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Abstract

The paper addresses the question of whether effects on economic growth of inward FDI differ according to the origin of investors. Implications are derived for trends of regionalism. To address the question, the magnitudes of productivity spillovers from foreign firms to local firms are measured using groups of foreign investors' home regions with data for Indonesian manufacturing. The results of analyses suggest that MNCs from eastern Asian economies impart positive externalities to local firms, whereas MNCs from non-Asian countries did not impart significant effects. Furthermore, the results suggest that eastern Asian countries' MNCs impart stronger effects than Japanese MNCs do, whereas the presence of Japanese MNCs enhanced the magnitude of spillovers from eastern Asian countries MNCs. These results support regionalism in eastern Asian economies, including Japan.

JEL classification: F23, O14
Keywords: Indonesia, MNCs, manufacturing, productivity spillovers

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1. Introduction

Several economies in eastern Asia have sought regional trade agreements in recent decades. The ASEAN Free Trade Area (AFTA), which has been in effect since 2002, is a notable example. Japan and Singapore also concluded a bilateral free trade agreement (FTA) in 2002. Furthermore, China, Korea, and Japan have each proposed and negotiated FTAs with ASEAN countries. More recently, Indonesia and Japan reached an agreement in principle on the major elements of an Economic Partnership Agreement (EPA). Japanese EPAs with ASEAN countries seek promotion not only of trade but also of foreign direct investment (FDI). These agreements discriminate among member countries and non-member countries. Consequently, the importance of national boundaries would decrease within a region, but would increase between regions. For that reason, the effects of trade and FDI on economic growth would be more or less affected by the mix of member countries. In addition, such regional agreements would further promote both regional trade and investment in eastern Asia, which have been expanded by market-driven forces since the mid-1980s.

Two purposes are advanced in this paper. The paper addresses the question of whether the effects of inward FDI on economic growth differ according to the investor's origin, and then derives the direct implication for trends of regional agreements. To elucidate the matter, the magnitudes of productivity spillovers from foreign firms to local firms are measured using groups of foreign investors' home regions with data for Indonesian manufacturing. To date, several determinants of productivity spillovers have been examined. Based on the implications that have emerged from the studies, we can presume different effects of FDI from different regions. Instead, in this paper, the resulting different effects are measured directly. Another related purpose is to evaluate the surge in Indonesia's inward FDI from less-developed countries (LDCs) that has occurred since the late 1980s. Indonesia experienced a large inflow of FDI after several waves of deregulation of FDI in 1990s. A considerable amount of FDI has come from LDCs in eastern Asia. The investments were mainly export-market-oriented, in contrast to the strong domestic orientation of 'older' FDI under the highly protectionist trade regime (Thee 1991). Although consequences of the surge in FDI from LDCs into Indonesian manufacturing have been evaluated in some respects (e.g. manufacturing export growth), the effects on local firms have not been examined sufficiently. In the subsequent section, the concept of productivity spillovers is explained. Characteristics

of spillovers are also discussed, focusing on the relationship to the origins of investors. Section 3 explains the data examined in this paper, which were newly constructed for these analyses. Then, a review of policy changes and experiences of the Indonesian manufacturing during recent decades is presented. Section 4 explains the methodology and results of econometric analysis. Finally, section 5 presents concluding remarks.

2. How do MNCs affect productivity of local firms?

2.1. Concept of productivity spillovers

Productivity spillovers from foreign firms are defined as externalities derived from foreign firm presence, which benefits other firms through improvement of their productivity (Blomström, Kokko and Zejan, 2000). Such spillovers to local firms occur through several channels. First, local firms can learn how MNC affiliates procure, produce, sell, manage, and adapt technology; they can then imitate the behavior of MNCs, reflecting a demonstration effect. Second, MNCs might find it profitable to develop local supplier networks and to help improve the performance of these networks by providing information related to sophisticated technology, technical assistance, and other services to local suppliers (Moran 2002, pp. 108–109). This development creates a backward linkage effect. Third, MNCs might supply similar services to local customers that purchase their products (e.g. for the use as inputs), thereby creating a forward linkage effect. Fourth, spillovers can result from the training of workers, who acquire specific knowledge and/or skills and eventually change their employment to other local plants or share their knowledge with them through other channels. This mechanism can be extremely important for developing countries like Indonesia, where public education systems are weak (Blomström et al. 2000). Fifth, even if no direct contact exists between MNCs or their workers and local plants, MNCs can increase competition in an industry and motivate local plants to increase productivity to protect their market shares and profits. In addition, increased sales or production of, for example, motorcycles by foreign firms would increase demand in after-markets for parts and components of motorcycles produced by local firms.

2.2. Developed countries' versus developing countries' MNCs

Productivity spillovers have been examined empirically in several previous analyses, but the results are mixed. According to a survey by Görg and Greenaway (2004), several studies found evidence supporting negative spillovers for developed and developing countries. In addition, of the 40 studies investigated, only 8 studies using panel data and appropriate estimation techniques reported evidence of positive spillovers. Moreover, only one of those is an examination of developing countries. Demonstrably, empirical findings supporting the existence of positive spillovers in developing countries are very limited. However, some evidence exists of the existence of positive spillovers in Indonesian manufacturing (e.g. Takii 2005).[1]

A possible explanation of the mixed results related to spillovers is that the externality does not automatically benefit local firms: rather, various factors affect the magnitude of spillovers. Therefore, if the factors differ among examined countries and periods, the resulting magnitudes of spillovers would also be different. Several studies have examined the factors influencing the magnitude of spillovers. An important factor is the relative backwardness of local firms, or technological gaps between MNC affiliates and local firms. Findlay (1978) constructed a simple dynamic model which emphasizes the importance of "relative backwardness" based on the idea that pressures for change within a backward region are positively correlated with the backlog of technological opportunities in the advanced region. In a cross section of 20 manufacturing sectors in Mexico, Blomström and Wolff (1994) found that the rate at which local plants catch up to MNCs is higher in sectors with greatly disparate productivity levels in the initial year. However, as a partial contrast, Kokko (1994) found that large productivity gaps and large foreign market shares together impede spillovers in the Mexican samples. Takii (2005) also found evidence supporting that spillovers are smaller in industries of Indonesian manufacturing, for which technology gaps are wide.

