The Impact of Foreign Direct Investment Spillover, Technology and Firm Size on the Productivity of Domestic Firm in Food Industry

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ABSTRACT

Foreign direct investment (FDI) is necessary for Indonesia since the rate of saving is still low compared to the higher demand for investment in Indonesia. FDI contributes not only to the higher rate of investment but also to the spillover of other industrial sectors through technology transfer. The FDI spillover could be in the form of horizontal or vertical spillover with upstream and downstream linkages. The spillover of FDI can give a positive or negative impact on the productivity of sectors or other industries. The objective of this study is to analyze the impact of FDI spillover on the productivity of the domestic food industry. The food industry had the highest value of FDI during 1990-2014, but it had a low value of total factor productivity. The research results show that the FDI spillover gives positive impact to the productivity of domestic food industry which has the highest foreign investment with upstream and downstream linkages. The horizontal and vertical spillover of FDI on upstream linkages gives positive impact to big domestic companies with higher levels of technologies. Meanwhile, the vertical spillover of FDI on downstream linkages gives positive impact to local companies with lower levels of technologies.

Keywords: Domestic Food Industry, Foreign Direct Investment, Horizontal Spillover, Vertical Spillover, Productivity
JEL Classifications: F21; E22; C23; O33

1. INTRODUCTION

In the macroeconomic framework of 2015-2019 National Medium Term Development Plan, the Government of Indonesia has estimated that Indonesia's economic growth rate will be 7% on average. Higher investments either in the form of domestic or foreign investment are required to achieve the target growth rate. In Indonesia, the level of domestic saving is not enough for investment. Therefore, Indonesia needs foreign direct investment (FDI).

FDI is an investment by capital owners (individual or group) in other countries by establishing a firm or buying firm shares in another country at least 10%. According to Krugman (1994), FDI is an international capital flow where firms from a country establish or expand their businesses in other countries.

FDI not only gives an impact on the sector/industry where it is invested but also affects other sectors/industries. In the sector/industry where FDI is implemented, FDI will increase investment, employment, output, and bring spillover. Meanwhile, in other sectors/industries, the spillover of FDI can increase their productivities.

The spillover of FDI is the impact of FDI through the advanced technology brought (products, processes, management and or

marketing systems) that can be used by other firms to increase productivity. According to Blalock and Gertler (2003), spillover is a result of an action by a company in an industry which is responded by other companies in the industry. The response is part of the learning processes of a company to survive in the industry. The activities conducted by the multinational of company itself could be in the form of innovation. When a company innovates (product innovation, processing technology, management or marketing system), other companies (including similar and related companies) can do a learning process by initially imitating the technique, followed by modifying, improving, and finally inventing new products.

The FDI spillover could give impact to the same industry (intra-industry) which is usually known as horizontal spillover. It could also give impact to a different sector (inter-industry) which is well known as vertical spillover. During 1990-2017, the most significant FDI in Indonesia came from food industry sector. Although the food industry sector had the most substantial proportion of FDI, the total factor productivity (TFP) of the food industry is quite low compared to chemical industry and textile industry (Saliola and Seker, 2011). The Aggregate and Average of TFP can be seen in Figure 1.

According to Figure 1, the aggregate and the average of TFP in the food industry was lower than the TFP in the textile and chemical industries. As explained earlier, FDI in the food industry was the largest during 1990-2017, but the average TFP was very low, even the aggregate TFP was negative. Comparing with the textile and the chemical industries, the aggregate TFP of the textile industry and the average TFP of the chemical industry were quite high.

The impact of FDI spillover on productivity is estimated to be varied among sector in the food industry. It could be positive, negative, or even non existent. Different impact of spillover has diversified the productivity of every sub-sector in the food industry. As a result, the productivity of the food industry is not optimal. Identifying the food industry sub-sector gaining positive or negative impact is essentially required to optimize the productivity of the sector.

As already explained previously, there are horizontal FDI spillover and vertical FDI spillover (upstream and downstream linkages).

Each sector in the food industry has different upstream and downstream linkages. However, in general, the upstream linkages of the food industry are the agricultural sector, and the downstream ties are the food supply sector. The agricultural and food supply sectors are expected to provide FDI spillover to increase the productivity of the food industry. The industry of other food products sector also has a relationship with the food industry (upstream and downstream linkages). Therefore, this study will analyze the impact of FDI spillover (horizontal and vertical with upstream and downstream linkages) on the productivity of domestic firms in the food industry and industry-specific, based on the proportion of input/output used in Table IO of 2010.

2. METHOD

2.1. Theoretical Framework

According to the new growth theory, FDI is a driving force for a country's economic growth. FDI could cause a spillover impact. The spillover impact is the transfer of technology from the advanced technology it carries. Technological progress can produce more goods with the same inputs or provide the same quantity of outputs with fewer inputs. With technological changes or with more efficient use of new technologies, the production function will change. Debertin (1986) explained that using new technology in the production process would increase the output for each input combination used. The changes are shown by the shift in the total production curve. Graphically, the relationship between technological changes and productivity (interpreted by shifting production functions) can be seen in Figure 2.

Gorg and Storbl (2004) stated that spillover impacts could be divided into three types, namely the spillover impacts in the form of increased productivity (productivity spillovers), access to the international market (market access spillover), and increased profit (financial spillovers). Spillover impacts can occur due to the presence of foreign-owned industry in similar industries, called horizontal spillover, or because of foreign-owned enterprise in different sectors (upstream or downstream), which are called vertical spillovers. The impact of FDI spillover will be diffused through five main channels: demonstration or imitation, labor mobility, exports, competition, and downward and upward linkages with domestic firms.

