Multinationals, Technology Upgrading, and Wages in Urban and Rural Indonesia

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Abstract

The purpose of this paper is to examine whether foreign direct investment has an effect on regional disparities in a developing country. For this purpose, the paper compares the magnitude of productivity and wage spillovers derived from a foreign presence to local firms in different locations. Using plant-level panel data for Indonesian manufacturing in 1990–95, the study finds supporting evidence for the hypotheses that the effects of a foreign presence on the level and growth of productivity and wages in locally owned plants are greater in regions where multinational corporation affiliates tend to have a higher concentration as compared to other regions in the same province. These findings indicate that the productivity and wage spillovers occur locally and diffuse to neighboring regions in part and thus that the concentration of foreign direct investment in a certain region imparts a greater positive externality on one hand and negatively affects regional disparities on the other.

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Keywords: FDI; Spillover effects; Regional disparity; Indonesia

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1 Introduction

Intra-country regional disparities are growing concerns in some developing East Asian countries that experienced rapid economic growth during the last two decades. In most of these countries, foreign direct investment (FDI) played an important role in the process of economic development. It is theoretically recognized that inward FDI has a positive effect on industry-level productivity or efficiency, as well as wage bills in host developing countries. However, the extent of the effects on the performance of local firms differs across industries and location. As noted in Hill (2002), rapid economic growth is inevitably uneven in its subnational impacts; some regions, which are usually those with better connections to the international economy, grow faster than others. This indicates that the recent movement of globalization or FDI is capable of widening intra-country regional disparities.

There are theoretically several channels through which FDI affects host economies. For example, FDI can raise the average wages in host countries through additional accumulation of capital stock and a rise in the marginal product of labor. Among other channels, the external effects derived from the foreign presence have been thought to be especially important because MNC affiliates are considered to have distinct characteristics that differ from that of local firms. One effect is that the entry of MNC affiliates can disturb the existing market equilibrium and force local firms to take action to protect their market shares and profits (Blomström and Kokko, 1997). Another is that MNCs are generally thought to possess firm-specific proprietary assets that are usually inaccessible in formal markets due to imperfect markets for technology. The transfer of such knowledge to affiliates in host economies is one of the important channels of international diffusion of sophisticated technology and skills. This enables local firms to more quickly imitate new production methods and management practices used in MNC affiliates. Thus, the presence of such MNC affiliates can cause productivity gains and/or a rise

in wages of local firms in the host countries. These indirect effects are referred to as productivity or wage spillovers in the literature.

Moreover, when there is personal contact between those who already have knowledge of the innovation and those who eventually adopt it, technology and skills can be diffused or copied efficiently (Findlay, 1978). This indicates that local firms that are situated near MNC affiliates can benefit more from the foreign presence. There are also other reasons for this expectation.[1] For example, local managers and engineers may resign and then use the knowledge obtained while working in the MNC affiliate for other projects. In this case, the managers and engineers are likely to work at local firms situated near the MNC affiliate. Another example is the case where local firms imitate production methods and management practices used in MNC affiliates. Such benefits are likely to be greater if local firms can closely observe MNC affiliates nearby. Therefore, FDI is capable of affecting regional disparities within a host country. This possibility is important because FDI tends to concentrate in certain regions in a developing country (this is discussed in the next section).

There are several studies examining the geographic aspects of productivity and wage spillovers. For example, Aitken and Harrison (1999) used plant-level data to examine the impacts on Venezuela's manufacturing industry in 1976–89. They failed to find empirical support for the hypothesis that productivity spillovers occur locally from foreign to locally owned plants. Girma and Wakelin (2000) used firm-level panel data for U.K. manufacturing and found evidence that productivity spillovers occur only to local firms that were in the same region as the foreign firms. Regarding wage spillovers, Driffield and Girma (2003) found similar evidence that wage spillovers from a foreign presence occur to local firms in the same region. A related study by Aitken et al. (1997) suggests that local exporting firms tend to locate in areas where foreign firms are concentrated. This indicates that local firms wishing to export can

[1] See Aitken and Harrison (1999), Girma and Wakelin (2000) and Aw and Palangkaraya (2004).

benefit from export spillovers from foreign firms.

The geographic aspects of spillovers in Indonesian manufacturing have also been examined.[2] A related study by Aw and Palangkaraya (2004) examined knowledge spillovers in Indonesian manufacturing industry. They conclude that knowledge spillovers are stronger among plants in the same sector and the magnitude decreases monotonically with geographical distance. On the other hand, Sjöholm (1999) examined productivity spillovers from a foreign presence at different levels of geographic aggregation using plant-level data for Indonesian manufacturing. The estimation results suggest that there exist positive intra-industry spillovers at the national level; however, he fails to find evidence for spillovers at the province and district levels. Summing up the results, he concludes that there is no advantage for locally owned plants that are situated near foreign-owned plants; that is, there is no geographic component in intra-industry spillovers from FDI.

