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Production Networks in East Asia: Strategic Behavior by Japanese and U. S. firms*

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Abstract

This paper analyzes the mechanism and features of international production networks, mainly in the machinery sector, focusing on the implications of fragmentation and of the role of MNEs in creating and coordinating the activities within the networks. By investigating data of Japanese and U.S. firms in East Asia and Latin America, we find that regional investment climate is more important in promoting production networks than differences in firm nationalities. In East Asia, both firms display very similar patterns in exploiting the international division of labor as well as close links between geographical proximity and arm's length fragmentation, unlike Latin America.

Key Words

international production networks, fragmentation, East Asia, Latin America, and Japanese and U.S. firms

1. Introduction

Apart from its rapid growth in recent years, the nature and composition of trade have undergone significant change. Intra-regional trade has grown relative to total trade

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in many parts of the world, and trade in parts and components has grown relative to trade in end products. These developments have been facilitated by trade liberalization at multilateral and regional levels and by cost-saving innovations in transportation and communications technologies.

Along with these changes in the patterns and composition of trade have come changes in international capital flows and in financial linkages among countries. In the process, the role of foreign direct investment (FDI) and of multinational enterprise (MNEs) has been both intensified and transformed.

These developments and the speed with which they have taken place have created challenges to policy makers and to theoretical and empirical economics. At the theoretical level, economists have used traditional as well as newer models in an effort to better understand the changes and to assess their effects. In this paper, we focus on the implications of cross-border "fragmentation" of production and of the spread of multi-country production networks, with particular focus on East Asia in comparison with Latin America.

The next section analyzes the effect of fragmentation at the level of countries and industries. Section 3 examines the issue from the point of view of firms, allowing for imperfect competition and introducing the multinational firm. Section 4 reviews features of East Asian trade, and Section 5 collects and assesses empirical evidence on the activities of Japanese and U.S. firms in East Asia and Latin America. Section 6 provides interpretations of the findings in light of underlying theoretical considerations. Section 7 examines corporate strategies in the era of globalization, while Section 8 considers the policy implications. Section 9 concludes.

2. Trade Theory and Cross-border Production Fragmentation

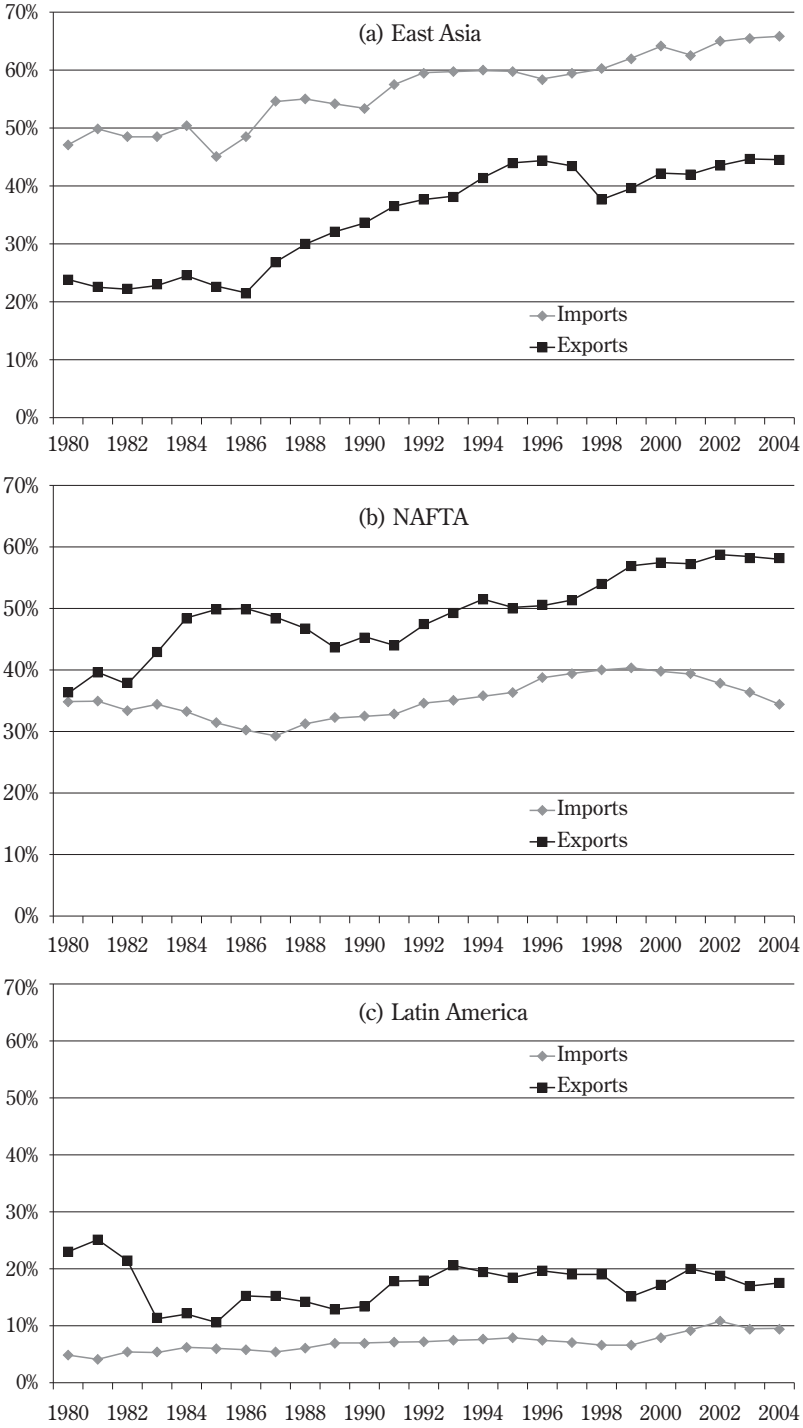
The rapid growth of international trade and of cross-country linkages of goods, services and financial markets has been widely noted. This development has been facilitated by reductions in trade barriers and market-opening policies, as well as cost-saving innovations in communications and transportation technologies.

While trade has grown generally, intra-regional trade has grown relative to total trade in many parts of the world, including East Asia and North America. Figure 1 (a) and (b) provide an overview of developments in those two regions. In contrast, Figure 1 (c) suggests a somewhat different picture for Latin America. That difference will be important in the subsequent discussion.

Another development that has been gaining strength in recent years is trade in parts and components relative to trade in finished goods. This phenomenon is a reflection of the growing importance of cross-border sourcing and production sharing and of international production networks. A term frequently used in this literature is cross-border "fragmentation" of production. Figure 2 provides a sampling of evidence for the machinery sector.

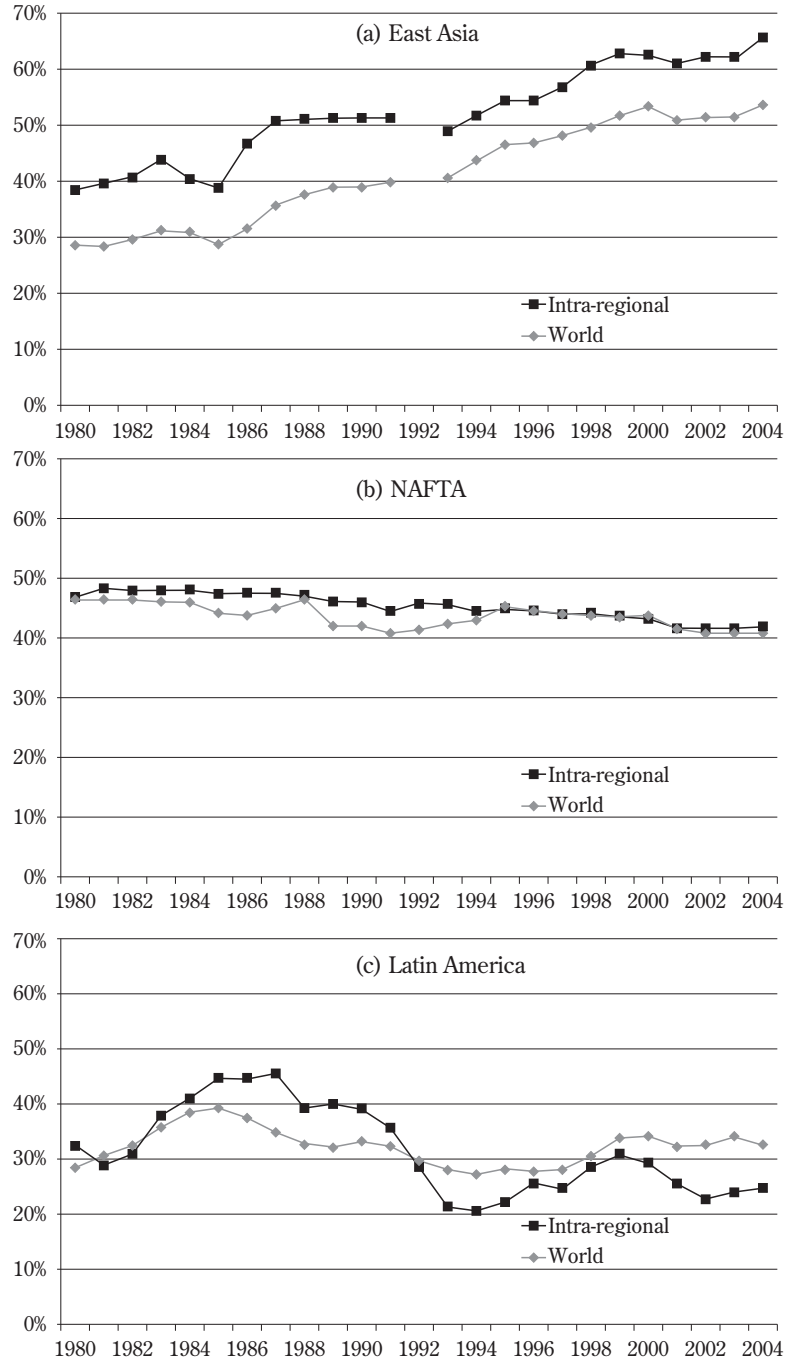
Cross-border production fragmentation has become increasingly feasible and profitable as trade liberalization, market opening, reductions in barriers to FDI and to flows of capital generally, as well as reforms in regulatory and other policies around the globe have created a freer world economy. As noted, an important contributing factor has been cost-saving innovations in communications and transportation technologies.

Figure 1 Intra-regional trade in manufacturing goods as a share of trade with the world



Data source: authors' calculation, based on UN COMTRADE.

Figure 2 Machinery parts and components as a share of total machinery trade: intra-regional trade and trade with the world



Data source: authors' calculation, based on UN COMTRADE.
Note: machineries in Figure 2 are composed of machinery, electronic products and equipment, and transportation equipment.

Communication by satellite and optical fiber, combined with computer-aided design and manufacturing, has played a key role.

These developments present a challenge to traditional trade theory, a key feature of which is its focus on the role of comparative advantage in determining international specialization and trade. Comparative advantage, in turn, is driven by differences among countries in factor endowments and in technological knowledge, combined with variations across commodities in production technologies and factor intensities. Under these conditions, the theory asserts that global resource utilization will be most efficient and welfare highest if each country specializes in the production and exportation of goods which make intensive use of the technologies and factors of production with which it is abundantly endowed, while importing products in which it has comparative disadvantage.

The fact that this formulation of comparative advantage has traditionally been applied more to trade in end products than to components, does not mean that it is not relevant to the latter. Indeed, it implies that, where cross-border dispersion of the various phases of production of a commodity is feasible, welfare maximization requires that countries specialize in the production of parts and components that make intensive use of the technology and factors of production with which they are relatively well endowed.

It is important to note that the focus of traditional trade theory is at the country level and on industries and broadly defined groups of productive resources. We shall see later, that a full understanding of the effects of cross-border production sharing requires an additional perspective, namely, that of the firm and its additional degree of freedom in cutting out production blocks.

At the country level, economic analysis has made extensive use of Ricardian and Heckscher-Ohlin frameworks.[1] In the Heckscher-Ohlin context, cross-border fragmentation of production generates welfare effects in ways that are analogous to those of technical progress, the analysis of which goes back to Rybczynski (1955).[2] When production sharing leads a labor-scarce country to substitute domestically produced labor-intensive components or assembly with imports from labor-abundant countries, welfare improves in ways similar to labor-saving technological progress. Hence, offshore sourcing is in some sense a substitute for technological progress, although it can also clearly be complementary. In addition, flexibility in how to fragment production into blocks yields further room for exploiting differences in location advantages.

Foreign sourcing may occur in both export and import-competing industries (and, in more elaborate formulations, in non-tradables sectors). If it is sector-specific or occurs to differing degrees in the import-competing and export sectors, then it leads to changes in relative factor returns. In a two-good, two-factor model, foreign sourcing by the labor-intensive sector raises the relative wage. If it occurs in the capital-intensive sector, the relative wage falls. In both instances, it can be shown that nominal returns rise under a wide range of specifications.

In the Heckscher-Ohlin framework, production sharing shifts resources into the sector undertaking foreign sourcing and, hence, output rises in that sector. When the country is large, this increase in production changes relative prices. If it raises output of the import good, then the country obtains an additional gain from the improvement in its

[1]For theoretical modeling, see Arndt (1997, 1998), Deardorff (2001a, 2001b), Jones and Kierzkowski (1990, 2001) and Kohler (2001). For empirical studies, see Feenstra and Hanson (1996) and Hummels, Ishii, and Yi (2001).

