeast Asia, trade facilitation efforts through the Asia-Pacific Economic Cooperation (APEC) forum and the Association of Southeast Asian Nations (ASEAN), as well as multilateral initiatives under the WTO, have been important in lowering trade costs and simplifying customs procedures in member countries.[404] Further, for both the Philippines and Vietnam, the attempts to create single customs windows are still ongoing.[405] The WTO trade facilitation efforts, coupled with APEC and ASEAN programs, are expected to positively contribute to lowering the costs of trade in both countries.[406]

Specialized Import and Export Processing Zones

The Philippines and Vietnam have designated certain areas and specific firms as part of export processing zones, allowing some firms to import and export goods without tariffs or value-added taxes and to benefit from rapid border processing. In Vietnam, the first specialized zones were introduced over 20 years ago. Currently, four export processing zones (three in and around Ho Chi Minh City, and one in Tay Ninh province) accommodate firms in various supply chains, including most semiconductor manufacturers.[407]

In the Philippines, the Department of Trade and Industry's Philippine Economic Zone Authority (PEZA) has authorized the creation of over 230 information technology parks and centers and more than 70 manufacturing economic zones since 1995.[408] These zones (which could be as large as industrial parks and as small as single buildings) aim for regulatory consistency and

[402] Government representatives, interviews with USITC staff, Ho Chi Minh City, December 2, 2016.
[403] Industry representatives, interviews with USITC staff, Hanoi, December 6, 2016.
[404] USITC, hearing transcript, February 9, 2017, 24, 28 (testimony of Ed Brzytwa, Information Technology Industry Council). APEC established two Trade Facilitation Action Plans—TFAP I (2002–06) and TFAP II (2007–10)—to advance "free and open trade" among APEC's 21 member countries. Among other goals, these plans aim to simplify customs procedures among APEC members and to ensure the mutual recognition of these countries' authorized economic operator (AEO) programs. Both the Philippines and Vietnam, which have ratified the WTO Trade Facilitation Agreement, are committed to customs reforms outlined in the TFAP.
[405] World Bank, *Doing Business 2017: Trading Across Borders; Technology Gains, 2017*, 82; World Bank, *Doing Business 2017: Trading Across Borders*, 2016.
[406] Government representatives, interviews with USITC staff, Ho Chi Minh City, December 2, and Hanoi, December 9, 2016.
[407] Vietnam Business Forum, "Industrial, Export Processing and Economic Zones," June 16, 2015.
[408] Government of the Philippines, DTI-PEZA, "Operating Economic Zone Map," October 31, 2016.

predictability, as well as offer exemption from corporate income tax, duty-free status for the import of raw materials and capital equipment, and simplified import and export procedures.[409] The PEZA program has been used by the Philippine government to encourage specific industries to invest, especially in two priority areas: information technology parks and export manufacturing. As a result, the semiconductor industry in the Philippines relies on PEZA zones to avoid tariffs and costly customs procedures. Almost all major semiconductor firms in the Philippines operate in PEZA zones.[410]

Conclusion and Outlook

The GSC for semiconductors is highly sensitive to tariffs and border costs in places like the Philippines and Vietnam. Semiconductor firms' successful participation in supply chains requires an environment of low tariff barriers and predictable application and enforcement of regulations.[411] The WTO ITA has eliminated tariffs on most semiconductor products among its signatories, including the Philippines and Vietnam. Thus, firms are allowed to operate through GSCs without facing significant tariff barriers. Moreover, regional and multilateral trade facilitation efforts, such as those associated with APEC, ASEAN, and the WTO, have helped streamline customs procedures and reduce trade costs in countries like the Philippines and Vietnam, thereby enabling these countries to more fully participate in GSCs.[412] In addition, national, regional, and multilateral initiatives to address these barriers and to lower border costs are currently being implemented or are under consideration in both countries. At the same time, however, the existence of LONIS in Vietnam, as well as the unpredictable enforcement of regulations and other technical barriers to semiconductor trade in Vietnam and the Philippines, may continue to impose costs on such trade in the two countries.[413]

[409] Government of the Philippines, DTI-PEZA, "Activities Eligible for PEZA Registration and Incentives" (accessed May 19, 2017).
[410] Industry representatives, interviews with USITC staff, Manila, December 5 and 6, 2016.
[411] USITC, hearing transcript, February 9, 2017, 101–102 (testimonies of Devi Keller, Semiconductor Industry Association; and Mario R. Palacios, Intel Corporation).
[412] Ibid., 24, 28, 36, 39, 42, and 101–102 (testimonies of Ed Brzytwa, Information Technology Industry Council; Devi Keller, Semiconductor Industry Association; and Mario R. Palacios, Intel Corporation).
[413] Ibid., 28 (testimony of Ed Brzytwa, Information Technology Industry Council).

