MAP 2.1 **Trade Ties Make East Asia a Tightly Knit Region**

Syrian Arab Rep.

Iran, Islamic Rep. of

Jordan

Kuwait

Qatar

Pakistan

United Arab Emirates

Saudi Arabia

Oman

India

Yemen, Republic of

China

Korea, Rep. of

Japan

Hong Kong, China

Taiwan, China

Thailand

Vietnam

Malaysia

Philippines

Singapore

Indonesia

Australia
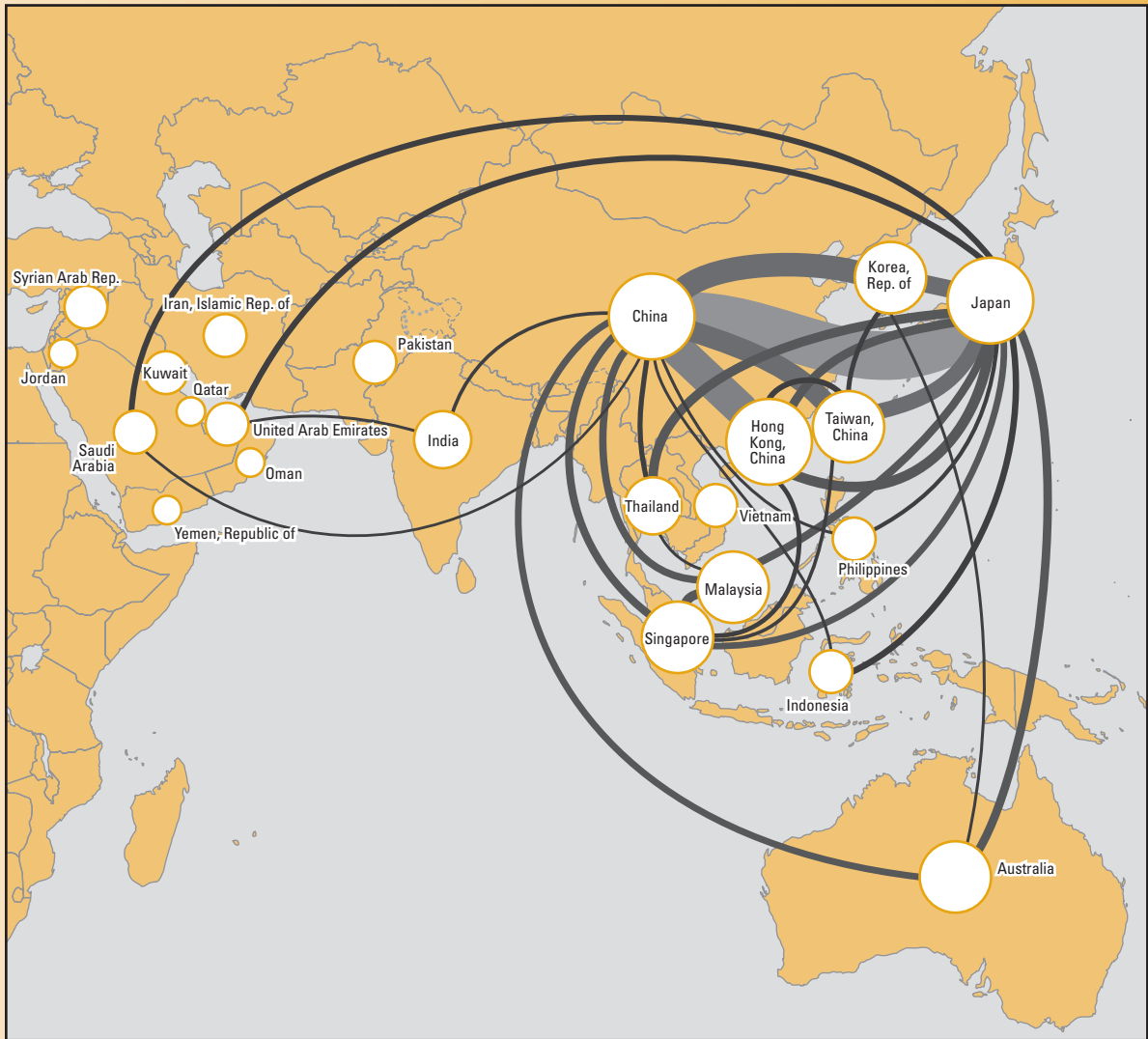
○ total imports (US$ billions)

<10
10–75
75–100
100–250
>250
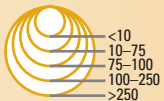
The area of each circle is proportional to the total imports into each country, in 2004.

>150
100–150
50–100
25–50
10–25

bilateral import flows
(US$ billions)
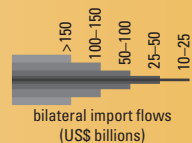
Each band is proportional to the total import flows in both directions for each pair of countries, in 2004.

Source: Direction of Trade Statistics Database, International Monetary Fund and ESDS International, http://www.esds.ac.uk/international/access/access.asp.

TRADE

Vigorously growing sectors are relying on scale economies. Regional production networks have deepened trade ties by leading to rapid expansion in the trade in parts and components.

For the last four decades, trade has been the engine of economic growth for most of East Asia. In the 1960s, Japan emerged as the region's first major exporter, and it was followed in the 1970s by a second generation of countries (Hong Kong [China], the Republic of Korea, Singapore, Taiwan [China]), in the 1980s by a third generation (Indonesia, Malaysia, the Philippines, Thailand), and in the 1990s by a fourth generation (China, Vietnam). While unilateral liberalizations by individual countries helped initiate export-led development in the region, the increasing economic integration of East Asia has been an important factor in sustaining the region's growth.

The region's economies share a reliance on export-oriented industries. However, the economies have developed in ways that are distinct and also revealing of the region's underlying growth dynamic. Japan began as a producer of low-priced final consumer goods and later moved into capital-intensive intermediate and capital goods. Second-generation countries (with the partial exception of Korea) entered the global stage as subcontractors, assembling or producing final consumer goods using the intellectual property (brand names, patents, organizational capital) of European, Japanese, and U.S. firms. Their industrial roots lay in the fact that firms from high-wage countries relocated their production processes by moving labor-intensive manufacturing stages to East and Southeast Asia. As second-generation countries increased the skill and capital intensity of the goods and services they produced, they became

sources of innovation in their own right. Industrialization in these economies has gone hand in hand with an expansion in the *varieties of goods* they produce by moving up a *quality ladder*.

Third- and fourth-generation exporters also entered global trade by providing subcontracting services to European, Japanese, and U.S. firms and competing in low-end consumer goods on the basis of lower unit labor costs. Over time, they have also become more specialized in producing components and other intermediate inputs for firms in Japan and in second-generation countries in East Asia and the Pacific through *production networks* managed by multinational firms in the region's entrepôts (Hong Kong [China], Singapore) and, increasingly, in the more industrialized East Asian economies (Japan, Korea, Taiwan [China]). Within these networks, intermediaries, be they multinationals or specialized traders, help coordinate production and lower transaction costs.

Trade within production networks contributes to *complementarity* among the development paths of countries in the region, even as it creates rivalry between countries for market share abroad. Income growth in one country increases the demand for intermediate inputs produced in nearby countries. By allowing input producers to enjoy *scale economies,* this lowers input production costs and enhances regional growth. In this way, *regional economic integration* has become a driver of growth.

One source of complementarity between production and trade in East Asian economies is the proximity of these economies to one another. Because of low transport costs and low trade barriers between the region's economies, growth in one East Asian economy tends to expand the trade between that economy and other East Asian economies rather than, say, Latin America. Low trade costs may magnify the advantages of fragmenting production, rendering the impact on trade of incremental reductions in trade barriers potentially large.

Production networks seem to be more extensive in East Asia than in other regions and are at the heart of the recent growth in intraregional trade (see map 2.1). This is due to a favorable policy setting (low tariffs, policies that encourage exports, such as duty drawback, and encouragement of export-oriented foreign direct investment [FDI]), first-mover advantages, and considerable intercountry unit labor cost differentials, combined with excellent logistics. Because of these advantages, East Asia has become a global production leader in products that exhibit increasing returns to scale, such as machinery, parts, and components.

The economic integration of China has deepened production fragmentation in East Asia to an unprecedented level. This vertical specialization has intensified the dynamism of East Asian economies and increased the economic interde-

pendence within the region. From this perspective, China has been a positive force. But each East Asian country still depends heavily on extraregional exports of final goods. In those third markets, China is a fierce competitor.

Many questions arise within this East Asian model. Is China, on balance, a substitute or a complement for other East Asian producers? Can we identify the countries and the sectors that are most affected? Do countries engaging in production networks climb the technology ladder rapidly or do they become trapped on the same rung over time? What if China develops its own technological capabilities while it still has cheap labor for manufacturing? Will regional production networks collapse into Chinese production networks? Does the strong interdependence across countries make these countries vulnerable to shocks in each others' economies or do the main risks still lie with the health of global demand?

This chapter will (1) review the changing direction of trade and the changing commodity composition of trade, (2) assess how the region is responding to China's emergence as a major trader, and (3) evaluate the impact on technology and growth.

Trade Patterns in East Asia

The exports of emerging East Asia have been growing rapidly.[1] They doubled in the six years since the crisis and probably surpassed US$2 trillion in value in 2005. They now account for more than one-fifth of total world exports (see table 2.1). The value of East Asia's exports is greater than that of the total exports of Latin America, South Asia, Eastern Europe, the former Soviet Union, the Middle East and North Africa, and sub-Saharan Africa combined. The ratio of exports to gross domestic product (GDP) in the region, at slightly more than 50 percent, is the highest of any region in the world. Trade is East Asia's economic lifeblood and the source of its dramatic growth.

Improvements in transportation infrastructure have certainly played an important role in the expansion in trade in East Asia (see figure 2.1). Asia has the lowest freight costs among all developing regions, although the levels are still higher in Asia than they are in developed countries. Firms have taken advantage of low-cost shipping hubs in Hong Kong (China), Singapore, and, increasingly, other major cities in the region, such as Shanghai and the port of Tanjung Pelepas (serving Johore, Malaysia) to ship their goods. The distribution networks of traders in these hubs are an important factor in promoting the economic integration of the region and give the region an advantage over other developing regions, such as Africa and Latin America, which lack major entrepôts.

merchandise exports, current US$

Region[a]	Value (US$ billion)			Share of world total (%)		
	1990	1998	2004	1990	1998	2004
Emerging East Asia	427.7	939.0	1,847.6	12.3	17.1	20.2
Australia, Japan, and New Zealand	336.7	455.9	672.6	9.7	8.3	7.4
North America (3)	521.3	896.5	1,135.4	15.0	16.3	12.4
Eastern Europe (12)	34.5	119.0	291.2	1.0	2.2	3.2
Rest of Europe (28)	1,623.0	2,383.5	3,718.1	46.7	43.3	40.7
Former Soviet Union (15)	n.a.	115.6	284.9	n.a.	2.1	3.1
Memo: European Union (25)	1,535.2	2,322.4	3,670.8	44.2	42.2	40.1
Middle East (14)	138.4	144.5	389.6	4.0	2.6	4.3
North Africa (7)	38.6	34.4	82.8	1.1	0.6	0.9
Sub-Saharan Africa (48)	68.2	71.8	143.7	2.0	1.3	1.6
World	3,475.1	5,504.4	9,145.0	100.0	100.0	100.0

Source: World Bank 2005.
Note: n.a. = not applicable.
a. The number of countries is shown in parentheses.

■ FIGURE 2.1 **Freight Costs across the World: Asia Is Doing Well**
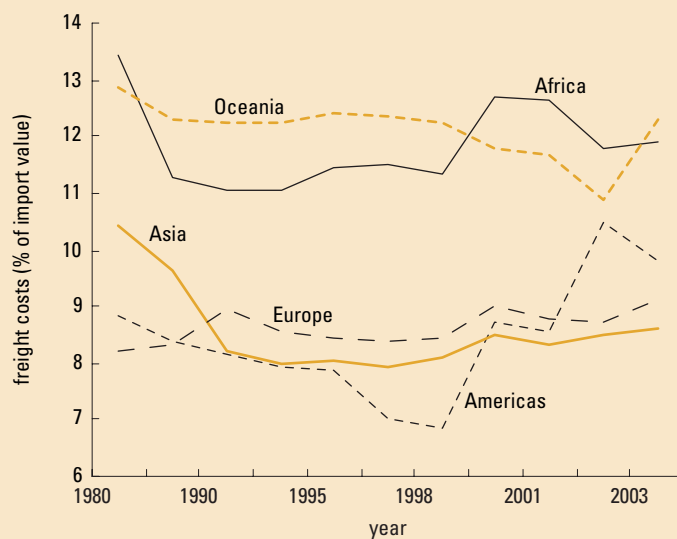
Source: UNCTAD, various years.
Note: Freight costs are typically around 4 percent of import value in developed countries.

Reexports and exports on which final-stage value adding activities are under-taken close to a major port are facilitated when import tariffs are low and when export-oriented firms have access to duty drawback schemes. East Asia has always featured low tariffs and extensive duty drawbacks. The trend to openness has been accelerated recently by rapid reductions in import-weighted tariffs in China, Indonesia, Malaysia, the Philippines, and Thailand. In a bold move, countries in the region opted to continue to liberalize and reduce tariffs even after the 1997–98 crisis and now have average weighted tariffs at only slightly above 5 per-cent (see figure 2.2).

