Absorptive Capacity and Foreign Direct Investment Spillover Effects: The Case of Vietnam

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Abstract

Many developing countries attract FDI with the hope that this capital will increase the productivity of domestic firms and improves the local manufacturing industries. At the same time, a lot of papers investigate the impact of FDI inflows on the performance of local firms in developing countries such as China, Mexico, Venezuela, Romania, and Lithuania using Cobb-Douglas production functions with the significant role of FDI intra-and-inter industries linkages and show the mixed results. Is there any evidence of that having one or some factors makes the impacts change their signs? This paper deals with Foreign Direct Investment inflows impact on domestic firms' productivity through horizontal and vertical linkages and the factors that affect this relationship with panel data at firm-level of manufacturing industry in Vietnam from 2004 to 2010. The research finds that forward and backward linkages of FDI firms with local enterprises increase the productivity of domestic firms but the horizontal linkage only has positive impact on these firms if the neighbor countries also attract FDI in the same industries, otherwise this impact is negative. Absorptive capacity of local firms also impacts on their performance, and the linkages between FDI and domestic firms have non-linear relationship with their productivity.

Key words: Foreign Direct Investment, spillover effect, absorptive capacity, IV, non-linear

1. Introduction

Spillover effects of FDI at developing countries are concerned by many policy makers and researchers recently because of the important role of FDI to these economies. Many researches try to point out the impact of this capital through the linkages between foreign affiliates and domestic partners as well as domestic competitors, and presence of foreign ownership in the local enterprises, and other factors may impact the strength of this relationship such as absorptive capacity of domestic firms. Using Vietnamese firm-level data to examine spillover effect of FDI, this paper has following contributions: (i) the new measurement of absorptive capacity of firm which plays a critical role in increasing domestic output; (ii) non-linear relationship between absorptive capacity and firm's productivity along with OLS method; (iii) instrument variable method that takes Thailand's FDI indicators into consideration of the spillover effect.

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Foreign Direct Investment (FDI) inflows became an important investment capital of Vietnamese economy from starting of reforming named “Doi Moi” in 1988 that is characterized by the increase of quality and quantity of new products, high technology, jobs and financial market. At the same time, FDI changes the performance of Vietnamese domestic firms. The government raises the concern about whether FDI enterprises have positive or negative impact on the productivity and existences of domestics firms in inter-industry and intra-industry. The reality shows both sceneries.

Research of the economics spillover effects of FDI inflows on the developing countries is getting more attentions of economists recently. FDI spillovers take place when the productivity of the local firms increases due to entry or presence of transnational corporations (TNCs). In horizontal linkage, domestic firms can mimic technology from TNCs, or compete with TNCs by using the existing technology and resources more efficiently, or create new tech (Blomström & Kokko, 1998). In vertical linkage, they try to develop their production standard to engage in the global value chain with the TNCs from upstream or downstream sectors. To measure the FDI spillover effects, economists apply variety ways such as the available of foreign equity in the firm (Aitken & Harrison, 1999), the share of foreign gross output within industry as horizontal linkages effect (Sjöholm, 1999), and the contracts between TNCs and their local suppliers/distributors as vertical linkage effects (Javorcik, 2004). While existing firm-level studies on Venezuela, Bulgaria, Poland, Lithuania, and Romania fail to find significant effect or negative impact of the TNCs on domestic firms in the same sector, research of Anwar and Nguyen (2014) on Vietnam finds mixed results depending on the host regions of FDI.

Beside linkages and presence of FDI enterprises, other determinants such as absorptive capacity or technology gap, geography and other methodology such as non-linear regression, instrument variable are investigated to explain the spillover of foreign affiliates. However, all of these researches have not explained well about the FDI spillovers. Measurement of absorptive capacity is not sufficients, non-linear regression of absorptive capacity has not found the consistent results, or the instruments also present the different outcomes. What should be better absorptive capacity variable? Does it have non-linear relationship with the domestic productivity? If absorptive capacity has heterogeneity problem, should another methodology like IV to measure spillover effect be better? Which are the best IV proxies?

This study has three purposes. First, it examines whether the presence of multinationals in intra-industry and inter-industry pushes the productivity of domestic firms. Second, this paper provides new measurement of absorptive capacity to test its impact on the productivity. Third, this research applies non-linear regression and IV to test the relationship between absorptive capacity and productivity of domestic firms as well as the impact of FDI inflows into Thailand on the productivity of firms in Vietnam.

