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The spillover effects of foreign direct investment on labor productivity

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Article Info	Abstract
	This study examines the effect of FDI spillovers, short-term and long-term effects of FDI spillovers on domestic firms' productivity. It also 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. **Findings/Originality**: 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 also demonstrates negative backward spillover effects on domestic firms' productivity across industries. In addition, this study points out that FDI spillovers affect capital-intensive domestic firms' 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 considerable literature on the effect of FDI spillovers on host countries' productivity, the literature shows mixed findings. Some recent literature, such as Javorcik (2004) study on FDI in Blalock and Gertler (2008) studies on FDI in Indonesia, and Liu (2008) study on FDI in China resulted in positive conclusions on the role of FDI. On the other hand, Haddad and Harrison (1993) find negative spillovers associated with FDI in Marocco. Aitken and Harrison (1999) study on Venezuela also finds foreign-invested joint ventures actually have negative effects on the productivity of domestic firms.

Regarding these two contrasting evidences, Javorcik (2004) argues that these different conclusions result from researchers looking for FDI spillovers in the wrong places. He 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 are 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 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 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 and 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 the Indonesian manufacturing sector, Blalock and 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 the industrial sector with a large foreign presence. However, although using the same source of data, more recent studies in Indonesia such as Negara and Adam (2012) and Bloch, Suyanto, and Salim (2014) find that FDI spillovers increase firms' productivity in the same industry but negatively affect domestic firms in the 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 Fujimori and 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 a model using three types of panel regression model: POLS, REM, and FEM. In addition, following Liu (2008), the long–run spillover effect of FDI can be estimated by looking at the coefficient of the interaction term between FDI variables and time trend. Furthermore, to deepen the analysis, this study also estimates the impact of FDI spillovers on the 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 a 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.

Methods

Empirical model specification

The aim of this study is examining whether FDI spillovers affect the labor productivity of 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:

$$Y_{ijt} = A_{ijt} K_{ijt}{}^{\alpha} L_{ijt}{}^{1-\alpha} \tag{1}$$

where Y_{ijt} is the level of output firm, K_{ijt} is the 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:

$$log\ Y_{ijt} = logA_{ijt} + \alpha \log K_{ijt} + (1-\alpha)L_{ijt} \tag{2}$$

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

$$log\ \frac{Y_{ijt}}{L_{ijt}} = logA_{ijt} + \alpha\ log\frac{K_{ijt}}{L_{ijt}} \tag{3}$$

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:

$$log\ A_{ijt} = \beta_0 + \beta_1\ hspill_{jt} + \beta_2\ bspill_{jt} \tag{4}$$

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 and Gertler, 2008)[1]. Therefore, the focus is on technology transfer through backward spillover to measure the FDI spillover to local firms' supplier in the upstream market.

Adopting the empirical model by Fujimori and Sato (2015), one of the 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 equations (3) and (4), time trend, and other independent variables, we can construct the regression framework for estimating a firm's productivity as follow:

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

Where:

ln_lp_{ijt} = labor productivity (value added/labor) in rupiah

$time$ = time trend within a 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 the downstream industry, in ratio, is defined as in Equation (7)

$hspill_{jt} * time$ = adding interaction term hspill with time trend

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

$bspill_{jt} * time$ = adding interaction term bspill with time trend

ln_k_{ijt} = capital intensity (capital/labor), in rupiah

ln_abs_{ijt} = absorptive capacity variable reflects the skill of labor, proxy used: total labor expenditure, in rupiah

$fsize_{ijt}$ = firm size, output firm i divided by total output in j sector, in a ratio

HHI_{jt} = Herfindahl-Hirschman Index (HHI) represents the level of market concentration, in a ratio

β_0 = the constant in intercept parameter estimation

β_1 = the slope of time trend

β_2 and β_3 = the slope capturing the effect of spillovers on the short-term level of productivity

β_4 and β_5 = the slope capturing the effect of spillovers on the long-term level of productivity

β_6 and β_9 = the slope of control variables

u_i = firm-specific effect

ε_{ijt} = error/ disturbance.

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

This study estimates equation (5) with three types of panel regression model: 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 the 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 data from 2010 to 2014. The number of original observations during the 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[4].

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[2] Folllowing Hill, Haryo, and Narjoko (2011), 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 every year. Based on BPS definition, the large establishment is those engaging with more than 99 employees. The medium establishment is those engaging with 20-99 employees.

[4] BPS assumes that technology is constant every five years and that is why BPS only provides data of I–O table every 5 years. The vertical (backward and forward) linkages are estimated by applying the most recent available data of I-O table year 2010.

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[5].

In constructing a consistent data set, several adjustments are conducted. These adjustments consist of adjusting for industrial code, cleaning for noise and typological errors, backcasting 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 the regression process.

