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TRADE INTEGRATION IN EAST ASIA: THE ROLE OF CHINA AND PRODUCTION NETWORKS

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Abstract:
Production networks have been at the heart of the recent growth in trade among East Asian countries. Fragmentation trade, reflected mainly in the trade in parts and components, is expanding more rapidly than the conventional trade in final goods. This is mainly due to the relatively more favorable policy setting for international production, agglomeration benefits arising from the early entry into this new form of specialization, considerable intercountry wage differentials in the region, lower trade and transport costs, and specialization in products exhibiting increasing returns to scale. The economic integration of China has deepened production fragmentation in East Asia, countering fears of crowding out other countries for international specialization. International production fragmentation in East Asia has intensified intraregional trade but has depended heavily on extraregional trade in final goods. While production networks centered on China have contributed significantly to growth in East Asia, they also breed vulnerabilities. They have not automatically led to technology spillovers and have led to an extreme interdependence across East Asian countries.

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TRADE INTEGRATION IN EAST ASIA: THE ROLE OF CHINA AND PRODUCTION NETWORKS

MONA HADDAD

For the last four decades, trade has been the engine of economic growth for most of East Asia.[1] In the 1960s, Japan emerged as the region's first major exporter, and it was followed in the 1970s by a second generation of economies (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, they 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 economies (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. Trade between East Asia and industrialized countries has its roots in the fact that firms from high-wage countries *fragmented* their production processes by moving labor-intensive manufacturing stages to East Asia. As second-generation economies have increased the skill and capital intensity of the goods and services they produce, they have become sources of innovation in their own right. In East Asia, industrialization tends to go hand in hand with an expansion in the *varieties of goods* industries produce by moving up a *quality ladder* of production.

Third- and fourth-generation exporters also entered global trade by providing subcontracting services to European and U.S. firms. However, over time, they have become more specialized in producing components and other intermediate inputs for firms in first- and second-generation economies in East Asia, suggesting that *economic integration* is an important contributor to the region's development. As second-generation economies have moved out of the production of low-end consumer goods, they have created room for third- and fourth-generation economies to enter these product niches. At the same time, the emergence of a large fourth-generation economy, China, has created a supply of labor-intensive intermediate inputs sufficient to push second- and third-generation economies up-market in terms of the activities they perform. Trade has thus contributed to *complementarity* between the production structures and the development paths of countries in the region, even as it has fostered rivalries between countries for market share abroad. Income growth in one country increases the demand for intermediate inputs produced in nearby countries, which, by allowing input producers to enjoy *scale economies*, lowers input production costs and enhances regional 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 favor an expansion in trade with other East Asian economies rather than with, 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. Helping to lower trade costs further are the *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.

East Asia today. Production networks have been at the heart of the recent growth in trade among East Asian countries. Fragmentation trade, reflected mainly in the trade in parts and components, is expanding more rapidly than the conventional trade in final goods. The degree of dependence of this new form of international specialization is proportionately larger in East Asia than in other parts of the world. This is mainly due to the relatively more favorable policy setting for international production (unilateral trade liberalization, policies favorable to exports such as duty drawback, the opening up of foreign direct investment [FDI] for the purposes of exportation), the agglomeration benefits arising from the early entry into this new form of specialization, and the considerable intercountry wage differentials in the region, combined with the lower trade costs (tariffs and transportation). The fact that East Asia is at a level in the technology ladder where products exhibit increasing returns to scale (such as machinery, parts, and components) has exacerbated the degree of specialization within production networks.

The economic integration of China has deepened production fragmentation in East Asia to an unprecedented level. The rapid integration of China into regional production networks has countered fears that China's global integration would crowd out the opportunities of other countries for international specialization. International production fragmentation has intensified the dynamism of East Asian economies and increased economic interdependence within the region. This has not meant less dependence on the global economy. Indeed, this growth dynamism based on vertical specialization has depended heavily on extraregional trade in final goods, and this dependence has increased over the years.

Many questions arise within this East Asian model. Is China a substitute or a complement for other East Asian countries? Are production networks leading to technology spillovers? Is the dependence of lower-income countries, especially China, on foreign capital and technology long-lasting, or will China develop its own technological capabilities? In the latter case, will the production networks in the region collapse? Does the strong interdependence across countries because of these production networks make them vulnerable to shocks in the absence of regional agreements?

This paper will (1) outline a conceptual framework on trade in East Asia by drawing on insights from recent theoretical and empirical research on production sharing, economic geography, intermediation, and innovation and growth; (2) review changing trends and patterns in trade within East Asia; (3) assess the nature of production sharing networks within East Asia and their technology spillovers; (4) assess the impact of the rise of China on other East Asian countries; and (5) provide views on the risks and challenges of the East Asian model as we look ahead.

TRADE DYNAMICS IN EAST ASIA: A CONCEPTUAL FRAMEWORK

In the global economy, intermediate goods are playing an important role in trade. The growing trade in inputs has resulted from the global fragmentation of production, whereby multinational firms outsource production to suppliers in various countries. Economies in East Asia have been at the forefront of this development. Yeats (2001) finds that the trade in inputs has grown much more rapidly than the trade in final goods and estimates that intermediates now account for 30 percent of world trade in manufactures. One source of trade in inputs is processing exports, defined by customs officials as export goods that are produced through the processing or assembly of imported intermediate inputs. This activity has grown enormously in China, for which Hong Kong (China) often acts as the intermediary, as well as in other countries in East Asia. Between 1988 and 2002, processing exports grew from 32 to 55 percent of total Chinese exports, and multinational firms had a major part in this development. China's outward processing (which is one form of global outsourcing) serves the newly industrializing economies (NIEs) in Asia,[2] as well as developed countries and regions such as Europe, Japan, and the United States.

The fragmentation of production across borders and the integration of national economies have been coincident events in East Asia.[3] To explain this fragmentation of production, we need to go beyond

traditional trade theory models. A conceptual framework to account for trade among the East Asian economies and between East Asia and the rest of the world would entail several components (see box 1):

- The incentive to fragment production across borders that is created by the interaction between variations in factor intensities across stages of production and variations in factor prices across countries; this is still a Heckscher-Ohlin model, but at a more refined level of specialization
- The incentive to locate production near sources of consumer demand and input supply that is created by the interaction between scale economies in production and the transport costs in shipping goods; this is the Krugman model of increasing returns to scale
- The incentive to manage international production through networks that is created by informational barriers to trade and other sources of transaction costs
- The incentive to reallocate production across borders over time that is created by factor accumulation and falling trade costs

Production networks driven by wage differentials. Wage differences between countries are a driving force behind production sharing in East Asia. Flows of capital and technology between countries complement production sharing and allow firms to expand global outsourcing and extend regional production networks. Reductions in trade costs thus raise the incentive for increased flows of trade, capital, and ideas across borders. This is contrary to what the world witnessed in the 1960s, 1970s, and early 1980s, when trade and capital flows between the United States and Western Europe represented substitutes rather than complements. The consequences of increased outsourcing are gains in national income, but also an internal redistribution of income, with global outsourcing tending to raise wage inequality within countries. Much of East Asia has been able to avoid increases in wage inequality by matching growth in the relative demand for skilled labor due to globalization with growth in the relative supply of skilled labor through investments in education (by households and governments).

Production networks and trade costs. Because economic integration in East Asia involves extensive trade in intermediate inputs, trade flows tend to be responsive to changes in trade costs. Small reductions in trade costs may have large impacts on trade since these reductions tend to increase trade along supply chains that link multiple countries. The Hong Kong (China)–China example is a case of one economy outsourcing to another. However, actual production sharing arrangements may cover many countries. In the production of apparel, for instance, multinational firms may use zippers produced in one country, buttons produced in a second, cloth produced in a third, and assembly services in a fourth. Where production networks are dense, global outsourcing may be especially sensitive to border trade barriers, because, within a given supply chain, inputs may need to cross multiple borders. Building on this logic, Yi (2003) shows how, theoretically, the trade in inputs allows a decline in trade barriers to trigger magnified decreases in production costs and thus dramatic increases in total trade flows. His results stand in contrast to standard models of trade in final goods, which cannot account for how the modest observed declines in trade barriers might have produced the dramatic observed growth in world trade. In an analysis of 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 foreign affiliates import from their U.S. parent companies. (The affiliates then process the inputs into finished products or more-finished products.) The responsiveness of vertical production networks to trade costs is consistent with Yi (2003).

Box 1 Why Do Production Sharing Networks Arise?

A simple model of production sharing

To understand why outsourcing occurs and what impact it has on national economies, consider a model of trade between a high-wage home country (for example, Hong Kong [China], Japan, Korea, or Taiwan [China]) and a low-wage foreign country (for example, China, Indonesia, the Philippines, or Vietnam). Suppose there are many intermediate inputs produced within each industry, which may be goods or services, but which are bundled together to produce a final output. Some inputs are more intensive in the use of unskilled labor (parts and components, assembly services, packaging); others are more intensive in the use of skilled labor (research and development [R&D], marketing, after-sales services). Intermediate inputs may be produced in either country and also traded internationally. By allowing trade in intermediate inputs, firms in the home country are able to outsource the production of intermediate inputs to the foreign country. To simplify the analysis, we focus on production and trade in a single industry, though the extension to the case of many industries is straightforward. (Capital is also an input in production, but, for the time being, we leave this in the background.)

In this setup, the international location of production is determined by factor-price differences among countries, as well as by trade costs. Consider first the case of zero trade costs. Suppose that the home country has a relatively abundant supply of skilled labor, while the foreign country has a relatively abundant supply of unskilled labor, such that the relative wage for unskilled labor is higher in the home country than in the foreign country. Given international wage differences, the cost-minimizing location of production will mean that the home country will produce more skilled-labor-intensive inputs, while the foreign country will produce more unskilled-labor-intensive inputs. In equilibrium, there will be a cutoff input of intermediate skill intensity that will determine when firms are indifferent between producing in the home country or a foreign country. Home firms, in effect, outsource the production of unskilled-labor-intensive inputs to the foreign country.

Production sharing and labor markets

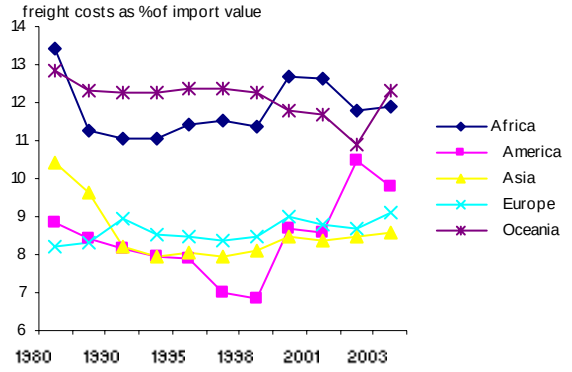
How do changes in the extent of global outsourcing affect national economies? If the foreign country lifts barriers to FDI (as did China and other developing East Asian countries), capital is allowed to flow from the home country to the foreign country. This would have the effect of lowering production costs in the foreign country (since an inflow of capital lowers the rental price) and raising production costs in the home country (since an outflow of capital raises the rental price). The range of intermediate inputs would expand in the foreign country and contract in the home country, rendering the cutoff intermediate input more skill intensive. The change in the cutoff input would increase the average skill intensity of production in the home country, since the inputs the country stops producing would be less intensive in skilled labor than the inputs the country continues to produce. By raising the average skill intensity in production in the home country, home-to-foreign-country FDI would increase the relative demand for skilled labor in the home country, causing the home country skilled-unskilled wage ratio to rise. A similar outcome occurs in the foreign country. The new inputs the foreign country begins to produce (and the home country ceases to produce) are more skill intensive than the inputs the foreign country produced before the capital inflow. Thus, the average skill intensity of production also rises in the foreign country, causing the relative demand for and the relative wages of skilled labor to rise there as well. An expansion of outsourcing, driven by international capital flows, raises the relative demand for and the relative wages of skilled labor in *both* countries. (A similar outcome occurs if the foreign country experiences growth in total factor productivity [TFP] or a proportional increase in supplies of labor relative to the home country.)

Production sharing and trade costs

What happens if we introduce trade costs into the simple model of outsourcing? The outsourcing equilibrium becomes a bit more complicated, but the qualitative results still hold. With positive trade costs, there is no longer a cutoff intermediate input, but, instead, a range of inputs of intermediate skill intensity that are not traded internationally. Inputs at higher skill intensity are produced in the home country (the skill-abundant country); inputs at lower skill intensity are produced in the foreign country (the labor-abundant country). For the intermediate range of nontraded inputs, the factor-cost differences between the two countries are too small to justify the trade costs incurred in outsourcing production from the home country to the foreign country. Thus, countries with lower trade costs will exhibit denser production networks.