Trade middlemen may efficiently reduce the information and search costs incurred by buyers and sellers. Sometimes these traders manage the entire sup-ply chain. The services they provide are valuable, especially when production involves multiple stages and many countries. A piece of evidence to support the idea that middlemen add more value when the supply chain lengthens is offered by Feenstra and Hanson (2004), who find that Hong Kong (China) traders charge


■ FIGURE 2.2 **Average Tariffs Have Fallen**

Source: World Bank 2005.
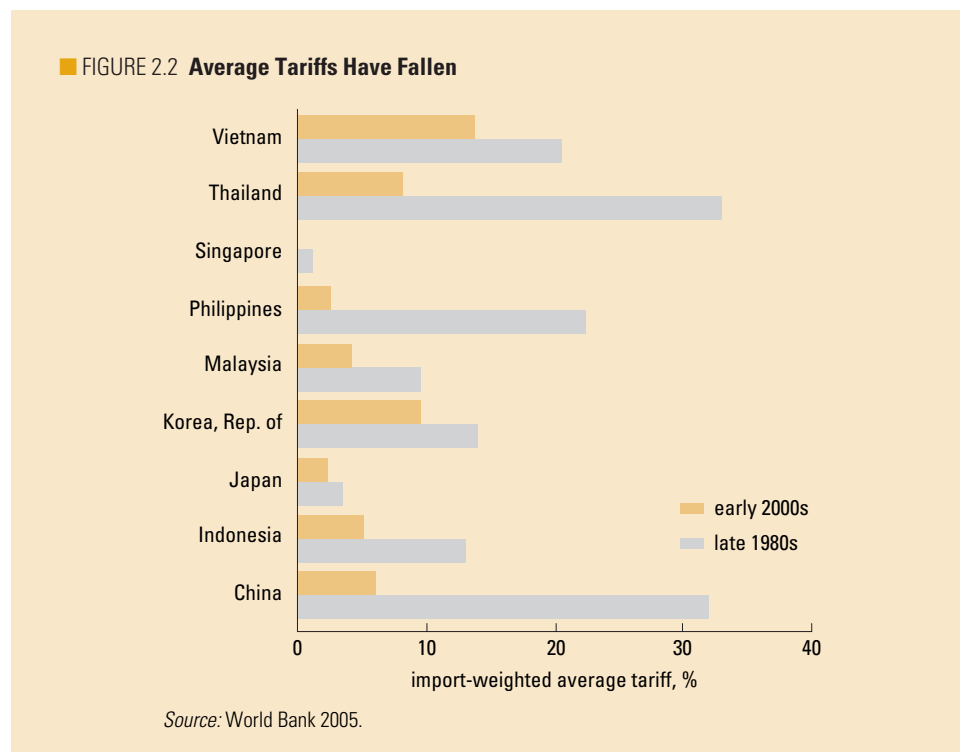
more on Chinese reexports in those export industries in which there is a higher share of processing exports from China.[2]

Much of the trade in the region is linked to the growth of FDI and the organization of regional production networks by multinational corporations. Figure 2.3 shows that the cumulative stock of FDI in the region has grown even more rapidly than have exports or GDP over the long term and that both exports and FDI have grown in economic importance. The 1997–98 crisis was accompanied by a fall in regional GDP and, consequently, a rise in the share of FDI (measured in U.S. dollars), but this aberration has been steadily offset as GDP has recovered.

The role of multinational corporations in trade and other economic aggregates is best exemplified by the case of China.[3] The share of multinational corporations in China's exports increased from 29 percent in 1994 to 55 percent in 2003 (see figure 2.4), while the corresponding share for imports increased from 46 to 56 percent. The high export and import orientation of multinational corporations differs according to the source and motive for investment. Affiliates of Japanese multinational corporations in Asia have a strong outward orientation; half their production is exported. Over 80 percent of these exports occur within Asia (47 percent go to Japan and 34 percent to other Asian

■ FIGURE 2.3 **FDI Has Played a Key Role in East Asia**

a. Exports, FDI inflows, and GDP

b. Exports and FDI as a share of GDP
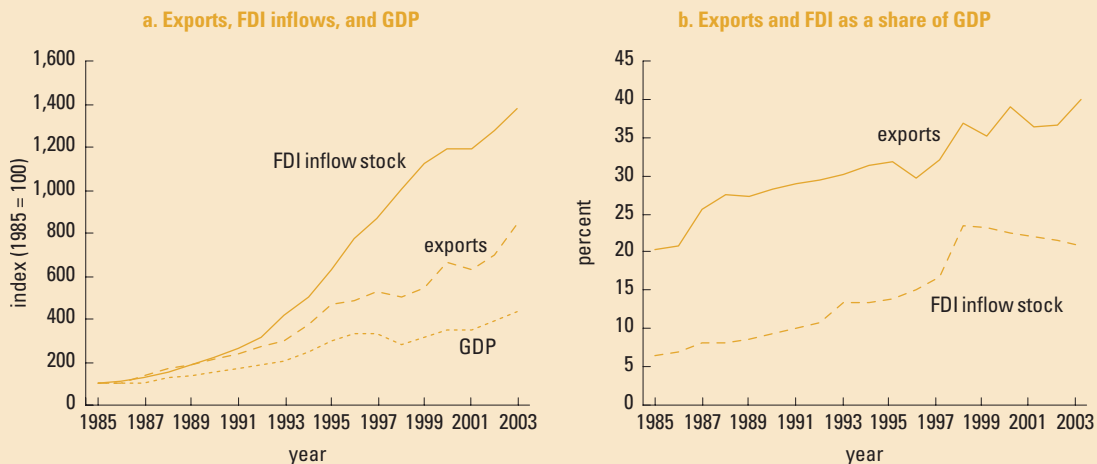
Source: World Bank 2005.

■ FIGURE 2.4 **Over Half of China's Exports Originate through Multinationals**
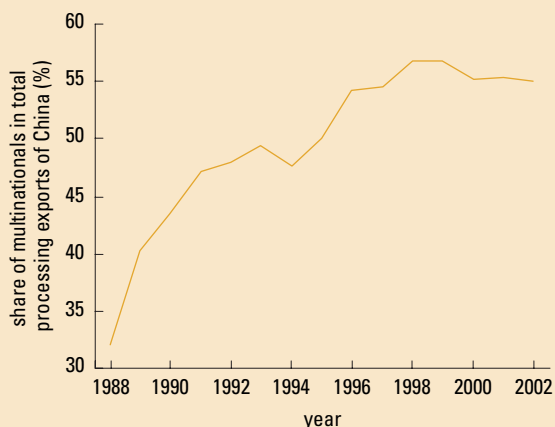
Source: China, National Bureau of Statistics, various years.

countries). Similarly, over 95 percent of Japanese multinational affiliate imports come from Asia (64 percent from Japan and 31 percent from other Asian countries). Much of this trade takes place within individual firms. Of the exports from the head offices of Japanese multinational corporations, 74 percent are destined to overseas affiliates, while 56 percent of the imports come from overseas affiliates. This high share of intrafirm trade indicates the closed nature of the regional production networks developed by Japanese multinational corporations, which have managed to fragment the stages of production and relocate each subprocess in the country offering the lowest unit cost. The same pattern now holds for multinational corporations from other East Asian economies, such as Hong Kong (China) and Singapore, which are emerging as important sources of FDI.

This Asian pattern of FDI contrasts with the traditional FDI that seeks to jump trade barriers and service domestic markets more effectively. From 1960 to the early 1980s, trade and capital flows between the United States and Europe tended to be substitutes rather than complements. That still holds for most European Union and U.S. FDI in Asia (especially China) and for Japanese affiliates in North America, which only export 14 percent of their production, producing the rest for the domestic market. In contrast, East Asian FDI has evolved so that trade and FDI flows move in parallel.

Shifts in the Direction of Trade

Dramatic changes in trade patterns among East Asian economies have taken place. Intraregional trade has expanded more rapidly than extraregional trade and accounts for over half of East Asia's trade (49 percent of exports and 55 percent of imports). This reflects the increasing division of labor within East Asia as the region becomes a factory for the world.

The aggregate figures are reflected in individual country data showing that the importance of intraregional trade grew for most East Asian countries (see table 2.2). All countries in the region have boosted their share of exports to China, in some cases dramatically. Hong Kong (China), Korea, Taiwan (China), and Vietnam have witnessed around 10 percentage point gains in the share of their exports going to China. At the same time, almost all countries in the region have seen a fall in their export shares to Japan, reflecting the slower growth of the Japanese economy over the last 10 years.

The exception to this trend is China. China's exports to East Asia have fallen since the country joined the World Trade Organization, and China has been able

■ TABLE 2.2 **East Asian Intraregional Exports Have Been Growing Thanks to China**
percent of total exports going to East Asia, China, and Japan

Exporter	East Asia		China		Japan	
	1990–94	2000–04	1990–94	2000–04	1990–94	2000–04
East Asia	44.1	49.0	6.4	11.1	8.6	8.2
China	60.5	45.3	n.a.	n.a.	15.8	14.3
Hong Kong, China	47.0	55.5	29.9	39.3	5.4	5.4
Indonesia	62.0	56.9	3.6	5.4	32.9	21.0
Japan	34.6	43.1	3.7	10.0	n.a.	n.a.
Korea, Rep. of	40.8	46.6	4.2	15.6	15.7	9.8
Malaysia	54.7	54.2	2.5	5.3	13.6	11.5
Philippines	36.1	53.7	1.2	4.2	17.4	16.4
Singapore	48.2	56.4	2.0	6.1	7.8	7.0
Taiwan, China	42.7	55.2	0.0	10.3	11.3	9.2
Thailand	41.7	48.3	1.5	5.3	17.3	14.7
Vietnam	—	49.0	—	9.6	—	15.7

Source: Direction of Trade Statistics Database, International Monetary Fund and ESDS International, http://www.esds.ac.uk/international/access/access.asp.
Note: n.a. = not applicable. — = no data are available.

to access markets in the European Union and the United States. But China still exports a large share to other East Asian countries; almost half of its total exports went to East Asian trading partners between 2000 and 2004.

More intraregional trade should not be interpreted as a reorientation of exporters toward Asia and away from the rest of the world. There are other explanations for intraregional trade. Most importantly, the East Asian economy has been growing more rapidly than the economy of the rest of the world. So, it is natural to expect that, for all countries, the share of their exports going to East Asia would rise. This effect accounts for almost two-thirds of the intraregional effects noted above.[4] In addition, as East Asia becomes more generally open by, for instance, lowering tariffs across the board, one would expect a higher share of trade within the region. This accounts for another quarter of intraregional export growth. The change in orientation toward the region accounts for a relatively small share of intraregional exports. So, the rapid expansion of intraregional trade has not come at the expense of extraregional trade. Instead, East Asian countries are adding regional trade expansion to their already formidable global exports.

Much regional trade is accounted for by a triangular pattern of exports. There is back-and-forth trade in intermediate goods, whereby additional processing is undertaken at each stage until the final product is exported. This is evident in several sectors in which East Asian newly industrializing economies (NIEs) and Japan export a significant share of parts for electrical appliances, office and telecommunications equipment, and textiles and apparel to China and middle-income countries in the Association of Southeast Asian Nations (ASEAN), where the processing is completed. The final products are then exported to the European Union and the United States. This triangular trade may be quantified as the product of two indexes: the share of total intermediate exports from Japan and the NIEs going to China and ASEAN and the share of China's and ASEAN's total finished goods exports going to Canada, the European Union, and the United States.[5] The composite index captures both legs of the triangular trade. When the assembler countries in East Asia raise their share of intermediate goods, the index rises, and when they sell more to the rich countries outside the region, the index rises. The results are shown in Figure 2.5. Triangular trade has risen most sharply in electrical machinery, office and telecommunications equipment, and the metal industries. It has declined in automobiles, where a different process is at work. There, the triangular flows are reversed. Emerging East Asian countries are the exporters of parts to Japan, where final assembly is carried out.

■ FIGURE 2.5 **China and ASEAN Are Intermediating More of East Asia's Trade**
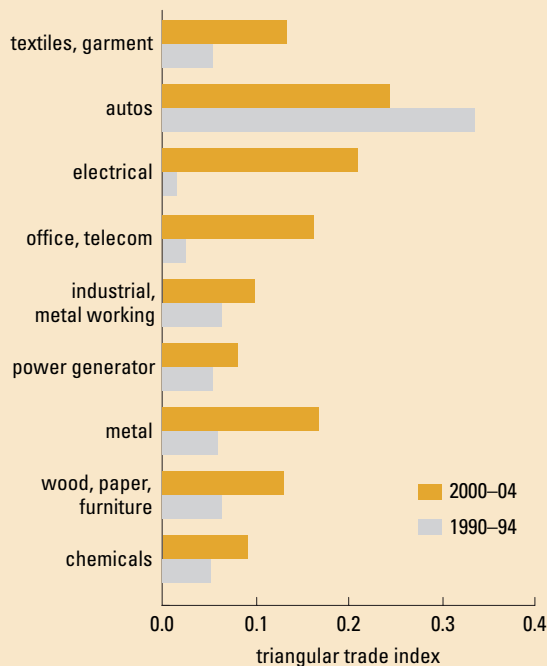
Source: Urata 2006.
Note: See the text and endnote 5 for an explanation of the index.

Shifts in the Commodity Composition of Trade

The rapid expansion of trade by East Asian economies has been accompanied by substantial changes in the commodity composition of trade. From 1990–94 to 2000–04, exports shifted from light manufacturing, such as textiles and garments, wood, paper, and furniture, to more sophisticated manufactures, such as machinery (see table 2.3). Thus, machinery accounted for over 50 percent of East Asia's exports and 42 percent of imports. Within machinery, the exports of office and telecommunications equipment and electrical machinery grew particularly rapidly in ASEAN, the NIEs, and China. For China, the share of office and telecommunications equipment in overall exports increased from 6 to 22 percent, while the share of electrical machinery increased from 4 to 10 percent. ASEAN countries, with the exception of Indonesia, saw exports of office and telecommunications equipment and electrical machinery rise significantly, and

■ TABLE 2.3 **The Commodity Composition of Foreign Trade in East Asia**
percentage share of total trade

Composition	East Asia		China		Japan	
	1990–94	**2000–04**	**1990–94**	**2000–04**	**1990–94**	**2000–04**
Export Composition						
Agriculture	7.0	4.1	13.7	5.2	1.1	1.0
Mining, fuels	5.4	5.1	6.4	4.1	1.3	1.7
Total manufacture	86.1	88.7	78.5	90.1	95.8	93.0
Machinery	46.6	53.6	17.4	40.6	71.6	67.1
Textiles, garments	12.7	9.1	29.1	18.3	2.1	1.5
Import Composition						
Agriculture	12.9	8.9	9.3	7.7	23.3	15.6
Mining, fuels	15.4	16.8	7.7	13.7	27.9	25.5
Total manufacture	68.8	72.7	82.3	77.9	45.7	56.7
Machinery	34.3	41.8	42.0	45.0	16.9	27.6
Textiles, garments	7.3	5.4	9.4	4.4	6.6	6.5

Source: United Nations Commodity Trade Statistics Database, United Nations Statistics Division, http://unstats.un.org/unsd/comtrade/.

these accounted for a combined share ranging from 30 to 60 percent of total country exports. Similar to the changes in exports, the share of imports of machinery, in particular office and telecommunications equipment and electrical machinery, increased in total imports in many East Asian economies, including Japan.

Machinery has become an important trade commodity for countries in East Asia.[6] Innovative machinery products have played a significant role in the success of Japan and the NIEs in global trade. The same is now happening in China, where the share of machinery in total exports leaped to 41 percent in 2000–04 from 17 percent a decade earlier.

Machinery encompasses a broad range of products, and the growth in this sector has been accompanied by an equivalent evolution in the nature of the products traded. The products made in China are shifting to more sophisticated machinery and away from mass manufactured goods with low-technology inputs. For example, China now exports more personal computers and related accessories than metalworking tools. China is also exporting cellular phones, personal digital assistants, and flat-screen televisions instead of transistor radios. While much of this production involves the assembly of high-technology products

using low-skilled workers, there has been true improvement in China's techno-logical capacity as well.