The analysis is based on three datasets. The first is from the Annual Enterprises Survey conducted by General Statistics Office of Vietnam (GSO). The survey covers all firms in Vietnam. The data constitutes a strong balanced panel covering the period 2004−2010 of manufacturing industry. The second is from Vietnamese input-output table 2007 also conducted by GSO where there are 138 industries for the whole economy. After merging these two datasets, the dataset includes 48 industries in manufacturing sector. The third dataset is the statistics of FDI inflows to Thailand that is made by The Board of Investment of Thailand (BOI). Focusing on developing country such as Vietnam to measure the FDI spillover effect is suitable for this project because the top investors in Vietnam are developed economies such as Japan, Singapore, Hong Kong, Taiwan etc. bringing skilled labors and high technology into Vietnam then makes Vietnam a good place for

productivity spillovers.

The results of this study can be summarized as follow. The empirical results are consistent with previous research that is the significant positive relationship of backward linkage of FDI and productivity of domestic firms. The forward linkage also have positive relationship with performance of domestic firms, this result is robust and bigger than the backward linkage. The horizontal linkage has mix signs. There is positive horizontal relationship of foreign capital with output of Vietnamese firms only if Thailand attracts FDI inflows in the same industry. Otherwise, the presence of FDI enterprises as competitors of domestic firms is not welcomed by local players.

The structure of this research is as follows: Section 2 gives a brief literature overview of FDI spillover channels and the role of absorptive capacity and methods used in spillover effect models. Section 3 discusses FDI inflows into Vietnam, data descriptions. Section 4 is estimation strategy. The results are presented in Section 5 and Section 6 is conclusions.

2. Literature review

As this paper links absorptive capacity of domestic firms and FDI spillover effect as well as some methodologies to solve endogeneity problems, this section briefly reviews absorptive capacity and methodologies of this strand of research.

FDI spillover effects are investigated in many previous researches. Spillover effects take place when appearance of FDI inflows has positive impact on the productivity, export etc… of the domestic firms through 2 channels: horizontal and vertical linkage with domestic firms (intra-industry and inter-industry). The existence of FDI may have different impacts on the domestic firms' performance that depending on many factors.

In horizontal linkage, the domestic firms most likely benefit from foreign affiliates by four channels. First, they imitate the new production or management procession of them. Second, they acquire the skilled-labors from TNCs. Third, they improve their productivity during competition under the pressure of TNCs on local rivals by using existing technology more efficiently. The last is the domestics firms can learn from the foreign affiliates how to enter the foreign market because FDI enterprises already have these experiences (Görg & Greenaway, 2004).

The reason that multinational corporations access foreign markets through FDI rather than export or license is they have their ownership advantages and they want to internalize certain transactions to protect their technology. How the firms in host country can absorb their proprietary knowledge though imitation, skills acquisition, completion or export depends on their absorptive capacity that is measured by technology gap (Kokko, 1994) (Girma, 2005), or depends on geography proximity (Aitken & Harrison, 1999). As suggested in theory of Findlay (1978), the greater the distance of development level of two economies, the greater the speed of uptake new technology. However, Glass and Saggi (1998) model presents that the longer the technological distance between the host and home country, the less likely the host country can absorb the technology from the home country.

Kokko (1994) measures technology gap by ratio of value added per employee in foreign plants to value added per employee in private locally owned plants in each industry. The result of this research shows that only technology gap does not seem to make spillovers, but both large productivity gaps and large foreign market

make the host country difficult to get the spillovers because the foreign affiliates crowd out local competitors from important segments of the market.

Girma has done a series of FDI spillover effect researches. In 2005, Girma mentioned about the absorptive capacity and FDI spillover effect using threshold regression techniques. He has done the research in the manufacturing industry at firm-level data from UK over the period 1989−1999. The absorptive capacity is measured by the distance of the firm from the technology frontiers intra-industry. He found that there are spillover effects. However, this marginal effect is smaller for firms with higher technological capacity and seems to have got the minimum absorptive capacity threshold from which the FDI spillover effects is not positive. The idea of current research is similar with Girma that the spillover effect of FDI has got the minimum absorptive capacity threshold. The way to measure absorptive capacity differentiates this research from previous papers in this field.

