United States, Japanese, and Korean FDI and Intra–East Asian Trade*

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Abstract
This paper documents the growing importance of intra–East Asian trade of parts and components. Our empirical analysis shows that foreign direct investment (FDI) does play an important and independent role in facilitating the trade of parts and components in East Asia. This is true for FDI from all three source countries: the United States, Japan, and South Korea. Furthermore, our empirical studies show that compared with U.S. and Korean FDI, FDI from Japan has a particularly strong influence on trade in parts and components as well as trade in capital goods. One policy implication is that economies need to improve their physical infrastructure as well as the quality of their institutions to integrate further into the East Asian production network.

1. Introduction

East Asia[1] has witnessed a remarkable increase in the volume of intra-regional trade during the past two decades. An important development that has contributed to the expansion of intra–East Asian trade has been identified as the international fragmentation of production where the production process of a final product is split into two or more steps and each production stage is undertaken in different locations across national boundaries.

Many alternative names have been coined for such a phenomenon, including "slicing the value chain" (Krugman

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1 In this study, East Asia covers the following countries/regions: China, Taiwan, Hong Kong, Japan, Republic of Korea, Indonesia, the Philippines, Malaysia, Singapore, and Thailand.

1995), "vertical specialization" (Hummels, Ishii, and Yi 2001; Dean, Fung, and Wang 2008), "international production sharing" (Ng and Yeats 2001), production fragmentation (Athukorala 2006) and "outsourcing" (Hanson, Mataloni, and Slaughter 2001). There is increasing evidence of the phenomenal increase in the international fragmentation of production around the globe in a variety of sectors, including textiles and apparel, machinery and transport equipment, consumer electronics, toys, and furniture. However, the extent of international production fragmentation and the depth of the production networks vary according to industries and regions (Aminian, Fung, and Ng 2009; Fung, Garcia-Herrero, and Siu 2009). As Hiratsuka (2008) points out, the international production fragmentation in industries such as textiles involves a relatively simple disintegration of procurement and production. In contrast, a much more elaborate and well-developed production network is found in the electronics and computer-related industry.

It is often hypothesized that multinational enterprises (MNEs) or foreign direct investment (FDI) play an important role in creating and coordinating the activities of production networks. MNEs that operate on the global stage combine many resources available at different locations across national borders by establishing their production networks. In East Asia, the rapid growth of intra-regional trade has also been associated with a rising volume of FDI. Partly because of this, East Asia (excluding Japan) has made gains in importance as recipients of FDI over time. Recent improvements in service links in terms of lower transportation and communications costs as well as the progressive liberalization and deregulation of international trade and FDI in the region also contributed to this trend. Furthermore, the dispersed production networks created by such fragmentation appear to be more extensive in East Asia than in other parts of the world (Ng and Yeats 2001, 2003; Athukorala 2006, 2008; Fung, Garcia-Herrero, and Siu 2009).

International production fragmentation and the formation of regional production networks can have various important implications for international trade. When MNEs engage in production fragmentation, initially production may be geographically fragmented across national boundaries but organizationally confined within the boundaries of a transnational firm. Affiliates of MNEs may rely heavily on imported intermediate products from their home countries if they are faced with limited choices of local suppliers of those products. This will be the case if intermediate inputs require specialized production techniques that are not yet available in the host countries. It is widely recognized that a significant amount of trade in the global economy is indeed carried out in the form of intra-firm trade, which may be symptomatic of the prevalence of FDI-based production fragmentation. Moreover, as production is fragmented across locations, exports of capital goods required to

produce parts and components from an FDI source country may also expand. It may also increase imports by an FDI source country as a host country increases exports of finished products back to the source country.

Over time, these networks disseminate knowledge to local suppliers in the host countries, which can then enhance local capability formation (Ernst 2000). Advanced knowledge possessed by the MNEs may spill over through contractual relationships with local firms. Production linkages as well as procurement relationships between the foreign affiliates and the domestic firms are likely to be created and local technological capability for producing intermediate goods improves. Furthermore, against the backdrop of intensified competition in the world market in many industries, MNEs have been under pressure to reduce their costs of sourcing intermediate products instead of focusing on the origin of the suppliers. Regional production networks then cover both intra- and inter-firm transactions linking together affiliates, joint ventures with its subcontractors, suppliers, and service providers. When foreign affiliates start sourcing intermediate goods locally, it will partially offset the trade-creating effect of FDI.

At the same time, industrial clusters in various sectors may form covering affiliates and non-affiliates for intermediate products when economies of scale create more profit to offset transportation costs. Countries then tend to specialize more narrowly within industries to define their own niche markets and achieve scale economies. Take the hard-disk drive industry in Thailand for instance. Parts and components are procured locally as well as from other countries in Asia. Indeed, several suppliers located in different countries supply the same parts and components to several assemblers on behalf of Seagate, Western Digital, Hitachi, Fujitsu, and so forth (Hiratsuka 2008). Evidence of industrial clusters can be found in various parts of East Asia; examples include the Shanghai-Jiangsu corridor and Guangzhou in China, the Eastern Seaboard in Thailand, Penang in Malaysia, and parts of Hsingchu and Taoyuang in Taiwan. The establishment of a number of industrial clusters subsequently led to the expansion of the international exchange of parts and components within East Asia.

Increasing evidence of the strong effects of these international production networks on the volume and the direction of regional trade flows has been documented. However, is it really true that FDI systematically facilitates trade in parts and components, particularly in East Asia? This paper examines the question for the three largest foreign direct investors in the developing countries of Asia: the United States, Japan, and South Korea. More specifically, we attempt to analyze the FDI–trade linkages in intra-regional exports and imports in East Asia focusing on

Japanese, U.S., and Korean investment in East Asia to investigate whether production networks established by those countries have different implications on intra-regional trade. Our analysis will be conducted on intra-regional exports and imports of parts and components as well as trade in capital goods.

The remainder of the paper is organized as follows: Section 2 describes some characteristics of international trade in East Asia, particularly the extent of intra-regional trade and the characteristics of trade by stages of production for each country. Section 3 presents an empirical analysis investigating the effects of FDI from these three countries on the volume of trade in various East Asian countries. It begins with a description of the variables used in the regression analysis, followed by the estimation methodology. The results for all regressions are reported and analyzed in Section 3.2. Concluding remarks are given in Section 4.

2. Patterns of trade in East Asia[2]

2.1 Intra-regional trade

Table 1a and 1b examine the changes in the share of geographic direction of individual East Asian imports and exports, respectively, for 1985, 1995, 2003, and 2006. These tables also include figures for North America[3] and EU15[4] for comparisons.

East Asia in general appears to have gone through significant changes in the direction of their imports. The share of East Asia's imports from other East Asian countries increased from 23.0 percent in 1985 to 40.9 percent in 2003 and to 45.2 percent in 2006, indicating increased dependency on regional trade. The increase is largely attributed to the newly industrialized economies (NIEs) and China. China's share more than doubled from 5.9 percent to 12.5 percent in 2003 and further increased to 16.3 percent in 2006, whereas the share of the NIEs increased from 10.7 percent to 18.4 percent in 2003 and appears to have leveled off since. On the other hand, Table 1a reports a relatively small gain in the share of ASEAN imports by 3.6 percent between 1985 and 2006. In contrast, a sizeable decline occurred in the share of Japanese imports by almost 11.3 percent during the same period. Despite the setback, however, Japan remains as the single largest import sourcing country for East

2 As defined in Table 1, in this chapter East Asia includes China, Hong Kong, Indonesia, Japan, Republic of Korea, Malaysia, the Philippines, Singapore, Taiwan Province of China, and Thailand.

3 North America is defined as the United States and Canada.

4 The EU15 comprises the following 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

Asia. The shares of North America as well as EU15 in East Asian imports also declined, although by lower intensities relative to the Japanese experience.

