# THE SPILLOVER EFFECTS FROM FOREIGN DIRECT INVESTMENT (FDI) ON LABOR PRODUCTIVITY: EVIDENCE FROM INDONESIAN MANUFACTURING SECTOR

(*Efek Spillover dari Foreign Direct Investment (FDI) terhadap Produktivitas Tenaga Kerja: Studi pada Sektor Manufaktur Indonesia*)

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***Abstrak***

*Meskipun perhatian terkait manfaat foreign direct investment (FDI) terhadap produktivitas semakin berkembang, masih sedikit penelitian yang menguji pengaruh FDI spillovers terhadap produktivitas tenaga kerja pada perusahaan domestik di Indonesia. Penelitian ini bertujuan untuk melakukan tiga hal. Pertama, menguji pengaruh FDI spillovers terhadap produktivitas perusahaan domestik. Kedua, menginvestigasi dampak jangka pendek dan jangka panjang dari FDI spillovers terhadap produktivitas perusahaan domestik. Ketiga, menelaah lebih dalam dampak dari FDI spillovers terhadap produktivitas perusahaan domestik pada kelompok industri yang berbeda berdasarkan intensitas faktor produksinya. Penelitian ini menggunakan mikro panel data yang mencakup kurang lebih 20.000 perusahaan industri manufaktur sedang dan besar tiap tahunnya pada tahun 2010-2014. Hasil estimasi menunjukkan bahwa, di industri yang sama, horizontal spillovers memiliki pengaruh negatif terhadap produktivitas perusahaan domestik di jangka pendek namun positif pada jangka panjang. Hasil estimasi juga menunjukkan bahwa di industri yang berbeda, backward spillovers berdampak negatif terhadap produktivitas perusahaan domestik. Selain itu, FDI Spillovers memengaruhi produktivitas perusahaan domestik dengan lebih efektif ketika industri tersebut capital-intensive. Dengan demikian, hasil penelitian menunjukkan pentingnya mempertahankan perspektif jangka panjang terhadap perusahaan investasi asing di Indonesia, dan pemerintah perlu untuk menstimulasi kebijakan yang dapat meningkatkan kapasitas perusahaan domestik dalam memasok barang setengah jadi dan barang modal ke perusahaan asing di pasar hilir dengan cara memotong kesenjangan teknologi antara perusahaan asing dan domestik.*
***Kata kunci:*** *FDI spillovers, horizontal spillover, backward spillover, produktivitas tenaga kerja*

**Abstract**

Despite growing concern regarding the productivity benefits of foreign direct investment (FDI), few studies have been conducted on the impact of FDI spillovers on domestic firms' labor productivity in Indonesia. This study aims to do three things. First, it examines the effect of FDI spillovers on domestic firms' productivity. Second, it investigates the short-term and long-term effects of FDI spillovers on domestic firms' productivity. Third, it explores the impact of FDI spillovers on domestic firms' productivity in different groups of industries based on their factor intensity. Micro-level panel data covering about 20,000 medium and large manufacturing establishments in each year over the period 2010 and 2014 was employed. This study suggests that, within the same industry, horizontal spillovers are associated with domestic firms' productivity: this relationship is negative in the short-term but positive in the long-term. This study's findings also demonstrate that, across industries, there are negative backward spillover effects on domestic firms' productivity. In addition, this study points out that FDI spillovers affect domestic firms' productivity effectively when they are capital-intensive. Therefore, the results imply the importance of maintaining a long-term perspective toward foreign-invested firms in Indonesia and the government needs to stimulate policies that can enhance domestic firms' capacity to supply intermediate materials and capital to foreign firm in downstream market by truncating the technology gap between foreign and domestic firms.
**Keywords:** FDI spillovers, horizontal spillover, backward spillover, labor productivity

## INTRODUCTION

Attracting Foreign Direct Investment (FDI) is still an important goal in many developing countries. It is widely believed that FDI can improve the growth of the domestic economies of host countries because FDI accounts for an important source of capital inflows that is relatively stable compared to other capital flows. Policymakers expect that foreign-invested firms bring new technology, capital, and management expertise through their interaction with domestic firms which, in turn, lead to domestic firms' productivity improvements. Therefore, it is important to investigate how FDI spillovers improve the productivity of domestic firms.

In fact, although there is a considerable literature on the effect of FDI spillovers on host countries' productivity, the literature shows mixed findings. For example, Caves (1974) finds positive and significant spillovers in Canada and Australian manufacturing sector. Moreover, Rhee & Belot (1989) argue that the entry of foreign firms is largely responsible for creation and subsequent growth in domestic textile sector in Bangladesh. On the other hand, Haddad & Harrison (1993) find negative spillovers associated

with FDI in Marocco. Aitken & Harrison's (1999) study on Venezuela also finds foreign-invested joint ventures actually have negative effects on the productivity of domestic firms.