A considerable proportion of machinery exports encompasses intermediate goods. For example, in electrical appliances, parts represent some 80 percent of East Asian exports, while finished products account for only 20 percent. These shares vary by sector, but they are indicative of the broader process of international production fragmentation that is driving the commodity composition of trade.

The fragmentation of production across borders and the economic integration of national economies have been coincident events in East Asia.[7] Several factors explain this fragmentation:

■ The desire to reduce costs by offshoring subprocesses to countries where unit labor costs are lowest; this may change as wage levels for different skills change
■ The desire to locate production near sources of consumer demand and input supply
■ The desire to centralize the production of finished goods or inputs to benefit from scale and other agglomeration economies, including thicker labor markets, and the more rapid learning of new technologies

As part of the production network in machinery, China has emerged as the most important final assembly hub, while Japan and the NIEs are the major sources of innovative intermediates. But the traditional production network is changing. It is no longer a simple model whereby Japan and the NIEs supply high-quality components and capital goods to developing East Asian countries, which assemble them into finished goods for export to markets in the European Union and the United States. A more sophisticated and complex network is developing, involving the transshipment of components.[8] An example of such a complex network is offered by the case of the production of hard drives in Thailand, where parts from 11 different countries are combined. Once a drive is made, it is exported elsewhere to be assembled into a finished personal computer. Clearly, a significant amount of trade is involved in this process.

China's increase in machinery exports is exceptional (see table 2.4). Between 1993–04 and 2003–04, the world market share of China doubled in power generating equipment, tripled in industrial machinery, quadrupled in electrical machinery, and quintupled in office and telecommunications equipment. By and large, other East Asian countries also raised their world market shares in the same products and at the same time as China. This is because these countries have been able to avail themselves of China's rapidly growing internal market.

■ TABLE 2.4 **The Share of Exports of Selected East Asian Countries in World Markets**
percent

Country	Power generating equipment		Industrial machinery		Office, data, and telecom-munications		Electrical machinery		Road transportation	
	1993–94	2003–04	1993–94	2003–04	1993–94	2003–04	1993–94	2003–04	1993–94	2003–04
China	1.3	2.4	1.0	3.3	2.8	15.7	2.4	8.2	0.5	1.6
China (imports)	3.8	4.5	7.9	8.6	2.6	5.5	2.8	9.4	1.5	1.9
Indonesia	0.1	0.4	0.1	0.1	0.6	0.7	0.4	0.6	0.2	0.1
Malaysia	0.8	0.3	0.6	0.5	4.3	3.6	4.8	3.0	0.1	0.1
Philippines	0.0	0.1	0.0	0.1	0.4	1.1	1.5	2.7	0.1	0.2
Thailand	0.6	0.8	0.6	0.6	2.0	1.7	1.4	1.6	0.3	0.5

Source: United Nations Commodity Trade Statistics Database, United Nations Statistics Division, http://unstats.un.org/unsd/comtrade/.
Note: Lightly (dark) shaded figures indicate products with increasing (decreasing) market shares.

Machinery has come to represent a much larger share in total exports in all other countries in the region as well. As a result, the structure of exports has become more similar across the board. One way of gauging this phenomenon is to examine the export shares of specific products from individual countries and from the region as a whole. The correlation between the shares across all products (measured at the 4-digit level of the standard international trade classification [SITC]) is a measure of the similarity of the export structure between the country and the region. This export similarity index increased for all countries in East Asia between 1990–94 and 2000–04 (see figure 2.6). Indonesia is practically the only country that exhibits a different composition in export products. If the same exercise is carried out to compare the export composition of the East Asian countries to that of the rest of the world, there is much less correlation.

If East Asian countries have similar exports and they are trading more with each other, it follows that there must be back-and-forth trade in the same products between countries in the region. This is exactly what has happened. Within the region, the share of intraindustry trade rose steadily from 1990 to 2004, while the share of interindustry trade went down (see figure 2.7).[9] One type of intraindustry trade is called horizontal. This refers to trade in products that are similar in function, price, and quality, but differentiated by design or other minor characteristics. Such trade occurs to satisfy the consumer demand for variety. The other type of intraindustry trade is called vertical. Products of different quality and

■ FIGURE 2.6 **The Exports of East Asian Countries Have Become More Similar**

a. Average correlation coefficient of export composition

b. Share of machinery in total exports
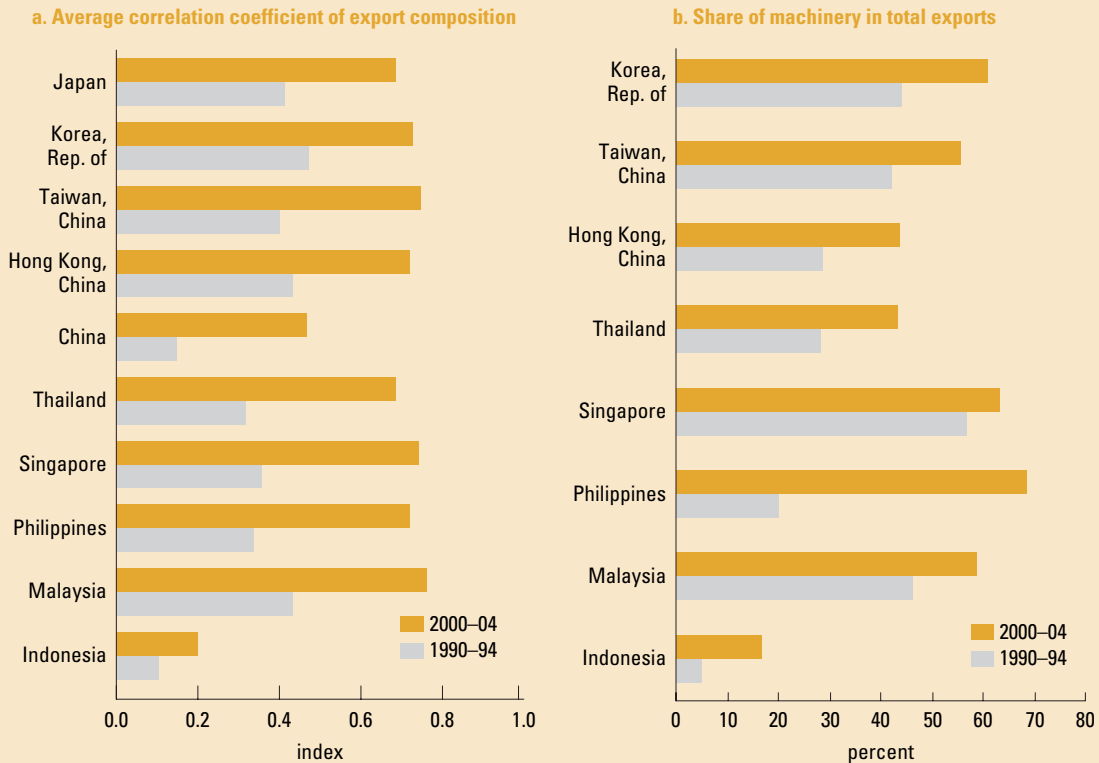
Source: Rahardja 2006.
Note: See the text for a brief explanation of the indexes.

prices are traded. An example of such trade involves standard color televisions and high-definition televisions, which are different in quality and price. Vertical intraindustry trade is common in footwear, garments, and electronics. But there is also considerable vertical intraindustry trade in parts and components, which can differ markedly from one another in quality and price. Ando and Kimura (2003) point out that the East Asian success story is mainly a vertical intraindustry trade phenomenon within which transactions are characterized by back-and-forth trade links whereby several countries in the region participate in various stages of single production chains.

Vertical intraindustry trade is a global phenomenon. The world trade in parts and components increased in value from US$400 billion in 1992 to over

■ FIGURE 2.7 **Vertical and Horizontal Intraindustry Trade Have Become More Important**
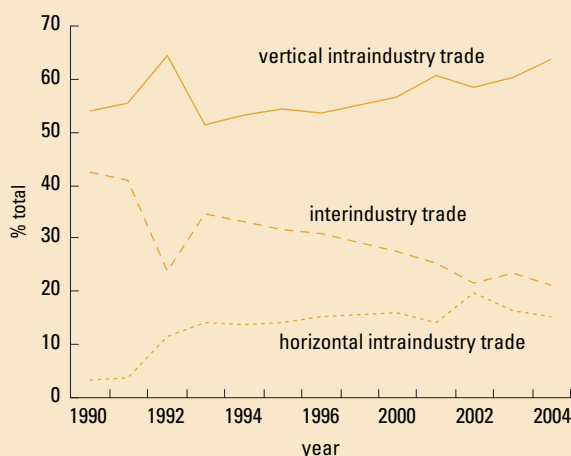
Source: United Nations Commodity Trade Statistics Database, United Nations Statistics Division, http://unstats.un.org/unsd/comtrade/.
Note: Aggregation is based on the 6-digit Harmonized Commodity Description and Coding System as revised in 1988. It has been computed using the method proposed by Fukao, Ishido, and Ito (2003).

US$1,000 billion in 2003 and now accounts for a sizable portion of total exports in many countries (see figure 2.8). The share of East Asia in the total exports of components rose from 31 percent in 1992 to 43 percent in 2003 despite a decline in the share of Japan.

Within East Asia, there has also been a change in the trade in parts and components (see table 2.5). China has become a major exporter of parts and components, increasing its share of the regional market by 11 percentage points between 1993 and 2004, while it is also a principal importer, raising its market share of imports by 16 percentage points. On the export side, China, the NIEs, and middle-income ASEAN have all increased their market shares at the expense of Japan. On the import side, the NIEs and middle-income ASEAN have lost market share to China and Japan. The growth in the imports of parts and components is occurring in Japan mainly in the automobile sector, while, in China, it is mainly in electronics and telecommunications.

A reorientation in the export of components is taking place from developing East Asia to China. Over the past 10 years, the proportion of components in the exports to China has increased almost 5 times for Indonesia, 15 times for

■ FIGURE 2.8 **Parts and Components Exports Are More Important in East Asia**
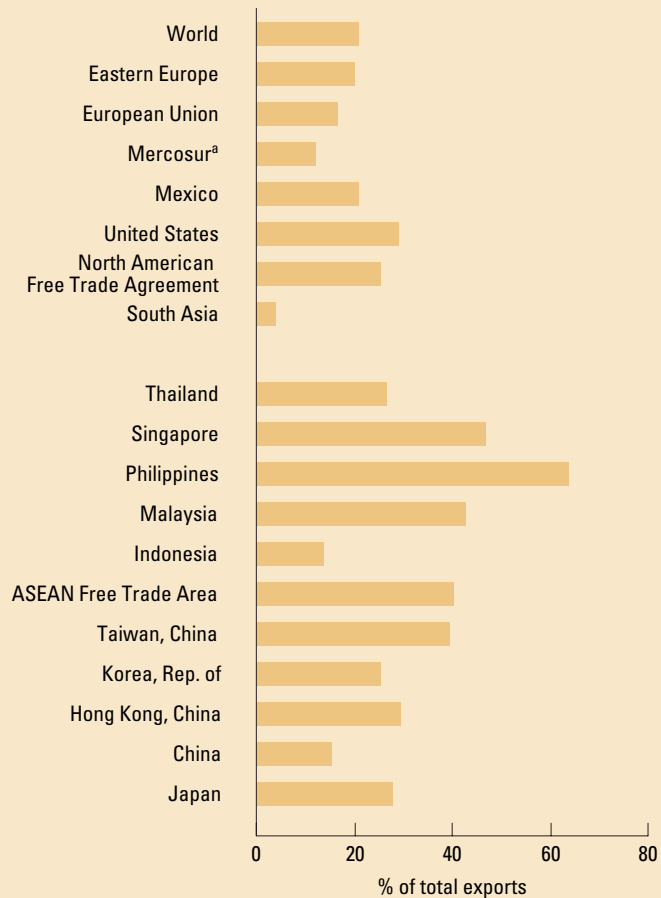
Source: Athukorala and Yamashita 2005.
a. Mercosur = the Southern Cone Common Market.

Thailand, 19 times for Malaysia, and 60 times for the Philippines. In 2003–04, countries in developing East Asia shipped almost 50 percent of their components within the region, a significant rise from the 33 percent in 1993–94. Other countries are also benefiting. For example, the proportion of components in the exports of Indonesia and the Philippines going to Malaysia increased by 2 and 10 times, respectively, during the decade.

■ TABLE 2.5 **Intra-Asian Trade in Parts and Components**

Exporters	Japan		NIEs		Importers ASEAN-4[a]		China		Asia	
	%, 2004	% point change, 1993–2004	%, 2004	% point change, 1993–2004	%, 2004	% point change, 1993–2004	%, 2004	% point change, 1993–2004	%, 2004	% point change, 1993–2004
Japan	n.a.	n.a.	11	−14	5	−8	7	+3	25	−22
NIEs	4	. .	15	. .	6	−2	15	+9	41	+7
ASEAN-4[a]	2	. .	7	−1	2	+1	4	+4	16	+4
China	3	+2	10	+7	2	+1	n.a.	n.a.	16	+11
Asia	10	+3	44	−8	15	−7	25	+16	100	n.a.

Source: CEPII-BACI Database, Centre d'Etudes Prospectives et d'Informations Internationales, http://www.cepii.fr/francgraph/bdd/baci.htm.
Note: n.a. = not applicable. . . = negligible.
a. ASEAN-4 = Indonesia, Malaysia, the Philippines, and Thailand.

Responding to China

China's integration into the world economy is one of the most important developments affecting the structure and evolution of the global and regional trading systems. Over the past two decades, China's economy has grown at nearly 10 percent per year, driven primarily by the expansion of a modern, export-oriented industrial sector. Some 20 million Chinese workers move each year from rural underemployment to the modern sector, and nearly 300 million workers have yet to be reallocated; this is not a one-time shock, but an ongoing process that might continue into the next decade.[10]

China is now the sixth largest economy in the world and the third largest in trade (behind the United States and Germany). Its exports have grown even more rapidly than its economy, at rates exceeding 20 percent per year. As a result, China's share of world trade has increased from less than 1 percent two decades ago to more than 6 percent today. Between 1990 and 2002, its market share more than tripled in Japan (from 5 percent to 18 percent) and rose from 3 percent to 11 percent in the United States and from 2 percent to 7 percent in the European Union.