Increased dependence on regional trade can be seen for all East Asian countries, although sizeable differences regarding the extent of the dependency exist among various countries. For example, the share of East Asia in Philippines' imports increased by 12.8 percent, whereas the corresponding figures for Indonesia and China are both 29.9 percent. At the same time, the dependency on North America and EU15 as an import source declined for all East Asian countries.

The increased importance of China as an import source country can be seen in all East Asian countries, particularly for more advanced nations such as Japan, South Korea, Taiwan, and Hong Kong. China has also become an increasingly important factor for non-regional markets. The increase in the share of China in the imports of North America between 1985 and 2006 was 13.8 percent. Despite the fact that intra-regional imports dominated in the EU15 accounting for 53.9 percent in 2006, China managed to gain its share by 5.3 percent since 1985. For both regions, China accounts for approximately 60 percent of their imports from East Asia in 2006.

Table 1a shows that there have been significant changes in the pattern of China's imports as well. In 1985, more than one-third of its imports originated from Japan. Two decades later, its reliance on Japan has declined to 14.6 percent. On the other hand, a large increase in the share of intra-regional imports from 14 percent in 1985 to 43.9 percent in 2006 is witnessed. The rise is largely from the increase in the share of the NIEs in China's imports.

On the export side, on average, the share of intra-regional exports increased from 25.5 percent to 40.7 percent. Of all countries examined, significantly higher increases in the shares of intra-regional exports are reported for Taiwan, by almost 42.2 percent and South Korea, by 28.9 percent, followed by Singapore, Japan, and Hong Kong by 23.4 percent, 21.6 percent, and 19.2 percent, respectively. The increases in the shares of intra-regional exports in all countries are largely attributed to China. Increased dependency on regional trade is seen for all other Asian countries except China. The share shrank from 36.4 percent to 29.1 percent.

Whereas over 36 percent of Chinese goods were destined to other East Asian countries in 1985, the figure declined to 29.1 percent in 2006. In contrast, a much higher portion of Chinese goods was absorbed by both North America and EU15 (but to a lesser extent) in 2006. As we have shown in the import side, the reliance on North America declined for all other East Asian countries except China and Malaysia. The decline in the reliance appears to be even larger on the export side. For Taiwan in

Table 1a. The geographic destinations of East Asian imports: 1985, 1995, 2003, 2006, in percent

		East Asia (%)	Japan (%)	China (%)	NIEs (%)	ASEAN4 (%)	N. America (%)	EU15 (%)
East Asia	1985	23.0	25.7	5.9	10.7	6.4	17.1	13.6
	1995	33.6	22.8	10.0	16.0	7.5	15.8	13.9
	2003	43.3	17.5	14.3	18.4	10.7	11.3	11.0
	2006	45.2	14.4	16.3	18.4	10.4	9.6	9.8
Japan	1985	25.9		5.1	7.7	13.1	24.0	7.6
	1995	34.7		10.8	12.3	11.5	25.9	14.5
	2003	42.4		19.7	10.2	12.5	17.6	12.8
	2006	41.4		20.5	9.8	11.1	13.7	10.0
South Korea	1985	10.6	24.2	0.0	3.5	7.1	22.8	11.0
	1995	15.4	24.6	5.6	4.2	5.6	24.7	13.4
	2003	26.8	20.3	12.3	7.1	7.5	15.0	10.8
	2006	28.3	16.8	15.7	5.6	7.0	11.9	9.4
Taiwan	1985	9.6	27.6	0.0	3.8	5.7	25.5	11.1
	1995	18.8	29.2	3.0	8.8	7.0	21.6	14.4
	2003	30.4	25.7	8.7	11.4	10.3	14.2	10.4
	2006	31.8	23.0	12.3	10.9	8.6	11.9	8.6
Hong Kong	1985	45.8	23.1	25.5	17.5	2.8	9.8	12.3
	1995	59.6	14.8	36.2	18.8	4.6	8.4	10.8
	2003	67.0	11.8	43.3	17.1	6.6	5.9	8.3
	2006	70.7	10.3	45.8	18.4	6.6	5.2	7.1
Singapore	1985	32.6	17.0	8.6	6.8	17.2	15.5	12.2
	1995	36.5	21.1	3.3	11.8	21.5	15.5	13.4
	2003	46.8	11.3	8.1	10.7	28.0	13.6	11.7
	2006	49.2	8.3	11.4	12.5	25.3	13.1	10.9
China	1985	14.0	35.8		11.9	2.1	14.6	16.5
	1995	32.6	22.0		28.1	4.5	14.2	16.1
	2003	42.2	18.0		27.6	8.4	9.3	12.8
	2006	43.9	14.6		25.9	8.7	8.5	11.0
Thailand	1985	23.4	26.5	2.4	13.7	7.2	12.6	16.1
	1995	24.7	30.7	3.0	15.3	6.4	12.7	15.9
	2003	33.4	24.1	8.0	13.8	11.6	10.0	10.0
	2006	36.3	20.1	10.6	13.6	12.1	7.1	8.4
Malaysia	1985	31.0	23.2	2.1	22.4	6.6	16.4	16.1
	1995	31.0	28.1	2.3	23.7	5.0	17.1	15.6
	2003	45.9	17.2	8.8	25.1	12.0	16.0	11.8
	2006	49.7	13.2	12.1	25.2	12.5	13.0	11.1
Philippines	1985	30.6	14.4	5.4	13.7	11.5	25.9	9.3
	1995	29.2	22.1	2.3	21.0	5.9	19.9	10.7
	2003	35.5	13.0	9.1	20.8	10.2	9.3	10.9
	2006	43.4	9.0	10.9	23.9	11.3	7.8	9.7
Indonesia	1985	17.2	25.8	2.4	13.5	1.2	18.7	19.0
	1995	24.6	22.7	3.7	17.0	3.9	13.7	20.1
	2003	40.1	19.5	4.6	21.5	9.4	22.4	8.1
	2006	46.0	14.2	7.2	26.2	10.0	16.6	8.3
N. America	1985	13.9	17.7	1.0	10.2	2.7	27.9	19.9
	1995	20.4	14.6	5.6	9.8	5.1	27.5	16.4
	2003	22.6	8.5	11.4	6.8	4.4	24.3	18.1
	2006	24.4	7.3	14.8	5.5	4.1	22.2	16.3
EU15	1985	3.0	3.5	0.4	1.7	0.9	8.4	56.2
	1995	6.4	4.1	1.7	3.0	1.6	8.1	61.5
	2003	8.4	3.1	4.1	2.5	1.8	7.2	58.5
	2006	9.8	2.4	5.7	2.5	1.5	6.4	53.9

Source: *Compiled from UN Comtrade database and authors' calculation.*

Table 1b. The geographic destinations of East Asian exports: 1985, 1995, 2003, 2006, in percent