Regarding to these two contrasting evidences, Javorcik (2004) argues that these different conclusions result from researchers looking for FDI spillovers in the wrong places. Actually, FDI could provide both direct and indirect benefits. The direct benefits from foreign affiliates can take in the form of new investments, productive capacity, labor demand, intermediate goods demand and exports that stimulate national income or economic growth, and increase tax revenue (Hymer, 1960; Kokko & Blomstorm, 1997). On the other hand, the indirect effects of FDI on host countries are often called productivity spillovers (Kokko & Blomstorm, 1997; Lipsey & Sjoholm, 2005). Moreover, Javorcik (2004) points out that positive productivity spillovers are more likely to happen between vertically linked industries, rather than within the same industry sector. This happens because, in the same industry, multinational firms have an incentive to prevent knowledge leakage to domestic firms which is regarded as competitors, but may transfer technology to local suppliers to get higher quality inputs at lower prices. In other words, spillovers from FDI are more likely to be vertical than horizontal in nature. However, the effects of spillovers in these different channels aren't captured by the earlier studies.

Differentiating the effect of FDI spillover on firms' productivity in the short-term and long-term also plays an important role in the analysis. Because of the learning process from foreign-invested firms, it is possible that the spillovers have a negative effect on the productivity of domestic firms in the short run yet a positive effect on the productivity of domestic firms in the long run. In the context of endogenous growth model such as those presented in Lucas (1988) and Romer (1990), firm-specific capital is the engine of firm-specific productivity growth and the accumulation of such capital requires the investment process in terms of time and effort. In addition, Eeckhout & Jovanovic (2002) argue that technology transfer in the form of spillovers doesn't take place automatically and is a costly learning process. Hence, examining the short term effect and long term effect of FDI spillover on firms' productivity is necessary.

In the case of Indonesian manufacturing sector, Blalock & Gertler (2008) is the first study examining the effect of FDI spillovers on firms' productivity which distinguishes the spillovers into different channels. They find evidence of productivity gains among Indonesian firms supplying industrial sector with a large foreign presence. However, although using the same source of data, more recent studies in Indonesia such as Negara & Adam (2012) and Bloch *et al.* (2014) find that FDI spillovers increase firms' productivity in the same industry but negatively affect domestic firms in upstream industry. Applying a distinction between the short-term effect and long-term effect of FDI on the productivity of domestic firm as what Liu (2008) and Fujimaro & Sato (2015) done is expected can explain more about these mixed findings in Indonesia case. In fact, studies that describe the effect of FDI spillovers on firms' labor productivity with time-trend effect analysis are lacking; make it interesting to be examined further.

Regarding these problems, this study builds on the existing literatures, and by answering the research question "Do spillovers from FDI affect firms' labor productivity in Indonesian manufacturing sector?", this study aims to do three things. First, it examines the effect of FDI spillovers on domestic firms' productivity. It divides FDI spillovers into *horizontal* and *backward*. Second, it investigates the short-term and long-term effects of FDI spillovers on domestic firms' productivity. Third, it explores the impact of FDI spillovers on domestic firms' productivity in different groups of industries based on their factor intensity.

In the empirical analysis, this study estimates model using three types of panel regression models: POLS, REM, and FEM. In addition, following Liu (2008), the long–run spillover effect of FDI can be estimated by looking at coefficient of interaction term between FDI variables and time trend. Furthermore, to deepen the analysis, this study also estimates the impact of FDI spillovers on productivity of domestic firms in different groups based on their factor intensity, and compares the coefficient of FDI spillovers of each group.

This study contributes to the current empirical literature to determine whether the FDI leads to labor productivity gains in Indonesia manufacturing sector in the following respects. First, this study investigates the relationship between FDI spillover and firms' labor productivity via industry linkage. Meanwhile, most of the existing study on Indonesia has focused on the FDI benefit without distinguishing FDI spillovers into horizontal and vertical. Second, it estimates FDI spillovers across industries more precisely by defining all sectoral variables at five-digit industry level and using the latest I-O Table 2010 which is based on 185 sectors. Third, this study investigates the short-term and long-term effects of FDI spillovers on firms' labor productivity which, surprisingly, the literature relating to this issue is hardly found in Indonesia. Finally, this study uses more improved data representing more recent Indonesia manufacturing sector conditions.

This study is organized as follows: the second part describes the empirical methodology used in the study, the third part presents the empirical result and discussion and finally concludes with policy implications.

## METHOD

### *Empirical Model Specification*

The aim of this study is to examine whether the FDI spillovers affect the labor productivity of the domestic firms. Theoretically, the most general approach used is based on the production function. Labor productivity is derived from a simple production function with two factors of production, mathematically this theory can be expressed as follows:

$$Y_{ijt} = A_{ijt} K_{ijt}^{\alpha} L_{ijt}^{1-\alpha} \quad \text{..... (1)}$$

Where, $Y_{ijt}$ is level of output firm, $K_{ijt}$ is level of physical capital. $L_{ijt}$ is level of labor inputs firm and $A_{ijt}$ is the productivity level represent technology progress which varies across firms within each. Then, equation (1) can be written in a logarithmic form:

$$logY_{ijt} = logA_{ijt} + \alpha logK_{ijt} + (1-\alpha)L_{ijt} \quad \text{..... (2)}$$

and divided by labor $L_{ijt}$, re-arranged to get:

$$Log\frac{Y_{ijt}}{L_{ijt}} = logA_{ijt} + \alpha log\frac{K_{ijt}}{L_{ijt}} \quad \text{..... (3)}$$