The structure of China's exports has also been changing away from the clothing, footwear, other light manufacturing, and fuels that dominated its trade in the 1980s and early 1990s toward office machinery, telecommunications, furniture, and industrial supplies in the late 1990s and automated data processing equipment and consumer electronics in recent years. Rodrik (2006) argues that China's success is not a simple story of specialization according to comparative advantage. Its export bundle is that of a country at a level of per capita income three times higher than the country's actual level. China has managed to latch on to the production of advanced, high-productivity exports beyond what is normally expected of a poor, labor-abundant country. This helps explain China's phenomenal growth and is at least partly a result of industrial policy.

With whom does China compete and in what product areas and markets? The answer to this question is critical in any assessment of the prospects of other countries in the region and in understanding whether China represents, on balance, an opportunity or a threat for other developing countries.

The majority of trade is still based on comparative advantage. Countries with similar income levels and, hence, similar wage levels tend to export similar products. So, one way of asking the question about China's competition is to investigate which countries exhibit similar export structures and the average income levels of these other countries.

For each good that a country exports, it is possible to construct an index of the income productivity of the export, or PRODY, to measure the productivity level

associated with the country's pattern of specialization.[11] First, a weighted average of the per-capita GDPs of the countries exporting the product is computed wherein the weights reflect the revealed comparative advantage of each country in that product. This results in an index for the product at the world level. Then, an income productivity level that corresponds to the country's export basket is computed by calculating the export-weighted average of the index for that country.

In 2000–04, China's exports had an average PRODY of US$9,963. This implies that the country's exports are representative of an exporter with a real per capita income of about US$10,000. During this period, East Asia and the Pacific had an average PRODY of US$11,000. The average per capita income in the sample of countries in East Asia and the Pacific, weighted by exports, is US$9,679, indicating that their representative exports are associated with a higher-income level (by about 14 percent). The real income level represented by China's exports is below that of countries in East Asia and the Pacific, but growing somewhat more rapidly; it has increased by 20 percent over the last 10 years (see table 2.6).

Figure 2.9 shows that China is following the pattern of other East Asian countries in that it has a PRODY that is much higher than the actual income level. Most countries in the region exhibit this same characteristic to varying degrees. The Philippines appears to be the greatest outlier, with a bundle of exports far more sophisticated than is typical for a country at that income level. But the inference from these calculations is that China and, indeed, other East Asian exporters are competing more vigorously with higher-income countries than with countries at low wage levels. This is good news for low-income exporters and perhaps explains why low-income garment exporters such as Bangladesh and Cambodia have been able to compete with China despite the lifting of quotas once the Agreement on Textiles and Clothing expired on January 1, 2005.

■ TABLE 2.6 **Index of the Average Wage of Export**
trade-weighted average PRODY

Exporter	1990–94	2000–04	Change (%)
East Asia and Pacific	9,604	11,001	14.5
China	8,308	9,963	19.9
Latin America and the Caribbean	8,143	9,128	12.1
World	10,679	11,108	4.0

Source: Freund 2006.
Note: The data have been calculated using the PRODY index in 2000–04, weighted by the average industrial trade share of the respective region (or country) over the period.

■ FIGURE 2.9 **East Asian Exports Are More Sophisticated Than Predicted by Income Levels**
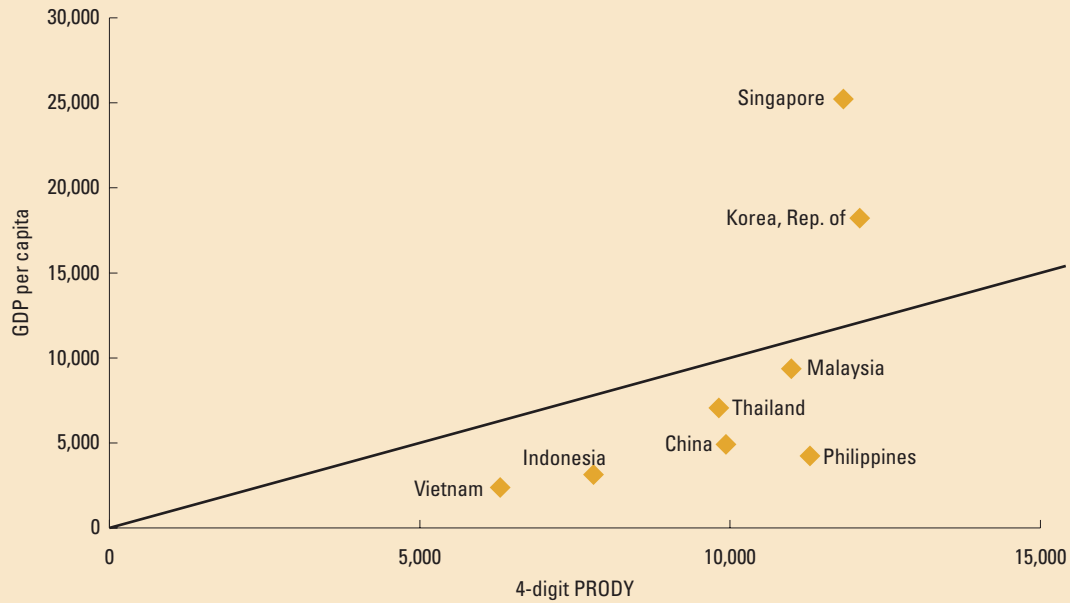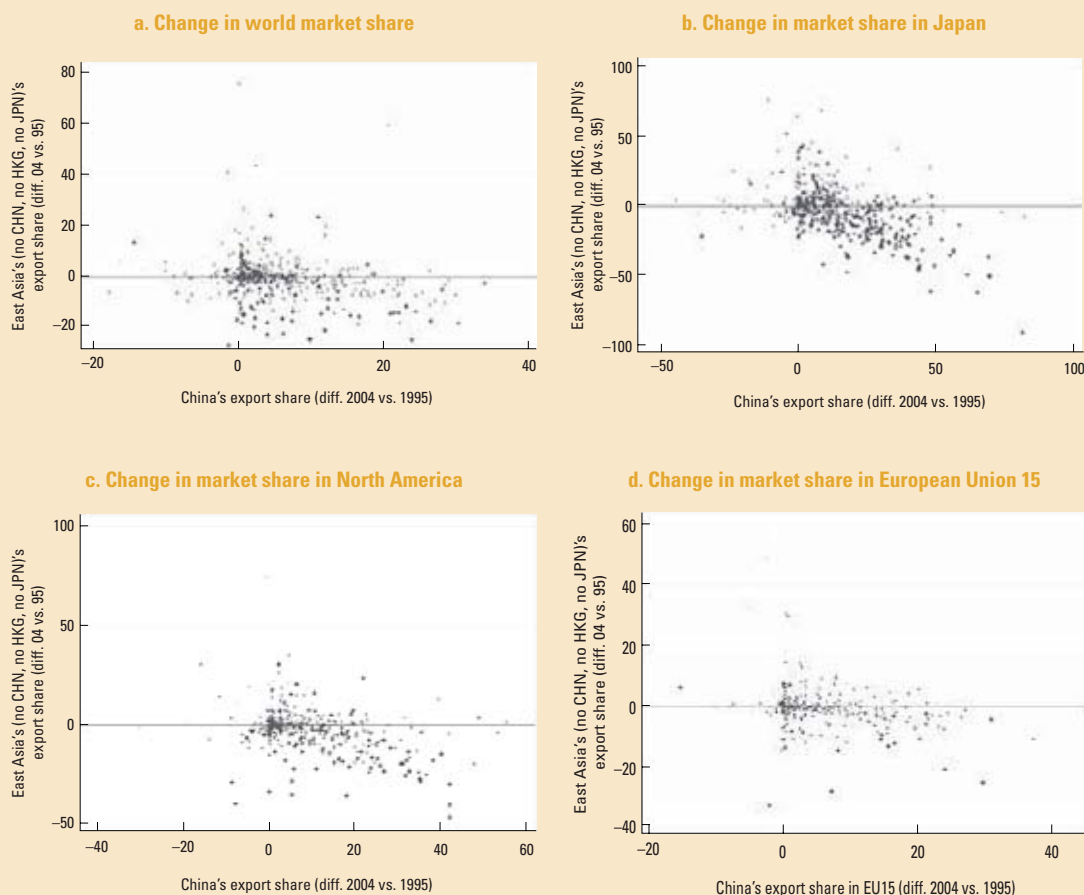

Source: Based on calculations by World Bank staff.
Note: The 4-digit PRODY is the trade-weighted average in 2000–04.

Another way of looking at the competition posed by China is to examine how market shares for specific products have changed in specific markets. Figure 2.10 plots changes in China's market share in the European Union, Japan, North America, and the world market against the market shares of non-China emerging East Asia. Every industry is represented (at the 4-digit level of aggregation). Each dot on the scatter plots of figure 2.10 therefore shows whether China and other emerging East Asian exporters have been gaining or losing market share in a particular industry.

When one looks at each major developed market, that is, Europe, Japan, and North America, there is a distinct downward slope to the pattern of dots. This suggests that, for products in which China is gaining market share, other exporters are losing market share. Most of the dots are concentrated toward the lower right portion of the charts. But that pattern disappears if the world market is considered (see chart a). There, the majority of dots are scattered around the horizontal zero market share change line. The difference, of course, is that, in the world market, China itself is a potential market for other exporters. The inference is that

■ FIGURE 2.10 **East Asian Exporters Recoup in China What They Lose Elsewhere to China**

a. Change in world market share

b. Change in market share in Japan

c. Change in market share in North America

d. Change in market share in European Union 15

Source: Freund 2006.
Note: "East Asia" in the above scatter plots does not include China, Hong Kong (China), or Japan. The change in the export shares in all cases refers to the difference between the situation in 1995 and that in 2004. Each data point represents a 4-digit SITC category, and the size of the point is weighted by the export shares at the beginning of the period. Points appearing toward the lower right portion of each chart show products for which the market share of countries in East Asia and the Pacific (excluding China) have fallen, while China's market share has risen. This portion is densely populated in charts b, c, and d, indicating that there are many significant industries in Europe, Japan, and North America in which East Asia and the Pacific have lost market share, while China has gained. In chart a, this is not so much the case. See the text for an explanation.

exporters in East Asia are making up in the China market what they are losing in richer country markets.

The market share approach is suggestive, but it does not necessarily imply any causality or actual economic displacement. It implicitly assumes that, absent any other forces, market shares will remain constant. But it is possible that China might be increasing its market share at the expense of domestic producers instead of other exporters. If this were the case, total exports would expand and, by definition, the share of other exporters would decline even if the quantity of their exports did not change at all. This analytical gray area is likely to appear whenever a relatively aggregate industry category, such as the 4-digit classification, is used. For example, assume China sells primarily overcoats, while other emerging East Asian exporters sell mainly suits. At the 4-digit level, these products will seem to be competing, but it is unlikely that an increase in overcoat exports from China will displace suit exports from East Asia and the Pacific. Hence, a loss in a share in a market is only an indication of potential welfare losses, not an accurate statement about actual losses.

An estimation of China's impact on other emerging East Asian exporters may be rendered more systematically by controlling for other effects that have an impact on market shares. This kind of econometric investigation shows the following:[12]

- On average, export growth to non-China markets in industrial products is low when Chinese exports in these same products are significant and growing (see table 2.7).
- A coefficient of about −0.3 implies that, in a product area with a Chinese market share of 10 percent and Chinese export growth of 20 percent, export growth

■ TABLE 2.7 **Is China Displacing the Exports of Other East Asian and Pacific Countries?**

Statistic	All products	Nonindustrial products	Industrial products
Export supply effect	1.176***	1.090***	1.194***
	[43.70]	[28.91]	[38.67]
China export effect	−0.208***	0.102	−0.307***
	[2.94]	[1.43]	[3.55]
Observations	1338229	299056	1039173
R-squared	0.35	0.34	0.35

Source: Freund 2006.
Note: The regressions include export, year, and 4-digit product-fixed effects. The estimates thus rely entirely on cross-market variation in Chinese import penetration in a given product. Robust t-statistics are shown in brackets.
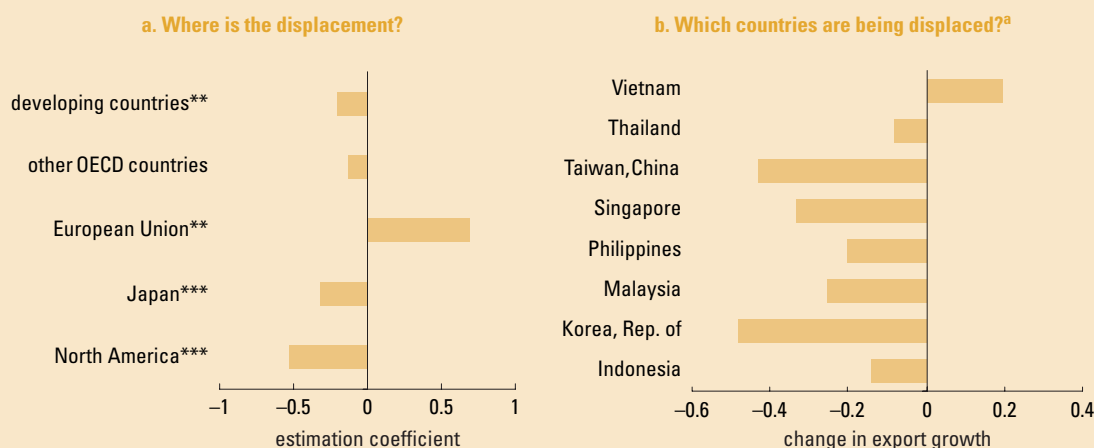***significant at 1 percent.

in emerging East Asia would be reduced by 0.6 percentage points (0.3 × 0.1 ×
20), a relatively small impact.

■ The negative impact has been strongest in the most recent period, 2000–04.

■ The negative impact is strongest in Japan and North America and in many
developing-country markets, but is actually positive in Europe (see figure 2.11,
chart a). This implies that Chinese exports may be opening up European prod-
uct markets for other East Asian countries.

■ Among East Asian exporters, 12 of 19 seem to be negatively affected by China;
the most serious impacts are in Korea, Singapore, and Taiwan (China) (see fig-
ure 2.11, chart b). But these countries are the ones that have also gained the
most from increasing their exports to China and that have taken advantage of
the triangular trade discussed earlier.

The same estimation method may be used to examine industry-specific effects.
In about 16 industries of the 67 studied, China emerges as a major threat to other
East Asian exporters. These industries are listed in table 2.8. They are mostly
industries in which the exports from emerging East Asia to China are growing
most rapidly. In fact, 11 of the 16 threat industries are in the top-20 list of the
most rapidly growing export industries to China.

■ FIGURE 2.11 **China Is Displacing East Asian Countries in Many Markets, but Not in Europe**

a. Where is the displacement?

b. Which countries are being displaced?[a]

Sources: Freund 2006; calculations of the authors.
a. This is the coefficient on diflnimpCHN in equation 2.3 (endnote 12) estimated by country for 1995–2004.
**significant at 5 percent; ***significant at 1 percent.