This paper also examines the geographical aspects of spillovers from a foreign presence using plant-level data for Indonesian manufacturing. While Sjöholm (1999) used data for two years, 1980 and 1991, this paper used a panel dataset for 1990–95. The dataset provides the advantage of panel data. In addition, the methodology used in this paper is different from that of Sjöholm (1999). His analysis is conducted at the lowest level of geographic aggregation and does not account for the possibility that productivity spillovers diffuse to neighboring districts. This paper accounts for the possibility by assuming that a foreign presence at the province level has different effects on the performance of locally owned plants in two groups of districts within a province. For this

[2] Empirical findings that support the existence of positive spillovers in developing countries are very limited. According to a survey by Görg and Greenaway (2003), of the 40 studies investigated, only six studies using panel data and appropriate estimation techniques report evidence of productivity spillovers and none of these studies is for developing countries. However, there is some evidence of the existence of positive spillovers in Indonesian manufacturing. For example, the results of Takii (2005) supported the existence of positive productivity spillovers. Lipsey and Sjöholm (2005) provide a survey on productivity spillovers in Indonesian manufacturing.

purpose, the districts are grouped by the degree of foreign presence based on the number of foreign-owned plants.

Thus, this paper contributes to the literature by examining the relationship between productivity and wage spillovers on one hand and the location of locally owned plants on the other. In other words, the paper asks the question: can locally owned plants that are situated relatively near foreign-owned plants benefit more from the existence of them? The paper also looks to derive supporting evidence for the hypothesis. The paper starts by examining regional disparities and the presence of MNC affiliates in the Indonesian manufacturing industry. This is followed by a section that explains the methodology that is used in this study to examine the relationship between spillovers and location of locally owned plants. Section 4 reports the empirical results using a plant-level panel dataset for Indonesian manufacturing during 1991–95. The final section summarizes the results and offers some concluding remarks.

2 Regional disparity and presence of MNC affiliates in Indonesia

2.1 Economic growth and FDI in the manufacturing industry

FDI has played an important role in many of Indonesia's industries over the last three decades. The inflow of FDI has been both a cause and a result of the remarkable economic growth achieved during the 1990s until just before the economic crisis. For example, Indonesia's economy grew an average of 8.2 percent annually in 1988–96, while annual inflows of FDI increased from US$0.6 billion in 1988 to US$6.2 billion in 1996 (International Centre for the Study of East Asian Development (ICSEAD), 2005, 109–10). In particular, employment and production (value added) of manufacturing multinational corporations (MNCs) increased rapidly, both absolutely and relative to Indonesian totals, during the rapid economic growth of the early and mid-1990s (Takii and Ramstetter, 2005). The series of deregulations on FDI since the mid-1980s contributed to the increase of FDI thereafter. When the economy

was sluggish, partially due to the sharp decline in oil price in the mid-1980s, the government began to wrestle with the issue of FDI reforms as well as reforms of the trade regime and exchange rate management. These reforms mainly aimed to stimulate non-oil and gas exports and investment. In fact, the heart of the sharp recovery from the setback was the strong growth in non-oil and gas exports, particularly manufactures (Hill, 1997, 302–303). As a result, the share of manufacturing industry in nominal GDP steadily increased from 16 percent in 1985 to 27 percent in 1997 (ICSEAD, 2005, 107–108). It is thus clear that FDI has contributed significantly to economic development in Indonesian manufacturing industries.

2.2 Regional distribution of MNC affiliates

The increase of FDI inflows is reflected in the number of foreign-owned plants in the manufacturing industry. According to an estimate from the industrial surveys conducted by BPS-Statistics, Indonesia (hereafter BPS-Statistics), the number of foreign-owned plants with 20 workers or more increased from 588 in 1990 to 1,200 in 1995 and 1,747 in 2000 (BPS-Statistics, Indonesia, various years a). [3] As mentioned in the previous section, the greater presence of foreign-owned plants might have some impact on the performance of locally owned plants. However, the location of foreign-owned plants tends to have been concentrated in certain regions compared to the location of locally owned plants. To examine this tendency, the regencies/municipalities (hereafter districts) in which manufacturing plants existed are classified into two groups. [4] The first group includes districts where there existed at least ten foreign-owned plants in a year and another includes other districts. Hereafter in this paper, the former is referred to as *Region-U* and the latter is referred to as *Region-R*. The *Region-U* can be interpreted as being those regions where

[3] In this paper, foreign-owned plants are defined as plants with a foreign ownership share of 10 percent or more. See Section 3.4 for more detail of the dataset.