		East Asia (%)	Japan (%)	China (%)	NIEs (%)	ASEAN4 (%)	N. America (%)	EU15 (%)
East Asia	1985	25.5	16.9	4.7	15.1	5.7	29.4	11.4
	1995	38.0	12.9	8.7	20.9	8.4	21.1	13.9
	2003	41.0	10.6	12.6	20.1	8.3	19.4	14.2
	2006	40.7	8.9	13.1	19.7	7.9	17.9	14.2
Japan	1985	24.1		7.1	12.8	4.2	40.2	13.2
	1995	42.0		5.0	25.0	12.1	28.9	15.9
	2003	44.9		12.2	23.5	9.2	26.5	15.3
	2006	45.7		14.3	23.2	8.1	24.3	13.6
South Korea	1985	10.8	15.0	0.0	7.4	3.4	39.7	11.7
	1995	31.1	13.7	7.5	15.9	7.7	21.3	13.3
	2003	38.3	8.9	18.1	13.6	6.6	19.2	12.9
	2006	39.7	8.2	21.3	12.7	5.6	14.8	12.5
Taiwan	1985	15.1	11.3	0.0	12.0	3.1	51.4	9.4
	1995	38.5	11.8	0.3	29.6	8.5	25.0	13.1
	2003	51.0	8.6	15.9	28.3	6.8	19.4	13.1
	2006	57.3	7.6	24.3	25.2	7.7	16.0	10.4
Hong Kong	1985	36.6	4.2	26.0	7.0	3.6	33.2	13.6
	1995	44.0	6.1	33.3	7.1	3.6	23.3	15.0
	2003	52.1	5.3	41.7	7.0	3.4	19.5	13.7
	2006	55.8	4.8	46.3	6.2	3.2	15.9	13.7
Singapore	1985	31.4	9.4	1.5	9.3	20.6	21.9	11.0
	1995	44.2	7.8	2.3	15.4	26.5	18.8	13.4
	2003	53.4	6.1	6.3	17.1	30.0	13.1	12.1
	2006	54.7	5.5	9.7	16.7	28.2	10.5	10.6
China	1985	36.4	22.2		33.7	2.7	9.4	9.2
	1995	36.8	19.1		33.1	3.7	17.7	12.9
	2003	30.1	13.6		26.1	4.0	22.4	16.5
	2006	29.1	9.5		25.2	4.0	22.7	17.5
Thailand	1985	25.6	13.4	3.8	15.4	6.3	20.9	19.8
	1995	30.9	16.8	2.9	23.0	4.9	18.9	15.1
	2003	34.7	14.2	7.1	17.9	9.7	18.2	14.7
	2006	35.3	12.7	9.0	16.6	9.6	16.0	13.0
Malaysia	1985	36.4	23.8	1.1	29.1	6.3	13.7	14.9
	1995	40.4	12.7	2.7	31.6	6.2	21.5	14.2
	2003	43.0	10.7	6.5	28.7	7.8	20.2	12.1
	2006	43.1	8.9	7.2	26.7	9.2	19.4	12.1
Philippines	1985	20.6	18.9	1.6	12.9	6.1	37.5	16.2
	1995	24.6	15.9	1.2	16.2	7.2	37.4	16.9
	2003	42.4	22.3	6.2	21.5	7.7	12.7	13.1
	2006	41.3	21.6	8.3	20.9	8.2	11.7	11.5
Indonesia	1985	18.4	46.2	0.5	16.1	1.9	22.0	6.4
	1995	31.0	27.1	3.8	22.2	5.0	14.7	14.9
	2003	35.4	15.9	5.9	25.5	11.0	21.0	16.3
	2006	37.3	16.7	9.8	22.4	9.1	18.9	18.0
N. America	1985	9.1	8.8	1.6	5.9	1.6	37.9	18.9
	1995	15.3	9.5	1.9	10.2	3.3	35.9	17.5
	2003	13.6	5.8	3.2	7.6	2.9	40.5	16.6
	2006	14.0	4.8	4.3	7.3	2.3	38.4	16.3
EU15	1985	3.0	1.2	0.8	1.5	0.7	10.8	57.8
	1995	5.7	2.1	1.0	3.2	1.6	7.3	61.8
	2003	4.7	1.6	1.6	2.2	0.9	9.7	60.9
	2006	4.9	1.3	1.9	2.1	0.8	9.0	59.1

Source: *Compiled from UN Comtrade database and authors' calculation.*

Table 2. Average growth rate of total manufactured goods, intermediate goods, and final goods, 1998–2007

	Imports			Exports		
	Total (%)	Intermediate goods (%)	Final goods (%)	Total (%)	Intermediate goods (%)	Final goods (%)
Asia Nations	12.4	13.6	10.2	12.7	13.3	12.0
Japan	8.0	10.2	5.8	7.1	7.9	6.1
East Asia	13.7	14.4	12.1	14.8	15.5	14.2
China	22.1	21.6	23.5	24.1	26.8	22.6
Hong Kong	8.1	10.6	5.1	8.3	11.9	4.8
Indonesia	10.7	10.3	11.6	11.9	13.3	9.2
Malaysia	10.5	10.8	10.0	9.8	10.3	9.2
Philippines	2.4	2.1	4.7	1.8	1.6	2.8
South Korea	16.2	14.6	21.1	12.4	12.0	13.1
Singapore	9.8	11.2	7.2	10.8	14.1	4.9
Thailand	13.5	14.2	12.1	12.2	13.7	11.0
EU15	8.9	9.0	8.8	8.7	8.8	8.5
North America	7.4	6.8	7.9	6.0	6.0	5.9
Others	11.5	11.3	11.8	12.2	13.2	11.1
World	9.8	10.1	9.4	9.9	10.3	9.5

Source: *Compiled from UN Comtrade database and authors' calculation.*

Notes: *Others refers to Non-Asia, Non-EU, and Non-North America (Latin America, Africa, etc.); world refers to all countries.*

particular, North America's share declined from 51.4 percent in 1985 to 16.0 percent in 2006.

2.2 Composition of trade by stage of production in East Asia

Section 2.1 leads to the conclusion that East Asian countries have generally become increasingly interdependent in trade. This section considers composition of trade by stage of production in East Asia.

Table 2 examines the annual growth rate of trade in total manufactured goods and compares them with the rate of growth of trade in finished and intermediate goods. The table provides strong evidence that trade in intermediate goods resulting from the international fragmentation of production has been the engine driving intra-Asian trade during recent years. Between 1998 and 2007, exports of intermediate goods grew at a rate of 13.3 percent among Asian nations on average, which is faster than the growth rate of 12.0 percent for exports of final goods. On the import side, trade in intermediate goods grew over 3 percentage points faster than trade in final goods. Compared with other parts of the world, the growth rate in intermediate goods is much faster among Asian nations, both for exports and imports. The growth rate of exports of intermediate goods for the world, EU15, and North America were 10.3 percent, 8.8 percent, and 6.0 percent, respectively, and those of imports were 10.1 percent, 9.0 percent, and 6.8 percent, respectively.

Table 3 further distinguishes different types of intermediate goods, namely, parts and components (IMPC) and semi-finished goods (IMSF). Finished goods are also

further classified into consumption goods (FC) and capital goods (FCA). Primary goods (P) form the last category. This classification by different stages of production is useful in showing how each East Asian nation is involved in production fragmentation and to what extent they differ from other regions of the world. The classification is explained in Appendix 1.

The most notable difference between the East Asian economies and the rest of the world can be found in the trade pattern of parts and components. At the global level, approximately one-fifth of both imports and exports constitute the exchange of parts and components. That share remained relatively stable between 1998 and 2006 although both import and export shares show a slight decline during the most recent years. Table 3 shows different trends for different regions. For example, North America experienced declines of 6.0 percent and 4.2 percent, respectively, in its import and export shares of parts and components from 1998 to 2006. The EU15 also experienced a similar declining trend in its parts and components trade, although more moderately relative to North America. The trend in East Asia contrasts markedly with the other regions, with the share of the parts and components trade increasing during the same period. It accounted for 27.0 percent of imports in 2006, which was 3.7 percentage points higher than the share in 1998. The upward trend can also be found, although to a lesser extent, on the export side, which increased from 24.6 percent in 1998 to 26.4 percent in 2006.

For finished products, the most distinguishing difference between the world and East Asian countries can be found in the trade pattern of consumption goods, particularly on the import side. Approximately 22 percent of world imports take the form of consumption goods. In the case of North America, the share is almost 28 percent. Among the East Asian nations, the corresponding share only amounts to 11.4 percent in 2006, which was a decline of more than 6.9 percentage points from 1998.