Figure 1: Aggregate and average total factor productivity of food, textile and chemical industry in several world countries
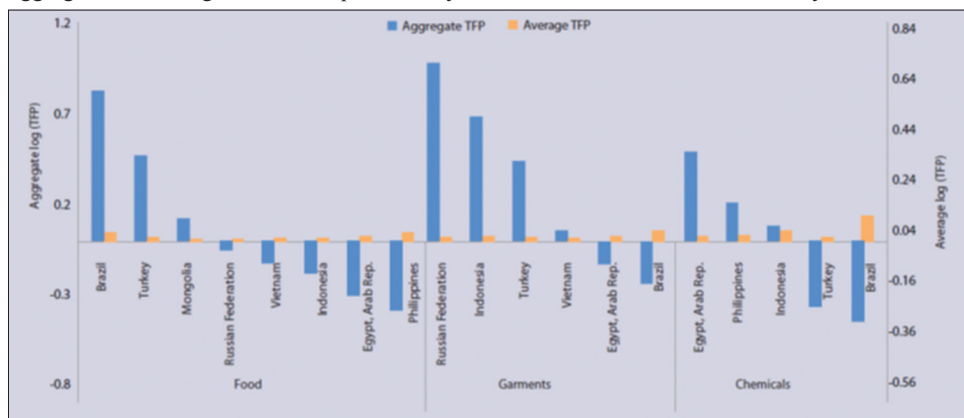
Source: Saliola and Seker (2011)

Figure 2: The concept of increasing productivity due to technology changes
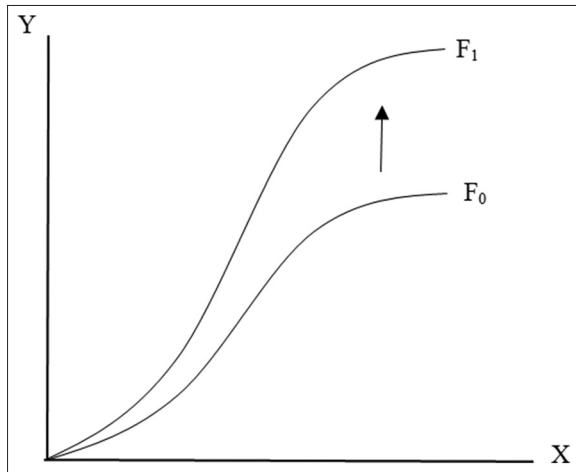
Source: Coelli et al. (1998)

According to Crespo and Fontoura (2007), the determinant factors of FDI spillover were the technological gap, absorptive capacity, regional impact, domestic firm characteristics (the size of the local firm). They also mentioned other factors such as the export capacity, firm ownership (private or government), the goals of the companies (exports or non-exports), the characteristics of FDI (the entry mode of FDI to the country), and other factors (intellectual property rights).

Therefore, this research is relevant to analyze the impact of FDI spillover on productivity, both horizontal and vertical spillover with upstream and downstream linkages. The impact of FDI spillover examined is the impact influenced by the characteristics of the firms which are the firm size and technological gap.

2.2. Estimation Model and Method of Analysis

The empirical model used in this paper is adopted from Anwar and Nguyen's (2013). Productivity is the dependent variable, whereas FDI spillover (horizontal and vertical with upward and downward linkages) and their interactions with domestic firm size and technological gap are the independent variables. The control variables used are local firm size, technological gap, export dummy, and the Herfindahl index.

Unlike the increase in production which only measures the increasing outputs, the increase in productivity measures the increasing outputs as well as the improvement in the way of of production. The FDI spillover cannot be directly measured. We use several proxies that are widely used in the existing literature. According to Liu (2008), FDI spillovers were estimated as follows:

$$HF_{jt} = FDI_{jt}/I_{jt} \times 100\% \tag{1}$$

$$UF_{jt} = \alpha_{kj}(FDI_{kt}/I_{kt}) \times 100\% \tag{2}$$

$$DF_{jt} = \beta_{jl}(FDI_{lt}/I_{lt}) \times 100\% \tag{3}$$

The HF_{jt} is the horizontal spillover of FDI in j industry in year t. UF_{jt} is the vertical spillover of FDI with upward linkages with j

industry in year t. DF_{jt} is the vertical spillover with downward ties with j industry in year t. FDI_{jt} is the FDI (FDI) in j industry in year t. FDI_{kt} is a FDI in k industry (with upward linkages in each food industry sub-sector) in year t. FDI_{lt} is FDI in l industry (with downward ties in each food industry sub-sector) in year t. I_{jt} is a total investment (FDI and domestic investment) in j industry in year t. I_{kt} is a total investment (FDI and domestic investment) in k industry in year t. I_{lt} is a total investment (FDI and domestic investment) in l industry in year t. α_{kj} is the proportion of output in k industry used in j industry, and β_{jl} is the proportion of production in j industry used in l industry.

Firm size and technological gap are also used in the interaction since both are parts of the companies' characteristics that indicate the ability of the companies to absorb the impact of FDI spillover. Firm size is defined as the size of the company in the industry which is calculated as the ratio of output in i company in j industry in the year t. Meanwhile, the technological gap is the differences in the productivity average of foreign company and domestic company in similar sector of an industry (intra-industry).

The export dummy is only used as a control variable because there is no indication that the export level of a domestic company will affect the productivity due to FDI spillover. The Herfindahl index is only used as a control variable because it shows the size of the company in relation to industry.