[4] Regencies/municipalities (*kabpaten/kotamadya*) are second-level administrative areas in Indonesia.

Table 1
Distribution of plants and employment in 1990, 1995 and 2000

Region	***Region-U***[a]			***Region-R***[a]		
Year	1990	1995	2000	1990	1995	2000
Number of districts	16	22	27	258	261	253
Number of plants	6,399	9,344	10,521	10,070	12,203	11,587
- foreign-owned	406	981	1,472	182	219	275
- locally owned	5,995	8,367	9,058	9,889	11,984	11,315
Number of employees (1,000 persons)	1,152	2,398	2,654	1,506	1,776	1,700
- in foreign-owned	180	611	787	95	122	144
- in locally owned	972	1,787	1,867	1,411	1,654	1,556

Note: a. *Region-U* is defined as those districts where there were ten or more foreign-owned plants, and *Region-R* is defined as other districts.
Source: Author's calculation from BPS-Statistics, Indonesia (various years a).

MNC affiliates tend to concentrate and thus there were a relatively large number of foreign-owned plants in these districts. According to the classification, only 16 of the 274 districts were classified as *Region-U* in 1990. In addition, these districts are mainly located in a few provinces (DKI Jakarta, West Java and East Java). In 2000, the number of districts classified as *Region-U* increased to 27 but was still small compared to the number of districts where locally owned plants existed.

Table 1 reports the number of plants and employment in each region. The sharp increase in the number of foreign-owned plants in *Region-U* is partially due to the spatiality of *Region-U*. However, it is apparent that foreign-owned plants tend to be concentrated in certain regions because the number of foreign-owned plants increased from more than 1,000 compared to the increase of 11 districts during 1990–2000. Moreover, employment in foreign-owned plants increased more than four times in *Region-U* while corresponding employment in *Region-R* increased about 50 percent during the period. There are several possible reasons for the concentration of foreign-owned plants in certain regions. One of the important factors is the development of industrial estates. Since private companies were allowed to develop industrial estates in

Table 2
Distribution of plants, employees and value added in 1990, 1995 and 2000

Region	***Region-U***[a]			***Region-R***[a]		
Year	1990	1995	2000	1990	1995	2000
Value added per employee[b]	6.009	8.891	12.400	5.627	6.179	7.068
- in foreign-owned	11.220	12.896	19.512	14.132	11.809	11.857
- in locally owned	5.046	7.521	9.403	5.056	5.764	6.625
Remuneration per employee[c]	1.851	2.343	2.549	1.419	1.481	1.709
- in foreign-owned	2.919	2.884	3.213	2.576	3.161	2.953
- in locally owned	1.653	2.157	2.269	1.341	1.357	1.594

Notes: a. See notes from Table 1. b. Value added (Rupiah millions) was deflated by the wholesale price index at a 3-digit Indonesian standard industrial classification from BPS-Statistics, Indonesia (various years b); calculated as the ratio of total value added to total number of employment. c. Remuneration (Rupiah millions) was deflated by consumer price index for whole country from BPS-Statistics, Indonesia (various years c); calculated as the ratio of total remuneration to total number of employment.
Sources: Same as Table 1; BPS-Statistics, Indonesia (various years b, c).

the end of the 1980s, the number of industrial estates has increased rapidly. There are 65 industrial estates developed by public and private companies (Investment Coordinating Board, Indonesia, 2005). Most of the large estates are located in West Java (including Banten), DKI Jakarta, Central Java and East Java. The development of these industrial estates contributed to the increase of FDI as firms were attracted to the simplified investment procedures and the requirement of lower infrastructure maintenance costs (Sato, 1999).

From the perspective of locally owned plants, *Region-U* can be interpreted as being regions in which they have more opportunities to interact with foreign-owned plants compared to other regions. The number of locally owned plants increased 50 percent in *Region-U* during 1990–2000, and employment in locally owned plants in *Region-U* also increased rapidly during the same period. In contrast, the increase in the number and employment of locally owned plants in *Region-R* was very modest. These facts indicate that locally owned plants also tended to locate in *Region-U* during the period. However, the number of plants was greater in *Region-R* compared to *Region-U* and most of the labor in locally owned plants are employed in *Region-R*.