While the positive impact of spillover effect through horizontal linkage is not significant, many researchers can find the positive impact of FDI on domestic firm through vertical linkages. When the FDI enterprises choose domestic firms as their suppliers for input and distributors for output, these linkages help local firms to upgrade quality of intermediate products to catch up TNCs' standards and improve technology in consequence, as well as provide sufficient guideline for the customers to use their product effectively (Görg & Greenaway, 2004). Research of (Javorcik, 2004) is well-known by demonstration of positive backward linkage spillover effect from FDI firm to domestic firm. This vertical linkage is measured at industry level because the limitation of available data at firm-level. This paper follows the approach of Javorcik to measure vertical linkages between FDI and domestic firms.

The reasons for mixed results of FDI spillover effects are not only technology gap, geography proximity, or development level of the host and home countries, but also the method used in these researches are not always sufficient. In the case that regressions may have endogenous problem, some authors use instrument variable to solve that problems as following researches do.

Suggesting that the OLS estimation for FDI spillover effects using cross-sectional data has endogenous problem with Hausman specification test, Jordaan (2011) has introduced an original instrument for measuring the general FDI intensity of manufacturing industries in Mexico. In addition, he found robust evidence of significantly larger positive FDI spillover effects by IV estimation than OLS method. The instrument variable he uses meets two criteria: uncorrelates with the error term of OLS function, and sufficiently correlates with the variable FOR. FOR stands for the presence of intra-industry FDI spillovers which is measured by employment share of foreign-owned firms within each industry. Variable named US is used as proxy of FDI intensity which is measured by the ratio of employees working in foreign-owned firms over the total number of industry employees in US industries. The second instrument is US-VA which is average value added for US manufacturing industries for the period 1988-1995. Results of this research shows that FDI inflows move toward the low productivity industry and the IV methods show more complex tendency from FDI flows that maybe OLS both underestimate or overestimate the FDI spillovers. Considering the case of Vietnam, current paper uses Thailands FDI inflows characteristic as IV variables. This IV variables have not yet examined in any previous paper about FDI spillover effect with Vietnamese case.

In the case of U.S. manufacturing industry with firm-level data in the period of 1987 to 1996, Keller and Yeaple (2009) show that FDI improve the domestic firms productivity especially in the high-tech sectors than

the low-tech sectors. The small firms with lower productivity in comparison with the frontier productivity benefit more from FDI spillovers than the larger and more productive firms. In this research, the authors also use instrumental variables estimation and find stronger spillovers effect than previous studies. The instrument variables likely avoid the possibility of endogeneity of FDI in case that FDI is intended on downward for market expanding or upward for high-productivity growth. The two IVs are changes in shipping costs and tariffs and lagged level of the real exchange rate interacted with industry dummies. The FDI spillovers account for between 8% to 19% of productivity growth of U.S. firms. The changes in FDI spillovers effect after using IV variable will be given in result section.

3. Description of data

This section describes data for empirical analysis. Firm-level data and industry-level data are extracted from Vietnamese Annual Enterprises Survey (VAES) by General Statistics Office of Vietnam (GSO) from the year 2004 to 2010. The survey of 2004 covers 19,910 firms in all manufacturing industries while the number of 2010 is 45,984. The information getting from these data includes balance sheet and income statement statistics such as sales, inventories, number of fulltime labors, long-term asset, short-term asset, foreign investment capital, total capital, and industry code for 5-digit, 4-digit, 2-digit, and 1-digit, and the enterprise code. Enterprise code is used to merge dataset and make the panel data. The summary statistics of firm-level data are shown in Table 1. The definitions of the variables in this table will be given in the next section.

The second database from GSO used in this research is Input-Output (IO) Table 2007 and 2000. The table of 2000 includes 112 industries and the table of 2007 includes 138 industries. Two IO data tables are merged and aggregated and downsized to 89 industries. New 89 IO industries table are merged with VAES data which has information of industry code at 5-digit level to make linkages measurements at industry-level. The aggregation of industry is made base on the official publication book of GSO named “Input-output (I/O) of Vietnam year 2007”[2].

The instrument variables are also introduced in this research. The reason why Thailand FDI statistics is used as instrumental variables will be explained in the next section. These statistics are conducted from The Board of Investment of Thailand. The data contains number of projects, total FDI capital, total registered capital and number of employment classified by industry.

