KEIO UNIVERSITY
MARKET QUALITY RESEARCH PROJECT

(A 21st Century Center of Excellence Project)

KUMQRP DISCUSSION PAPER SERIES

DP2004－24

Two-dimensional Fragmentation in East Asia : Conceptual Framework and Empirics

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Abstract

East Asian economies have been drastically changed during the last 10-15 years. As one of the projects of our group, "International issues and Asia", this paper proposes the concept of two-dimensional fragmentation and empirically analyzes the international production/distribution networks in East Asia. Two dimensions of fragmentation are in terms of geographical distance and controllability of a firm for fragmented production processes. The increase in service link cost comes from physical separation of production processes and uncontrollability while the reduction of production costs comes along location advantages and the counterparts' ownership advantages. Our empirical investigation using disaggregated international trade data and micro data of Japanese corporate firms reveals the development of production networks in East Asia with active back-and-forth transactions of parts and components through fragmentation beyond national borders. It also emphasizes their development with sophisticated combination of intra-firm and arm's-length transactions along flexible de-internalization decision-making for outsourcing and with more developed industrial clusters. The paper suggests that policy environment in East Asia has an important role in reducing the service link cost due to uncontrollability as well as physical distance.

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Two-dimensional Fragmentation in East Asia: Conceptual Framework and Empirics [†]

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Forthcoming in the special issue of *International Review of Economics and Finance*, 'Outsourcing and Fragmentation: Blessing or Threat?'.

[†] The METI database was prepared and analyzed in cooperation with the Research and Statistics Department, Economic and Industrial Policy Bureau, the Ministry of Economy, Trade, and Industry, Government of Japan and Japan Center for Economic Research.

Abstract

This paper proposes the concept of two-dimensional fragmentation and empirically analyzes the international production/distribution networks in East Asia. Two dimensions of fragmentation are in terms of geographical distance and controllability of a firm for fragmented production processes. The increase in service link cost comes from physical separation of production processes and uncontrollability while the reduction of production costs comes along location advantages and the counterparts' ownership advantages. Our empirical investigation using disaggregated international trade data and micro data of Japanese corporate firms reveals the development of production networks in East Asia with active back-and-forth transactions of parts and components through fragmentation beyond national borders. It also emphasizes their development with sophisticated combination of intra-firm and arm's-length transactions along flexible de-internalization decision-making for outsourcing and with more developed industrial clusters. The paper suggests that policy environment in East Asia has an important role in reducing the service link cost due to uncontrollability as well as physical distance.

JEL code: F10, F23, and L23

Key words: service link, intra-firm trade, cross-border production sharing, outsourcing, micro data

1. Introduction

The applicability of the fragmentation theory has been extended far beyond the original idea as the globalization of corporate activities has developed. The original source of the idea was perhaps the U.S.-Mexico back-and-forth production sharing where an American firm exports parts and components to its affiliate located in Maquiladora, makes it assemble and sends finished products back to the U.S. headquarters. This is an intra-firm, cross-border fragmentation in which firms take advantage of differences in location advantages, particularly low wages, backed up with lowered service link cost. Such a simple form of fragmentation does not lose its significance at all, but we now observe much more sophisticated structure of fragmentation, particularly in East Asia. The newly developed production/distribution networks in East Asia involve a number of countries in the region, and parts and components, particularly in machinery industries, are actively traded among countries with different location advantages. Transactions in the networks include both intra-firm and arm's-length, the latter of which are sometimes between firms with different firm nationalities. Arm's-length vertical division of labor in geographical agglomeration is also an important feature of the networks. To analyze the mechanics of international production/distribution networks in East Asia, some expansion of the theoretical framework is needed.

This paper proposes the concept of two-dimensional fragmentation and reinterprets the cost structure of fragmentation. One axis presents traditional fragmentation in terms of geographical distance. In this type of fragmentation, differences in location advantages are exploited once the service link cost due to the geographical detachment of fragmented production block is overcome. The other axis denotes controllability of a firm over fragmented production block. When fragmentation goes beyond the boundary of the firm, i.e., when a firm outsources some production processes to other firms, the firm has much weaker managerial control over fragmented production block. In this case, increasing service link cost comes from uncontrollability while the reduction of production costs is generated by de-internalization advantages or the counterparts' ownership advantages. Such benefits from fragmentation along the controllability axis are particularly gained in geographical agglomeration.

Based on the concept of two-dimensional fragmentation, the paper analyzes the mechanics of international production/distribution networks in East Asia by using

finely disaggregated international trade data and the micro data of Japanese corporate firms. Our empirical analysis reveals that the development of production/distribution networks extended in East Asia with active back-and-forth transactions of parts and components through fragmentation beyond national borders. We also emphasize that the production/distribution networks in East Asia have been formed with sophisticated combination of intra-firm and arm's-length transactions along flexible de-internalization decision to outsource some fragmented production processes and with more developed industrial clusters. The paper suggests that policy environment in East Asia plays an important role in reducing the service link cost due to uncontrollability in addition to physical distance.

The paper plan is as follows: the next section proposes a novel framework of two-dimensional fragmentation and discusses the connection with agglomeration. Section 3 provides overview on the formation of international production/distribution networks in East Asia. Section 4 presents detailed statistical analysis on the mechanics of such networks from the viewpoint of Japanese corporate firms' behavior. Section 5 briefly discusses policy background in the formation of such networks. The last section concludes the paper.

2. Theoretical background

2.1 Two dimensions of fragmentation

Since the seminal work by Jones and Kierzkowski (1990) presenting the concept of fragmentation in a simple and versatile theoretical framework, both theoretical thought and empirical observation on fragmentation have been accumulated.[1] In particular, the East Asian economies have been a rich source of inspiration because unprecedented international production/distribution networks have developed there. Although we observe active cross-border production sharing in other regions such as the US-Mexico nexus and vertical linkage between Germany and Central/Eastern Europe, production/distribution networks in East Asia are truly distinctive in their extensiveness covering many countries and their sophistication combining both intra-firm and arm's-length transactions.

To investigate the entangled mechanics of fragmentation, we reorganize various types of fragmentation into two-dimensional space (Figure 1). One axis

[1] See, for instance, Arndt and Kierzkowski (2001), Deardorff (2001), and Cheng and Kierzkowski (2001) for fragmentation theories.

represents “physical distance” between the original position and a new location of the fragmented production block. When the distance is short and the fragmentation is within the national border, it is “domestic fragmentation.” When a fragmented production block is placed beyond national border, it becomes “cross-border fragmentation.” The other axis denotes “uncontrollability”; as we go further along the axis, managerial controllability over the fragmented production block reduces. Capital ownership is supposed to link with such controllability though the relationship may not be linear; as the capital share that the parent firm occupies in its affiliate gets smaller, the managerial control gets weaker. Once the fragmented production block is beyond the boundary of firm, the relationship becomes arm’s-length. Among arm’s length transactions, there still exist different degrees of controllability; long-lasting outsourcing arrangements or subcontracting system may be accompanied with a certain level of controllability while competitive bidding in the spot market may have the weakest controllability. In the case of cross-border and arm’s-length fragmentation, we go further in the Northeast direction in the diagram.

== Figure 1 ==

For simplicity, let us assume that the total production cost can be decomposed into the service link cost that is treated as a fixed cost and the production cost per se that is formulated as constant marginal cost. Then the famous diagram, Figure 2, can be drawn. Whether fragmentation saves the total production cost or not depends on the service link cost drawn as the height of the intercept of the total cost curve and the marginal production cost represented by the slope of the total cost curve.

== Figure 2 ==

The economic elements determining the service link cost and the production cost are different between fragmentation along the distance axis and fragmentation along the uncontrollability axis (see Table 1). In the case of fragmentation in terms of the distance, enhancing service link cost is due to geographical distance between the original position and the location of the fragmented production block, which includes transport cost, telecommunication cost, (intra-firm) coordination cost, and others. Possibly lowered production cost, on the other hand, comes from location advantages of

the place where the fragmented production block is sited. Location advantages consist of a long list of economic conditions, and a firm weighs strengths and weaknesses of a candidate location for the fragmented production block. Among various components of location advantages, traditional economic elements such as wage level, factor/resource availability, and technology transferability are of course important. But other elements cannot be neglected such as infrastructure services and the procurement of parts and components. Benefits from agglomeration are particularly important in keeping efficient procurement channels for customized parts and components with strict delivery timing.[2] Policies of the host country's governments, both central and local, are also important. To effectively use such location advantages, reasonably low service link cost is a necessary condition.

== Table 1 ==

Fragmentation along the controllability axis is accompanied with different ingredients for service link cost and marginal production cost. Additional service link cost due to the loss of controlling grips over the fragmented production block includes the cost caused by incomplete information and the lack of credibility as well as the cost due to losing the stability of contracts without effective/efficient dispute settlement mechanism. On the other hand, lowered marginal production cost may come from "de-internalization" advantages or, in another way to say, the counterpart's ownership advantages. When the business partner has better technology and managerial ability in some production processes, outsourcing, rather than doing everything in-house, may reduce the total production cost.

2.2 Sophistication and the link to agglomeration

The discussion so far is a relatively simple form of fragmentation where one parent firm fragments one production block. Actual production networking can be much more complicated, particularly in East Asia; one firm may have multiple fragmented production blocks, and both intra-firm and arm's-length transactions are combined in the sophisticated manner.

The link between fragmentation and agglomeration is important particularly

[2] See, for example, Krugman (1995) and Fujita, Krugman, and Venables (1999) for the agglomeration theory or industrial clustering.

when the relationship among firms is at issue. The forces of fragmentation and agglomeration seem to work in the opposite direction; and it is true when intra-firm location decisions are considered. What happens in East Asia is rather the interacting combination between intra-firm/arm's-length fragmentation and agglomeration of multiple firms. There are several channels for the connection between fragmentation and agglomeration. One channel comes from the increasing returns nature of service links. Service links along both distance and uncontrollability axes typically have strong economies of scale so that production blocks fragmented by many firms tend to locate in some specific place where service link cost is low. The channel is especially important when the host country for fragmented production blocks is a developing country. Overall improvement of economic infrastructure and policy environment covering the whole territory is not an easy task for a developing country, but some specific province, city, or industrial estate can lower the service link cost relatively easily. Shenzhen and Suzhou in China are typical examples of lowered service link cost taking advantage of economies of scale.

Another channel is to use arm's-length fragmentation inside agglomeration. Some transactions such as procurement of customized parts and components require frequent spec changes and exact delivery timing, and thus upstream and downstream firms must locate nearby. Agglomeration of computer parts and components manufacturers in Dongguan in China is an extreme example where more than 30 thousand Taiwanese companies are networking in a just-in-time manner. Shah Alam in Malaysia for electric/electronic machineries and Guangdong in China for copy machines are also the examples.

Once the critical mass of agglomeration is formed, it becomes one of the important elements of location advantages for individual firms considering fragmentation along the distance axis. At the same time, the existence of various kinds of potential business partners generates opportunities for fragmentation along the uncontrollability axis. Such environment also nurtures indigenous firms penetrating into international production/distribution networks once they gain competitiveness.

3. Overview of international trade and FDI patterns in East Asia

3.1 International trade

In the last few decades, East Asian countries rapidly developed intra-regional

trade relationships in both absolute and relative terms.[3] Table 2 presents intra-regional trade of East Asia in terms of exports in 1981, 1991, and 2001. China enlarged intra-regional trade 10.9 times in the period of 1981-2001, ASEAN4 4.7 times, NIEs4 10.2 times, and Japan 4.2 times. As a result, intra-regional trade of East Asia as a whole expanded by 6.7 times in absolute term, while the world trade by, to much less extent, 3.1 times during the same period. More interestingly, East Asian countries relatively strengthened intra-regional trade relationships to the level that intra-regional trade reaches almost half of the total East Asia's trade. What is important here is that, in the process, each country's trade activities involved various countries in the region at different income levels, with heavier weights than before on countries having had weaker trade relationships.

== Table 2 ==

Figures 3 and 4 depict shares of machinery goods and machinery parts and components in total exports and imports of each country at the beginning and the end of the 1990s for major economies in East Asia and other regions.[4] The machinery goods include general machinery (the Harmonized System (HS) 84), electric machinery (HS85), transport equipment (HS86-89), and precision machinery (HS 90-92). Note that the figures organize countries from left to right, beginning with the one with the highest export share of machinery parts and components. Figures 3 and 4 provide several interesting insights. First, the last decade witnesses a sharp increase in machinery trade, particularly in machinery parts and components trade. In the decade, machinery trade as a share of total exports and imports rapidly went up, with the explosive expansion of trade in machinery parts and components; the percentage of machinery goods and that of machinery parts and components reached over 40 percent and 20 percent, respectively, for half of the countries in the figure including East Asian countries. As the fragmentation theory suggests, it is more likely that location decisions are now made at the intra-product level, rather than at the final good or

[3] "East Asia" includes China, ASEAN4 (Association of Southeast Asian Nations 4: Indonesia, the Philippines, Thailand, and Malaysia), and NIEs4 (Newly Industrializing Economies 4: Taiwan, Korea, Hong Kong, and Singapore), and Japan, except in some cases that are mentioned

[4] See Ando and Kimura (2004, Table A.1) for a definition of machinery parts and components.

industry level as the traditional trade theory predicts.

== Figure 3 ==

== Figure 4 ==

Second, inter-industry trade patterns between the North and South or developed and developing countries seem to have considerably changed, particularly in East Asia. At the beginning of the 1990s, most of the countries with relatively high shares of machinery parts and components are developed countries such as Japan, the United States, the United Kingdom, and Germany (Figure 3). In 2000, however, East Asian developing countries moved up to the left side.[5] Although China and Indonesia are still relatively on the right side, they are rapidly moving toward the left side. The Japan's pattern also suggests a drastic change in trade and production patterns in the region. Japan has kept close to 80 percent of machinery share for its exports. Nonetheless, the component of machinery exports apparently changed; while a large portion of its machinery exports is of machinery final goods in 1990, the half of its machinery exports is of machinery parts and components in 2000. Moreover, its share of imports in machinery parts and components increased.

The rapid increase in machinery parts and components trade for both exports and imports suggests the existence and development of active back-and-forth transactions of intermediate goods in the region.[6] As Ando (2004) emphasizes, which decomposes machinery trade of each East Asian country at the disaggregated level into one-way trade, vertical intra-industry trade (IIT), and horizontal IIT in the 1990s, vertical international production sharing became an essential part of each East Asian economy in the 1990s. Although a certain amount of East Asian machinery trade has been stably one-way trade, it rapidly lost the relative importance. Instead, vertical IIT,

[5] See Ando (2004) for the development of trade patterns for each East Asian country throughout the last 10-15 years in terms of commodity composition as well as machinery intermediate goods.