[2]Foreign sourcing improves the productivity of domestic resources and thereby shifts out the production possibility frontier for the industry in which it takes place. See Arndt (1997, 1998) for details.

terms of trade. If it occurs in the export sector, the resulting deterioration of the terms of trade diminishes the welfare gains from cross-border fragmentation itself.

Production sharing between two countries, one of which is a high-wage advanced country and the other a low-wage emerging economy, should produce a pattern of specialization in which the former produces capital- and skill-intensive components and assembly, while the latter focuses on labor-intensive components and assembly. Thus, production sharing of a commodity which is the advanced country's import good and the emerging economy's export good, increases relative wages in both countries. If production sharing occurs in the export commodity of the advanced country (and hence the import commodity of the emerging economy), wages fall relative to the return to capital or to skilled labor (human capital).

An important consequence of cross-border production fragmentation is that a country's exports will contain foreign value-added, while its imports contain domestic value-added. Hence, the values traded are often less than the value of trade. Motor vehicles exported by Mexico to the United States, for example, are built with U.S.-made components (engines, ignition systems, etc.). Those components constitute the major part of the value of Mexican vehicle exports. Similarly, Chinese exports of electronic equipment to the United States, such as automatic data processing machinery (ADP), contain components made in other countries, including the United States and countries in East Asia.

This feature of trade in the age of production sharing has far-reaching implications for the way we look at and interpret movements in trade balances. For example, if China were to allow the yuan to appreciate, the results might disappoint U.S. officials. According to traditional trade theory, a yuan appreciation will raise U.S. exports to China and reduce imports from China. These adjustments will be driven by price changes, but whether and to what extent prices change now depends on more than the bilateral exchange rate between the two countries. The extent to which Chinese exports to the U.S. fall, for example, depends as well on how the yuan moves relative to the currencies of countries from which China imports the components that go into those exports. If it appreciates against them, then the yuan price of imported components will fall, allowing China to reduce the yuan price of its exports and thus to mitigate the effect of the yuan appreciation on the dollar price of those exports.

The effect of cross-border fragmentation on economic welfare also depends on the nature of the trade regime. It is generally welfare-enhancing under conditions of free trade and it is welfare-enhancing as part of a preferential trade agreement, except when its implementation is restricted by rules of origin. On the other hand, its welfare effects are ambiguous when the import-competing good is protected by a tariff.[3]

Implementation of production sharing between an advanced and an emerging economy typically requires prior flows of foreign direct investment, which presuppose an investment-friendly environment in the host country. It also requires supporting infra-structure, which often needs to be provided by government. Public infra-structure investment and FDI play an important role in supporting the "service links" needed to facilitate communication and coordination of production activities that span national borders. Indeed, while production sharing reduces production costs, it may require installation of costly communications and coordination infra-structure. These are

[3]For detailed examination of these issues, see Arndt (2001, 2004).

the "service links" discussed in the literature.[4] Clearly, production sharing will not be profitable if the latter costs exceed the savings in production costs.

3. Cross-border Fragmentation and the Firm

While the country perspective of traditional trade theory provides a number of important insights, a full picture can only be obtained by consideration of decisions at the level of the firm, particularly the multinational enterprise (MNE). The empirical evidence, which is examined in detail below, suggests that MNEs play a very important role in creating and coordinating the activities of production networks.

A useful perspective of firm-level operations is provided by the literature on trade and imperfect competition.[5] This line of inquiry seeks to understand the criteria on the basis of which firms determine optimal production arrangements, as they choose among consolidated production at home or abroad, in which the entire product is produced within the firm, as opposed to domestic or foreign outsourcing, where outsourcing may occur at "arm's length," that is, with unaffiliated firms, or with affiliated firms, which in turn may be minority- or majority-owned.

In making these choices, firms not only take into account relative production and coordination costs, but issues arising with respect to the transfer of technology. Production costs, as well as coordination costs, are affected by intra-firm and extra-firm scale economies, and by regulatory requirements, customs-related costs (including the constraints imposed by rules of origin), the availability of infra-structure and facilities, and so on.

While MNEs have been operating abroad for a very long time, the nature of their activities has changed significantly over the years. For the U.S. multinationals who went to Europe in the fifties and sixties, "tariff-jumping" to avoid the discriminatory trade practices of the EEC and EFTA was a major objective. It meant that the primary purpose of setting up facilities in Europe was to produce finished products for the local market. IBM, Ford, General Motors, and a long list of well-known U.S. companies enhanced their status as "multinationals" in that period. Over time, Japanese multinationals and companies from other countries adopted similar models. Although today's multinationals continue that tradition, they also use their foreign operations to produce finished products destined for the home market and to produce parts and components to be incorporated into end products manufactured in the home country or in third countries.

One of the most successful examples of this expanded approach to foreign operations may be found in Ireland, where multinationals produce end products aimed at the European Union market as well as markets elsewhere, and where parts and components are produced for inclusion into products made in the United States and elsewhere. This networking is particularly well-developed in the Irish electronics sector.

Similar developments may be observed in East Asia. What is important in these set-ups, compared to, say, production -sharing in the motor vehicles sector between the U.S. and Canada and the U.S. and Mexico, is that the networks are multi-country rather

[4]See Jones and Kierzkowski (1990) for a detailed treatment of the nature and role of service links.

[5]See Baldwin (2005) and Helpman and Krugman (1985). See also Grossman and Helpman (2005), Helpman, Melitz, and Yeaple (2004), Melitz (2003), Eaton, Kortum, and Kramarz (2004), Bernard, Eaton, Jensen, and Kortum (2003), and McLaren (2000). For an excellent survey, see Helpman (2006).

than bilateral in nature. To make such complicated systems work, requires significantly more complex coordination patterns. Since multinationals operate at very large scales, a cluster of small countries such as those in East Asia, linked into a production network can generate significant spillovers. This is an important example of multi-country-level external economies of scale serving the needs of fragmentation. We examine these activities in East Asia more closely in the empirical sections that follow.

While there are good reasons why production networks and components trade require the participation of multinationals, particularly for start-up investment and operation of the system, there comes a stage after which non-affiliated firms may play an increasing role in the network. There is evidence in East Asia, for example, that the ratio of arm's length to intra-firm trade is growing. Agglomeration and clustering can play a very important role in spreading the costs of infra-structure development and helping to attract venture capital. This process can generate significant industry-level scale economies, very much as it did in California's Silicon Valley and Ireland.

The recent literature on the role of multinationals has made significant progress in understanding the decision processes involved. While there is no definitive answer and only very incomplete evidence, it is clear that the conditions for effective production networking vary significantly across regions. While multinationals operate in a number of Latin American countries, they are there primarily to supply the local market with end products rather than to produce parts and components for a variety of local and foreign destinations. That is especially true for Japanese multinationals, but applies as well to U.S. firms. Production sharing also tends to be more bilateral than multi-country in nature in Latin America as compared with East Asia. Both natural and man-made barriers explain the more limited patterns of behavior in Latin America.

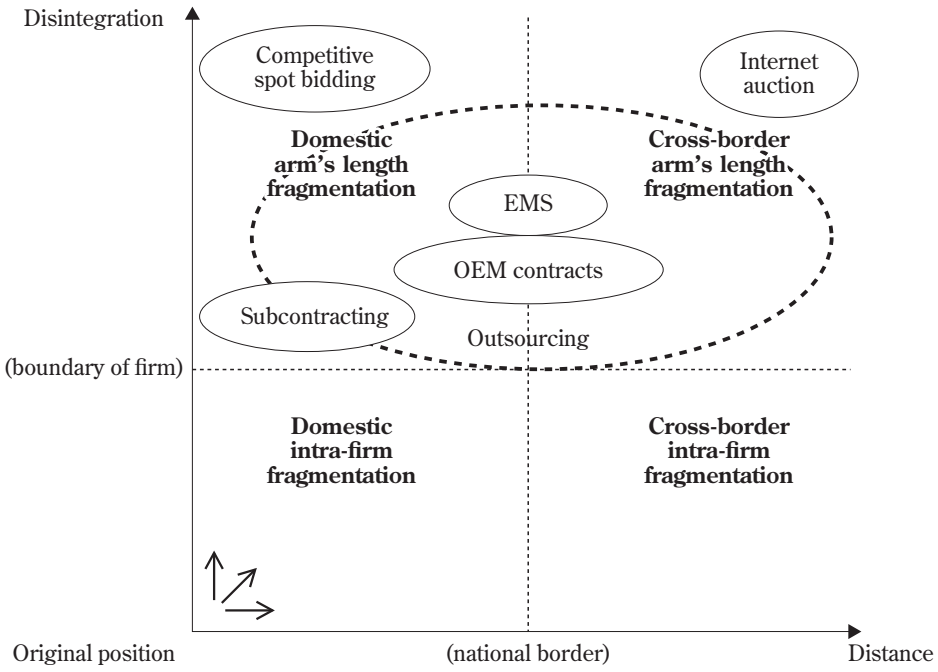
In order to bring together the country-level and firm perspectives, and building on the insights of Jones and Kierzkowski (1990, 2001), Kimura and Ando (2005a) develop a two-dimensional model of fragmentation and its cost structure (Figure 3). Distance is measured along the horizontal axis. The larger distances involved in cross-border production sharing relative to dispersion that is purely domestic imply rising costs of transportation and communication, which will be acceptable only if warranted by lower production costs.

An important point to note is the role assigned to "location advantages" along the horizontal axis. While traditional trade theory can take account of location-related advantages, it has tended to take them for granted. Location advantages go beyond accounting for resource endowments and their effects on factor prices and include a variety of infra-structure issues, including access to transportation and communication networks. Firms have the degree of freedom to decide what sorts of activities to detach and thus to exploit multi-faceted location advantages.

The vertical axis measures the degree of integration/disintegration in terms of consolidated production, intra-firm production and production involving affiliates at the lower end of the axis and moving increasingly to arm's length production toward the top. As noted above, the process of movement up along the axis is probably affected significantly by the extent of clustering and agglomeration. As the market evolves, it becomes increasingly capable of standing alone, that is, free of close guidance from multinationals.

This is an important answer to some critics of production networks, who may be concerned that the multinational firm will force the local economy to be forever

Figure 3 Fragmentation in a two-dimensional space



Source: Kimura and Ando (2005a).

relegated to supplying labor-intensive parts and components. The process envisaged here, foresees a gradual evolution from intra-firm activities to relationships that become increasingly arm's length and take place in a framework of local industrial clustering and agglomeration. This approach has the potential of contributing significantly to industrial development in emerging economies.

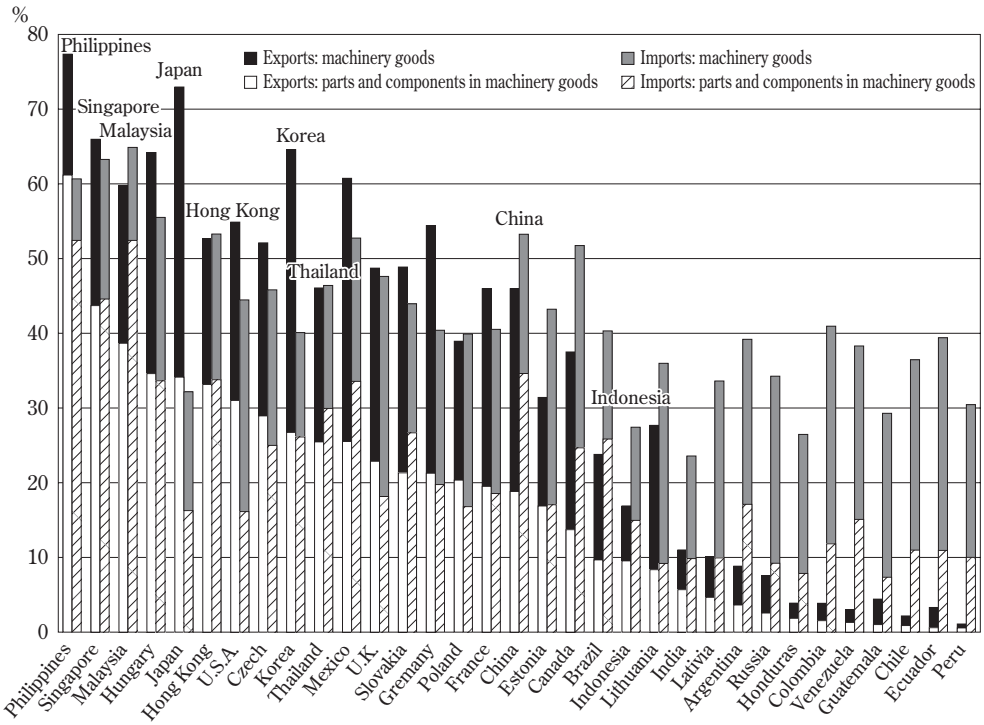
4. International Trade in East Asia

Before moving to the detailed empirical investigation of activities of Japanese and U.S. firms in East Asia, this section briefly reviews some features of East Asian trade. As discussed in section 2, shares of machinery trade are high in East Asia. Figure 4 presents the shares of machinery goods and machinery parts and components in total exports to and imports from the world in 2003 for a broad range of countries.[6] Countries are arrayed from left to right, starting with the country with the highest export share of machinery parts and components. Clearly, a number of East Asian developing countries are located on the left-hand side, with high export and import shares of machinery parts and components, suggesting the existence of active back-and-forth transactions.