Assuming that firms' productivity level is a linear function of technology spillovers because technology spillovers can take place due to foreign presence, we can define:

$$\log A_{ijt} = \beta_0 + \beta_1 hspill_{jt} + \beta_2 bspill_{jt} \quad \text{..... (4)}$$

Equation (4) postulates that total factor productivity $A_{ijt}$ is determined by a set of variables including horizontal spillover ($hspill_{jt}$) and vertical spillover, in this study, vertical spillover is disaggregated only into backward spillover ($bspill_{jt}$) because most multinational companies in Indonesia are export-oriented and generally do not supply to local firms' customers (Blalock & Gertler, 2008)[1]. Therefore, the focus is on technology transfer through backward spillover to measure the FDI spillover to local firms' supplier in upstream market.

Adopting empirical model by Fujimori & Sato (2015), one of important analyses in this study is to distinguish the effect of FDI spillover on firms' productivity in the short-term and long-term. According to Liu (2008), the long-run spillover effect of FDI can be estimated by the coefficient of interaction term of FDI variables and time trend.

Therefore, by combining equation (3) and (4), time trend, and other independent variables, we can construct the regression framework for estimating a firm's productivity as follows:

$$\ln\_lp_{ijt} = \beta_0 + \beta_1 time + \beta_2 hspill_{jt} + \beta_3 bspill_{jt} + \beta_4 hspill_{jt} * time + \beta_5 bspill_{jt} * time + \beta_6 ln\_k_{ijt} + \beta_7 ln\_abs_{ijt} + \beta_8 fsize_{ijt} + \beta_9 HHI_{jt} + u_i + \varepsilon_{ijt} \quad (5)$$

Where:

| | | |
|---|---|---|
| $\ln\_lp_{ijt}$ | : | labor productivity (value added/ labor) in rupiah. |
| *time* | : | time trend within sample. |
| $hspill_{jt}$ | : | horizontal spillover, the share of foreign establishment output over total outputs, in ratio, can be expressed as in Equation (6). |
| $bspill_{jt}$ | : | backward spillover, the weighted average output of foreign establishment in downstream industry, in ratio, is defined as in Equation (7). |
| $hspill_{jt} * time$ | : | adding interaction term *hspill* with time trend. |
| $bspill_{jt} * time$ | : | adding interaction term *bspill* with time trend. |
| $ln\_k_{ijt}$ | : | capital intensity (capital/labor), in rupiah. |
| $ln\_abs_{ijt}$ | : | absorptive capacity variable reflects skill of labor, proxy used: total labor expenditure, in rupiah. |
| $fsize_{ijt}$ | : | firm size, output firm *i* divided by total ouput in *j* sector, in ratio. |
| $HHI_{jt}$ | : | Herfindahl-Hirschman Index (HHI) represents level of market concentration, in ratio. |
| $\beta_0$ | : | the constant in intercept parameter estimation. |
| $\beta_1$ | : | the slope of time trend. |
| $\beta_2$ and $\beta_3$ | : | the slope capturing the effect of spillovers on the short-term level of productivity. |
| $\beta_4$ and $\beta_5$ | : | the slope capturing the effect of spillovers on the long-term level of productivity. |
| $\beta_6$ and $\beta_7$ | : | the slope of control variables. |
| $u_i$ | : | firm specific effect. |
| $\varepsilon_{ijt}$ | : | error/disturbance. |

*i* represents the firm, *j* represents sector, *t* represents the time period of 2010-2014.

[1] The same case also happens in the study of Indian Manufacturing Sector, only backward spillover is estimated (Fujimori & Sato, 2015).

This study estimates equation (5) with three types of panel regression models: POLS, REM, and FEM. Moreover, this study estimates the models which take one-year lagged FDI variables to deal with the simultaneous problem. In order to deepen the analysis, this study examines the effect of FDI spillovers on firms' productivity by categorizing the firms based on their factor intensity[2]. In addition, the coefficient of foreign presence measured in each panel is compared.

***Data and Variables Construction***

The main data of this study employed from the annual surveys of medium and large manufacturing establishments (*Survey Tahunan Perusahaan Industri Manufaktur*) conducted by the Indonesian Central Board of Statistics (*Badan Pusat Statistik or BPS*). The survey is designed to census and covers all manufacturing establishments[3]. These annual surveys cover a wide range of information from each surveyed establishment. The basic information includes founding year, industrial classification, location, ownership information, including foreign and domestic ownership, and production information such as gross output, value added, number of workers in production and non-production, fixed capital, material usage, and energy consumption. *Survey Tahunan Perusahaan Industri Manufaktur* has been conducted since 1975 and the most recent available data is 2014. Therefore, this study uses the data from 2010 to 2014. The number of original observations during selected period is 118,534 establishments which vary year by year with the minimum number of 23,345 establishments in 2010 and the maximum number of 24,529 establishments in 2014. Additionally, Input-Output (I-O) table 2010 is employed to measure supply-input interactions across industries. In order to apply this information to the dataset, BPS provides a concordance table from I-O commodity code to identity code of each firm or establishment[4].