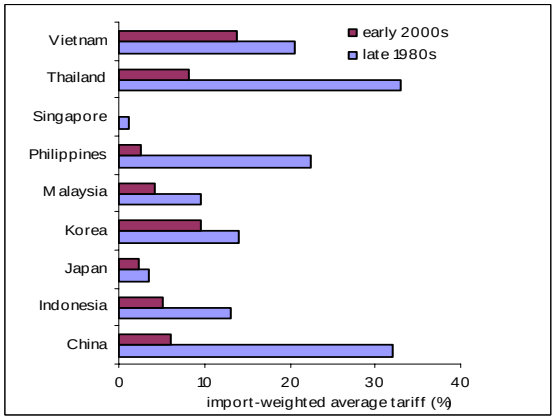
Reductions in tariffs (and extensive use of duty drawbacks) and improvements in transportation infrastructure in East Asia have certainly played a key role in the expansion of production networks in the region (see figures 1 and 2). Yet, import taxes and transport costs are by no means the only barriers to trade. High information and search costs also impede trade. Some firms attempt to reduce these costs by using middlemen located in the region's entrepôts. These middlemen act as intermediaries for transactions between buyers and sellers. Where production involves multiple stages and where exchanges between suppliers and buyers are subject to informational problems at each stage, there are gains in allowing traders to manage entire supply chains. Feenstra and Hanson (2004) find that the markups Hong Kong (China) traders charge on Chinese reexports are higher in industries in which processing trade accounts for a higher share of China's exports. Another reason firms may ship exports from China through Hong Kong (China) is to take advantage of shipping hubs. The distribution networks of traders in Hong Kong (China) and Singapore (and, increasingly, other major cities in the region, such as Shanghai) are an important factor in promoting the economic integration of East Asia and give the region an advantage over other developing regions, such as Africa and Latin America, which lack major entrepôts.

Figure 1 Freight Costs among Developing Countries: Asia Is Doing Well



Source: UNCTAD, various.
Note: Freight costs are typically around 4 percent of import value in developing countries.

Figure 2 Low Protection



Source: World Bank 2005.

Increasing returns to scale and firm location. In the model presented so far, factor prices and trade costs drive the decisions of firms about their own locations. If increasing returns to scale are important, access to markets may influence these decisions in a manner not captured by standard models of comparative advantage (in which technology exhibits constant returns to scale). Scale economies create an incentive for firms to cluster spatially. If average production costs decline as the scale of production rises at the firm, industry, or regional level, then there are advantages to concentrating production in a particular location. The link between scale economies and agglomeration has long been recognized by urban and regional economists. In the last decade, trade economists have begun to apply the insights to the global economy. Scale economies represent an incentive for the formation of regional production networks.

Consider the model in Venables (1996) in which the agglomeration of economic activity results from input-output linkages between firms.[4] Suppose there are fixed costs in production. Suppose also that production requires intermediate inputs that are also subject to fixed costs, as well as raw factor inputs, whereby the shipment of inputs or outputs is subject to transport costs and other trade barriers. All else being equal, to minimize the transport costs and the fixed production costs, input suppliers and output producers have an incentive to serve the global market by choosing to produce in a single, common location. The agglomeration of economic activity drives up wages in the emerging industry cluster,

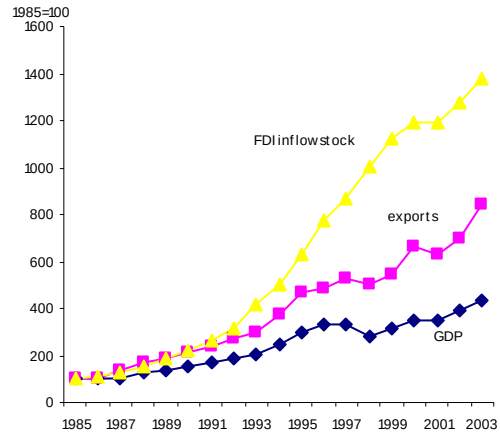
however, which will induce some firms to locate in less agglomerated regions where the wages are lower. The result is a core-periphery structure of production.[5]

TRENDS AND EVOLUTION OF TRADE PATTERNS IN EAST ASIA

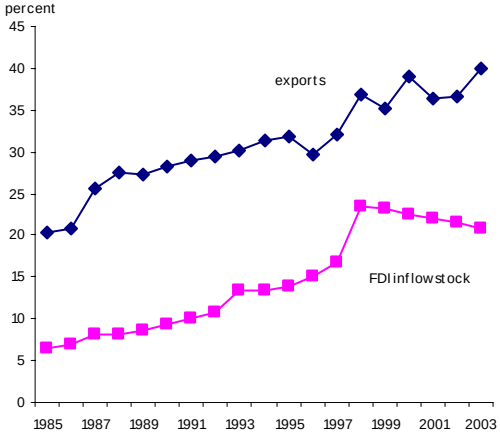
The rapid expansion of foreign trade and FDI has had a major part in successful economic development in East Asia (see figure 3). Through foreign trade and FDI, East Asian economies have obtained technology and management know-how from foreign countries, and this has contributed to economic growth by improving production and technological capability. There have been dramatic changes in trade patterns over the years. Intraregional trade has expanded more rapidly than extraregional trade and now accounts for over half of East Asia's trade, resulting in an increase in intraregional dependency. The composition of trade is shifting from low-skill products, such as textiles and garments, to higher-skill, higher-technology products, especially machinery, which now accounts for over 40 percent of East Asia's exports and over 50 percent of intraregional exports. Among machinery exports, electronics (office and telecommunications equipment) and electrical products are the most substantial. Within East Asia, intraindustry trade has expanded more rapidly than interindustry trade; a dominant portion of the intraindustry trade takes the form of vertical intraindustry trade or production sharing networks. Indeed, the trade in parts within East Asia accounts for a large share of the total trade (that is, the trade in parts and finished products), and the share is increasing: over 50 percent of textiles and garments and over 80 percent of electrical machinery. This pattern reflects the expanding division of labor inside East Asia as it has become a factory of the world. These changes in trade patterns have occurred with the active involvement of multinational corporations in FDI and foreign trade; the corporations have taken advantage of the business opportunities arising from the freer trade and FDI environment in the region.

Figure 3 FDI Has Played a Key Role in East Asia

a. Exports, FDI inflows, and gross domestic product



b. Exports and FDI as a share of gross domestic product



Source: World Bank 2005.

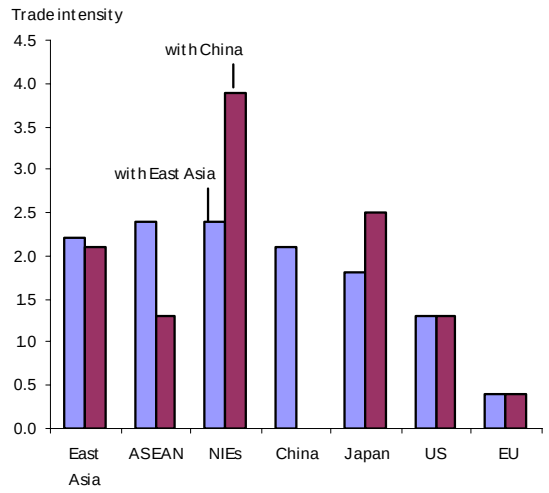
The expansion in intraregional trade did not come at the expense of extraregional trade. The dynamics of intraregional trade reveals the new role of East Asia as a factory for the world market. Half of East Asia's trade is now conducted inside the region (49 percent of exports and 55 percent of imports). The importance of intraregional trade has grown for most East Asian economies (see table 1). China has become an important trading partner for other East Asian countries; all have increased their share of exports to China. At the same time, the share of China's exports to East Asia has dropped, while the share of China's exports has increased to the European Union and the United States. The trade intensity of Japan and the NIEs with China is high, reflecting the strength of their production sharing networks (see figures 4 and 5).

Table 1 Changing Regional Patterns of Trade
percent of total exports going to East Asia, China, and Japan

	East Asia		*China*		*Japan*	
Exporter	*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

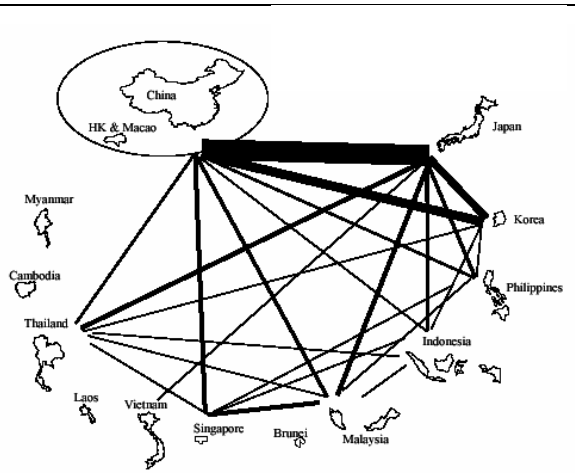
Source: Direction of Trade Statistics Database, International Monetary Fund and ESDS International, http://www.esds.ac.uk/international/access/access.asp.
Note: n.a. = not applicable. — = no data are available.

Figure 4 Trade Intensity with East Asia and China, 2000–04



Source: UNCOMTRADE
Note: The trade intensity index captures the "bias" in trade relationship by considering the trade volume of the trading partner. Trade relationship is more (less) intensive (or biased) than normal if the value of trade intensity is greater (less) than unity.

Figure 5 Intraregional Trade in East Asia, 2000–04



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

The commodity composition of exports is becoming similar across countries. The rapid expansion of foreign trade among East Asian economies has been accompanied by substantial changes in the commodity composition of trade. From 1990–94 to 2000–04, there was a clear shift from light manufacturing, such as textiles and garments, wood, paper, and furniture, to more sophisticated manufactures, such as machinery (see table 2). Thus, machinery now accounted for over 50 percent of East Asia's exports and 42 percent of its imports. Within machinery, the exports of office and telecommunications equipment and electrical machinery have grown particularly rapidly in the Association of Southeast Asian Nations (ASEAN), the NIEs, and China. For China, the share of office and telecommunications equipment in overall exports increased remarkably, from 6 to 22 percent, while

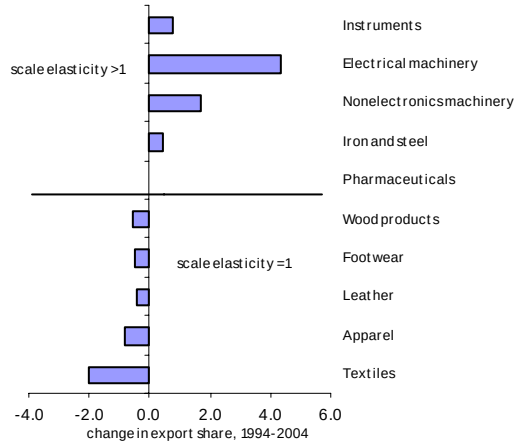
the share of electrical machinery increased from 4 to 10 percent. ASEAN countries, with the exception of Indonesia, saw exports of office and telecommunications equipment and electrical machinery rise significantly, and these now accounted for a combined share ranging from 30 to 60 percent of total country 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. The export commodities where East Asia is specializing are inherently products with increasing returns to scale and high skill intensity (see figure 6).

Table 2 The Commodity Composition of Foreign Trade in East Asia
percentage share of total trade

	East Asia		*China*		*Japan*	
Composition	*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: UNCOMTRADE

Figure 6 The Share of Exports Increased More in Sectors with Increasing Returns to Scale, 1994–2004

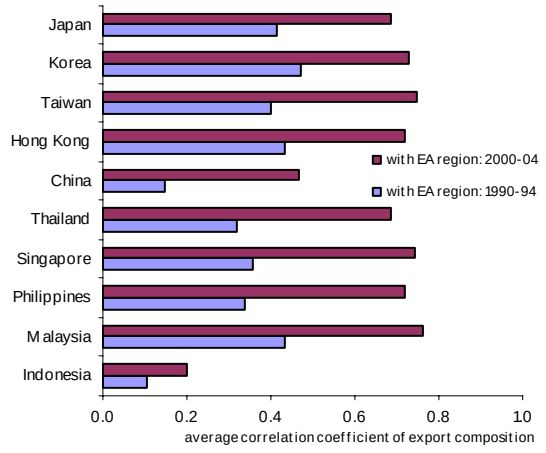


Sources: Antweiler and Trefler 2002 and World Bank.