A large portion of such machinery parts and components trade in East Asia is intra-regional (Figure 5). If intra-regional export shares in 1990 are compared with those

[6]See Ando and Kimura (2005) for a definition of machinery parts and components.

Figure 4 Machinery goods and machinery parts and components: shares in total exports and imports in 2003



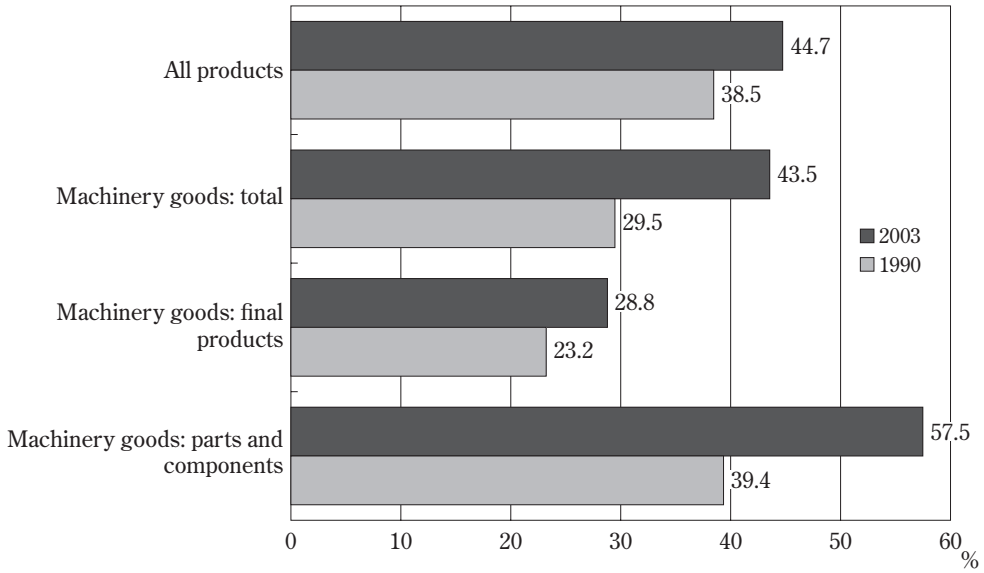
Data source: Ando and Kimura (2006a).
Notes: machineries are composed of HS84-92, i.e., general machinery, electric machinery, transport equipment, and precision machinery. See Ando and Kimura (2005, 2006a) for a definition of machinery parts and components.

in 2003, one can observe the rapid expansion of intra-regional trade particularly for machinery parts and components: the intra-regional export share is close to 60 percent in 2003 relative to 40 percent in 1990, and the intra-regional export value of machinery parts and components is 5.5 times that of 1990 on a current price basis. This strong increase in intra-regional trade of machinery parts and components explains half of the intra-regional export growth from 1990 to 2003, i.e., 191 percent (Figure 6). This can be regarded as a sort of "magnification effect" of machinery intermediates trade, as discussed by Yi (2003).

Figure 7, in turn, decomposes machinery trade (exports plus imports) in 1990, 1996, and 2000 into inter-industry trade, vertical intra-industry, and horizontal intra-industry trade, with a distinction of machinery parts and components from machinery final products.[7] In the 1990s, vertical transactions, particularly vertical back-and-forth transactions of parts and components, expanded significantly in East Asia. In this region,

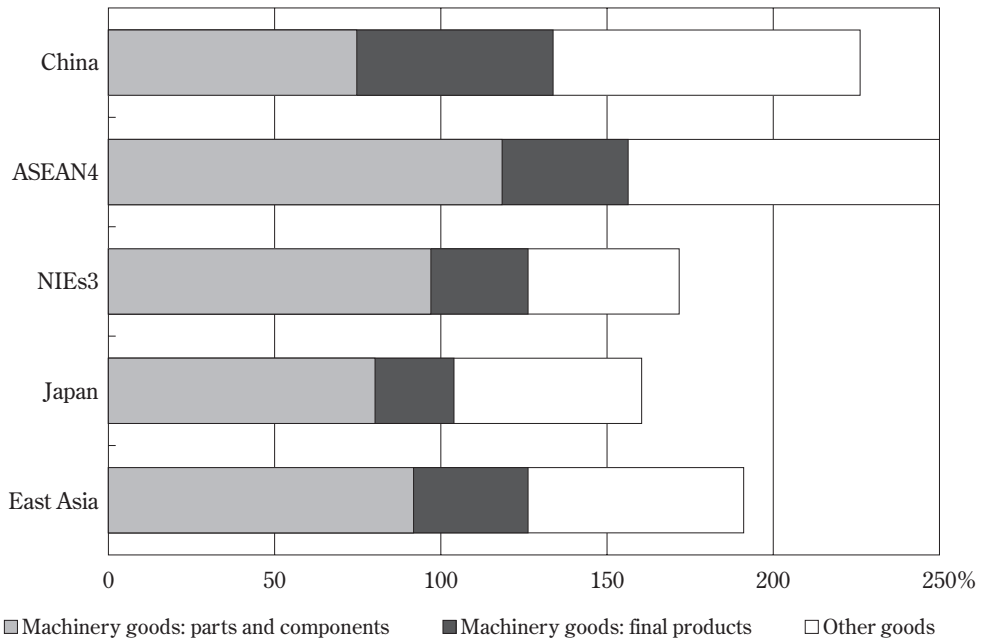
[7]Figure 7 is based on the results of the following decomposition: first, export values are compared with import values for each commodity at the finely disaggregated (HS six-digit) level, and commodities with more than 10 times' differences are classified into one-way trade and the rest are into intra-industry trade. Then, for commodities categorized into intra-industry trade, export-import unit price ratios are calculated to divide them into vertical intra-industry trade (with export-import unit price ratios more than a certain criteria) and horizontal intra-industry trade (with export-import unit price ratios less than that criteria). See Ando (2006) for details and discussion of changes in East Asian trade structure in the 1990s.

Figure 5 Intra-regional export ratios in East Asia in 1990 and 2003



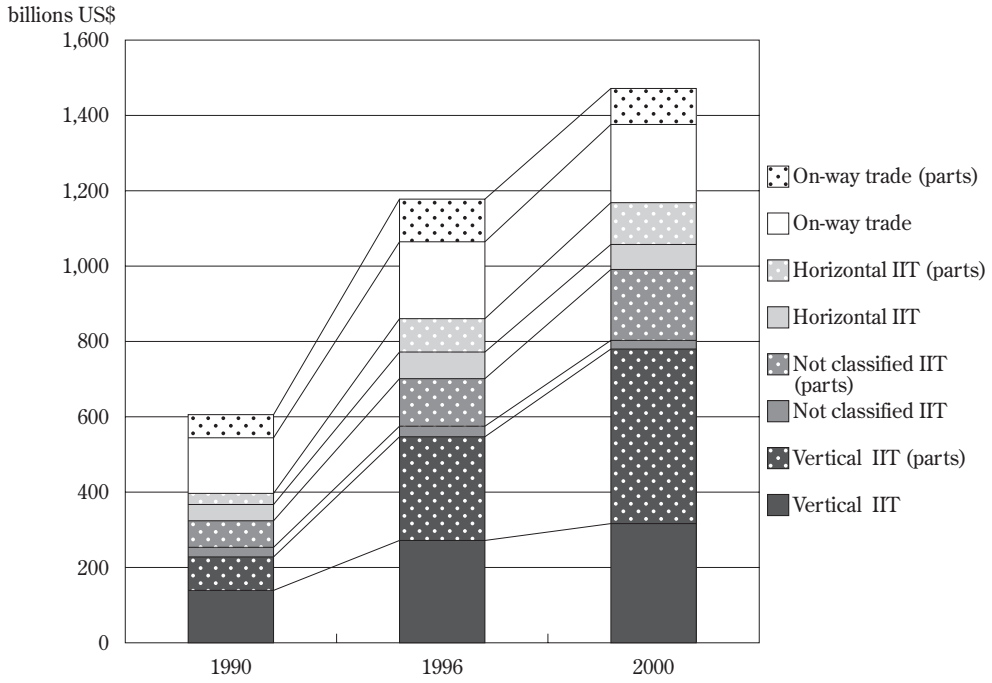
Data source: Ando and Kimura (2006a).
Notes: "East Asia" here includes China, ASEAN4, NIEs3, and Japan. Due to lack of data available from UN COMTRADE, (i) Taiwan is not included in East Asia, (ii) data for China in 1992 and Hong Kong in 1993 are used in calculating intra-East Asian exports in 1990, (iii) data for the Philippines are not included in calculating intra-East Asian exports in 1990. See also notes for Figure 4.

Figure 6 Decomposition of growth rates of intra-regional exports in 1990-2003



Data source: Ando and Kimura (2006a).
Notes: growth rates are on a current price bases. See also notes for Figure 5.

Figure 7 Rapid expansion of vertical IIT in machinery goods and machinery parts and components for East Asia's trade



Data source: Ando (2006).
Note: the Philippines is not included for 1990. Data of 1990 for China and Hong Kong are of 1992 and 1993, respectively.

active division of labor at the production process level has stepped into the formation of international production and distribution networks.

In other regions, in contrast, higher shares of machinery trade and of machinery parts and components trade are observed for some countries such as the U.S., Mexico, U.K, Germany, Hungary, Czech Republic, and Slovakia (Figure 4). This reflects the development of production networks in machinery industries between the U.S. and Mexico and between U.K./Germany and Central and Eastern European (CEE) countries, but these networks encompass smaller numbers of countries than their counterparts in East Asia.[8] Other countries, particularly those in Latin America except Mexico, are found on the right-hand side with far lower shares of machinery exports. In addition, the shares of machinery exports are much lower than those of imports, suggesting an import-substituting structure of trade.

5. Japanese and U.S. Firms' Activities in East Asia

This section investigates Japanese and U.S. firms' activities in East Asia with micro

[8]See Ando and Kimura (2006b) for features of production sharing in the WE (Western Europe)-CEE nexus.

data, focusing on similarities and differences between the two nationalities. To shed light on their features in East Asia, we include information on Latin America, particularly Mexico, which has close economic relationship with the U.S.

The micro data analysis of Japanese corporate firms is conducted using the following two data bases collected by Japan's Ministry of Economy, Trade and Industry (METI): 1. The F/Y 2001 Basic Survey of Business Structure and Activity (with data for 2000) and 2) The 23rd (data for F/Y 1992), 26th (F/Y1995), 29th (F/Y 1998), 32nd (F/Y2001), and 35th (F/Y 2004) Survey of Overseas Business Activities of Japanese Companies.[9] Japanese affiliates abroad are defined as those with no less than 20 percent Japanese ownership in the former data base, while foreign affiliates include both "affiliates abroad" with no less than 10 percent ownership by Japanese parent firms and "affiliates of affiliates abroad" with more than 50 percent ownership by "affiliates abroad" in the latter data base. Note that foreign affiliates with parent firms belonging to finance and insurance, and real estate sectors are not included in the latter data base. Therefore, the coverage of non-manufacturing affiliates, particularly services affiliates, is narrower for Japanese affiliates abroad than the coverage for U.S. affiliates abroad.

On the other hand, the micro data analysis of U.S. corporate firms is conducted, using the Bureau of Economic Analysis (BEA) data base collected by the U.S. Department of Commerce: U.S. Direct Investment Abroad, Final Results from the 1989 and 1999 Benchmark Surveys as well as Preliminary 2003 Estimates.[10] In our analysis, U.S. affiliates abroad are defined as majority owned non-bank foreign affiliates (with more than 50 percent U.S. ownership) of U.S. non-bank parent firms. Note that the BEA data base is not for raw data, but aggregated data at the host country/industry level.

Table 1 presents sectoral patterns of Japanese FDI in East Asia: the number of (a) all sized parent firms and (b) small and medium sized parent firms (SMEs with regular workers of less than 300) with Japanese affiliates in East Asia and the number of affiliates in East Asia by the industry of parent firms and by the industry of affiliates. 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 categorized into manufacturing sectors and half into the machinery sector. Moreover, Japanese manufacturing affiliates, regardless of the industries of their parent firms, account for 62 percent of the total Japanese affiliates in the region. These figures clearly show how dominant manufacturing activities are in East Asia in terms of both Japanese parent firms and their affiliates.

Industries of parent firms and those of affiliates do not necessarily coincide, since parent firms in general engage in various activities across industries and establish foreign affiliates in order to conduct a subset of those activities.[11] Japanese manufacturing parent firms, however, have 75 percent of their total affiliates in East Asia in manufacturing

[9]To obtain intra-firm/arm's length ratios of sales and purchases by Japanese affiliates abroad, we need to use extensive surveys of Overseas Business Activities of Japanese Companies with detailed information on overseas business activities, which are conducted every three years, though the surveys are conducted every year. The latest survey with data for 2004 is used only in Table 3, based on the aggregated data since raw data are not accessible for us at this moment.