Takii (2005) also examined the effect of foreign ownership shares on the magnitude of spillovers. Whole and majority ownership can facilitate control of affiliates, thereby preventing leakage of firm-specific knowledge. In this case, the greater presence of majority-

[1] Lipsey and Sjöholm (2005) provide a survey on productivity spillovers in Indonesian manufacturing.

owned or wholly owned foreign plants might reduce the magnitude of spillovers.[2] Takii (2005) found supporting evidence of that hypothesis. The relationship between competition and spillovers was examined in Kokko (1994). In addition to other factors that have been examined empirically, several factors have been shown to affect the magnitude of spillovers theoretically. For example, appropriateness of technology would be an important factor. Given that foreign-owned plants are large and capital-intensive compared to locally owned plants, the technology used in foreign-owned plants might not be appropriate for locally owned plants, which are probably smaller, with more labor-intensive production (Takii 2005).

These arguments indicate that the effects of foreign firms on local firms would be different if the characteristics of MNCs from different regions were different. For several reasons, characteristics of MNCs are expected to different according to the origin of investors. The most important differences might stem from differences in stages of economic development of the home countries. In particular, for Indonesia, most neighboring countries are classified as LDCs. The investment development path (IDP) theory suggests that, in the early stage of IDP, imports and inward FDI contributed to the development of firm-specific advantages mainly in low/medium knowledge-intensive industries and/or resource-based sectors (Dunning 1993; UNCTAD 2006, p. 147). Therefore, FDI from LDCs might be characterized as investment into low/medium knowledge-intensive and/or resource-intensive technology, whereas MNCs from developed countries exploit high knowledge-intensive technology in host countries.

Furthermore, the competitive advantages of firms from LDCs are similar and appropriate to the conditions of other LDCs than competitive advantages firms from developed countries. Chen (1990) discussed the possibility that MNCs from LDCs tend to establish industries that are more appropriate and use more appropriate product technology; MNCs from developed countries do not tend to do so. A two-stage transfer of technology also implies that firms in LDCs modify the technology introduced from developed countries, thereby adapting it for use in the local situation. They subsequently transfer the technology to other LDCs (Parry 1981, Chen 1990).

[2] MNCs from Asian economies other than Japan tend to have higher foreign ownership shares, on average, in Indonesian manufacturing (Takii 2007).

In addition to the difference between LDCs and developed countries, characteristics of MNCs are expected to differ among developed countries. One important source of difference is the distance from home countries to the host country. The theoretical model of Rodriguez-Clare (1996) predicts that the linkage effects of MNCs on host economy are greater when the cost of communication between MNC parents and affiliates, which tends to increase with 'distance', is high because MNCs have an incentive to procure inputs in host countries,[3] which implies that the characteristics of MNCs differ by the origin of investors.

3. MNCs in large and medium manufacturing

3.1. Data

Investors' countries of origin can be an important issue when the volume of FDI and the activity of existing MNCs from particular countries or regions are expected to change. Notwithstanding, it is sometimes difficult to know the situation of FDI and MNCs in a developing economy, mainly because of a lack of data, especially that related to origins of investors. Indonesia is no exception. Data from the Investment Coordinating Board (*Badan Koordinasi Penanaman Modal*, BKPM) are most commonly used, and can be disaggregated by industry and country of origin. Another source is the balance of payment statistics from Bank Indonesia, but those data cannot be disaggregated. Several problems hinder collection of reliable data related to Indonesia's inward FDI from these sources (Lindblad and Thee 2007). In addition, although these sources are most reliable for flows of FDI, they are insufficient to examine the trend of MNCs' activities because the sources do not contain information on value added, change of employment, and other variables that are necessary for economic analyses.

The datasets that enable us to examine the activities of manufacturing plants are those from the industrial surveys (*Statistiki Industri Besar dan Sedang*) conducted by BPS-Statistics since 1975. The survey results are applicable to manufacturing plants with 20 or

[3] Javorick, Saggi, and Spatareanu (2004) examined the relationship between vertical spillovers and investors' nationalities using data for Romanian firms.

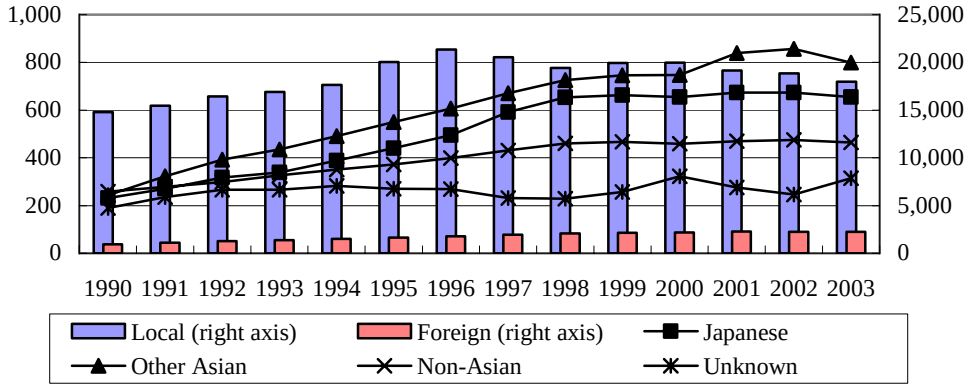
more workers (L&M manufacturing plants) including foreign-owned plants; the datasets are useful for economic analyses. However, the datasets contain no reliable information on the origin of foreign investors. Although the datasets contain information related to the main country of investors for each foreign-owned plant in a few years, the information seems insufficient, with many missing numbers.

Various sources including ownership information were first gathered to estimate the country of the ultimate beneficial owner and therefore to analyze the characteristics of foreign-owned plants by the origin of investors. The BPS-Statistics' Manufacturing Directory contains information related to the location, sectors, and employment, which are in general consistent with the two datasets (BPS-Statistics various years b). Furthermore, CIC data (2003, 2005) were useful to gather information related to the countries of investors for each firm. Toyo Keizai (various years) and JETRO (2005) data were used to identify Japanese-owned firms operating in Indonesia. For plants that were not described in these sources, various sources, including websites of companies, business organizations, and industrial estates were used. The datasets were then merged and the information from alternative sources with ownership information described above was aggregated to yield a useful panel dataset.