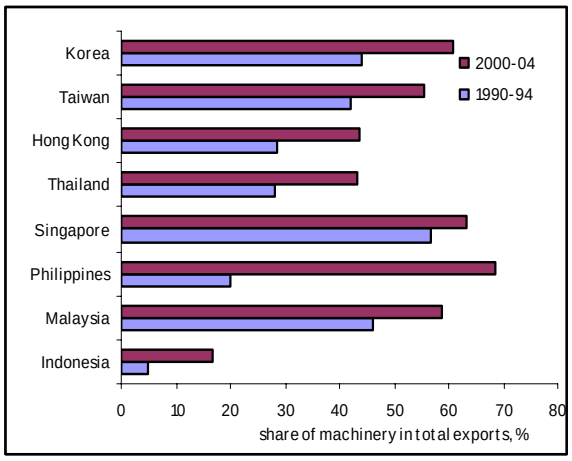
…and for most countries over half of exports is accounted by machinery. There was a growing similarity in the commodity composition of exports among economies within the region between 1990–94 and 2000–04. This is reflected in the increase in the correlation coefficient of export composition between most pairs of economies in East Asia (the averages are shown in figure 7). In 2000–04, Indonesia was practically the only country that exhibited a different composition in export products. The export composition of the East Asian countries is more similar in terms of their trade with each other than it is in terms of their trade with the rest of the world. In most East Asian countries, exports of machinery account for more than half of their total exports.

Figure 7 Export Similarity Among East Asian countries

a. Average correlation coefficient of export composition



b. Share of machinery in total exports

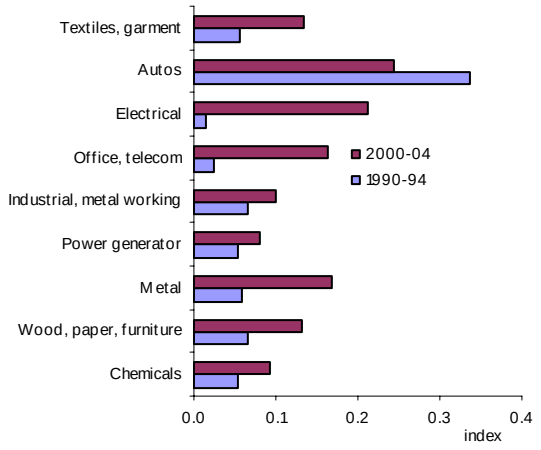


Source: UNCOMTRADE

Trade in machinery is largely triangular, and a driving force to the region's trade performance. The pattern of intra–East Asia trade in machinery parts differs according to the products and the economies involved. In electrical appliances, approximately 80 percent of East Asia's exports are accounted for by parts, while the remaining 20 percent are represented by finished products regardless of the export destination. China is an exception, however. For China, the share of finished products in exports of electrical appliances is high, especially among the exports to developed countries. There is a triangular trade in these commodities, whereby East Asia exports a high share of the parts for electrical appliances, and office and telecommunications equipment to China, and China exports the finished products to the European Union and the United States. In road vehicles, all economies in East Asia, including China, export a significant share of parts to Japan; China also exports a large share of parts to the European Union and the United States. In electronics and electrical machinery, developing East Asia is becoming a world factory whereby these economies are assembling the parts and components supplied by developed and developing economies and selling the finished products on the world market. Through this triangular trade, parts produced by Japan and the NIEs are exported to China and the ASEAN countries to be assembled as finished products, which are then exported to Europe and North America. The triangular trade index increased from 1990–94 to 2000–04 for many products, including machinery (see figure 8).[6]

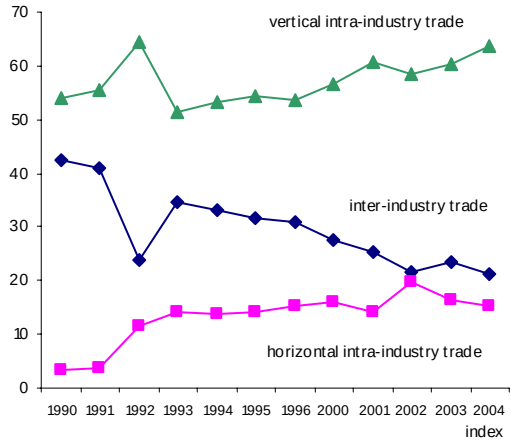
Intraindustry trade is expanding and is mainly vertical. Many East Asian economies have experienced an expansion in intraindustry trade with the rest of the world, as well as with other East Asian economies.[7] Within the region, the share of intraindustry trade rose in notable fashion from 1990 to 2004, while the share of interindustry trade went down (see figure 9). A large part of intraindustry trade in East Asia may be characterized as vertical, which has been driven by two factors.[8] First, the vertical intraindustry trade in intraregional trade in East Asia reflects substantial diversity in the level of economic development among the East Asian economies. In several *final* products, including footwear, specific types of garments, and electronics, the unit export prices of the products from developed economies such as Japan are significantly higher than those from developing economies such as China. Second, vertical intraindustry trade in intraregional trade in East Asia also reflects the emerging regional production networks through which *parts and components* of differing quality and characteristics are being actively traded for the production of final products.

Figure 8 Triangular Trade Index



Source: UNCOMTRADE

Figure 9 Intraindustry Trade within East Asia

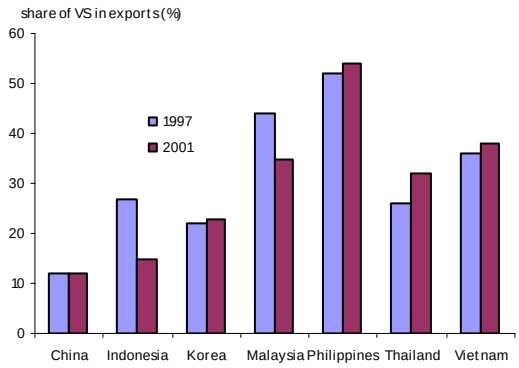


Source: UNCOMTRADE and Urata 2006
Note: The indices are aggregated at the 6-digit HS level and computed using the method proposed by Fukao, Ishido, and Ito (2003).

Production sharing, by definition, incorporates the back-and-forth nature of trade: the importation of inputs for assembly or additional processing, as well as the exportation of intermediate goods for assembly or additional processing by third countries. This is distinguished from pure intraindustry trade, one-way production sharing, and the trade in intermediate goods. 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.[9] A sizable share of the exports of Malaysia, the Philippines, Thailand, and Vietnam are accounted for by vertical specialization (VS). Indonesia is a poor performer in this area: its share of exports involved in vertical specialization declined dramatically, from 27 percent in 1997 to 15 percent in 2001. However, Indonesia's vertical specialization 1 (VS1) contribution to export growth (see figure 10) is much more significant. Countries such as Brazil, Chile, and South Africa have achieved high levels of VS1, indicating that they are increasingly engaged in the intermediate stage of the manufacturing value chain as opposed to the final stage.

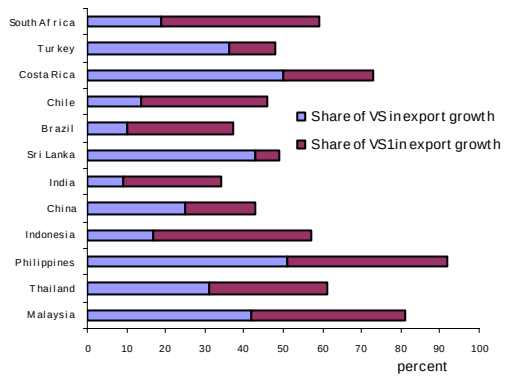
Figure 10 Vertical Specialization in East Asia

a. As a share of exports



Source: Based on the Global Trade, Assistance, and Production Database, Center for Global Trade Analysis, Purdue University, data versions 5 and 6.

b. Contribution to export growth,1992–2000

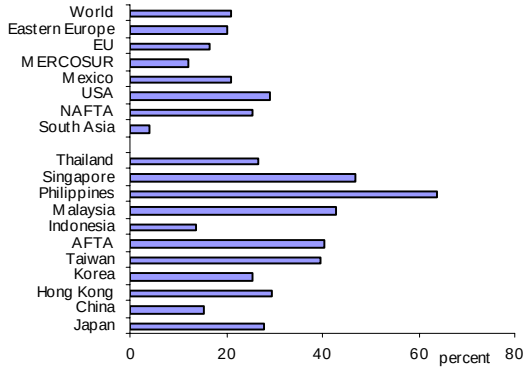


Source: Pitigala 2006; UNCOMTRADE; production data from the United Nations Industrial Development Organization.
Note: Exports are aggregated at the 3-digit HS level.

PRODUCTION SHARING: AT THE CORE OF EAST ASIA'S TRADE PERFORMANCE

International production fragmentation—the crossborder dispersion of component production and assembly within vertically integrated production processes whereby each economy specializes in a particular stage of the production sequence—has been an important feature of the deepening structural interdependence of the world economy in recent decades. This phenomenon has been reflected in a growth in the trade in parts and components at a rate exceeding that of the trade in final goods because a good crosses multiple borders while it is involved in processing (see figure 11). The world trade in parts and components increased in value from US$400 billion in 1992 to over US$1,000 billion in 2003. Developed countries account for the bulk of the trade in components, but the share of developing countries has increased sharply over the years. The share of East Asia in the total exports of components rose steadily, from 31 percent in 1992 to 43 percent in 2003, despite a decline in the share of Japan. Contrary to the popular perception of crowding out by China, the increase in the share of the exports of components by China and Hong Kong (China)[10] has occurred within an overall increase in exports from relative newcomers in trade in the region, including Vietnam (see table 3).

Figure 11 Share of Parts and Components in Total Exports



Source: Athukorala and Yamashita 2005.
a. Mercosur = the Southern Cone Common Market.
b. NAFTA = North American Free Trade Agreement.
c. AFTA = ASEAN Free Trade Area.

The engine for the expansion of trade in East Asia in recent years has been international processing activities, in which China has been a major manufacturing base relying on inputs imported from other Asian countries. Production sharing with advanced Asian economies has permitted rapid diversification in China's manufacturing export capacities. Firms in Asia have moved production facilities to China, enhancing China's integration in the regional economy and leading to the reorganization of industry in East Asia. Production sharing has enabled developing countries to take advantage of differences in comparative advantage at a more sophisticated level of specialization. East Asia has been at the forefront of this international fragmentation of production. Malaysia, the Philippines, and Thailand performed exceptionally well in exports of finished or assembled machinery between 1998 and 2004. Japan accounts for over half of East Asia's exports in machinery. The production networks that initially linked Japanese industry vertically with Korea and Taiwan (China) in low-skill assembly activities have gradually been transferred to lower-wage countries such as Malaysia, the Philippines, and Thailand. (Indonesia, however, has shown little success despite even lower wage levels.) These networks are also now being transferred to China and Vietnam.

Table 3 Intra-Asian Trade in Parts and Components

	Importers									
	Japan		*NIEs*		*ASEAN-4*[a]		*China*		*Asia*	
Exporters	*%, 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.

The trade in machinery is at the heart of production sharing in East Asia

Machinery has become an important trade commodity for countries in East Asia.[11] Innovative machinery products have played a significant role in the success of Japan and the NIEs in global trade. In recent years, this commodity group has also become an important driver of trade among countries in developing East Asia. In 2000–04, machinery products accounted for half of the total imports of these economies. During the same period, the share of machinery in the total exports of these economies, excluding China, reached 51 percent, from 38 percent in 1990–94, superseding the share of any other commodity groups. The most remarkable performance was that of China, where the share of machinery in total exports leaped to 41 percent in 2000–04, from 18 percent in 1990–94.

As the trade in machinery in developing East Asia increased, its nature evolved. Products made in China are shifting to more sophisticated machinery and away from mass-manufactured, low-technology goods. For example, China now exports more personal computers and related accessories than metalworking tools. China is also exporting more 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-skill workers, there has been true improvement in China's technological production capacity (see below). As part of the regional production network in machinery, China has emerged as the most important final assembly hub, while Japan and the NIEs are, by far, the most important sources of innovative inputs into processing. But the traditional production network is changing. It is no longer the simple model whereby Japan and the NIEs supply high-quality components and capital goods to emerging East Asia, including China, which assembles them for final markets in the European Union and the United States. Another sort of production network involving the transshipment of components is also appearing in the region. In this more sophisticated and complex network, Japan and the NIEs provide high-quality materials, including design, to their FDI affiliates in developing East Asia, which uses them to produce components. The components are then sent back to the originators for further processing. The originators perform quality control, organize the components, and send them back to developing East Asia as kits for final assembly.[12] There are also even more complex models (see figure 12).