Logistics Services in Sub-Saharan Africa

Introduction

The third and final case study discusses customs and other border impediments to trade affecting third-party logistics (3PL) firms in sub-Saharan Africa (SSA).[414] In general, the logistics sector is a growing facilitator of global trade and supply chain activity, and global 3PL revenues rose by 5.9 percent annually between 2010 and 2015.[415] The largest global logistics firms have evolved from being primarily transportation services providers to managing their customers' supply chains.[416] This evolution reflects, in part, the geographic dispersion of production activities and the increasing tendency for manufacturing firms to outsource noncore functions to third-party firms, including logistics providers.

In SSA, the quality of the region's logistics infrastructure has often been poor, constraining trade within the region as well as between SSA and foreign countries. This handicap has limited the region's participation in GSCs.[417] Goods encounter repetitive and lengthy delays at the border, decreasing the efficiency and increasing the costs of trade for supply chains in the region. World Bank data show that SSA is the world's most expensive and time-consuming region in terms of meeting border compliance requirements (figure 3.9).[418] Customs barriers at SSA's ports of entry, coupled with the poor quality of the region's road infrastructure, result in even higher transport costs in SSA's landlocked countries, further impeding the region's supply chain performance. Illustratively, 94 percent of SSA's losses in agricultural goods are due to the poor condition of the region's logistics infrastructure.[419]

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[414] 3PL firms provide a range of services to their customers, including transportation, warehousing, freight forwarding, customs brokerage, and supply chain management services, among others. USITC, *Recent Trends in U.S. Services Trade*, May 2015, 54. For the purposes of this section, the terms "3PL" and "logistics" are used interchangeably.

[415] Capgemini, *2012 Third-Party Logistics Study*, 2012, 7; Armstrong & Associates, "Global 3PL Market Size Estimates," October 3, 2016.

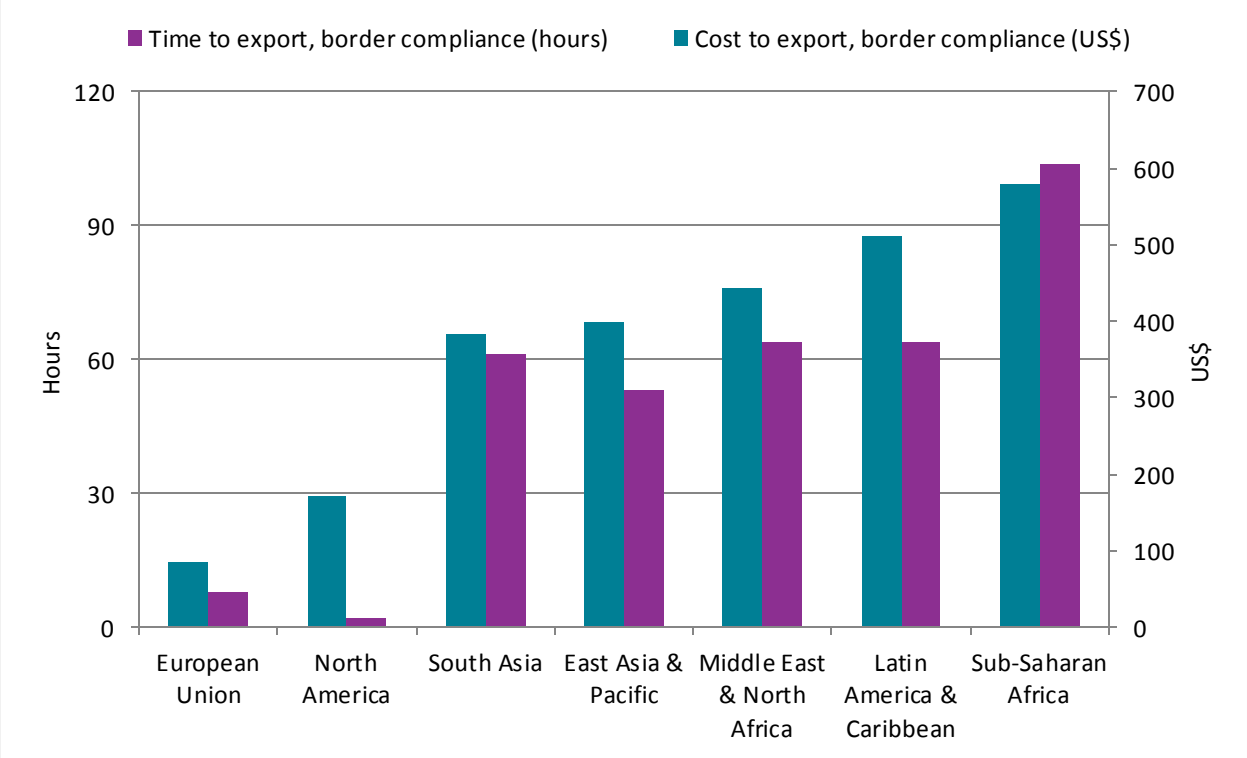
[416] World Economic Forum, *Outlook on the Logistics and Supply Chain Industry,* 2013, 6.