Consequently, a new dataset was constructed including information about the country of the ultimate beneficial owner for the foreign plants.[4] A foreign plant is defined as any plant with a foreign ownership share of 1% or greater when defining the country of the ultimate beneficial owner. If a Japanese firm ultimately controls a plant and the Japanese holding is the largest of known foreign holdings, the plant is defined as a Japanese plant. A similar methodology was applied to plants that are ultimately controlled by firms from Asian countries other than Japan (designated as *Other Asian plants*) and from non-Asian countries (designated as *Non-Asian plants*). Sufficient information related to owners for several plants was impossible to obtain. In such cases, educated guesses were made given the available information. However, several plants' owners were not identified. They were defined as *Plants with unknown ownership* if such plants reported positive foreign ownership shares.

[4] See Section 3 in Takii (2007) for more details of the constructed dataset.

Figure 1 Number of plants by group



Sources) Takii (2007), Fig. 2.

Figure 1 shows the number of plants by group. About 30 percent of foreign-owned plants were Japanese owned, indicating the great presence of the group in L&M manufacturing. The largest foreign group in terms of the number of plants is Other Asian plants, most of which were owned by MNCs of less-developed countries of eastern Asia, followed by Japanese plants, and Non-Asian plants. Using the new datasets, the analyses in this paper examine and compare the four groups of foreign-owned plants and a group of locally owned plants.

3.2. MNCs and related policies in Indonesian manufacturing

Substantial trade liberalization measures were initiated in 1985 in Indonesia (Pangestu 1996, p. 38). Customs deregulation and sweeping reductions of tariff and non-tariff barriers were implemented in 1985 and thereafter. Numerous other reforms were implemented during the period, when Indonesia first sought in earnest to promote non-oil exports to replace declining oil export revenues. These policy changes toward outward-looking policies from an import-substitution strategy played a key role in attraction of foreign firms that were export-oriented and labor-intensive. The late 1980s and early 1990s showed a surge in FDI from other Asian countries, mainly from Korea and Taiwan; most of the manufacturing projects were located in labor-intensive industries characterized by simple low-level technologies (Thee 1991). In addition to the reforms in the host countries, some incentives brought increased FDI on the investors' side. In the 1980s, when the Japanese Yen appreciated against the US dollar, Japanese companies that lost export competitiveness relocated operations to Asian countries, where wage levels were low. Similarly to MNCs of Japan, those of Korea, Taiwan, Hong Kong, and Singapore began to relocate operations to other

Table 1 Employment and value added in Japanese manufacturing MNCs

Period	1986-1989				1990-1996				1997-2003/2000			
Japanese/Non-Japanese	L	J	A	N	L	J	A	N	L	J	A	N
Employment (period average, percentage of total employment)									1997-2003			
Manufacturing	88	3	3	3	82	4	7	4	74	7	11	5
31 Food	93	0	2	3	92	1	3	3	89	1	4	4
32 Textiles	88	4	5	3	77	3	13	3	69	4	20	4
33 Wood/Furniture	90	1	5	1	90	1	6	1	87	2	7	2
34 Paper/Printing	92	2	4	2	87	2	8	2	82	3	13	1
35 Chemicals	84	3	3	6	81	5	3	8	75	9	6	9
36 Non-metallic mineral	89	3	1	6	87	5	2	6	82	7	5	6
37 Basic metal	75	13	5	7	72	16	5	5	67	18	8	5
38 Fab. Metal and machinery	79	11	2	6	67	16	6	6	49	30	11	7
39 Other manufacturing	92	5	1	2	61	5	21	5	48	5	29	12
Value Added (period average, percentage of total value added)									1997-2000			
Manufacturing	75	9	5	7	69	13	8	9	57	18	12	10
31 Food	87	1	4	6	85	1	5	8	78	2	8	11
32 Textiles	76	9	5	10	74	6	12	4	56	10	25	5
33 Wood/Furniture	85	1	9	1	80	1	14	1	80	2	14	2
34 Paper/Printing	78	2	17	3	71	4	17	7	76	7	15	2
35 Chemicals	71	7	5	11	60	11	5	21	48	19	7	24
36 Non-metallic mineral	68	10	2	18	66	10	3	20	59	15	10	16
37 Basic metal	72	23	3	1	73	18	4	4	48	38	7	5
38 Fab. metal and machinery	52	27	1	12	39	42	4	10	33	47	8	9
39 Other manufacturing	82	16	0	2	49	18	23	3	37	6	36	15

Notes) "L" refers to locally owned plants and "J", "A" and "N" refer to Japanese plants, Other Asian plants, and Non-Asian plants. Foreign plants with unknown ownership were excluded.
Sources) Author's estimates from BPS-Statistics (various years a)

lower cost countries, such as Indonesia, in response to increasing domestic wage levels and the appreciation of their own countries' currencies (Agrawal 2002).

The gradual relaxation or removal of restrictions related to FDI and other MNC activities since the late 1980s was an important reform that was accelerated in the early-1990s to mid-1990s, which is particularly important in the present context. For example, partial deregulation in 1992 formally allowed 100 percent foreign ownership for certain types of investments for the first time since the 1970s, while relaxing previous divestment requirements. Subsequently, a formal, more sweeping deregulation in 1994 removed restrictions on foreign ownership shares and minimum capital requirements, and further relaxed divestment requirements (Pangestu 1996, 2002). These policy changes explain, in part, why FDI increased more rapidly in the first half of the 1990s, especially from less-developed economies in the region. The surge in export-market-oriented FDI in the late 1980s and in the 1990s contrasts with the strong domestic orientation of 'older' FDI under the earlier highly protectionist trade regime (Thee 1991). The foreign firms in the 1970s were

Table 2 Labor productivity and capital intensity

(Percentage differentials from locally owned plants, %)