[6] Although the figures show the pattern of each country's trade with the world, we can conclude that active back-and-forth transactions of intermediate goods in the vertical international production chains do exist in the region, considering that half of the East Asia's trade is intra-regional trade with various countries in the region as discussed above.

particularly vertical IIT at the intra-product level, became the important pattern of machinery trade in current East Asia in absolute and relative terms.[7] In East Asia, the vertical production networks have been developed partially with the rapid increase in vertical IIT based on quality differences in the context of vertical IIT theory and, more importantly, partially with the enormous expansion of vertical back-and-forth transactions with value added embodied at different steps of the vertically fragmented production processes across borders in the context of the fragmentation theory.[8]

In other regions, on the other hand, higher shares of machinery trade and those of machinery parts and components trade are observed only for some specific countries such as the U.S., Mexico, Germany, Hungary, and Czech Republic. It suggests the existence of networks in machinery sectors between the U.S. and Mexico and between Germany and Central and Eastern European countries, but these networks are not extensively covering a number of countries in the regions. Other countries, particularly those in Latin America except Mexico, are found on the right side with by far lower shares of machinery exports. In addition, the shares of machinery exports are much lower than those of imports.

3.2 Foreign direct investment

Before moving to the micro data analysis of Japanese corporate firms in the next section, let us briefly review the trend of inward FDI in East Asia on the balance of payment (BOP) basis.[9] Table 3 presents the trend of (a) FDI inflow, (b) FDI stock, and (c) FDI stock as a percentage of GDP in each East Asian country. As the table clearly indicates, East Asia has significantly increased in FDI; FDI stock is US$ 211.6 billions in 1980, US$ 332.5 billions in 1990, and US$ 1129.2 billions in 2000. In particular, ASEAN countries and China have rapidly accumulated FDI in the 1990s. Among ASEAN countries, Malaysia and Thailand started to expand their FDI stock mainly in manufacturing sectors in the latter half of the 1980s, the Philippines and Indonesia in the 1990s. Although Indonesia had FDI stock much larger than that of other ASEAN

[7] While the theoretical literature of intra-industry trade has often focused on horizontal IIT in final products, horizontal IIT holds only a small portion of machinery trade in East Asia, if any, in machinery parts and components. See, for example, Helpman and Krugman (1985) for a study on horizontal IIT.

[8] See, for instance, Falvey (1981), Falvey and Kierzkowski (1987), and Flam and Helpman (1987) for vertical product differentiation in international trade.

[9] See Urata (2004) for recent patterns of FDI flows in East Asia.

countries until the end of the 1990s, the high FDI stock includes large amount of FDI in natural resources sectors such as mining.[10] China began to outstandingly expand its inward FDI in the 1990s, particularly in the latter half of the 1990s. As a result, China's FDI stock exceeded total FDI stock of ASEAN4 in the mid-1990s.

== Table 3 ==

Moreover, the size of FDI in each economy has steadily increased in East Asia except Hong Kong and Indonesia.[11] Considering the economic growth in East Asia, such steady increases in FDI stock-GDP ratios suggest how large the size of FDI has become and how rapidly FDI has accumulated in each East Asian economy, particularly in ASEAN countries in the 1990s and China in the latter half of the 1990s.

4. Observations from Japanese micro data

This section analyzes the behavior of Japanese corporate firms and provides empirical evidences on the features of networking in East Asia.[12] After providing data description of micro data employed in the analysis, the section first investigates characteristics of Japanese firms investing in East Asia. Then, the section analyzes corporate firms' behavior from the viewpoint of Japanese affiliates abroad, focusing on their intra-firm and arm's length transactions.

4.1 Data description

The analysis in this section is based on the two sets of micro data conducted by the Ministry of Economy, Trade, and Industry (METI), Government of Japan (the former name was the Ministry of International Trade and Industry (MITI)): 1) *The*

[10] U.S. FDI stock in 2003, for instance, shows that the mining share is 80 percent and the manufacturing share is only five percent for Indonesia while the manufacturing share is 46 percent for the Philippines, 42 percent for Thailand, and 62 percent for Malaysia. Japanese FDI outflow data also present that a large portion of Japanese FDI in Indonesia goes to the mining sector, while that in other ASEAN countries goes to manufacturing sectors, particularly machinery sectors.

[11] The major reason behind the FDI-GDP ratio outstandingly increased in 1998 in Indonesia is the depreciation of local currency due to Asian crisis, which results in a small GDP in terms of U.S. dollars.

[12] Strictly speaking, "East Asia" in this section includes all Asian countries east of Pakistan. Nonetheless, Japanese FDI to South Asia is minimal.

1996F/Y and 2001F/Y Basic Survey of Business Structure and Activity and 2) *The 1996F/Y and 1999F/Y Survey (the 24th and 27th Survey) of Overseas Business Activities of Japanese Companies*. The first firm-level database provides detailed information on parent firms located in Japan as well as the number, industry, and regional location of their foreign affiliates.[13] Tables 4 to 6 are constructed from this database, where foreign affiliates are defined as those with no less than 20 percent Japanese ownership. The second database presents information on the performance of foreign affiliates of Japanese firms. In particular, the extensive surveys conducted every three years include more detailed information on overseas business activities such as intra-firm and arm's length transactions. In Tables 7 to 9 and Tables A.2 to A.5, which are based on this database, foreign affiliates include both "affiliates abroad" with no less than 10 percent ownership by Japanese parent firms and "affiliates of affiliates abroad" with no less than 50 percent ownership by "affiliates abroad".

The Basic Survey of Business Structure and Activity was first conducted by the MITI for 1991F/Y, for 1994F/Y, and annually since then. The samples in the survey are comprehensive, covering all firms with more than 50 workers, capital of more than 30 million yen, and establishments in mining, manufacturing, wholesale/retail trade, and restaurants. Moreover, the ratios of questionnaire returns are high; the actual ratios are not disclosed, but are probably more than 90 percent. As *the Basic Survey* is designated statistics, firms in the survey must to return the questionnaires under the Statistics Law.[14] On the other hand, *the Survey of Overseas Business Activities of Japanese Companies* has been conducted annually since 1970F/Y. To analyze changes in intra-firm and arm's length relationships, the paper employs the latest available two extensive surveys of the 1996F/Y and 1999 F/Y. Firms targeted by the survey are those with Japanese affiliates abroad, except those in finance, insurance,

[13] Unfortunately, the location of foreign affiliates is not identified on the country basis. In addition, we should note that some of the detailed contents of the questionnaire have changed. A critical change for our research is that the questionnaires from *the 1995F/Y Basic Survey* do not include information on the performance of foreign affiliates, except the number, industry, and regional location of foreign affiliates. Moreover, the questionnaires from *the 1997F/Y Basic Survey* include only East Asia (Asia), Europe, and North America as regional categories. Furthermore, the questionnaire related to outsourcing, in which our interest falls, has slightly changed between 1996F/Y and 2001F/Y surveys.

[14] Statistics collected by the Government of Japan are legally classified into two categories: designated statistics (*shitei toukei*) and approved statistics (*shounin toukei*).

or real estates. Since the survey is approved statistics, the effective return ratios tend to be as low as 60 percent. The industry classification is presented in Table A.1.[15]

4.2 Characteristics of Japanese firms investing in East Asia

This subsection investigates patterns of Japanese firms going to East Asia. To shed light on the features of firms going to East Asia, we include information on those going to North America and Europe.[16] Table 4 presents the number of 1) all sized firms/ 2) SMEs with affiliates in East Asia/North America/Europe and the number of affiliates in East Asia/North America/Europe by the industry of parent firms and by the industry of affiliates. In 2000, 3,773 out of 27,655 firms located in Japan (in the data set) totally have 18,943 foreign affiliates. Among them, 2,994 firms have 10,224 affiliates in East Asia. That is, as many as 80 percent of the Japanese all sized firms going abroad has at least one affiliate in East Asia, and more than half of their foreign affiliates are located in East Asia.

== Table 4 ==

Japanese manufacturing parent firms, particularly machinery parent firms are active investors in East Asia; close to 70 percent of the Japanese firms with affiliates in East Asia are in manufacturing sectors (Industries 120-340) and half of them are in machinery sectors (290-320). Moreover, Japanese manufacturing affiliates, regardless of the industries of their parent firms, account for 60 percent of the total Japanese affiliates in the region, while 38 percent for North America and 31 percent for Europe. Considering that the number of affiliates increased from 9,132 in 1995 to 10,224 in 2000 in East Asia[17] and that the manufacturing share remained the same, manufacturing activities of Japanese firms are dominant and tend to be intensified in East Asia.[18]

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[15] Since the industry classification of *the Survey of Overseas Business Activities of Japanese Companies* is different from that of *the Basic Survey*, the former is matched with the latter.

[16] As mentioned above, Japanese affiliates in Latin America cannot be unfortunately identified from *the 1997F/Y Basic Survey.* See Kimura and Ando (2003) for a comparative study on patterns of Japanese MNEs in Latin America and East Asia.

[17] The number of Japanese affiliates decreased in North America and Europe during the same period.

[18] Although the figures are based on the non-panel dataset, both of the panel and non-panel datasets present the tendency of intensifying manufacturing activities in East Asia.

Japanese SMEs with regular workers of less than 300 have played an important role in such an expansion of manufacturing activities in East Asia. The portion of SMEs in all sized parent firms with affiliates in East Asia reaches 45 percent (1,348 out of 2,994 firms in 2000), which is much higher than the shares in the case of North America (29 percent) and Europe (17 percent). In addition, Japanese manufacturing affiliates of SMEs account for 67 percent of total Japanese affiliates in the region. Such active FDI by Japanese SMEs has contributed to forming a critical mass of industrial clusters in manufacturing sectors in East Asia.

Parent firms in general have various activities across industries and establish foreign affiliates in order to conduct a subset of those activities.[19] Japanese manufacturing parent firms have 75 percent of their total affiliates in East Asia in manufacturing sectors. The corresponding portion is even higher for manufacturing SMEs: 87 percent of their affiliates are manufacturing. Such behavior is a typical strategy for firms involved in manufacturing activities, aimed at supplying intermediate goods for other firms and/or for their own affiliates, that is, a sort of "vertical FDI".[20] Even non-manufacturing firms, though most of them are wholesales firms (including wholesales trading companies called *Sogoshousha* in Japanese), have 35 percent of their total affiliates in East Asia in manufacturing sectors, contributing to the development of industrial clusters. Japanese manufacturing parent firms also have non-manufacturing affiliates in East Asia (25 percent of total affiliates of manufacturing firms), particularly in the wholesales sector: (17 percent). Another strategy for firms investing in East Asia is to establish global distribution networks by internalizing wholesale trade activities.

Firms investing abroad, of course, do not necessarily establish affiliates only in one region. Table 5 provides patterns of foreign affiliates' holding in multiple regions in 2000F/Y. Among firms going to East Asia, 61 percent of them have

[19] A firm often has various activities at the same time. The industrial classification of a firm located in Japan is determined by the largest activities the concerned firm conducts in terms of the value of sales.

[20] Japanese manufacturing firms with affiliates in North America have the share of non-manufacturing affiliates, 49 percent, and those with affiliates in Europe have the share 60 percent. Even manufacturing SMEs have half of their affiliates in non-manufacturing sectors such as the wholesales sector in these regions. It indicates that Japanese manufacturing firms often go to North America or Europe to sell their products or to produce goods to be sold there; Japanese FDI in these regions is a sort of "horizontal FDI".

affiliate(s) only in East Asia[21], 36 percent have at least one affiliate in North America, 25 percent have in Europe, and 21 percent have in both North America and Europe.[22] The firm size expressed by the average number of workers at home apparently shows that most of the firms with affiliates only in East Asia are likely to be SMEs, while the firms with affiliates in multiple regions including East Asia are large in size at home.

== Table 5 ==

Now, let us formally analyze the characteristics of Japanese parent firms investing in East Asia. To shed light on those of Japanese parent firms going to East Asia, logit regression analysis is separately conducted for the cases of Japanese firms investing abroad (regression No.1), those investing in East Asia (regression No.2), those investing in North America (regression No.3), and those investing in Europe (regression No.4).[23] Moreover, considering that Japanese SMEs are active investors in East Asia, the logit regression analysis is conducted for the data sample with Japanese SMEs and that with Japanese large firms. The independent variables are the number of regular workers, tangible assets per regular workers, foreign sales, research and development (R&D) expenditure, and outsourcing dummy. Outsourcing is the most interesting one. Whether the firm has outsourcing activities expresses the firms' behavior toward flexible internalization decision and the fragmentation of production though we cannot distinguish outsourcing activities in a domestic market from those in foreign markets.[24]

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[21] Strictly speaking, 61 percent of the firms investing in East Asia have affiliates in East Asia but not in either North America or Europe.

[22] The shares in terms of the number of firms with affiliates in other regions more clearly tell us that many of them have affiliates also in East Asia: 67 percent of the firms investing in North America and 80 percent of the firms investing in Europe have affiliate(s) in East Asia.

[23] Firms investing abroad do not necessarily establish affiliates only in one region as discussed above. Moreover, our main purpose of this analysis here is not to examine the differences among multiple patterns of foreign affiliates' holdings (location advantage in Dunning's OLI framework) but to capture the characteristics of Japanese firms investing in East Asia (ownership advantage). Thus, we apply logit estimation for each case and compare the case for East Asia with others.

[24] The information used to construct data for 1995 and 2000 are not exactly same due to the changes in questionnaires. In the case of 1995, the questionnaire strictly limits to the production commission in the production of manufacturing goods. On the other hand, in the case of 2000, the questionnaire asks the outsourcing expenditure embodied in production cost, sales cost, and so on.

Since firms investing abroad would have more flexible behavior toward de-internalization of their production processes to outsource some fragments of production blocs, the coefficient for outsourcing dummy is expected to be positive. The number of regular workers at home is included as a variable to control the firm size, and the coefficient for the firm size is expected to be positive. Tangible assets per worker, foreign sales, and R&D expenditure are included as proxy variables of firm specific assets. As a firm going abroad would have superior technology or more capital-intensive technology, international competitiveness enough to go abroad and/or learning effects from activities abroad, and intangible assets, their coefficients are expected to be positive.

Table 6 reports the results of logit regression analysis for (a) Japanese SMEs and (b) Japanese large firms in 1995 and 2000. The results for regression No.1 show that the coefficients for the firm size, tangible assets per worker, foreign sales, R&D, and outsourcing dummy are all positive and statistically significant. It indicates that firms going abroad are likely to have large employment size at home, superior technology, large foreign sales, and in-house R&D activities and to more flexibly de-internalize their production processes to outsource the fragments of production blocs.[25] A comparison of the results for East Asia with those for North America and Europe highlights two features of firms investing in East Asia; first, the coefficients for the firm size, capital-intensive technology, and R&D are smaller. It implies that firms going to East Asia are relatively small as we have descriptively discussed, and thus less capital intensive and less R&D intensive, compared with firms going to North America and those going to Europe.