Table 2 compares value added and remuneration per employee in each

Table 3
Employment and value added in locally owned plants by region and sector[a]

	Employment share of *Region-U*[b] (%)			**Value added share of *Region-U*[b] (%)**		
Year	1990	1995	2000	1990	1995	2000
31 Food, beverages, tobacco	17.7	29.6	29.1	15.3	31.7	37.4
32 Textiles, apparel, leather, footwear	55.5	69.3	68.4	61.3	74.4	77.9
33 Wood products, furniture	20.4	8.4	36.3	16.7	30.1	31.6
34 Paper prod., printing & publishing	52.5	64.1	65.8	56.7	70.6	78.4
35 Chemicals, rubber, plastics	50.8	63.1	65.6	44.1	58.9	66.6
36 Non-metallic mineral products	45.7	50.3	54.8	50.0	56.7	50.5
37 Basic metals	79.7	94.8	93.1	90.9	97.9	92.8
38 Metal products, machinery	67.0	79.9	75.6	78.7	91.5	86.2
39 Miscellaneous manufacturing	58.1	57.7	63.8	73.7	66.6	84.2

Notes: a. Sectors were classified based on 2-digit Indonesian standard industrial classification. b. See note from Table 1.
Source: Same as Table 1.

Region. Because the classification of *Regions* changes over time and the number of foreign-owned plants was relatively small, it is difficult to compare the performance of foreign-owned plants in *Region-U* and *Region-R*. However, from the table, it is clear that value added and remuneration per employee were higher in foreign-owned plants compared to locally owned plants in both *Regions*. Furthermore, value added and remuneration per employee tend to have been higher in locally owned plants in *Region-U* compared to *Region-R*. In particular, value added per employee in locally owned plants in *Region-U* grew faster compared to locally owned plants in *Region-R*. It is also worth noting that value added and remuneration per employee increased in locally owned plants in both *Regions* during the decade.

The distribution of employment and value added differ across sectors (Table 3). *Region-U*'s shares of employment vary from 18 percent for food, beverages and tobacco to 80 percent for basic metals in 1990. Employment in *Region-U* increased relatively rapidly in most sectors at the 2-digit classifica-

tion during 1990–2000. Similar trends can be seen in corresponding shares of value added for some sectors. In most of the combinations of year and sector, value added shares of *Region-U* are higher than that of *Region-R*. This indicates that productivity of locally owned plants in *Region-U* tend to have been higher than that of locally owned plants in *Region-R* within each sector.

3 Empirical methodology

3.1 Basic framework

As explained in the first section of this paper, personal contacts can facilitate the diffusion of technology and skills from MNC affiliates to local firms. This implies that a larger foreign presence is positively correlated with opportunities for locally owned plants to interact with foreign-owned plants. This interaction then facilitates the spread of sophisticated technology and skills from MNCs to locally owned plants. This idea has been used in empirical models that examine the magnitude of spillovers. [5]

More explicitly, a production function of locally owned plants can be written in the following form:

$$Y = A(Fs, \boldsymbol{x})f(K,\, E), \tag{1}$$

where Y is the value added of a locally owned plant, K is capital stock and E is the labor employed in the locally owned plant. The parameter A (hereafter referred to as a production shift factor) is a function of Fs, which is a proxy for the foreign presence and is measured as the share of labor employed in foreign-owned plants in the industry (and region). The vector $\boldsymbol{x}$ includes all other factors that affect productivity. Assuming a Cobb-Douglas production

[5] Caves (1974), Globerman (1979) and Blomström (1986) are the pioneer works in the empirical literature. Görg and Greenaway (2003), Hanson (2001) and Lipsey (2004) provide a comprehensive survey on productivity and wage spillovers.

function or log-linearizing, Eq. (1) yields:

$$\ln Y = C + \alpha_1 Fs + \boldsymbol{\alpha x} + \alpha_2 \ln K + \alpha_3 \ln E. \tag{2}$$

If the coefficient on the foreign share variable, α_1, is significantly positive, it can be interpreted that there exists positive productivity spillovers.

In addition, a foreign presence can affect wage levels in locally owned plants through the change in the production shift factor. In equilibrium in the labor market, the wage level is equal to the marginal revenue product of labor. From the production function in Eq. (1) and the labor market equilibrium condition, the wage level can be expressed as follows:

$$W = P_w \times A(Fs, \boldsymbol{x}) f_E(K,\, E(W)), \tag{3}$$

where W is the nominal wage level, P_w is the price of output and $E(W)$ is the labor supply curve. After log-linearizing, the reduced form of Eq. (3) can yields: [6]

$$\ln W = C' + \beta_1 Fs + \boldsymbol{\beta x} + \beta_2 \ln K + \beta_3 \ln P_w. \tag{4}$$

If the coefficient on the foreign share variable, β_1, is significantly positive, it can be interpreted that there exists positive wage spillovers.