	Labor productivity			Capital intensity		
Period	1986-89	1990-96	1997-03	1988-89	1990-96	1997-03
Japanese plants (estimated coefficient*100)						
Manufacturing	153	117	138	113	146	172
31 Food	90	77	101	-	155	136
32 Textiles	79	89	86	162	168	113
33 Wood/Furniture	65	59	72	-	114	131
34 Paper/Printing	-	-	137	-	-	197
35 Chemicals	125	112	120	101	117	152
36 Non-metallic mineral	-	93	145	-	150	189
37 Basic metal	-	110	128	-	102	102
38 Fab. metal and machinery	124	114	114	128	139	149
39 Other manufacturing	-	59	120	-	-	156
Other Asian plants (estimated coefficient*100)						
Manufacturing	105[-]	77[-]	93[-]	92	92[-]	93[-]
31 Food	129	90	91	190	140	126
32 Textiles	36[-]	55[-]	77	102	69[-]	55[-]
33 Wood/Furniture	92	71	63	91	82	85[-]
34 Paper/Printing	-	71	79[-]	-	63[-]	(44)[-]
35 Chemicals	77[-]	86	94[-]	(43)	110	106[-]
36 Non-metallic mineral	-	-	65[-]	-	-	-
37 Basic metal	-	72	(32)[-]	-	111	46
38 Fab. metal and machinery	(47)[-]	69[-]	71[-]	79	72[-]	75[-]
39 Other manufacturing	-	49	54[-]	-	67	(4)[-]
Non-Asian plants (estimated coefficient*100)						
Manufacturing	133	142[+]	154	128	165	166
31 Food	103	123[+]	121	142	148	148
32 Textiles	57	66	74	182	126	90
33 Wood/Furniture	-	50	42[-]	-	57	35[-]
34 Paper/Printing	-	-	149	-	-	-
35 Chemicals	106	125	129	130	124	155
36 Non-metallic mineral	60	89	111	166	167	137
37 Basic metal	-	101	100	-	-	-
38 Fab. metal and machinery	111	89[-]	93[-]	117	107[-]	101[-]
39 Other manufacturing	-	68	110	-	103	107

Sources) Calculated from estimated coefficients. See sources in Table 1.

Notes) Results of plants with unknown ownership are not shown. The numbers within ( ) indicate that the coefficient on a corresponding dummy was not statistically significant at a 5% level. The signs within [ ] indicate that the differentials from Japanese plants were statistically significant at a 5% level (+: greater than that of Japanese; -: smaller). "-" indicates that the average number of sample plants per year was less than 5 (e.g., for 1986–1989, the average number of sample plants was less than 20 =5 × 4 years).

involved mainly in fields in which Indonesia did not have a comparative advantage: capital-intensive and technology-intensive projects. They generally enjoyed greater protection under the import-substitution strategy.

3.3. Comparisons of MNCs

A main characteristic of the Indonesian L&M manufacturing is that Japanese plants account for a large share in all value added; they also account for a considerable share in all employment. Since the mid-1980s, both shares of value added and employment in Japanese plants have increased rapidly (Table 1). Japanese plants had accounted for large shares of value added in the fabricated metals and machinery sector and in the basic metals sector in the latter 1980s. Corresponding shares of employment in these sectors were also high, but they were lower than that of value added. Shares of Japanese plants in the chemicals sector increased during 1986–2003/2000.

Another important trend is the surge in shares of plants owned by Asians other than Japanese. The share of employment of the group in all employment increased from 3 percent in 1986–1989 to 11 percent in 1997–2003; the corresponding share in all value added increased from 5 percent in 1986–1989 to 12 percent in 1997–2000. Surges in the employment share of other Asian plants mainly occurred in the textiles sector, the fabricated metals and machinery sector, and the paper and printing sector. On the other hand, the increases of corresponding shares of value added in these sectors were slower that those of employment, indicating that other Asian plants tended to have engaged in labor-intensive activities. The shares of non-Asian plants increased more slowly than those of Japanese and other Asian plants.[5]

Table 2 shows a comparison of the average labor productivity and capital intensity of locally owned plants and the three groups of foreign-owned plants. The table shows estimated coefficients in the following equation:

$$\ln Y_{it} = \alpha_0 + \alpha_1 DJ_i + \alpha_2 DA_i + \alpha_3 DN_i + \alpha_4 DU_i + \boldsymbol{\alpha DY} + \varepsilon_{it}, \quad (1)$$

where Y_{it} refers to labor productivity or capital intensity in plant *i* in year *t*. *DJ*, *DA*, *DN*, and *DU* are dummy variables that equal one, respectively, for Japanese plants, other Asian plants, non-Asian plants, and plants with unknown ownership. Therefore, the coefficient, α_1, can be interpreted as the percentage difference in *Y* between Japanese plants and local plants. Similarly, the coefficients, α_2, α_3, and α_4, respectively represent percentage differences of

[5] Takii (2007) compared various aspects of groups of foreign-owned plants.

corresponding groups of foreign plants from local plants. In the equation, **DY** is a vector of year dummies.

According to the results, each group of foreign-owned plants had higher average productivity and capital intensity than locally owned plants in all L&M manufacturing. In addition, of 66 cases in which labor productivity of locally owned plants and each group of foreign-owned plants were compared by sector, only two cases did not allow rejection of a hypothesis of equal labor productivity (indicated by parentheses: local versus other Asian plants in the basic metals sector during 1997–2003 and in the fabricated metals and machinery sector during 1986–1989). Similarly, each group of foreign-owned plants has higher capital intensity than locally owned plants in most sectors. In addition, most comparisons suggest that there are quite large differentials of both labor productivity and capital intensity between foreign-owned plants and locally owned plants. In 25 of 66 cases of labor productivity and 42 out of 59 cases of capital intensity, the differentials are of more than 100 percentage points.

Among groups of foreign-owned plants, average labor productivity and capital intensity of other Asian plants were, in general, smaller than those of Japanese and non-Asian plants in all L&M manufacturing (indicated by [-]; except Japanese versus other Asian plants in capital intensity during 1988–1989 and non-Asian versus other Asian plants in labor productivity during 1986–1989). These indicate that labor productivity and capital intensity depend on the stage of economic development in home economies, and/or that foreign-owned plants from neighboring less-developed economies tend to concentrate in labor-intensive industries. The former interpretation was supported by sectoral comparisons. Most comparisons between Japanese and other Asian plants suggest that other Asian plants have lower labor productivity and capital intensity than do Japanese plants. Particularly, the trend is clear in recent years. Similar trends are visible when comparisons are made between other Asian and non-Asian plants.