== Table 6 ==

Second, more interestingly, the coefficients for outsourcing dummy are larger. Furthermore, while the coefficients for outsourcing dummy in the regressions in 1995 are positive and statistically significant in all the cases, those in the regressions in 2000 are not significant any more in the case of North America for (a) SMEs and the case of

[25] Variables for foreign sales and R&D expenditure are a ratio of foreign sales to the total sales and a dummy variable of in-house R&D, respectively. The estimations with dummy variables for foreign sales and R&D expenditure instead of the ratios are also conducted. They however provide similar results.

Europe for (b) large firms, and the coefficient is rather negative though not significant in the case of Europe for (a) SMEs. It suggests that Japanese firms going to East Asia are likely to more flexibly de-internalize their production processes and conduct outsourcing activities than those going to other regions such as North America and Europe. This is particularly true for Japanese SMEs investing in East Asia, and such a trend seems to be strengthened. The analysis confirms that Japanese corporate firms have fragmented their production processes and contributed to forming and further developing production networks in East Asia.

4.3 Intra-firm and arm's length transactions by Japanese affiliates in East Asia

Let us move to the empirical analysis of corporate firms' behavior from the viewpoint of Japanese affiliates abroad. Table 7 presents the number of Japanese affiliates in East Asia and their sales/purchases by sector in 1995 and 1998.[26] Table 7 also shows shares of by-destination sales in total sales and by-origin purchases in total purchases by Japanese affiliates in East Asia and intra-firm transaction ratios of by-destination sales/ by-origin purchases. Similarly, Tables A.2 to A.4 represent the performance of Japanese affiliates in NIEs4, ASEAN4, and China, respectively. Table 8 summarizes the shares of intra-firm and arm's length transactions in total sales/purchases by Japanese manufacturing affiliates in East Asia, NIEs4, ASEAN4, and China, estimated from Table 7 and Tables A.2 to A.4. To highlight the features of East Asia, the same analysis is also conducted for Japanese affiliates in Latin America. Considering that Japanese manufacturing affiliates in Mexico and Brazil accounts for around 80 percent in terms of both the number of Japanese manufacturing affiliates in the region and the share in their total sales/purchases, Table 9 provides the shares of intra-firm and arm's length transactions in total sales/purchases by Japanese affiliates in Latin America, Mexico, and Brazil, estimated from Table A.5.[27]

== Table 7 ==

[26] Note that the data for 1998 no doubt reflect the influence of Asian crisis, particularly for the ASEAN countries.

[27] Even for firms in the U.S., Mexico and Brazil are the main locations for their manufacturing activities in Latin America, particularly in machinery sectors. See Kimura and Ando (2004a) and Lipsey (2004) for the performance of U.S. affiliates in Latin America, with a comparison with that in East Asia.

== Table 8 ==

== Table 9 ==

They provide various supporting evidences on the patterns of developing intra-regional production networks in East Asia. First, transactions of Japanese manufacturing affiliates in East Asia do involve East Asian countries other than the local and Japan, and the intra-regional production sharing in the region is being intensified through intra-firm and arm's length fragmentation. The products of Japanese manufacturing affiliates in East Asia go not only to the local market or Japan but also to other East Asian countries: in 1998, for instance, 49 percent for the local market, 25 percent for Japan, and 17 percent for intra-regional countries except local and Japan. The products purchased by Japanese manufacturing affiliates in East Asia also come not only from the local market and Japan but also from other intra-regional countries: in 1998, 43 percent for local, 35 percent for Japan, and 19 percent for other East Asian countries. That is, more than 90 percent of the sales/purchases by Japanese manufacturing affiliates in East Asia go to/ come from the East Asian countries including countries other than the local and Japan, indicating the existence of the intra-regional international production networks in East Asia.[28]

Moreover, the shares of intra-regional countries other than local and Japan in total sales/ purchases went up from 13 percent in 1995 to 17 percent in 1998 for sales and from 14 percent to 19 percent for purchases through both intra-firm and arm's length transactions. Combined with increasing total shares of East Asia from 91 percent to 92 percent for sales and from 95 percent to 97 percent for purchases, it suggests the development of the international production sharing among countries in East Asia.

Latin America presents a sharp contrast with East Asia. The shares of intra-regional countries in total sales and purchases are much lower than those for the case of East Asia and are rather decreasing: the shares in 1995 and 1998 are three percent and two percent for sales and are 1.5 percent and 1.1 percent for purchases, respectively. The production relationships of Japanese affiliates in Mexico with other Latin American countries are even weak: the shares are one to two percent for sales and are almost zero

[28] A similar pattern is observed for the U.S. affiliates in East Asia. In 1999, for instance, 17 percent of their products go to other East Asian countries.

for purchases.[29] Instead, the shares of North America are much larger for both sales and purchases than the cases of Latin America as a whole: the shares in 1995 and 1998 are 44 percent (eight percent for Latin America) and 29 percent (12 percent) for sales and 22 percent (nine percent) and 16 percent (nine percent) for purchases, respectively. These indicate that intra-regional production networks involving many countries in the region cannot be observed in Latin America, except the ones between the U.S. and Mexico.

Second, Japanese manufacturing affiliates in East Asia tend to gradually substitute arm's-length transactions for intra-firm transactions in the process of developing production networking in the region. The shares of intra-firm sales went down from 83 percent in 1995 to 73 percent in 1998 for Japan, from 16 percent to eight percent for the local market, from 49 percent to 47 percent for other East Asian countries, and the shares of intra-firm purchases decreased from 77 percent to 59 percent for Japan and from 15 percent to seven percent for the local market (Table 7). In addition, the shares of intra-firm transactions in total sales/ purchases in East Asia decreased from 31 percent to 30 percent for sales and from 43 percent to 33 percent for purchases, while the shares of arm's length transactions went up from 59 percent to 61 percent for sales and from 52 percent to 65 percent for purchases (Table 8). These figures confirm that intra-firm transactions by Japanese affiliates in East Asia are gradually substituted by arm's-length transactions, at least in the late 1990s. Although it is still often too much emphasized that activities of Japanese MNEs heavily depends on *Keiretsu* or *Shitauke* relationships, firms in East Asia, including Japanese firms, have been effectively utilizing both intra-firm and arm's-length transactions.

Japanese manufacturing affiliates in Latin America, on the other hand, rather increased in the shares of arm's length transactions on the sales side from 1995 to 1998 though decreased in the shares on the purchases side.[30] The production networks between Mexico and the U.S. also heavily depend on intra-firm transactions; in 1998, 60 percent to 70 percent of total sales to/purchases from the U.S. by Japanese manufacturing affiliates in Mexico are intra-firm transactions. The performance of

[29] A similar pattern is observed for the U.S. affiliates in Latin America again. In the case of the U.S. affiliates in Mexico in 1999, only five percent of their products go to other Latin American countries.

[30] The shares of intra-firm sales went up from 25 percent to 73 percent for Japan, from three percent to nine percent for the local market, and from 29 percent to 39 percent for intra-regional countries.

U.S. affiliates in Mexico also confirms that intra-firm transactions are dominant among the transactions between Mexico and the U.S.; in 1999, around 30 percent of the goods produced by the U.S. affiliates in Mexico go to the U.S., and over 90 percent of them goes to their parent firms in the U.S. Third, the purchases from Japan by Japanese manufacturing affiliates in East Asia, particularly the intra-firm purchases from Japan, tend to be replaced by the local arm's length purchases and/or the purchases from other East Asian countries through intra-firm and/or arm's length fragmentation. While the shares of intra-firm purchases from Japan in total purchases lowered from 31 percent to 21 percent, and the shares of local intra-firm purchases from six percent to three percent, the shares of local arm's length purchases went up from 34 percent to 40 percent (Table 8). In other words, combined with increased shares of purchases from other East Asia, the intra-firm purchases from Japan are substituted by arm's length purchases in the local market, not intra-firm purchases there, and by intra-firm and arm's length purchases from other East Asian countries. Note that purchases from intra-regional countries (other than the local market and Japan) include both intra-firm and arm's length transactions, and the weights between them are different among countries.[31]

In the case of China, while the share of intra-firm purchases from Japan drastically fell from 39 percent in 1995 to 19 percent in 1998, the share of local arm's length purchases outstandingly increased from 23 percent to 42 percent. Considering that the intra-region's share slightly decreased, intra-firm purchases from Japan were mainly replaced by the local arm's length purchases. Remember that China has rapidly accumulated FDI in the latter half of the 1990s as discussed in Section 3. Moreover, as Table A.4 clearly presents, the performance of Japanese manufacturing affiliates in China drastically enlarged from 732 billion JPY in 1995 to 1,757 billion JPY in 1998 for sales and from 430 billion JPY in 1995 to 1,062 billion JPY in 1998 for purchases. The shift from intra-firm purchases from Japan to local arm's length purchases would reflect the lowering service link costs and more developed industrial clusters (agglomeration) involving MNEs of different nationalities and indigenous firms becoming more competitive than before in China.

[31] The arm's length's share is greater for ASEAN and NIEs countries, while the intra-firm's share is much greater for China; the shares of intra-regional intra-firm and arm's length purchases in total in 1998 for instance are 15 percent and four percent for China, nine percent and 14 percent for ASEAN4, and eight percent and nine percent for NIEs4, respectively.

Fourth, the patterns of by-destination sales and by-origin purchases for the electric machinery sector and the transport equipment sector are different from the patterns for machinery sectors as a whole. The electric machinery sector accounts for about half of machinery sectors in terms of the number of affiliates in East Asia and in terms of sales/purchases (Table 7). The shares of intra-region for both sales and purchases in the electric machinery sector are much larger than the shares for machinery sectors on average, and increased from 20 percent (13 percent for machinery sectors on average) to 25 percent (17 percent) for sales and from 25 percent (14 percent) to 26 percent (19 percent) for purchases. It indicates that intra-regional back-and-forth transactions are more active than other machinery sectors and are being intensified in the electric machinery sector. On the other hand, the share of local sales is much larger, and the shares of intra-regional transactions in the transport equipment sector are much smaller than the shares for machinery sectors on average. Although the share of intra-regional transactions is indeed increasing from one percent in 1995 to two percent in 1998 for sales and from one percent to six percent for purchases, relationships across borders in the region are still weak compared with other machinery sectors, and the local market is the main destination of the products of Japanese affiliates in East Asia.

What to be addressed here is that the international production networks do make East Asia more competitive, particularly in the electric machinery sector. If we look at purchases by Japanese manufacturing affiliates in Mexico, for instance, East Asia's share in their total purchases rapidly increased from three percent (six percent for the electric machinery sector) in 1995 to 11 percent (20 percent) in 1998 while North America's share dropped from 22 percent (eight percent) to 16 percent (three percent) as Table 8 clearly shows. The shares of East Asia including Japan are even higher; 36 percent (38 percent for the electric machinery sector) in 1995 and 43 percent (62 percent) in 1998.[32] In addition, the arm's length purchases from East Asia as a share of total purchases from East Asia increased from 5.2 percent to 45.2 percent (Table 7). We address that East Asia as a region is becoming more competitive as suppliers in manufacturing sectors of the global markets, according to the development of the international production networks with features above.

5 Policy environment in East Asia

[32] The shares of East Asia including Japan increased for Japanese affiliates in the electric machinery sector in Latin America as a whole and in Brazil, too.

As a background of such drastic changes in trade and production patterns in East Asian countries, there is a shift in their development strategies. Most of the East Asian economies have traditionally applied the so-called "dual track approach," that is, an approach trying to foster both import-substituting industries and export-oriented industries at the same time. From the 1970s to the mid-1980s or the early 1990s, they invited selective FDI primarily in import-substituting industries. While they utilized selective FDI for export promotion as well, they insulated potentially competing domestic industries from the activities of MNEs by implementing policies that restrict such activities within geographically segregated places, i.e., typically caged export-processing zones. From the latter half of the 1980s in Malaysia and Thailand and from the early 1990s in the Philippines, Indonesia, and China, however, development strategies began to shift the weights from import substitution to export orientation and to change FDI hosting policy from selective acceptance policy to basically "accept everybody" policy. They started trying to host as many foreign companies as possible, formulate industrial clusters, and participate in the international production networks, while still keeping trade protection for import-substituting industries.

To invite export-oriented foreign companies, a country must provide the world's best or second best location advantages for incoming investors. Trade protection, of course, negatively affects location advantages. So as to partially neutralize negative effects of import-substituting industry protection, the East Asian countries have introduced various types of policies and measures to promote exports. One of the key measures implemented in East Asia is the extensive use of duty drawback system, i.e., the system of refunds of duties and indirect taxes on imported inputs in export production. Most export-oriented MNEs pay little import tariffs on their imported intermediate goods under this system and are able to more easily spread their production processes within the region beyond national border on the basis of cost and market considerations.

East Asian countries also implemented various types of FDI facilitation measures. They concentrated their public resources on the development of economic infrastructure including roads, ports, electricity and water supply, telecommunications, and industrial estate services, which helped to reduce service link costs and promote the creation of industrial clusters. At the same time, they have improved the services of FDI-hosting agencies. For example, the Board of Investment (BOI) of the Thai Government paid a lot of effort to attract FDI just after the burst of Asian currency crisis

by establishing themselves as a "one-stop shop for services." As a result, FDI inflows to Thailand actually recorded the highest in 1998 though the increase was partially due to cross-border mergers and acquisitions (M&As).[33] The East Asian governments at city/region/country levels have made efforts to improve economic infrastructure and industrial estate services by competing with others to promote FDI to their own area.

6. Conclusion

This paper proposed the analytical framework of two-dimensional fragmentation and applied it for interpreting international production/distribution networks particularly developed in East Asia. Our exercise revealed that the two axes of fragmentation, namely geographical distance and uncontrollability, provided valuable viewpoints in examining the entangled mechanics of networking with both intra-firm and arm's-length fragmentation and in deepening our understanding on the relationship between fragmentation and agglomeration.

The framework of decomposing cost structure is especially useful in identifying background economic elements allowing active networking in East Asia, most of which are not directly measurable in statistics. As for fragmentation along the distance axis, the reduction of service link cost in East Asia seems to work well in providing favorable environment for overcoming geographical distance. A symbolic example is rapid construction of container yards and highway networks in the past decade, which facilitates explosive increase in container transportation backed up by various trade facilitation measures. The lowered service link cost enables firms to take advantage of differences in location advantages across countries in East Asia with widely different income levels and development stages.

As for fragmentation along the uncontrollability axis, the reduction of service link cost again seems to be the key in the development of production/distribution networks. Although it is difficult to identify the exact counterparts, a number of case studies and field works strongly support the view that arm's-length transactions include not only among firms with same firm nationality (such as transactions among Japanese firms) but also firms with different firm nationalities. As a background, both governments and private companies in the region made a number of efforts for overcoming or at least mitigating the cost of uncontrollability; the creation of innovative

[33] Another example is Malaysia. See Kimura and Ando (2004b) for further discussion on host countries' policy environment in East Asia.

contract forms such as OEM contracts and EMS firms, dissemination of information on potential vendors by JETRO (Japan External Trade Organization) and other industrial organizations, FDI facilitation services by host countries' government agencies, and the improvement of legal system enhancing the stability of private contracts are examples of such efforts. The room for reducing production cost per se comes from differences in ownership advantages such as technology and managerial ability. The existence of firms with various firm nationalities, particularly firms from Taiwan and Hong Kong, enhances the choices of potential business partners. The development of local firms, particularly in China, is also a factor to provide more flexibility in internalization decisions by multinational enterprises. The development of arm's-length transactions goes hand in hand with the development of agglomeration.