Another interesting point to note is the gradual decline in the import share of capital goods, which can be seen in all East Asian countries examined except Hong Kong and South Korea. However, one must use caution about BEC (Broad Economic Categories) classification for capital goods. Capital goods (41) include producers' goods that are defined in the System of National Accounts (SNA) as part of fixed capital formation. However, there are goods in capital goods (41 and 51) that can be used as intermediate products in a related industry. Examples include motors, diesel and semi-diesel engines, generators, transformers, radiators, rectifiers, and so on.

Furthermore, there is considerable variation in the trade patterns across East Asian countries. China's trade structure can be characterized by a larger import share of parts and components and semi-finished products, and by a large export share of

Table 3. Import and export trends across regions, 1998–2006

Imports		China (%)	China, Hong Kong SAR (%)	Indonesia (%)	Japan (%)	Malaysia (%)	Philippines (%)	South Korea (%)	Singapore (%)	Thailand (%)	Asia (%)	North America (%)	EU15 (%)	World (%)
1998	FC	4.4	32.9	6.1	28.3	6.2	8.6	5.0	12.7	8.3	18.3	29.5	27.4	24.8
	FCA	19.4	15.6	21.5	12.7	18.2	10.4	12.0	21.0	17.3	15.8	18.1	16.1	17.0
	IMPC	21.8	19.2	16.3	13.2	46.1	46.7	24.3	39.7	26.7	23.3	21.1	17.6	18.9
	IMSF	44.5	28.6	37.5	23.6	21.7	24.7	33.0	16.4	34.6	28.6	20.1	27.7	27.1
	P	8.2	2.1	12.6	19.1	3.7	9.5	22.7	6.0	11.2	11.4	6.4	7.7	8.3
1999	FC	4.6	33.0	8.5	28.8	7.3	8.7	6.1	12.5	7.7	18.1	29.5	27.7	24.9
	FCA	19.2	14.7	12.9	13.1	14.7	9.3	13.7	19.3	15.3	15.1	18.2	16.7	17.0
	IMPC	23.5	21.0	12.1	13.5	47.3	45.3	25.6	41.6	27.9	24.3	21.1	17.8	19.4
	IMSF	41.6	27.5	39.7	22.9	23.2	25.0	30.9	15.3	34.0	27.7	19.2	26.1	25.8
	P	8.7	2.1	18.0	18.3	3.8	11.7	20.9	5.7	12.1	11.6	6.8	7.7	8.6
2000	FC	4.2	30.2	6.0	26.3	6.6	7.4	6.5	11.2	6.8	16.1	28.1	24.9	22.8
	FCA	17.5	15.4	14.1	12.6	14.9	9.6	15.7	18.4	14.2	15.0	18.1	16.2	16.6
	IMPC	24.2	24.5	13.7	14.5	48.6	46.1	23.9	42.8	31.1	25.5	20.1	17.4	19.5
	IMSF	38.1	26.3	39.1	22.9	21.2	22.6	27.8	14.0	31.1	26.4	18.9	25.2	25.1
	P	13.5	1.9	16.7	19.9	4.4	13.0	22.9	7.3	14.3	13.5	9.1	9.7	10.7
2001	FC	4.4	30.4	5.6	27.6	7.3	7.5	8.3	11.8	7.1	16.6	30.2	26.8	24.3
	FCA	20.1	16.8	15.3	12.3	16.3	8.6	14.2	19.1	17.2	15.8	17.6	15.9	16.5
	IMPC	25.1	24.5	14.1	13.9	44.8	47.6	22.1	40.3	28.4	24.6	18.2	17.2	18.7
	IMSF	35.8	24.8	37.6	22.9	21.8	22.5	28.9	14.5	30.6	26.3	19.1	25.6	25.4
	P	12.2	2.0	19.2	19.5	5.4	12.6	23.1	7.2	14.6	13.3	8.9	9.2	10.2
2002	FC	4.5	29.6	6.6	27.7	7.6	6.9	9.8	11.9	7.6	16.1	32.1	28.8	25.3
	FCA	21.0	16.0	14.0	12.3	15.0	7.0	14.5	17.2	17.5	15.8	17.4	14.9	16.1
	IMPC	27.4	26.9	13.8	14.4	47.0	55.5	22.7	41.4	27.1	26.4	17.4	16.5	18.5
	IMSF	34.7	24.2	35.6	22.5	20.8	19.4	29.5	14.7	31.6	26.2	19.0	25.7	25.3
	P	10.6	2.0	19.5	19.3	4.7	9.5	20.2	7.0	14.3	12.3	8.7	9.1	10.0
2003	FC	4.5	27.3	7.4	26.4	7.7	7.1	9.2	11.7	7.7	14.8	31.7	29.1	24.9
	FCA	21.6	15.2	12.5	12.1	13.3	7.1	15.0	16.8	17.3	16.0	17.1	14.4	15.9
	IMPC	28.4	29.9	13.4	14.3	48.3	52.9	22.4	41.9	26.7	27.0	16.4	16.1	18.2
	IMSF	32.0	24.1	34.6	23.2	20.4	20.9	29.9	14.2	31.4	26.0	19.0	25.4	25.4
	P	11.8	2.0	21.1	20.2	5.3	9.8	20.0	7.0	14.7	12.8	10.3	9.2	10.5
2004	FC	4.0	25.0	7.3	25.0	7.6	7.1	8.0	10.5	7.3	13.3	29.8	28.3	23.6
	FCA	21.1	15.2	14.5	11.8	14.7	6.2	15.6	17.0	15.6	16.1	17.0	14.7	16.1
	IMPC	28.6	32.4	13.0	14.5	44.0	52.4	20.6	42.0	25.5	27.1	16.3	15.6	18.1
	IMSF	29.3	23.7	37.5	23.5	22.7	20.8	31.2	13.9	33.0	25.9	20.1	25.6	25.7
	P	15.0	1.9	17.0	21.3	5.6	9.5	21.3	8.0	16.4	14.2	11.3	9.9	11.4

Table 3. *(Continued)*

Imports		China (%)	China, Hong Kong SAR (%)	Indonesia (%)	Japan (%)	Malaysia (%)	Philippines (%)	South Korea (%)	Singapore (%)	Thailand (%)	Asia (%)	North America (%)	EU15 (%)	World (%)
2005	FC	4.0	23.6	6.1	23.1	7.5	7.6	8.1	10.1	7.4	12.4	28.1	27.4	22.6
	FCA	19.4	15.7	13.8	11.5	14.6	6.4	15.1	13.9	15.8	15.3	16.7	14.6	15.8
	IMPC	29.5	34.2	12.2	13.7	43.1	50.3	19.2	42.2	22.9	26.8	15.6	15.0	17.6
	IMSF	28.2	22.4	31.9	22.9	22.5	20.1	30.3	14.4	32.1	25.1	20.0	25.5	25.4
	P	17.0	1.9	17.7	24.7	6.5	11.5	24.2	10.1	19.0	16.4	13.2	11.5	12.9
2006	FC	4.2	21.6	6.5	20.8	7.5	7.7	8.3	9.0	7.7	11.4	27.9	25.8	21.5
	FCA	19.2	16.1	14.6	11.0	14.4	6.6	14.6	14.6	14.3	15.2	16.4	14.2	15.5
	IMPC	30.5	36.2	10.5	13.7	41.4	48.4	17.6	40.7	22.9	27.0	15.1	14.5	17.3
	IMSF	26.0	21.5	31.3	23.5	22.9	19.6	30.3	14.3	32.0	24.4	20.3	26.1	25.2
	P	17.9	2.1	19.2	26.8	7.6	13.2	26.1	9.3	20.3	17.6	14.0	12.1	13.5