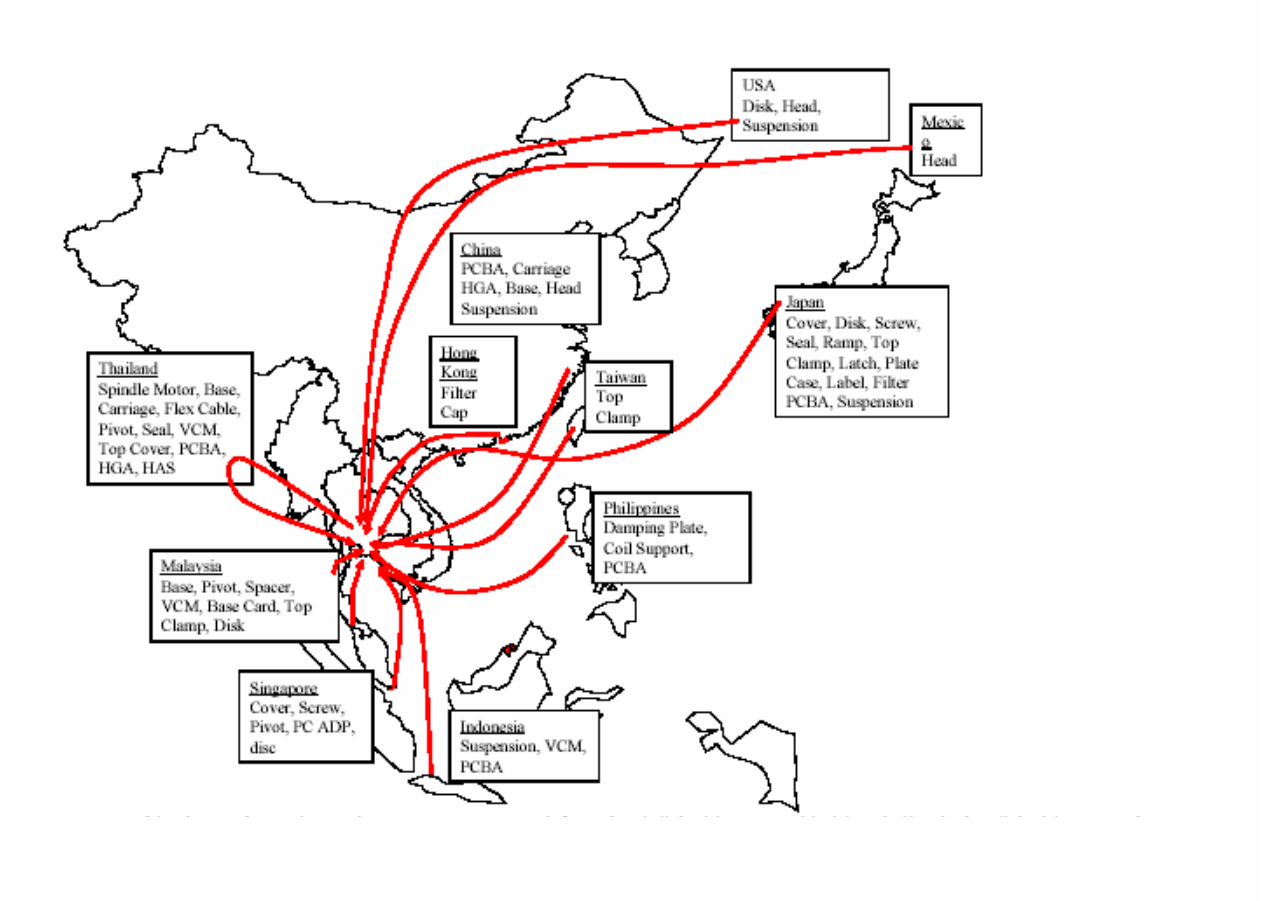
China's increase in machinery exports is exceptional. Between 1993–94 and 2003–04, the world market share of China in office, data, and telecommunications equipment rose from 2.8 percent to 15.7 percent (see table 4). China's world market share doubled in power generating equipment, tripled in industrial machinery, and quadrupled in electrical machinery. China also now accounts for a large share of the world market in machinery imports, reflecting its rapid industrialization. Other important players in the global trade in machinery include Malaysia and the Philippines, especially in office, data, and telecommunications equipment, and electrical machinery.

Table 4 The Share of Exports of Selected East Asian Countries in World Markets
percent

Country	*Power generating equipment*		*Industrial machinery*		*Office, data, and telecommunications*		*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: UNCOMTRADE.
Note: Lightly (dark) shaded figures indicate products with increasing (decreasing) market shares.

Figure 12 A Complex Network



Source: Richard Baldwin, 2006.
Note: The figure shows the sourcing of the parts for hard drives assembled in Thailand; after assembly, the drives are shipped on to various markets to be used in electronic products.

Countries in developing East Asia are also increasing their role as assemblers of machinery products. Clearly, within this category, office, data, and telecommunications equipment, and electrical machinery are at the core of the production sharing networks. But the picture is not uniform. Indonesia and Thailand import many of their component inputs from Japan; Malaysia and the Philippines, from Japan, the NIEs, and the United States; and China, from Japan and the NIEs. Most countries not only import components, but also export components and finished products. Malaysia's exports of finished products are geared mainly toward the United States, while the exports of the other economies go to Japan and the NIEs, as well as the United States.

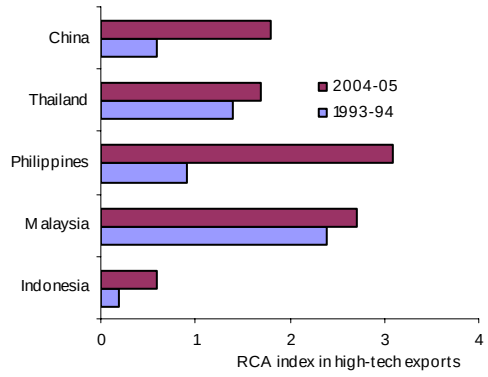
A reorientation in the exportation of components is taking place from developing East Asia to China. Over the past 10 years, the proportion of components in the exports to China has increased by almost 5 times for Indonesia, 15 times for Thailand, 19 times for Malaysia, and 60 times for the Philippines. In 2003–04, countries in developing East Asia shipped almost 50 percent of their components within the region, a significant increase from the 33 percent in 1993–94. Over the past 10 years, the proportion of components in the exports of Indonesia and the Philippines going to Malaysia has increased by 2 and 10 times, respectively. However, the reorientation in the exports of components from countries in developing East Asia going to China has been the most dramatic by far.

Most Southeast Asian countries have increased their competitiveness in high-technology products (see figure 13). Countries such as Malaysia and the Philippines have emerged as the most competitive

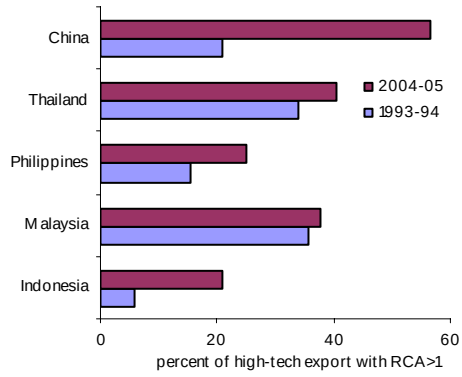
manufacturers of high-technology products among the countries in developing East Asia. But the number of products with a revealed comparative advantage (RCA) index greater than 1 is larger for China than it is for other countries in developing East Asia. China is not only gaining competitiveness in high-technology products, but is also becoming more competitive in a broader range of machinery products.

Figure 13 China Is Catching Up in High-Technology Machinery Exports

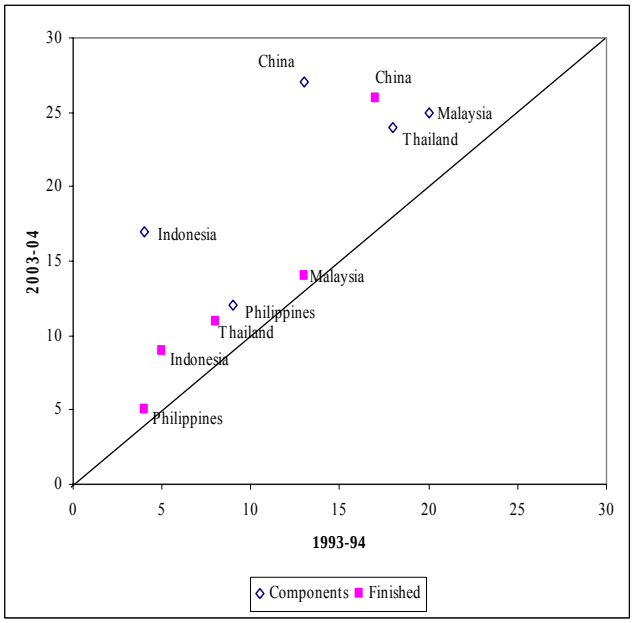
a. RCA index in high-technology exports



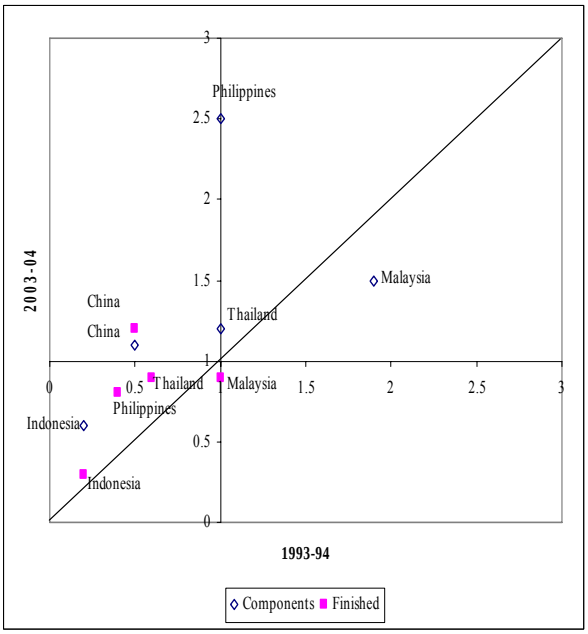
b. % of high-technology exports for which RCA>1



c. % of machinery products for which RCA>1



d. RCA index in machinery



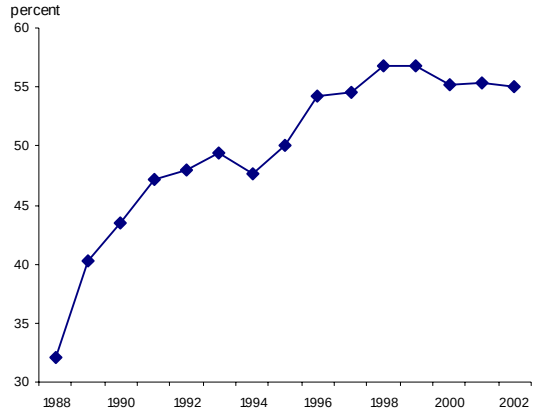
Source: Rahardja 2006.

Multinational corporations: recycling comparative advantage to drive production sharing

The development of production networks has contributed to the rise of successive waves of NIEs in East Asia, especially the emergence of the latest wave (Malaysia, the Philippines, and Thailand, and then China and Vietnam). Since the mid-1980s, firms in the most industrialized economies in the region (Hong Kong [China], Japan, Korea, Taiwan [China], Singapore) have, through FDI and outprocessing operations, gradually moved their production capacity in low-technology, labor-intensive sectors to overseas export platforms located in low-wage countries. These relocations have helped Southeast Asian countries and then China develop their comparative advantage in manufacturing industries and progressively to upgrade their industrial capacities and exports.