In the effort of drawing lessons for developing countries in other regions, the importance of policies should be emphasized. Fundamental transformation of development strategies so as to host network-forming FDI and help form agglomeration is the key for taking advantage of the forces of globalizing corporate activities for economic development. Intentional effort to reduce two kinds of service link costs is also effective. Going beyond the traditional infant industry protection argument, we economists have to define the new role of government in this globalization era.

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Figure 1 Two dimensions of fragmentation

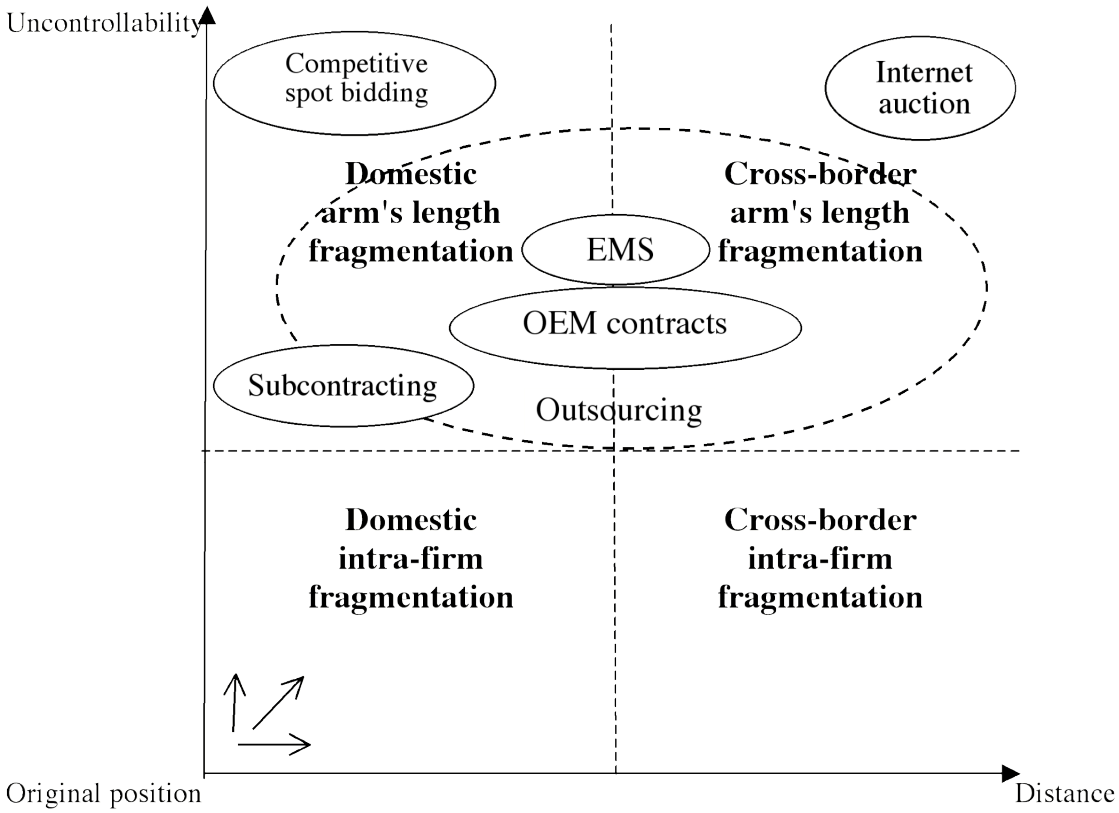


Figure 2 Total cost reduction with fragmentation

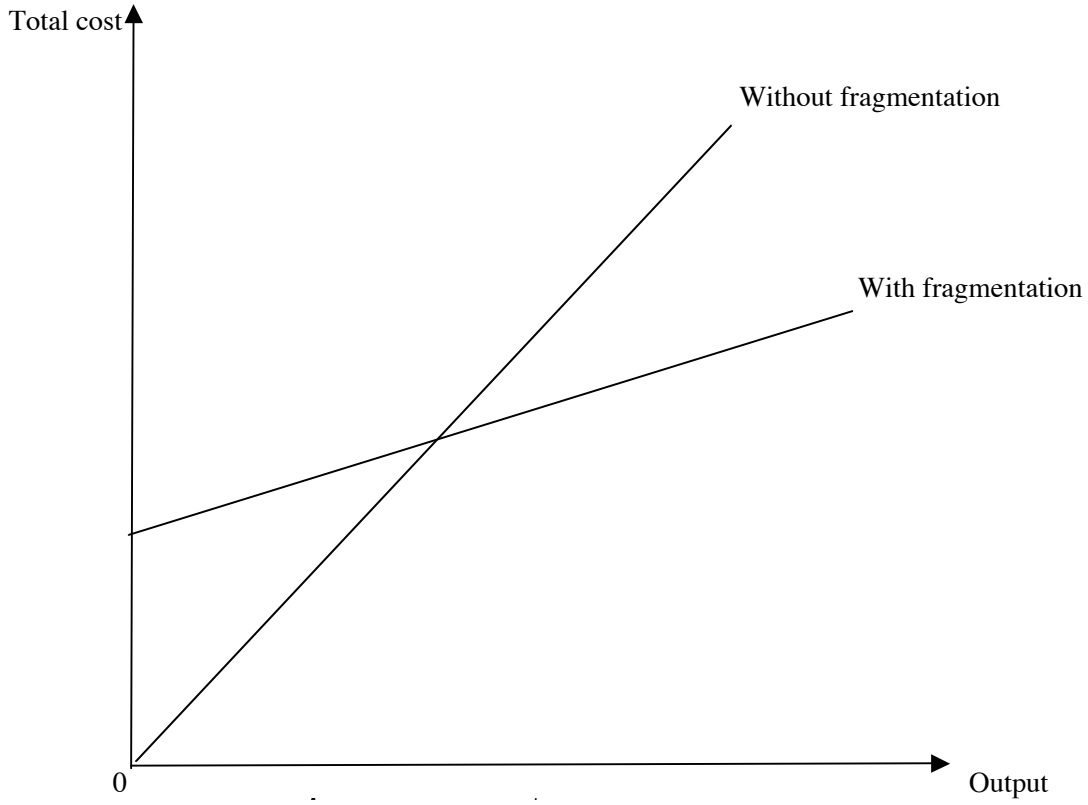


Table 1 Cost structure of two-dimensional fragmentation

	Service link cost	Production cost *per se*
Fragmentation (distance)	cost due to geographical distance	location advantages
Fragmentation (uncontrollability)	cost due to weaker controllability	"de-internalization" advantages (counterpart's ownership advantages)

Table 2 Development of intra-regional trade in East Asia

(100 million US$, %)

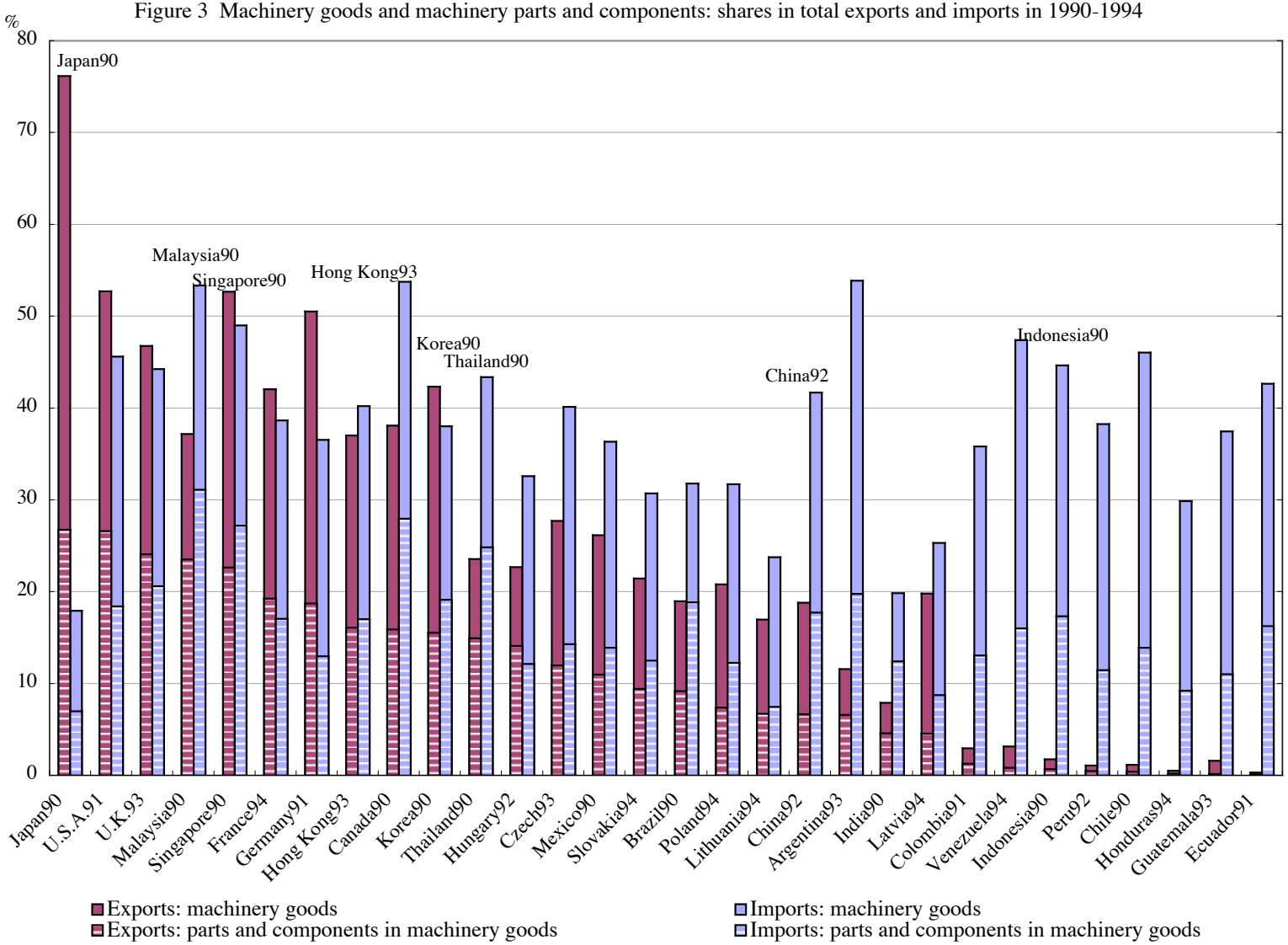
	1981		1991		2001	
	Value	Share	Value	Share	Value	Share
(a) East Asia						
East Asia (region)	1,045	34.6	3,331	42.0	7,028	46.9
World	3,019	100.0	7,928	100.0	14,972	100.0
(b) China						
Japan	47	28.5	103	14.3	450	16.9
China	-		-		-	
NIEs4	60	36.3	369	51.4	698	26.2
Hong Kong from China	53	32.1	321	44.7	465	17.5
ASEAN4	7	4.2	21	2.9	100	3.8
East Asia (total)	114	69.0	493	68.6	1,248	46.9
World	165	100.0	718	100.0	2,661	100.0
(c) ASEAN4						
Japan	162	34.6	231	22.9	403	16.7
China	4	0.9	23	2.3	110	4.6
NIEs4	89	19.0	234	23.2	588	24.3
ASEAN4 (region)	17	3.6	41	4.1	180	7.5
East Asia (total)	272	58.2	529	52.5	1,281	53.0
World	468	100.0	1,008	100.0	2,416	100.0

	1981		1991		2001	
	Value	Share	Value	Share	Value	Share
(d) NIEs4						
Japan	91	10.5	320	10.5	499	8.5
China	22	2.5	286	9.4	984	16.8
China from Hong Kong	20	2.3	267	8.7	701	12.0
NIEs4 (region)	83	9.6	417	13.6	871	14.9
ASEAN4	92	10.6	277	9.1	586	10.0
East Asia (total)	288	33.3	1,300	42.5	2,940	50.2
World	866	100.0	3,057	100.0	5,861	100.0
(e) Japan						
Japan	-		-		-	
China	51	3.4	86	2.7	309	7.7
NIEs4	213	14.0	669	21.3	875	21.7
ASEAN4	107	7.0	254	8.1	375	9.3
East Asia (total)	371	24.4	1,009	32.1	1,559	38.6
World	1,520	100.0	3,145	100.0	4,034	100.0

Data source: Ando (2004). (Original data source: author's calculation, based on Ministry of Economy, Trade and Industry (2004) *White Paper on International Trade 2003;* UN Comtrade online; Council for International Economic Cooperation and Development (2004) *Taiwan Statistics Data Book 2003*).

Note: Intra-regional trade are expressed in terms of exports. East Asia includes China, ASEAN4, NIEs4, and Japan.