3.2 Spillover effects on level

To examine regional differences in the extent of productivity and wage spillovers using the analogy explained above, a dummy variable, *Dur*, is introduced in Eq. (2) and Eq. (4). The variable, *Dur*, is equal to one if locally owned plants are located in districts where there were at least ten foreign-owned plants (i.e., *Region-U*); otherwise the dummy value was given a value of zero. In addition, to control for other production shift factors, plant-specific time-invariant factors (α_i and β_i), year-specific factors ($\boldsymbol{Dye}$) and industry-

[6] See Aitken, Harrison, and Lipsey (1996, 348–49) for more details on the derivation of the reduced form.

specific time-invariant factors (***Din***) are included in the estimated models, as well as plant-specific time variant factors. Taking all this, Eq. (2) and Eq. (4) are specified as follows:

$$\begin{aligned}\ln Y_{ijpt} = {} & \alpha_i + \alpha_1^U[Fs_{jpt} \times Dur_{ijp,t-1}] + \alpha_1^R[Fs_{jpt} \times (1 - Dur_{ijp,t-1})] \\ & + \alpha_s \ln Siz_{ijp,t-1} + \alpha_E Dex_{ijpt} + \alpha_M Dim_{ijpt} + \alpha_N Rnp_{ijpt} \\ & + \boldsymbol{\alpha_Y Dye} + \boldsymbol{\alpha_I Din} + \alpha_2 \ln K_{ijpt} + \alpha_3 \ln E_{ijpt}, \end{aligned} \tag{5}$$

$$\begin{aligned}\ln W_{ijpt} = {} & \beta_i + \beta_1^U[Fs_{jpt} \times Dur_{ijp,t-1}] + \beta_1^R[Fs_{jpt} \times (1 - Dur_{ijp,t-1})] \\ & + \beta_s \ln Siz_{ijp,t-1} + \beta_E Dex_{ijpt} + \beta_M Dim_{ijpt} + \beta_N Rnp_{ijpt} \\ & + \boldsymbol{\beta_Y Dye} + \boldsymbol{\beta_I Din} + \beta_2 \ln K_{ijpt} \\ & + \beta_3 \ln Wpi_{w,jt} + \beta_4 \ln Cpi_{c,pt}, \end{aligned} \tag{6}$$

where subscripts i, j, p and t denotes plant, industry, province and year, respectively. Fs_{jpt} is the share of labor employed in foreign-owned plants relative to total employment in industry j, province p and year t. The interaction term, $[Fs_{jpt} \times Dur_{ijp,t-1}]$, captures the spillover effects for locally owned plants that were located in *Region-U* in the previous year, while $[Fs_{jpt} \times (1 - Dur_{ijp,t-1})]$ captures the corresponding effects for locally owned plants located in *Region-R*. Therefore, we can examine the difference in the magnitude of spillovers across regions by comparing the magnitude of coefficients on these variables. Four variables are included as plant-specific time variant factors. One is plant size measured by output in the previous year ($\ln Siz$). Dummies (with a value of one) were also included if locally owned plants were exporting or importing (Dex and Dim). Exports and imports can be another important channel for international technology diffusion because exporting or importing plants can more easily access information on sophisticated technology through trading partners abroad compared to non-exporting and importing plants. Rnp is included as a proxy for skill level of labor. In the wage equation, $\ln Wpi$ captures the effect of a change in output price, and the logarithm of provincial consumer price index ($\ln Cpi$) is included because nominal wages can be

affected by inflation. [7]

3.3 Spillover effects on growth

The models in Eq. (5) and Eq. (6) examine the static effects of the foreign presence on levels of productivity and wage in locally owned plants. On the other hand, it is also important to examine the effects on growth of productivity and wage. To examine the dynamic effects, this paper also analyzes another specification in which the growth of the production shift factors, instead of level as in Eq. (3), is assumed as a function of foreign presence. Using this specification of the shift factors in Eq. (3) and totally differentiating after taking logarithm yields the following:

$$\begin{aligned}\Delta \ln Y_{ijpt} = {} & \alpha' + \alpha_1^{'U}[Fs_{jpt} \times Dur_{ijp,t-1}] + \alpha_1^{'R}[Fs_{jpt} \times (1 - Dur_{ijp,t-1})] \\ & + \alpha_1^{'0} Dur_{ijp,1990} + \alpha_s' \ln Siz_{ijp,t-1} + \alpha_E' Dex_{ijpt} + \alpha_M' Dim_{ijpt} \\ & + \alpha_N' Rnp_{ijpt} + \boldsymbol{\alpha_Y' Dye} + \boldsymbol{\alpha_I' Din} \\ & + \alpha_2' \Delta \ln K_{ijpt} + \alpha_3' \Delta \ln E_{ijpt} + \boldsymbol{\alpha_P' Dpr}, \end{aligned} \tag{7}$$

where Δ denotes first difference. Similarly, the growth version of Eq. (6) can be expressed as follows:

$$\begin{aligned}\Delta \ln W_{ijpt} = {} & \beta' + \beta_1^{'U}[Fs_{jpt} \times Dur_{ijp,t-1}] + \beta_1^{'R}[Fs_{jpt} \times (1 - Dur_{ijp,t-1})] \\ & + \beta_1^{'0} Dur_{ijp,1990} + \beta_s' \ln Siz_{ijp,t-1} + \beta_E' Dex_{ijpt} + \beta_M' Dim_{ijpt} \\ & + \beta_N' Rnp_{ijpt} + \boldsymbol{\beta_Y' Dye} + \boldsymbol{\beta_I' Din} + \beta_2' \Delta \ln K_{ijpt} \\ & + \beta_3' \Delta \ln Wpi_{w,jt} + \beta_4' \Delta \ln Cpi_{c,pt} + \boldsymbol{\beta_P' Dpr}. \end{aligned} \tag{8}$$

In those growth equations, plant-specific time-invariant factors cancel out. Instead, province dummies ($\boldsymbol{Dpr}$) are included to capture the difference in growth across provinces. Moreover, a dummy variable which has a value of one if plants locate in *Region-U* in 1990 ($Dur_{ijp,1990}$) is included in both

[7] It is worth noting that estimating the nominal wage equation expressed in Eq. (6) is equivalent to estimating a real wage equation because the estimated model is of a log-linear form. This is straightforward after subtracting *lnCpi* from both sides of Eq. (6). In addition, although provincial consumer price index captures changes over time, it does not capture differences across provinces. These differences in price across provinces can be accounted for by plant-specific factors (α_i and β_i).

equations. Foreign MNCs are naturally expected to locate affiliates in areas where there are location advantages such as well-managed infrastructures, low transportation costs and other social capitals that can affect productivity and wage growth. These advantages have the characteristics of public goods, and thus can impart externalities to not only foreign-owned plants but also locally owned plants. In order to partially distinguish the externality derived from the location advantages from spillover effects derived from the foreign presence on the growth of productivity and/or wages in locally owned plants, the dummy variable is included in the estimated models. Although this variable is included to try to capture the effects of location-specific time-invariant factors, it should be noted that it partially captures spillovers derived from the foreign presence as well because the variable is defined as based on the number of foreign-owned plants existing in the area. [8]

3.4 Data

The data examined in this paper were mainly taken from the raw datasets underlying industrial surveys. [9] BPS-Statistics has conducted the survey annually since 1975, and it covers manufacturing plants with 20 workers or more. In the regression analysis here, data for 1990–95 were mainly used. One of the main reasons for this is that consistent data for capital stock are available only from 1988, but the quality of data for 1988–89 is poor compared to other available years and data for 1996 is not available. In addition, Indonesian manufacturing was hit hard by the Asian economic crisis that began in 1997. To avoid capturing unusual factors during the crisis period, the sample was limited to the period 1991–95 (one-year lagged variables are included in the models). The unbalanced panel data analyzed here includes 33,513 observa-

[8] In the models in Eq. (5) and Eq. (6), the time-invariant effects of location advantages on productivity and/or wage levels can be captured by the time-invariant plant-specific factors (α_i and β_i).

[9] Data for provincial consumer price index and national wholesales price index were taken from BPS-Statistics, Indonesia (various years b).

tions for 6,831 locally owned plants that were active during the period. [10]