4. Empirical model and results

4.1 General model and variables description

To find the spillover effect of FDI on the productivity of domestic firms called Y_{ijt}, Cobb-Douglas production function is used as a basic model in this research. In addition to the effect of labor and capital and other control variables (X_{ijt}) on the productivity of firm from original model, FDI spillover effect would be result in the change of the productivity. This spillover effect is defined by the impact of relative relationship among FDI enterprises and domestic firms on productivity of firms. The relationship can be measured by various methods. This paper uses two kinds of relationships. First proxy of these linkages is presented by

2) The link of that book is http://www.gso.gov.vn/default.aspx?tabid=512&idmid=5&ItemID=10752 and link for industry comparision is http://www.gso.gov.vn/Modules/Doc_Download.aspx?DocID=12648

vector variables $FDILinks_{jt}$ at industrial level. Vector variables $AC_{ijt/jt}$ namely absorptive capacity is second proxy of the relationship between domestic firm and FDI firm at both firm level and industry level. Detail explanation of these two vectors will be presented along with following empirical model.

$$lnY_{ijt} = \beta_0 + \beta_1 X_{ijt} + \beta_2 FDILinks_{jt} + \beta_3 \boldsymbol{AC_{ijt/jt}} + fe_t + fe_j + \varepsilon_{ijt} \quad (1)$$

The dependent variable log output Y_{ijt} of firm i in sector j at year t is regressed on a vector of control variables inputs X_{ijt} and other independent variables including the vector of linkages of FDI enterprises and domestic partners/rivals at industry-level $FDILinks_{jt}$, and the absorptive capacity between domestic firms and FDI firms intra-industry and inter-industry $AC_{ijt/jt}$. In the model, the main interest parameter is β_2. This should be positive signal suggesting higher absorptive capacity, higher productivity of domestic firms.

The output Y_{ijt} is calculated by the total sales of firm i at the end of year t plus inventories at the end of the year minus inventories at the beginning of the year of finished goods of this firm. This output measurement is better for productivity measurement than sales.

In the right hand side, vector of control variables X_{ijt} includes labor, capital, material, and Herfindahl-Hirschman index which have definition as follow. K_{ijy} is capital of the firm that is measured by long-term assets, L_{ijt} is number of labors, M_{ijt} stands for material which is measured by short-term asset, all at the end of year t. As we can see from the summary statistic table 1, the average output of an individual firm Y_{ij} is 24 billion VND while the mean value of material M_{ij} is more than seventy per centum of the output in comparison with more than fifty percent of K_{ij}. Each firm has 43 labors in average while the maximum number of labor is 87,225. This largest firm works in the shoes industries and is 100% FDI enterprise. Most firms in Vietnam are small and medium enterprises. The expected sign of Labor, Capital and Material are positive as suggested in theory of Cob-Douglass.

The last control variable in vector X_{ijt} is an industrial level variable namely Herfindahl-Hirschman Index HH_j. It stands for monopolistic or competition power of an industry j. This value ranges from close to 0 to 1 (Sjöholm, 1999).

$$HHIj = \sum_{i\ for\ all\ i \epsilon j} \left(\frac{Sale_i}{Sale_j} * 100\right)^2 \quad (2)$$

If there is only one firm in industry j, then HHI_j=100^2=10.000. This means the market is monopoly. If there are many firms in an industry where the $Sale_i$ of each firm is not far different from other firms, HHI_j is close to 0, and the market is perfect competition. If there are some big companies that have majority market shares, the HHI_j becomes larger. The market transforms from competition to monopoly depending on how big market share of some largest enterprises is in that industry. The bigger the value of this index, the more concentration of the industry, or only few firms have majority market share and vice versa. This index should have negative relationship with the productivity of firms. The mean value of this index is around 181 for all industries of Vietnam with standard deviation of 504 and the min value is 11 to max value of 9678.

To summarize expected significance of these control variables, the *hypothesis 1* for them is: *Labor, capital, and material have positive relationship with output of firm, while the more competitive the market is (or Herfindahl index is low), the more productive the firms are.*

Beside the control variables, one of interest vector variables in this research is the $FDILinks_{jt}$. This group of variables includes Horizontal, Backward and Forward linkage of FDI firms with domestic firms.