The impact of FDI spillovers and their interaction on productivity can be formulated as follows:

$$A_{ijt} = \eta + \theta_1 UF_{jt} + \theta_2 HF_{jt} + \theta_3 DF_{jt} + \theta_4 Size_{ijt} + \theta_5 T_{ijt} + \theta_6 Herf_{jt} + \theta_7 dX_{ijt} + \theta_8 Size_{ijt} * UF_{jt} + \theta_9 Size_{ijt} * HF_{jt} + \theta_{10} Size_{ijt} * DF_{jt} + \theta_{11} T_{ijt} * UF_{jt} + \theta_{12} T_{ijt} * HF_{jt} + \theta_{13} T_{ijt} * DF_{jt} + \varepsilon_{it} \tag{4}$$

A_{ijt} is productivity of i firm in j industry in year t; UF_{jt} is the vertical FDI spillover with upward linkages in j industry in year t; HF_{jt} is the spillover of horizontal FDI in j industry in year t. DF_{jt} is vertical FDI spillover with downward linkages in j industry in year t. $SIZE_{ijt}$ is the relative size of i firm in j industry in year t. T_{ijt} is a technological gap between the foreign and domestic firm in the i firm in j industry in year t. $HERF_{jt}$ is the Herfindahl index in j industry in year t, and dX_{ijt} is export dummy (1: Export and 0: No Export). $\theta_1, \theta_2, \theta_3, \theta_4, \theta_5, \theta_6, \theta_7, \theta_8, \theta_9, \theta_{10}, \theta_{11}, \theta_{12}, \theta_{13}$ are the coefficient of the independent variable, while ε_{it} is an error term.

In this study, when the total number of domestic firms in the food industry sub-sector is smaller than the observation time (25 years), the unobserved heterogeneity between sectors will exist. In other words, every industry is believed to have different characteristics which correlate with the independent variable in the model. In the model, it is also assumed that there exist heteroscedasticity and autocorrelation caused by sectors and between times. Therefore, this model is estimated by using the fixed effect cross section SUR model.

Meanwhile, when the total number of domestic firms in the food industry sub-sector is bigger than the observation time (25 years), it is expected that there will be unobserved heterogeneity between

sectors and time. In other words, every industry is believed to have different characteristics, but the features do not have any correlation with the independent variable in the model. As a result, the model can be estimated using a random impact model.

According to the model used, the impact of vertical spillover with upstream linkage and its interaction with the influencing factors (firm size and technological gap) on the productivity of domestic firms can be formulated as follows:

$$\frac{\partial A_{ijt}}{\partial UF_{jt}} = \theta_1 + \theta_8 * Size_{ijt} + \theta_{11} * T_{ijt} \theta_1, \theta_8 > 0; \theta_{11} \lessgtr 0 \quad (5)$$

The impact of horizontal spillover and its interaction with the influencing factors (firm size and technological gap) on the productivity of domestic firms can be written as:

$$\frac{\partial A_{ijt}}{\partial HF_{jt}} = \theta_2 + \theta_9 * Size_{ijt} + \theta_{12} * T_{ijt} \theta_2, \theta_9 > 0; \theta_{12} \lessgtr 0 \quad (6)$$

The impact of vertical spillover with downstream linkage and its interaction with the influencing factors (firm size and technological gap) on the productivity of domestic firms can be formulated as follows:

$$\frac{\partial A_{ijt}}{\partial DF_{jt}} = \theta_3 + \theta_{10} * Size_{ijt} + \theta_{13} * T_{ijt} \theta_3, \theta_{10} > 0; \theta_{13} \lessgtr 0 \quad (7)$$

2.3. Types and Data Sources
This study used secondary data in the form of firm-level panel data from 18 sub-sectors of the food industry from 1990 to 2014. The selected sectors were based on KBLI which has been adjusted to

KLUI 1990, KBLI 1997, KBLI 2000, KBLI 2005, KBLI 2009, KBLI 2015, and the industry codes in the IO Table. The data were obtained from the National Bureau of Statistics of Indonesia (BPS) and Capital Investment Coordination Board of Indonesia (BKPM). The variables used in the model came from the unpublished results of a questionnaire from the Large and Medium Industry (LMI).

This study is limited only to assess the impact of FDI spillover with upstream linkage in the agricultural sector or other food industry sub sectors. As for the downstream linkage, it is limited only to assess the impact in the agricultural sector, the food supply sector, or the other food industry sub sectors. The sub-sectors with upward linkages and downward linkages are selected based on the most significant proportion of input/output used in other sub-sectors using the Input-Output Table of 2010 as shown in Table 1.

3. RESULTS AND ANALYSIS

In general, the impact of FDI spillover on productivity in the domestic food industry with random effect model is shown in Table 2. The estimated results show that FDI spillover both horizontal and vertical with upward and downward linkages have positive impacts on the productivity of the food industry. This is supported by Sari et al. (2016) who found that FDI spillover has a positive impact on the productivity of firms in Indonesia. Suyanto and Salim (2010) state that FDI spillover is a source of increased productivity in the food processing industry sector. Sjoholm (2016) also states that foreign firms have a positive impact on the added value of domestic firms. However, the impact of FDI spillover on