4 Comparison of productivity and wage spillovers

The models in Eq. (5) and Eq. (6) were estimated taking advantage of the panel dataset. Because Hausman tests were rejected at a 1 percent significance level for all models, the results of the least squares dummy variable (LSDV) estimation (or fixed effect estimation) are reported in Table 4. Column [1] shows the results of Eq. (5). Fsu and Fsr represent the interaction terms $[Fs_{jpt} \times Dur_{ijp,t-1}]$ and $[Fs_{jpt} \times (1 - Dur_{ijp,t-1})]$, respectively. The coefficients on both variables were significantly positive at the 1 or 5 percent level, respectively. These results indicate that there exist positive productivity spillovers. However, the magnitude of the coefficient on Fsu was greater than the corresponding coefficient on Fsr. The test of equal coefficient was rejected at the 1 percent significance level. In addition, Dur was also significantly positive. These results suggest that the magnitude of productivity spillovers is greater for locally owned plants which were situated relatively nearby foreign-owned plants (in *Region-U*) compared to other locally owned plants (in *Region-R*) after accounting for location-specific factors. Regarding other variables, the estimation results suggest that relatively large plants, exporting plants and importing plants have relatively high productivity. Column [2] in the table shows the estimation results of Eq. (5) with the assumption of constant return to scale. The adjusted R^2 was relatively low in Column [2], but the main results of Column [1] remained.

Column [3] reports the estimation results of Eq. (6). The coefficient on Fsu was statistically significant and positive while the coefficient on Fsr was

[10] Data on foreign ownership shares were modified in some cases. In the original dataset, for example, foreign ownership shares were 90 percent for all but one year in middle of the sample. Such entries were thought to be typographical errors and the foreign ownership share was modified to be 90 percent during the whole period in such cases. See Appendix in Takii and Ramstetter (2004) for further explanation of the data cleaning process.

Table 4
External effects on productivity and wage level by region (LSDV estimation, 1991–95)[a,b]

Column	**[1]**	**[2]**	**[3]**
Dependent variable	ln V	ln V/E	ln W
	Coef. (t-value)	Coef. (t-value)	Coef. (t-value)
Fsu (spillover effects for *Region-U*)	0.513 (4.81)***	0.484 (4.52)***	0.202 (3.19)***
Fsr (spillover effects for *Region-R*)	0.233 (2.12)**	0.238 (2.15)**	0.102 (1.60)
ln O_{t-1}(plant size measured by output)	0.129 (11.40)***	0.097 (8.70)***	0.055 (7.87)***
Dex (=1 if exporting)	0.070 (2.82)**	0.051 (2.01)**	-0.01 (0.62)
Dim (=1 if importing)	0.056 (2.20)**	0.042 (1.64)*	-0.00 (0.07)
Rnp (ratio of non-production worker)	0.019 (0.26)	0.060 (0.75)	0.206 (4.70)***
ln E (log of number of employment)	0.599 (23.46)***	-	-
ln K (log of capital stock)	0.081 (9.57)***	-	0.032 (5.22)***
ln K/E (log of cap. stock per employ.)	-	0.111 (12.53)***	-
ln Wpi (log of wholesales price index)	-	-	0.071 (1.51)
ln Cpi (log of consumer price index)	-	-	0.472 (1.75)*
Year dummies and Industry dummies	Included	Included	Included
Adjusted R squared	0.920	0.766	0.849
Number of observation	33,513	33,513	33,513
Test of Fsu=Fsr (p-value)	8.218 (0.00)***	6.248 (0.01)**	2.788 (0.09)*

Notes: a. *Region-U* is defined as districts where there were ten or more foreign-owned plants, and *Region-R* is defined as other districts. T-values are based on White's adjustment for heteroskedasticity (Davidson and MacKinnon, 1993, Ch. 16). b. ***, ** and * indicate significance at a 1%, 5% and 10% levels, respectively.

Table 5
External effects on productivity and wage growth by region (pooled OLS estimation, 1991–95)[a]

Column	**[1]**	**[2]**	**[3]**
Dependent variable	$\Delta \ln V$	$\Delta \ln V$	$\Delta \ln W$
	Coef.(t-value)	Coef.(t-value)	Coef.(t-value)
Fsu (spillover effects for *Region-U*)	0.135(2.97)**	0.079(1.65)*	0.048(1.76)*
Fsr (spillover effects for *Region-R*)	-0.03(0.73)	0.008(0.18)	0.038(1.39)
Dur (=1 if *Region-U* in 1990)	-	0.037(4.43)***	0.017(3.43)***
$\ln O_{t-1}$(plant size measured by output)	-0.05(20.82)***	-0.05(20.92)***	-0.01(7.48)***
Dex (=1 if exporting)	0.104(7.91)***	0.104(7.91)***	0.027(3.68)***
Dim (=1 if importing)	0.060(6.61)***	0.059(6.50)***	0.015(2.83)***
Rnp (ratio of non-production worker)	0.031(1.07)	0.032(1.11)	0.026(1.46)
$\Delta \ln E$ (log of number of employment)	0.560(22.17)***	0.560(22.15)***	-
$\Delta \ln K$ (log of capital stock)	0.064(8.51)***	0.064(8.52)***	0.030(4.97)***
$\Delta \ln Wpi$ (log of wholesales price index)	-	-	0.112(1.83)*
$\Delta \ln Cpi$ (log of consumer price index)	-	-	0.215(0.74)
Constant	0.647(12.07)***	0.655(12.22)***	0.199(5.33)***
Year, Industry, Province dummies	Included	Included	Included
Adjusted R squared	0.082	0.082	0.009
Number of observation	33,513	33,513	33,513
Test of Fsu=Fsr (p-value)	15.30(0.00)***	1.715(0.19)	0.127(0.72)