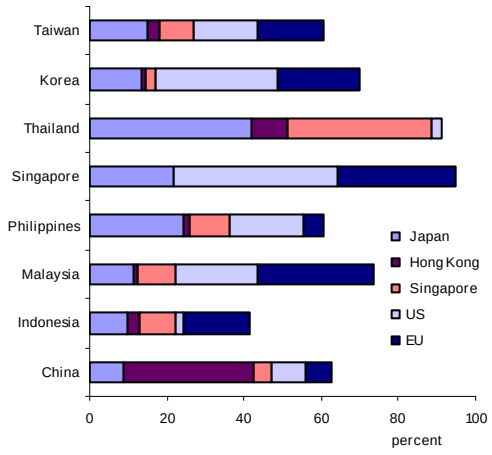
Multinational corporations have had a huge impact on East Asian economies in various ways, including by generating production, fixed investment, employment, and trade.[13] For example, the share of the exports of multinational corporations in China's exports increased from 29 percent in 1994 to 55 percent in 2003 (see figure 14), while the corresponding share for imports increased from 46 to 56 percent. Similarly, affiliates of Japanese multinational corporations in Asia have a strong export orientation compared to Japanese affiliates in other parts of the world; the ones in Asia exported over half of their production, compared to only 14 percent among the ones in North America. The bulk of the trade of Asian affiliates of Japanese firms occurs within Asia: over 80 percent of their exports (47 percent to Japan and 34 percent to other Asian countries) and over 95 percent of their imports (64 percent from Japan and 31 percent from other Asian countries). While most European Union and U.S. FDI in Asia (especially China) seems to be market seeking, Asian FDI is more export oriented. Japanese multinational corporations have greatly contributed to the increase in intraregional trade and triangular trade in East Asia. They have developed their own production and distribution networks in Asia by fragmenting their production processes into several subprocesses and locating the subprocesses in places where they may be conducted at the least cost. Of the exports from the head offices of Japanese multinational corporations, 74 percent are destined to the overseas affiliates, while 56 percent of the imports come from overseas affiliates. This high share of intrafirm trade indicates the closed nature of the production and distribution networks established by Japanese multinational corporations.

Figure 14 China's Processing Exports by Foreign Enterprises



Source: China, National Bureau of Statistics, various.

Figure 15 Source Shares of FDI Inflows to East Asia



Source: Compiled by World Bank staff from national data sources.

Production networks and technological spillover

In China and, increasingly, Vietnam, foreign affiliates are responsible for a major, growing share of the trade, especially with Asian countries. But how much spillover actually takes place is not entirely clear.

Taking part in labor-intensive production may not lead to technological spillovers. The evolution of the specialization patterns in East Asia confirms the "flying geese model" developed by Akamatsu (1961). However, changes in the global economy, together with shifts in technology and production techniques have precluded homogeneous trajectories. Japan developed a strong and indigenous base for innovation. The NIEs have remained dependent on imported technology. Southeast Asia is greatly dependent on foreign-controlled firms and exhibits a high import content in exports. China's imports of intermediate products from Asian industrialized countries have been an important channel of technology transfer and

have helped China rapidly to improve the high-technology content of its foreign trade. An important caveat is the case of developing East Asia (including China), which has demonstrated a comparative advantage in high-technology products, particularly electrical and electronics products. This seeming inconsistency may be due to the development of an interprocess division of labor in East Asia, whereby the labor-intensive production of high-technology products is conducted in low-wage developing economies. The main promoter of the emergence of this interprocess division of labor has been multinational corporations from developed economies such as Japan and the United States and developing economies such as Korea, Taiwan (China), and others. But, up to now, the technological upgrading of China's trade and that of some Southeast Asian countries has remained circumscribed to the production and export networks of foreign firms.

China has succeeded in rapidly upgrading the technological content of its foreign trade. The high-technology content of China's exports may be explained by the high-technology import content of these products. Half of China's high-technology imports are used for export processing activities (and not for the domestic market). China's high-technology trade is heavily concentrated in a limited number of products: three sectors account for 80 percent of China's high-technology imports (radios and televisions, office machinery, and precision instruments), and the top two export products (radios and televisions, and office machinery) account for 85 percent of high-technology imports. The dependence of China's high-technology trade on foreign affiliates is high: almost 80 percent of China's high-technology exports to and imports from Asia rely on foreign affiliates, and more than half rely wholly on foreign firms (see figures 16 and 17).

Figure 16 High-Technology Trade in Total Trade by Category of Firm

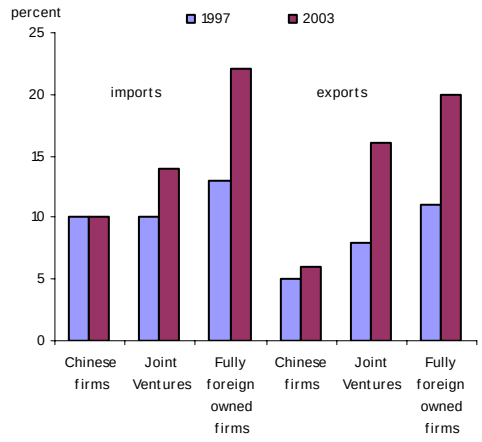
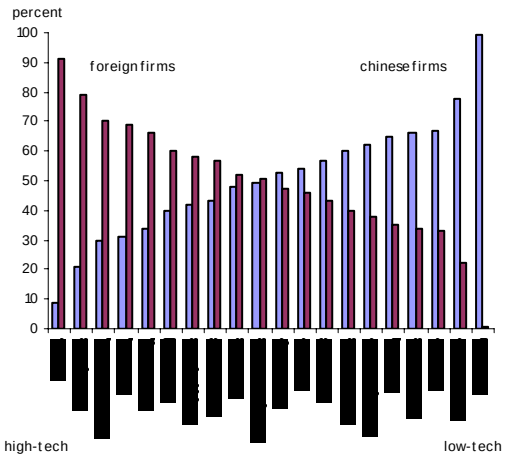


Figure 17 China's Exports by Type of Firm, 2003



Sources: Gaulier, Lemoine, and Ünal-Kesenci 2005; China, General Administration of Customs, various.

To the end of the 1990s, China relied heavily on FDI for technological modernization. But FDI has not had all the positive effects anticipated by the Chinese authorities. First, the acquisition of technology through the importation of high-technology products is usually less amenable to the wider dissemination of technology than are other channels such as patents or licenses. Second, the fact that the bulk of China's high-technology imports is handled by foreign affiliates and, especially, wholly owned foreign firms is likely to have increased the obstacles to the dissemination of high technology. Third, evidence shows that high-technology imports have been used as a substitute for local expenditure on R&D. In sectors which have benefited from large high-technology imports and substantial FDI, the increase in R&D expenditures has been slower than it has in other industries. Surveys of industrial firms in China in the 1990s bear out that high-technology imports had a rather limited effect on domestic innovative capacity.[14] The performance of Chinese firms in terms of productivity and innovation has been determined by their own

efforts; the acquisition of foreign technology has had a positive effect only when it has been associated with in-house R&D expenditure.

The prospects of China's technological catch-up will depend on its ability to disseminate foreign technology into local industries and to develop its own innovative capacities. 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 gross domestic product (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 the strategies of the firms.

Will China remain sustainably dependent on foreign technology? Until now, the rapid technological upgrading of China's trade has been associated with growing dependence on foreign capital and technology. The question is whether this dependence will be long-lasting or whether China will develop its own capacity for technological innovation in the coming years.

EAST ASIA RESPONDS TO CHINA

China's integration into the world economy is one of the most important developments affecting the structure and evolution of the global trading system. 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.[15]

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 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 been changing as well, 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 (as computed using an index of the income productivity of exports, or PRODY).[16] 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 it is at least partly a result of industrial policy.

In 2000–04, China's exports had an average PRODY of US$9,963 (see figure 18). This implies that the country's exports are representative of an exporter with a real per capita income of US$9,963. During this period, East Asia had an average PRODY of US$11,001. The average per capita income in the sample of countries in East Asia, 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 wage level represented by China's exports is below that of countries in East Asia, but growing somewhat more rapidly; it has increased by 20 percent over the last 10 years (see table 5).

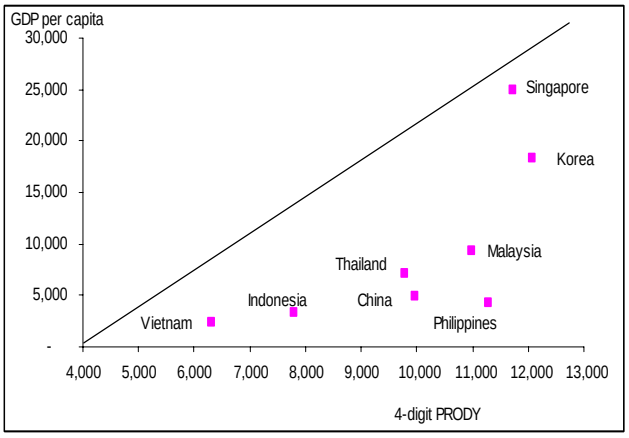
Table 5 Index of the Average Wage of Exports
trade-weighted average PRODY

Exporter	*1990–94*	*2000–04*	*Change (%)*
East Asia and the 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.

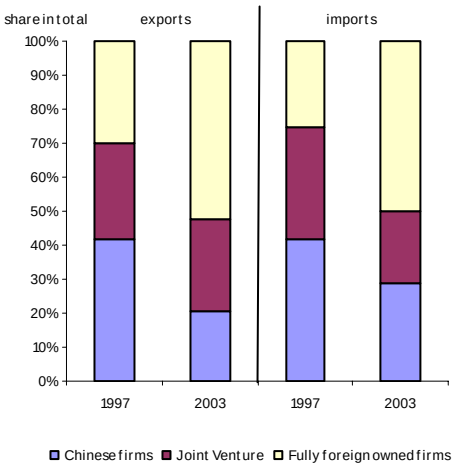
While it would be expected that China's success would affect countries at similar stages of economic development, factor abundance, technological capability, and production costs, the fact that China is exporting more sophisticated products than its income level implies suggests that the potential impact may be larger on more advanced economies in East Asia. An important caveat is that it may appear that the NIEs are losing market share to China in third markets, but this does not account for the fact that the NIEs are exporting through their foreign affiliates in China; so there is a reshuffling in production strategies (from the NIEs to China) rather than a loss in exports. More than half of China's exports in high-technology products are undertaken by foreign firms (see figure 19). The next section looks at the impact of China on the NIEs and Southeast Asia.

Figure 18 PRODY, 2000–04



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

Figure 19 China's High-Technology Trade by Category of Firms

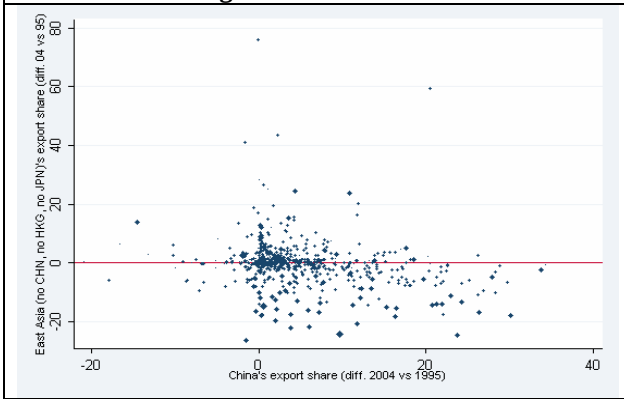


Source: China, General Administration of Customs, various.