Table 1: 18 Sectors of the food industry with upward and downward linkages

Forward linkages	Food Industry Sectors	Backward linkages
Animal production	Slaughterhouse	Processing and preserving of meat
Slaughterhouse	Processing and preserving of meat	Manufacture of prepared animal feeds
Fishing and aquaculture	Processing and preserving of fish, crustaceans, and molluscs	Manufacture of other food products
Growing of fruit and vegetable	Processing and preserving fruit and vegetables	Manufacture of soft drinks; production of Mineral water and other bottled water
Growing of leguminous crops and oil seeds	Manufacture of vegetable and animal oil and fats	Manufacture of other food products
Growing of oleaginous fruits	Manufacture of coconut oil	Manufacture of other food products
Growing of oleaginous fruits	Manufacture of palm oil	Manufacture of other food products
Growing of rice	Manufacture of rice mill	Manufacture of other food products
Growing of cereals	Manufacture of grain mill products	Manufacture of bakery products; manufacture of macaroni and noodles
Manufacture of grain mill products	Manufacture of bakery products	Food and beverages services activities
Manufacture of grain mill products	Manufacture of macaroni and noodles	Food and beverages services activities
Livestock	Manufacture of dairy products	Manufacture of cocoa, chocolate, and sugar confectionery
Growing of sugar cane	Manufacture of sugar	Manufacture of soft drinks; production of mineral water and other bottled water
Growing of beverage crops	Manufacture of cocoa, chocolate, and sugar confectionery	Manufacture of other food products
Growing of beverage crops	Manufacture of tea and coffee	Manufacture of soft drinks; production of mineral water and other bottled water
Growing of rice, fruit, and vegetables and processing and preserving of meat	Manufacture of prepared animal feeds	Livestock
Manufacture of sugar	Manufacture of soft drinks; production of mineral water and other bottled water	Food and beverages services activities
Processing and preserving of fish; manufacture of rice mill; manufacture of oil; manufacture of cocoa, chocolate, and sugar confectionery	Manufacture of other food products	Food and beverages services activities

Table 2: The impact of FDI spillover in productivity in the domestic food industry

Independent Variable	Dependent Variable	
	A	(t-stat)
Constant	159.3841	(113,94)***
UF	0.162482	(72,64195)***
HF	0.308129	(225,082)***
DF	0.494783	(175,0033)***
Size	–2.789078	(–113,6305)***
T	–0.947674	(–5476,146)***
Herf	0.053632	(12,90811)***
dX	–9.987411	(–52,43831)***
Size*UF	0.029996	(64,35158)***
Size*HF	0.032452	(123,4063)***
Size*DF	–0.0000071	(–0,020542)
T*UF	0.000387	(133,7296)***
T*HF	–0.0000816	(–30,19475)***
T*DF	0.000702	(52,5941)***
R-Squared	0.923801	
Adj R-Squared	0.923801	

***Significant at 1%, **Significant at 5%, *Significant at 10%

productivity in the food industry sector has different implications for every sub-sector.

By entering data in equation (5), an increase in vertical FDI spillover with an upward linkage of 1% will increase the productivity of domestic industries by 0.256%. The increasing of horizontal FDI spillover by 1% according to equation (6), will increase domestic industrial productivity by 0.44%. Meanwhile, according to equation (7), an increase in vertical FDI spillover with a backward linkage of 1% will increase the productivity of domestic industries by 0.46%.

The impact of FDI spillover on productivity in the domestic food industry sub sector with fixed effect cross section SUR or random effect model can be seen in Table 3. According to Table 3, the FDI spillover in the livestock, fishery and aquaculture, paddy field, palm oil, sugar cane, coffee and tea (vertical spillover FDI with upward linkages) has positive impacts on the productivity of domestic firm in the food industry. The results are similar to Liang (2016) who mentioned the positive impact of FDI spillover on the productivity of firms that using raw materials from foreign firms. Sjoholm (1998) also supports the idea. According to Sjoholm (1998), vertical FDI spillover has a positive impact on firm productivity in the food processing industry sector.

The increasing FDI spillover in the livestock sector by 1% will increase the productivity of domestic slaughter firms by $(0.70198-0.00524*Size_{it}-0.00005*T_{it})$%. The increasing FDI spillover in the fisheries sector by 1% will increase the productivity of domestic processing and preserving fish firms for $(0.06556-0.18965*Size_{it}-0.00045*lnL_{it})$%. An increase in the spillover of FDI in the rice agriculture sector by 1% will increase the productivity of domestic rice milling firms by $(0.24243-0.28013*Size_{it}-0.01160*T_{it})$%. The increasing FDI spillover of the oil palm plantation sector by 1% will increase the productivity of domestic palm oil firms by $(1.77512+0.03923*Size_{it}-0.01634*T_{it})$%. The increasing spillover of FDI in the sugar cane plantation sector by 1% will increase domestic sugar firms by

$(2.29570+0.30211*Size_{it}+0.00551*T_{it})$%. The increasing FDI spillover in the coffee and tea plantation sector by 1% will increase the productivity of domestic coffee and tea processing firms by $(0.15295+0.02109*Size_{it}-0.00646*T_{it})$%.

The FDI spillover in the livestock sector is doesn't only give a positive impact on the productivity of domestic slaughterhouses but also the productivity of local preserved animal feed firms (vertical spillover FDI with downward linkages). The increasing FDI spillover in the livestock sector by 1% will increase the productivity of domestic animal feeds firms by $(0.00241-0.03234*T_{it})$%. The results support the idea of Kokko and Thang (2014) who believe that the vertical FDI spillover with downstream linkage has positive impacts on the ability of a domestic company to survive. Bwalya (2006) also mentions the positive impact of FDI spillover to the productivity of companies in the different industry (inter-industry) with downstream linkage.

Domestic companies with bakery and cakes, as well as noodles and macaroni products, gain positive impact from FDI spillover, either horizontal or vertical spillover with upstream and downstream linkages. The results are supported by Sjoholm (2016) who states that foreign companies could give a positive impact on the value added of domestic companies. The increasing FDI spillover in other grain milling and flour industries around 1% (vertical spillover with upstream linkages) will increase the productivity of local bakery firms by $(0.41744-0.00881*Size_{it}-0.00149*T_{it})$% and domestic noodles and macaroni firms amounting to $(1.15473-0.02635*Size_{it}+0.00111*T_{it})$%. The increasing FDI spillover in the bakery product industry by 1% (horizontal spillover) will increase the productivity of its domestic firms by $(0.20140-0.01377*Size_{it}+0.00016*T_{it})$%. The increasing spillover of FDI in the macaroni and noodle industry by 1% (horizontal spillover) will increase the productivity of its domestic firms by IDR $(0.13293+0.01284*Size_{it}-0.00120*T_{it})$%. An increase in the spillover of FDI in the food and beverage activities by 1% (vertical spillover FDI with backward linkages) will increase the productivity of domestic bakery product firm by $(0.08649+0.02545*Size_{it}+0.00053*T_{it})$% and local noodle and macaroni firms amounting to $(0.20577+0.00963*Size_{it}-0.00229*T_{it})$%.