Statistically significant differentials were not observed in most comparisons of the two groups of developed economies. Most notable exceptions suggest that Japanese plants have higher labor productivity and capital intensity compared not only to other Asian plants but also to non-Asian plants in the fabricated metal and machinery sector.

4. Analysis of productivity spillovers

4.1. Statistical methodology for spillover analysis

This section statistically examines the magnitude of productivity spillovers derived by locally owned plants from each group of foreign-owned plants. Several empirical studies have been made of spillover effects, arising from foreign presence, on the productivity of local firms or efficiency in an industry. Most frameworks used for these statistical analyses are based on the conjecture that technical innovations are diffused most effectively from foreign firms to local firms when there is personal contact between them (Findlay 1978). Accordingly, in the empirical models, it has often been assumed that the extent of spillovers is proportional to foreign presence, which is, for example, measured as a foreign share of all employment in an industry.[6] In sum, the higher the foreign share in an industry, the more local firms have the opportunity to contact with persons who are engaged with foreign affiliates; consequently, local firms can better raise their productivity or efficiency because they can efficiently copy technologies transferred to the foreign affiliates. Therefore, statistical studies of spillovers generally estimate a production function with a technology level index that is assumed as a function of foreign share variables and others. The coefficient on the variable, which is often measured as the share of employment engaged in foreign affiliates in all employment of an industry, is considered as the magnitude of spillovers. A coefficient that is significant and positive suggests the existence of positive spillover effects.

The following simple model is first estimated to compare the magnitude of spillovers by a group of investors' countries of foreign plants.

$$\begin{aligned}\ln V_{it} = {} & \mu_i + \eta_t + \alpha_J FsJ_{it} + \alpha_A FsA_{it} + \alpha_N FsN_{it} + \alpha_U FsU_{it} \\ & + \alpha_2 \ln(\ln L_{it} - \overline{\ln L}) + \alpha_3 (\ln K_{it} - \overline{\ln K}) \\ & + \alpha_4 \ln(\ln L_{it} - \overline{\ln L})^2 + \alpha_5 (\ln L_{it} - \overline{\ln L})(\ln K_{it} - \overline{\ln K}) + \alpha_6 (\ln K_{it} - \overline{\ln K})^2 + \varepsilon_{it}.\end{aligned} \tag{2}$$

Therein, V_{it} represents the value added for plant i in year t, which is deflated by the wholesale price index, which appears to be appropriate for each three-digit ISIC classification. The number of workers and capital stock are denoted respectively by L and K. Capital stock is

[6] Early empirical analyses of spillovers were undertaken by Caves (1974), Globerman (1979), and Blomström and Persson (1983).

also deflated by price deflators.[7] The upper bars on ln L and ln K respectively denote the average of ln L or ln K over the sample observations in a regression. Consequently, eq. 2 is a translog production function with an intercept of sum of μ_i, η_i, $\alpha_J FsJ$, $\alpha_A FsA$, $\alpha_N FsN$ and $\alpha_U FsU$. The *FsJ* refers to the share of employment engaged in Japanese plants in all L&M manufacturing. In addition, *FsA*, *FsN*, and *FsU* respectively correspond to shares of other Asian plants, non-Asian plants, and plants with unknown ownership. The coefficients of these four variables can be interpreted as the magnitude of spillovers derived from corresponding groups of foreign-owned plants. If these coefficients are equal, eq. (2) is a widely used estimation model for the case in which the origin of investors is not distinguished. The μ_i is an individual effect, as estimated using the panel technique. The η_i is a year-specific effect, as estimated using year dummies. The equation was estimated using a sample of locally owned plants, for which at least three observations were available during the period for the regression.

4.2. Comparison of spillovers to locally owned plants

The first two columns of Table 3 show the between-estimates of eq. 2. In the equation shown on the first column, the coefficients for *FsA*, *FsN*, and *FsU* were assumed to be equal; and the sum of *FsA*, *FsN*, and *FsU* is the employment share of non-Japanese foreign-owned plants. The between-estimates are based on the regression of the individual mean over time without individual effect, μ_i. Results of between-estimates suggest that the employment share of each group of foreign-owned plants is positively correlated with the productivity level in locally owned plants after accounting for the volume of factor inputs. That result indicates that, compared to other locally owned plants, locally owned plants in industries where the foreign presence is large had higher productivity. Another interpretation is that foreign-owned plants tend to be situated in industries where locally owned plants have high

[7] Buildings, machinery and equipment, vehicles and other fixed capital were respectively deflated using wholesale indices for construction materials of buildings, imported machinery, transport machinery, and the general wholesale price index (BPS-Statistics, various years b); then the sum of the four categories was calculated as the measure of capital stock for each plant. In addition, because consistent data on capital stock in 1996 are not available, the capital stock in 1996 was interpolated using data for 1995 and 1997.

Table 3 Spillovers from foreign to local plants, 1990–2003, sample: local plants only

	Between	Between	Within	Within	Within
Column	[1]	[2]	[3]	[4]	[5]
Share of Japanese plants	1.309	1.377	0.807	0.813	0.679
	(17.72)	(17.76)	(7.93)	(7.93)	(6.11)
Share of non-Japanese plants	1.661	-	0.747	-	-
	(35.58)		(14.82)		
Share of Other Asian plants	-	1.776	-	1.225	1.149
		(17.17)		(15.91)	(13.40)
Share of Non-Asian plants	-	1.105	-	-0.030	0.039
		(8.99)		(0.18)	(0.21)
Share of unknown ownership	-	1.780	-	-0.026	-
		(5.59)		(0.18)	
ln [Labor]	0.809	0.804	0.869	0.869	0.853
	(102.53)	(101.28)	(99.31)	(99.33)	(84.92)
ln [Capital]	0.411	0.413	0.122	0.122	0.11
	(112.61)	(112.17)	(35.75)	(35.72)	(30.06)
ln [Labor]^2	-0.016	-0.016	-0.029	-0.029	-0.049
	(2.46)	(2.42)	(5.26)	(5.31)	(8.41)
ln [Labor] × ln [Capital]	-0.006	-0.008	-0.018	-0.017	-0.011
	(0.96)	(1.13)	(4.07)	(4.01)	(2.83)
ln [Capital] ^{2}	-0.003	-0.003	0.007	0.007	0.003
	(1.53)	(1.22)	(5.00)	(4.99)	(2.75)
Year Dummies	Included	Included	Included	Included	Included
Number of plants	22,551	22,551	22,551	22,551	22,551
Number of observations	-	-	171,637	171,637	171,637
Adjusted R^2	0.855	0.855	0.896	0.896	0.896