In constructing a consistent data set, several adjustments are conducted. These adjustments consist of adjusting for industrial code, cleaning for noise and typological errors, back casting missing values of capital, and matching firm for a balanced panel. The balanced panel data are preferable in this study to remove the influence of a firm that appears only in one or two years. After the adjustments, the final balanced panel of data consists of 53,437 observations.

Descriptive statistics for the original data before the adjustment process and for the balanced panel data are provided. The original data consist of many establishments that do not report complete information on output, labor, capital, material, or energy. Especially fixed asset shows high variations year to year and many establishments report missing values or zero. Therefore, for original data, these establishments are excluded from the calculation of the descriptive statistics while the balanced panel data reports clean data used in regression process.

Table 1 shows that the minimum values of variables *ln_lp*, *ln_k*, and *ln_abs* for the original data are lower if compared to the minimum values of those variables from the balanced panel. This makes sense as the balanced panel data removes some observations during the adjustment process. The maximum values of those variables are higher in the original data compared to those in balanced panel data. Overall, the mean values of variables are higher in the balanced panel data compared to those in original data.

Furthermore, the minimum value and the maximum value of variables horizontal spillover (*hspill*) and backward spillover (*bspill*) are the same for the original data and for the balanced panel, as the calculation of these inter-industry variables is based on all firms in the original data as in Blalock & Gertler (2008). The mean values of these two spillover variables are higher in the balanced panel compared to those in the original data. From the descriptive statistics, it shows that there is no substantial bias in the adjustment process since there is no substantial difference in the maximum value, minimum value, mean value, and standard deviation.

***Measuring Variables***

The exogenous variables included in the models can be divided into main variables and other exogenous variables. The main variables are FDI spillover variables: horizontal spillovers (*hspill*), and backward spillovers (*bspill*). The other variables are capital intensity (k), absorptive capacity (abs), firm size (*fsize*) and the degree of market concentration (HHI). All the sectoral variables in this study are classified based on the five-digit industrial code (KBLI) and all calculations of their values are based on the

[2] Folllowing Hill, *et al.* (2010), two-digit KBLI manufacturing sub-sector can be aggregated into three categories of factor intensity: labor intensive, resource intensive and capital intensive.

[3] Establishments are the medium and manufacturing establishment employing at least 20 workers in every year. Based on BPS definition, large establishment is those engaging with more than 99 employees. Medium establishment is those engaging with 20-99 employees.

[4] I-O table is based on 185 products which BPS provides a concordance table of five-digit KBLI sub-sectors. The author did an adjustment from 185 products into 450 five-digit KBLI.

**Table 1**. Summary Statistics

| Variables | Original Data[a] | | | | | Balanced Panel Data | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. Obs | Mean | Min | Max | Std. | No. Obs | Mean | Min | Max | Std |
| Ln Labor Productivity (*ln_Lp*) | 111,933 | 10.64 | 6.91 | 20.04 | 1.37 | 53437 | 10.49 | 6.91 | 17.96 | 1.34 |
| Horizontal Spillover (*hspill*) | 111,933 | 0.28 | 0.00 | 1.00 | 0.24 | 53437 | 0.28 | 0.00 | 1.00 | 1.02 |
| Backward Spillover (bspill) | 111,933 | 1.92 | 0.00 | 10.48 | 1.65 | 53437 | 2.01 | 0.00 | 10.48 | 1.69 |
| Ln Capital Intensity (*ln_k*) | 65,876 | 9.86 | -6.72 | 22.33 | 1.83 | 53437 | 9.91 | -6.72 | 22.33 | 1.82 |
| Ln Absortive Capacity (*ln_abs*) | 111,933 | 14.06 | 7.15 | 22.38 | 1.89 | 53437 | 14.12 | 8.18 | 22.38 | 1.97 |
| Firm Size (*fsize*) | 111,933 | 0.01 | 0.00 | 1.00 | 0.07 | 53437 | 0.017 | $2 \times 10^{-8}$ | 1.00 | 0.07 |
| The HHI index | 111,933 | 0.03 | 0.01 | 0.79 | 0.04 | 53437 | 0.03 | 0.001 | 0.79 | 0.04 |

a. exclude: the establishments that do not report information on output, value added, labor, capital, noise, typological error, industrial code.

original observations. Furthermore, all variables in monetary term or rupiah are deflated with Producer Price Indices (PPI) published by BPS at constant rate 2010.

To capture the scope of FDI spillovers both horizontal and backward spillovers, defining foreign ownership is important. There are some different definitions of foreign ownership. Studies by Hill *et al.* (1995), Blomström & Sjöholm (1999), Ramstetter (1999), and Narjoko & Hill (2007) readily accept any positive amount of foreign ownership, while Haddad & Harrison (1993) consider firms with at least 5 percent equity owned by foreigners. The IMF (2004) and OECD (2009) definition of foreign firms is an incorporated enterprise in which a foreign investor owns 10 percent or more of their equity capital. The IMF and OECD definition are frequently the international threshold standard of foreign firm. Another study, Djankov & Hoekman (2000), consider the relevant threshold to be 20 percent. This study accommodates several thresholds of foreign assets percentages. All joint-venture companies with 5, 10, and 20 percent of foreign assets will be considered as foreign firms in this study.