[10]To obtain detailed information of by-destination sales to third countries other than local market and the U.S. by U.S. affiliates abroad, we have to use the Benchmark Survey of U.S. Direct Investment Abroad, Final Results. The data for 1999 are the latest available one among the Benchmark Surveys with final results. The data for 2003 are used only in Table 3.

[11]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.

Table 1 Sectoral patterns of Japanese parent firms and their affiliates in East Asia: 2000 F/Y

Industry of parent firm	Number of parent firms	%	Number of total affiliates	%	Industry of affiliate: Manufacturing: Number of affiliates	Manufacturing: Share	Manufacturing: share (machinery)	Non-manufacturing: Number of affiliates	Non-manufacturing: Share	Non-manufacturing: share (wholesales)
(a) All sized parent firms										
Manufacturing	2,050	68%	6,296	62%	4,726	75.1	39.7	1,570	24.9	17.3
Machinery (total)	1,012	34%	3,386	33%	2,478	73.2	69.2	908	26.8	18.8
- General machinery	286	10%	810	8%	523	64.6	57.4	287	35.4	26.4
- Electric machinery	429	14%	1,598	16%	1,158	72.5	69.5	440	27.5	19.3
- Transport equipment	222	7%	752	7%	638	84.8	81.9	114	15.2	7.8
- Precision machinery	75	3%	226	2%	159	70.4	66.8	67	29.6	24.8
Non-manufacturing	944	32%	3,928	38%	1,356	34.5	9.8	2,572	65.5	39.2
Wholesales	697	23%	3,350	33%	1,277	38.1	10.8	2,073	61.9	45.3
Total	2,994	100%	10,224	100%	6,082	59.5	28.2	4,142	40.5	25.7
(b) Small and medium sized parent firms										
Manufacturing	874	65%	1,295	60%	1,123	86.7	36.9	172	13.3	10.7
Machinery (total)	385	29%	590	27%	503	85.3	76.9	87	14.7	11.5
- General machinery	129	10%	179	8%	149	83.2	70.9	30	16.8	12.8
- Electric machinery	181	13%	303	14%	256	84.5	78.2	47	15.5	12.2
- Transport equipment	46	3%	61	3%	57	93.4	83.6	4	6.6	4.9
- Precision machinery	29	2%	47	2%	41	87.2	83.0	6	12.8	10.6
Non-manufacturing	474	35%	870	40%	332	38.2	9.7	538	61.8	46.8
Wholesales	410	30%	774	36%	312	40.3	9.6	462	59.7	51.8
Total	1,348	100%	2,165	100%	1,455	67.2	26.0	710	32.8	25.2

Source: Kimura and Ando (2005a).

Notes: (1) The figures for "share in total" indicate (a) shares in total number of all sized parent firms investing abroad and their foreign affiliates and (b) shares in total number of small and medium sized parent firms investing abroad and their foreign affiliates. (2) The figures for "share" for manufacturing, machinery, 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/small and medium sized parent firms in each sectoral category.

sectors, which is higher than the ratios for other regions.[12] 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 to other firms and/or to their own affiliates, that is, a sort of "vertical FDI". Large manufacturing activities by Japanese firms, particularly with active FDI by Japanese SMEs, are one of the essentials to production networking in East Asia.

Table 2 shows sectoral patterns of U.S. FDI: the number of parent firms with foreign affiliates and the number of foreign affiliates, classified by the industry of parent firms and by the industry of affiliates. Since the location of affiliates abroad by industry cannot be identified in the BEA data base of U.S. firms, Table 3 presents sales by Japanese and U.S. affiliates in (a) East Asia and (b) Latin America) in the latest available years by the industry of affiliates.[13] In general, U.S. firms in non-manufacturing, mainly services sectors, are more active in FDI than Japanese firms are; manufacturing and machinery

[12]The corresponding ratios are 40 percent to 50 percent for Japanese parent firms with affiliates in North America, those in Latin America, and those in Europe. See Kimura and Ando (2005b) for the details.

[13]See Table A.1 in the Appendix for (a) sales and (b) gross product by U.S. affiliates in East Asia and Latin America in 1999, classified by industry of the affiliate.

Table 2 U.S. parent firms and foreign affiliates by industry, 1999 F/Y

Industry	By industry of parent firm				By industry of affiliate	
	Number of parent firms	Share in total (%)	Number of affiliates	Share in total (%)	Number of affiliates	Share in total (%)
Manufacturing	**1,295**	**52**	**13,250**	**63**	**7,494**	**36**
Machinery (total)	543	22	5,492	26	2,821	13
- Machinery	163	7	1,306	6	865	4
- Computer and electronic products	232	9	1,610	8	862	4
- Electrical equipment, appliances etc.	57	2	662	3	307	1
- Transport equipments	91	4	1,914	9	787	4
Non-manufacturing	**1,176**	**48**	**7,792**	**37**	**13,548**	**64**
Wholesale trade	262	11	1,613	8	4,928	23
Total	**2,471**	**100**	**21,042**	**100**	**21,042**	**100**

Data source: authors' calculation, based on BEA database.
Note: U.S. affiliates are majority-owned non-bank foreign affiliates with more than 50% U.S. ownership.

shares are 52 percent and 22 percent (Table 2). Moreover, foreign affiliates of U.S. firms concentrate on non-manufacturing sectors; manufacturing and machinery shares are as low as 36 percent (62 percent for Japanese affiliates in East Asia) and 13 percent (33 percent).

Table 3, however, reveals that manufacturing activities in terms of sales, particularly in the machinery sectors, are dominant not only for Japanese affiliates but also for U.S. affiliates in East Asia: manufacturing and machinery shares are 59 percent and 45 percent for Japanese affiliates and 46 percent and 30 percent for U.S. affiliates, while machinery shares are 37 percent and 21 percent for Japanese and U.S. machinery affiliates abroad, respectively. Moreover, the corresponding shares are high for Japanese and U.S. affiliates in East Asia excluding Hong Kong and Singapore, where sales by non-manufacturing affiliates are large: manufacturing and machinery shares are 65 percent and 48 percent for Japanese affiliates and 57 percent and 39 percent for U.S. affiliates.[14] These numbers suggest that manufacturing activities by U.S. firms, particularly in the machinery sectors, are as intensive in East Asia as those by Japanese firms, reflecting the importance of East Asian host countries, though foreign affiliates of U.S. firms in general operate more intensively in non-manufacturing sectors.

We turn next to analyze by-destination sales and by-origin purchases of Japanese and U.S. affiliates in East Asia. Given the significance of manufacturing, and of the machinery sectors in particular, we focus on the performance of manufacturing affiliates and machinery affiliates. Purchases are investigated only for Japanese affiliates since comparable information for U.S. affiliates is not available. Moreover, since detailed information on by-destination sales by U.S. manufacturing affiliates is not available, sales by U.S. affiliates are examined for all industries combined, along with estimated patterns of sales by U.S. manufacturing affiliates.

Tables 4 to 6 and Figures A.1 and A.2 in the Appendix present shares of (a) by-destination sales and (b) by-origin purchases by Japanese manufacturing affiliates and machinery affiliates in 1992 and 2001 and U.S. (manufacturing) affiliates in 1989 and

[14]Sector shares of sales by Japanese affiliates in East Asia excluding Hong Kong and Singapore are those by Japanese affiliates in East Asia excluding Hong Kong but including Singapore, due to lack of access to raw data at this moment for us.

Table 3 Sales by Japanese and U.S. affiliates in East Asia and Latin America

(i) Japanese and U.S. affiliates in East Asia

	By-sector sales shares (%)						Ratios of country/region in East Asia (%)			
	World	East Asia	East Asia (excl. Hong Kong and Singapore)	China	ASEAN4	NIEs4	East Asia	China	ASEAN4	NIEs4
(a) Japanese affiliates in 2004										
Manufacturing	**49**	**59**	**65**	**78**	**80**	**38**	**100**	**24**	**43**	**33**
Machinery (total)	37	45	48	61	60	27	100	25	44	32
-General machinery	3	3	3	7	2	3	100	39	20	41
-Electric machinery	14	23	23	34	26	18	100	26	34	40
-Transport equipment	20	17	20	17	32	4	100	20	67	14
-Precision machinery	1	2	1	3	1	2	100	26	20	54
Non-manufacturing	**51**	**41**	**35**	**22**	**20**	**62**	100	**9**	**15**	**76**
Wholesale trade	43	35	29	18	16	55	100	9	14	78
Others	8	6	6	5	4	7				
Total	100	100	100	100	100	100	100	18	31	51
Total sales values (billions JPY)	162,638	52,610	43,063	8,938	15,961	25,885				
(b) U.S. affiliates (majority owned) in 2003										
Manufacturing	**46**	**46**	**57**	**72**	**56**	**35**	**100**	**24**	**29**	**48**
Machinery (total)	21	30	39	52	n.a.	n.a.	100	26	n.a.	n.a.
-Machinery	2	2	3	5	1	1	100	39	11	50
-Computer and electronic products	7	25	31	41	35	17	100	25	33	43
-Electrical equipment, appliances, etc.	1	1	2	5	n.a.	n.a.	100	55	n.a.	n.a.
-Transport equipments	10	2	4	3	n.a.	n.a.	100	17	n.a.	n.a.
Non-manufacturing	**54**	**54**	**43**	**28**	**44**	**65**	100	**8**	**19**	**74**
Wholesale trade	25	34	18	17	14	45	100	7	10	83
Others	28	20	25	11	30	20				
Total	100	100	100	100	100	100	100	15	23	62
Total sales values (millions US$)	2,905,867	326,275	171,698	48,823	75,695	201,756				

(Continue)

(ii) Japanese and U.S. affiliates in Latin America

	By-sector sales shares (%)					Ratios of country in Latin America (%)			
	World	Latin America	Latin America (excl. Mexico and Brazil)	Mexico	Brazil	Latin America	Mexico	Brazil	Other Latin American countries
(a) Japanese affiliates in 2001									
Manufacturing	**47**	**29**	**7**	**82**	**54**	**100**	**51**	**33**	**16**
Machinery (total)	37	22	6	77	24	100	63	19	17
-General machinery	2	1	0	1	3	100	23	77	0
-Electric machinery	15	5	1	16	10	100	55	36	8
-Transport equipment	17	16	5	60	10	100	68	11	21
-Precision machinery	1	0	0	0	1	100	42	58	0
Non-manufacturing	**53**	**71**	**93**	**18**	**46**	100	**5**	**11**	**84**
Wholesale trade	48	65	86	14	42	100	4	11	85
Others	5	6	8	5	3				
Total	100	100	100	100	100	100	31	26	43
Total sales values (billions JPY)	134,917	7,055	4,557	1,261	1,238				
(b) U.S. affiliates (majority owned) in 2003									
Manufacturing	**46**	**46**	**24**	**67**	**62**	**100**	**49**	**26**	**24**
Machinery (total)	21	22	4	42	32	100	64	28	8
-Machinery	2	2	1	3	6	100	38	51	11
-Computer and electronic products	7	6	1	10	12	100	57	39	4
-Electrical equipment, appliances, etc.	1	1	0	1	1	100	52	36	13
-Transport equipments	10	13	2	28	12	100	73	18	9
Non-manufacturing	**54**	**54**	**76**	**33**	**38**	100	**20**	**14**	**66**
Wholesale trade	25	22	33	11	17	100	16	15	69
Others	28	32	43	22	21				
Total	100	100	100	100	100	100	34	19	47
Total sales values (millions US$)	2,905,867	334,424	156,971	112,313	65,140				

Data source: authors' calculation, based on METI database, METI, the 35th Survey of Overseas Business Activities of Japanese Companies, and U.S. Department of Commerce, U.S. Direct Investment Abroad: Operation of U.S. Parent Campanies and Their Foreign Affiliates, Preliminary 2003 Estimates.

Notes: Coverage of non-manufacturing sectors for U,S, affiliates aborad is wider than that for Japanese affiliates abroad. "East Asia (excl. Hong Kong and Singapore)" for Japanese affiliates in 2004 includes Singapore since it can not be identified when aggregated data are used. Similarly, share of wholesales trade sector for Japanese affilaites abroad expressed as "World" in 2001 is that of wholesales trade and retail sectors since they can not be identified when aggregated data are used.

1999, in East Asia, Latin America, Mexico, and Brazil. Mexico and Brazil are separately presented, because they are the major countries for manufacturing activities by Japanese and U.S. firms, as shown in Tables 3 and A.1, and because Mexico has a closer economic relationship with the U.S.[15] The tables for Japanese affiliates also present the ratios of intra-firm transactions at each destination/origin, while the table for U.S. affiliates shows the ratios of transactions among the same firm nationality at each destination, i.e., U.S. parent firm sales to the U.S. and those of other U.S. affiliates in sales to the local market and in countries other than the local market and the U.S. Table 7 summarizes the shares of intra-firm and arm's length transactions in total sales/purchases by Japanese machinery affiliates in East Asia, NIEs4, ASEAN4, and China, estimated from the corresponding tables to Table 5.