[417] Limão and Venables, "Infrastructure, Geographical Disadvantage, Transport Costs, and Trade," October 2001.

[418] The World Bank databank defines border compliance as "the time and cost associated with compliance with the economy's customs regulations and with regulations relating to other inspections that are mandatory in order for the shipment to cross the economy's border, as well as the time and cost for [cargo] handling that takes place at its port or border. The time and cost for this segment include time and cost for customs clearance and inspection procedures conducted by other government agencies."

[419] *Logistics Update Africa*, "Capitalizing on Perishables Trade," 2016.

Figure 3.9: Cost and time to export in sub-Saharan Africa compared to other regions based on border compliance procedures, 2016



Source: World Bank, "Databank: World Development Indicators," 2017 (accessed June 30, 2017).

However, although measurements of trade and logistics performance in SSA lag behind those of other developing regions, it is notable that many SSA countries are experiencing some of the fastest improvements in both areas, albeit from a low base.[420] Recognizing the benefits of increased international trade for their economies, a number of countries in SSA are taking measures to address the poor quality of their logistics services. They are primarily targeting the pervasive problem of customs delays, both at the border and along trade routes. For example, there has been a rise in the number of single customs windows dedicated to streamlining paperwork at the border in SSA countries.[421] Also, there have been initiatives to track and discourage customs officials from demanding bribes and imposing delays on trucks passing through customs checkpoints.[422] Finally, a number of large-scale port, road, and rail investments are being made. These are aimed at achieving low-cost delivery service to SSA's

[420] USITC calculations from World Bank, World Development Indicators, 2017. For further discussion of how logistics performance, among other factors, help influence the degree to which developing countries, such as those in SSA, better integrate into global value chains, see OECD, "The Participation of Developing Countries," April 2015.
[421] Tsen, "Ten Years of Single Window Implementation," 2011, 5. Single customs windows do not necessarily require Internet technology, although it has been part the aim of most single-window projects to establish a single paperless facility where traders can submit all relevant information, whether for export, import, or transit.
[422] Kingombe, *Hard and Soft Infrastructure Development in Africa*, July 1–3, 2014, 18.

landlocked countries, thereby potentially improving the efficiency of the region's supply chain operations.

This case study begins with an overview of the global logistics market, followed by a discussion of logistics services in SSA as they relate to the region's ability to integrate into GSCs. It then explores how inefficient and nontransparent customs and border procedures, as well as inadequate transport infrastructure, limit market access for logistics firms in SSA and increase the costs of moving goods throughout the region. The case study concludes with an overview of recent efforts to improve SSA's customs environment.

Overview of the Global Logistics Market

Industry Description

Logistics services include a range of activities that pertain to the transport of primary, intermediate, and final goods between suppliers, producers, and consumers. These activities often include freight forwarding; transport by air, ship, truck, or rail; warehousing and storage; tracking and tracing; and customs brokerage.[423] Producers seeking to export may outsource many of these services to 3PL providers in order to reduce their costs and allow them to better focus on their core competencies. In addition, 3PL firms provide services to help their customers manage all phases of their supply chains from planning, storing merchandise, and facilitating border crossing, to final delivery of products. Many logistics firms have operations dedicated to supply chains that make trade more efficient.[424] As 3PL firms are increasingly involved with each supplier in their customers' supply chain, they are important participants in global trade.

Primary Global Participants

Many of the largest 3PL firms began by providing physical distribution in the 1960s and 1970s, expanding to become larger logistics operations in the 1980s and 1990s and evolving into broader supply chain management service providers in the 2000s.[425] In 2015, global 3PL revenue reached $721 billion.[426] The Asia-Pacific region comprised the largest market, accounting for 38.4 percent of global revenue, followed by North America (26.4 percent),

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[423] USITC, *Logistic Services: An Overview of the Global Market*, May 2005, 2-1. These activities facilitate the physical distribution of goods from origin to end user.