■ TABLE 2.8 **The Threat Industries of China**

SITC code	Industry	Export growth from East Asia to China, 1990–94 to 2000–04 (annual %)
34	Gas, natural and manufactured	23.5
56	Fertilizers, manufactured	−23.1
59	Chemical materials and products n.e.s.	14.5
65	Textile yarn, fabrics, made-up articles n.e.s., related products	6.9
66	Nonmetallic mineral manufactures n.e.s.	14.4
69	Manufactures of metals n.e.s.	9.3
71	Power generating machinery and equipment	12.4
72	Machinery specialized for particular industries	11.0
73	Metalworking machinery	14.7
74	General industrial machinery, equipment, parts n.e.s.	9.6
75	Office machines, automatic data processing machines	29.2
76	Telecommunications, sound recording equipment	14.1
77	Electrical machinery, apparatus, appliances n.e.s.	27.0
81	Sanitary, plumbing, heating, lighting fixtures n.e.s.	1.4
89	Miscellaneous manufactured articles n.e.s.	7.5
95	Arms, ammunition	−3.4
Weighted average		14.2

Source: United Nations Commodity Trade Statistics Database, United Nations Statistics Division, http://unstats.un.org/unsd/comtrade/.
Note: The codes in italics indicate the industries on the top-20 list of the most rapidly growing export industries to China. n.e.s. = not elsewhere specified.

Table 2.8 suggests that the greatest threat industries are involved in machinery products, sectors in which other East Asian exporters also excel. Given the importance of machinery exports for the economies of these countries, it is useful to delve more deeply into the impact of China. Additional analysis is needed.[13]

One finding that emerges is that China appears to be pushing other exporters up the value chain in parts and components. For products in which Chinese exports are growing most rapidly, the unit value of other East Asian exports of the same commodity has been growing. This indicates that, rather than trying to compete head to head with China, other exporters are refining their products and specializing in higher-value parts and components. If this process continues, it may bring benefits both to China and to other exporters.

If one looks at finished machinery, however, a different story emerges. In finished products, the competition with China is much more significant. For finished goods in which Chinese exports are growing most rapidly, other East Asian exporters have had to lower their prices in response. This is not surprising. If the Chinese production of finished goods is the last stage of an efficient regional production network, then it follows that other producers will also have to match the efficiency gains and reflect these in lower prices if they wish to compete.

So far, it seems that efficiency gains and cost and price reductions in other countries have allowed these countries to maintain their market shares even as China's exports are growing rapidly. In those instances where market shares have fallen, this does not appear to be the result of the threat from China, but rather of the internal restructuring of the exporter economy. The exporters who have lost global market share are those who have also reduced revealed comparative advantage (RCA) in the export product.[14] Significant internal restructuring has been taking place in countries as they adapt to the changing global market. So, it is not surprising to see some countries losing market share in particular products even as China is increasing its market share in these products. The causality, however, is the reverse of what was feared. The initial exporter is moving up the value chain, thereby leaving space that China is filling.

But the dominant feature of the changes in the trade in machinery continues to be the evidence that the increase in China's exports of finished machinery products is linked to a substantial rise in the exports of parts and components from other emerging East Asian exporters. This triangular trade is the most notable empirical phenomenon of the last few years.

Trade and Growth

The trade performance of East Asia rests on the intricate production sharing networks and on the open trade and foreign investment regimes that allow these networks to materialize. But how much does this contribute to growth? Production networks may breed long-term vulnerabilities even as they promote short-term growth. There is a risk that specialization in one portion of a production network may limit the potential for an improvement in technology. There is also a risk that production networks may create a regional interdependence that makes East Asian countries hostage to the performance of their neighbors.

The evidence suggests that production networks are, indeed, increasing the sophistication of technology in the region and that the composition of exports is shifting toward the most efficiently produced products in each country. When the

category of high-technology exports is examined, it is clear that East Asian producers are becoming more specialized in their exports relative to the rest of the world. Figure 2.12 shows the revealed comparative advantage (RCA) of high-technology exports from five middle-income economies. It indicates that, in all cases except Indonesia, the RCA is greater than 1, demonstrating that these economies have larger shares of high-technology exports than does the world as a whole and that the RCAs are growing. If one disaggregates further into high-technology exports and computes the RCA for individual items, a pattern emerges showing that more and more of the high-technology exports do, indeed, have RCAs greater than 1.

Because RCAs have a long tradition in the trade literature as indicators of export efficiency, the inference is that East Asian exporters are becoming more specialized and more efficient in their exports as they participate in regional production networks. At least in the short term, the technology and efficiency gains are positive. High RCAs suggest specialization in exports. This is what is happening. In China, for example, the top two export product areas—office machinery, and radios and televisions—account for 85 percent of all high-technology exports.

In addition to static efficiency gains, there is another mechanism through which trade may contribute to growth. Romer (1990), Grossman and Helpman (1991), and Jones (1995a, 1995b) emphasize the importance of the availability of a large variety of intermediate inputs. In the Jones model, the creation of new input vari-

■ FIGURE 2.12 **Specialization and Efficiency Are Growing in High-Tech Machinery Exports**
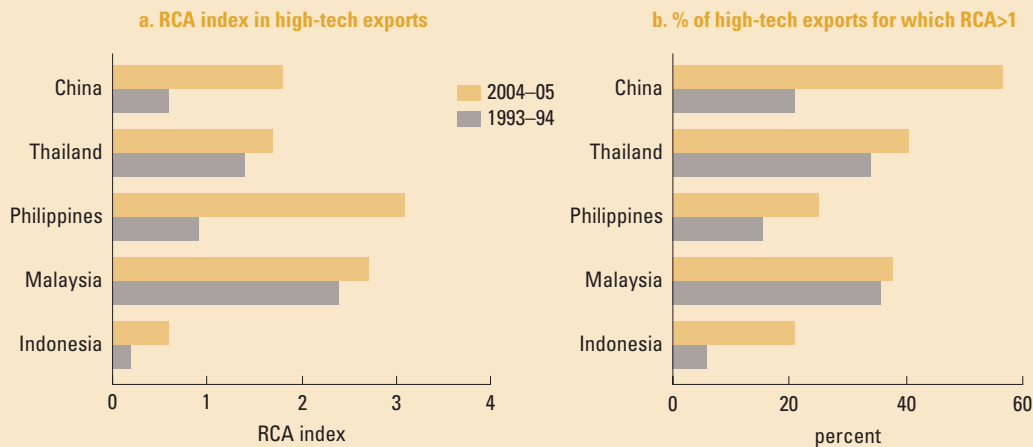
Source: Rahardja 2006.
Note: RCA = revealed comparative advantage, a measure of the country's ability to compete successfully in world markets.

eties by firms sustains growth even in the absence of factor accumulation. This growth is made possible because, it is assumed, the research and development (R&D) costs of creating new varieties fall as the number of input varieties in existence rises. Thus, the creation of new input varieties today reduces the cost of creating new input varieties tomorrow, rendering growth self-sustaining.

Evidence from Korea and Taiwan (China) consistent with this theory that product varieties contribute to growth. Over the period 1975–91, one study finds that changes in sectoral product varieties are positively correlated with changes in sectoral total factor productivity (TFP).[15] Nearly all the sectors showing a positive correlation between changes in product variety and the TFP use differentiated manufacturing products as inputs, which is consistent with the Jones model. The sectors showing a zero or negative correlation are nearly all industries that primarily use natural resources and other raw materials as inputs. These results suggest that, as the variety of inputs to which firms have access increases, the firms will enjoy gains in the TFP. For these gains to become self-sustaining, the increases in variety must lower the R&D costs of creating new varieties. On this issue, there is little research. We do not yet know whether falling R&D costs in Korea, Taiwan (China), and other countries have been caused by the documented increases in input variety or by other factors entirely.

Further evidence on the relationship between product variety and productivity is offered by Feenstra and Kee (2006), who estimate the impact of export variety on TFP for a large sample of countries over the 1980–2000 period. They find that export variety and TFP are strongly and positively correlated. In Korea, for example, export variety, as measured by the growing number of new export products, has been growing substantially over time, and so has the TFP. Japan, on the other hand, has not had much growth in new products, and the TFP has been more or less flat. In fact, Korea's exports are now 95 percent as varied as Japan's, compared to 66 percent in the early 1980s. The TFP in Korea has grown to 53 percent of the level for Japan, compared to 47 percent in 1980.

Figure 2.13 shows partial regression plots of the TFP on export variety for a cross-section of countries (controlling for other regressors). While there is a clear, positive correlation between the two variables, it does appear that many emerging East Asian countries (Indonesia, Korea, Malaysia, the Philippines, Singapore, and Thailand) show up below the regression line, indicating that the TFP is lower than one would expect given the observed levels of export variety in these countries. In East Asia, only Japan is above the regression line. Thus, while the region exports a relatively wide variety of goods, this outcome has not translated into such high levels of the TFP as seen in other countries.

■ FIGURE 2.13 **Countries with Greater Export Variety Have Higher Productivity Growth**

coef = 0.58884275, se = 0.12346561, t = 4.77
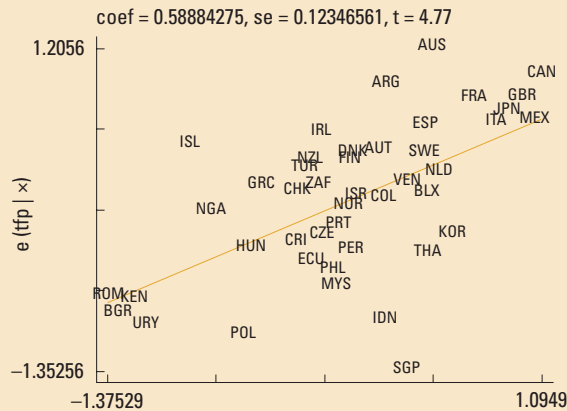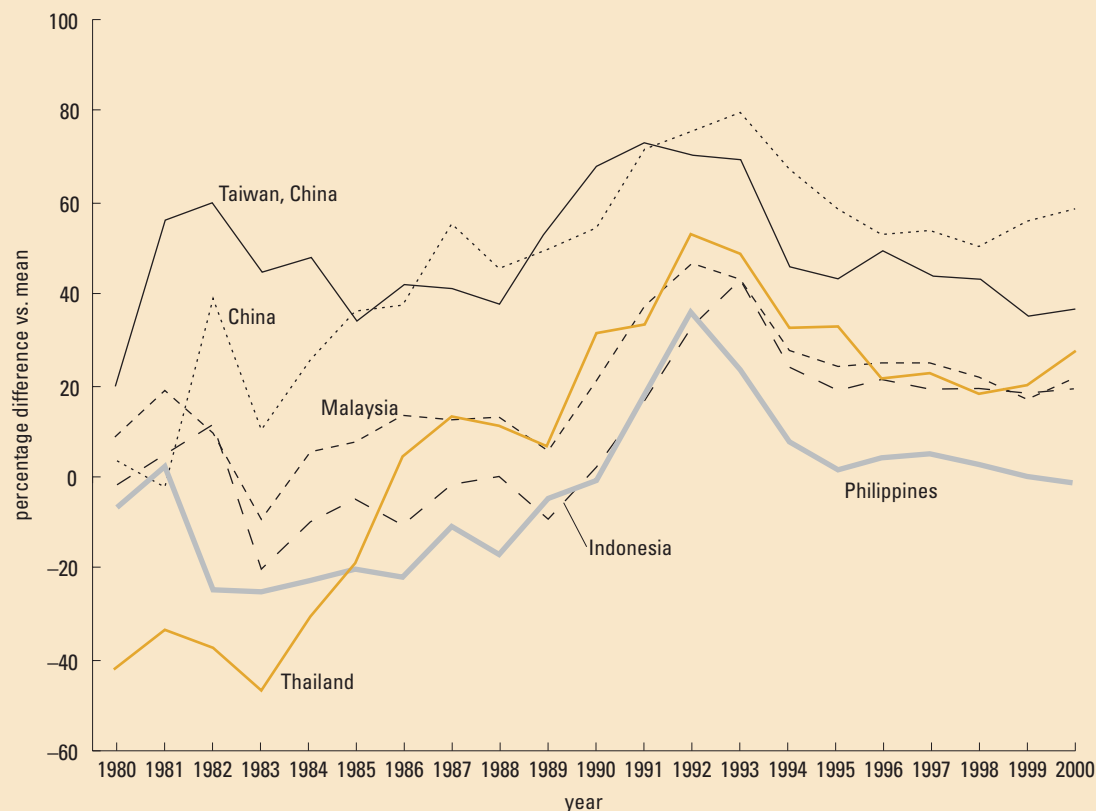

Source: Feenstra and Kee 2006.
Note: The figure shows a partial regression plot of the TFP against export variety.

Perhaps this is good news and a reflection of the relatively recent experience with regional production networks. The cross-country regressions indicate long-term effects; so, one might expect that Asian countries have considerable room to grow based on their export mastery of many different products.

East Asian countries are consistently developing new export varieties at a more rapid pace than their competitors. Figure 2.14 shows the change in export variety in six East Asian economies compared to a sample of 44 countries. The figure shows, as one would suspect, that China is among the leaders in the development of new export varieties, but almost all other East Asian countries are following suit. The exception is the Philippines. Thailand has had one of the most rapid expansions in export varieties. In the early 1980s, it lagged behind other developing countries, but has since risen to the same level of diversity as Malaysia.

Recent research suggests that the introduction of new export products and the level of sophistication of exports might be related to the pace of economic growth across countries and over time.[16] Economies tend to follow a common path during the process of development; at the start, they possess highly concentrated export structures, but they introduce new export products as their income levels rise. Nonetheless, it is important not to equate the desirable pattern whereby new

■ FIGURE 2.14 **China Has Become a Leader in the Development of New Exports**

Source: Feenstra and Kee 2006.
Note: The figure shows comparative export varieties over time by indicating the percentage difference in country results versus the sample mean. The sample includes 44 countries from 1980 to 2000.

export products are created with old concepts of export diversification. In East Asia, exports remain specialized so as to achieve economies of scale, but, with innovation, the composition of export structures may change.

Production networks are organized to minimize costs and achieve maximum efficiency and innovation over time. So, it is not surprising that, where production networks are dense, as in East Asia, outsourcing is especially sensitive to border trade barriers. In such an environment, small changes in border costs may have large effects on trade. This is exactly what has been found

worldwide. In an analysis of the trade between U.S. parent firms and their affiliates abroad, Hanson, Mataloni, and Slaughter (2005) find that affiliate imports of intermediate inputs are strongly and negatively correlated with trade costs. A 1 percent fall in trade costs leads to a 2–4 percent increase in the quantity of intermediate inputs imported by the affiliates from their U.S. parent companies. The affiliates then process these inputs into finished products or more-finished products.