These tables provide several interesting insights regarding firm nationalities. First, the behavior of Japanese affiliates in terms of the international division of labor is similar to that of U.S. affiliates in the same regions. In East Asia, most of the sales and purchases by Japanese and U.S. affiliates are transactions among investing countries (Japan/the U.S.), local market, and the East Asian countries with a significant portion of East Asian countries other than the local market and Japan (expressed as "East Asia" as destinations/origins); the shares of sales to Japan/the U.S., local market, and East Asia are 26 percent (Japan), 46 percent, and 19 percent in 2001 for Japanese manufacturing affiliates and 27 percent (the U.S.), 42 percent, and 18 percent in 1999 for U.S. manufacturing affiliates.[16] Moreover, shares of transactions with other East Asian countries tend to become larger over time; they are 19 percent of sales and purchases in 2001 from 10 percent of sales and 8 percent of purchases in 1992 for Japanese manufacturing affiliates, and 18 percent of sales in 1999 from 14 percent of sales in 1989 for U.S. manufacturing affiliates.[17] These suggest the presence and development of strong intra-regional production networks involving not only the local market but also other East Asian countries through back-and-forth transactions of intermediate goods, regardless of firm nationalities.

In Latin America, in contrast, shares in the region other than the local market (expressed as "Latin America") are small: by-destination sales ratios of other regional countries are only three percent in 2001 for Japanese manufacturing affiliates and six percent for U.S. (manufacturing) affiliates in 1999. By-origin purchase ratios of other regional countries by Japanese manufacturing affiliates are as low as zero percent in 1992 and four percent in 2001.[18] In addition, shares of the local market are large: 59 percent

[15]In the case of U.S. affiliates in Latin America in 2003, for instance, Mexico and Brazil hold as high as 76 percent and 92 percent of the sales by U.S. affiliates in manufacturing sectors and machinery sectors in the region (Table 3). Once Mexico and Brazil are excluded, the manufacturing share in Latin America becomes 24 percent, and the machinery share goes down to as low as four percent. Similarly, Mexico and Brazil hold 74 percent and 73 percent of the sales by Japanese affiliates in manufacturing sectors and machinery sectors in the region in 2004, and manufacturing and machinery shares for Latin America excluding two countries are only seven percent and six percent. These indicate that manufacturing activities by Japanese and U.S. firms, particularly in machinery sectors, are extremely thin in Latin America except Mexico and Brazil.

[16]Note that the ratios of Japan and East Asia as destinations of sales by U.S. manufacturing affiliates are estimated by using shares of Japan and East Asia for U.S. affiliates in all industries, and shares of third countries for U.S. affiliates in all industries, and shares of third countries for U.S. manufacturing affiliates. Given that manufacturing activities particularly in machinery sectors are dominant for U.S. affiliates in East Asia, these estimates would be reasonable.

[17]Note that 14 percent in 1989 is the ratio of East Asia for U.S. affiliates in all industries since the ratio is not available for U.S. manufacturing affiliates in that year.

[18]The corresponding ratios are nine percent for Mexico and one percent for Brazil in 2001, which were zero percent for both countries in 1992. This indicates the development of production networking, particularly for Mexico.

Table 4 Development of intra-regional production networks by Japanese manufacturing affiliates in East Asia and Latin America

	Number of affiliates	Sales/ purchases (billions JPY)	By-destination sales ratio/ by-origin purchases ratio													
			Japan	(Intra-firm)	Local	(Intra-firm)	Third countries (total)	(Intra-firm)	East Asia	(Intra-firm)	North America	(Intra-firm)	Europe	(Intra-firm)	Latin America	(Intra-firm)
(a) Sales																
1992																
East Asia	1,463	7,887	15.8	(84.2)	66.0	(6.3)	18.2	(42.9)	10.0	(44.6)	3.4	(62.6)	1.8	(47.7)	0.1	(11.3)
Latin America	160	878	7.1	(20.6)	77.9	(5.1)	15.0	(19.3)	1.2	(3.3)	6.3	(50.1)	2.5	(6.6)	3.2	(12.2)
- Mexico	35	352	0.8	(0.0)	66.5	(0.0)	32.7	(60.9)	0.0	-	27.9	(64.7)	2.7	(52.3)	1.6	(18.1)
- Brazil	83	335	12.8	(20.6)	69.4	(8.3)	17.7	(3.7)	2.1	(3.3)	5.7	(5.0)	2.4	(4.0)	5.6	(0.1)
2001																
East Asia	4,247	20,382	25.9	(77.4)	46.1	(10.9)	28.0	(46.1)	18.6	(44.0)	4.9	(58.1)	2.6	(43.8)	0.4	(29.9)
Latin America	260	2,013	5.7	(73.1)	59.4	(8.1)	35.0	(31.2)	10.2	(0.5)	18.7	(49.6)	2.6	(34.7)	3.4	(19.7)
- Mexico	89	1,029	1.3	(100.0)	40.2	(5.1)	58.4	(33.5)	20.7	(0.1)	35.5	(51.6)	0.8	(99.9)	1.5	(27.5)
- Brazil	102	671	12.2	(70.1)	74.7	(12.3)	13.1	(14.9)	0.9	(11.8)	3.6	(34.7)	4.7	(12.2)	3.7	(0.2)
(b) Purchases																
1992																
East Asia	1,463	3,384	37.9	(78.2)	48.4	(4.2)	13.7	(42.7)	8.1	(50.2)	1.6	(47.7)	0.0	-	0.7	(0.1)
Latin America	160	238	33.1	(40.6)	58.9	(12.9)	8.0	(39.5)	1.9	(63.0)	2.5	(13.7)	1.2	-	0.0	(2.9)
- Mexico	35	39	14.8	(94.3)	72.3	(47.3)	12.9	(96.9)	1.2	(84.9)	11.7	(10.8)	0.0	-	0.0	-
- Brazil	83	99	20.1	(20.4)	74.7	(5.0)	5.1	(22.0)	0.9	(35.8)	0.7	(17.0)	1.1	-	0.0	(0.0)
2001																
East Asia	4,247	13,781	35.8	(66.0)	43.3	(9.5)	21.0	(42.0)	18.6	(42.6)	1.0	(43.1)	0.6	(19.2)	0.1	(28.9)
Latin America	260	1,327	36.8	(30.7)	38.3	(14.9)	24.9	(18.8)	5.6	(51.3)	14.7	(11.3)	0.3	(19.8)	4.2	(1.8)
- Mexico	89	659	38.4	(19.6)	26.6	(24.2)	35.0	(6.5)	0.3	(68.0)	26.0	(7.4)	0.2	(0.8)	8.5	(1.8)
- Brazil	102	426	35.7	(26.2)	55.1	(11.9)	9.2	(22.5)	2.4	(12.8)	5.5	(29.0)	0.6	(27.5)	0.5	(2.2)

Data source: authors' calculation, base on METI database.
Note: figures in the parenthesis indicate intra-firm transaction ratios in each destination/origin.

Table 5 Development of intra-regional production networks by Japanese machinery affiliates in East Asia and Latin America

	Number of affiliates	Sales/ purchases (billions JPY)	By-destination sales ratio/ by-origin purchases ratio													
			Japan	(Intra-firm)	Local	(Intra-firm)	Third countries (total)	(Intra-firm)	East Asia	(Intra-firm)	North America	(Intra-firm)	Europe	(Intra-firm)	Latin America	(Intra-firm)
(a) Sales																
1992																
East Asia	715	5,202	16.8	(90.5)	66.2	(7.8)	17.0	(57.7)	9.4	(53.9)	4.0	(76.6)	1.8	(65.0)	0.0	(15.4)
Latin America	82	650	5.4	(0.1)	88.1	(2.8)	6.4	(63.4)	0.1	(100.0)	3.4	(100.0)	2.5	(100.0)	0.2	(18.6)
- Mexico	25	328	0.0	-	74.5	(0.0)	25.5	(98.3)	0.0	-	24.2	(99.7)	1.0	-	0.0	(63.9)
- Brazil	38	149	14.0	(0.1)	81.2	(4.0)	4.8	(26.1)	0.2	(100.0)	0.6	(100.0)	2.9	(100.0)	0.5	(0.0)
2001																
East Asia	2,121	14,826	29.1	(79.3)	40.1	(13.7)	30.9	(52.6)	19.9	(51.6)	5.8	(62.4)	2.9	(47.6)	0.5	(27.1)
Latin America	145	1,535	0.8	(100.0)	61.2	(3.9)	37.9	(34.8)	13.0	(0.4)	22.4	(52.4)	0.5	(99.1)	2.0	(45.0)
- Mexico	64	974	1.4	(100.0)	39.0	(5.6)	59.6	(32.7)	21.9	(0.0)	36.7	(50.9)	0.3	(99.9)	0.6	(68.4)
- Brazil	51	298	0.1	(99.5)	96.0	(3.8)	3.9	(98.2)	0.2	(95.3)	2.4	(99.9)	1.1	(99.7)	0.1	(24.6)
(b) Purchases																
1992																
East Asia	715	2,466	46.2	(84.4)	43.4	(2.0)	10.3	(62.6)	8.3	(58.8)	1.3	(80.8)	0.0	-	0.0	(100.0)
Latin America	82	186	45.5	(40.4)	47.5	(22.8)	7.0	(53.8)	2.5	(62.9)	2.9	(15.5)	1.1	-	0.0	(4.0)
- Mexico	25	37	14.9	(96.7)	71.6	(50.8)	13.6	(98.3)	1.1	(100.0)	12.5	(10.8)	0.0	-	0.0	-
- Brazil	38	53	35.3	(18.6)	61.0	(11.2)	3.7	(15.3)	1.3	(26.8)	0.4	(62.0)	1.1	-	0.0	(0.0)
2001																
East Asia	2,121	10,417	38.0	(69.9)	40.3	(10.1)	21.7	(46.4)	20.2	(45.4)	0.7	(64.7)	0.3	(41.3)	0.0	(88.7)
Latin America	145	1,039	44.3	(29.4)	29.3	(12.8)	26.5	(18.6)	6.9	(51.3)	15.8	(7.8)	0.4	(21.5)	3.4	(2.6)
- Mexico	64	624	39.7	(19.4)	27.1	(24.6)	33.2	(6.6)	0.3	(63.2)	26.5	(7.0)	0.2	(0.8)	6.2	(2.5)
- Brazil	51	207	57.6	(23.0)	35.2	(0.0)	7.2	(13.4)	4.2	(12.8)	2.2	(7.0)	0.8	(30.9)	0.0	(100.0)

Data source: authors' calculation, base on METI database.
Note: figures in the parenthesis indicate intra-firm transaction ratios in each destination/origin.

Table 6 Development of intra-regional production networks by U.S. affiliates in East Asia and Latin America

	Number of affiliates	Sales (millions US$)	By-destination sales ratio													
			U.S.		Local		Third countries (total)									
				(U.S. parent firms)		(Other U.S. affiliates)		(Other U.S. affiliates)	Japan	(Other U.S. affiliates)	East Asia	(Other U.S. affiliates)	Europe	(Other U.S. affiliates)	Latin America	(Other U.S. affiliates)
(a) Sales																
1989 (all)																
East Asia (excl. Japan)	1,353	62,322	24.2	(86.1)	49.0	(10.5)	26.8	(42.2)	4.1	(18.7)	13.8	(41.2)	3.9	(56.9)	0.4	(43.4)
Japan	481	58,420	5.8	(90.7)	85.1	(9.9)	9.1	(49.5)	-	-	6.3	n.a.	2.4	(59.7)	n.a.	n.a.
Latin America	2,411	87,014	21.2	(80.6)	64.4	(5.0)	14.3	(48.3)	0.9	(45.7)	1.9	(32.3)	6.5	(49.9)	3.8	(52.6)
- Mexico	413	16,437	26.6	(98.5)	68.1	(7.6)	5.4	(70.7)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
- Brazil	395	30,588	7.1	(93.0)	86.7	(3.7)	6.2	(38.5)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1999 (all)																
East Asia (excl. Japan)	2,555	233,434	17.1	(86.8)	56.7	(10.7)	26.2	(58.8)	3.7	(51.2)	15.0	n.a.	3.9	(83.2)	0.3	n.a.
Japan	651	121,786	3.3	(97.1)	92.1	(6.9)	4.5	(73.0)	-	-	3.4	(69.8)	0.8	n.a.	0.2	(97.8)
Latin America	3,454	251,575	17.3	(88.0)	65.9	(7.2)	16.8	(56.0)	0.4	(36.0)	2.6	(70.0)	5.7	(50.6)	7.3	(55.9)
- Mexico	802	81,473	26.7	(91.4)	64.8	(11.2)	8.5	(73.4)	0.0	n.a.	1.1	n.a.	1.6	(72.8)	4.6	(63.6)
- Brazil	533	56,066	5.8	(90.8)	84.2	(3.4)	10.0	(59.8)	0.2	(41.2)	0.3	n.a.	3.2	(59.9)	5.9	(62.6)
1999 (manufacturing)																
East Asia (excl. Japan)	n.a.	110,960	27.1	n.a.	41.7	n.a.	31.2	n.a.	4.4	n.a.	17.8	n.a.	4.6	n.a.	0.4	n.a.
Japan	n.a.	41,837	2.7	n.a.	90.2	n.a.	7.0	n.a.	-	-	5.3	n.a.	1.3	n.a.	0.3	n.a.
Latin America	n.a.	132,509	21.7	n.a.	65.2	n.a.	13.1	n.a.	0.3	n.a.	2.0	n.a.	4.4	n.a.	5.7	n.a.
- Mexico	n.a.	61,614	34.4	n.a.	55.2	n.a.	10.4	n.a.	0.0	n.a.	1.4	n.a.	1.9	n.a.	5.6	n.a.
- Brazil	n.a.	35,590	8.4	n.a.	78.3	n.a.	13.3	n.a.	0.3	n.a.	0.4	n.a.	4.2	n.a.	7.9	n.a.