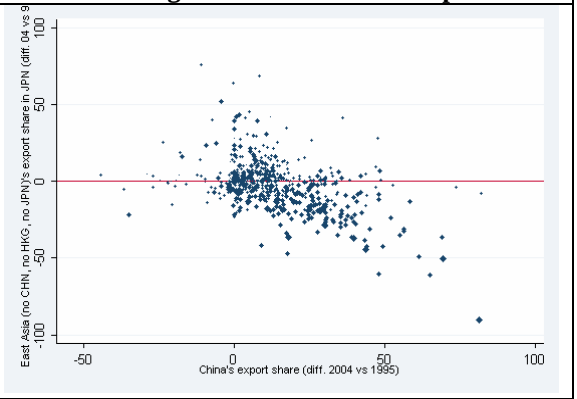
The export performance of the East Asian economies has been remarkable. Merchandise exports have increased by a factor of 13 since 1985, more than twice the rise in world exports. Chinese exports have done even better, surging by more than a factor of 20 over this period. What has been the impact of China's rapid export expansion on the rest of East Asia? In which industries and which markets is the competition from China greatest? There are many significant industries where East Asia has lost market share and China has gained market share, as seen by the number of dots in the lower right quadrants in figure 20.[17]

Figure 20 Change in Export Market Shares in East Asia

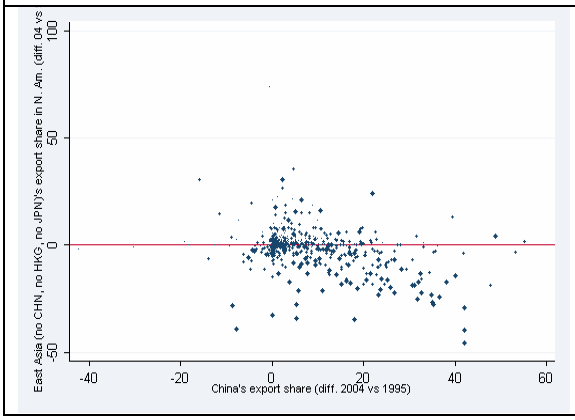
a. Change in world market share



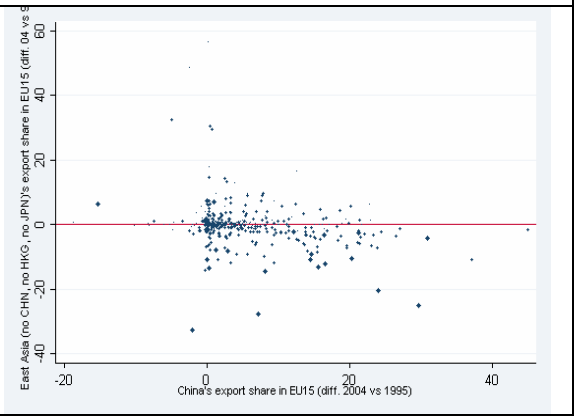
b. Change in market share in Japan



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 standard international trade classification (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 (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 has lost market share, while China has gained. In chart a, this is not so much the case. See the text for an explanation.

Estimations of the China displacement effect on East Asia show the following:[18]

- The coefficient on China is negative and significant, indicating that, on average, export growth is low when Chinese exports are large and growing (see table 6).
- Looking at nonindustrial versus industrial products, one sees that the effect occurs entirely in the industrial sector. The coefficient of about −0.3 implies that, in a product with a Chinese market share of 10 percent and Chinese export growth of 20 percent, the export growth of East Asia would be reduced by 0.6 percentage points (.3*.1*20).
- Looking at the effect over time in more detail by disaggregating it into four periods, 1986–89, 1990–94, 1995–99, and 2000–04, one sees that the robust negative effect of China on the exports of East Asia is only evident since 2000. (The results are not shown.)
- The negative impact is strongest in Japan and North America. The China effect is also negative and significant in developing-country markets. It is positive, but only moderately significant in the European Union (see figure 21).

- The effects by country since 1995 show that, of the 19 countries, 12 show negative impacts of the China effect; Singapore and Taiwan (China) are the most significantly affected. (This is consistent with the fact that the NIEs are moving production to China rather than exporting.)

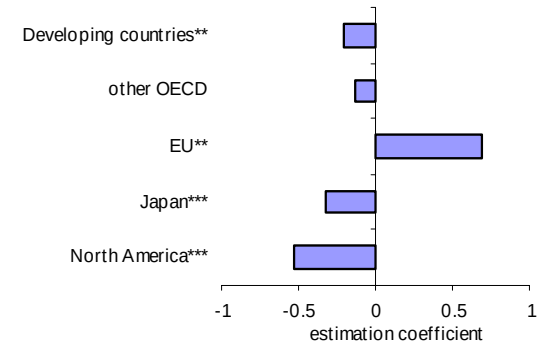
Table 6 Is China Displacing the Exports of Other East Asian Economies?

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

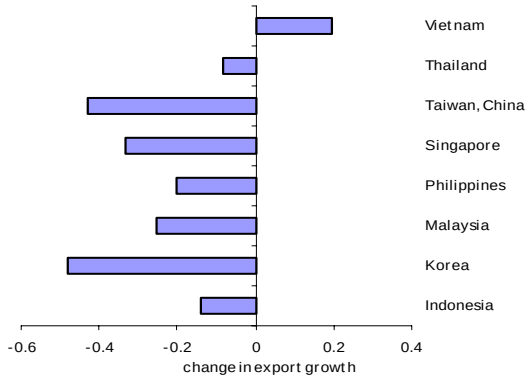
Source: Freund 2006.
Note: The regressions include export, year, and 4-digit product-fixed effects. The estimates thus rely entirely on cross-market variation in Chinese import penetration in a given product. Robust t-statistics are shown in brackets. For the terms in parentheses, see equation (e) in endnote 18.
*** significant at 1 percent.

Figure 21 Who Is Displaced and Where?

a. Where is the displacement



b. Which countries are being displaced?[a]

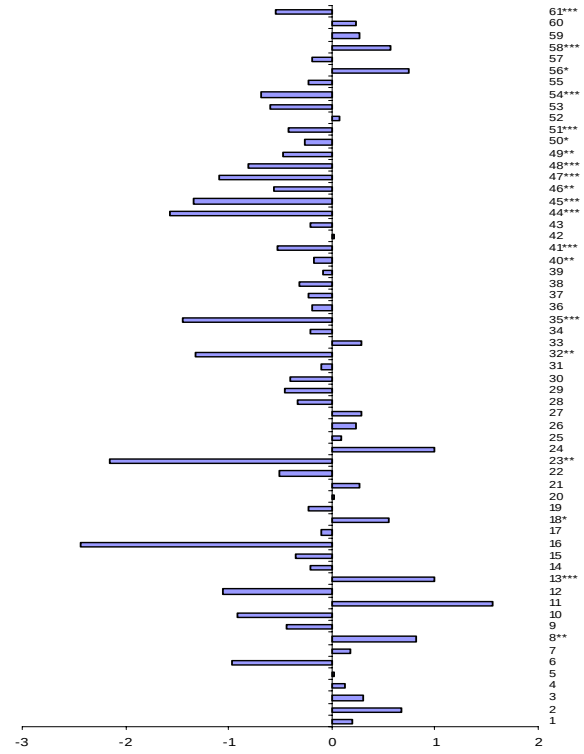


Sources: Freund 2006; calculations of the author.
a. This is the coefficient on diflnimpCHN in equation (e) in endnote 18 estimated by country for 1995–2004.
b. OECD = Organisation for Economic Co-operation and Development.
** significant at 5 percent; *** significant at 1 percent. For example, a coefficient of −0.5 implies that, for a product with a Chinese market share of 10 percent and Chinese export growth of 20 percent, the export growth in East Asia would be reduced by 1 percentage point. Observations: 1,338,229. R-squared: 0.35.

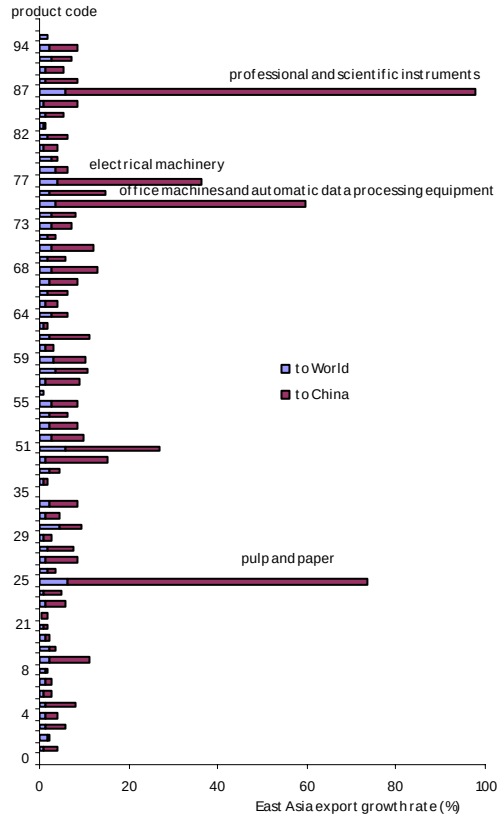
China's competition is mainly in high-wage export products. Estimations for each 2-digit category separately for the first period and the second period (see above) reveal that 39 of 67 categories (about 60 percent) show negative impacts of Chinese exports in the second period. Of these, 16 are significant (see figure 22). Many of these products that are negatively affected by Chinese export growth tend to be high-technology products, including electronics, communications equipment, and machinery. The trade-weighted average PRODY for the products in which China is displacing East Asia tends to be high; the trade-weighted average PRODY of this group of products is US$12,205, above the average PRODY of US$11,001 for East Asia.

Figure 22 Which Sectors Are Being Displaced?

a. China is displacing East Asia higher up the technology ladder in third markets



b. In these products, China is itself a major market



Source: Freund, 2006

Note: The product categories are adapted from the standard international trade classification (SITC), Rev. 3 (2-digit), United Nations Statistics Division.

Evidence suggests there is a relocation of production within the region. Of the 16 2-digit China threat industries, 11 are among the top-20 list of the most rapidly growing East Asian export industries to China (see italics in table 7). This implies that some of these products—especially those in electronics (those with a standard international trade classification [SITC], Rev. 3 [2-digit] code in the 70s)—do involve fragmentation in production. So, while economies in East Asia—especially the more advanced economies—are losing trade share in third countries, they are gaining in China. China's emergence has considerably exacerbated the triangular trade pattern by speeding up the withdrawal of the most advanced Asian economies from the production and exportation of labor-intensive products and enlarging the trade in sophisticated intermediate goods within Asia.

China is likely to maintain a long-lasting specialization in labor-intensive products. Its huge labor supply and the anticipated, substantial migration among the labor force from agriculture to industry in the coming years will maintain the country's comparative advantage. Its gains in market share, which have come primarily at the expense of the advanced economies of the region, will provide an incentive for these economies to move up the value added chain. China will displace the NIEs in labor-intensive industries that they relinquish, as, in an earlier period, the NIEs displaced Japan in these industries. The main threat is to the less-advanced Asian economies that face China's competition in labor-intensive products. It is not clear whether they will be able to move up the quality and technology ladder to keep a comparative edge over China.

Table 7 The Threat Industries of China

SITC code	*Industry*	*Export growth from East Asia to China, 1990–94 to 2000–04* (annual %)	*PRODY*
34	Gas, natural and manufactured	23.5	5791
56	Fertilizers, manufactured	−23.1	7120
59	Chemical materials and products n.e.s.	14.5	*15310*
65	Textile yarn, fabrics, made-up articles n.e.s., related products	6.9	*9409*
66	Nonmetallic mineral manufactures n.e.s.	14.4	11332
69	Manufactures of metals n.e.s.	9.3	*11894*
71	Power generating machinery and equipment	12.4	*11933*
72	Machinery specialized for particular industries	11.0	*11016*
73	Metalworking machinery	14.7	*9919*
74	General industrial machinery, equipment, parts n.e.s.	9.6	*12955*
75	Office machines, automatic data processing machines	29.2	*13021*
76	Telecommunications, sound recording equipment	14.1	*13138*
77	Electrical machinery, apparatus, appliances n.e.s.	27.0	*12124*
81	Sanitary, plumbing, heating, lighting fixtures n.e.s.	1.4	12068
89	Miscellaneous manufactured articles n.e.s.	7.5	*12878*
95	Arms, ammunition	−3.4	2196
Weighted average		14.2	12205

Source: UNCOMTRADE
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.

What is the impact of China on Southeast Asia in machinery? Regarding the impact of China on Southeast Asia in machinery, the largest competing export sector, two hypotheses are tested:

- whether the increasing role of China in manufacturing machinery affects the value of the exports of machinery from other developing countries in East Asia; the emergence of China as an important final assembly hub may be displacing the Southeast Asian countries (Indonesia, Malaysia, the Philippines, and Thailand) that used to be competitive in assembly
- whether developing East Asia will be able to take advantage of the increasing role of China as a powerful assembly hub by exporting machinery components; if Southeast Asian countries move up the technology ladder, they will be exporting components of machinery for assembly in China

The regression equations are shown in box 2.

Box 2 Is China's Emergence Putting Pressure on Machinery Prices?

To what extent is the emergence of China as an important player in the global trade in machinery putting competitive pressure on prices? We estimate a linear regression model through which 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:

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

where *V* is the unit value of 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), 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 observables 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 (1) 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, *Qjt−1* and *Vijt−1*, are predetermined, we estimate equation (1) 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:

$$\Delta MS_{ijkt} = \delta_0 + \delta_1 * F_{jk} + \delta_2 \Delta CMS_{jt-1} + \delta_3 (F_{jk} * \Delta CMS_{jt-1}) + \delta_4 \Delta RCA_{ijkt-1} + W_{ijt} \Gamma + \xi_{ijkt} \qquad (2)$$

On the left-hand side of equation (2), *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 RCA index (scale from 0 to 100), product *j*, category *k*, and Γ contains other covariates similar to *Z* in equation (1). 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).