One disadvantage of an overly heavy reliance on exports as a driver of TFP growth is that it may become difficult for domestic firms to capture any of the productivity benefits. As discussed above, a large share of China's exports and imports comes through foreign-owned firms or joint ventures. This is also true of the trade in high-technology products; almost 80 percent of China's high-technology exports to and imports from Asia rely on foreign affiliates, and more than half rely on wholly foreign-owned firms. The share of high-technology products in the trade of foreign-owned and joint venture companies in China is two to three times as high as the share of high-technology products traded by domestically owned firms (see figure 2.15). Indeed, if one stratifies products according to their technological sophistication, it is clear that foreign firms dominate in the export of high-technology products, while domestic firms dominate in the export

■ FIGURE 2.15 **Foreign Firms Are Increasingly Concentrated in High-Technology Trade**
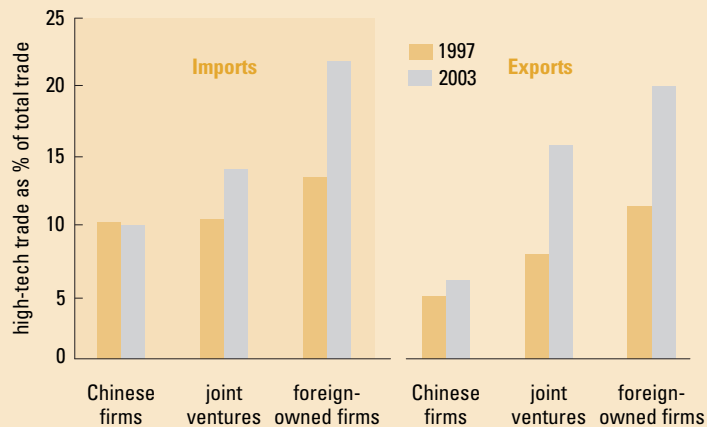
Sources: Gaulier, Lemoine, and Ünal-Kesenci 2005; China, General Administration of Customs, various issues.

of low-technology products such as basic metals, textiles, and chemicals (see figure 2.16).

There is some concern that too much reliance on foreign firms may actually slow broader technological change. In some sectors, high-technology imports and FDI have been used as a substitute for local expenditures on R&D. But surveys of industrial firms in China in the 1990s confirm that productivity and innovation are highest when in-house R&D is raised to internalize effectively the new technologies being brought in from abroad. So, in several high-technology sectors, there has been only a limited effect on domestic innovative capacity.[17]

At the end of the 1990s, the Chinese authorities began to implement a new policy that put emphasis on the development of domestic innovative capacities. As a result, R&D expenditures increased, and their share in GDP rose from 0.7 percent in 1997 to 1.3 percent in 2002 and may have reached 1.5 percent in 2005. FDI may now help China to catch up because foreign firms investing in China have started to increase their involvement in R&D activities not only as a result of political pressure by the Chinese government to intensify technology transfers, but also as a result of evolving strategies of the firms themselves.

Institutional Support for Trade

East Asian trade has developed through market-based structures. It has been driven by unilateral openness in most countries in the region and a strong adherence to multilateral principles of nondiscrimination. But the significant supply-side integration of the region points to the growing vulnerability of each country with respect to the performance of its neighbors. Any firm in the region that is participating in a production network is exposed to the trade, economic, and political frictions among the Asian economies.[18] So far, tensions have not spilled over into the economic realm, but a new source of tension may arise in the region. The commercially important elements of East Asian regionalism, the ASEAN-China Free Trade Area and the ASEAN-Japan bilateral agreements are only now beginning to cut tariffs on a discriminatory, preferential basis. The discrimination has led to trade tensions in other regions. A more structured framework within East Asia might be desirable so as to manage any frictions that arise.

The ASEAN Free Trade Area was the only major free trade area until 2002, when Japan and Singapore agreed to a New Age Japan-Singapore Economic Partnership Agreement. Since then, there has been a surge in the number of new institutional trade agreements not only among countries within East Asia, but also outside the

■ FIGURE 2.16 **Domestic Firms Dominate in China's Low-Technology Export Industries**
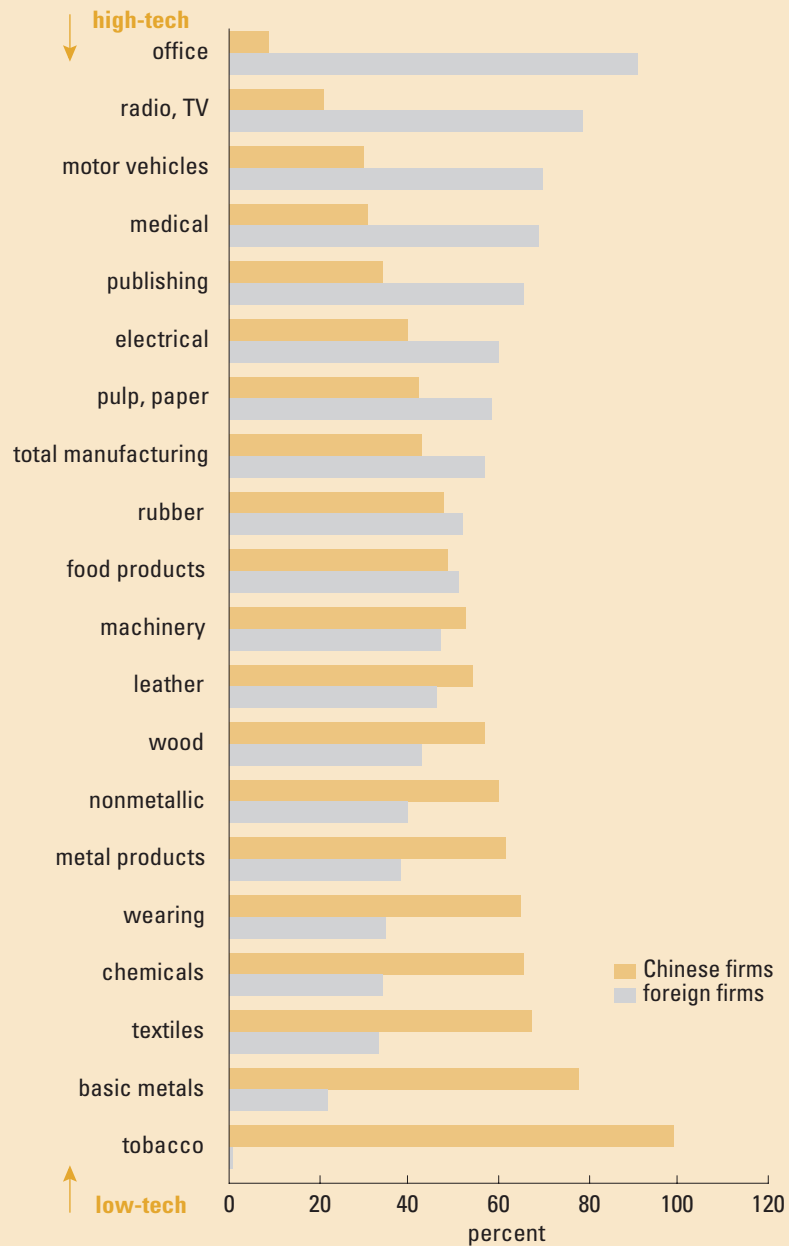
Source: China, General Administration of Customs, various issues.
Note: The product categories are adapted from SITC, Rev. 3 (2-digit), United Nations Statistics Division, http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=14.

region (see figure 2.17). In addition to individual country bilateral agreements, ASEAN as a group has become active in discussions on free trade areas in recent years. ASEAN and China enacted a free trade area in goods trade in July 2005, and they are currently negotiating a free trade area in services. ASEAN is also negotiating free trade areas with India, Japan, Korea, and others.

While free trade areas appear to have offered benefits to the region, it is too soon to quantify the full impact. The ASEAN Free Trade Area has been useful for low-income countries such as Cambodia and the Lao People's Democratic Republic because it has brought them into a more open regional trading system prior to accession to the World Trade Organization, of which Cambodia is now a member, and Lao PDR is in membership negotiations. Free trade areas also permit countries greater latitude to exclude sensitive products from trade liberalization. So, a substantial number of products, including important agricultural commodities such as rice, have been exempt from liberalization. Many agreements take the form of comprehensive economic partnerships that encompass trade and FDI facilitation, liberalization, and economic and technical cooperation. However, the implementation of these partnerships has been slow. A particular challenge is the development of straightforward rules of origin so that it is possible to realize the complex network of regional agreements without imposing undue administrative costs on firms.

The current blueprint for free trade agreements in the region is far less overarching than the corresponding agreements of the European Union or the North American Free Trade Agreement. In the latter instances, single sets of rules govern regional trade, and there are clear arrangements for dispute resolution. No single entity in East Asia now plays this role. Perhaps the most similar grouping is the ASEAN+3 (ASEAN countries, plus China, Japan, and Korea), but ASEAN+3 has focused more on financial cooperation than on trade. It is safe to say that the institutional underpinnings for Asia's complex production networks are not yet in place.

The Way Forward

East Asia's rapid export growth and the region's growing concentration in machinery and the redirection of exports among countries within the region are all based on the expanding regional production networks. These networks have centered on China, but the dynamism of China has offset on any of the threats China poses to its competitors in third markets. China is increasingly competing with higher-income exporters that are better able to adapt by mov-

■ FIGURE 2.17 **East Asian Free Trade Agreements Are Surging**

a. Active free trade areas

**East Asia Free Trade Agreements in effect as of April 2006**
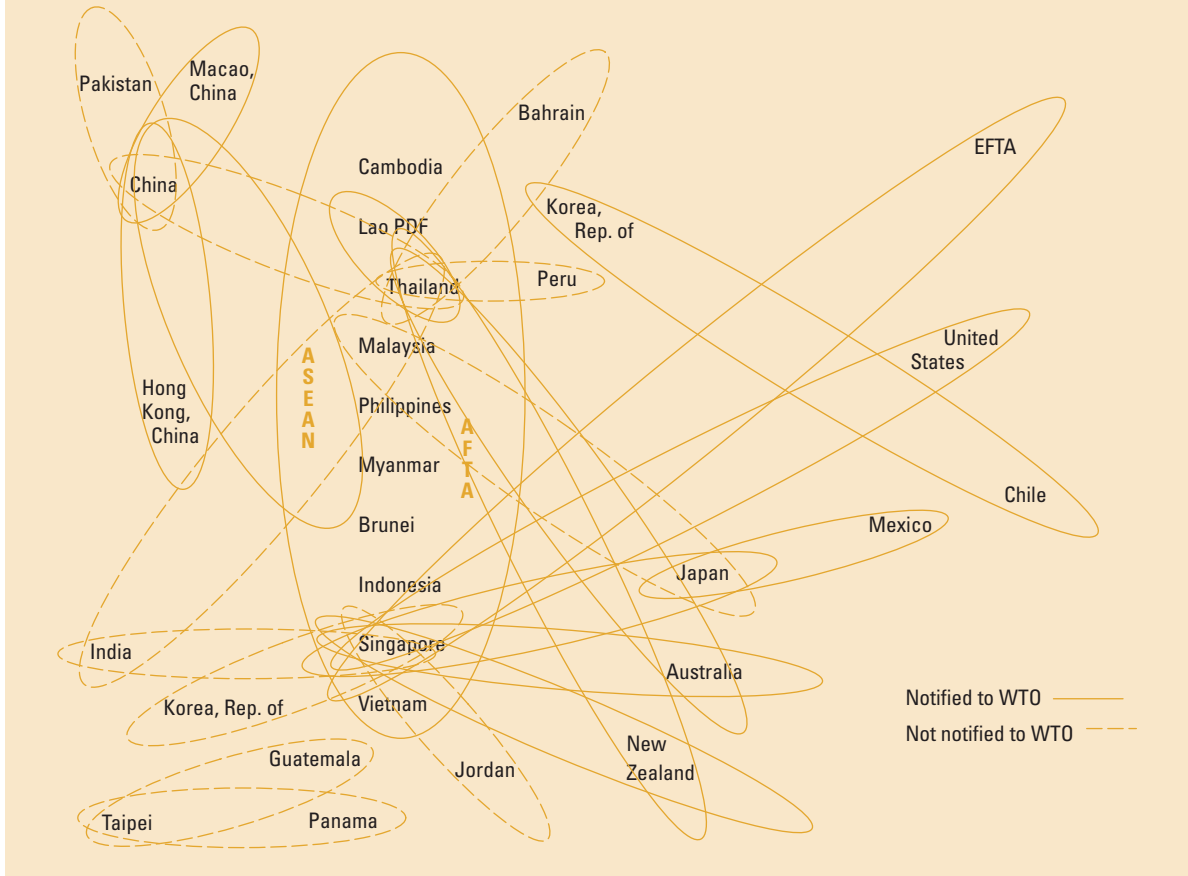
ing up the value chain. There is good evidence that this is happening in the region and is driving growth in all countries.