Exports		China (%)	China, Hong Kong SAR (%)	Indonesia (%)	Japan (%)	Malaysia (%)	Philippines (%)	South Korea (%)	Singapore (%)	Thailand (%)	Asia (%)	North America (%)	EU15 (%)	World (%)
1998	FC	47.9	42.6	20.5	20.0	14.0	17.7	19.2	10.9	37.4	27.0	16.6	27.2	24.9
	FCA	15.0	12.3	4.1	27.4	18.5	12.2	20.2	28.4	13.0	20.1	21.3	19.2	17.9
	IMPC	9.8	17.6	4.7	29.6	36.5	59.6	22.0	37.4	24.8	24.6	26.3	17.9	19.4
	IMSF	22.9	24.9	36.3	19.4	23.9	9.0	34.5	13.9	18.8	22.6	24.1	28.3	26.5
	P	3.8	1.5	17.5	0.4	5.3	1.5	0.8	0.8	4.0	2.3	6.8	3.1	7.0
1999	FC	46.8	42.1	24.3	20.5	12.5	14.0	19.7	9.4	35.5	26.5	17.0	27.6	24.6
	FCA	15.9	12.8	4.3	26.4	17.9	13.4	22.0	26.6	13.3	20.1	21.0	19.1	17.7
	IMPC	11.6	19.0	6.4	30.2	41.0	64.3	24.9	40.1	25.4	26.6	27.0	18.1	20.0
	IMSF	21.8	24.0	42.2	19.3	21.2	6.8	29.1	14.4	18.3	21.6	23.8	27.3	25.3
	P	3.3	1.5	18.8	0.3	5.4	1.4	0.4	0.7	3.5	2.2	6.3	3.3	7.8
2000	FC	43.8	39.3	22.4	18.7	12.4	14.4	18.2	8.2	32.0	24.8	16.0	25.8	22.6
	FCA	17.3	13.5	8.1	26.5	18.9	15.7	21.6	24.1	13.2	20.3	20.3	19.0	17.2
	IMPC	12.8	22.2	8.7	31.7	40.0	60.3	27.7	44.2	27.0	28.1	27.4	17.9	20.2
	IMSF	21.4	23.2	40.5	19.1	20.0	7.1	26.9	12.7	19.2	21.0	24.0	27.0	24.5
	P	3.7	1.5	17.7	0.3	6.0	1.3	0.3	0.6	3.9	2.3	7.1	3.7	9.7

2001	FC	42.3	38.4	23.1	20.2	13.4	16.2	19.8	8.6	34.1	26.2	16.9	27.6	24.2
	FCA	18.4	14.0	6.8	24.8	21.2	16.6	24.8	23.2	12.8	20.2	19.8	19.1	17.2
	IMPC	14.0	23.4	8.8	30.2	35.6	57.7	22.3	42.4	25.1	26.2	26.1	17.6	19.2
	IMSF	20.9	22.4	39.6	20.0	21.4	7.4	27.4	14.2	19.2	21.4	24.0	27.0	24.7
	P	3.4	1.5	19.5	0.6	5.1	1.3	0.3	0.6	3.7	2.5	7.6	3.2	9.3
2002	FC	40.2	35.9	20.8	22.4	12.7	14.8	19.4	8.5	33.1	26.3	17.6	29.2	25.1
	FCA	20.0	14.7	8.2	23.0	18.8	17.0	26.2	22.0	14.9	20.1	18.9	18.3	16.7
	IMPC	15.6	25.5	8.7	29.6	38.2	59.3	24.3	42.8	23.3	26.7	25.7	17.1	19.0
	IMSF	20.3	22.2	40.4	20.2	22.2	6.5	25.9	15.1	19.9	21.3	24.4	27.0	24.8
	P	2.9	1.4	19.5	0.4	5.1	1.4	0.3	0.7	4.5	2.4	7.5	3.4	8.9
2003	FC	37.4	33.0	20.1	21.6	11.9	15.0	19.2	8.1	31.0	25.2	17.7	29.4	24.9
	FCA	23.3	14.3	6.5	22.9	17.8	14.4	26.1	20.2	15.7	20.6	18.1	17.4	16.3
	IMPC	16.0	28.4	9.1	30.2	36.8	60.0	25.2	42.3	23.5	27.0	24.7	16.8	18.6
	IMSF	19.6	22.4	41.8	20.5	24.3	7.6	25.6	17.4	20.8	21.5	24.9	27.1	25.1
	P	2.6	1.7	19.9	0.5	6.0	1.4	0.4	0.7	5.5	2.4	8.9	3.4	9.4
2004	FC	34.2	30.3	21.8	20.0	11.5	13.4	18.0	7.5	29.8	23.6	17.2	28.5	23.9
	FCA	25.2	13.9	7.1	23.9	19.2	18.8	26.2	18.7	16.0	21.6	18.3	17.4	16.5
	IMPC	16.7	31.6	9.5	30.0	33.4	56.8	26.3	43.2	23.1	27.1	23.7	16.6	18.4
	IMSF	21.2	22.4	39.2	21.0	25.2	8.2	25.2	17.4	21.8	22.0	25.9	27.4	25.6
	P	1.9	1.6	19.8	0.7	6.9	1.8	0.4	0.7	5.8	2.2	9.3	3.8	9.7
2005	FC	32.6	28.8	18.2	19.9	11.3	13.4	16.2	7.4	28.7	22.9	17.1	28.0	22.9
	FCA	26.4	14.6	6.4	22.6	19.8	18.1	26.3	16.9	17.8	21.7	18.2	17.7	16.3
	IMPC	16.9	34.8	8.4	29.6	32.3	56.1	26.9	42.9	21.3	26.8	22.8	16.6	17.8
	IMSF	21.1	20.1	41.2	22.1	24.5	8.8	24.9	16.8	22.5	22.0	25.9	27.7	25.3
	P	1.9	1.4	23.6	0.8	7.9	2.2	0.4	0.6	5.8	2.5	10.0	4.0	11.3
2006	FC	31.1	26.5	17.1	20.6	10.6	13.2	14.8	7.7	27.2	22.4	16.6	26.8	22.1
	FCA	26.8	14.9	5.8	22.1	20.4	15.6	27.6	14.4	17.9	21.8	18.9	18.2	16.6
	IMPC	17.4	36.4	7.1	28.5	30.9	53.7	25.9	44.4	21.3	26.4	22.1	16.3	17.6
	IMSF	22.2	20.3	41.8	22.5	25.3	12.6	25.1	16.1	22.6	22.5	26.1	28.1	25.7
	P	1.4	1.6	25.5	0.9	8.4	2.5	0.5	0.7	6.6	2.6	10.2	4.2	11.3

Source: *Compiled from UN Comtrade database and authors' calculation.*

Note: *FC = consumption goods; FCA = capital goods; IMPC = parts and components; IMSF = semi-finished goods; P = primary goods.*

consumption goods as well as capital goods. This reflects China's role in production fragmentation as a processing and assembly base for finished products destined for the world market.

The general feature of three ASEAN countries—Malaysia, the Philippines, and Indonesia—is a large share of intermediate goods among both imports and exports. The decomposition of intermediate goods shows that whereas parts and components account for a large share of imports and exports in Malaysia and the Philippines, semi-finished goods account for a large share in Indonesia. The import structure of Thailand is similar to these three ASEAN countries; the distinctive difference, however, can be found in its export structure (i.e., a much larger share of exports of consumption goods). In this comparison, Singapore is treated separately from the three other ASEAN countries due to its relatively high wages, and is discussed in later paragraphs.