Notes) *t*-statistics within parentheses are based on White's adjustment for heteroskedasticity
Sources) See sources in Table 1.

productivity. Based on the latter interpretation, other Asian plants tend to be situated in more productive industries than are Japanese and non-Asian plants, as indicated by the rejections of hypotheses of equal coefficients between *FsA* and *FsJ* and between *FsA* and *FsN* at a one-percent significance level. The results also suggest that Japanese plants tend to be situated in more productive industries than are non-Asian plants, as indicated by rejection of the corresponding hypothesis.

The within-estimates (or fixed effect model) can resolve another question of where the productivity level in locally owned plants increases when the foreign presence increases. Hausman tests were rejected. For that reason, the last three columns of the table show within-estimates of eq. 2. The results suggest that coefficients of both shares of Japanese plants and non-Japanese plants were significant and positive. This result is consistent with previous studies of productivity spillovers in Indonesian manufacturing by Blomström and Sjöholm

(1999), Sjöholm (1999), Takii (2005), and Todo and Miyamoto (2006).[8] ; The hypothesis test of equal coefficients was not rejected at a five-percent level. However, the results shown in column 4 suggest that the magnitude of productivity spillovers depends on the foreign investors' region of origin. According to the result, productivity spillovers derived from Japanese plants and other Asian plants were significant and positive, but those from non-Asian plants and plants with unknown ownership were not statistically significant. Furthermore, the test of the null hypothesis of equal coefficients suggests that the magnitude of the spillovers from other Asian plants was greater than that of Japanese plants (at a one-percent level). Their main results were confirmed when *FsU* was omitted from the regression (column 5).[9] Therefore, the results shown in Table 3 indicate that the existence of Japanese and other Asian plants tended to affect the productivity in local plants positively during 1990–2003. Especially, the effect of other Asian plants was large. The result also indicates that productivity spillovers derived from Japanese plants were larger than those from the group of non-Asian plants, which mainly includes technologically advanced countries other than Japan.[10]

4.3. Before and after the crisis

The magnitude of spillovers is partially dependent on the environment surrounding both foreign and local firms. During the period analyzed here, some important changes occurred in the environment. One change is the economic crisis of 1997–1998. High economic growth before the crisis was a cause and result of the rapid increase of inward FDI and the acceleration of foreign firms' activities in manufacturing. However, the economy was

[8] Blomström and Sjöholm (1999) and Sjöholm (1999) used cross-sectional data in 1980 and 1991. Takii (2005) and Todo and Miyamoto (2006) used panel data for the periods of 1990–1995 and 1994–1997, respectively.

[9] The correlation coefficient calculated using all sample observations was 0.70 between shares of other Asian plants and foreign plants with unknown ownership. However, the result suggests that the estimation was not affected by multicollinearity. The correlation coefficients for other combinations of foreign shares were less than 0.3.

[10] The magnitude of spillovers derived from Japanese plants was also larger than that of foreign plants with unknown ownership, which might include foreign plants owned by investors from other advanced countries.

Table 4 Spillovers from foreign to local plants for 1990–1996 and 1997–2003

Period	1990-1996		1997-2003	
Column	[4a]		[4b]	
Share of Japanese plants	1.217	(5.52)	0.715	(6.13)
Share of Other Asian plants	1.555	(10.59)	0.813	(8.96)
Share of Non-Asian plants	0.094	(0.31)	-0.305	(1.56)
Share of unknown ownership	0.157	(0.68)	0.426	(2.20)
ln [Labor]	0.848	(68.01)	0.811	(56.25)
ln [Capital]	0.122	(24.48)	0.096	(18.04)
ln [Labor]^2	-0.038	(5.08)	-0.040	(4.87)
ln [Labor] × ln [Capital]	0.007	(1.18)	-0.033	(5.32)
ln [Capital]^2	0.001	(0.62)	0.011	(4.68)
Year Dummies	Included		Included	
Number of plants	15,626		14,142	
Number of observations	83,800		77,299	
Adjusted R^2	0.917		0.897	

Notes) *t*-statistics within parentheses are based on White's adjustment for heteroskedasticity
Sources) See sources in Table 1.

severely affected by the crisis: economic growth rates were lower those of the pre-crisis period. A putative cause of low economic growth has been low FDI. The sluggish demand would affect the performance of local and foreign plants and their mutual relationship. For example, some foreign plants might start production of intermediate products that had been previously produced by and procured from local firms in response to the decreased demand. Therefore, the spillovers might be impeded. In addition, movements toward economic integration would also change the procurement system of intermediate products and would affect the magnitude of productivity spillovers.