Borrowing Blalock & Gertler (2008) formula, as a proxy for horizontal spillover, this study uses the following measure:

$$hspill_{jt} = \frac{\sum \text{foreign\_output}_{it}}{\sum \text{output}_{it}}, \text{ for all } i \text{ element of } j, \quad \ldots\ldots (6)$$

This variable measures the impact of foreign firms on domestic firms' productivity within an industry. It measures the degree of foreign presence (FDI) in sector *j* at time *t,* which is defined as foreign firms' output averaged over all firms output in a particular *j* sector.

FDI can also generate vertical spillovers through the linkage channel. As discussed before, because most multinational companies in Indonesia are export-oriented and generally do not supply to Indonesian customers, the focus of this study is only on technology transfer through backward spillover. And the next question is how specifically do we measure the share of industry *j*'s output, that is sold to foreign firms in year *t*? Blalock & Gertler (2008) demonstrate it that considering three industries: wheat flour milling, pasta production, and baking. They suppose that half of the wheat flour industry's output is purchased by the bakery industry and the other half is purchased by the pasta industry. Further, they suppose that the bakery industry has no foreign factories but foreign factories produce half of the pasta industry output. The calculation of downstream FDI for the flour industry would yield 0.25=0.5(0.0)+0.5(0.5).

Blalock & Gertler's calculation is well-represented in backward spillovers formula as follows:

$$bspill_{jt} = \Sigma_k b_{kl} * hspill_{jt}, \text{ for all } k \neq j, \quad \ldots\ldots (7)$$

Where $b_{kl}$ is the proportion of sector *k*'s output supplied to sector *l* (with FDI presence). $b_{kl}$ is established from Leontief inverse matrix coefficient of I-O table year 2010 which capture both direct and indirect (inter-sectoral) linkage. It shows the total units of output required, direct and indirectly, from all sectors when the demand for industry's product rises by one unit. In Equation (7), inputs supplied within the industry are not included, because the effects are already captured by horizontal spillovers.

An absorptive capacity is a critical factor in firms' ability to catch up with other firms at the technological frontier then will lead them to productivity improvements. They depend on the capability of the human capital in a recipient country. Hence, human capital plays a crucial role on absorptive capacity of host industries in which the foreign firms operate (Mastromarco & Ghosh, 2009).

The most appropriate indicator to assess human capital on the firms' productivity is the quality of the workers. Since the number of skilled workers is not available, Le & Pomfret (2011) argue that, total expenditure in labor can be used as a proxy for the human capital. This is based on the assumption that firms with higher average labor costs per-worker employ higher skilled-labor. Therefore, the total labor expenditure per-worker will be used as a proxy for absorptive capacity variable ($abs_{ijt}$) in this study.

Regarding degree of market concentration, Herfindahl-Hirschman Index (HHI) can be used as a proxy. Higher-values of HHI denote greater concentration of sales among producers and thus less competition. Regarding its effect on productivity, two arguments emerge: (1) suggests that higher values of HHI are associated with greater productivity and (2) suggests that higher values of HHI are associated with lower productivity.

The measure of market concentration of industry *j* at time *t* can be calculated as follows:

$$HHI_{jt} = \Sigma^{n}_{i=1} s_{it}^{2}, \text{ for } i \text{ element of } j, \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where $s_{it}^{2}$ is market share of each firms.

The firm size variable ($fsize_{ijt}$) is also included in the models. Based on a number of studies such as Sjoholm (1999b) and Kokko (1994), the $fsize_{ijt}$ can control industry effects, especially when using a sample covering many industries and using aggregation. In this study, the $fsize_{ijt}$ is measured by output of the firm *i* divided by total output of the industry *j* at time *t.*

**RESULT AND DISCUSSION**

Table 2 reports the empirical results using the fixed-effect model (FEM) on a sample of domestic firms which Hausman Test, in all model specifications, suggests the FEM as the most adequate. It shows results from estimating different model specifications to explore the robustness of firms' productivity and also estimates inclusion of some control variables for horizontal and backward spillover. The first column of Table 2 presents the results of replicating the empirical model from a previous study (Fujimori & Sato, 2015). Column 2 through 4 shows this study's results: column 2 is horizontal spillover, column 3 is backward spillover, and column 4 is the effects of both spillovers. From column 1, we can say that by replicating the same model, both the previous study and the present study show similar results regarding the effect of FDI spillovers on firms' productivity except the backward spillover is insignificant in short-term and negative and significant in long term. In contrast, the previous study, Fujimori & Sato (2015) find a positive effect of FDI spillovers on productivity of domestic firms supplying intermediate goods in upstream market.