Japan's trade structure is quite a contrast compared to those of developing Asia. Japan is a large supplier of parts and components, reflecting Japanese industries turning to other countries of the region for the assembly of Japanese products (Jones, Kierzkowski and Lurong 2004). The trend is also marked by a small export share of consumption goods. Table 3 also indicates that capital goods hold a large share of Japan's exports, which reflects in part large FDI outflows from Japan. Production fragmentation has been facilitated greatly by MNEs and consequent FDI, which has had a significant impact on exports from investing countries to host countries. This may be due to the fact that new production facilities need to be equipped using capital goods from the investing country or because new capital goods are required for expanding existing production capacities.

A large share of parts and components trade can also be found in Singapore and Hong Kong, where wage costs are much higher relative to other developing countries of East Asia. In Singapore, parts and components make up a substantial share of its imports and exports. Over 40 percent of both imports and exports are induced by the need for parts and components. This represents Singapore's pivotal role as an outsourcing center in East Asia, particularly in high-tech manufacturing and as a hub for many leading international firms. Singapore's superior logistics sector as well as the finance industry helps to form world-class supply chains in the region.

Hong Kong as a trading hub for electronic parts and components in Asia hosts a number of multinational manufacturers that source parts of key components and take advantage of its free port status. At the same time, the Hong Kong electronics industry is characterized by its heavy dependence on imported parts of key

components. Local firms source worldwide as well as from Chinese firms. Hong Kong's import share of parts and components increased dramatically from 19.2 percent in 1998 to 36.2 percent in 2006. On the export side, the electronics industry is the largest export industry, accounting for nearly 50 percent of Hong Kong's total exports in 2006.

3. Gravity equation

3.1 Model specification and estimation method

The gravity model has been widely applied in various studies of international trade and FDI (Feenstra, Markusen, and Rose 2001). The gravity equation in international trade using cross-country data is commonly written as:

$$X_{ij} = f(GDP_i, GDP_j, F_{ij}), \tag{1}$$

where X_{ij} is the value of the trade flow of goods from country i to country j, GDP_i and GDP_j are the GDP in country i and j, respectively, and F_{ij} is a vector of factors that influence the trade flow. The factors commonly used include the physical distance between the two countries i and j, which is used as a proxy for transportation or trade costs and a dummy variable assuming the value 1 if i and j share a common land border and 0 otherwise.

The model specification is augmented to examine the economic impact of FDI inflow on the host country's trade. China, Hong Kong, Singapore, South Korea, Thailand, Malaysia, the Philippines, Indonesia, and Japan are included in the estimation here for 1998–2006. Of particular interest is the impact of U.S., Japanese, and Korean FDI on various forms of intra-regional trade in East Asia. One possible specification issue for including FDI in the gravity analysis is the endogeneity problem. More specifically, the causal relationship between FDI and trade may be driven by unobserved common factors such as variation in government policy, technology, tastes, and so on. The strategy adopted here to deal with this issue is to estimate FDI at the first stage using various instrumental variables whereas in the second stage, bilateral trade is estimated with the predicted value of FDI as the additional independent variable. The error term in the FDI equation then is uncorrelated with the error term in the trade equation.

The model predicts that FDI flow and bilateral trade flows between any two countries as:

$$\begin{aligned} FDI_i = {} & a_0 + a_1 DIFPGDP_{ij} + a_2 DIFWAGE_{ij} + a_3 DUTY_i + a_4 CTAX_i \\ & + a_5 CORRUPT_i + a_6 GSTAB_i + a_7 LAW_i + a_8 TEL_i, \end{aligned} \tag{2}$$

where subscripts *i* and *j* refer to the reporting country and the partner country. Annual data for nine economies from 1998 to 2006 are used in the estimation.

The definitions of the variables in equation (2) are:

- FDI_i—the level of FDI stock in the reporting country.
- $DIFPGDP_{ij}$—the absolute value of the difference in per capita GDP between *i* and *j*.
- $DIFWAGE_{ij}$—the absolute value of the difference in wages between *i* and *j*.
- *DUTYi*—import tariff of the host country.
- $CTAX_I$—corporate tax rate of the host country.
- $CORRUPT_i$—an index of corruption in the host country.
- $GSTAB_i$—an index of government stability in the host country.
- LAW_i—an index of rule of law in the host country.
- TEL_i—the number of telephone main lines per 1,000 people in the host country.
- $DIST_{ij}$—the geographical distance between the capital cities in *i* and *j*.
- T_{ij}—the volume of exports or imports by country *i* to or from *j* in trade in parts and components and trade in capital goods.
- *GDP*—gross domestic product.
- DMB_{ij}—a dummy variable that is 1 if *i* and *j* share a common border and 0 otherwise.

The independent variables included in equation (2) are believed to exert an influence on inward FDI in each East Asian economy by changing the investment environment through institutional and policy changes and economic conditions.

Two variables have been incorporated in this analysis that may influence the level of foreign production: the absolute difference of per capita GDP *(DIFPGDP)* and wages *(DIFWAGE)*. The gap in per capita GDP and wages between a reporting country and a partner country should have a positive influence on FDI of the vertical type.[5] Trade in intermediate goods can be sensitive to cost differences between two countries. Factor price differentials between countries allow fragments to be produced more cheaply in another country (Deadorff 2001).

Policy-related variables, tariff barriers proxied by import duty, and corporate tax rates have also been included. MNEs, which set up vertical production networks, may be encouraged to invest in a country with relatively low tariff barriers due to

5 For an interesting study on how vertical intra-industry trade helps integrate East Asia, see Wakasugi (2007).

the lower costs of their imported intermediate products. Under such an arrangement, goods-in-process may cross multiple borders while they are being produced. Because a tariff may be imposed each time these goods-in-process cross a border, the effect of the lower tariff rate on the reduction in the cost of production of these goods can be magnified.

Another policy-related variable that can influence a host country's location advantage is the host country's corporate tax or other tax rates. As global profit maximizers, MNEs should be sensitive to tax factors, because such factors have a direct effect on their profits. Evidence of significant negative influence from corporate tax rates on FDI have been reported in previous studies by Wei (1997), Gastanaga, Nugent, and Pashamova (1998), and Hsiao (2001).

Also included in equation (2) are institutional factors, the level of corruption, the stability of each government, and the rule of law. Corruption can discourage FDI by inducing a higher cost of doing business. Hines (1995) showed that FDI from the United States grew more rapidly in less corrupt countries than in more corrupt countries after 1977. Wei (1997) presented an alternative explanation of the negative and significant effect of corruption on FDI. Unlike taxes, corruption is not transparent and involves many arbitrary factors. Wei demonstrated the fact that this type of uncertainty induced by corruption leads to a reduction in FDI. Political stability of a government and a sound system of the rule of law can also be important factors in the inflow of FDI. Uncertain political environments and their related risks can impede FDI inflows despite favorable economic conditions.

The last variable, *TEL,* included in equation (2) is a proxy for the quality of infrastructure. On the other hand, as theorized by Jones and Kierzkowski (1990), production fragmentation is not costless. A high quality of infrastructure can induce investors to invest in particular locations to facilitate production sharing.

We now turn to equation (3), which is run for trade in parts and components and capital goods separately. The definition of the variables was listed previously. In addition, the impact of each explanatory variable on bilateral import flows and export flows are examined separately.

$$T_{ij} = b_0 + b_1 GDP_i + b_2 GDP_j + b_3 DIST_{ij} + b_4 DMB_i + b_5 FDI_i \,. \tag{3}$$

The volume of trade in both intermediate and final products is expected to be positively related to the market sizes of the two countries concerned. The variable GDP captures the idea that larger countries trade more than small countries as they can

offer more differentiated products to satisfy a wide variety of consumers. At the same time, for producers of both intermediate products as well as capital goods, the larger the market size of both exporting and importing countries due to the presence of economies of scale, the larger the volume of trade. According to the theory of fragmentation outlined by Jones, Kierzkowski, and Lurong (2004), scale of production would determine the lengths to which the division of labor can proceed since the level of the workers' specialization increases as the scale of production rises. As Grossman and Helpman (2005) proposed, the variable can also be treated as a proxy for the "thickness" of the markets; this has a positive impact on the location of outsourcing, as the likelihood of the firms finding an appropriate partner in their search increases as the size of a country increases.