The domestic firms in developing countries are assumed to absorb the better productive technology or know-how from foreign affiliates because they often come from more advanced economy, both at horizontal linkages and vertical linkages; or local enterprises have to exit from the market under competition of FDI enterprises. It is not easy to get the data to measure this kind of horizontal or vertical contract between FDI and domestic firms at firm level. Therefore, this research follow (Javorcik, 2004) and (Aitken & Harrison, 1999) to measure these relationships at industry level. However, this research aggregates more detail manufacturing industry level than the two previous researches (47 industries in comparison with 22 industries).

Hypothesis 2: The stronger the vertical linkages, the higher the productivity and the stronger the horizontal linkage, the less the productivity of domestic firm.

$HorizontalFKI_{jt}$ is measured by FDI presence in the sector j at time t that is defined as average foreign equity share in the sector weighted by the share of firm in industry output. $FShare_{it}$ is foreign equity share of firm i at time t.

$$HorizontalFDI_{jt} = \sum_{i\ for\ all\ i\in j} FShare_{ijt} * Y_{ijt} / \sum_{i\ for\ all\ i\in j} Y_{ijt} \quad (3)$$

This indicator is higher with the higher foreign ownership and output Y of foreign affiliates within the industry.

Vertical FDI linkages include $BackwardFDI_{jt}$ and $ForwardFDI_{jt}$. $BackwardFDI_{jt}$ is the *Backward* relationship *of FDI* firm with industry j. It is the proxy of relationship between FDI enterprises in all industries k except j, and their domestic suppliers in industry j. The formula of $BackwardFDI_{jt}$ is as followed:

$$BackwardFDI_{jt} = \sum_{k\ if\ k\neq j} \propto_{jk} HorizontalFDI_{kt} \quad (4)$$

where $\propto_{jk}$ is the proportion of sector j output supply to sector k. FDI enterprises are at downstream while other enterprises are at upstream. If this value is higher, it means that demand of intermediate goods from industry j necessary for production of FDI enterprises in other sectors is higher. In other words, FDI firms demand intermediate goods from sector j. This value is calculated from input-output table 2000 of Vietnam for data from 2004 to 2006 and from input-output table 2007 of Vietnam for data 2007–2010. The industries level j which is used in this research are as detailed as 89 industries for the whole economy and 47 industries for manufacturing after downsize about more than 600 industries of 5-digit level industry of VAES, 138 industries in IO table 2007, and 112 industries in IO table 2000. Input supply within sector j is not included because its effect is already calculated in the formula of . The value of this variable is bigger if the share of foreign equity in sectors k supplied by sector j and proportion of sector j output supply to sector k is greater.

The relationship between FDI enterprises in all industries m except j, and their distributors or customers in industry j $ForwardFDI_{jt}$ is estimated as followed:

$$ForwardFDI_{jt} = \sum_{m\ if\ m\neq j} \sigma_{jm} HorizontalFDI_{mt} \quad (5)$$

σ_{jm} is the share of inputs purchased by industry j from industry m in total inputs sourced by sector j. FDI firms are suppliers for sector j. $ForwardFDI_{jt}$ means Forward linkage of FDI firm with industry j. The purchase within the sector j is excluded because it is already presented in the formula. Actually, the export of foreign affiliates should be eliminated in $HorizontalFDI_{mt}$ because only domestic distributors should be the subject in this study. However, due to the lack of export data for every year from 2004 to 2010, the export of foreign enterprises is not eliminated in this study. Value of this variable has positive relationship with the share of foreign output in the upstream sector $_m$.

Among these three linkages, Backward linkage of FDI firms with domestic firms has highest mean value (0.82) while Horizontal linkage mean value is only 0.12 and Forward linkage is only 0.22. The min value of Horizontal linkage is equal to 0. It means that in some industries there is no FDI enterprise. Even though Vietnam does not have good supporting industries compared with some neighbor countries but the statistics suggests that FDI inflows to Vietnam tends to find domestic suppliers through backward linkage than seeking for market or distributors in local market.