In general, all model specifications show negative and significant association between FDI spillover and firms' productivity through horizontal spillover, but it positively affects firm's productivity when it interacts with time trend. This suggests that, in the same industry, an FDI spillover has a negative short-term effect on domestic firms' productivity but a positive long-term effect on domestic firms' productivity. These findings are commensurate with several prior studies, for example Aitken & Harrison's (1999) study on Venezuela finds foreign-invested join venture actually has negative effect on domestic firms' productivity in the same industrial sector. Regarding interaction term between FDI variables and time, the results are consistent with the study of Liu (2008) that, in the short-term, the increase of horizontal spillover is associated with the decrease in the firms' productivity, but in the long-term, spillover of FDI seems likely to increase firms' productivity. These results are consistent across various model specifications, in which an increase of horizontal spillover between zero and one leads to about 18.2 percent decrease in firms' productivity level in the short-term and raises 6.3 percent firms' productivity in long-term. The lack of horizontal spillover *(hspill*) in short term can be attributed to several factors: limited hiring of domestic employees in higher level positions, very little labor mobility between domestic firms and foreign firms, and few incentives by multinational firms to diffuse their knowledge to assist in domestic firms' productivity in the short-time.

On the other hand, in term of backward spillovers' effects, the negative and statistical significance coefficients appear in all model specifications both in short- and long-term. Intuitively, it means that the benefit of foreign presence in downstream market doesn't exist for domestic supplier firms. Although it seems to contrast with the related literature (Fujimori & Sato, 2015; Javorcik, 2004), in the case of Indonesian manufacturing sectors, these results make sense since it may happen because the intermediate inputs produced by local suppliers are not used intensively by foreign firms and foreign firms may import their

**Table 2**. Regression Result *Dependent Variable: Labor Productivity (ln_p)*

| Variables | Coefficient of Fixed-Effect Estimates | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Time (*t*) | 0.088*** | 0.062*** | 0.088*** | 0.074*** | 0.035*** | 0.099*** | 0.051*** |
| | (0.003) | (0.004) | (0.005) | (0.006) | (0.007) | (0.007) | (0.008) |
| Horizontal Spillover (*hspill*) | -0.165 *** | -0.161*** | | -0.181*** | | | |
| | (0.033) | (0.043) | | (0.043) | | | |
| Backward Spillover (*bspill*) | -0.001 | | -0.015** | -0.011* | | | |
| | (0.004) | | (0.005) | (0.006) | | | |
| Horizontal Spillover*time (*hspill*t*) | 0.021 *** | 0.058*** | | 0.063*** | | | |
| | (0.009) | (0.013) | | (0.014) | | | |
| Backward Spillover*time (*bspill*t*) | -0.009 *** | | -0.007*** | -0.009*** | | | |
| | (0.001) | | (0.002) | (0.002) | | | |
| Horizontal Spillover (*hspill*) lagged | | | | | -0.320*** | | -0.351*** |
| | | | | | (0.049) | | (0.049) |
| Backward Spillover (*bspill*) lagged | | | | | | 0.002 | 0.018*** |
| | | | | | | (0.006) | (0.007) |
| Horizontal Spillover*time (*hspill*t*) lagged | | | | | 0.201*** | | 0.217*** |
| | | | | | (0.02) | | (0.02) |
| Backward Spillover*time (bspill*t) lagged | | | | | | -0.004 | -0.01*** |
| | | | | | | (0.003) | (0.003) |
| Ln Capital Intensity (*ln_k*) | | 0.031*** | 0.031*** | 0.032*** | 0.031*** | 0.028*** | 0.031*** |
| | | (0.004) | (0.004) | (0.004) | (0.005) | (0.005) | (0.005) |
| Ln Absortive Capacity (*ln_Abs*) | | 0.037*** | 0.035*** | 0.036*** | 0.019*** | 0.016*** | 0.019*** |
| | | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| Firm Size (*fsize*) | | 1.371*** | 1.391*** | 1.381*** | 1.648*** | 1.642*** | 1.643*** |
| | | (0.138) | (0.137) | (0.138) | (0.169) | (0.169) | (0.169) |
| The HHI index | | -0.207 | -0.272 | -0.216 | 0.171 | 0.051 | 0.151 |
| | | (0.155) | (0.154) | (0.155) | (0.205) | (0.204) | (0.205) |
| Constant | 10.517*** | 9.467*** | 9.497*** | 9.517*** | 9.783*** | 9.694*** | 9.733*** |
| | (0.015) | (0.067) | (0.068) | (0.074) | (0.074) | (0.077) | (0.078) |
| No of Observation | 94,575 | 53,437 | 53,437 | 53,437 | 41,117 | 41,117 | 41,117 |
| R-Square | 0.062 | 0.212 | 0.181 | 0.265 | 0.194 | 0.161 | 0.193 |

Figures in parentheses are robust standard errors. Lagged indicates the independent variables are lagged by 1 year. *significant at the 10 percent level. **significant at 5 percent level. *** significant at 1 percent level.

intermediate inputs rather than use intermediate inputs from local suppliers. The export-import data can explain that the nature of Indonesian manufacturing sector is too dependent on the import of raw materials and capital goods. Data shows that Indonesian imports are dominated by raw materials, intermediate goods, and capital goods worth USD18,119 million (product share of 13.36 percent), USD45,407 million (product share of 33.47 percent), and USD41,641 million (product share of 30.70 percent) respectively (World Bank, 2016).

Column 5 through 7 shows this study's results using one-year lag in FDI variables to deal with the simultaneous problem. From the estimation results,

we can say that the results are still the same when one-lag year is applied to FDI variables, except backward spillover positive and significantly affects firms' productivity. It is possible that the direction of causality may go from productivity of firms to foreign equity share in the firms. Suppose, if foreign firms select only the more productive domestic firms to be their suppliers, this estimation result may suffer from simultaneously bias. One method that can be used to deal with the potential simultaneously bias is to use the lagged value of the variable interest (Liu, 2008).