Domestic firms of grain mill products do not get a positive impact from the presence of FDI spillover, both horizontally and vertically with a linkage to upstream and downstream. The firms do not get positive impact since there are not many cereal farms and the ability of Boga Sari to control the market. The impact of FDI spillover (horizontal and vertical with upward and downward linkages) on the productivity of domestic firms in 18 food industries can be seen in Figure 3.

According to Figure 3, the FDI spillover, both horizontally and vertically with upward and downward linkages has more positive impacts on productivity in the food industry. The most significant sectors in the food industry that have a positive impact from FDI spillover are the fish processing and preservation industry, bakery industry, noodle and macaroni industry, and sugar manufacturing. Those four sectors gain positive impact from FDI spillover, both horizontally and vertically with upward and downward linkages.

Table 3: Impact of FDI spillover on productivity in the domestic food industry sub sector

A - industri	UF	HF	DF	UF Size	UF T	HF Size	HF T	DF Size	DF T	R squared
Slaughterhouse	0.70198***	0.89246***	−25.85772***	−0.00524	−0.00005	0.00114	−0.00014***	0.10962	0.00218	0.999948
Meat	0.57279	0.28173	3.61879	0.00478	−0.00174	0.02464	−0.00014	−0.17220	0.00731	0.989465
Fish	0.06556***	0.14691***	0.429604***	−0.1896***	−0.00045**	−0.0045	−0.0006***	5.61713***	0.00085	0.037636
Fruit and vegetables	−3.01942*	−0.10264	7.24998***	−4.63627	−0.00627	1.51715*	0.00051	4.88132	−0.00182	0.982934
Vegetable and animal oil and fats	0.01967	0.07330***	0.52137***	−0.02028	0.08532***	0.01104***	−0.00028***	0.01673***	0.00297***	0.827412
Coconut oil	0.02171	−2.70038**	24.32012***	1.07665	0.00955	1.45841**	−0.01143***	−3.62496**	0.08988***	0.721949
Palm oil	1.77512***	−0.57955**	0.86409	0.03923**	−0.01634***	−0.01347	0.00936***	−0.11320	−0.00092	0.932619
Rice mill	0.24243***	−3.31688***	−2.56999***	−0.28013***	0.01160***	0.41661***	−0.02224***	2.15971***	−0.03973***	0.991633
Grain mill Products	0.03747	−0.06267	0.00871	−0.00479*	−0.00122	0.00808***	0.00178**	−0.00281	0.00137**	0.708049
Bakery products	0.41744***	0.20140***	0.08649***	−0.00881**	−0.00149***	−0.01377***	0.00016***	0.02545***	0.00058***	0.943215
Macaroni and noodles	1.15473***	0.13293***	0.20577***	−0.02635***	0.00111***	0.01284***	−0.00120***	0.00963***	−0.00229***	0.750075
Dairy products	0.01197	0.10453***	−2.33634***	0.02753***	−0.00464***	−0.00200	0.00148***	−0.11310	0.02982***	0.96083
Sugar	2.29570***	0.93344***	0.51149***	0.30211***	0.00551***	−0.07612***	0.00044***	−2.76890***	−0.02514***	0.98515
Cocoa and Chocolate	−0.76962***	−0.18188***	2.64910***	0.05994***	−0.00849***	−0.00058	0.00018***	0.03019***	0.00663***	0.99562
Tea and coffee	0.15295***	−0.43946***	3.42810***	0.02109***	−0.00646***	0.02847***	−0.00265***	−0.17616***	0.03188***	0.940003
Prepared animal feeds	0.58252***	−0.30649***	1.66358***	0.03944***	−0.00048*	−0.00184	0.00112***	0.01229	−0.03234***	0.963898
Soft drinks	2.05578***	0.34442***	−0.28350***	0.14187***	−0.00175**	0.00752**	0.00025	0.01492	−0.00085***	0.96017
Other food Products	1.58768***	0.20223***	−0.03414***	0.10251***	−0.01627***	0.02984***	−0.006614***	0.04202***	0.00046***	0.872563

***Significant at 1%, **Significant at 5%, *Significant at 10%

The vertical FDI spillover with an upward linkage gives a positive impact on the productivity of domestic firms in the food industry. More than 50% or 12 food industry sub-sectors receive a benefit from the vertical FDI spillover with an upward linkage. Meanwhile, two food industry sub-sector receive a negative impact, and the remaining food industry sub-sectors do not obtain any impact. The results are similar to the study of Liang (2016) that found the positive impact of FDI spillover on local firms that using raw materials from foreign firms. According to Sjoholm (1998), vertical FDI spillover has a positive impact on firm productivity in the food processing industry sector.

On the other hand, horizontal FDI spillover also gives some negative impact on the productivity of domestic firms in the food industry. Sjoholm (1998) also stated that horizontal FDI spillover has negative impact on the productivity of the domestic firms in food processing industry. Bwalya (2006) states that the impact of FDI spillover on the productivity of local firms in the industry (intra-industry) is negative. Kokko and Thang (2014) also indicate that horizontal FDI spillover could hinder the ability of domestic firms to survive. According to this study, the horizontal FDI spillover has a positive impact on the productivity of nine food industry sub-sector, while it also influences negatively on six food industry sub-sector, and gave no impact to the other three.