[424] For instance, see DHL, "Supply Chain Solutions," http://www.dhl-usa.com/en/logistics/supply_chain_solutions.html; FedEx, "Making Integrated Logistics Management Your Competitive Advantage," http://supplychain.fedex.com/; UPS, "Welcome to UPS Supply Chain Solutions," https://www.ups-scs.com/ (all accessed May 3, 2017).

[425] Dittmann and Vitasek, "Selecting and Managing a Third Party Logistics Provider," 2016, 3.

[426] Armstrong & Associates, Inc., "Global 3PL Market Size Estimates," October 3, 2016.

Europe (21.4 percent), and South America (4.9 percent) (table 3.7). Together, these four regions account for 91.1 percent of the global 3PL market, with the remaining 8.9 percent encompassing the Middle East, North Africa, and SSA.[427]

Table 3.7: Global third-party logistics (3PL) revenues by region, 2006–15

Region	2015 global 3PL revenue (billion $)	Global market share (%)	Annual revenue growth, 2006–14 (%)
Asia-Pacific	276.9	38.4	10.2
North America	190.1	26.4	4.3
Europe	154.5	21.4	0.7
South America	35.3	4.9	8.1
Other	64.2	8.9	
Total	721.0		

Source: Capgemini, *2016 Third-Party Logistics Study*, 2016, 12; Armstrong & Associates, "Global 3PL Market Size Estimates 2015," October 3, 2016.

In 2015, Europe as a whole ranked third in terms of 3PL global market share: 5 of the top 10 individual 3PL providers in that year were European firms (table 3.8), possibly reflecting historical trade relationships.[428] Overall, 17 of the 50 largest 3PL firms are based in Europe, and those firms account for 56 percent of the total gross revenue among the top 50 ranked firms. In addition, 19 firms on the list were from the United States, 6 from Japan, and 1 from China.[429]

Table 3.8: Leading global 3PL firms, 2015

Rank	3PL firm	Country of headquarters	Gross revenue (million $)	Market share (%)
1	DHL Supply Chain & Global	Germany	29,562	4.1
2	Kuehne + Nagel	Switzerland	21,100	2.9
3	DB Schenker	Germany	17,160	2.4
4	Nippon Express	Japan	15,822	2.2
5	C.H. Robinson	United States	13,476	1.9
6	UPS Supply Chain Solutions	United States	8,215	1.1
7	DSV	Denmark	7,574	1.1
8	Sinotrans	China	7,314	1.0
9	CEVA Logistics	Netherlands	6,959	1.0
10	Expeditors	United States	6,617	0.9
25	Imperial Logistics	South Africa	3,596	0.5

Source: Armstrong & Associates, Inc., "A&A's Top 50 Global Third-Party Logistics Providers (3PLs) List," July 14, 2016, and USITC calculations.

Several of the largest 3PL firms have a significant international presence outside of their respective domestic markets, although some are domestically oriented. In 2015, Germany's

[427] Armstrong & Associates, Inc., "Global 3PL Market Size Estimates," October 3, 2016.
[428] Armstrong & Associates, Inc., "A&A's Top 50 Global Third-Party Logistics Providers (3PLs) List," July 14, 2016.
[429] Europe is the largest U.S. export and import market for air freight and airport services, used here as a proxy for logistics services, followed by the Asia-Pacific region and Latin America. SSA holds the smallest share of both U.S. exports and imports of logistics services, accounting for only 2 percent each. USDOC, BEA, *Survey of Current Business*, December 2016, 14–25, table 2.2.

Deutsche Post DHL Group (DHL) derived less than half of its revenue from the European market, compared to 37 percent from the Asia-Pacific region and 19 percent from the Americas.[430] Similarly, Kuehne + Nagel, a Switzerland-based firm, derived 64 percent of its revenue from Europe, the Middle East, and Africa in 2015.[431] Conversely, two of the largest U.S. 3PL firms—C.H. Robinson and UPS—earned the majority of their revenue in the domestic market. In 2015, C.H. Robinson garnered roughly 90 percent of its revenue in the United States,[432] while this share was 78 percent for UPS.[433]

GSCs and the Logistics Environment in SSA

Background on GSCs in the Region

While 3PL firms expand the range of services that they provide to their clients, GSCs in SSA have been less prominent than those in other parts of the globe. However, they are growing in significance. In the apparel sector, for example, GSC activities related to design, production, and retail are routinely carried out in SSA.[434] African designers of men's wear and women's wear, particularly in Nigeria, are achieving global acclaim, and cut-and-sew and other production operations related to GSCs are common in SSA. In a 2015 survey by the management consulting firm McKinsey, 13 percent of the responding procurement professionals from large apparel companies identified Ethiopia as one of their top three global locations for garment manufacturing.[435] Although many garments made in Africa are marketed abroad, online shopping sites, such as Jumia and Konga, facilitate efforts by African garment designers and manufacturers to complete the final retail link of the GSC within Africa. 3PL firms are expected to play an increasingly important role in facilitating this transformation.