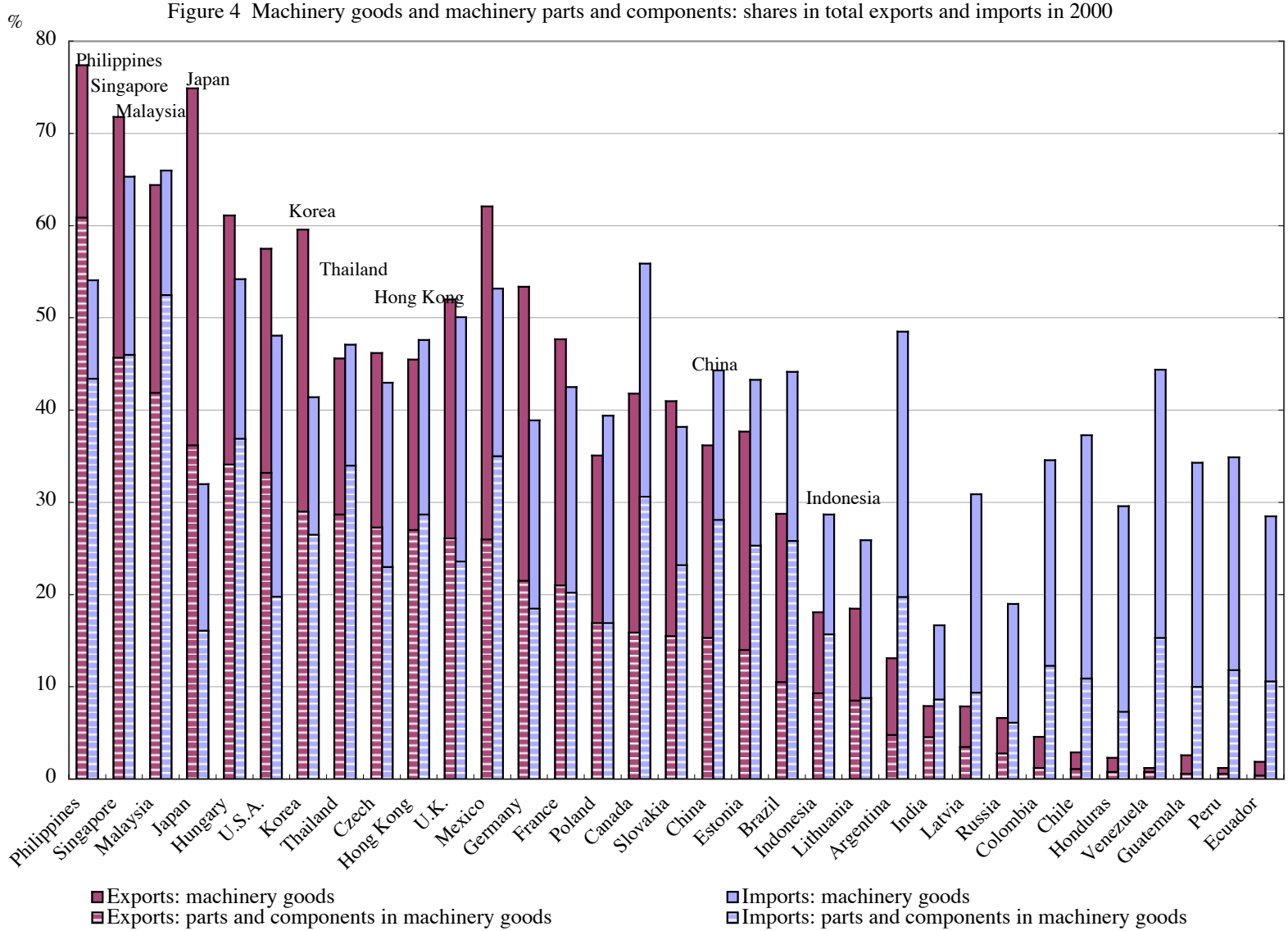
Figure 3 Machinery goods and machinery parts and components: shares in total exports and imports in 1990-1994



Data source: Ando (2004). (Original data source: author's calculation, based on UN COMTRADE online.)

Note: data is of 1990 or close to 1990. For instance, Japan90 and U.S.A.91 indicate that data is of 1990 for Japan and 1991 for U.S.A. Estonia, Philippines, and Russia are not included in Figure 1 though included in Figure 2, due to the lack of available data of 1990-1994.

Figure 4 Machinery goods and machinery parts and components: shares in total exports and imports in 2000



Data source: Ando and Kimura (2004). (Original data source: authors' calculation, based on UN COMTRADE for exports of Hong Kong and exports and imports for Russia and Slovakia and UN PC-TAS for others).

Note: Data for Russia and Slovakia is of 1999 due to the lack of data of 2000.

Table 3 Inward FDI flows and stock in East Asia by country

	1980	1985	1990	1995	2000	2002
(a) FDI inflows (millions of US dollars)						
China	57	1,659	3,487	35,849	40,772	52,700
Indonesia	180	310	1,092	4,346	-4,550	-1,523
Philippines	-106	12	550	1,577	1,345	1,111
Thailand	189	164	2,575	2,070	3,350	1,068
Malaysia	934	695	2,611	5,815	3,788	3,203
Korea	6	234	789	1,776	9,283	1,972
Taiwan	166	342	1,330	1,559	4,928	1,445
Hong Kong	710	-267	3,275	6,213	61,939	13,718
Singapore	1,236	1,047	5,575	11,503	12,464	7,655
East Asia	3,372	4,194	21,283	70,708	133,319	81,348
(b) FDI inward stock (millions of US dollars)						
China	6,251	10,499	24,762	137,435	348,346	447,892
Indonesia	10,274	24,971	38,883	50,601	60,638	55,836
Philippines	1,281	2,601	3,268	6,086	9,081	11,579
Thailand	981	1,999	8,209	17,452	24,468	30,226
Malaysia	5,169	7,388	10,318	28,731	52,747	56,505
Korea	1,327	2,160	5,186	9,451	37,106	43,689
Taiwan	2,405	2,930	9,735	15,736	27,924	33,478
Hong Kong	177,755	183,219	201,652	227,532	455,469	433,065
Singapore	6,203	13,016	30,468	65,644	113,431	124,083
East Asia	211,646	248,783	332,481	558,668	1,129,210	1,236,353
(b) FDI inward stock / GDP (%)						
China	3	3	7	20	32	36
Indonesia	13	28	34	25	40	32
Philippines	4	8	7	8	12	15
Thailand	3	5	10	10	20	24
Malaysia	21	23	23	32	59	59
Korea	2	2	2	2	8	9
Taiwan	6	5	6	6	9	12
Hong Kong	624	525	270	163	275	266
Singapore	53	74	83	79	124	143

Data source: UNCTAD, *FDI database* .

Note: East Asia includes China, ASEAN4, and NIEs4. Data is on the BOP basis.

Table 4 Sectoral patterns of Japanese parent firms and their affiliates, 2000 F/Y

Industry of parent firm	Number of **all sized** parent firms	Number of total affiliates	Industry of affiliate: Manufacturing: Number of affiliates	Share	share (machinery)	Non-manufacturing: Number of affiliates	Share	share (wholesales)	Number of parent **SMEs**	Number of total affiliates	Industry of affiliate: Manufacturing: Number of affiliates	Share	share (machinery)	Non-manufacturing: Number of affiliates	Share	share (wholesales)
			(a-1) East Asia								(a-2) East Asia					
Manufacturing	2,050	6,296	4,726	75.1	39.7	1,570	24.9	17.3	874	1,295	1,123	86.7	36.9	172	13.3	10.7
Machinery (290-320)	1,012	3,386	2,478	73.2	69.2	908	26.8	18.8	385	590	503	85.3	76.9	87	14.7	11.5
290	286	810	523	64.6	57.4	287	35.4	26.4	129	179	149	83.2	70.9	30	16.8	12.8
300	429	1,598	1,158	72.5	69.5	440	27.5	19.3	181	303	256	84.5	78.2	47	15.5	12.2
310	222	752	638	84.8	81.9	114	15.2	7.8	46	61	57	93.4	83.6	4	6.6	4.9
320	75	226	159	70.4	66.8	67	29.6	24.8	29	47	41	87.2	83.0	6	12.8	10.6
Non-manufacturing	944	3,928	1,356	34.5	9.8	2,572	65.5	39.2	474	870	332	38.2	9.7	538	61.8	46.8
Wholesales (480)	697	3,350	1,277	38.1	10.8	2,073	61.9	45.3	410	774	312	40.3	9.6	462	59.7	51.8
Total	2,994	10,224	6,082	59.5	28.2	4,142	40.5	25.7	1,348	2,165	1,455	67.2	26.0	710	32.8	25.2
Share in total	79.4	54.0							77.5	69.5						
			(b-1) North America								(b-2) North America					
Manufacturing	1,105	2,150	1091	50.7	30.7	1,059	49.3	28.6	272	302	157	52.0	27.8	145	48.0	33.4
Machinery (290-320)	645	1,307	663	50.7	47.7	644	49.3	31.8	165	181	88	48.6	44.8	93	51.4	39.8
290	205	411	181	44.0	39.9	230	56.0	38.9	67	75	32	42.7	41.3	43	57.3	40.0
300	215	434	187	43.1	38.7	247	56.9	38.5	63	70	36	51.4	42.9	34	48.6	41.4
310	178	383	264	68.9	68.7	119	31.1	14.1	21	22	14	63.6	63.6	8	36.4	31.8
320	47	79	31	39.2	36.7	48	60.8	44.3	14	14	6	42.9	42.9	8	57.1	42.9
Non-manufacturing	487	1,349	243	18.0	6.1	1,106	82.0	41.9	186	231	34	14.7	6.9	197	85.3	51.1
Wholesales (480)	340	1,085	225	20.7	6.6	860	79.3	49.9	148	186	29	15.6	7.5	157	84.4	61.3
Total	1,592	3,499	1334	38.1	21.2	2,165	61.9	33.7	458	533	191	35.8	18.8	342	64.2	41.1
Share in total	42.2	18.5							26.3	17.1						
			(c-1) Europe								(c-2) Europe					
Manufacturing	650	1,896	758	40.0	24.9	1,138	60.0	41.6	80	96	47	49.0	22.9	49	51.0	36.5
Machinery (290-320)	399	1,249	474	38.0	36.1	775	62.0	46.2	46	51	23	45.1	41.2	28	54.9	45.1
290	130	468	141	30.1	27.8	327	69.9	56.8	23	26	10	38.5	38.5	16	61.5	46.2
300	148	436	172	39.4	38.1	264	60.6	44.3	19	20	11	55.0	45.0	9	45.0	45.0
310	87	256	123	48.0	45.7	133	52.0	30.5	1	1	0	0.0	0.0	1	100.0	0.0
320	34	89	38	42.7	42.7	51	57.3	44.9	3	4	2	50.0	50.0	2	50.0	50.0
Non-manufacturing	264	1,017	143	14.1	6.5	874	85.9	51.1	74	93	14	15.1	5.4	79	84.9	62.4
Wholesales (480)	193	871	136	15.6	6.9	735	84.4	58.4	65	83	14	16.9	6.0	69	83.1	66.3
Total	914	2,913	901	30.9	18.5	2,012	69.1	44.9	154	189	61	32.3	14.3	128	67.7	49.2
Share in total	24.2	15.4							8.9	6.1						

Data source: Authors' calculation, based on METI database.

Notes: The figures for (a-1, b-1, c-1) are those of all sized parent firms and figures for (a-2, b-2, c-2) are of parent SMEs. The figures for "share in total" indicate (1) shares in total number of all sized parent firms investing abroad and their foreign affiliates and (2) shares in total number of parent SMEs investing abroad and their foreign affiliates. The figures for "share" for manufacturing, machinery (290-320), non-manufacturing, and wholesales express the shares of manufacturing affiliates, machinery affiliates, non-manufacturing affiliates, and wholesales affiliates in total number of affiliates of all sized firms/SMEs in each sectoral category.

Table 5 Patterns of foreign affiliates' holding: multiple regions, 2000F/Y

	Total		East Asia		North America		Europe		3 regions: East Asia, North America, and Europe	
		share (%)		share (%)		share (%)		share (%)		share (%)
Number of firms with affiliates in East Asia	2,994	100.0	1,815	60.6	1,064	35.5	734	24.5	619	20.7
(firm size: average number of workers)	(1,334)		(476)		(2,747)		(3,434)		(3,736)	
Number of firms with affiliates in North America	1,592	100.0	1,064	66.8	428	26.9	719	45.2	619	38.9
(firm size: average number of workers)	(2,110)		(2,747)		(793)		(3,351)		(3,736)	
Number of firms with affiliates in Europe	914	100.0	734	80.3	719	78.7	80	8.8	619	67.7
(firm size: average number of workers)	(2,941)		(3,434)		(3,351)		(883)		(3,736)	

Data source: Authors' calculation, based on METI database.

Note: In the case of firms with affiliates in East Asia, for instance, the figures indicate that 1,815 out of 2,994 firms (60.6%) do not have affiliates in either North America or Europe, 1,064 (35.5%) have affiliates in North America, 734 firms (24.5%) have in Europe, and 619 firms (20.7%) have in three regions including East Asia. Similarly, the figures show the pattern of foreign affiliates' holding in multiple regions in the case of firms with affiliates in North America and Europe.

Table 6 Logit estimation: characteristics of Japanese firms going to East Asia, North America, and Europe

	(i) Dependent variable: 1995				(ii) Dependent variable: 2000			
Variables	Foreign affiliates with=1; without=0	Affiliates in East Asia with=1; without=0	Affiliates in North America with=1; without=0	Affiliates in Europe with=1; without=0	Foreign affiliates with=1; without=0	Affiliates in East Asia with=1; without=0	Affiliates in North America with=1; without=0	Affiliates in Europe with=1; without=0
(a) SMEs	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	-6.916 ***	-7.139 ***	-9.463 ***	-12.404 ***	-6.889 ***	-6.775 ***	-9.475 ***	-12.630 ***
	(-23.84)	(-21.96)	(-18.27)	(-12.69)	(-25.03)	(-22.40)	(-18.07)	(-13.38)
Firm size	0.717 ***	0.715 ***	0.986 ***	1.326 ***	0.784 ***	0.719 ***	1.033 ***	1.459 ***
	(12.14)	(10.81)	(9.47)	(6.87)	(14.02)	(11.68)	(9.81)	(7.82)
Tangible assets per worker	0.004 **	0.0014	0.002 ***	0.002 **	0.003 ***	0.0010 *	0.003 ***	0.002 ***
	(2.55)	(1.63)	(2.92)	(2.10)	(6.15)	(1.93)	(6.04)	(2.86)
Foreign sales ratio to total sales	4.554 ***	3.913 ***	4.121 ***	4.404 ***	7.033 ***	5.789 ***	5.245 ***	5.634 ***
	(22.18)	(19.98)	(18.85)	(15.05)	(24.86)	(22.42)	(19.07)	(16.17)
In-house R&D dummy	0.406 ***	0.323 ***	0.689 ***	0.699 ***	0.706 ***	0.670 ***	0.923 ***	0.827 ***
	(6.98)	(4.97)	(6.64)	(3.68)	(12.29)	(10.54)	(8.79)	(4.58)
Outsourcing dummy	0.927 ***	0.953 ***	0.553 ***	0.398 **	0.371 ***	0.346 ***	0.079	-0.149
	(15.15)	(13.75)	(5.43)	(2.20)	(6.00)	(5.05)	(0.70)	(-0.79)
Log likelihood	-4790.1484	-4000.2851	-1958.3926	-715.34342	-5209.7651	-4461.1101	-1895.1505	-754.15905
Number of observations	19957	19957	19957	19957	20828	20828	20828	20828
(b) Large firms	(1)'	(2)'	(3)'	(4)'	(1)'	(2)'	(3)'	(4)'
Constant	-7.862 ***	-8.225 ***	-10.036 ***	-12.330 ***	-6.877 ***	-6.791 ***	-9.231 ***	-10.820 ***
	(-26.17)	(-27.18)	(-29.22)	(-29.20)	(-24.08)	(-23.83)	(-27.58)	(-27.69)
Firm size	0.821 ***	0.831 ***	1.019 ***	1.230 ***	0.706 ***	0.643 ***	0.906 ***	1.044 ***
	(19.07)	(19.42)	(21.64)	(22.41)	(17.39)	(16.05)	(20.05)	(20.56)
Tangible assets per worker	0.017 ***	0.010 ***	0.018 ***	0.014 ***	0.003 ***	0.003 ***	0.003 ***	0.004 ***
	(7.20)	(4.38)	(7.28)	(5.09)	(5.50)	(5.27)	(4.76)	(6.83)
Foreign sales ratio to total sales	8.289 ***	5.957 ***	6.796 ***	6.770 ***	10.886 ***	6.961 ***	7.347 ***	7.049 ***
	(17.85)	(16.83)	(18.96)	(19.41)	(17.78)	(16.67)	(18.38)	(18.82)
In-house R&D dummy	0.646 ***	0.665 ***	0.645 ***	0.870 ***	1.373 ***	1.382 ***	1.508 ***	1.469 ***
	(8.84)	(8.42)	(6.75)	(6.49)	(19.49)	(18.40)	(15.72)	(12.07)
Outsourcing dummy	1.096 ***	1.149 ***	0.952 ***	0.691 ***	0.364 ***	0.402 ***	0.260 **	0.206
	(15.89)	(15.50)	(10.96)	(6.26)	(4.55)	(4.65)	(2.43)	(1.55)
Log likelihood	-2987.8065	-2779.08	-2178.7778	-1449.2139	-2994.8379	-2831.9426	-2121.1265	-1552.453
Number of observations	6353	6353	6353	6353	6589	6589	6589	6589

Data source: Authors' calculation, based on METI database.