Table 1. Summary Statistics

Variables	Original Data[a]					Balanced Panel Data				
	No of Obs	Mean	Min	Max	Std Dev	No of Obs	Mean	Min	Max	Std Dev
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	1	0.24	53437	0.28	0	1	1.02
Backward Spillover (bspill)	111, 933	1.92	0	10.48	1.65	53437	2.01	0	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 Absorptive 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	1	0.07	53437	0.017	2×10^{-8}	1	0.07
The Herfindahl-Hirschman index (HHI)	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.

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,

[5] 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

as the calculation of these inter-industry variables is based on all firms in the original data as in Blalock and 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 the 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 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 Blomstorm and Sjoholm (1999); Narjoko and Hill (2007); Ramstetter (1999) readily accept any positive amount of foreign ownership, while Haddad & Harrison (1993) consider firms with at least 5% equity owned by foreigners. The OECD (2009) definition of foreign firms is an incorporated enterprise in which a foreign investor owns 10% or more of their equity capital. The IMF and OECD definition is frequently the international threshold standard of a foreign firm. Another study, Djankov and Hoekman (2000), considers the relevant threshold to be 20 %. This study accommodates all thresholds of foreign assets percentages used by those studies. All joint-venture companies with more than 5% of foreign assets will be considered as foreign firms in this study.

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

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

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

$$bspill_{jt} = \sum_k b_{kl} * hspill_{jt} \text{ , for all k} \neq \text{j} \tag{7}$$

where b_{kl} is the proportion of sector k's output supplied to sector l (with FDI presence). b_{kl} is established from the 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 the 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.

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 in the 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 and 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 an absorptive capacity variable (abs_{ijt}) in this study.

Regarding the degree of market concentration, Herfindahl-Hirschman Index (HHI) can be used as a proxy. Higher-values of HHI denotes the 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, 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:

$$HHI_{jt} = \sum_{i=1}^{n} s_{it}^2, \text{ for } i \text{ element of } j, \tag{8}$$

where s_{it}^2 is the market share of each firm.

The firm size variable ($fsize_{ijt}$) is also included in the models. Based on a number of studies such as Sjöholm (1999) 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 the output of the firm i divided by total output of the industry j at time t.

Results 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 the 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 and Sato (2015) find a positive effect of FDI spillovers on the productivity of domestic firms supplying intermediate goods in the upstream market.

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 Herfindahl-Hirschman Index(HHI)		-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	94575	53437	53437	53437	41117	41117	41117
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% level. **significant at 5 % level. *** significant at 1 % level.

In general, all model specifications show a negative and significant association between FDI spillover and firms' productivity through horizontal spillover, but it positively affects firms productivity when it interacts with a 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 and Harrison's (1999) study on Venezuela finds foreign-invested joint venture actually has a 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, the 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 % decrease in firms' productivity level in the short-term and raises 6.3 % 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. Whereas, horizontal spillovers in long-term may arise through demonstration effect, labor mobility and competitions (Blalock & Gertler, 2008). Regarding demonstration effects, the domestic firms can adopt directly from foreign firm's technologies through imitation or simply observing multinationals. For example, local firms can learn how foreign firms procure, produce, sell, manage, and adapt their technology which leads to innovation, invention, and increased productivity. Regarding labor mobility, productivity spillover occurs when the workers who master foreign firms' technology and production techniques move to domestic firms or establish their own businesses. Furthermore, entry of foreign firms may lead to greater competitions in domestic markets and force local firms to become more efficient and lead to increasing productivity

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 the 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 intermediate inputs rather than use intermediate inputs from local suppliers. The export-import data can explain that the nature of the 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 US$ 18,119 million (product share of 13.36%), US$ 45,407 million (product share of 33.47%), and US$ 41,641 million (product share of 30.70%) respectively (Word 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 the 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 the 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 simultaneous 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 a 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 the 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, Haryo, and Narjoko (2011), 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.

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; manufacture of articles of straw and plaiting materials
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

Furthermore, Table 4 shows the estimating results for each group and it proves that aggregating firms based on their factor intensity reveal 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 the 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 suppliers increases.

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 Herfindahl-Hirschman Index(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	10212	7999	19690	15042	23535	18076
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% level. **significant at 5 % level. *** significant at 1 % level.

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 the regression of all firms result. It means that within capital-intensive firms, a

higher value of HHI is associated with greater productivity. Thus, high concentration and less competition are likely to have a rapid technological change which can remove less productive firm and leads to increasing firms' productivity. Relating to other independent variables, even after grouping the industries by their factor intensity, the result demonstrates expected results: capital intensity, firms' expenditures on labor (absorptive capacity) and firms' size positively affect firms' labor productivity. These variables have a positive and significant effect. It means that firms with high capital intensity, high expenditure on skilled labor, and bigger firms' size are associated with higher levels of productivity. For all group of industries (capital, labor, or resource intensive group), 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. Moreover, firms with higher expenditures on labor have more skilled labor as a result of their training and capacity development program. Hence, it will increase labor productivity. Regarding the positive relation between firm size and firms' productivity, the bigger firms are likely to possess modern technology and capital equipment compared to smaller firms. Hence, higher productivity will occur.