Data source: authors' calculation, base on BEA database.

Notes: (1) East Asia and Latin America as destinations show sales in the Asia-Pacific except Japan and Latin America and Other Western Hemisphere, respectively. (2) "all" and "manufacturing" indicate U.S. affiliates in all industries and manufacturing industries, respectively. (3) Ratios of individual regions of third countries for U.S. manufacturing affiliates are estimated by using the corresponding shares for U.S. affiliates and shares of third countries for U.S. affiliates in all industries and manufacturing affiliates. (4) Figures in the parenthesis indicate transaction ratios with U.S. parernt firms/other U.S. affiliates in each destination. (5) For East Asia in 1898, ratios of other U.S. affiliates for individual third countries are calculated, based on the data of Asia-Pacific (excl. Japan) including Australia, NZ and India, and by-destination sales ratios for individual third countries are estimated, using sales ratios of third countries and the indiviual destinations' shares derived from data of Asia-Pacific other than Japan.

Table 7 Intra-firm and arm's length transactions by Japanese machinery affiliates in East Asia

	East Asia (total)				NIEs4				ASEAN4				China			
	1992	1995	1998	2001	1992	1995	1998	2001	1992	1995	1998	2001	1992	1995	1998	2001
Number of affiliates	715	1,428	1,809	2,121	343	559	609	644	286	505	666	791	54	318	422	552
(a) Sales																
Values (billion JPY)	5,202	9,080	8,485	14,826	2,770	4,140	3,429	5,213	2,125	4,100	3,300	6,399	114	549	1,242	2,427
Share in total (%)																
(i) Japan	**16.8**	**20.8**	**29.3**	**29.1**	**19.4**	**20.8**	**30.1**	**30.6**	**15.0**	**21.9**	**38.3**	**30.3**	**39.9**	**25.4**	**20.3**	**29.6**
Intra-firm	15.2	18.8	22.3	23.0	18.1	18.9	22.6	20.2	12.8	19.5	29.8	26.7	39.6	24.5	14.8	25.1
Arm's length	1.6	2.0	7.0	6.0	1.3	1.9	7.5	10.4	2.2	2.4	8.5	3.6	0.3	0.9	5.5	4.5
(ii) Local	**66.2**	**56.6**	**43.3**	**40.1**	**63.7**	**54.2**	**45.5**	**44.4**	**66.2**	**56.9**	**27.1**	**30.7**	**45.9**	**45.9**	**51.5**	**45.2**
Intra-firm	5.1	11.2	4.0	5.5	4.0	7.6	4.9	4.5	7.2	17.3	4.1	7.3	0.1	2.3	3.2	4.2
Arm's length	61.1	45.4	39.2	34.6	59.7	46.6	40.6	39.9	58.9	39.6	23.0	23.4	45.7	43.6	48.3	41.0
(iii) East Asia	**9.4**	**12.8**	**18.6**	**19.9**	**10.3**	**13.2**	**16.3**	**14.4**	**9.6**	**11.6**	**22.7**	**24.9**	**11.4**	**24.0**	**22.5**	**18.3**
Intra-firm	5.1	7.7	10.1	10.3	3.3	7.0	5.1	6.9	7.1	6.7	13.0	11.7	11.4	21.8	18.7	14.8
Arm's length	4.3	5.1	8.5	9.6	7.0	6.2	11.1	7.6	2.5	4.9	9.6	13.2	0.0	2.2	3.8	3.5
(i+ii+iii) East Asia (total)	**92.4**	**90.2**	**91.2**	**89.0**	**93.4**	**88.1**	**91.8**	**89.5**	**90.8**	**90.4**	**88.0**	**86.0**	**97.2**	**95.3**	**94.3**	**93.2**
Intra-firm	25.4	37.8	36.5	38.8	25.4	33.4	32.6	31.6	27.2	43.5	46.9	45.7	51.2	48.6	36.7	44.1
Arm's length	67.0	52.4	54.7	50.2	68.0	54.7	59.2	57.9	63.6	46.9	41.1	40.2	46.1	46.7	57.7	49.1
(b) Purchases																
Values (billion JPY)	2,466	5,479	5,764	10,417	1,140	2,298	2,556	3,733	1,204	2,666	2,090	4,560	54	352	816	1,626
Share in total (%)																
(i) Japan	**46.2**	**44.1**	**36.8**	**38.0**	**47.3**	**38.7**	**40.9**	**40.1**	**44.1**	**49.2**	**35.1**	**35.7**	**75.8**	**50.2**	**34.6**	**37.8**
Intra-firm	39.0	35.5	22.8	26.6	38.6	31.6	27.2	31.7	39.0	40.8	23.0	22.8	71.0	42.2	17.5	24.0
Arm's length	7.2	8.5	14.0	11.4	8.7	7.1	13.7	8.3	5.1	8.4	12.2	12.9	4.8	8.0	17.1	13.8
(ii) Local	**43.4**	**38.6**	**41.3**	**40.3**	**41.8**	**43.3**	**40.8**	**37.6**	**45.4**	**34.4**	**38.4**	**40.5**	**20.7**	**26.7**	**42.4**	**43.5**
Intra-firm	0.9	6.0	2.7	4.1	0.6	5.5	2.6	3.4	1.0	6.7	3.4	5.2	5.1	7.4	2.5	3.2
Arm's length	42.6	32.6	38.6	36.2	41.3	37.8	38.3	34.2	44.4	27.7	35.0	35.3	15.6	19.3	39.9	40.2
(iii) East Asia	**8.3**	**15.4**	**20.3**	**20.2**	**9.7**	**15.6**	**17.4**	**20.9**	**7.7**	**14.8**	**24.1**	**21.9**	**1.7**	**21.8**	**21.8**	**18.0**
Intra-firm	4.9	7.3	10.1	9.2	9.1	8.8	8.7	10.6	1.7	4.4	9.2	7.7	1.7	17.5	18.5	11.6
Arm's length	3.4	8.1	10.1	11.1	0.6	6.7	8.7	10.3	6.1	10.4	14.9	14.2	0.0	4.3	3.2	6.3
(i+ii+iii) East Asia (total)	**98.0**	**98.0**	**98.4**	**98.5**	**98.8**	**97.5**	**99.2**	**98.5**	**97.2**	**98.4**	**97.6**	**98.1**	**98.1**	**98.7**	**98.8**	**99.3**
Intra-firm	44.8	48.8	35.7	39.8	48.2	45.9	38.4	45.7	41.7	51.9	35.6	35.7	77.7	67.0	38.5	38.9
Arm's length	53.2	49.2	62.7	58.7	50.6	51.6	60.8	52.8	55.6	46.5	62.0	62.4	20.4	31.6	60.3	60.4

Data source: Ando and Kimura (2006).

(Latin America), 40 percent (Mexico), and 75 percent (Brazil) for sales by Japanese manufacturing affiliates in 2001 and 65 percent (Latin America), 55 percent (Mexico), and 78 percent (Brazil) for sales by U.S. manufacturing affiliates in 1999.[19] Considering such large shares of the local market and much smaller intra-regional transactions than the cases for Japanese and U.S. affiliates in East Asia even for Mexico and Brazil, Japanese and U.S. firms in general have affiliates in Latin America to sell products in local markets, sometimes with simple local processing, rather than building dense production networks extending across the region.

What is interesting, however, is that production networking between the U.S. and Mexico seems to have expanded from the viewpoint of both U.S. and Japanese firms. Shares of sales to the U.S. are 34 percent in 1999 for U.S. manufacturing affiliates and 36 percent in 2001, moving up from 28 percent in 1992 for Japanese manufacturing affiliates in Mexico.[20] Moreover, shares of purchases from the U.S. are 26 percent, relative to 12 percent for Japanese manufacturing affiliates in Mexico. These numbers confirm again that features of location (host country) are important for the behavior of Japanese and U.S. affiliates in terms of the international division of labor, regardless of firm nationalities, as we emphasized in the case of East Asia.

Second, the behavior of Japanese affiliates in terms of transactions within/beyond the same firm nationality is different from that of U.S. affiliates in East Asia. If intra-firm ratios of sales at the local market and in other East Asian countries by Japanese manufacturing affiliates are compared with ratios of sales to other U.S. affiliates at the local market and in other intra-regional countries by U.S. affiliates, one notices that they are more or less equal: intra-firm sales ratios of Japanese manufacturing affiliates are 11 percent for the local market and 44 percent for East Asia, while ratios of sales to other U.S. affiliates by U.S. affiliates are 11 percent for the local market and 41 percent (in 1989) for East Asia (Tables 4 and 6). Considering that some portion of arm's length transactions by Japanese affiliates are those with Japanese affiliates of other Japanese firms, ratios of intra-firm sales plus sales to Japanese affiliates of other Japanese firms are certainly larger than those of sales by U.S. affiliates to firms with the same firm nationality (that is, other U.S. affiliates) at the local market and in other East Asian countries. It suggests that U.S. firms in East Asia seem to more significantly utilize transactions beyond the firm nationality than Japanese firms in East Asia do, though Japanese intra-firm transactions tend to be replaced by arm's length transactions over time, as will be discussed below.

Third, the behavior of Japanese affiliates in terms of transactions with a close link between geographical proximity (agglomeration) and arm's length fragmentation is similar to that of U.S. affiliates in East Asia. In the case of Japanese affiliates, ratios of intra-firm/arm's-length transactions conform to the two-dimensional fragmentation framework very well. Intra-firm transaction ratios with Japan (investing country), other East Asian countries, and the local market in 2001 are as follows: 77 (79) percent, 44 (52) percent, and 11 (14) percent, respectively, for sales and 66 (70) percent, 43 (45) percent, and 10 (10) percent for purchases by Japanese manufacturing (machinery) affiliates in East Asia (Tables 4 and 5). Interestingly, ratios of transactions among U.S. firms (other U.S. affiliates) by U.S. affiliates in East Asia, which consist of intra-firm transactions plus

[19]The local sales ratio is even higher, 96 percent, for Japanese machinery affiliates in Brazil (see also differences between Figure A.1 and A.2.).

[20]Note that shares of U.S. for Japanese affiliates are for North America, which may include Canada. These shares tend to be small, however.

arm's length transactions with other U.S. firms, show similar patterns. That is, ratios of intra-firm sales (plus arm's length sales to other U.S. firms) to the U.S. (investing country), other East Asian countries, and the local market are as follows: 87 percent, 41 percent, and 11 percent, respectively, for sales by U.S. affiliates in East Asia in 1999 (Table 6). These observations prove a close link between geographical proximity (agglomeration) and disintegration-type fragmentation, indicating the formation of agglomeration of fragmented production blocks, as discussed in section 3, regardless of firm nationalities.[21]

Before ending this section, we note some additional features of production networks in East Asia and Latin America. As Table 7 clearly indicates, intra-firm transactions by Japanese machinery affiliates in East Asia tend to be replaced by arm's length transactions, including when they sell goods to or purchase goods from other East Asian countries.[22] In addition, purchases from Japan by Japanese machinery affiliates in East Asia tend to be shifted to arm's length purchases from the local market and intra-firm and arm's length purchases from other East Asian countries. Purchases from Japan by Japanese affiliates in China, in particular, seem to be replaced by arm's length purchases in the local market: while shares of intra-firm purchases from Japan (total purchases from Japan) in total purchases by Japanese machinery affiliates in China are decreasing from 71 percent (76 percent) in 1992 to 24 percent (38 percent) in 2001, arm's length purchases in the local market (total purchases in the local market) are increasing from 16 percent (21 percent) in 1992 to 40 percent (44 percent) in 2001, ultimately reaching the level of ASEAN4. Such a rapid shift suggests the formation of local vertical links in agglomeration in China, reflecting declining service link costs and more developed industrial clusters (agglomeration) involving MNEs and increasingly competitive indigenous firms.[23]

On the other hand, transactions between the U.S. and Mexico seem to depend on intra-firm relations. In the case of U.S. (manufacturing) firms, 27 (34) percent of the sales by U.S. affiliates in Mexico in both 1989 and 1999 are sold to the U.S., and most of them involve U.S. parent firms: 99 percent in 1989 and 91 percent in 1999. Similarly, Japanese manufacturing affiliates in Mexico sell 36 percent of their sales to the U.S., and purchase 26 percent from the U.S in 2001. In addition, more than half of the sales to the U.S. go to Japanese affiliates of the same firms located in the U.S, though intra-firm ratios are indeed falling from 1992 to 2001. These numbers suggest that production networking in the U.S.-Mexico nexus still depends on intra-firm transactions, though arm's length transactions are playing an increasing role.