Similarly, as governments across the continent invest in its agricultural sector and adopt more market-friendly policies, important supply chains in SSA will consist of agricultural products that are grown in SSA and marketed in Europe.[436] Examples include table grapes from South Africa,[437] fresh fruits from South Africa,[438] and cashews from West Africa.[439] Many of these products, the most perishable of which are transported in refrigerated containers, must clear

[430] DHL, *Deutsche Post DHL 2015 Annual Report*, March 9, 2016, 62.
[431] Kuehne + Nagel, *Kuehne + Nagel 2015 Annual Report*, March 2016, 20.
[432] C.H. Robinson, *C.H. Robinson 2015 Annual Report*, February 29, 2016, 40.
[433] UPS, *UPS 2015 Annual Report*, 2016, 2.
[434] Toesland, "Africa's Fashion Industry Comes of Age," October 12, 2016.
[435] Berg, Hedrich, and Russo, "East Africa: The Next Hub for Apparel Sourcing?" August 2015.
[436] Sanghvi, Simons, and Uchoa, "Four Lessons for Transforming African Agriculture," April 2011.
[437] Ras and Vermeulen, "Sustainable Production and the Performance," 2009, 1–17.
[438] Muller, Vermeulen, and Glasbergen, "Pushing or Sharing as Value-Driven Strategies," 2012, 127–40.
[439] See, for example, USAID, "Hub Looks to Build Links with Cashew Exporters," September 26, 2016. Nine countries in West Africa produce 35 to 40 percent of global cashews. Major supply chain steps include farming, trading, processing, roasting, and retailing.

customs promptly to maintain their integrity. As a result, the frequent delays associated with inspection at customs checkpoints are a serious problem.

The Role of 3PL Firms in SSA

International transport and logistics companies that have established operations in SSA now maintain a sizable footprint in the region. The companies provide 30 percent of SSA's logistics tonnage and of that amount, 15 to 20 percent is supplied by 3PL firms.[440] These firms have helped SSA to integrate into GSCs. For example, improved road and air cargo connections through Nairobi have helped to accelerate Kenya's position in the GSC for supplying horticultural products to Europe.[441] Kenya now accounts for a 38 percent share of the EU market for cut flowers: it has 10 air cargo freighters dedicated to that route, each equipped with the capability for cold-chain delivery.[442] However, although many foreign 3PL firms operate successfully in SSA, market barriers limit opportunities for local firms and may restrict smaller 3PLs from achieving economies of scale.

Regulatory Environment for SSA Logistics and Transport Firms

Limited growth in SSA's logistics sector is partly due to the region's regulatory environment for transportation services.[443] Logistics costs are consistently high within the region, but may vary by country. For example, while transport costs account for 30 to 50 percent of export value within SSA, in SSA's landlocked countries, transport costs account for as much as 75 percent of the value of export shipments.[444] Logistics costs are high both because of inadequate road, rail, and port infrastructure and also because of poor regulations and a poor regulatory environment. The regulatory environment includes the implementation of rules and informal practices, such as delays in approving licenses and bribery. Bribery occurs not just at the border, but at various points along trade routes and has been estimated to account for about 10

[440] *Logistics Update Africa*, "3PLs Have a New Focus," May–June 2015, 8–11. Although SSA's transition to a more integrated logistics environment is slow, many large firms in the region are increasingly using 3PL services, although some continue to handle logistics within the firm. Also, the majority of firms in SSA continue to use smaller logistics operators and single function trucking and shipping firms, often due to cost considerations. Industry representative, interview by USITC staff, Washington, DC, March 3, 2017.
[441] World Bank, *Air Freight: A Market Study*, 2009, 46–47.
[442] Kannoth, "From Farm to Vase," January–February 2016, 6–7.
[443] The regulatory environment refers to informal practices and the way regulations are made and carried out as discussed in Teravaninthorn and Raballand, "Transport Prices and Costs in Africa," 2009, 5. It may include freight-sharing schemes (where shippers must deal with a freight-assigning entity instead of directly with a trucking company), restrictions on the types of vehicles that can be used, and other practices.
[444] *Logistics Update Africa*, "Kenya: Country in Focus," May–June 2014.

percent of the direct logistics costs, with delays due to poor road conditions contributing much more than that (box 3.2).[445]

Box 3.2: Containers Transiting from Ghana to Burkina Faso Encounter Time Delays and High Costs

Supply chains that involve shipping into African ports and then overland to landlocked countries face especially high logistics costs in Africa.