The distance variable is considered to be a crucial factor in explaining international trade because distance increases trade costs, which negatively influences bilateral trade volume. In particular, transport or trade costs can have a larger impact on decisions concerning production fragmentation, as each intermediate product that belongs to the same value-added chain often crosses boarders multiple times. Geographical proximity, on the other hand, promotes bilateral trade flows as it reduces transportation needs, information costs, cultural unfamiliarity, and so forth. Therefore, the expected sign of the variable is negative.

The final variable is a dummy variable with regard to whether the importing country and exporting country are adjacent. The dummy variables may capture various factors that lead to reduced business transaction costs. For example, firms in adjacent countries are likely to have a better understanding of business practices than firms from a different business environment. Such familiarity also helps reduce the difficulty of finding an appropriate outsourcing partner in production networks. As the variable is assumed to capture additional proximity between trading partners that facilitate trade, it is expected to have a positive sign.

Except for the dummies, all variables are log-linearized. Sources for the variables are listed in Appendix 2.

3.2 Estimation results

Table 4 represents the results of the estimations by random effect model. Our results show a positive and statistically significant influence of all Japanese, U.S., and Korean direct investment on trade in parts and components as well as capital goods, indicating a complementary relationship between such modes of trade and FDI in East Asia. However, a large variation exists in the magnitude of the impact of the variable between the United States and Japan and across the two types of disaggregated data.

Table 4. Regression results

Explanatory variables	Export					
	Japan		United States		South Korea	
	PC coefficient	CA coefficient	PC coefficient	CA coefficient	PC coefficient	CA coefficient
GDP, reporter	0.715 ***	0.791 ***	0.758 ***	0.912 ***	0.713 ***	0.920 ***
	(0.059)	(0.059)	(0.061)	(0.061)	(0.063)	(0.067)
GDP, partner	0.747 ***	0.703 ***	0.751 ***	0.734 ***	0.764 ***	0.808 ***
	(0.056)	(0.056)	(0.061)	(0.062)	(0.060)	(0.065)
DIST	−1.194 ***	−0.949 ***	−1.183 ***	−0.987 ***	−1.262 ***	−1.124 ***
	(0.201)	(0.178)	(0.224)	(0.198)	(0.234)	(0.220)
DB	−0.225	0.394	−0.219	0.329	−0.268	0.216
	(0.526)	(0.464)	(0.585)	(0.516)	(0.615)	(0.577)
FDIHAT	0.613 ***	1.094 ***	0.371 ***	0.485 ***	0.444 ***	0.372 ***
	(0.098)	(0.109)	(0.070)	(0.076)	(0.066)	(0.077)
LM	1	1	1	1	1	1
No. of obs.	643	643	643	643	643	643

Explanatory variables	Import					
	Japan		United States		South Korea	
	PC coefficient	CA coefficient	PC coefficient	CA coefficient	PC coefficient	CA coefficient
GDP, reporter	0.879 ***	0.833 ***	0.875 ***	0.820 ***	0.893 ***	0.891 ***
	(0.059)	(0.058)	(0.063)	(0.061)	(0.062)	(0.064)
GDP, partner	0.641 **	0.707 ***	0.701 ***	0.787 ***	0.696 **	0.858 ***
	(0.063)	(0.061)	(0.064)	(0.061)	(0.065)	(0.067)
DIST	−1.080 ***	−0.811 ***	−1.080 ***	−0.805 ***	−1.162 ***	−0.956 ***
	(0.228)	(0.185)	(0.244)	(0.196)	(0.250)	(0.218)
DB	−0.301	0.272	−0.314	0.261	−0.376	0.123
	(0.599)	(0.483)	(0.638)	(0.511)	(0.660)	(0.573)
FDIHAT	0.619 ***	0.858 ***	0.332 ***	0.475 ***	0.322 ***	0.250 ***
	(0.098)	(0.110)	(0.071)	(0.075)	(0.067)	(0.076)
LM	1	1	1	1	1	1
No. of obs.	643	643	643	643	643	643

Source: *Authors' calculations.*

Note: *GDP, reporter = exporting country and importing country in the equation for export and import, respectively; GDP, partner = importing country and exporting country in the equation for export and import, respectively; DIST = geographic distance between the importing and exporting countries; DB = dummy variable taking unity when the importing country and exporting country are adjacent; FDIHAT = the predicted value of FDI in equation (2); PC = parts and components; CA = capital goods. Heteroskedasticity-consistent standard errors (White) are in parentheses. A constant is included in the model but is not reported. Statistical significance based on the standard t-test is denoted as ***1%, **5%, *10%.*

With regard to trade in parts and components, Japanese direct investment appears to have a much larger effect relative to U.S. or Korean direct investment. On the export side, it shows that a 1 percent increase in Japanese direct investment inflow leads to a 0.61 percentage point increase in intra-regional bilateral exports, whereas U.S. and Korean direct investment inflows only lead to a 0.37 and 0.44 percentage point increase, respectively. The impact of Japanese direct investment exerted on regional bilateral exports of parts and components is approximately 1.7 times as large as that of the U.S. direct investment and 1.4 times as large as that of Korean direct investment. On the import side, a similar difference exists between FDI from these countries. The coefficient for Japan is approximately 1.8 and 1.9 times as large as that for the United States and South Korea, respectively.

Electrical industries as well as automobile industries consist of layers of subcontractors in Japan. Small and medium enterprises (SMEs) as subcontractors to larger multinationals are suppliers of intermediate goods. After large Japanese manufacturers shifted their production site from Japan to various Asian countries seeking low-cost assembly sites for labor-intensive production processes in 1970s and 1980s, SMEs also established their overseas production to extend the long-term close business ties they had created with the MNEs back in Japan. A large part of FDI by Japanese MNEs is thus undertaken by SMEs, which is a distinctive characteristic of Japanese FDI. Those SMEs that produce parts and machinery for large manufacturers established support industries in East Asian countries. Over time, Japanese manufacturing industries concentrated production of components and parts through their business networks in East Asia. The large impact of Japanese direct investment on the intra-regional trade of parts and components may be attributed to this distinctive characteristic of Japanese direct investment.

The results also indicate that FDI by Japan, the United States, and South Korea all cause both intra-regional bilateral exports and imports of parts and components to increase among the Asian countries. Thus inward FDI of different sources and trade are complementary. Furthermore, the predicted impact on exports is insignificantly different from the predicted impact on imports of parts and components for the Japanese and the U.S. cases. This indicates that increased levels of Japanese FDI have an insignificant impact on the trade balance of parts and components of these Asian countries. In contrast, Korean FDI seems to have a larger impact on intra-regional bilateral export than on their imports.

A significantly positive impact of FDI inflow is also found on trade in capital goods for all FDI source countries. On the import side, the result may be attributed to various trade liberalization policies and institutional changes that many East Asian

economies pursued during the 1990s. For example, many East Asian economies unilaterally eliminated their tariffs on capital and intermediate goods. In addition, duties on trade in information technology products were completely eliminated due to the completion of the Information Technology Agreement (ITA). This is important because among the commodities actively traded in the East Asian region (excluding Japan) the leading category is information technology products. Regarding institutional changes, the establishment of Export Processing Zones (EPZ), where manufacturers can enjoy import duty exemption on imported inputs as well as extensive usage of duty drawbacks on the imported parts and components used for the production of exports, effectively reduces the impact of tariff barriers on trade.