Relating to other independent variables, as expected, a firms' productivity is positively related to capital intensity, firms' expenditures on labor (absorptive capacity) and firms' size. These variables have positive and significant effect, meaning that firms with high capital intensity, high expenditure on skilled labor, and bigger firms' size are associated with higher levels of productivity. Intuitively, firms with higher capital intensity will employ a higher share of skilled labor, which in turn, leads to more efficient production than firms which have lower capital intensity. This finding, the positive relation between firm size and firms' productivity, is not a surprise: bigger firms are likely to possess modern technology and capital equipment compared to smaller firms. Hence, higher productivity will occur.

***The Effect of FDI Spillovers on Domestics Firms' Productivity: Categorizing Firms by Factor Intensity***

To deepen analysis regarding negative effects of backward spillover on firms' productivity, the author regards that grouping the industries by their factor intensity is needed to explain more about this relationship. Following the approach of Hill *et al.* (2010), the two-digit industrial code can be aggregated into three categories of factor intensity: labor intensive, resource intensive and capital intensive as shown in Table 3.

Furthermore, Table 4 shows the estimating results for each group and it proves that aggregating firms based on their factor intensity reveals two main points: firstly, backward spillover positively and significantly affects firm's productivity when the firms are capital intensive (column 2); secondly, the coefficient of horizontal and backward spillovers is bigger in capital-intensive industry groups rather than in other groups. This finding is supported by the summary statistics of data employed in this study: the biggest mean value of backward spillover is on 26 and 28 two-digit industrial code which is part of capital-intensive group of industries. It makes sense that capital-intensive firms often employ a higher share of relatively more skilled/trained labor compared to other firms. Skills and knowledge can be transferred to suppliers as part of maintaining the quality of intermediate input and, as a consequence, the productivity of domestic supplier's increases.

**Table 3**. The Classification of Manufacturing Based on Factor Intensity

| | |
|---|---|
| **Capital Intensive** | |
| 23 | other non-metallic mineral products |
| 24 | basic metals |
| 25 | fabricated metal products, except machinery and equipment |
| 26 | computer, electronic and optical products |
| 27 | electrical equipment |
| 28 | machinery and equipment n.e.c |
| 29 | motor vehicles, trailers and semi-trailers |
| 30 | other transport equipment |
| **Labor Intensive** | |
| 13 | textiles |
| 14 | wearing apparel |
| 15 | leather and related products |
| 16 | wood and of products of wood and cork, except furniture |
| 31 | furniture |
| 32 | Other manufacturing |
| 33 | Repair and installation of machinery and equipment |
| **Resource Intensive** | |
| 10 | food products |
| 11 | beverages |
| 12 | tobacco products |
| 17 | paper and paper products |
| 18 | printing and reproduction of recorded media |
| 19 | coke and refined petroleum products |
| 20 | chemicals and chemical products |
| 21 | basic pharmaceutical products and pharmaceutical preparations |
| 22 | rubber and plastics products |

Source : Hill *et al.* (2010)

In contrast to estimation result for all firms, distinguishing firms by factor intensity reveals that HHI has a positive effect on firms' productivity. There is no evidence of HHI's effect on firms' productivity in regression of all firms result. It means that within capital-intensive firms, higher value of HHI is associated with greater productivity. Thus, high concentration and less competition are likely to have a rapid technological