The model shown in column 4 in Table 3 was estimated using data for two sub-periods to elucidate the difference in the magnitude of spillovers in Indonesian manufacturing before and after the economic crisis. Columns 4a and 4b of Table 4 respectively show regression results for 1990–1996 and 1997–2003. For both periods, the coefficients for *FsJ* and *FsA* were significant and positive; the point estimates for the latter are greater than those for the former. However, the hypotheses of equal coefficients were not rejected, even at a ten-percent level. Comparing the results for the two periods, the coefficients for *FsJ* and *FsA* were smaller for 1997–2003 than the coefficients for 1990–1996. The hypothesis tests of equal coefficients suggest that the magnitude of productivity spillovers from both Japanese and other Asian plants decreased during the period. Although the change in the magnitude might be temporary in the process of economic recovery or might be permanent under the liberalized trade regime, these results suggest that there existed positive productivity

Table 5 Interaction effects of spillovers

	Within	Within	Within
Period	1990-2003	1990-1996	1997-2003
Column	[1]	[2]	[3]
Share of Japanese plants	0.990	0.567	0.852
	(6.41)	(1.78)	(4.75)
Share of other Asian plants	0.382	0.804	0.159
	(3.58)	(3.49)	(1.15)
Share of non-Asian plants	-0.564	-0.050	-1.181
	(2.27)	(0.13)	(3.36)
Interaction of Japanese and other Asian plants	3.437	12.563	-0.310
	(2.61)	(4.44)	(0.21)
Interaction of Japanese and non-Asian plants	-7.913	-7.975	-2.188
	(4.39)	(1.81)	(1.01)
Interaction of other Asian and non-Asian plants	12.799	7.457	12.575
	(8.67)	(1.61)	(6.13)
$\ln L$, $\ln K$, $[\ln L]^2$, $[\ln L][\ln K]$, $[\ln K]^2$	Included	Included	Included
Year Dummies	Included	Included	Included
Number of plants	22,551	15,626	14,142
Number of observations	171,637	83,800	77,299
Adjusted R^2	0.896	0.861	0.897

Notes) *t*-statistics within parentheses are based on White's adjustment for heteroskedasticity
Sources) See sources in Table 1.

spillovers, but that the magnitude decreased after the economic crisis. Another difference that is apparent before and after the economic crisis is the coefficients for *FsU*, which was significant and positive for 1997–2003, indicating that some important foreign-owned plants were included in this group.

4.4. Interaction effects of productivity spillovers

The magnitude of productivity spillovers derived from a group of foreign-owned plants to locally owned plants can be affected by the presence of other groups. For example, increased production of vehicles by a group might increase the demand in aftermarkets of auto parts. The backward linkage effects can benefit not only locally owned plants but also other groups of foreign-owned plants. It remains unclear whether the presence of other foreign plants affects the magnitude of spillovers to locally owned plants positively or negatively. In some cases, productivity in locally owned plants might increase as a result of competition with other foreign-owned plants. In other cases, locally owned plants cannot benefit from the increasing demand. To examine interaction effects of foreign presence, eq. (2) was estimated using interaction terms of foreign share variables. For simplicity of analysis, the share of plants with unknown ownership, *FsU*, was omitted from the regression equation.

The estimation results shown in Table 5 suggest that the interaction terms of Japanese plants and other Asian plants were significant and positive for 1990–2003 and for 1990–1997, which indicates that the degree of productivity spillovers derived from Japanese plants (other Asian plants) increases with the presence of other Asian plants (Japanese plants). Similarly, interaction terms of other Asian and non-Asian plants were also significant and positive for 1990–2003 and for 1997–2003. On the other hand, the interaction term of Japanese and non-Asian plants, both of which are mainly from developed economies, was significant and negative for 1990–2003. These indicate that the combination of MNCs from developed and less-developed economies enhances the productivity spillovers from foreign-owned plants to locally owned plants. An interpretation is that developed countries' MNCs impart externality effects on companies engaging in labor-intensive activities, and that competition between local firms and less-developed countries' MNCs increased benefits from the externality. Nevertheless, the interaction term of Japanese and other Asian plants was not statistically significant for 1997–2003.

4.5. Benefits of spillovers among foreign plants

The foreign presence can benefit not only local plants but also other foreign plants through productivity improvement. A possible effect is agglomeration economies. For example, most Japanese plants are located in industrial areas in and near Jakarta, and on the Batam Islands. The increase in the share of Japanese plants can decrease transaction costs when Japanese firms transact with other Japanese firms. In addition, productivity spillovers can occur from foreign plants owned by investors from developed countries to foreign plants owned by investors from developing countries. The following model was estimated using data for all plants, including foreign plants, to examine productivity spillovers among foreign plants:

$$\begin{aligned}\ln V_{it} = \quad & \alpha_{jl} FsJ_{it} + \alpha_{jj} DJ_i \times FsJ_{it} + \alpha_{ja} DA_i \times FsJ_{it} + \alpha_{jn} DN_i \times FsJ_{it} \\ & + \alpha_{al} FsA_{it} + \alpha_{aj} DJ_i \times FsA_{it} + \alpha_{aa} DA_i \times FsA_{it} + \alpha_{an} DN_i \times FsA_{it} \\ & + \alpha_{nl} FsN_{it} + \alpha_{nj} DJ_i \times FsN_{it} + \alpha_{na} DA_i \times FsN_{it} + \alpha_{nn} DN_i \times FsN_{it} \\ & + \mu_i + \eta_t + \alpha_2 \ln(\ln L_{it} - \overline{\ln L}) + \alpha_3 (\ln K_{it} - \overline{\ln K}) \\ & + \alpha_4 \ln(\ln L_{it} - \overline{\ln L})^2 + \alpha_5 (\ln K_{it} - \overline{\ln K})^2 + \alpha_6 (\ln L_{it} - \overline{\ln L})(\ln K_{it} - \overline{\ln K}) + \varepsilon_{it},\end{aligned} \tag{3}$$

Table 6 Spillovers among foreign-owned plants

Column	[1]	[2]	[3]	[4]
Recipients	Local plants	Japanese	Other Asian	Non-Asian
Period: 1990–2003				
Share of Japanese plants	0.779	1.360	1.327	2.712
	(7.27)	(3.40)	(2.88)	(4.59)
Share of Other Asian plants	1.158	2.341	2.308	2.697
	(15.35)	(3.52)	(6.40)	(4.01)
Share of Non Asian plants	-0.142	1.157	2.219	-0.132
	(0.83)	(1.11)	(2.36)	(0.12)
Number of plants: 23,097 Number of observations: 170,550 Adjusted R^2: 0.906				
Period: 1990–1996				
Share of Japanese plants	1.123	1.530	2.077	4.467
	(5.11)	(2.39)	(1.24)	(2.78)
Share of Other Asian plants	1.501	2.725	2.651	3.267
	(11.04)	(2.14)	(3.97)	(3.11)
Share of Non Asian plants	0.107	3.205	4.754	2.443
	(0.35)	(1.59)	(1.95)	(1.09)
Number of plants: 16,456 Number of observations: 88,052 Adjusted R^2: 0.923				
Period: 1997–2003				
Share of Japanese plants	0.676*	0.836	1.370	2.746
	(5.83)	(1.34)	(2.56)	(3.12)
Share of Other Asian plants	0.853**	1.148	1.019**	0.932*
	(9.89)	(1.30)	(2.43)	(0.99)
Share of Non Asian plants	-0.277	-1.409**	-0.384*	-1.818*
	(1.42)	(1.18)	(0.33)	(1.74)
Number of plants: 15,110 Number of observations: 82,311 Adjusted R^2: 0.906				