A study of the trade route between Ghana and Burkina Faso published by the U.S. Agency for International Development (USAID) in 2010 details the delays and high costs that cargo can incur. The study found that, due to congestion at the port of Tema, containers could wait at sea for up to 41 hours before even reaching their berth.[a] Once offloaded from the ship, containers were held by the port for more than 14 days and could then take 56 hours to clear customs. The process of getting goods through the port took an average of 40 days from start to finish.[b]

The study also found that upon leaving the Tema port, transit cargo encountered more delays—and demands for bribes—as it continued north to Burkina Faso.[c] At checkpoints within Ghana, truck drivers paid between $0.03 and $0.17/km to officials from government agencies ranging from forestry and customs to the police—this varied by checkpoint and by time of year. Collectively, these payments accounted for between 2 and 10 percent of truck drivers' variable costs. At the Ghana-Burkina Faso border, further bribes and delays might be incurred while paperwork was being processed on both sides of the border before trucks could enter Burkina Faso. The USAID report found that, in total, it took an average of 599 hours (25 days) to transit 1,000 km from Ghana's port in Tema to Ouagadougou, Burkina Faso, for a travel speed of only 40 km (about 25 miles) a day.[d] The study also found that delays in some other routes from ports to landlocked countries in Africa and to other developing countries were comparable and suggested infrastructure improvements and better procedures to reduce costs and delays.

[a] USAID and Nathan Associates, Inc., *West Africa Logistics Analysis Using FastPath*, January 2010, x–xi.
[b] A firm survey conducted in 2011 found similar results. Raballand et al., *Why Does Cargo Spend Weeks in Sub-Saharan African Ports?* 2012, 4. This study found that after being unloaded from a vessel at Tema, transit containers remained at the port an average of 20 days before departing for their destination in Burkina Faso.
[c] USAID and Nathan Associates, Inc., *West Africa Logistics Analysis Using FastPath*, January 2010, x–xi.
[d] Ibid.

The indirect effects of SSA's regulatory environment also impose substantial costs on logistics services providers. For example, in West Africa, there is a quasi-duopoly by two terminal operators: Bolloré Logistics Limited (France) and APM Terminals (Netherlands). These operators manage almost 80 percent of the transport of containerized cargo in the region.[446] Although these two firms have introduced better technology and more modern infrastructure, their market power nonetheless limits competition.[447] In addition, the regulation of road freight

[445] *Economist*, "Trade: Obstacle Course," April 16, 2016.
[446] For example, in SSA, APM Terminals operates ports in Abidjan (Côte d'Ivoire), Tema (Ghana), Lagos-Apapa (Nigeria), and Badagry (Nigeria). Bolloré operates ports in Conakry (Guinea), Cotonou (Benin), Lomé (Togo), Freetown (Sierra Leone), and Dakar (Senegal).
[447] These firms are followed by DP World (Dubai) and Mediterranean Shipping Company (Switzerland). World Bank, "Making the Most of Ports in West Africa," 2015, 20.

through state-owned freight bureaus and shippers' councils—a process susceptible to corruption—encourages and supports small and inefficient trucking companies that do not typically invest in better technology or capital equipment.[448] As a consequence, one industry representative of a firm with operations throughout the continent noted that the firm only used a 3PL company in southern Africa, as high logistics costs prohibited the use of 3PL firms in East or West Africa.[449] Some logistics customers in Africa resort to using small trucking companies with just one or two trucks, despite these firms' relative inefficiency.[450]

Major Customs Barriers Faced by Logistics Firms in SSA

Many (though not all) SSA governments rely heavily on customs revenue. In 2015, 8 of the 20 countries most reliant on international trade taxes for government revenue were in SSA.[451] Lesotho led this global list, deriving 47 percent of its revenue from trade taxes, followed by Madagascar, at 42 percent; Côte d'Ivoire, at 40 percent; Namibia, at 35 percent; and Liberia, at 30 percent.[452] This fits with the empirical finding that less-developed countries rely more on trade-related revenue, whereas countries with higher levels of economic development and liberalized trade regimes rely on income and consumption taxes.[453]