Notes: figures in parenthesis are t-statistics. *** indicates that the results are statistically significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level. The data for outsourcing dummy for 1995 and 2000 are not exactly same due to the changes in questionnaires. In the case of 1995, the questionnaire strictly limits to the production commission in the production of manufacturing goods. On the other hand, in the case of 2000, the questionnaire asks the outsourcing expenditure embodied in production cost, sales cost, and so on.

Table 7 Japanese affiliates in East Asia and their intra-regional production networks: by-destination sales and by-origin purchases

Year	Sector	Number of affiliates	Share in total (%)	Total sales/purchases (million JPY)	Share in total (%)	By-destination sales/by-origin purchases: shares in total sales/purchases						Intra-firm transactions: shares in sales by-destination/purchases by-origin					
						Japan	Local	Third countries				Japan	Local	Third countries			
									East Asia	North America	EU				East Asia	North America	EU
(a) Sales																	
	Manufacturing	2,966	64.5	12,299,770	50.0	18.8	58.4	22.8	13.3	3.6	1.8	83.2	15.8	45.4	49.1	57.0	60.7
	Machinery	1,428	31.0	9,080,009	36.9												
	290	234	5.1	540,926	2.2	28.5	48.5	23.1	13.9	0.7	5.4	97.6	1.5	68.8	66.5	71.4	98.7
1995	300	755	16.4	5,107,148	20.8	28.7	38.0	33.2	19.6	5.6	2.2	88.9	9.0	52.6	59.5	56.7	58.4
	310	339	7.4	3,094,685	12.6	2.2	92.8	5.0	0.8	2.3	0.8	85.1	27.3	65.4	30.3	97.2	94.5
	320	100	2.2	337,250	1.4	51.2	27.7	21.1	15.9	1.9	2.2	98.9	66.6	74.7	76.6	69.3	75.5
	Total	4,600	100.0	24,578,689	100.0	17.8	54.7	27.5	13.5	2.5	1.4	67.6	10.4	24.3	31.2	49.1	58.3
	Manufacturing	3,835	61.7	12,324,572	53.0	25.4	49.2	25.4	16.9	4.5	2.7	73.1	7.6	45.9	47.2	48.3	40.7
	Machinery	1,809	29.1	8,485,148	36.5												
	290	315	5.1	688,971	3.0	40.7	32.4	27.0	14.8	5.5	4.6	90.7	6.9	79.7	76.7	91.5	87.4
1998	300	916	14.7	5,191,673	22.3	32.9	32.3	34.8	24.9	5.3	3.0	73.6	14.5	51.4	55.4	46.0	37.4
	310	478	7.7	2,140,129	9.2	11.1	81.0	7.9	2.2	3.5	1.5	82.1	2.8	73.0	52.2	98.5	52.6
	320	100	1.6	464,375	2.0	45.9	27.2	26.9	23.1	1.5	2.0	70.6	26.8	16.3	15.9	11.3	18.6
	Total	6,213	100.0	23,235,149	100.0	21.9	49.6	28.4	21.2	3.4	2.6	62.7	5.6	32.3	30.1	47.4	34.1
(b) Purchases																	
	Manufacturing	2,966	64.5	6,913,965	47.5	40.3	40.3	19.4	14.4	1.4	0.7	76.5	15.1	40.8	44.9	32.6	50.7
	Machinery	1,428	31.0	5,478,894	37.6												
	290	234	5.1	380,291	2.6	44.0	42.9	13.2	12.6	1.1	1.0	82.9	1.6	25.7	35.4	25.1	13.2
1995	300	755	16.4	2,834,205	19.5	38.9	33.8	27.3	24.8	1.3	0.2	86.0	14.1	46.5	45.9	33.1	48.2
	310	339	7.4	2,007,679	13.8	51.6	45.6	2.8	1.0	0.8	0.7	73.6	16.1	68.8	39.9	97.2	85.2
	320	100	2.2	256,719	1.8	44.3	34.9	20.8	20.6	0.1	0.1	85.9	42.4	73.7	74.5	0.0	0.3
	Total	4,600	100.0	14,558,757	100.0	31.5	36.1	32.4	14.9	1.3	1.4	69.1	14.2	23.2	36.2	44.7	27.5
	Manufacturing	3,835	61.7	7,501,823	49.3	35.1	43.3	21.6	18.6	1.5	0.6	58.7	7.1	44.9	47.0	44.7	31.6
	Machinery	1,809	29.1	5,764,360	37.9												
	290	315	5.1	400,705	2.6	32.2	57.7	10.1	8.8	0.8	0.4	79.1	3.4	76.1	85.1	21.2	0.0
1998	300	916	14.7	3,711,079	24.4	37.0	35.8	27.2	26.3	0.4	0.2	64.0	6.5	49.7	50.8	24.0	7.4
	310	478	7.7	1,380,996	9.1	37.2	53.4	9.4	6.1	2.5	0.7	43.8	5.2	48.4	36.2	89.5	17.0
	320	100	1.6	271,580	1.8	41.2	40.2	18.6	14.5	2.6	1.5	72.9	20.5	22.6	22.3	0.0	65.3
	Total	6,213	100.0	15,222,761	100.0	33.4	41.1	25.5	20.7	1.5	1.3	59.3	9.9	35.6	39.4	41.8	15.4

Data source: Authors' calculation, based on METI database.

Note: Manufacturing is industry classification 120-340, and machinery is industry classification 290-320.

Table 8 Arm's length / intra-firm sales and purchases by Japanese manufacturing affiliates in East Asia

(million JPY, %)

		Affiliates in East Asia				Affiliates in NIEs4				Affiliates in ASEAN4				Affiliates in China			
		1995		1998		1995		1998		1995		1998		1995		1998	
(a) Sales																	
Value	Manufacturing sectors	12,299,770		12,324,572		5,614,012		5,136,399		5,625,150		4,848,460		732,434		1,756,528	
	Electric machinery sector	5,107,148		5,191,673		2,792,722		2,161,123		1,984,190		2,234,930		311,034		749,951	
Share																	
(i)	Japan	**18.8**	**(28.7)**	**25.4**	**(32.9)**	**18.5**	**(22.6)**	**24.2**	**(28.1)**	**18.9**	**(36.2)**	**30.7**	**(41.9)**	**29.0**	**(29.7)**	**23.6**	**(22.5)**
	Arm's length: Japan	3.1	(3.2)	6.8	(8.7)	3.0	(2.7)	6.3	(8.2)	3.3	(4.1)	8.0	(10.1)	4.5	(1.4)	7.0	(6.7)
	Intra-firm: Japan	15.7	(25.5)	18.6	(24.2)	15.5	(19.9)	17.9	(19.9)	15.6	(32.1)	22.7	(31.8)	24.5	(28.3)	16.6	(15.8)
(ii)	Local	**58.4**	**(38.0)**	**49.2**	**(32.3)**	**55.8**	**(45.4)**	**52.6**	**(44.2)**	**60.1**	**(29.3)**	**37.8**	**(17.2)**	**44.7**	**(34.1)**	**53.5**	**(40.8)**
	Arm's length: local	49.2	(34.6)	45.4	(27.6)	48.8	(42.2)	48.5	(38.7)	47.2	(25.5)	33.8	(13.4)	42.6	(31.6)	50.4	(36.3)
	Intra-firm: local	9.2	(3.4)	3.8	(4.7)	7.0	(3.2)	4.1	(5.6)	12.9	(3.8)	4.0	(3.7)	2.1	(2.5)	3.1	(4.5)
(iii)	Intra-region (other than Japan and local)	**13.3**	**(19.6)**	**16.9**	**(24.9)**	**14.8**	**(17.4)**	**15.2**	**(18.8)**	**11.7**	**(20.3)**	**20.6**	**(28.4)**	**21.0**	**(30.8)**	**17.6**	**(31.7)**
	Arm's length: intra-region	6.8	(7.9)	8.9	(11.1)	8.6	(8.1)	11.3	(12.3)	6.1	(8.6)	10.2	(12.6)	3.4	(2.9)	3.4	(4.5)
	Intra-firm: intra-region	6.5	(11.6)	8.0	(13.8)	6.2	(9.2)	3.9	(6.4)	5.6	(11.7)	10.4	(15.8)	17.6	(27.9)	14.2	(27.2)
(i+ii+iii)	East Asia (total)	**90.5**	**(86.3)**	**91.5**	**(90.1)**	**89.1**	**(85.3)**	**92.0**	**(91.1)**	**90.7**	**(85.9)**	**89.1**	**(87.4)**	**94.7**	**(94.6)**	**94.7**	**(95.0)**
	Arm's length: East Asia (total)	59.1	(45.7)	61.1	(47.4)	60.4	(53.0)	66.1	(59.2)	56.6	(38.2)	52.0	(36.1)	50.5	(35.9)	60.8	(47.5)
	Intra-firm: East Asia (total)	31.4	(40.6)	30.4	(42.7)	28.7	(32.3)	25.9	(31.9)	34.1	(47.6)	37.1	(51.3)	44.2	(58.7)	33.9	(47.5)
(b) Purchases																	
Value	Manufacturing	6,913,965		7,501,823		2,956,239		3,241,888		3,349,191		2,866,092		430,484		1,062,301	
	Electric machinery	2,834,205		3,711,079		1,454,721		1,700,051		1,156,828		1,451,967		209,214		532,101	
Share	Manufacturing																
(i)	Japan	**40.3**	**(38.9)**	**35.1**	**(37.0)**	**35.0**	**(37.8)**	**39.0**	**(42.5)**	**44.3**	**(37.1)**	**31.8**	**(33.7)**	**49.1**	**(53.3)**	**36.1**	**(33.3)**
	Arm's length: Japan	9.5	(5.4)	14.5	(13.3)	6.9	(4.2)	14.7	(14.7)	10.6	(6.4)	12.6	(12.0)	10.1	(8.2)	17.6	(13.9)
	Intra-firm: Japan	30.8	(33.5)	20.6	(23.7)	28.1	(33.5)	24.3	(27.8)	33.7	(30.7)	19.2	(21.7)	39.0	(45.1)	18.5	(19.4)
(ii)	Local	**40.3**	**(33.8)**	**43.3**	**(35.8)**	**43.4**	**(38.4)**	**42.3**	**(36.4)**	**37.9**	**(31.2)**	**42.0**	**(36.0)**	**29.2**	**(18.7)**	**44.3**	**(33.7)**
	Arm's length: local	34.2	(29.0)	40.2	(33.5)	37.8	(30.8)	39.9	(33.8)	31.1	(29.4)	37.8	(33.9)	22.7	(16.9)	41.8	(31.1)
	Intra-firm: local	6.1	(4.8)	3.1	(2.3)	5.6	(7.6)	2.4	(2.6)	6.8	(1.8)	4.2	(2.1)	6.5	(1.8)	2.5	(2.6)
(iii)	Intra-region (other than Japan and local)	**14.4**	**(24.8)**	**18.6**	**(26.3)**	**15.0**	**(20.4)**	**16.9**	**(20.7)**	**13.4**	**(30.1)**	**21.4**	**(29.1)**	**20.3**	**(27.0)**	**18.3**	**(32.1)**
	Arm's length: intra-region	7.9	(13.4)	9.8	(12.9)	7.1	(8.4)	8.9	(9.6)	9.5	(22.2)	13.6	(18.9)	4.5	(4.6)	3.6	(5.0)
	Intra-firm: intra-region	6.5	(11.4)	8.8	(13.4)	7.9	(12.0)	8.0	(11.1)	3.9	(7.9)	7.8	(10.2)	15.8	(22.4)	14.7	(27.1)
(i+ii+iii)	East Asia (total)	**95.0**	**(97.5)**	**97.0**	**(99.1)**	**93.4**	**(96.6)**	**98.2**	**(99.5)**	**95.6**	**(98.4)**	**95.2**	**(98.8)**	**98.6**	**(99.0)**	**98.7**	**(99.1)**
	Arm's length: East Asia (total)	51.6	(47.9)	64.5	(59.8)	51.8	(43.5)	63.5	(58.0)	51.2	(58.0)	64.0	(64.8)	37.3	(29.7)	63.0	(50.0)
	Intra-firm: East Asia (total)	43.4	(49.6)	32.5	(39.4)	41.6	(53.1)	34.7	(41.5)	44.4	(40.4)	31.2	(33.9)	61.3	(69.3)	35.7	(49.1)

Data source: Authors' calculation, estimated from Table 7 and Tables A.2-A.4.

Note: Figures in parenthesis are of the electric machinery sector.