The vertical FDI spillover with backward linkage gives a positive impact on the productivity of domestic firms in the food industry. The existence of foreign companies may provide benefits to domestic firms that work as input suppliers. The benefits are gained through the increasing demand for local input. The foreign companies usually ask specific quality as a standard for every raw material they requested. For a certainty, the foreign companies could provide benefit to the domestic firms through technological support to enhance the product quality, introduce innovation (through job training), facilitate the support on productive infrastructure, access the raw material, and assist in the organization and management level. The vertical FDI spillover with backward linkage in food industry sub-sector gives a positive impact on the productivity of 10 food industry sub-sectors, while it also influences the five food industry sub-sectors negatively. Meanwhile, the vertical FDI spillover with backward linkage gives no impact to the remaining food industry sub-sectors such as the meat processing and preservation industry, palm oil industry, and other grain milling and flour industries
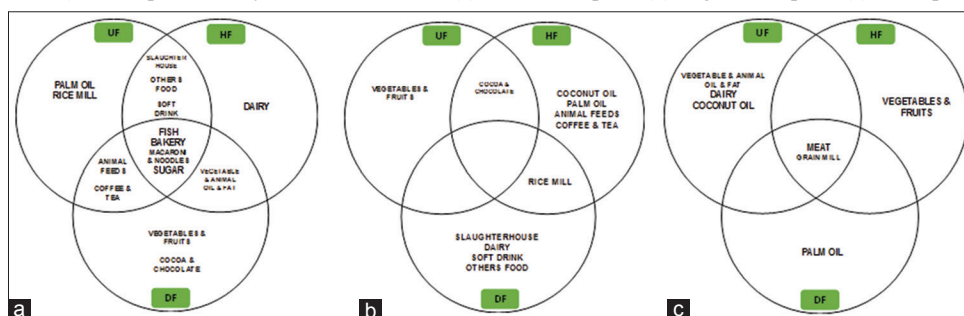
The impact of FDI spillover interactions (horizontal and vertical with upward and downward linkages) with firm size on the productivity of domestic firms in 18 food industries is illustrated in Figure 4.

According to Figure 4, it can be seen that larger firm size has a more significant positive impact from FDI spillover (either horizontally or vertically with upward and downward linkages) to the productivity of domestic firms. However, it can also be seen that quite some industries are not influenced by the size of the firm to obtain the impact of vertical FDI spillover with downward linkages to the productivity of domestic firms. Another food industry is one of the sectors that is influenced by the firm size in obtaining a positive impact of FDI spillover. Meanwhile, the industries that are not affected by firm size in getting the impact of FDI spillover are the slaughterhouse industry, meat processing and preservation industry.

The interaction between the vertical FDI spillover with upward linkages and firm size has a positive impact on the productivity of domestic firms in the food industry. The results are similar to the study of Crespo and Fontoura (2007) that the factor influencing the FDI spillover is the characteristic of domestic firms such as firm size. The size of a local firm is related to the firm's capacity to gain benefit from the presence of foreign firms. Domestic firms obtain some inputs from foreign firms with high quality. However, increasing input quality will probably be followed with the rising price of the product. If the local firms do not adjust their capacity by improving the quality of their products, they will not be able to gain the benefits from the increasing aspect of inputs but a negative impact from the rising cost of input (Javorcik, 2004).

The interaction between vertical FDI spillover with upward linkages and firm size has a positive impact on the productivity of 8 food industry sub-sectors. Those industries are dairy product manufacturing, palm oil industry, cocoa, chocolate, and sugar confectionery industry, preserved animal feeds manufacture, as well as the production of soft drinks, sugar, coffee and tea, and other food products. The interaction between vertical FDI spillover with upward linkages and firm size influences negatively the productivity of 5 food industry sub-sectors such as the grain mill products, fish processing and preservation industry, rice mill industry, noodles and macaroni industry, and bakery product manufacture. The interaction between vertical FDI spillover with upward linkages and firm size does not have an

Figure 3: The impact of foreign direct investment spillover (horizontal and vertical with upstream and downstream linkages in food industry sector) on the productivity of domestic firms. (a) Positive impact, (b) negative impact, (c) no Impact

Figure 4: The impact of the interaction of foreign direct investment spillovers (horizontal and vertical with upstream and downstream linkages) and firm size on the productivity of domestic firms. (a) Positive impact, (b) negative impact, (c) no impact
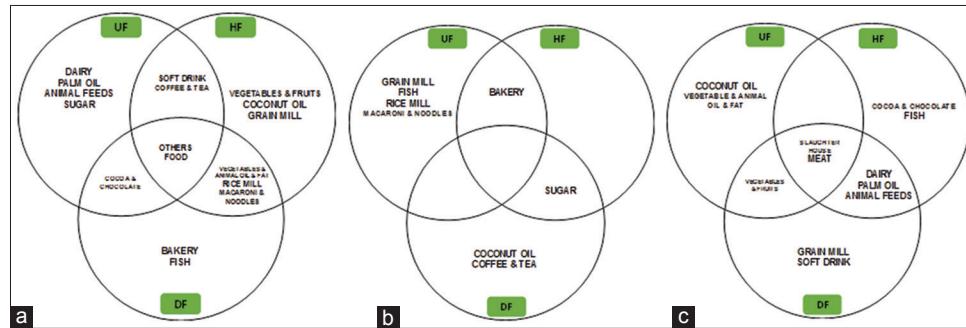
impact on the productivity of 5 food industry sub-sectors such as the slaughterhouse industry, meat processing and preservation industry, fruit and vegetable processing and preservation industry, the coconut oil manufacture, as well as the vegetable and animal oil and fat industry.