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:

$$SCC_{ijt} = \gamma_0 + \gamma_1 CMF_{jt-1} + \gamma_3 RCAC_{ijt-1} + W_{ijt} \Pi + \eta_{ijt} \qquad (3)$$

On the left-hand side of equation (3), *SCC* is the share of exports in the components of product *j* from country *i* to China at time *t* (the share of 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 tariff.

For equation (3), we reclassify our product into a 3-digit SITC more broadly than we do in equation (2). 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 (3) using Tobit, using zero as the lower censoring point.

We estimate equations (1) to (3) 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).

Source: Rahardja 2006.

The results suggest the following (see table 8):

- The increase in the volume of China's exports in components is associated with a rising unit value in Southeast Asia's exports of components (α_2 is positive and statistically significant).
- The emergence of finished machinery exports from China is associated with a decreasing unit value in similar product exports from Southeast Asia (the net coefficient $\alpha_2 + \alpha_3$ is negative and statistically significant). The decreasing unit value in the exports of finished machinery from Malaysia and Thailand is associated with the emergence of China's exports of similar products.
- There is no evidence that the change in the market share of exports from Southeast Asian countries is associated with China's expansion (the estimates of δ_2 and $\delta_2 + \delta_3$ are not statistically significant in all major categories). But the change in the market share of these countries in the global exports of machinery is associated significantly with the competitiveness of the products; lower RCA tends to be related to a lower market share. This implies that the decline in the market share of the Southeast Asian countries in exports of finished machinery is not associated with China, but rather with a reshuffling of the exports and the markets of these countries.
- There is evidence of a spillover effect exerted by the market share of China in finished products on the exports of components from Southeast Asian countries (the sign of γ_2 is positive and statistically significant). This implies that China's expansion in its exports of finished machinery is causing the Southeast Asian countries to increase their shipments of components to China relative to their shipments to other countries and regions.

Table 8 With What Is China Associated?: Signs of Regression Estimates

Variable, result, and method	*Equation (1)*		*Equation (2)*		*Equation (3)*
Dependent variable	Log of value per unit		Change in global market share		Share of component exports to China
Main explanatory variables	China's expansion in export volume		Change in China's global market share		China's global market share in finished product
	Column A	Column B	Column C	Column D	Column E
Results	Components	Finished	Components	Finished	Components 3
Overall	(+)	(−)	n.s.	n.s.	(+)
By main machinery products					
Power generating equipment	(−)	n.s	n.s.	n.s.	n.s.
Industrial machinery, equipment	(−)	(+)	n.s.	n.s.	n.s.
Office, data, telecommunications	(+)	n.s	n.s.	n.s.	(+)
Electrical, apparatus	(+)	(−)	n.s.	n.s.	(+)
Road vehicles	(+)[a]	(−)	n.s.	n.s.	n.s.
Other transportation	(+)	n.s	n.s.	n.s.	n.s.
By country					
Indonesia	(+)	(+)	n.s.	n.s.	(+)
Malaysia	n.s.	(−)	n.s.	n.s.	n.s.
Philippines	(+)	(+)	n.s.	n.s.	(+)
Thailand	(+)	(−)	n.s.	n.s.	n.s.
Estimation method	ordinary least squares		ordinary least squares		Tobit
Sample classifications	6-digit Harmonized Commodity Description and Coding System		4-digit SITC		3-digit SITC

Source: Rahardja 2006

Note: The numbers in Column A represent estimates of coefficient α_2 in equation (1) of box 2 above (components), while the numbers in Column B represent estimates of $\alpha_2 + \alpha_3$, that is, the net effect of quantity on the unit value of finished products. Columns C and D present results from estimations of equation (2); and Column E presents results from estimations of equation (3). The rows represent the scope of the sample in which equations (1) through (3) are estimated.

Results that are statistically significant at least at the 5 percent level are given a plus (+) or a minus (−) sign, while "n.s." indicates results that are not statistically different from zero.

a. Significant at the 10 percent level.

THE WAY FORWARD

East Asia's phenomenal performance in trade rests on intricate production sharing networks that are being expanded and that are becoming more dense. It also rests on the unilateral openness in trade and foreign

investment regimes that have allowed these networks to develop. While production networks centered on China have contributed significantly to growth in East Asia, they also breed vulnerabilities. First, the production sharing networks have not automatically led to an increase in technology spillovers; they need to be complemented by an increase in export varieties to ensure that they become sustainable. Second, the production networks have led to an extreme interdependence across East Asian countries; this highlights the need for a structured framework for problem solving and to establish rules of the game.

From production sharing to expanding export varieties

Production sharing contributes to economic growth. Has the trade in intermediate inputs contributed to higher rates of economic growth in East Asia? One mechanism through which trade may contribute to growth is by increasing the variety of inputs available. This is the mechanism that underlies the endogenous growth models of Romer (1990) and Grossman and Helpman (1991), as revised by Jones (1995a, 1995b). In the Jones model, the creation of new input varieties by forward-looking firms sustains growth. This growth is made possible even in the absence of factor accumulation because the cost of the R&D needed for the creation of new varieties decreases 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.

Feenstra et al. (1999) find evidence consistent with the theory that product varieties contribute to growth in the cases of Korea and Taiwan (China). Over the period 1975–91, they find that changes in sectoral product varieties are positively correlated with changes in sectoral TFP. 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 increases in input variety documented by Feenstra et al. 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 the TFP for a large sample of countries over the 1980–2000 period. By examining the TFP and export variety in levels, they aim to capture the impact of greater export variety on productivity posited in recent static trade models, such as Melitz (2003) and Eaton and Kortum (2002). Consistent with earlier results, they find that export variety and the TFP are strongly and positively correlated. For example, as Korea's export variety has grown relative to Japan over time, Korean TFP has also increased relative to Japan (see figure 23). Figure 24 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, there are also systematic differences in the correlation across the region. Many countries (Indonesia, Korea, Malaysia, the Philippines, Singapore, Thailand) show up below the regression line, indicating that the TFP is lower than one might expect given the observed levels of export variety in these countries. Only Japan shows up above the regression line. Thus, while the region exports a relatively wide variety of goods, this outcome has not become translated into such high of levels of the TFP as seen in other countries and regions.

Figure 23 Export Variety Versus the TFP in Japan and South Korea

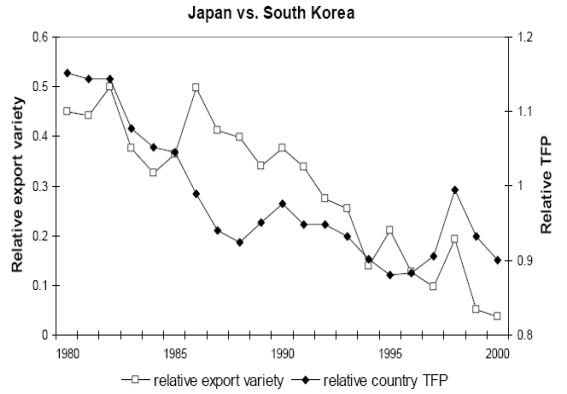
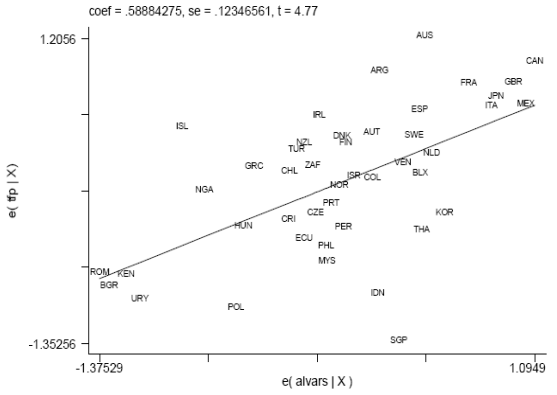


Figure 24 Partial Regression Plot of the TFP against Export Variety

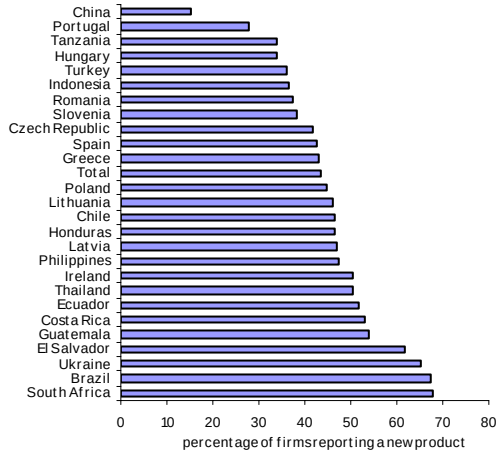


Source: Feenstra and Kee (2006).

Is the growth potential of East Asia less than fully realized? Given the size of the region's market and the variety of goods the region produces, one may be puzzled to find that the TFP and average income of the region are lower than anticipated, especially given the empirical regularities in other countries (see figure 24). This may mean that, relative to countries in other regions, the growth potential of the economies in East Asia is less than fully realized. In this case, we might expect to see these economies continue to outperform the rest of the world over the near term. The model of economic development in East Asia, which involves global production sharing, crossborder flows of capital and technology, and dense regional production networks, appears to be alive and well.

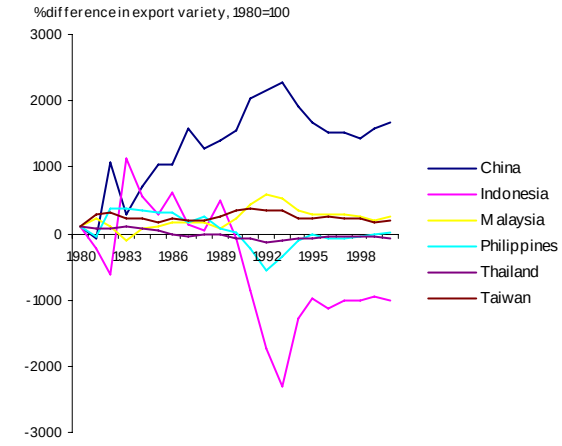
Figures 25 and 26 suggest that, while the export varieties of China are expanding, Chinese firms are not involved in developing many new products. This tends to confirm the findings that the export variety and high-technology exports of China are driven mainly by multinational corporations and that there is little spillover to Chinese firms.

Figure 25 Export Variety and Innovations



Source: World Bank, Investment Climate Assessments Database.

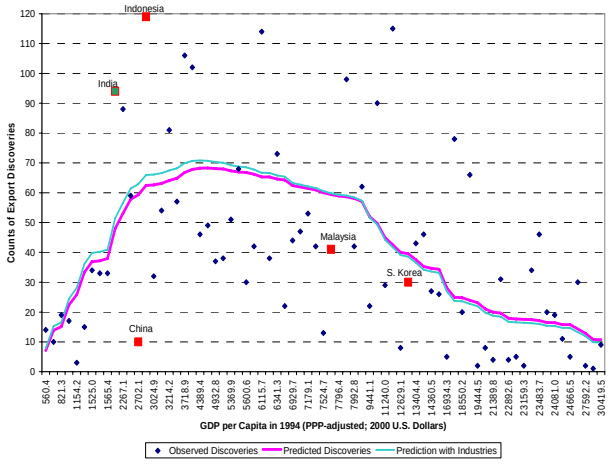
Figure 26 Comparative Export Varieties over Time



Source: Feenstra and Kee 2006.
Note: 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.