Table 9 Arm's length / intra-firm sales and purchases by Japanese manufacturing affiliates in Latin America

(million JPY, %)

		Affiliates in Latin America				Affiliates in Mexico				Affiliates in Brazil			
		1995		1998		1995		1998		1995		1998	
(a) Sales													
Value	Manufacturing sectors	1,612,335		1,665,181		284,688		585,266		863,897		755,863	
	Electric machinery sector	214,208		406,293		38,086		98,845		161,018		268,693	
Share													
(i)	Japan	**8.0**	**(0.1)**	**8.3**	**(5.2)**	**4.4**	**(0.3)**	**6.1**	**(11.8)**	**4.9**	**(0.0)**	**11.5**	**(0.0)**
	Arm's length: Japan	6.0	(0.0)	2.3	(0.0)	0.0	(0.0)	0.3	(0.0)	4.2	(0.0)	3.8	(0.0)
	Intra-firm: Japan	2.0	(0.1)	6.0	(5.2)	4.4	(0.3)	5.8	(11.8)	0.7	(0.0)	7.7	(0.0)
(ii)	Local	**71.2**	**(88.0)**	**70.5**	**(78.6)**	**46.3**	**(64.8)**	**63.0**	**(55.9)**	**81.2**	**(96.5)**	**69.0**	**(96.7)**
	Arm's length: local	68.8	(81.8)	64.0	(65.3)	36.8	(49.5)	57.6	(45.6)	79.6	(93.7)	60.1	(77.3)
	Intra-firm: local	2.4	(6.2)	6.5	(13.3)	9.5	(15.3)	5.4	(10.3)	1.6	(2.8)	8.9	(19.4)
(iii)	Intra-region (other than local)	**2.6**	**(2.4)**	**2.4**	**(2.5)**	**1.5**	**(0.3)**	**1.1**	**(0.9)**	**2.5**	**(1.0)**	**2.3**	**(3.2)**
	Arm's length: intra-region	1.8	(1.1)	1.5	(1.1)	0.5	(0.0)	0.5	(0.6)	2.5	(0.9)	1.6	(1.5)
	Intra-firm: intra-region	0.8	(1.3)	0.9	(1.4)	1.0	(0.3)	0.6	(0.3)	0.0	(0.1)	0.7	(1.7)
(iv)	North America	**7.5**	**(6.9)**	**12.2**	**(13.2)**	**43.6**	**(24.4)**	**29.0**	**(30.0)**	**3.4**	**(1.9)**	**6.5**	**(0.0)**
	Arm's length: North America	3.3	(1.3)	6.4	(9.1)	6.3	(0.6)	11.8	(20.6)	3.2	(1.7)	4.9	(0.0)
	Intra-firm: North America	4.2	(5.6)	5.8	(4.1)	37.3	(23.8)	17.2	(9.4)	0.2	(0.2)	1.6	(0.0)
(v)	East Asia other than Japan	**1.0**	**(0.1)**	**0.6**	**(0.0)**	**0.1**	**(0.0)**	**0.0**	**(0.0)**	**1.5**	**(0.2)**	**0.5**	**(0.0)**
	Arm's length: East Asia excl. Japan	0.9	(0.0)	0.5	(0.0)	0.0	(0.0)	0.0	(0.0)	1.3	(0.0)	0.4	(0.0)
	Intra-firm: East Asia excl. Japan	0.1	(0.1)	0.1	(0.0)	0.1	(0.0)	0.0	(0.0)	0.2	(0.2)	0.1	(0.0)
(i+v)	East Asia including Japan	**9.0**	**(0.2)**	**8.9**	**(5.2)**	**4.5**	**(0.3)**	**6.1**	**(11.8)**	**6.4**	**(0.2)**	**12.0**	**(0.0)**
	Arm's length: East Asia including Japan	6.9	(0.0)	2.8	(0.0)	0.0	(0.0)	0.3	(0.0)	5.5	(0.0)	4.2	(0.0)
	Intra-firm: East Asia including Japan	2.1	(0.2)	6.1	(5.2)	4.5	(0.3)	5.8	(11.8)	0.9	(0.2)	7.8	(0.0)
(b) Purchases													
Value		420,687		819,714		64,037		147,170		212,475		450,289	
		95,569		301,944		26,056		65,764		62,606		206,499	
Share													
(i)	Japan	**28.4**	**(21.2)**	**29.0**	**(33.1)**	**33.2**	**(32.2)**	**32.6**	**(42.3)**	**17.3**	**(16.4)**	**17.6**	**(32.3)**
	Arm's length: Japan	2.1	(4.2)	7.7	(9.6)	1.8	0.0	13.1	(17.0)	3.0	(6.4)	4.0	(5.7)
	Intra-firm: Japan	26.3	(17.0)	21.3	(23.5)	31.4	(32.2)	19.5	(25.3)	14.3	(10.0)	13.6	(26.6)
(ii)	Local	**51.3**	**(48.3)**	**54.3**	**(46.3)**	**40.7**	**(51.8)**	**40.5**	**(34.8)**	**67.1**	**(49.5)**	**68.4**	**(47.2)**
	Arm's length: local	46.1	(36.3)	49.6	(40.7)	23.5	(20.0)	34.0	(19.9)	63.9	(44.5)	63.2	(47.2)
	Intra-firm: local	5.2	(12.0)	4.7	(5.6)	17.2	(31.8)	6.5	(14.9)	3.2	(5.0)	5.2	(0.0)
(iii)	Intra-region	**1.3**	**(2.9)**	**0.5**	**(0.1)**	**0.0**	**(0.1)**	**0.0**	**(0.0)**	**1.6**	**(2.8)**	**0.8**	**(0.0)**
	Arm's length: intra-region	0.4	(0.2)	0.5	(0.1)	0.0	(0.1)	0.0	(0.0)	0.6	(0.0)	0.8	(0.0)
	Intra-firm: intra-region	0.9	(2.7)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	1.0	(2.8)	0.0	(0.0)
(iv)	North America	**9.0**	**(4.7)**	**8.5**	**(2.1)**	**22.2**	**(7.7)**	**16.3**	**(2.9)**	**3.0**	**(3.5)**	**5.9**	**(0.5)**
	Arm's length: North America	2.5	(2.3)	5.1	(1.5)	6.8	(1.0)	5.1	(1.4)	1.6	(2.8)	5.7	(0.5)
	Intra-firm: North America	6.5	(2.4)	3.4	(0.6)	15.4	(6.7)	11.2	(1.5)	1.4	(0.7)	0.2	(0.0)
(v)	East Asia other than Japan	**6.6**	**(21.3)**	**5.3**	**(14.1)**	**2.5**	**(5.6)**	**10.6**	**(20.0)**	**9.6**	**(27.2)**	**3.8**	**(11.8)**
	Arm's length: East Asia excl. Japan	5.4	(17.5)	2.2	(6.2)	0.1	(0.0)	4.8	(10.3)	8.6	(24.4)	1.4	(4.2)
	Intra-firm: East Asia excl. Japan	1.2	(3.8)	3.1	(7.9)	2.4	(5.6)	5.8	(9.7)	1.0	(2.8)	2.4	(7.6)
(i+v)	East Asia including Japan	**35.0**	**(42.5)**	**34.3**	**(47.2)**	**35.7**	**(37.8)**	**43.2**	**(62.3)**	**26.9**	**(43.6)**	**21.4**	**(44.1)**
	Arm's length: East Asia including Japan	7.5	(21.7)	9.9	(15.8)	1.9	(0.0)	17.9	(27.3)	11.6	(30.8)	5.4	(9.9)
	Intra-firm: East Asia including Japan	27.5	(20.8)	24.4	(31.4)	33.8	(37.8)	25.3	(35.0)	15.3	(12.8)	16.0	(34.2)

Data source: Authors' calculation, estimated from Table A.5.

Note: Figures in parenthesis are of the electric machinery sector.

Table A1 Industry classification

Manufacturing sector		Non-manufacturing sector	
120	Food processing	050	Mining
130	Beverages, tobacco, and animal feed	480	Wholesale trade
140	Textiles	540	Retail trade
150	Apparel	Other	Services and other
160	Wood and wood products		
170	Furniture and fixtures		
180	Pulp, paper, and paper products		
190	Publishing and printing		
200	Chemicals		
210	Petroleum and coal products		
220	Plastic products		
230	Rubber products		
240	Leather and leather products		
250	Ceramics, clay, and stone products		
260	Iron and steel		
270	Nonferrous metal		
280	Metal products		
290	General machinery		
300	Electric machinery		
310	Transport equipment		
320	Precision machinery		
330	Arms		
340	Other manufacturing		
290+300+310+320	Machinery sector		

Table A.2 Japanese affiliates in NIEs4 and their intra-regional production networks: by-destination sales and by-origin purchases

Year	Sector	Number of affiliates	Share in total (%)	Total sales/purchases (million JPY)	Share in total (%)	By-destination sales/by-origin purchases: shares in total sales/purchases						Intra-firm transactions: shares in sales by-destination/purchases by-origin					
						Japan	Local	Third countries				Japan	Local	Third countries			
									East Asia	North America	EU				East Asia	North America	EU
(a) Sales																	
	Manufacturing	1,037	52.8	5,614,012	36.9	18.5	55.8	25.7	14.8	3.3	2.2	83.6	12.5	38.2	42.1	51.0	64.5
	Machinery	559	28.4	4,139,871	27.2												
	290	114	5.8	369,535	2.4	26.0	50.1	23.9	11.5	0.9	8.3	96.6	0.7	59.6	43.3	70.1	99.4
1995	300	302	15.4	2,792,722	18.4	22.6	45.4	32.1	17.4	5.1	2.4	88.1	7.0	43.7	53.1	50.9	59.1
	310	86	4.4	757,806	5.0	1.9	92.8	5.3	0.7	1.3	0.1	88.1	24.5	26.4	41.9	87.5	11.0
	320	57	2.9	219,808	1.4	55.0	24.8	20.2	13.9	2.7	2.1	98.6	51.2	62.8	61.9	70.6	64.5
	Total	1,965	100.0	15,201,621	100.0	18.3	48.3	33.4	16.2	2.2	1.6	63.1	7.1	17.1	22.3	39.3	59.8
	Manufacturing	1,141	47.8	5,136,399	38.4	24.2	52.6	23.3	15.2	4.2	2.9	74.2	7.8	31.7	26.0	36.3	56.4
	Machinery	609	25.5	3,428,594	25.6												
	290	132	5.5	410,923	3.1	45.7	33.5	20.8	9.0	3.2	6.4	97.6	4.6	64.6	41.9	78.3	98.2
1998	300	324	13.6	2,161,123	16.2	28.1	44.2	27.7	18.8	4.6	3.4	70.9	12.6	38.3	34.3	47.5	50.2
	310	93	3.9	556,605	4.2	3.1	91.0	5.9	2.9	2.2	0.4	44.1	5.8	57.9	29.5	95.1	78.9
	320	60	2.5	299,943	2.2	49.0	23.6	27.5	23.7	1.5	2.0	63.8	18.8	9.9	11.4	0.6	0.0
	Total	2,385	100.0	13,369,973	100.0	20.8	48.3	31.0	24.0	3.1	2.9	55.6	4.8	19.8	15.6	38.4	35.6
(b) Purchases																	
	Manufacturing	1,037	52.8	2,956,239	33.0	35.0	43.4	21.6	15.0	1.4	0.7	80.3	13.0	42.4	52.7	21.5	16.1
	Machinery	559	28.4	2,297,952	25.6												
	290	114	5.8	272,580	3.0	41.5	45.1	13.4	11.1	1.3	0.5	82.9	0.3	20.6	18.0	4.7	38.8
1995	300	302	15.4	1,454,721	16.2	37.8	38.4	23.9	20.4	1.6	0.3	88.8	19.7	58.0	58.7	22.2	47.6
	310	86	4.4	388,562	4.3	34.6	64.3	1.1	0.2	0.3	0.3	55.0	0.6	54.8	22.9	85.8	20.1
	320	57	2.9	182,089	2.0	50.2	29.3	20.6	20.5	0.0	0.1	83.1	28.5	66.7	66.9	-	0.7
	Total	1,965	100.0	8,959,047	100.0	27.5	30.4	42.1	16.9	1.4	1.8	67.5	11.5	20.7	35.7	47.9	19.0
	Manufacturing	1,141	47.8	3,241,888	34.2	39.0	42.3	18.8	16.9	1.0	0.5	62.3	5.7	45.0	47.7	20.0	41.3
	Machinery	609	25.5	2,556,490	27.0												
	290	132	5.5	248,326	2.6	30.7	62.3	7.0	5.1	1.3	0.5	80.6	0.9	59.9	76.1	19.5	0.0
1998	300	324	13.6	1,700,051	17.9	42.5	36.4	21.1	20.7	0.3	0.1	65.4	7.1	53.1	53.8	24.7	33.3
	310	93	3.9	418,601	4.4	31.7	60.8	7.4	6.1	0.3	0.3	41.0	9.2	19.0	18.3	86.4	0.0
	320	60	2.5	189,512	2.0	48.8	31.6	19.6	18.2	0.0	1.4	69.1	11.1	22.2	16.3	0.0	98.5
	Total	2,385	100.0	9,471,534	100.0	35.2	38.3	26.5	20.6	1.4	1.9	62.5	9.0	25.9	29.7	34.6	12.2

Data source: Authors' calculation, based on METI database.

Note: Manufacturing is industry classification 120-340, and machinery is industry classification 290-320.

Table A.3 Japanese affiliates in ASEAN4 and their intra-regional production networks: by-destination sales and by-origin purchases

Year	Sector	Number of affiliates	Share in total (%)	Total sales/purchases (million JPY)	Share in total (%)	By-destination sales/by-origin purchases: shares in total sales/purchases						Intra-firm transactions: shares in sales by-destination/purchases by-origin					
						Japan	Local	Third countries				Japan	Local	Third countries			
									East Asia	North America	EU				East Asia	North America	EU
(a) Sales																	
	Manufacturing	1,111	69.0	5,625,150	70.0	18.9	60.1	21.0	11.7	4.2	1.6	82.4	21.5	46.9	47.7	59.3	53.7
	Machinery	505	31.4	4,099,516	51.0												
	290	65	4.0	118,811	1.5	26.0	63.6	10.5	8.0	0.4	0.2	98.3	3.4	67.7	83.9	79.8	6.5
1995	300	266	16.5	1,984,190	24.7	36.2	29.3	34.4	20.3	6.8	1.9	88.6	13.0	55.5	57.7	60.9	49.2
	310	157	9.8	1,920,034	23.9	2.5	91.9	5.6	0.9	3.0	1.4	81.7	37.3	82.7	30.4	99.1	97.6
	320	17	1.1	76,481	1.0	44.2	43.5	12.4	8.5	0.1	3.6	100.0	94.7	93.7	93.8	0.0	99.0
	Total	1,609	100.0	8,031,882	100.0	16.4	64.1	19.4	9.1	3.1	1.2	73.5	15.4	37.2	44.6	58.2	52.8
	Manufacturing	1,472	68.4	4,848,460	71.9	30.7	37.8	31.4	20.6	5.5	3.3	73.9	10.6	47.8	50.5	53.2	31.4
	Machinery	666	30.9	3,300,016	49.0												
	290	91	4.2	155,239	2.3	40.6	30.0	29.3	23.1	2.4	2.3	89.3	7.3	94.6	93.1	100.0	100.0
1998	300	343	15.9	2,234,930	33.2	41.9	17.2	41.0	28.4	6.8	3.3	75.9	21.7	50.1	55.6	45.9	24.8
	310	217	10.1	842,530	12.5	25.3	59.9	14.8	3.6	7.6	2.2	83.1	5.4	91.3	76.1	99.3	95.3
	320	15	0.7	67,317	1.0	42.2	31.8	26.0	18.8	2.9	3.1	95.9	91.7	52.6	46.9	40.3	81.6
	Total	2,152	100.0	6,739,149	100.0	26.6	46.1	27.3	17.9	4.6	2.8	72.9	8.2	47.3	49.5	55.5	33.8
(b) Purchases																	
	Manufacturing	1,111	69.0	3,349,191	69.5	44.3	37.9	17.8	13.4	1.7	0.8	76.0	18.1	32.1	29.0	37.9	79.7
	Machinery	505	31.4	2,666,310	55.3												
	290	65	4.0	78,789	1.6	55.2	36.3	8.5	13.5	1.3	3.3	89.8	7.9	44.8	88.2	90.8	0.2
1995	300	266	16.5	1,156,828	24.0	37.1	31.2	31.7	30.1	1.1	0.0	82.7	5.8	27.4	26.3	54.1	66.9
	310	157	9.8	1,379,720	28.6	61.1	35.7	3.2	1.1	1.0	0.9	82.3	26.8	79.7	53.9	98.1	95.4
	320	17	1.1	50,973	1.1	31.0	64.4	4.6	3.8	0.3	0.4	96.6	68.4	83.0	100.0	0.0	0.0
	Total	1,609	100.0	4,821,625	100.0	36.9	45.8	17.3	11.0	1.3	0.8	71.6	16.6	26.1	28.4	35.8	60.8
	Manufacturing	1,472	68.4	2,866,092	73.5	31.8	42.0	26.2	21.4	2.4	0.8	60.5	10.1	36.2	36.4	51.8	35.3
	Machinery	666	30.9	2,090,165	53.6												
	290	91	4.2	64,903	1.7	40.8	32.5	26.7	26.2	0.0	0.5	87.6	2.2	85.7	87.3	100.0	0.0
1998	300	343	15.9	1,451,967	37.2	33.7	36.0	30.3	29.1	0.4	0.5	64.4	5.8	34.0	34.9	25.0	5.5
	310	217	10.1	519,594	13.3	41.0	46.0	13.0	8.0	4.6	0.4	62.1	10.7	65.7	52.7	86.7	81.4
	320	15	0.7	53,701	1.4	24.1	54.2	21.7	5.9	13.2	2.5	88.7	53.9	12.9	47.2	0.0	0.0
	Total	2,152	100.0	3,898,344	100.0	31.4	44.3	24.3	20.3	2.0	0.7	57.5	11.4	36.9	37.0	52.1	38.9

Data source: Authors' calculation, based on METI database.