More interestingly however, the size of the impact of Japanese direct investment is 2.3 times and 2.9 times as large as that of U.S. and Korean direct investment, respectively, on the export side. An equally large difference in the size of the coefficient can also be found on the import side. The coefficient for Japan is 1.8 times and 3.4 times as large as those for the United States and South Korea, respectively. The notable difference can be due partly to the extensiveness of Japanese machinery production in Asia and the fact that a wide range of goods that can be used as intermediate inputs in related industries is being classified as "Capital Goods" in BEC, as we discussed previously.

The overseas structure of the Japanese general machinery industry is characterized by continual expansion in the number of production and bases around the world. The geographical spread of general machinery affiliates is diverse, but reflects the locations of the electrical, electronics, and automotive industries, which are supplied by firms in the general machinery industry (Farrell 2008). In 2003, 18 percent of general machinery industry affiliates were located in China, 16 percent in North America, 15 percent in ASEAN, and 8 percent in the NIEs' three economies (Japan Bank for International Cooperation Institute 2004). Furthermore, with the *Keiretsu* system and the assistance of the local Japanese government in deploying overseas operation for SMEs (at the prefecture and the ward level), intra- and inter-industry relationships originating from Japan remain strong even when the firms are operating abroad.

Another key feature of the Japanese machinery industries is that they have been strong and highly competitive industries since World War II. Japan was the early adaptor and developer of the new Numeric Control technology (NC), which was then aggressively applied to Japanese products with continual improvements. Indeed by 1982, Japan had become the largest machine tool producer in the world. At its peak production in 1990, Japan recorded US$ 13 billion of output. Since then Japan has continued to be a leader in this sector.

With the aid of the NC technology, Japan was able to remain competitive in a wide range of industries. A large impact of Japanese direct investment on the bilateral intra-regional trade in Asia can be best understood by the wide spectrum of manufacturing exports from Japan and from their affiliates in Asia many of which fall into the "Capital Goods" classification.

The coefficients for the two standard variables, the market size of both reporting and partner countries, and distance have the expected signs and are statistically significant at the 1 percent level for intermediate goods and capital goods. The overall results for GDP are consistent with the hypothesis that larger countries with a large production capacity are more likely to enjoy economies of scale and to export more, while at the same time importing more due to a higher capability of absorption.

Distance is found to be an important resistance factor for trade flows of both exports and imports of both types of trade. Distance is likely to represent not only transportation costs, but also other trade costs such as communications, local distribution, and regulatory costs. Lowering the costs of these service links that connect the two production blocks is crucial for countries to successfully integrate in production networks.

The adjacency dummy included to capture additional advantages arising from geographical proximity is not found to have significant influence on regional bilateral trade.

4. Conclusion

In this paper we document the growing importance of intra–East Asian trade of parts and components. Our empirical analysis shows that FDI does play an important and independent or exogenous role in facilitating the trade of parts and components in East Asia. This is true for FDI from all three source countries: the United States, Japan, and South Korea.

Furthermore, our empirical studies show that FDI from Japan has a particularly strong influence on trade in parts and components as well as trade in capital goods. With respect to capital goods, it is fairly well known that the Japanese engineering and machinery sector has a long and distinguished history and continues to be a strong sector of the economy. It seems likely that Japanese affiliates are set up abroad to import machinery from Japan or to manufacture and export some of the capital goods to other East Asian economies. Such capital goods are used to produce and export parts and components. Thus for the case of Japan, trade in capital goods

and trade in parts are both facilitated by Japanese investment. In addition, FDI rather than local supply is needed because of the quality of the machinery as well as the importance of safeguarding the intellectual content of such capital goods. Other complementary explanations of the significant influence of Japanese FDI on the two modes of intra–East Asian trade include the activities of SMEs as well as other *Keiretsu* suppliers that follow the Japanese multinationals when they go abroad. In contrast, investments from the United States and South Korea also facilitate trade in parts and components as well as capital goods but they lack the focused activities of their machinery sectors. They may also have stronger tendencies to use local suppliers as well as supplies from other non-U.S. and non-Korean foreign affiliates.

There are several implications from our studies. First, there are other Asian economies that have been outside of the Asian production network so far, including much of South Asia. It is clear that to promote trade in parts and components, these economies will need to adopt policies that are friendly not only to trade, but also to FDI. A set of policies that are important to both trade and FDI will be the improvement of infrastructure, including ports, highways, airports, and so on. In addition, existing studies show that the quality of institutions (rule of law, corruption, intellectual property rights protection, etc.) is likely to be important to attract FDI, which then will facilitate the formation of the production network.

Finally, there may be particular reasons that East Asian economies should focus on deepening their production network, which is facilitated by FDI from other Asian countries and more centered on Asian consumptions. First, as we have witnessed recently in the global financial crisis that originated in the United States, American consumers have shifted some of their patterns of consumption. Production and trade networks that are more centered in Asia and hopefully more geared toward Asian consumers and Asian government purchases may thus be more stable and less likely to face sudden sharp declines.

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Appendix I

	Commodity code
1	Food and beverages
11	Food and beverages, primary
111	Food and beverages, primary, mainly for industry (P)
112	Food and beverages, primary, mainly for household consumption (F-C)
12	Food and beverages, processed
121	Food and beverages, processed, mainly for industry (IM-SF)
122	Food and beverages, processed, mainly for household consumption (F-C)
2	Industrial supplies new
21	Industrial supplies new, primary (P)
22	Industrial supplies new, processed (IM-SF)
3	Fuels and lubricants
31	Fuels and lubricants, primary (P)
32	Fuels and lubricants, processed
321	Fuels and lubricants, processed, motor spirit
322	Fuels and lubricants, processed (other than motor spirit) (IM-SF)
4	Capital goods (except transport equipment), and parts and accessories thereof
41	Capital goods (except transport equipment) (F-CA)
42	Parts and accessories of capital goods (except transport equipment) (IM-PC)
5	Transport equipment, and parts and accessories thereof
51	Transport equipment, passenger motor cars (F-C)
52	Transport equipment, other
521	Transport equipment, other, industrial (F-CA)
522	Transport equipment, other, non-industrial (F-C)
53	Parts and accessories of transport equipment (IM-PC)
6	Consumption goods new
61	Consumption goods new, durable (F-C)
62	Consumption goods new, semi-durable (F-C)
63	Consumption goods new, non-durable (F-C)
7	Goods new

Note: *P = primary goods; IM-SF = semi-finished goods under intermediate goods; IM-PC = parts & components under intermediate goods; F-CA = capital goods under final goods; F-C = consumption goods under final goods.*

321 and 7 are treated as "others."

Appendix 2

Source of variables

FDI: Aggregate FDI inflows of each country, aggregate FDI inflows to East Asia, and aggregate FDI to the world are from UNCTAD.

CORRUPT: An index of corruption from the International Country Risk Guide by the PRS Group. It ranges from 0 to 6, with a higher number indicating a lower level of corruption.

GSTAB: An index of government stability from the International Country Risk Guide by the PRS Group. The range is from 0 to 12. A higher score means higher stability of a government.

Law: An index of Law and Order from the International Country Risk Guide by the PRS Group. It ranges from 0 to 6, where a higher number indicates a better system of law and order.

DUTY: Import duties are from the International Monetary Fund's *Government Finance Statistic Yearbook.*

WAGE: Average wages in manufacturing from the United Nations Common Database, LABORSTA, and official country Web sites.

CPTAX: Corporate income tax rate, measured in percentage points, from *Worldwide Summary* by PricewaterhouseCoopers Web site.

TEL: Telephone mainlines (per 1,000 people) from World Development Indicators.

GDP: GDP in U.S. dollars are from EconStats.

PGDP: Per capita GDP are from EconStats.