**Table 4**. Regression Result Based on Factor Intensity *Dependent Variable: Labor Productivity (ln_p)*

| Variables | Coefficient of Fixed Effect Estimates | | | | | |
|---|---|---|---|---|---|---|
| | Capital Intensive | | Labor Intensive | | Resource Intensive | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Time (*t*) | -0.021*** | -0.101* | 0.052*** | 0.073*** | 0.107*** | 0.076*** |
| | (0.015) | (0.024) | (0.011) | (0.015) | (0.008) | (0.008) |
| Horizontal Spillover (*hspill*) | -0.787*** | | 0.019 | | -0.153** | |
| | (0.103) | | (0.068) | | (0.076) | |
| Backward Spillover (*bspill*) | -0.031*** | | -0.013* | | -0.009 | |
| | (0.014) | | (0.008) | | (0.015) | |
| Horizontal Spillover*time (*hspill*t*) | 0.208*** | | 0.055** | | 0.033 | |
| | (0.029) | | (0.022) | | (0.027) | |
| Backward Spillover*time (*bspill*t*) | -0.002 | | 0.003 | | -0.015*** | |
| | (0.004) | | (0.003) | | (0.004) | |
| Horizontal Spillover (*hspill*) lagged | | -0.546*** | | -0.189** | | - 0.325*** |
| | | (0.109) | | (0.077) | | (0.012) |
| Backward Spillover (*bspill*) lagged | | 0.027** | | -0.002 | | 0.019 |
| | | (0.014) | | (0.009) | | (0.016) |
| Horizontal Spillover*time (*hspill*t*) lagged | | 0.409*** | | 0.144*** | | 0.152*** |
| | | (0.041) | | (0.032) | | (0.038) |
| Backward Spillover*time (Bspill*t) lagged | | -0.004 | | 0.003 | | -0.008 |
| | | (0.007) | | (0.005) | | (0.006) |
| Ln Capital Intensity (*ln_k*) | 0.049*** | 0.046*** | 0.018*** | 0.025*** | 0.029*** | 0.021*** |
| | (0.011) | (0.012) | (0.007) | (0.008) | (0.007) | (0.008) |
| Ln Absortive Capacity (*ln_Abs*) | 0.027*** | 0.015** | 0.037*** | 0.013*** | 0.034*** | 0.018*** |
| | (0.008) | (0.008) | (0.004) | (0.004) | (0.005) | (0.005) |
| Firm Size (*fsize*) | 1.181*** | 1.581*** | 1.501*** | 2.001*** | 1.803*** | 1.849*** |
| | (0.223) | (0.282) | (0.32) | (0.392) | (0.258) | (0.297) |
| The HHI | 1.345*** | 2.375*** | -0.987 | 0.141 | -0.05 | 0.108 |
| | (0.612) | (0.77) | (0.467) | (0.587) | (0.196) | (0.248) |
| Constant | 10.014*** | 10.049*** | 9.348*** | 9.511*** | 9.62 | 9.941*** |
| | (0.159) | (0.215) | (0.106) | (0.127) | (0.107) | (0. 117) |
| No of Observation | 10,212 | 7,999 | 19,690 | 15,042 | 23,535 | 18,076 |
| R-Square | 0.168 | 0.312 | 0.114 | 0.101 | 0.158 | 0.145 |

Figures in parentheses are robust standard errors *significant at the 10 percent level. **significant at 5 percent level. *** significant at 1 percent level.

change which can removes less productive firm and leads to increasing firms' productivity.

## CONCLUSION

This study finds evidence supporting FDI's positive contribution to Indonesian economy especially domestic firms' labor productivity. This study suggests that, within the same industry, horizontal spillovers are associated with domestic firms' productivity: this relationship is negative in the short-term but positive in the long-term. It means that, FDI spillovers lower the short-term productivity

level, but raise domestic firms' productivity in a long-term. In contrast, in different industry, this study lacks evidence of positive effects of FDI spillovers on the productivity of domestic firms supplying input both in short-term and long-term. In addition, this study points out that FDI spillovers affect domestic firms' productivity effectively when they are capital-intensive.

Regarding control variables, as expected, a firms' productivity is positively related to capital intensity, firms' expenditures on labor (absorptive capacity), and firms' size. These variables have positive and significant effect, meaning that firms with high capital intensity, high expenditure on skilled labor, and bigger firms' size are associated with higher levels of productivity.

Compared to the previous study conducted by Fujimori & Sato (2015), this study reveals different results. This study's findings point out that backward spillover has negative effect on domestic firms' productivity while Fujimori & Sato's study finds positive relationship between FDI spillovers on productivity of firms supplying input in upstream market. This finding is due to the nature of foreign firms in Indonesia which import their intermediate inputs rather than use intermediate inputs from local suppliers.

The contributions of this study to the current empirical literature are: (1) it investigates the relationship between FDI spillover and firm's labor productivity via industry linkage, (2) it estimates FDI spillovers across industries more precisely by defining all sectoral variables at five-digit industry level and using I-O Table 2010 which is based on 185 sectors, (3) it investigates the short-term and long-term effects of FDI spillovers, and (4) it updates manufacturing sector data for current conditions.

The findings suggest the need for further studies on why backward spillovers cannot be associated with firms' level of productivity in Indonesia. One of possible ways is by considering a better proxy for backward spillover in the model. It is suggested to employ data that allows us to gather information about foreign firms and their individual supplier rather than relying on I-O matrices to measure interaction between sectors.

Regarding the FDI spillovers effects on firms' productivity within an industry; negative in the short-term but positive in the long-term, results imply the importance of maintaining a long-term perspective toward foreign-invested firms in Indonesia. The author suggests government to create either fiscal or non-fiscal policy promoting investment in the long-term. Moreover, these positive effects of FDI spillovers can be maximized as stated in the literature (Blalock & Gertler, 2008; Javorcik, 2004; Liu, 2008) in three main ways: demonstration effect, labor mobility, and competition.

There are several policy lessons that can be drawn from the weak backward spillover evidence: Indonesia needs to stimulate policy that can enhance domestic firms' capacity to supply intermediate materials and capital to foreign firm in downstream market. Commensurate with these findings, Koko (1994) and Takii (2001) find that FDI spillovers are less likely to take place if there are large gaps between the local and foreign firms. Therefore, there are several ideas for capacity enhancement in Indonesia: Firstly, Indonesia should invest more in good technical education to develop plenty of quality workers with better skill and knowledge. Secondly, improvement in the investment climate is required to attract much-needed investment (both foreign direct investment and domestic direct investment). Finally, truncating a technology gap between foreign and domestic firms is important. Therefore, government should provide more incentives to domestic firms which actively promote R&D activities, for example by providing fiscal or non-fiscal incentives to those firms.

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