Note: Manufacturing is industry classification 120-340, and machinery is industry classification 290-320.

Table A.4 Japanese affiliates in China and their intra-regional production networks: by-destination sales and by-origin purchases

Year	Sector	Number of affiliates	Share in total (%)	Total sales/purchases (million JPY)	Share in total (%)	By-destination sales/by-origin purchases: shares in total sales/purchases						Intra-firm transactions: shares in sales by-destination/purchases by-origin					
						Japan	Local	Third countries				Japan	Local	Third countries			
									East Asia	North America	EU				East Asia	North America	EU
(a) Sales																	
	Manufacturing	741	81.6	732,434	75.3	29.0	44.7	26.4	21.0	2.4	1.1	84.5	4.6	79.5	84.1	71.1	85.0
	Machinery	318	35.0	548,910	56.4												
	290	50	5.5	51,531	5.3	45.9	14.2	39.9	36.2	0.0	0.0	99.7	0.3	97.3	97.2	100.0	-
1995	300	176	19.4	311,034	32.0	29.7	34.1	36.2	30.8	2.3	2.2	95.2	7.4	89.6	90.5	72.5	98.4
	310	67	7.4	145,384	14.9	5.5	87.9	6.7	1.9	4.6	0.1	94.5	0.4	71.1	11.7	97.5	0.0
	320	25	2.8	40,961	4.2	40.9	17.2	41.9	41.6	0.0	0.2	99.3	71.2	98.9	99.6	0.0	0.0
	Total	908	100.0	972,811	100.0	27.7	47.6	24.8	16.3	1.9	0.9	77.2	9.5	66.8	83.9	70.9	84.7
	Manufacturing	1,039	73.8	1,756,528	69.9	23.6	53.5	22.9	17.6	4.0	0.8	68.5	5.8	74.6	81.0	57.5	35.4
	Machinery	422	30.0	1,242,094	49.5												
	290	80	5.7	114,548	4.6	31.0	27.4	41.5	24.3	13.0	2.1	67.9	14.3	91.0	97.6	98.2	2.6
1998	300	219	15.6	749,951	29.9	22.5	40.8	36.6	31.7	3.2	1.1	70.1	11.1	79.6	85.9	34.9	43.6
	310	101	7.2	281,265	11.2	7.9	88.4	3.7	1.4	2.3	0.0	88.1	0.4	65.9	8.6	99.9	100.0
	320	22	1.6	96,330	3.8	34.2	40.2	25.6	24.5	0.3	0.8	88.5	0.0	14.0	14.4	0.0	5.9
	Total	1,407	100.0	2,511,523	100.0	22.2	52.0	25.8	21.4	3.3	0.7	65.2	5.2	66.8	69.8	56.5	33.7
(b) Purchases																	
	Manufacturing	741	81.6	430,484	72.4	49.1	29.2	21.8	20.3	0.5	0.1	79.5	22.2	76.9	78.0	99.5	44.0
	Machinery	318	35.0	352,380	59.3												
	290	50	5.5	28,586	4.8	38.1	41.3	20.6	20.5	0.0	0.0	64.0	0.0	31.6	28.4	-	0.0
1995	300	176	19.4	209,214	35.2	53.3	18.7	28.0	27.0	0.0	0.0	84.6	9.4	81.7	83.0	100.0	-
	310	67	7.4	90,923	15.3	52.9	43.3	3.8	1.0	2.3	0.0	85.1	55.7	81.5	76.4	100.0	-
	320	25	2.8	23,657	4.0	27.9	14.9	57.2	57.2	0.0	0.0	98.5	7.7	91.4	91.4	-	-
	Total	908	100.0	594,727	100.0	45.8	34.1	20.1	18.3	0.5	0.1	80.4	32.1	77.1	77.6	99.5	44.0
	Manufacturing	1,039	73.8	1,062,301	70.8	36.1	44.3	19.5	18.3	0.9	0.2	51.2	5.6	78.8	80.5	60.5	1.7
	Machinery	422	30.1	815,764	54.5												
	290	80	5.7	84,813	5.7	29.9	63.2	6.8	6.5	0.1	0.2	68.2	11.3	95.6	99.1	100.0	0.0
1998	300	219	15.6	532,101	35.5	33.3	33.7	33.0	32.1	0.8	0.1	58.2	7.7	82.6	84.4	21.8	0.0
	310	101	7.2	171,058	11.4	43.0	52.3	4.7	1.8	2.8	0.1	22.7	0.1	94.6	92.3	100.0	0.0
	320	22	1.6	27,792	1.9	21.9	72.1	6.0	6.0	0.0	0.0	98.7	0.0	98.0	97.9	-	100.0
	Total	1,407	100.0	1,499,526	100.0	31.3	42.7	26.1	24.9	1.0	0.1	50.8	13.1	84.1	86.2	44.2	1.6

Data source: Authors' calculation, based on METI database.

Note: Manufacturing is industry classification 120-340, and machinery is industry classification 290-320.

Table A.5 Japanese affiliates in Latin America and their intra-regional production networks: by-destination sales and by-origin purchases

Year	Sector	Number of affiliates	Share in total (%)	Total sales (million JPY)	Share in total (%)	By-destination sales: shares in total sales							Intra-firm sales: shares in sales by-destination						
						Japan	Local	Third countries					Japan	Local	Third countries				
									North America	Latin America	East Asia	EU				North America	Latin America	East Asia	EU
(a) Sales																			
								Latin America											
1995	Manufacturing	214	34.4	1,612,335	46.4	8.0	71.2	20.8	7.5	2.6	1.0	3.1	25.3	3.4	30.0	56.2	29.0	13.6	35.6
	Machinery	115	18.5	726,795	21.0														
	300	45	7.2	214,208	6.2	0.1	88.0	12.0	6.9	2.4	0.1	0.2	100.0	7.0	60.2	80.8	52.3	100.0	100.0
	Total	622	100.0	3,472,007	100.0	20.3	52.2	27.4	4.0	5.9	3.5	3.6	27.1	3.0	24.6	48.1	30.3	24.8	17.1
1998	Manufacturing	268	33.1	1,665,181	41.8	8.3	70.6	21.2	12.2	2.4	0.6	5.8	72.6	9.3	33.9	47.6	38.7	11.9	6.8
	Machinery	161	19.9	1,267,633	31.8														
	300	69	8.5	406,293	10.2	5.2	78.6	16.2	13.2	2.5	0.0	0.6	100.0	16.9	37.7	31.4	56.2	100.0	100.0
	Total	809	100.0	3,980,260	100.0	11.7	62.6	25.6	6.5	11.1	2.6	5.2	49.2	11.2	23.4	46.3	20.8	5.3	9.8
								Mexico											
1995	Manufacturing	66	62.9	284,688	66.2	4.4	46.3	49.3	43.6	1.5	0.1	0.5	99.4	20.6	79.2	85.5	66.9	90.8	100.0
	Machinery	43	41.0	257,093	59.8														
	300	17	16.2	38,086	8.9	0.3	64.8	34.9	24.4	0.3	0.0	0.0	100.0	23.6	69.4	97.4	100.0	-	100.0
	Total	105	100.0	429,892	100.0	16.2	38.5	45.3	24.4	0.8	8.3	0.3	66.1	23.8	53.5	85.5	65.1	29.5	100.0
1998	Manufacturing	88	61.5	585,266	80.3	6.1	63.0	30.9	29.0	1.1	0.0	0.8	95.4	8.5	60.2	59.4	55.4	35.6	98.5
	Machinery	62	43.4	549,332	75.4														
	300	33	23.1	98,845	13.6	11.8	55.9	32.3	30.0	0.9	0.0	1.4	100.0	18.5	34.5	31.4	36.9	100.0	100.0
	Total	143	100.0	728,943	100.0	6.9	65.1	28.0	22.9	4.0	0.5	0.6	92.9	6.7	55.7	61.4	12.6	96.9	98.5
								Brazil											
1995	Manufacturing	102	54.8	863,897	65.9	4.9	81.2	13.9	3.4	2.5	1.5	3.0	14.9	2.0	3.5	5.0	1.0	12.6	3.3
	Machinery	46	24.7	322,662	24.6														
	300	18	9.7	161,018	12.3	0.0	96.5	3.5	1.9	1.0	0.2	0.3	-	2.9	23.2	9.8	5.9	100.0	100.0
	Total	186	100.0	1,310,729	100.0	16.3	66.6	17.1	2.4	2.2	3.6	2.0	12.8	1.7	11.7	8.3	11.6	40.8	3.2
1998	Manufacturing	117	52.2	755,863	45.8	11.5	68.9	19.5	6.5	2.4	0.5	9.7	66.6	12.9	14.3	24.8	30.9	23.9	3.2
	Machinery	64	28.6	445,271	27.0														
	300	25	11.2	268,693	16.3	0.0	96.7	3.2	0.0	3.2	0.0	0.0	100.0	20.1	54.0	22.2	54.3	-	-
	Total	224	100.0	1,648,640	100.0	11.7	75.5	12.7	4.3	1.4	0.4	6.4	59.2	9.2	20.3	28.3	30.8	17.9	13.5

(Continue)

Year	Sector	Number of affiliates	Share in total (%)	Total purchases (million JPY)	Share in total (%)	By-origin purchases: shares in total purchases							Intra-firm purchases: shares in purchases by-origin						
						Japan	Local	Third countries					Japan	Local	Third countries				
									North America	Latin America	East Asia	EU				North America	Latin America	East Asia	EU
(b) Purchases																			
										Latin America									
1995	Manufacturing	214	34.4	420,687	29.7	28.4	51.3	20.3	9.0	1.3	6.6	0.5	92.6	10.2	52.1	72.4	67.5	17.9	39.7
	Machinery	115	18.5	318,479	22.4														
	300	45	7.2	95,569	6.7	21.7	48.3	30.0	4.7	2.9	21.3	0.5	80.3	24.8	32.3	52.0	92.2	17.7	29.6
	Total	622	100.0	1,417,879	100.0	39.9	35.0	25.2	10.4	3.8	5.3	0.3	78.9	17.3	53.2	74.6	39.0	38.7	40.9
1998	Manufacturing	268	33.1	819,714	43.1	29.1	54.3	16.7	8.4	0.5	5.3	2.2	73.5	8.7	41.7	40.1	5.1	58.0	22.2
	Machinery	161	19.9	662,992	34.8														
	300	69	8.5	301,944	15.9	33.1	46.3	20.6	2.1	0.1	14.1	4.3	71.1	12.2	41.0	27.6	0.0	55.7	0.3
	Total	809	100.0	1,903,544	100.0	40.4	38.8	20.9	11.9	3.1	4.2	1.2	62.5	14.2	30.5	40.3	0.4	30.0	22.0
										Mexico									
1995	Manufacturing	66	62.9	64,037	41.6	33.2	40.7	26.0	22.2	0.0	2.5	0.0	94.6	42.3	72.6	69.2	10.0	94.8	-
	Machinery	43	41.0	54,127	35.2														
	300	17	16.2	26,056	16.9	32.2	51.8	16.0	7.7	0.1	5.6	0.0	100.0	61.3	93.2	87.1	0.0	100.0	-
	Total	105	100.0	153,758	100.0	25.6	49.1	25.3	13.5	0.0	1.5	0.0	95.0	20.5	64.6	70.5	8.6	94.8	-
1998	Manufacturing	88	61.5	147,170	67.2	32.6	40.5	26.9	16.3	0.0	10.5	0.0	59.9	16.0	63.2	68.8	-	54.8	7.3
	Machinery	62	43.4	126,250	57.7														
	300	33	23.1	65,764	30.0	42.3	34.8	22.9	2.9	0.0	20.0	0.1	59.9	42.9	48.6	52.4	-	48.3	0.0
	Total	143	100.0	218,924	100.0	40.0	33.9	26.1	19.2	0.0	6.9	0.0	76.7	12.5	64.4	67.9	100.0	54.8	38.6
										Brazil									
1995	Manufacturing	102	54.8	212,475	55.6	17.3	67.1	15.6	3.0	1.6	9.7	0.7	82.8	4.7	27.8	47.6	63.0	10.7	22.0
	Machinery	46	24.7	157,827	41.3														
	300	18	9.7	62,606	16.4	16.4	49.5	34.1	3.5	2.8	27.2	0.7	61.1	10.2	18.9	18.6	100.0	10.4	33.5
	Total	186	100.0	381,889	100.0	19.9	60.6	19.6	10.8	1.0	6.4	0.4	90.2	15.0	59.5	90.5	62.8	10.5	22.0
1998	Manufacturing	117	52.2	450,289	53.3	17.6	68.4	14.0	5.9	0.8	3.8	3.0	77.0	7.6	18.1	2.6	0.8	62.6	0.6
	Machinery	64	28.6	320,861	38.0														
	300	25	11.2	206,499	24.5	32.3	47.2	20.6	0.5	0.0	11.8	8.3	82.3	0.0	37.1	3.2	-	64.5	0.3
	Total	224	100.0	844,349	100.0	25.0	59.4	15.7	11.0	0.4	2.1	1.8	60.6	4.9	39.0	44.1	0.8	57.5	0.5

Data source: authors' calculation, based on METI database.

Note: Manufacturing is industry classification 120-340, and machinery is industry classification 290-320.