6. Interpreting the Findings

The evidence presented in the preceding pages provides useful insights into the continuing evolution of the global economy away from traditional patterns into new forms of organization. As noted in Section 2, trade theory has traditionally focused on final goods, although the importance of trade in "intermediates" has long been recognized. What is new in the patterns studied in this paper is the fragmentation of

[21]See Ando and Kimura (2006a) for a more detailed discussion of transactions by Japanese affiliates in East Asia and the close link between geographical proximity (agglomeration) and disintegration-type fragmentation.
[22]The same trend is observed for transactions by Japanese manufacturing affiliates or Japanese electric machinery affiliates in East Asia.
[23]Operations by Japanese firms in China were seriously started in the latter 1990s (see the number of affiliates as well as sales in Table 7).

production across borders.

While this is no trivial change, the rules and considerations that govern the location of the constituent activities of production across countries are very much in line with those identified in traditional trade theory. Traditional sources of gains from trade such as different technological capabilities and different resource endowments still plays a key role, as the evidence presented above makes clear. In broad terms, components production and assembly will be moved to where costs are lowest, and costs are generally affected by location advantages.

We however must note that the division of labor at the level of production processes brings in some new elements that have not been emphasized in traditional international trade theories. One is the cost of service links between fragmented production blocks. Even if the benefits derived from location advantages are huge, fragmentation will not occur if service-link costs are high. This element is often crucially important when fragmentation involves less developed countries where infrastructure and governance relating to service links are immature. Another is flexibility in firms' decisions on the activities to be detached from the original position. This degree of freedom provides further room for firms to exploit various aspects of location advantages in a flexible way.

In the examination of the data of Japanese and U.S. firms, we find a sharp contrast between their activities in East Asia and in Latin America. In East Asia, both Japanese and U.S. firms have deeply committed themselves to constructing production networks along the logic of two-dimensional fragmentation. In Latin America (except Mexico), on the other hand, neither Japanese nor U.S. firms seem to utilize such novel globalizing forces, preferring instead to produce more for the local market than is true in East Asia. Their activities in Latin America (except Mexico) seem to follow a more traditional logic of tariff jumping, import substitution, or provision of services to the local market.

What is important in the present context, therefore, are the organizational capabilities that multinationals bring to the management of production networks. In the industry we study, finished products tend to be complex and production processes are multi-faceted. Production often involves large firms, whether it occurs in one place or is dispersed across borders. The evidence presented above shows the important role of such firms in production networking.

While multinationals play key roles in coordinating activities within production networks, trade within those networks is not necessarily purely intra-firm in nature. Indeed, we find a variety of organizational patterns, ranging from trade between parents and minority- and majority-owned affiliates to arm's-length trade between parents as well as affiliates and third parties. The gradual entry of independent local enterprises into the production network is one of the key benefits of such network arrangements and a key element in transferring knowledge and fostering industrialization and development.

7. Lessons for Corporate Strategies

The development of international production/distribution networks provides new frontiers for corporate activities, and firms are in a position of enjoying new opportunities as well as being exposed to novel risks. The following three inter-related features seem to be important for firms to successfully operate in the new economic environment.

First, proper evaluation of the investment climate is vital to the success of corporate

firms. In making investment decisions, a long checklist of location advantages and service links must be prepared and examined. Under fragmentation, firms must choose the activities to be detached from the base and to be moved to a new location. This flexibility provides opportunities for firms to exploit multi-faceted location advantages by designing appropriate networks. The behavior of other firms also affects location advantages and service-link costs. Agglomeration typically generates both positive and negative externalities. Thus, to be a pioneer or to be a follower of other firms in location choices also becomes a crucial decision.

As for Japanese firms in particular, there is a tendency that existing conditions are treated as given and unchanging. However, as far as the host country/region has enthusiasm in receiving FDI, there often exists room for corporate firms to encourage the host country to make necessary policy reforms, perhaps in cooperation with local entrepreneurs. Negotiations over free trade agreements offer opportunities for accelerating policy reforms. Japanese firms must be more active in participating in the effort of improving the business environment.

Second, international production/distribution networks nurture creative innovation of business models, and firms must effectively utilize such opportunities. In East Asia, there exist a variety of location advantages as well as a variety of potential business partners with various firm nationalities. Thus, once the proper regulatory environment, legal system and economic institutions are in place, a burst of new business models is observed with active cross-learning among firms of different nationalities. East Asia has several prototype models for production networking, including the vertical subcontracting system of Japan, horizontal subcontracting arrangements in Taiwan, and processing deal trade between Hong Kong and Guangdong. Current forms of production/distribution networks have evolved from these prototype models. Operations in East Asia by Dell Computer and Toyota have obviously stimulated strong interest in supply chain management.

As for Japanese firms, there is still a strong tendency to favor relations with other Japanese firms over firms with different nationalities, even after we allow for knowledge protection, transaction costs, and other considerations. There is room for Japanese firms to learn from the business models of firms with different nationalities including U.S. firms.

Third, local entrepreneurs and indigenous firms in developing countries must recognize and take advantage of the new types of business opportunities available in this era of globalization. Relative to the era of infant industry protection or of import-substituting development, local producers are much more exposed to harsh international competition. But, at the same time, they can have access to MNEs operating in their proximity and thus to potentially significant technological spillovers, as competitive pressures force those MNEs to seek local business partners. Vertical linkages between local firms and MNEs accelerate the improvement of competitiveness of local firms.

As for the interface between local firms/entrepreneurs and Japanese firms, we observe both strong points and weak points. On the one hand, Japanese firms are good at upgrading the capability of local parts & components producers. Particularly in electric appliances and automobile manufacturing, there are substantial efforts to strengthen the technological and managerial ability of local partners in order to enhance international competitiveness. On the other hand, Japanese firms seem perform less well in fostering and effectively utilizing local human resources. Here, Japanese firms have a lot to learn from U.S. firms. For example, beginning in the 1970s, Intel made substantial efforts to foster local entrepreneurship in Penang, Malaysia by encouraging job hopping. Similar

lessons may be found in the popularity of U.S. and EU firms among Chinese workers.

8. Policy Implications

One of our major findings is that differences in location characteristics seem to be much more important in explaining observed behavior than differences due to different firm nationalities. This is apparent when firm activities are compared between East Asia and Latin America, for example. Both Japanese and U.S. firms take advantage of the opportunities of two-dimensional fragmentation in East Asia, while choosing completely different strategies Latin America, with the partial exception of Mexico.

Table 8 presents a set of policy examples for facilitating two-dimensional fragmentation and agglomeration. For the distance and the disintegration dimensions of fragmentation, important considerations include 1) reducing set-up cost in constructing production/distribution networks; 2) reducing service link costs in connecting production blocks; and 3) reducing production cost *per se* within production blocks.

In traditional industrialization promotion, improving location advantages attracted a large portion of policy interest, and the rest was largely neglected. Even in the case of inward FDI, containing the footloose behavior of MNEs was emphasized rather than facilitating entry and exit. Heavy, thicker investment was preferred over reduction of service link costs. Various types of regulations and performance requirements were imposed on MNEs, while creation of incentives for MNEs to enhance international competitiveness was neglected.

In the age of fragmentation and agglomeration, however, the basic design of industrial promotion policies must be revised fundamentally. Policy makers in developing East Asia now face a different policy agenda, which includes 1) how to attract production blocks of MNEs; 2) how to promote the formation of agglomeration even if it initially involves mainly MNEs; and 3) how to provide access for local firms into the production networks developed by MNEs.

While countries at different development stages have different policy needs, Table 8 is still useful as a checklist. The original ASEAN countries and China are already in harsh competition over location advantages and service link costs. Congestion effects in the form of wage hikes, transportation cost, and the like are a growing concern. In order to facilitate further production networking, substantial improvements in the policy environment will be required. Among the ASEAN latecomers, low wages are certainly a strength, but location disadvantages and high service link costs impede the promotion of inward FDI. How to take advantage of the proximity of other countries in furthering agglomeration is a key consideration.

Developed/investing countries such as Japan can also draw important policy lessons from Table 8. In the globalization era, enhancing the international competitiveness of corporate firms and the national welfare goal do not automatically coincide. There are concerns about unemployment due to outsourcing and the hollowing-out of domestic industry. To improve the compatibility between the needs of corporate entities and national welfare, central and local governments must protect and improve the domestic investment climate. Particularly in Japan, governments should pay more attention to maintaining and improving location advantages and reducing service link costs.

Table 8 Two-dimensional fragmentation and improvement in investment climate

	Reduction in fixed costs to develop production/distribution networks	Reduction in service link costs connecting production blocks	Further cost reduction in production cost per se in production blocks
Fragmentation along the distance axis	Various policies to reduce investment costs	Geographical distance, various policies to overcome effects of national border	Various policies to strengthen location advantage
	examples : (i) improvement in stability, transparency, and expectancy of investment-related policies, (ii) investment facilitation in investment (FDI)-hosting agencies and industrial estates, (iii) liberalization and fullfilment in financial services related to investment capital supply	examples : (i) Reduction/removal of trade barriers such as tariffs, (ii) Trade facilitation including simplification and improved efficiency in custom clearance/procedures, (iii) Development of transport infrastracture and improved efficiency in transport and distibution services, (iv) Improved efficiency in financial services related to operation and capital movement, (v) Reduction in costs of coordination between remote places by facilitation of labor movement etc	examples : (i) establishment of educational/occupational institutions for personnel training to secure various types of human resources, (ii) establishment of stable and elastic labor-related laws and institutions, (iii) establishment of efficient international and domestic financial services, (iv) Reduction in costs of intrastructure services such as electricily etc at industrial estates etc, (v) Development of agglomeration to faciliate vertical division of labor, (vi) establishment of institutions such as investment rule and intellectual property rights, (vii) various trade and investment faciliations
Fragmentation along the disintegration axis	Establishment of economic environment to reduce set-up costs for arm's length transactions	Developemet of institutional environment to reduce implimenting costs of arm's length transactions	Various policies to strengthen competitiveness among potential business partners
	examples : (i) establishemnt of economic system to allow co-existance of various business partners as well as making contracts elastically, (ii) various policies to reduce costs of information gathering on potencial business partners, (iii) securing fairness, stability, and efficiency in contracts, (iv) establishment of institutial system to secure intellectual property rights stably and effectively	examples : (i) policies to reduce monitoring cost of business partners, (ii) improvement in legal system and economic institutions to activate dispute settlement mechanism, (iii) policies to promote technical innovations in modues etc to further facilitate outsourcing	examples : (i) hosting and education for various business partners including foreign and indiginous firms, (ii) Strengthening of supporting industries, (iii) various policies to promote agglomeration

9. Concluding Remarks

This paper's focus is on the implications of production sharing and fragmentation and of the role of MNEs in creating and coordinating the activities within production networks, particularly in the machinery sector. The empirical study investigates the activities of Japanese and U.S. firms in developing East Asia and Latin America. Among its findings is the fact that the regional investment climate is more important in promoting production networks than differences in firm nationalities. In East Asia, both Japanese and U.S. firms display very similar patterns in exploiting the international division of labor extended and both present close links between geographical proximity and arm's length fragmentation. The pattern for both is very different in Latin America, suggesting that the explanation lies in differences between the two regions. This finding has implications for policy makers.

In many developing countries around the globe, there still exists a strong sentiment against MNEs and FDI. This is based on concerns that many types of FDI are resource-exploiting and import-substituting which can introduce undesirable political economy trends into local economies. The nature and characteristics of FDI in international production/distribution networks are quite different, however. They offer policy makers in developing countries new industrialization strategies, but only if supported by an appropriate investment climate. Recent developments in East Asia provide a useful example.