Production networks spawn specialization and physical concentration. They also trigger innovations, especially in intermediate goods, and this tends to accelerate growth. East Asia seems to be enjoying a phase of development during which export specialization is going hand in hand with a blossoming in the variety of exports. The export specialization is permitting the exploitation of economies of scale, while

■ FIGURE 2.17 (**Continued**)

b. Free trade areas under negotiation

East Asia Free Trade Agreements under negotiation as of April 2006
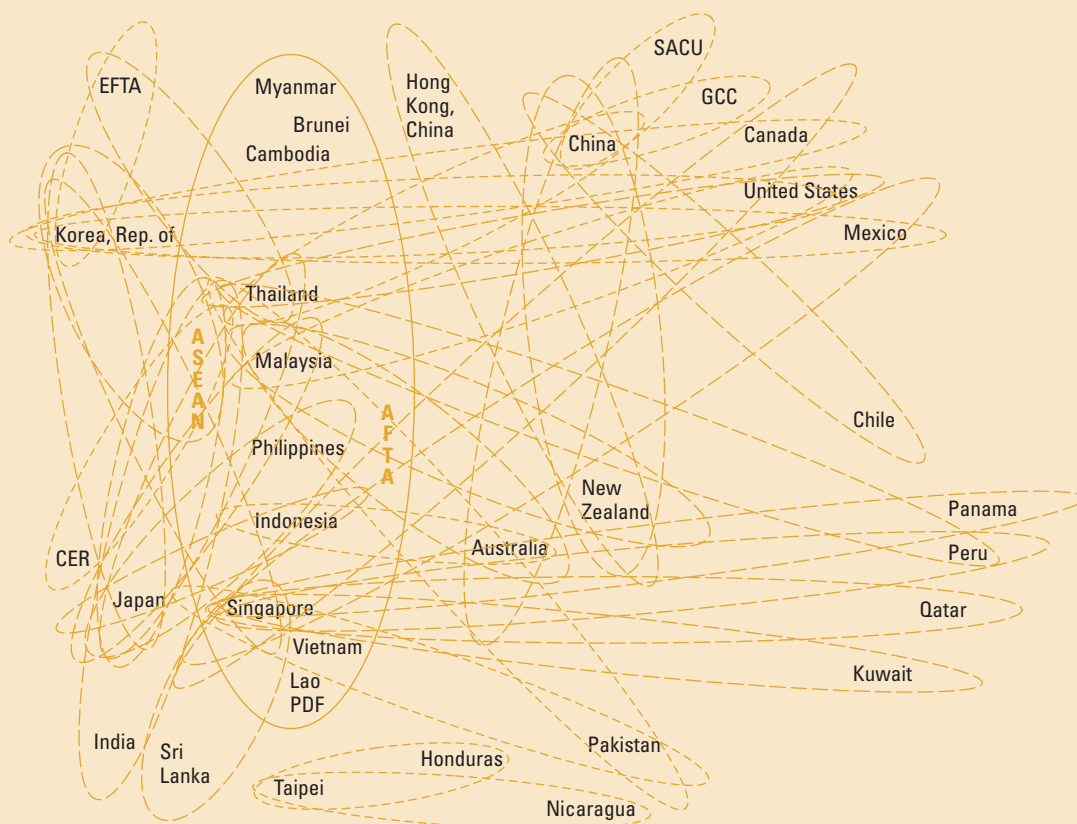
Source: Based on data in ADB 2006.

the increasing variety in exports is driving new product development. This will be a winning combination if it can be sustained.

Production networks may become more dense and extend into additional sectors only if the trade barriers remain low. East Asia has performed well in bringing down barriers to the trade in goods. International transport costs have been constrained, but there is still considerable scope in many countries to bring down the internal costs involved in the transport of goods from the factory gate to ports

and of integrating firms that are not located in designated export processing zones. Logistics must therefore be a priority.

The region has also benefited from steps to liberalize trade tariffs. It is not surprising that the most dynamic production networks are found in sectors in which the tariffs are lowest. Because regional trade agreements have focused on manufacturing, one may only expect that tariffs will continue to fall.

The region has performed less well in the trade in services, and, as services become more important in stitching together production networks, there will be pressures on this front. Countries that move quickly to liberalize services stand to gain more because they will be able to attract additional component manufacturing. Because component manufacturers tend to become concentrated in single locations, there are important advantages for the first movers.

This is perhaps one reason why so many countries are now entering into bilateral trade agreements. Such agreements ensure market access. Moreover, a country that has entered into a large number of agreements and that has thus acquired maximum market access is also able to entice more manufacturers and obtain ever larger gains from economies of scale.

But just as the rewards may be enhanced by attracting more investment, so may the tensions between countries increase. Unlike conventional interindustry trade, vertical intraindustry trade generates winners and losers. Trade tensions may flare if the rules of the game are not clearly established and followed. In other regions, such rules have evolved through the deliberations of formal institutional bodies. In East Asia, no such umbrella body yet exists. This institutional vacuum is a source of uncertainty that might retard the speed of development of production networks and, hence, overall growth in the region.

Notes

1. East Asia refers to the member countries of the Association of Southeast Asian Nations (Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam), plus China, Hong Kong (China), Japan, the Republic of Korea, Mongolia, and Taiwan (China). Emerging East Asia refers to East Asia, minus Japan. Developing East Asia refers to emerging East Asia, minus Hong Kong (China), Korea, and Singapore.

2. Processing exports are goods for export that are produced using imported intermediate inputs and for which production takes the form of processing or assembly.

3. On the impacts of FDI on trade, see, for example, Urata (2001) and Kawai and Urata (1998, 2004).

4. See Kharas, Aldaz-Carroll, and Rahardja (2007).

5. The triangular trade index is defined as: [(exports of intermediate goods from Japan and the NIEs to China and ASEAN) ÷ (exports of intermediate goods from Japan and the NIEs to the world)] × [(exports of finished goods from ASEAN and China to Canada, the European Union, and the United States) ÷ (exports of finished goods from emerging East Asia to the world)].

6. Machinery comprises all commodities classified under code 7 in the standard international trade classification (SITC); see http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=14.

7. Various terms have been used to describe production networks, including slicing up the value chain (Krugman 1995), outsourcing (Feenstra and Hanson 1996, 1997), the disintegration of production (Feenstra 1998), the fragmentation of production (Deardorff 1998; Jones and Kierzkowski 2001), and intraproduct specialization (Arndt 1997).

8. See, for example, Ando and Kimura (2003) and Athukorala and Yamashita (2005).

9. The intraindustry trade index (IIT) is computed as:

$$\text{IIT} = 1 - \left[\Sigma\Sigma\Sigma \left| X_{ijk} - M_{ijk} \right| \div \left(X_{ijk} + M_{ijk} \right) \right], \tag{2.1}$$

where X_{ijk} represents exports from industry i by country j to country k, and M_{ijk} represents the corresponding import values. The greater the degree of intraindustry trade, the greater the value of IIT. IIT tends to increase with the level of aggregation in terms of the number of countries under one group, such as East Asia, rather than individual countries. It also tends to increase with the level of product aggregation, say, from SITC 3-digit to SITC 2-digit. See Fukao, Ishido, and Ito (2003) for the classification of three types of trade; the 6-digit Harmonized Commodity Description and Coding System classification is used.

10. See Eichengreen, Rhee, and Tong (2004).

11. We follow Hausmann, Hwang, and Rodrik (2005) and create an index of the average real wage (as measured by per capita GDP at purchasing power parity) associated with exporters in a given industry. The index is created at the world level and is defined as follows:

$$PRODY_k = \sum_j \frac{\left(exports_{jk} / EXPORTS_j \right)}{\sum_j \left(exports_{jk} / EXPORTS_j \right)} GDPPC_j, \tag{2.2}$$

where k denotes the industry, j denotes the country, and $GDPPC$ is per capita GDP at purchasing power parity. $Exports_{jk}$ is exports of country j in industry k, and $EXPORTS_j$ is total exports of country j. Thus, the weight on GDPPC is a country's revealed comparative advantage or RCA (that is, the share of its export basket in a product over the sum of the export shares of all countries; see also endnote 14). Export weights alone would place too much weight on large exporters of k for whom k might still be a small portion of overall exports. We calculate $PRODY$ for each 4-digit SITC industry using average bilateral trade and average GDPPC using purchasing power parity data from 2000–04.

12. In our empirical analysis, we use bilateral trade data at the 4-digit SITC level from 1985 to 2004. We test whether Chinese exports to a particular country in a given category are affecting exports from East Asia and the Pacific to a greater extent than exports from other countries and areas. We also control for overall exporter supply growth. The advantage of this specification is that we are exploiting both cross-sectional and time series variation to estimate how the exports of East Asia and the Pacific are affected by China. If Chinese export growth is primarily displacing domestic producers or is not competing with East Asia and the Pacific for some other reason, we will not pick it up. While Chinese exports might not be pushing out the exports of East Asia and the Pacific (it may be that China is entering because East Asia and the Pacific are exiting), this is less likely since we are controlling for export supply growth.

We estimate the following equation:

$$dif \ \ln exp_{ijt}^k = \alpha_{it} + \beta_0 dif \ \ln impnonCHN_{jt}^k + \beta_1 dif \ \ln impCHN_{jt}^k + \varepsilon_{ijt}^k, \tag{2.3}$$

where i is the exporter, j is the importer, k is the industry, t is the time, *dif lnexp* is export growth, *dif lnimpnonch* is the growth in non-China exports to j in product k at time t, and *diflnimpCHN* is the growth in China's exports, multiplied by China's lagged market share in the specific sector and market. Weighting China's export growth by the lagged market share ensures that only sectors are picked in which China is a significant supplier. A negative coefficient on China (β_1) indicates that Chinese export growth is correlated with a decline in East Asian export growth in a given industry.

13. To what extent is the emergence of China as an important player in the global trade in machinery putting competitive pressures on prices? We estimate a linear regression model where we test whether the unit value of exports in machinery from Southeast Asian countries is affected by the quantity of China's exports. The model is given as:

$$\ln V_{ijkt} = \alpha_0 + \alpha_1 * F_{jk} + \alpha_2 \ln Q_{jkt-1} + \alpha_3 \left(F_{jk} * Q_{jkt-1} \right) + \alpha_4 \ln V_{ijt-1} + Z_{ijt}\beta + \varepsilon_{ijt}, \qquad 2.4$$

where V is the unit value of the exports, F is a dummy variable for the finished good, Q is the volume of exports from China, Z is a matrix of covariates, and ε is the error term. The subscripts i, j, k, and t represent the country (Indonesia, Malaysia, the Philippines, and Thailand), the product classification at the 6-digit level of the Harmonized Commodity Description and Coding System, the category (components or finished products), and the time (spanning from 1992 to 2004).

To control for observable characteristics, we include a set of covariates Z such as time, product, country dummies and their interactions, the importation of capital goods, world GDP per capita (excluding the reporter country i), the difference between country i GDP per capita and world GDP per capita, and world tariff rates. Note that we also include a lagged dependent variable on the right-hand side of equation (2.4) to allow for the possibility that a previous period has determined the current period of the unit value (a control for possible rigidity). Had we not included this variable as a regressor, the lagged volume of Chinese exports, Q, might have correlated with the error term. This problem arises because China's export volume at time $t − 1$ might correlate with the world import price at $t − 1$. We also include the share of imports of capital goods from China as a control for the possible existence of cheaper imports of capital goods from China. Assuming that the lagged volume of exports from China and the unit value, Q_{jt-1} and V_{ijt-1}, are predetermined, we estimate equation (2.4) using ordinary least squares.

Whether or not the increase in China's presence in the global trade in machinery has caused changes in the market share of exports in machinery from Southeast Asian countries, the exportation of machinery from China is rapidly gaining market share. However, the exports of machinery from countries in Southeast Asia are also increasing the presence of these countries in the global market. The empirical model for our analysis on this question is given as:

$$\Delta MS_{ijkt} = \delta_0 + \delta_1 * F_{jk} + \delta_2 \, \Delta CMS_{jt-1} + \delta_3 \left(F_{jk} * \Delta CMS_{jt-1} \right) + \delta_4 \Delta RCA_{ijkt-1} + W_{ijt}\Gamma + \xi_{ijkt} \qquad 2.5$$

On the left-hand side of equation (2.5), ΔMS is the change in the global market share of product category k at the 4-digit SITC, component, finished, in the exportation of commodity j from country i at time t. On the right-hand side, F is a dummy variable for finished goods, ΔCMS is China's change in global market share for product j at time t, ΔRCA is the change in the revealed comparative advantage (RCA) index (scale from 0 to 100), product j, category k, and Γ contains other covariates similar to Z in equation (2.4). To control for the degree of competitiveness of a particular product produced by a particular country, we include a lagged change in the RCA index in the right-hand side variable of equation (2.5).

The third objective is to examine the direction of specialization in the context of product fragmentation. The data suggest that several countries are becoming more competitive in producing components. Apart from the situation as regards China, the performance of the countries in Southeast Asia in the exportation of components compares more favorably with that in finished machinery. Therefore, we examine the extent to which China's shift in specialization in finished machinery is causing Southeast Asia to shift its exportation of components to China. The empirical model for this objective is given as:

$$SCC_{ijt} = \gamma_0 + \gamma_1 CMF_{jt-1} + \gamma_3 RCAC_{ijt-1} + W_{ijt}\Pi + \eta_{ijt} \qquad 2.6$$

On the left-hand side of equation (2.6), SCC is the share of exports in the components of product j from country i to China at time t (the share of the exports going to the world is 100 percent). On the right-hand side, CMF is China's global market share for finished machinery of product j at time $t − 1$, $RCAC$ is the RCA index in components for country j (scale 0 to 100) at time $t − 1$. Finally, matrix W contains covariates such as dummy variables for industry, location, time, and China's import tariffs.

For equation (2.6), we reclassify our product into a 3-digit SITC more broadly than we do in equation (2.5). This relatively more aggregate category reduces the extreme variation in market share relative to a

more detailed product category, thereby allowing us to examine the effect of spillover more accurately. In our sample, we also retain products that have components in their classification. Finally, because some countries do not engage in the exportation of particular products, *SCC* is censored from below. Thus, we estimate equation (2.6) using Tobit, using zero as the lower censoring point.

We estimate equations (2.4) to (2.6) using pooled time series and cross-product data. The time series spans from 1992 to 2004, while the cross product varies depending on the estimated equation. Most of our trade data come from the United Nations Commodity Trade Statistics Database (http://unstats.un.org/unsd/comtrade/), and the rest have been obtained from the World Development Indicators Database (http://www.worldbank.org/data/datapubs/datapubs.html). Rahardja (2006) provides details on the estimation results.

14. RCA is a measure of a country's specialization in the exportation of a product relative to the rest of the world. The RCA of a good, *k,* is given as the ratio of the share of exports of good *k* in the total exports of country *i,* divided by the share of exports of good *k* in global exports. See also endnote 11.