While many SSA governments depend on customs revenue, the collection of such revenue is hampered by corruption,[454] inefficiencies in the customs clearance process, and inadequate road and rail infrastructure. In 2016, SSA surpassed South Asia as having the least efficient customs clearance process of any region, according to the World Bank's Logistics Performance Index (LPI).[455] For example, of the 13 countries where traders need 10 days or longer to clear goods through customs for export, 8 are in SSA.[456] In addition, goods transiting from one country to another within SSA may be required to travel in convoys escorted by customs vehicles. In the West African port of Lomé (Togo), these convoys depart from the port only

[448] Teravaninthorn and Raballand, *Transport Prices and Costs in Africa*, 2009, 33.
[449] Raballand et al., *Why Does Cargo Spend Weeks in Sub-Saharan African Ports?* 2012, 4.
[450] Industry representative, interview by USITC staff, Washington DC, March 3, 2017.
[451] Databank, World Development Indicators database (accessed June 30, 2017). According to the World Bank, taxes on international trade (as a percent of revenue) include "import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes."
[452] World Bank, Databank, World Development Indicators database (accessed January 26, 2017).
[453] Seelkopf, Lierse, and Schmitt, "Trade Liberalization and the Global Expansion of Modern Taxes" January 2016; Brautigam, "Building Leviathan," May 2002, 10–20.
[454] Ghana Business News, "Ghana Loses $150m Monthly Due to Corruption at Tema Port," June 14, 2013.
[455] World Bank, Databank, World Development Indicators database (accessed January 26, 2017). In addition, customs transactions in SSA require 40 documents, 200 data entries (15 percent of which must be re-entered 30 times or more). Traders are not well informed about the required documentation, which further adds to delays. UNECA, "Trade Facilitation and Intra-African Trade," 2010, 3.
[456] These are Mauritania, Burundi, Tanzania, Malawi, Zambia, Djibouti, Kenya, and Uganda, as ranked from the longest delays to the shortest. World Bank, Databank, World Development Indicators database (accessed January 26, 2017).

three times per week, so that delays occur when trucks must await the departure of the next convoy.[457]

Moreover, border crossings in SSA could require authorization from numerous government entities, including the revenue authority, the standards bureau, and the police, as well as agencies pertaining to customs, immigration, agriculture, and health. Thus, bureaucratic approvals required at certain border posts result in goods waiting an average of 10.3 days to clear customs at the border in SSA, compared to a global average of 7.7 days.[458] An industry representative noted that these documentation and border delays posed the biggest challenge for moving goods throughout East or West Africa.[459]

SSA's landlocked countries also face higher logistics costs, as the region's road and rail network is not well connected to port infrastructure.[460] One report noted that high customs clearance costs in Niger, a landlocked country in West Africa, amounted to 20 percent of total logistics costs for truck operators in that country. The report goes on to say that delays from waiting at inland checkpoints, as well as from poor road and other infrastructure conditions, may impose further logistics costs on trucking firms.[461] By contrast, infrastructure improvements can increase customs revenue. For example, customs revenue collected at a border crossing between Sierra Leone and Guinea went up by 70 percent following the rehabilitation of the primary road that connects the border posts because of the growth in traffic volume.[462]

[457] USAID, West Africa Trade Hub, *Transport and Logistics Costs*, January 2012, 27. Overall, the cartelization of trucking services in many parts of SSA has resulted in the underutilization of trucking fleets—and the overloading of trucks that are placed into service. Overloading can cause premature damage to the fragile road network, so countries like Kenya, Tanzania, and Uganda have undertaken significant measures to restrict this practice through axle-weight restrictions, which limit the weight per axle of trucks. However, implementation of these rules has been limited, to some degree, by the insufficient training of personnel. Teravaninthorn and Raballand, *Transport Prices and Costs in Africa, 2009*, 55; Grodzicki, "Harmonization of Axle Load Control at EAC Level," 2013, 3.
[458] World Bank, Databank, World Development Indicators database (accessed June 30, 2017).
[459] Industry representative, interview by USITC staff, Washington, DC, March 3, 2017.
[460] Accenture, "African Ports: The Challenges and Opportunities 2015/16," August 28, 2015, 2.
[461] MCC, *MCC Niger Threshold Program Design Constraints*, January 2014, 12.
[462] MCC, *MCC Sierra Leone Threshold Program Design Constraints*, December 2013, 207.