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Table A.1 Sales and gross products by U.S. affiliates in East Asia and Latin America by industry, 1999 F/Y

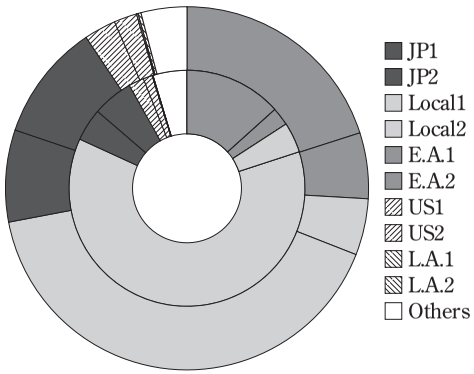
	East Asia (2,555)		Latin America				
			Total (3,454)		*excl. Brazil (533) and Mexico (802)* (2,119)		Share of Brazil and Mexico (%)
	Value	%	Value	%	Value	%	
(a) Sales (million US$)							
Manufacturing	**110,960**	**48**	**132,509**	**53**	**35,305**	**31**	**73**
Machinery (total)	78,025	33	58,010	23	5,253	5	91
-Machinery	3,136	1	7,897	3	595	1	92
-Computer and electronic products	68,968	30	14,087	6	455	0	97
-Electrical equipment, appliances, etc.	2,747	1	2,692	1	240	0	91
-Transport equipments	3,174	1	33,334	13	3,963	3	88
Non-manufacturing	**122,474**	**52**	**119,066**	**47**	**78,731**	**69**	**34**
Wholesale trade	75,212	32	42,487	17	29,269	26	31
Total	233,434	100	251,575	100	114,036	100	55
(b) Gross products (million US$)							
Manufacturing	**20,864**	**43**	**33,472**	**55**	**8,820**	**33**	**74**
Machinery (total)	13,572	28	10,556	17	856	3	92
-Machinery	805	2	2,309	4	67	0	97
-Computer and electronic products	11,282	23	1,074	2	152	1	86
-Electrical equipment, appliances, etc.	690	1	670	1	41	0	94
-Transport equipments	795	2	6,503	11	596	2	91
Non-manufacturing	**27,344**	**57**	**27,169**	**45**	**17,672**	**67**	**35**
Wholesale trade	7,073	15	5,337	9	3,600	14	33
Total	48,208	100	60,641	100	26,492	100	56

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

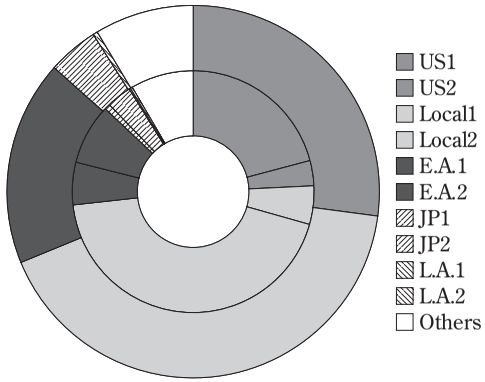
Notes: (1) Number of affiliates for each case is shown in parenthesis. (2) Shares of Brazil and Mexico indicate their shares in total sales/gross products by U.S. affiliates in Latin America.

Figure A.1 Ratios of by-destination sales and by-origin purchases for Japanese and U.S. affiliates in East Asia and Latin America

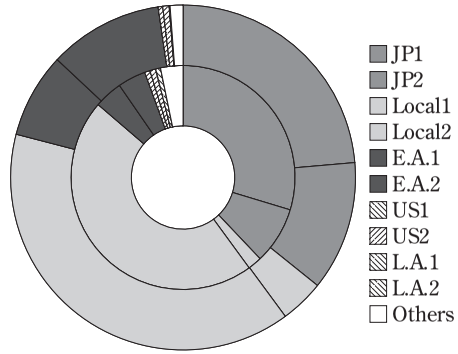
(a-1) sales by Japanese manufacturing affiliates
(i) East Asia



(a-2) sales by U.S. affiliates
(i) East Asia

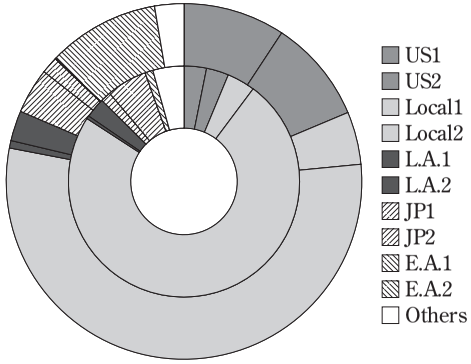


(b) Purchases by Japanese manufacturing affiliates
(i) East Asia

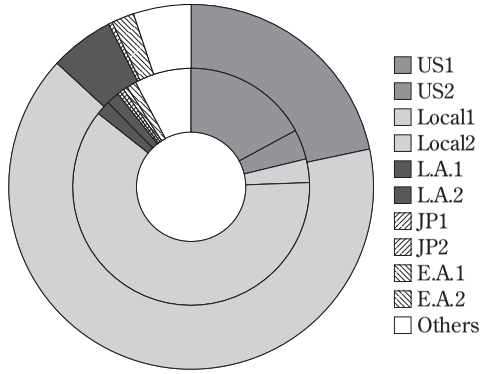


Manufacturing sectors in 1992 (inside) and 2001 (outside) for Japanese affiliates; all sectors in 1989 (inside) and manufacturing sectors in 1999 (outside) for US affiliates

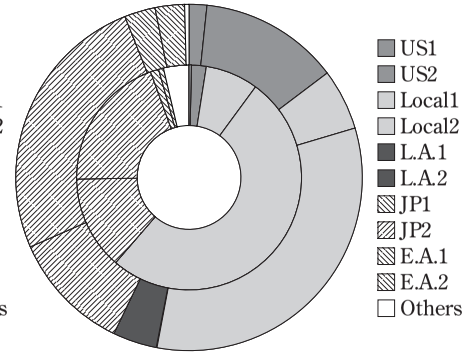
(ii) Latin America



(ii) Latin America



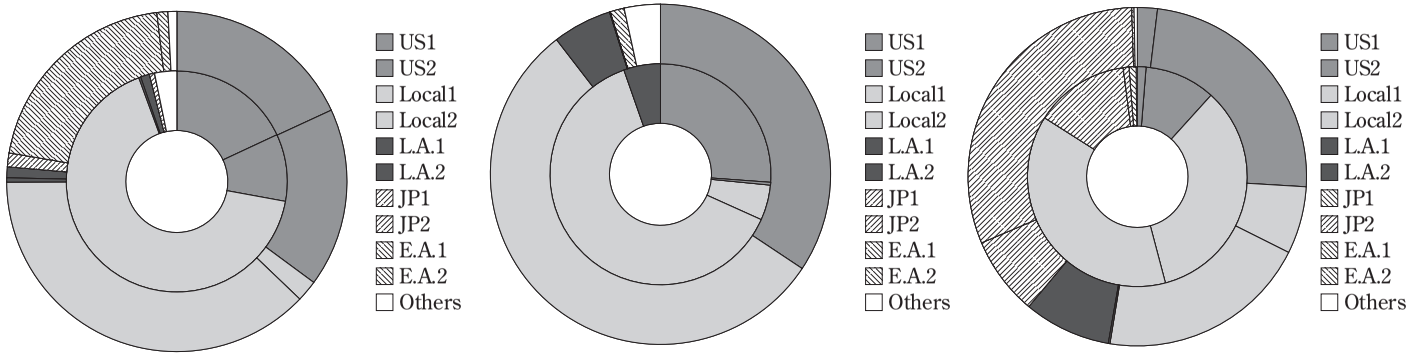
(ii) Latin America



(Continue)

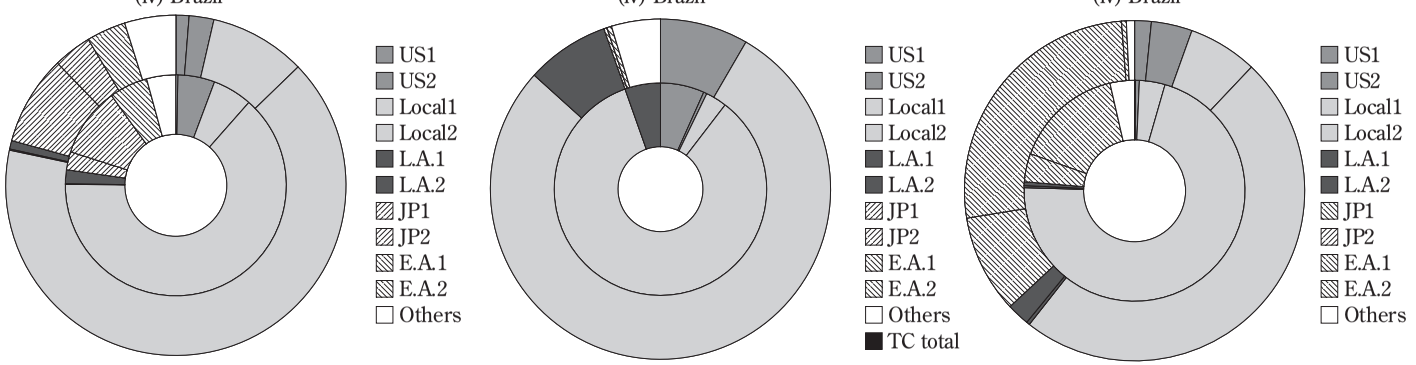
(a-1) sales by Japanese manufacturing affiliates (a-2) sales by U.S. (mamufacturing) affiliates (b) Purchases by Japanese manufacturing affiliates

(iii) Mexico



Manufacturing sectors in 1992 (inside) and 2001 (outside) for Japanese affiliates; all sectors in 1989 (inside) and manufacturing sectors in 1999 (outside) for US affiliates

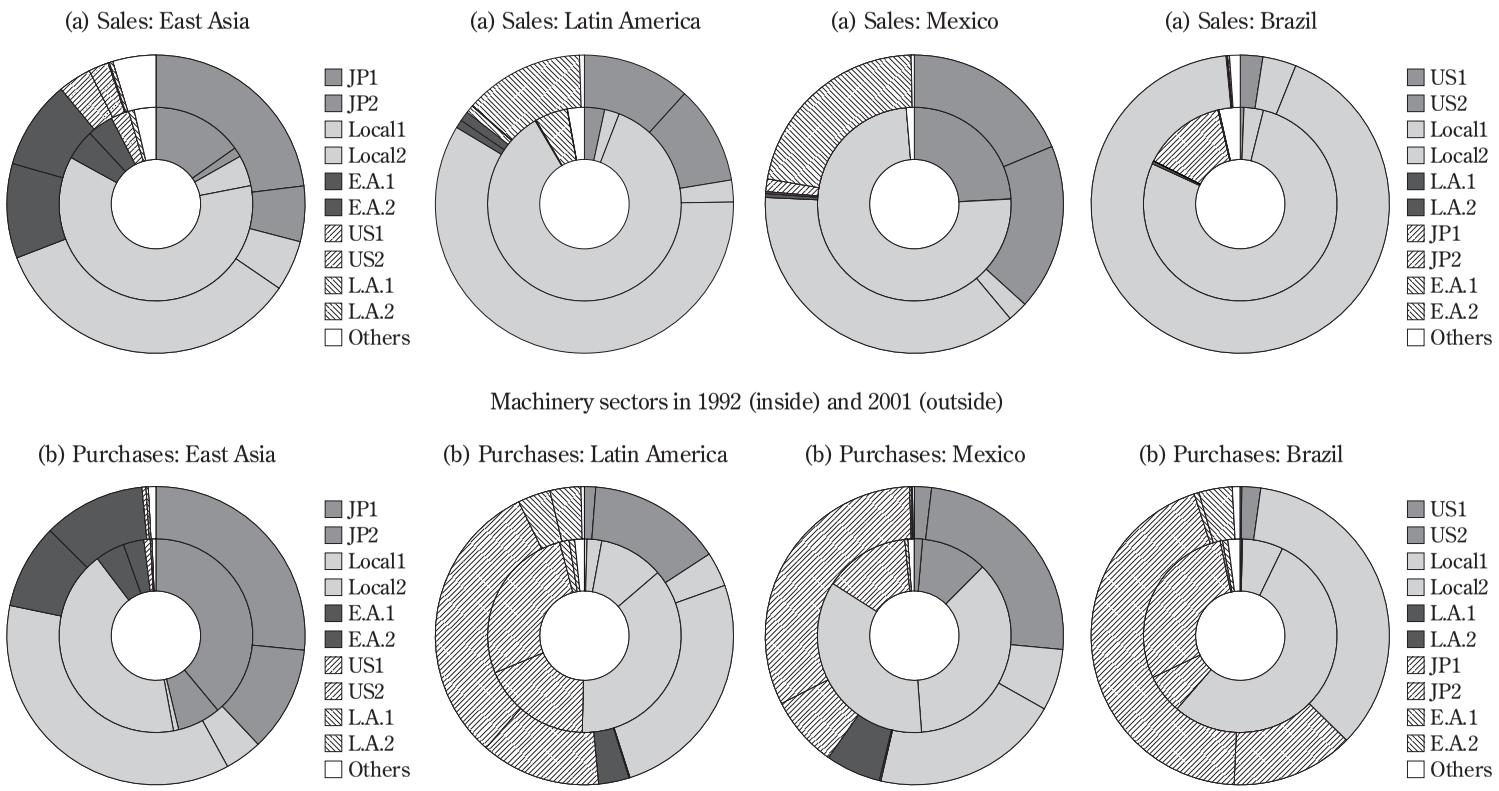
(iv) Brazil



Data source: Tables 4 and 6.

Notes: (1) "1" and "2" indicate intra-firm and arm's length transactions for Japanese affiliates and transactions with US firms (other US affiliates) and those with non-US firms (affiliates) for US affiliates. (2) "JP", "E.A"., and "L.A." are Japan, East Asia, and Latin America. (3) "US" for Japanese manufacturing affilaites is "North America" in Table 4. (4) "TC total" for US manufacturing affiliates in Mexico and Brazil is "Third countries (total)", which is the sum of "E.A.", "JP", "L.A.", and "Others". (4) Estimated shares of individual third countries are used for U.S. manufacturing affiliates in 1999.

Figure A.2 Ratios of by-destination sales and by-origin purchases by Japanese machinery affiliates in East Asia and Latin America



Data source: Table 5.
Notes: (1) "1" and "2" indicate intra-firm and arm's length transactions. (2) "JP", "E.A"., and "L.A." are Japan, East Asia, and Latin America. (3) "US" is "North America" in Table 5.