Notes) *t*-statistics within parentheses are based on White's adjustment for heteroskedasticity
Sources) See Table 1 sources. "*" and "**" respectively denote that the null hypothesis was rejected that the coefficient equals the corresponding coefficient for 1990–1996 at a 10 percent or 5 percent level.

where *DJ*, *DA*, and *DN* are dummy variables which respectively equal one if a plant is a Japanese plant, other Asian plant, and a non-Asian plant. The coefficients α_{xy} (x, y=J, A, N, L) can be interpreted as the magnitude of spillovers from a group of foreign plants to other groups of plants.

Table 6 summarizes the estimation results of α_{xy} (x, y=J, A, N, L). Results of the whole period suggest that the existence of Japanese plants derives productivity spillovers, not only to local plants but also to other foreign plants including other Japanese plants. Similarly, the results suggest that other Asian plants also impart spillovers to other foreign-owned plants. These results indicate that foreign plants owned by Asian investors contributed to productivity improvement in Indonesian manufacturing, thereby imparting externalities on other plants. On the other hand, the coefficients related to the shares of Non-Asian plants were not significant, with one exception: α_{na}. That fact suggests that, in general, no productivity spillovers were derived from the group to other groups of foreign plants.

Results of estimation by period suggest that Japanese plants benefited from other Japanese plants in the group of Japanese plants and other Asian plants during 1990–1996. However, the results for the latter period suggest that these positive effects disappeared in a statistical sense. On the other hand, the effects from Japanese plants to other Asian plants turned to be significant and positive in 1997–2003, which indicates the consistency of the interpretation described in the previous subsection. Similarly, with the effects on the productivity in local plants, the magnitude of the externality among the foreign groups decreased after the economic crisis for some cases. These results indicated that the benefit for foreign plants operating in Indonesian manufacturing was decreased in terms of externalities derived from and within the foreign groups.

5. Discussion and concluding remarks

Using the newly constructed database, this paper has described the effects of intra-regional FDI on the performance of locally owned plants. Several implications were derived from the analyses. First, results of analyses confirmed that Japanese MNCs have accounted for large shares of employment and value added in Indonesian large and medium manufacturing, which amount to more than the combined shares of non-Asian countries' MNCs. Results also confirmed that the presence of eastern Asian less-developed countries' MNCs has increased drastically since the mid-1980s. These suggest that intra-regional inward FDI, including that from Japan, has contributed greatly to manufacturing growth in Indonesia because the remarkable economic growth in the country was a cause and consequence of the increased inward FDI during recent decades.

Second, eastern Asian less-developed countries' MNCs show several characteristics that differ from those of MNCs from developed countries. The results of analysis suggest that the level of labor productivity and capital intensity in foreign MNCs depends on the stage of economic development in home economies. Labor productivity and capital intensity of eastern Asian less-developed countries' MNCs were confirmed as lower in several industries than they were in developed countries' MNCs from Japan and non-Asian countries, which indicates that the activities by less-developed countries' MNCs differ from those of other

MNCs and are rather similar to those of locally owned plants, which are characterized as less technology-intensive and less capital-intensive.

The related third result is that productivity spillovers from eastern Asian less-developed countries' MNCs are stronger than those of developed countries' MNCs. This result is consistent with the results described by Kokko (1994) and Takii (2005), which suggest that the wider technological gaps between foreign and local firms decrease the magnitude of productivity spillovers. The result is also supportive of the view that the appropriateness of technology is an important determinant of productivity spillovers. Furthermore, technological similarity and product similarity foster higher competition, which might force local firms to enhance competitiveness. The result also supports the movement to regionalism in eastern Asia, which would promote intra-regional FDI.

Fourth, the results of analyses also suggest that Japanese MNCs imparted positive productivity spillovers to local firms whereas non-Asian developed countries' MNCs did not have significant effects. Although the magnitude of spillovers derived from Japanese MNCs was smaller than that of less-developed countries' MNCs in the region, the results suggest that Japanese MNCs contribute to the development of the manufacturing sectors in terms not only of growth of employment and value added but also in terms of external effects on productivity in local firms.

Fifth, a more important implication is that these effects of FDI have synergistic effects. In other words, productivity spillovers were enhanced when both developed and less-developed countries' MNCs existed in an industry. The results of empirical analyses, for example, suggest that the magnitude of spillovers from eastern Asian less-developed countries' MNCs was positively correlated with the presence of Japanese MNCs during 1990–1996. Furthermore, the average productivity level in eastern Asian less-developed countries' MNCs was also correlated with the presence of Japanese MNCs. The effect in the opposite direction was also confirmed. These indicate the importance of the existence of developed countries' MNCs, as well as less-developed countries' MNCs, for economic development. Assuming that neighboring countries of a less-developed country are generally less developed, regional agreement on FDI would benefit member countries through productivity spillovers. However, the results presented in this paper also suggest that productivity spillovers are enhanced by the presence of developed countries' MNCs.

Finally, although it is difficult to interpret the results now, the results of analyses suggest that the magnitude of positive effects from foreign-owned plants decreased after the economic crisis. An interpretation is that the results for aftermath of the economic crisis do not reflect the relationship between foreign presence and productivity in local firms, or that the magnitude of productivity spillovers depends on the economic condition. Another interpretation is that the characteristics of foreign-owned plants have changed in the movement toward trade liberalization, including tariff cuts, and the change caused the decrease on the magnitude of spillovers. However, data for longer periods are necessary to examine the causes of the decline in the magnitude of spillovers.

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