Efforts to Improve Customs and Infrastructure Barriers in SSA

Among efforts to improve the customs environment in SSA are the introduction of single customs windows, the development of joint border posts, and improvement in the region's transport infrastructure. Most importantly, the use of single customs windows at SSA's border checkpoints has increased across the continent, although their deployment is partly hampered by inadequate information, technology, and communications infrastructure in the region.[463] These single windows are designed to simplify and harmonize trade documents, as well as to restructure the practices of customs-related government agencies. At least 12 countries across SSA are considering or have completed setting up single windows.[464]

For example, Rwanda's new single customs window has resulted in cost savings and improved government transparency in customs processing. In southern Africa, efforts to expedite the border crossing between Zambia and Zimbabwe—a major transit point for much of southern Africa, handling an average of 268 trucks daily—has created a single stop for transiting vehicles. Consequently, the time it takes for a truck to pass through the border post has been reduced from as long as two to three days to only two hours.[465] In West Africa, Senegal is also introducing a single customs window, and joint border posts are being built between the countries of Benin and both Niger and Nigeria, as well as between Ghana and Togo. These border posts are designed to assist with cross-border transactions and improve travel time and costs, and more projects are envisaged.[466]

Furthermore, there also have been reforms to facilitate trade at checkpoints within a country, especially along the main highway networks. For example, Tanzania has established "one-stop" inspection stations on the central corridor route that links the landlocked countries of Burundi, Rwanda, Uganda, and the Democratic Republic of the Congo.[467] These stations were established in order to coordinate and reduce the number of checks on transit vehicles by the country's revenue authority, police force, and national roads agency and have reduced total

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[463] African trade is still hampered by low levels of data sharing between customs administrations and exporters, importers, and shippers. One report suggests that improved single windows enabled with information, technology, and communications systems would improve customs-related data exchange, lessen the opportunity for data-entry errors, and lower transit times for cargo. World Bank, *ICTs for Regional Trade and Integrations in Africa*, 2012, 16–17.

[464] In SSA, the countries of Benin, Congo, Côte d'Ivoire, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Rwanda, Senegal, Tanzania, and Togo have either solicited proposals for single windows or have already have established one. Tsen, "Ten Years of Single Window Implementation," 2011, 19, 22. For example, Rwanda introduced an electronic single window in January 2013 that reduced clearance times for goods from 34 hours in 2010 to 23 hours in 2014. OECD, "Rwanda Electronic Single Window," December 30, 2014, 1.

[465] Barka, Border Posts, *Checkpoints, and Intra-African Trade*," 2012, 4.

[466] Kingombe, "Hard and Soft Infrastructure Development in Africa," 2014, 21.

[467] Central Corridor Transit Transport Facilitation Agency, "Progress in Construction of Manyoni and Nyakanazi" (accessed June 30, 2017).

stops from 17 to 3.[468] These reforms, coupled with improvements at its largest port in Dar-es-Salaam, help explain why Tanzania went from being one of the worst-performing SSA countries in 1995 in terms of export participation in GSCs, to being the second best in 2011.[469]

Finally, SSA has dedicated resources to improving transportation infrastructure, although the pace of such reform is relatively slow. As an example, only 34 percent of rural SSA residents have access to roads that are open to vehicle traffic year-round, with some short-term exceptions. Despite new investment in roads, ports, and rail infrastructure, the region still has an $18.2 billion shortfall in transport spending, of which $9.4 billion is needed for the operation and maintenance of existing infrastructure.[470] A 2010 World Bank study estimated that a $50 billion infrastructure investment in SSA could increase annual GDP growth in the region by as much as 2.5 percent.[471]

Conclusion and Outlook

Cross-border trade in SSA has been aided by improvements in the region's transport infrastructure (including roads, airports, and shipping ports) and by customs reform. These improvements have also made it easier for 3PL firms to operate in the region and have encouraged SSA's participation in GSCs. However, there is still ample room to improve the overall customs environment in SSA and, by extension, the operating environment for 3PL firms. In Nigeria, for instance, high border costs still cause firms to divert trade to shipping ports in the nearby countries of Togo and Benin, or to stop trading through West African ports altogether.[472] While certain issues, such as corruption, may persist in the short to medium term, in the long term SSA's continued commitment to trade facilitation will likely improve the transparency and efficiency of customs and logistics services throughout the region.

[468] Kingombe, *Hard and Soft Infrastructure Development in Africa*, 2014, 18.
[469] UNECA, *Economic Report on Africa*, 2015, 110–11.
[470] World Bank, Databank, World Development Indicators database (accessed January 26, 2017).
[471] Foster and Briceno-Garmendia, *Africa's Infrastructure: A Time for Transformation*, World Bank, 2010, 25.
[472] Industry representative, interview by USITC staff, Washington, DC, February 28, 2017.

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