The interaction between horizontal FDI spillover and firm size has a positive impact on the productivity of domestic firms in the food industry. The results of this study also supported by the study of Crespo and Fontoura (2007). According to Crespo and Fontoura (2007), the factor influencing FDI spillover is the characteristic of domestic firms such as firm size. The size of a local firm is related to the firm's capacity to gain benefit from the presence of foreign firms. Small-scale domestic firms are not able to compete with foreign firms and will suffer more significant losses (Aitken and Harrison 1999). Small local firms do not have enough production scale to imitate the technology brought by foreign firms. Domestic firms with larger sizes are expected to gain benefit from the presence of foreign firms. The results of the study reveal that the interaction between horizontal FDI spillover and firm size has a positive impact on the productivity of 9 food industry sub-sectors. The reciprocal action may also give an adverse impact on the productivity of two food industry sub-sectors such as the bakery and sugar manufactures. However, the interaction does not provide any significant impact to the productivity of 7 food industry sub-sectors such as the slaughterhouse, meat processing and preservatives, dairy products, palm oil, cocoa, chocolate, and sugar confectionery, preserved animal feeds, and fish processing and preservatives industries.

The interaction between vertical FDI spillover with downward linkages and firm size has no impact on the productivity of domestic firms in the food industry. Crespo and Fontoura (2007) found a different result. When the foreign companies have a sub-contracting cooperation with local input providers, the foreign companies do not consider the firm size factor, and thus, the interaction between vertical FDI spillover with downward linkages and firm size has no impact on their productivity.

The impact of the interactions between FDI spillover (horizontal and vertical with upward and downward linkages) and technological gap on the productivity of domestic firms in 18 food industries can be seen in Figure 5.

According to Figure 5, it can be seen that the higher the difference in technology, the higher the opportunities of FDI spillover (horizontal and vertical with upward linkages) to obtain the negative impact, thereby reducing the positive impact of FDI spillover. However, the vertical FDI spillover with downward ties has more positive impacts on firms with considerable technological gap. The food industry sectors that are not affected by technological gap in obtaining the impact of FDI spillover are the industry of meat processing and preservatives, the fruits and vegetable processing and preservative industries.

The interaction between FDI spillover (horizontal and vertical with upward linkages) and technological gap has negatively affected the productivity of domestic firms in the food industry. This results are opposite to the study of Crespo and Fontoura (2007) which stated that firms must have moderate technological gap with foreign firms to be able to gain benefit from the advanced technology brought by foreign firms. If the technology difference is small, foreign firms will only provide a small profit for domestic firms. According to Crespo and Fontoura (2007), FDI spillover will increase with greater technological gap because it can increase the chances of local firms to get a higher level of efficiency by imitating foreign technology. However, the estimation results show the opposite results. The diffusion of technology does not automatically obtain, and this is not an indirect impact of advanced technology from foreign firms. The distribution of technology requires the recipient to have the ability to absorb or adopt the technology.

The interaction between vertical FDI spillover with upward linkages and technological gap has a positive impact on the productivity of 4 food industry sub-sectors. Those sub-sectors are vegetable and animal oil and fat, rice mill, noodle and macaroni, and sugar manufactures. The interaction between the vertical FDI spillover with upward linkages and technological gap causes a negative impact on the productivity of 9 food industry sub-sectors. Those include dairy products, palm oil, cocoa, chocolate, and sugar confectionery, preserved animal feeds, soft drinks, fish processing and preservatives, bakery product, coffee and tea, as well as other food product industries. The interaction between vertical FDI spillover with upward linkages and technological gap has no impact on the productivity of 5 food industry sub-sectors such as slaughterhouse, meat processing and preservatives, fruit and vegetable processing and preservatives, coconut oil, and grain mill product industries.

Figure 5: The impact of the interaction of foreign direct investment spillovers (horizontal and vertical with upstream and downstream linkages) and technological gap on the productivity of domestic firms. (a) Positive impact, (b) negative impacts, (c) no impact
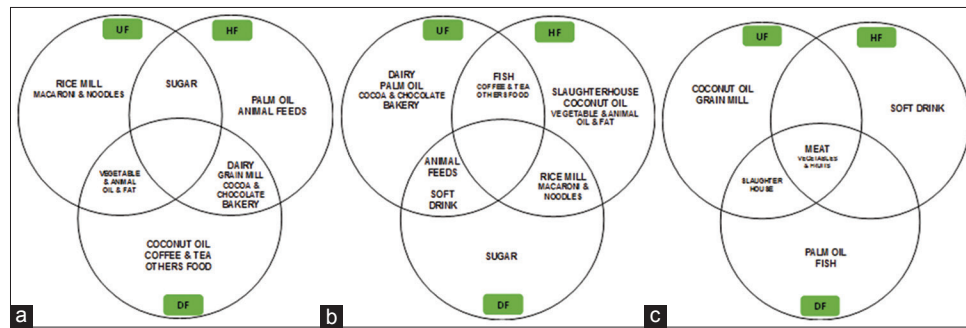
The interaction between horizontal FDI spillover and technological gap has a positive impact on the productivity of 7 food industry sub-sectors. Those are the manufacture of dairy products, palm oil, grain mill products, cocoa, chocolate, and sugar confectionery, preserved animal feeds, bakery products, and sugar. The interaction between horizontal spillover FDI and technological gap has a negative impact on the productivity of 8 food industry sub-sectors such as the slaughterhouse industries, the manufacture of coconut oil, fish processing and preservatives, vegetable and animal oil and fat, rice mill, noodle and macaroni, coffee and tea, and other food products. The interaction between horizontal FDI spillover and technological gap has no impact on the productivity of the three food industry sub-sectors. Those sub-sectors include the industry of meat processing and preservatives, fruit and vegetable processing and preservatives, and soft drinks.