Conclusion

This study finds evidence supporting FDI's positive contribution to the 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 the long-term. In contrast, in a 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 a 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 and Sato (2015), this study reveals different results. This study's findings point out that backward spillover has a negative effect on domestic firms' productivity while Fujimori and Sato's study finds a positive relationship between FDI spillovers on productivity of firms supplying input in the 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.

This study contributes to the current empirical literature: 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) investigates the short-term and long-term effects of FDI spillovers, 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 the 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 the 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 the government 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 a foreign firm in a downstream market. Commensurate with these findings, Kokko (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, the 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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References

Aitken, B., & Harrison, A. (1999). Do domestic firms benefit from the direct foreign investment? Evidence from Venezuela. *American Economic Review*, *89*, 605–618.

Blalock, G., & Gertler, P. (2008). Welfare gains from foreign direct investment through technology transfer to local suppliers. *Journal of International Economics*, *74*(2), 402–421.

Bloch, H., Suyanto, S., & Salim, R. (2014). Which firms benefit from foreign direct investment? Empirical evidence from Indonesian manufacturing. *Journal of Asian Economics*, *33*, 16–29.

Blomstorm, M., & Sjoholm, F. (1999). Technology transfer and spillovers: Does local participation with multinationals matter? *European Economic Review*, *43*(4–6), 915–923.

Djankov, S., & Hoekman, B. (2000). Foreign investment and productivity growth in Czech enterprises. *World Bank Economic Review*, *14*(1), 49–64.

Eeckhout, J., & Jovanovic, B. (2002). Knowledge spillovers and inequality. *American Economic Review*, *92*(5), 1290–1307.

Fujimori, A., & Sato, T. (2015). Productivity and technology diffussion in India: The spillover effects from foreign direct investment. *Journal of Policy Modelling*, *37*(4), 630–651.

Haddad, M., & Harrison, A. (1993). Are there positive spillovers from direct foreign investment? Evidence from panel data from Morocco. *Journal of Development Economics*, *2*(1), 51–74.

Hill, H., Haryo, A., & Narjoko, D. (2011). Indonesian industrialization: Jobless growth? In *Employment, living standard and poverty in contemporary Indonesia* (pp. 113–133). Singapore: Institute of Southeast Asian Studies.

Javorcik, B. (2004). Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages. *American Economic Review*, *94*(33), 605–627.

Kokko, A. (1994). Technology, market characteristics, and spillovers. *Journal of Development Economics*, *43*(2), 279–293.

Le, H., & Pomfret, R. (2011). Technology spillovers from foreign direct investment in Vietnam: Horizontal or vertical spillovers? *Journal Asia Pacific Economics*, *16*(2), 183–201.

Liu, Z. (2008). Foreign direct investment and technology spillovers: Theory and evidence. *Journal of Development Economics*, *85*(1–2), 176–193.

Mastromarco, C., & Ghosh, S. (2009). Foreign capital, human capital, and efficiency: A stochastic frontier analysis for developing countries. *World Development Review*, *37*(2), 489–502.

Narjoko, D. A., & Hill, H. (2007). Winners and losers during a deep economic crisis: Firm-level evidence from Indonesian manufacturing. *Asian Economics Journal*, *21*(4), 343–368.

Negara, S., & Adam, L. (2012). Foreign direct investment and firms' productivity level. *ASEAN Economic Bulletin*, *29*(2), 116–127.

OECD. (2009). *OECD benchmark definition of foreign direct investment 2008*. France: Organisation for Economic Co-operation and Development Publishing.

Ramstetter, E. (1999). Trade Propensities and Foreign Ownership Shares in Indonesian Manufacturing. *Bulletin of Indonesian Economic Studies*, *35*(2), 43–66. Retrieved from https://econpapers.repec.org/RePEc:taf:bindes:v:35:y:1999:i:2:p:43-66

Romer, P. (1990). Endogenous technological change. *Journal of Political Economy*, *98*(5), s71--102.

Sjöholm, F. (1999). Technology gap, competition and spillovers from direct foreign investment: Evidence from establishment data. *Journal of Development Studies*, *36*(1), 53–73.

Takii, S. (2001). *Productivity spillovers and characteristics of foreign multinational plants in Indonesian manufacturing 1990-95* (ICSEAD Working Paper). Kitakyushu, Japan.

Word Bank. (2016). *World Bank Open Data*. Retrieved from https://data.worldbank.org/