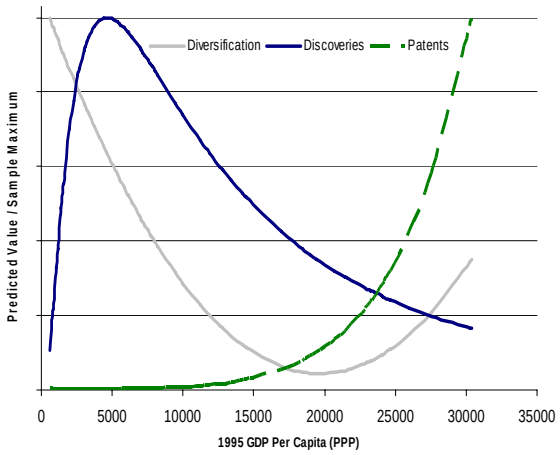
Recent research suggests that export diversification, the introduction of new export products, and the level of sophistication of exports might be related to the pace of economic growth across countries and over time. Thus, Khan (2004) finds that the introduction of new products affects economic growth and is associated with increases in the rate of capital accumulation across countries. Lederman and Maloney (2006) present econometric evidence suggesting that export diversification, measured according to the Herfindahl index of export-revenue concentration, is positively correlated with subsequent growth in GDP per capita in a broad sample of countries during 1975–2000. Imbs and Wacziarg (2003) were perhaps the first to note that the process of development is associated with economic diversification rather than specialization in terms of both production and employment concentration across sectors of economic activity. More recently, Klinger and Lederman (2006) observe that the introduction of new export products (or "export discoveries") and export diversification according to the Herfindahl index (measured at the 4-digit level of the Harmonized Commodity Description and Coding System) follow a common path during the process of development. In other words, at the start, poor countries possess highly concentrated export structures and rely on a few export products, but they introduce new export products as their export structures undergo the process of diversification during economic development (see figures 27 and 28).

Figure 27 Predicted versus Actual Export-Discovery Counts, 1994–2003



Source: Klinger and Lederman 2006.

Figure 28 Diversification and Innovation: Where Does East Asia Stand?



Source: Klinger and Lederman 2006.

A discovery is defined as a good that was not exported during 1994–96, but exported at a value of more than US$10,000 in 2002 and 2003. The information is based on disaggregated export data at the 6-digit level of the Harmonized Commodity Description and Coding System.[19] Figure 27 shows the predicted and the observed number of export discoveries during 1994–2003 as a function of the level of development (GDP per capita) in a sample of 73 countries. The figure shows two different predictions. One is derived from a negative binomial estimation that controls only for GDP per capita and its squared term, while the other also controls for sector-specific effects, where Leamer's (1984) 10 commodity groups encompass the corresponding sectors. This latter control might have been important if the introduction of new export products in developing countries were the result of structural transformation, whereby growing economies change their patterns of production due to changes in factor endowments brought about by capital accumulation. Since both curves are similar, the data suggest that structural transformation is not an important part of the story. Economies in East Asia appear both above and below their predicted number of new exports. Indonesia seems to have performed better during the period under examination (1994–2003) than other East Asian economies, including China, Korea, and Malaysia. In fact, the latter three performed below the level predicted by their GDP per capita, while Indonesia—surprisingly—overperformed.

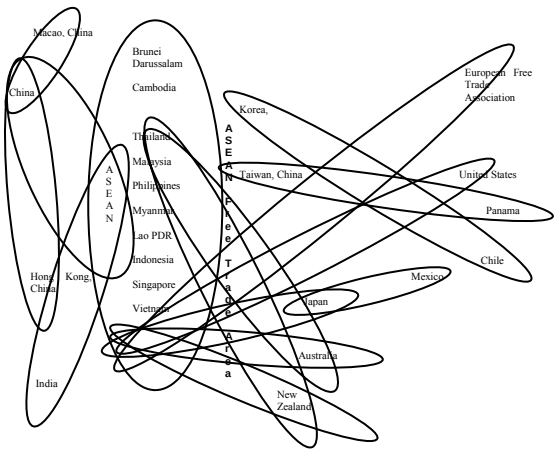
From market-based to institutions-based regionalism

Given the extreme supply-side integration of the region, conflicts within a country or among countries of the region may pose a threat to the competitiveness of ASEAN, Chinese, Japanese, and Korean firms in European and U.S. markets. For example, a serious commercial dispute between, say, Malaysia and Thailand or Indonesia and Malaysia might hinder the production of Japanese firms. Any such conflict would make it difficult for Japanese firms to provide low-cost, high-quality products in third markets in a timely fashion. The same is true for ASEAN, Chinese, and Korean firms (see Baldwin 2006a).

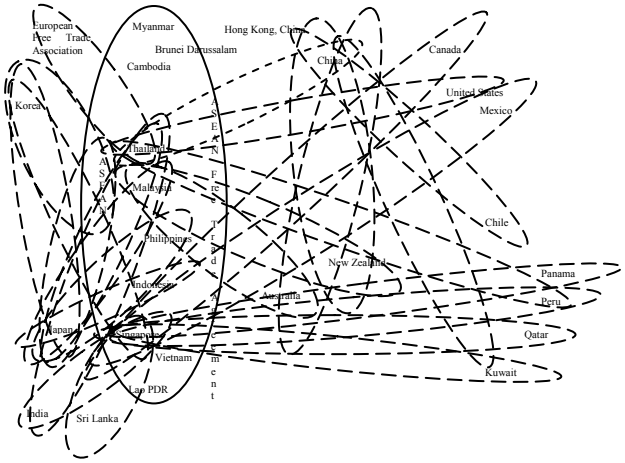
Unlike the European Union or the North American Free Trade Agreement region, intra-regional trade expanded in East Asia without the formation of preferential regional trade agreements. The ASEAN Free Trade Area was the only major free trade area (FTA) until Japan and Singapore enacted the Japan-Singapore Free Trade Area (formally, the New Age Japan-Singapore Economic Partnership Agreement) in 2002. Market-driven regionalization seems to be giving way to institution-driven regionalization; a large number of attempts have been made to establish regional preferential agreements not only among countries in the region, but also with countries outside the region (see figure 29). ASEAN as a group has become active in discussions on FTAs with other countries in recent years. ASEAN and China enacted an FTA in goods in July 2005, and they are currently negotiating an FTA in services. ASEAN is also negotiating FTAs with Japan, Korea, and others.

Figure 29 FTAs in East Asia

a. In action as of April 2006



b. Under negotiation as of April 2006



Source: Based on data in ADB 2006.

There are many reasons behind the recent surge of FTAs in East Asia. First, the rapid expansion of such areas in other parts of the world has made the East Asian economies realize the importance of establishing FTAs to maintain and expand their export opportunities. Second, a stalemate of the negotiations under the Doha Development Agenda turned the attention of the members of the World Trade Organization with an interest in trade liberalization toward the advantages of FTAs. Third, the Asian financial crisis in 1997–98 prompted East Asian economies to more awareness of the need for regional cooperation through initiatives such as FTAs to avoid another crisis. Fourth, rivalry among East Asian economies over leadership in the region has activated strategies involving FTAs.

It is too soon to quantify the impact of FTAs in the region. 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. Despite the possible benefits of FTAs through the expansion in trade to members, FTAs in East Asia have not been very successful. A substantial number of products, including important commodities mainly in agriculture, are excluded from trade liberalization. Many agreements take the form of economic partnerships that include trade and FDI facilitation, liberalization, and economic and technical cooperation. However, the implementation of these partnerships has been slow. The proliferation of FTAs with different specifications and rules of origin is likely to give rise to a noodle bowl effect, an entangled system of rules among the economies in the region and many economies outside the region. FTAs are also likely to have a negative impact on multilateral negotiations by diverting interest and negotiating resources away from the World Trade Organization.

The extreme interdependence in East Asian competition suggests that a more structured framework might be desirable among these countries. A strong regional framework is needed to consolidate the many agreements in place or being negotiated and to put structure into the region's trading patterns. ASEAN+3 (the ASEAN countries, plus China, Japan, and Korea) might take the lead in putting in place such a framework. This would safeguard intra-regional transactions involved in production sharing networks against disputes or provide a forum to address disputes should they arise.

Notes

[1] In this paper, 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] In this paper, the NIEs include Hong Kong (China), Korea, and Taiwan (China).
[3] 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).
[4] For a broader discussion of the theory on geography and trade, see Fujita, Krugman, and Venables (1999).
[5] See Redding and Venables (2004).
[6] 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)] x [(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)].
[7] The intraindustry trade index (IIT) is computed as:

$$IIT = 1 - [\sum\sum\sum|X_{ijk} - M_{ijk}| \div (X_{ijk}+M_{ijk})], \qquad (a)$$

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 the standard international trade classification (SITC) 3-digit to the 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.
[8] Two types of intraindustry trade may be identified. One type is called horizontal intraindustry trade, which refers to trade in products that are similar in quality and price, but differentiated by design or other characteristics. Such trade may occur between countries at similar income levels (and similar endowments), wherein consumers have similar tastes, but also demand variety. The other type is called vertical intraindustry trade, which refers to trade in products differentiated in quality and price. An example of such trade involves standard color televisions and high-definition televisions, which are different in quality and price. Vertical intraindustry trade tends to take place between developing and developed countries, where the factor prices are very different.
[9] A more appropriate approach to capturing such back-and-forth links, following Hummels, Ishii, and Yi (2001), is called vertical specialization, which is defined as production arrangements whereby firms produce final goods in multiple stages across multiple countries. Vertical specialization may comprise some types of intraindustry trade, but is a broader concept. Vertical specialization only occurs when the following conditions are met: (1) goods are produced in multiple, sequential stages; (2) two or more economies add value during the production sequence; and (3) at least one economy uses imported inputs during its stage of the production process and exports some of the resulting output. The vertical specialization chain involves a minimum of three economies: (1) economy 1 produces intermediate goods (including raw materials) and exports them to economy 2; (2) economy 2 combines the imported intermediate goods with capital and labor (adding value) and domestically produced intermediate inputs to produce a good, which may be a final good or another intermediate good (gross output); and (3) economy 2 exports some of the good to economy 3 (though, in practice, economy 1 and economy 3 may

be the same economy). "Vertical specialization" captures the value of the back-and-forth links when the subject economy is in the position of economy 2 (the exporter of a good incorporating imported intermediate inputs), while "vertical specialization 1" captures the value of vertical specialization when the subject economy is in the position of economy 1 (the exporter of intermediate goods to an economy that uses them in the production of the export good).

Vertical specialization is defined as:

$$VS_{ki} = \left(\frac{Intermediate\ Imports_{ki}}{Gross\ Manufactured\ Output_{ki}} \right) Manufactured\ Exports_{ki}\ , \qquad \text{(b)}$$

where *k* and *i* denote the economy and the good, respectively.

Vertical specialization 1 is defined as:

$$VSI_{ki} = \sum_{j=1}^{n} Exported\ Intermediates_{kji} \left(\frac{Exports_{ji}}{Gross\ Manufactured\ Output_{ji}} \right), \qquad \text{(c)}$$

where *j* is the destination of economy *k*'s exports.

[10] Much of the component trade in Hong Kong (China) relates to production fragmentation–based activities in China.

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

[12] See, for example, Ando and Kimura (2003); Athukorala and Yamashita (2005).

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

[14] See Jefferson et al. (2003).

[15] See Eichengreen, Rhee, and Tong (2004).

[16] We follow Hausman, 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:

$$PRODY_k = \sum_j \frac{(\exp orts_{jk} / EXPORTS_j)}{\sum_j (\exp orts_{jk} / EXPORTS_j)} GDPPC_j\ , \qquad \text{(d)}$$

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 RCA (that is, the share of its export basket in a product over the sum of the export shares of all countries). 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 standard international trade classification (SITC) industry using average bilateral trade and average GDPPC using purchasing power parity data from 2000–04.

[17] The market share approach introduces two problems. First, it is possible that China is increasing its market share at the expense of domestic producers, but *not* displacing other exporters. As a result, the export market *shares* of other exporters will decline, by definition, but there will not necessarily be an economic loss imposed on them. Second, the use of a relatively aggregate export category may overstate displacement if exports are actually in very different subcategories. For example, assume China primarily

sells overcoats and that other East Asian exporters sell mainly suits. At the 3-digit level, these products will appear to be competing, but it is unlikely that an increase in overcoat exports from China will displace suit exports from other East Asian exporters.

[18] In our empirical analysis, we use bilateral trade data at the 4-digit standard international trade classification (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 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 are affected by China. If Chinese export growth is primarily displacing domestic producers or is not competing with East Asia for some other reason, we will not pick it up. While Chinese exports might not be pushing out the exports of East Asia (it may be that China is entering because East Asia is exiting), this is less likely since we are controlling for export supply growth.

We estimate the following equation:

$$dif \ln \exp_{ijt}^{k} = \alpha_{it} + \beta_0 dif \ln impnonCHN_{jt}^{k} + \beta_1 dif \ln impCHN_{jt}^{k} + \varepsilon_{ijt}^{k}, \qquad \text{(e)}$$

where i is the exporter, j is the importer, k is the industry, t is the time, *dif lnexp* is export growth, *diflnimpnonch* 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.

[19] See Klinger and Lederman (2006).

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