The most interest parameter is β_3 with absorptive capacity. The idea of absorptive capacity measurement between firm i in sector j and foreign affiliates in the same sector is based on research of Girma (2005) and Kokko (1994). While Girma defines absorptive capacity as the level of Total Factor Productivity (TFP) in the previous period divided by the maximum level of TFP within the industry, Kokko measures it by value added per employee between domestic and foreign firms also in industry level. This paper defines absorptive capacity by four ways for robust check purpose. First, it is measured by the ratio between labor productivity of domestics firm and foreign affiliates at both firm-level AC_{ijt} and industry-level AC_{ijt} and adjusted by the foreign equity share in each firm. Distance between productivity of domestic firm and the average FDI's firms' technology intra-industry is considered in this research instead of frontiers because it is supposed that any firm which has above average technology power would have some absorptive capacity.

Hypothesis 3: The greater the absorptive capacity, the greater the productivity.

The formula of absorptive capacity at firm-level with labor productivity is:

$$ACL_{ijt} = \frac{LP_{ijt}}{LP^{f}_{jt}} = \frac{\frac{Y_{ijt}}{L_{ijt}}}{\frac{\sum_{i=1}^{F}\left(\frac{Y_{ijt}}{L_{ijt}}\right)*FShare_{ijt}}{\sum_{i=1}^{F} FShare_{ijt}}} \tag{6}$$

The formula of absorptive capacity at industry-level with labor productivity is:

$$ACL_{jt} = \frac{LP_{jt}}{LP^{f}_{jt}} = \frac{\frac{\sum_{i=1}^{J}\frac{Y_{ijt}}{L_{ijt}}}{J}}{\frac{\sum_{i=1}^{F}\left(\frac{Y_{ijt}}{L_{ijt}}\right)*FShare_{ijt}}{\sum_{i=1}^{F} FShare_{ijt}}} \tag{7}$$

Table 1: Summary statistics

Variable	N	Mean	Sd	Min	Max
Yij	1,140,534	24,240	445,583	1	112,000,000
Kij	1,040,221	13,193	639,552	1	260,000,000
Lij	1,138,610	44	390	1	87,225
Mij	1,136,688	18,628	704,390	1	329,000,000
HorizontalFDIij	1,140,534	0.12	0.16	−	0.91
BackwardFDIj	1,140,020	0.82	0.65	0.00	1.70
ForwardFDIj	1,140,020	0.22	0.20	0.02	1.33
HHIj	1,140,534	181	504	11	9678
ACLKij	1,032,587	0.97	1.24	− 254.10	216.24
ACLKj	1,133,845	0.97	0.96	− 132.61	26.28
ACLij	1,131,925	0.55	6.78	−	3,480.99
ACLj	1,133,845	0.57	4.71	0.01	708.36

In formula (6), the numerator LPijt = Yijt/Lijt stands for Labor Productivity (LP) of firm i whereas $LP_{jt}^{f} = \frac{\sum_{i=1}^{F}\left(\frac{Y_{ijt}}{L_{ijt}}\right)*FShare_{ijt}}{\sum_{i=1}^{F} FShare_{ijt}}$ is the proxy of Foreign Labor Productivity of industry j. This indicator is defined by average LP of foreign affiliates weighted by share of foreign equity of each firm in the industry. F is total number of foreign affiliates of this sector. A firm is considered as foreign affiliate when it has from 10% foreign equity share upwards. The denominator of formula (7) is the same with that of formula (6) and they are all industry-level measurement. The thing which makes formula (6) and formula (7) different is that formula (6) is the absorptive capacity at firm-level when formula (7) is the absorptive capacity at industry-level with labor productivity of industry j at the numerator $LP_{jt} = \frac{\sum_{i=1}^{J}\frac{Y_{ijt}}{L_{ijt}}}{J}$ where J is total number of firms of this sector.

Beside labor productivity, this research uses the average total factor productivity (ATFP) in the formula of absorptive capacity.

Absorptive capacity at firm-level formula with ATFP is:

$$ACLK_{ijt} = \frac{ATFP_{ijt}}{ATFP_{jt}^{f}} = \frac{ln\frac{Y_{ijt}}{L_{ijt}} - \alpha ln\frac{K_{ijt}}{L_{ijt}}}{\frac{\sum_{i=1}^{F}\left(ln\frac{Y_{ijt}}{L_{ijt}} - \alpha ln\frac{K_{ijt}}{L_{ijt}}\right)*FShare_{ijt}}{\sum_{i=1}^{F} FShare_{ijt}}};\ i \in j \quad (8)$$