Notes: a. $\Delta X_t \equiv X_t - X_{t-1}$; also see notes from Table 4.

positive but not significant. These results suggest that there exist positive wage spillovers for locally owned plants that are relatively near foreign-owned plants, but the magnitude of the effects on locally owned plants that were relatively far from foreign-owned plants was negligible in a statistical sense. The positive coefficient on *Rnp* indicates that wages for non-production workers were relatively high compared to production workers.

The estimation results of Eq. (7) and Eq. (8) using pooled ordinary least squares (OLS) method are reported in Table 5. [11] In the case where *Dur* was omitted from the independent variables of Eq. (7) (Column [1]), the coefficient on Fsu was statistically significant and positive while the coefficient on Fsr was not significant. In addition, the hypothesis of equal coefficient was rejected at the 1 percent significance level. These results suggest that the dynamic effects of positive productivity spillovers exist only for locally owned plants situated relatively nearby foreign-owned plants. However, as mentioned in the previous section, the higher growth of production shift factors might be caused by not only the spillover effects derived from the foreign presence, but also location advantages. In the case where *Dur* was included as an independent variable (Column [2]), the coefficient on the variable was significantly positive, indicating that locally owned plants located in *Region-U* grew faster than other locally-owned plants. After accounting for this factor, the coefficient on Fsu was not significant at a 5 percent significance level, but was significant at the 10 percent level. The coefficient on Fsr remained insignificant. Although the hypothesis of equal coefficient was not rejected, these results weakly support the hypothesis that locally owned plants that are situated relatively near foreign-owned plants can benefit more from the foreign presence

[11] In order to account for possible plant heterogeneity in the growth of productivity and wages, these equations can be estimated using a panel dataset without location-specific time-invariant factors (*Dpr* and *Dur*). The hypothesis that plant-specific time-invariant factors (individual effects) are equal ($\alpha_i = \alpha$) was rejected in the estimated fixed effect model of Eq. (7). However, the main results of the fixed effect model remained in the estimation results reported in Table 5. The corresponding hypothesis for the wage equation in Eq. (8) was not rejected.

as compared to other locally owned plants. Similar results were obtained when the wage equations in Eq. (8) were estimated. In the estimated model without Dur (not reported), the coefficient on Fsu was significantly positive at the 1 percent level and the hypothesis of equal coefficient was rejected at the 5 percent level. In the estimated model with Dur (Column [3]), the coefficient on Fsu was significantly positive at the 10 percent level but the hypothesis of equal coefficient was not rejected.

5 Summary and concluding remarks

This paper examined the geographic aspects of productivity and wage spillovers in Indonesian manufacturing using plant-level data. The empirical results suggest that an increase in foreign presence causes productivity gains in locally owned plants. These external effects occur both to locally owned plants that are situated relatively nearby foreign-owned plants and to other locally owned plants in the same province and sector. However, the former can benefit more from the externality compared to the latter. Similarly, this paper found evidence that there exists positive wage spillovers and that the spillovers occur mainly in the districts where foreign-owned plants tend to be concentrated. In addition, this paper examined the effects of the foreign presence on productivity and wage growth in locally owned plants. Although the evidence is not strong, the empirical results suggest that growth rates of productivity and wages in locally owned plants in the districts where foreign-owned plants tend to be concentrated were positively correlated with the degree of foreign presence, while corresponding growth rates for other locally owned plants in the same province and sector were not correlated.

These results indicate that the presence of MNC affiliates does not negatively affect productivity and wages in locally owned plants and that the effects differ depending on whether the locally owned plants are situated in the same district and sector as foreign-owned plants. Therefore, in this respect, FDI is capable of affecting regional disparities while, at the same time, FDI can

facilitate economic growth. The evidence that emerges from the analysis has important implications for regional equality in Indonesia. As shown in section 3, FDI tends to be concentrated in a relatively small number of districts and the number of locally owned plants in these districts also increased. However, there are still many instances where there are locally owned plants in districts where there are none or a relatively small number of foreign-owned plants and thus the benefit from the foreign presence is small.

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