The interaction between vertical FDI spillover with downward linkages and technological gap has a positive impact on the productivity of domestic firms in the food industry. The results of this study are supported by Crespo and Fontoura (2007) which stated that local firms must have moderate technological gap with foreign firms to be able to benefit from the advanced technology brought by foreign firms. If the technology difference is small, foreign firms will only provide a small profit for domestic firms. According to Crespo and Fontoura (2007), technological gap will increase FDI spillover because it can increase the chances of local firms to get a higher level of efficiency by imitating foreign technology.

The interaction between vertical FDI spillover with downward linkages and technological gap has a positive impact on the productivity of 8 food industry sub-sectors. Those food industry sub-sectors include the manufacture of dairy products, coconut oil, grain mill products, cocoa, chocolate, and sugar confectionery, vegetable, animal oil and fat, bakery products, coffee and tea, as well as other food products. The interaction between vertical FDI spillover with downward linkages and technological gap causes a negative impact on the productivity of the five food industry sub-sectors, that is the manufacture of preserved animal feeds, soft drinks, rice mill, noodle and macaroni, and sugar. The interaction between vertical FDI spillover with downward linkages and technological gap has no impact on the productivity of the five food industry sub-sectors. Those industries are slaughterhouse, meat processing and preservatives, fruit and vegetable processing

and preservatives, palm oil, and fish processing and preservatives.

4. CONCLUSION AND POLICY RECOMMENDATIONS

According to the results of this study, it could be concluded that the spillover of FDI, both horizontally and vertically with upward and downward linkages, gives more positive impacts on the productivity of the domestic food industry. The larger the size of the firm, the higher the positive impact of FDI spillover (horizontal and vertical with upward linkages) on the productivity of local firms. Technological gaps have a negative influence on the impacts of horizontal and vertical FDI spillover with downward ties on the productivity of local firms. Meanwhile, technological gaps will give a positive influence on the impact of vertical FDI spillover with a downward linkage on the productivity of domestic firms.

Therefore, it is suggested for the government to: (1) give opportunities for FDI to enter Indonesia by providing easy access to invest in Indonesia. However, it is also necessary to require foreign companies that invest in Indonesia to carry out technology transfer. The transfer of technology could be in the form of demonstrating the technique brought or training on the advanced technology brought to the labor in similar domestic industry; (2) formulate a regulation that requires the foreign investors to cooperate or use domestic industries with upward and downward linkages as their sub-contracting. Furthermore, the foreign investors also should introduce and conduct training on advanced technology to the workers in the domestic industry which has an upward and backward linkage to the foreign companies; (3) provide financial facilities to local firms. Therefore, the domestic firms could increase the size of their firms, and they could obtain a more significant impact from the FDI spillover; and (4) provide training on advanced technology for local firms with low technology levels. Hence, the domestic firms will gain a more substantial impact from the FDI spillover.

REFERENCES

Aitken, B.J., Harisson, A.E. (1999), Do domestic firms benefit from direct foreign investment? Evidence from Venezuela. The American Economic Review, 89(3), 605-618.

Anwar, S., Nguyen, L.P. (2011), Foreign direct investment and export

spillovers: Evidence from Vietnam. International Business Review, 20, 177-193.

Blalock, G., Gertler, P. (2003), Technology from Foreign Direct Investment and Welfare Gains Through Supply Chains. USA: Indonesia Industry Discussion. Working Paper.

Bwalya, S.M. (2006), Foreign direct investment and technology spillovers: Evidence from panel data analysis of manufacturing firms in Zambia. Journal of Development Economics, 81, 514-526.

Coelli, T., Rao, D.S.P., Battese, G.E. (1998), An Introduction to Efficiency and Productivity Analysis. Massachusetts: Kluwer Academic Publisher.

Crespo, N., Fontoura, M.P. (2007), Determinant factors of FDI spillovers-what do we really know? World Development, 35(3), 410-425.

Debertin, D.L. (1986), Agricultural Production Economics. New York: Macmillan Publishing Company.

Gorg, H., Storbl, E. (2004), Foreign Direct Investment and Local Economic Development: Beyond Productivity Spillovers. Research Paper 2004/11. University of Nottingham.

Javorcik, B.S. (2004), Does foreign direct investment increase the productivity of domestic firms? In search spillovers through backward linkages. The American Economic Review, 94(3), 605-627.

Kokko, A., Thang, T.T. (2014), Foreign direct investment and the survival of domestic private firms in Vietnam. Asian Development Review, 31(1), 53-91.

Krugman, P.R. (1994), International Economics: Theory and Practice. New York: Harper Collins.

Liang, F.H. (2016), Does foreign direct investment improve the productivity of domestic firms? Technology spillovers, industry linkages, and firm capabilities. Research Policy, 46(1), 138-159.

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

Saliola, F., Seker, M. (2011), Total Factor Productivity across the Developing World. Enterprise Surveys, Enterprise Note Series, Note No. 23. Washington: World Bank Group.

Sari, D.W., Khalifah, N.A., Suyanto, S. (2016), The spillover impacts of foreign direct investment on the firms productivity performance. Journal of Productivity Analysis, 46(2), 199-233.

Sjoholm, F. (1998), Productivity Growth in Indonesia: The Role of Regional Characteristics and Direct Foreign Investment. Working Paper in Economics and Finance No. 216. Sweden: Stocholm School of Economics.

Sjoholm, F. (2016), Foreign Direct Investment and Value Added in Indonesia. Working Paper. Lund University, Department of Economics. p31.

Suyanto S, Salim R.A. (2010), Sources of productivity gains from FDI in Indonesia: Is it efficiency improvement or technological progress? The Developing Economics, 48(4), 450-72.