15. See Feenstra et al. (1999).

16. See Lederman and Maloney (2006).

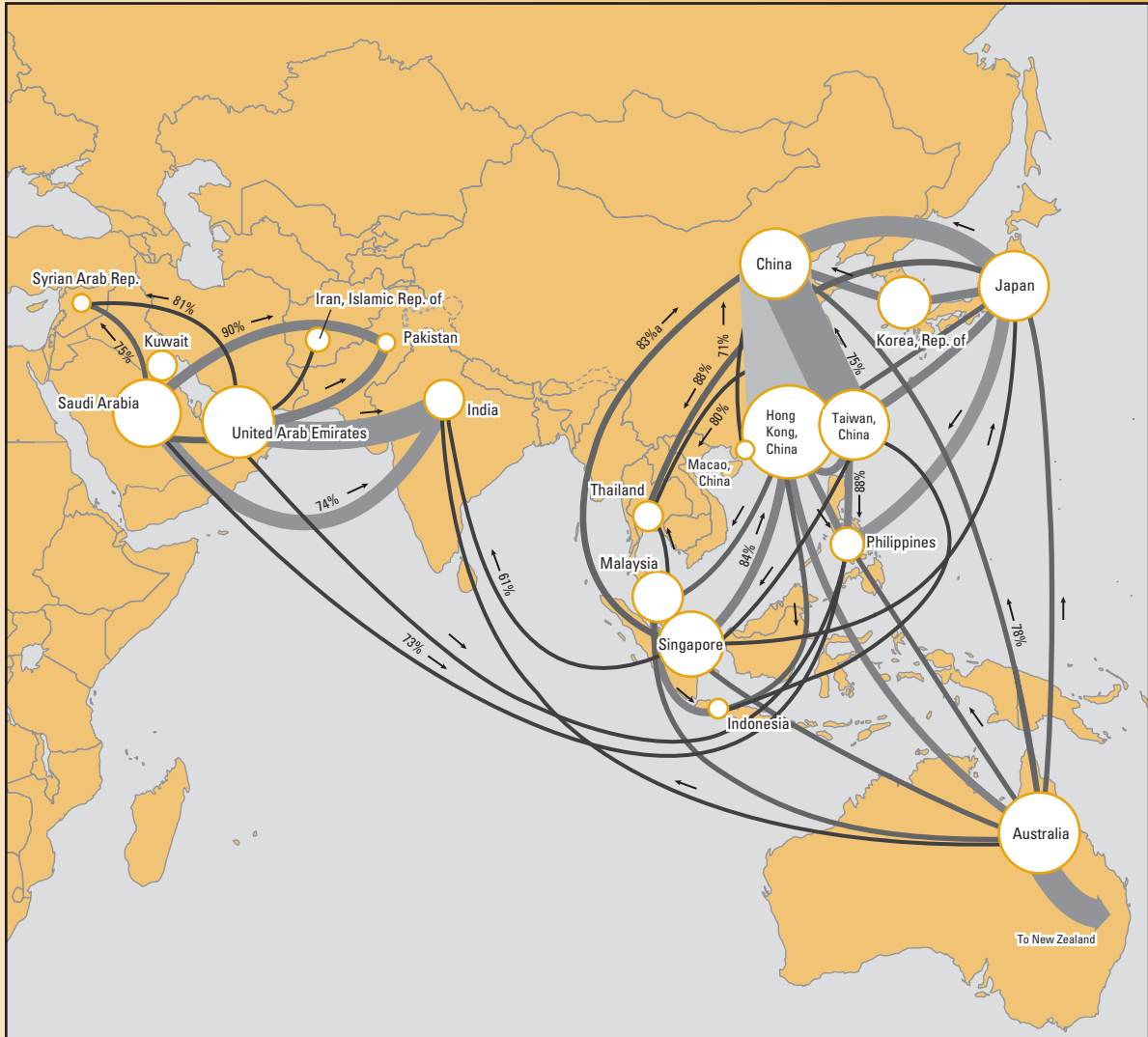17. See Jefferson et al. (2003).

18. See Baldwin (2006a).

References

ADB (Asian Development Bank). 2006. *Asian Development Outlook 2006.* Manila: Asian Development Bank.

Akamatsu, Kaname. 1961. "A Theory of Unbalanced Growth in the World Economy." *Weltwirtschaftliches Archiv* 86 (2): 196–217.

Ando, Mitsuyo, and Fukunari Kimura. 2003. "The Formation of International Production and Distribution Networks in East Asia." NBER Working Paper 10167, National Bureau of Economic Research, Cambridge, MA.

Antweiler, Werner, and Daniel Trefler. 2002. "Increasing Returns and All That: A View from Trade." *American Economic Review* 92 (1): 93–119.

Arndt, Sven W. 1997. "Globalization and the Open Economy." *North American Journal of Economics and Finance* 8 (1): 71–79.

Athukorala, Prema-chandra, and Nobuaki Yamashita. 2005. "Production Fragmentation and Trade Integration: East Asia in a Global Context." Working Papers in Trade and Development 2005–07, Research School of Pacific and Asian Studies, Australian National University, Canberra.

Baldwin, Richard E. 2006a. "Managing the Noodle Bowl: The Fragility of East Asian Regionalism." CEPR Discussion Paper 5561, Center for Economic Policy Research, London.

_____. 2006b. "Implications of European Experiences with Regionalism for Future Economic Integration in Asia." Unpublished paper, Graduate Institute of International Studies, Geneva.

China, General Administration of Customs. Various issues. *China's Customs Statistics.* Hong Kong, China: Economic Information and Agency.

China, National Bureau of Statistics. Various years. *State Statistical Yearbook.* Beijing: China Statistics Publishing House.

Chodos, Daniel, Bailey Klinger, and Daniel Lederman. 2006. "International Trade and Innovation: A Review of Policy Issues, Empirical Evidence, and East Asia's Performance." Unpublished working paper, World Bank, Washington, DC.

Deardorff, Alan. 1998. "Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World?" In *The Regionalization of the World Economy*, ed. J. A. Frankel, Chapter 1. Chicago: University of Chicago Press.

Eaton, Jonathan, and Samuel Kortum. 2002. "Technology, Geography, and Trade." *Econometrica* 70 (5): 1741–80.

Eichengreen, Barry, Yeongseop Rhee, and Hui Tong. 2004. "The Impact of China on the Exports of Other Asian Countries." NBER Working Paper 10768, National Bureau of Economic Research, Cambridge, MA.

Feenstra, Robert C. 1998. "Integration of Trade and Disintegration of Production in the Global Economy." *Journal of Economic Perspectives* 12 (4): 31–50.

Feenstra, Robert C., and Gordon H. Hanson. 1996. "Foreign Investment, Outsourcing, and Relative Wages." In *The Political Economy of Trade Policy: Papers in Honor of Jagdish Bhagwati,* ed. Robert C. Feenstra, Gene M. Grossman, and Douglas A. Irwin, 89–127. Cambridge, MA: MIT Press.

———. 1997. "Foreign Direct Investment and Relative Wages: Evidence from Mexico's Maquiladoras." *Journal of International Economics* 42 (3–4): 371–93.

———. 2004. "Intermediaries in Entrepôt Trade: Hong-Kong Re-Exports of Chinese Goods." *Journal of Economics and Management Strategy* 13 (1): 3–35.

Feenstra, Robert C., and Hiau Looi Kee. 2006. "Export Variety and Country Productivity: Estimating the Monopolistic Competition Model with Endogenous Productivity." Unpublished paper, University of California–Davis, Davis, CA.

Feenstra, Robert C., Dorsati Madani, Tzu-Han Yang, and Chi-Yuan Liang. 1999. "Testing Endogenous Growth in South Korea and Taiwan." *Journal of Development Economics* 60 (2): 317–41.

Freund, Caroline. 2006. "The Effect of China's Exports on East Asian Trade with the World." Unpublished paper, World Bank, Washington, DC.

Fujita, Masahisa, Paul R. Krugman, and Anthony J. Venables. 1999. *The Spatial Economy: Cities, Regions and International Trade.* Cambridge, MA: MIT Press.

Fukao, Kyoji, Hikaru Ishido, and Keiko Ito. 2003. "Vertical Intra-Industry Trade and Foreign Direct Investment in East Asia." RIETI Discussion Paper 03-E-001, Research Institute of Economy, Trade, and Industry, Tokyo.

Gaulier, Guillaume, Françoise Lemoine, and Deniz Ünal-Kesenci. 2005. "China's Integration in East Asia: Production Sharing, FDI and High-Tech Trade." CEPII Working Paper 2005–09, Centre d'Etudes Prospectives et d'Informations Internationales, Paris.

———. 2006a. "The Emergence of China and Its Impact on Asian Trade." Background paper (June), World Bank, Washington, DC.

———. 2006b. "China's Emergence and the Reorganization of Trade Flows in Asia." CEPII Working Paper 2006–05, Centre d'Etudes Prospectives et d'Informations Internationales, Paris.

Grossman, Gene M., and Elhanan Helpman. 1991. *Innovation and Growth in the Global Economy.* Cambridge, MA: MIT Press.

Haddad, Mona. 2006. "Trade Integration in East Asia: The Role of China and Production Networks." Draft working paper, World Bank, Washington, DC.

Hanson, Gordon H. 2006. "Trade in the East Asia and Pacific Region." Unpublished paper, World Bank, Washington, DC.

Hanson, Gordon H., Raymond J. Mataloni, and Matthew J. Slaughter. 2005. "Vertical Production Networks in Multinational Firms." *Review of Economics and Statistics* 87 (4): 664–78.

Hausmann, Ricardo, J. Hwang, and Dani Rodrik. 2005. "What You Export Matters." NBER Working Paper 11905, National Bureau of Economic Research, Cambridge, MA.

Hiratsuka, Daisuke. 2005. "Vertical Intra-Regional Production Networks in East Asia: A Case Study of the Hard Disc Drive Industry." Working paper, Institute of Developing Economies, Japan External Trade Organization, Chiba City, Japan.

Hu, Albert Guangzhou, and Gary H. Jefferson. 2002. "FDI Impact and Spillover: Evidence from China's Electronic and Textiles Industries." *World Economy* 25 (8): 1063–76.

Hummels, David, Jun Ishii, and Kei-Mu Yi. 2001. "The Nature and Growth of Vertical Specialization in World Trade." *Journal of International Economics* 54 (1): 75–96.

Imbs, Jean, and Romain Wacziarg. 2003. "Stages of Diversification." *American Economic Review* 93 (1): 63–86.

Jefferson, Gary H., Albert Guangzhou Hu, Xiaojing Guan, and Xiaoyun Yu. 2003. "Ownership, Performance, and Innovation in China's Large and Medium-Size Industrial Enterprise Sector." *China Economic Review* 14 (1): 89–113.

Jones, Charles. 1995a. "Time Series Tests of Endogenous Growth Models." *Quarterly Journal of Economics* 110 (2): 495–526.

———. 1995b. "R&D Based Models of Economic Growth." *Journal of Political Economy* 103 (4): 759–84.

Jones, Ronald W., and Henryk Kierzkowski. 2001. "Globalization and the Consequences of International Fragmentation." In *Money, Capital Mobility, and Trade: Essays in Honor of Robert A. Mundell*, ed. Guillermo A. Calvo, Rudiger Dornbusch, and Maurice Obstfeld, 365–84. Cambridge, MA: MIT Press.

_____. 2003. "International Fragmentation and the New Economic Geography." Unpublished paper, University of Rochester, Rochester, NY.

Kawai, M., and Shujiro Urata. 1998. "Are Trade and Direct Investment Substitutes or Complements?: An Empirical Analysis of Japanese Manufacturing Industries." In *Economic Development and Cooperation in the Pacific Basin: Trade, Investment and Environmental Issues*, ed. H. Lee and D. Roland-Holst, 251–93. Cambridge: Cambridge University Press.

_____. 2004. "Trade and Foreign Direct Investment in East Asia." In *Exchange Rate Regimes and East Asia*, ed. G. de Brouwer and M. Kawai, 15–102. London: Routledge Curzon.

Kharas, Homi, Enrique Aldaz-Carroll, and Sjamsu Rahardja. 2007. "East Asia: Regional Integration among Open Economies." In *Economic Integration in Asia and India*, ed. Masahisa Fujita. Basingstoke, United Kingdom: Palgrave Macmillan.

Klinger, Bailey, and Daniel Lederman. 2006. "Diversification, Innovation, and Imitation Inside the Global Technological Frontier." Policy Research Working Paper 3872, World Bank, Washington, DC.

Krugman, Paul R. 1995. "Growing World Trade: Causes and Consequences." Brookings Papers on Economic Activity 1: 327–77.

Leamer, E. 1984. *Sources of Comparative Advantage.* Cambridge, MA: MIT Press.

Lederman, Daniel, and William F. Maloney. 2006. "Trade Structure and Growth." In *Natural Resources, Neither Curse Nor Destiny*, ed. Daniel Lederman and William F. Maloney, Chapter 2. Palo Alto, CA: Stanford University Press.

Melitz, Marc. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71 (6): 1695–1725.

Pitigala, Nihal. 2006. "Opportunities in Production Sharing in Kenya." Unpublished paper, World Bank, Washington, DC.

Rahardja, Sjamsu. 2006. "Big Dragon, Little Dragons: The Role of China in Exporting Machinery to Developing Southeast Asia." Unpublished paper, World Bank, Washington, DC.

Redding, Stephen, and Anthony J. Venables. 2004. "Economic Geography and International Inequality." *Journal of International Economics* 62 (1): 53–82.

Rodrik, Dani. 2006. "What's So Special about China's Exports?" NBER Working Paper 11947, National Bureau of Economic Research, Cambridge, MA.

Romer, Paul M. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98 (5): 71–102.

UNCTAD (United Nations Conference on Trade and Development). Various years. *Review of Maritime Transport.* Geneva: United Nations.

Urata, Shujiro. 2001. "Emergence of an FDI-Trade Nexus and Economic Growth in East Asia." In *Rethinking the East Asian Miracle*, ed. Joseph E. Stiglitz and Shahid Yusuf, 409–59. Washington, DC: World Bank; New York: Oxford University Press.

_____. 2006. "The Changing Patterns of International Trade in East Asia." Background paper, World Bank, Washington, DC.

Venables, Anthony J. 1996. "Equilibrium Locations of Vertically Linked Industries." *International Economic Review* 37 (2): 341–60.

World Bank. 2005. *World Development Indicators 2005.* Washington, DC: World Bank. http://devdata.worldbank.org/wdi2005/Cover.htm.

Yeats, Alexander J. 2001. "Just How Big Is Global Production Sharing?" In *Fragmentation: New Production Patterns in the World Economy*, ed. Sven W. Arndt and Henryk Kierzkowski, 108–43. New York: Oxford University Press.

Yi, Kei-Mu. 2003. "Can Vertical Specialization Explain the Growth of World Trade?" *Journal of Political Economy* 111 (1): 52–102.

MAP 3.1 **Telecommunications Flows in East Asia Suggest a Vigorous Exchange of Ideas**
intra-Asian telecommunication traffic flows, 2004

Syrian Arab Rep.
81%
Iran, Islamic Rep. of
Kuwait
90%
Pakistan
75%
Saudi Arabia
United Arab Emirates
India
China
Japan
Korea, Rep. of
83%·a
71%
88%
75%
80%
Hong Kong, China
Taiwan, China
Macao, China
74%
Thailand
Philippines
88%
Malaysia
84%
61%
Singapore
73%
Indonesia
78%
Australia
To New Zealand

Key

All figures are given in millions of minutes of telecommunications traffic for the public telephone network.

The map shows all intra-Asian routes with a combined 2004 volume of more than 100 million minutes.

Traffic flows (minutes, millions)

800
500
100

Each band is proportional to the total annual traffic on the public telephone network in both directions for each pair of countries.

○ total outgoing traffic (minutes, millions)

100
500
1,500

The area of each circle is proportional to the volume of the total annual outgoing traffic from each country.

⟵ % of traffic

On routes where traffic in one direction accounts for more than 60 percent of the total, an arrow shows the direction of most of the traffic flows.

Not all thicknesses of lines represented; not all circle sizes represented.

Source: TeleGeography Research 2006.