Absorptive capacity at industry-level formula with ATFP is:

$$ACLK_{jt} = \frac{ATFP_{jt}}{ATFP_{jt}^{f}} = \frac{\frac{\sum_{i=1}^{J}\left(ln\frac{Y_{ijt}}{L_{ijt}} - \alpha ln\frac{K_{ijt}}{L_{ijt}}\right)}{J}}{\frac{\sum_{i=1}^{F}\left(ln\frac{Y_{ijt}}{L_{ijt}} - \alpha ln\frac{K_{ijt}}{L_{ijt}}\right)*FShare_{ijt}}{\sum_{i=1}^{F} Fshare_{ijt}}};\ i \in j \quad (9)$$

The value of α equals to 1/6 according to the regression model and research of Tomiura (2007). Instead of using Labor Productivity in the calculation the absorptive capacity like (6) and (7), the formulas of (8) and (9) use $ATFP_{ijt} = ln\frac{Y_{ijt}}{L_{ijt}} - \alpha ln\frac{K_{ijt}}{L_{ijt}}$.

According to statistics in Table 1, the average value of absorptive capacities at firm-level and industry-level in both aspect LP and ATFP are quite similar. Meanwhile the average absorptive capacities calculated by ATFP is higher than the one measured by LP, both average values are lower than 1. It means that domestic firms have relatively lower productivity than FDI firms.

4.2. Effects of Absorptive Capacity on Productivity

Table 2 shows that the sign of the interested parameter for absorptive capacity is positive as expected. The higher the absorptive capacity is, the higher the productivity of domestic firm is. Main results of general model are presented in this table and will be discussed as follows.

The column (1) is the result for control variables: capital, labor, material, and Herfindahl-Hirschman (HH) index which presents market competition power. All of control variables that show expected results such as capital, labor, and material have positive impact on the productivity of firms. The highest magnitude belongs to labor which is about 6 times higher than capital while material is about 4 times. This result suggests that the most important inputs of Vietnamese firms are labor and material, capital is not that important for the development of firms. This result is also evidence from which we use the value of α is 1/6 for the formula to measure the ATFP at firm level. HH has negative impact on productivity of firm. This measurement is at industry level, it means that within highly monopolized industry where some firms have very large market share, productivity of firm is lower than the firm in other industry with many small companies. The robust checks for these dependent variables have consistent and stable value of parameters through columns (2) to columns (6).

Three important variables to determine linkages of FDI firm with domestic firm in an industry are Horizontal, Backward and Forward linkages. The linkage which has strongest positive impact on the productivity of firm is forward linkage which has the same power as the effect of labor. About one percent increases in Forward linkage make 0.6 percent increase in productivity of firm. In other word, if one industry has higher output and foreign equity at downstream sector and domestic firm is at upstream sector, that industry has higher output of domestic firms. Backward linkage also has positive relationship with output of firm but opposite side in case of horizontal linkage. The more concentration of FDI firm in one industry, the less output of domestic firm. This effect is known as “crowding out” effect.

The most important variable here is absorptive capacity at firm level and industry level. If the domestic firm has higher ATFP in comparison with average FDI productivity, their absorptive capacity is higher. The result shows that if absorptive capacity increases one percent, the productivity increase about 0.02 percent to 0.09 percent.

This significant is at 99% level and the magnitude is 0.0164 for ACL at firm level and 0.0792 or 0.0896 for ACL at industry level.

The Table 3 shows consistent result with Table 2 after replacing labor absorptive capacity by ATFP absorptive capacity. This relationship even is stronger than labor absorptive capacity (from 0.2 to 2) and positive.

Table 2: Relationship between domestic firm's performance and absorptive capacity measured by Labor productivity

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	lnYij	lnYij	lnYij	lnYij	lnYij	lnYij
lnKij	0.0919***	0.0895***	0.0905***	0.0910***	0.0881***	0.0888***
	(0.00293)	(0.00293)	(0.00291)	(0.00293)	(0.00291)	(0.00293)
lnLij	0.526***	0.531***	0.538***	0.528***	0.544***	0.533***
	(0.00487)	(0.00487)	(0.00485)	(0.00487)	(0.00485)	(0.00487)
lnMij	0.389***	0.380***	0.385***	0.387***	0.376***	0.379***
	(0.00327)	(0.00330)	(0.00325)	(0.00328)	(0.00328)	(0.00331)
HHIj	− 0.424***	− 0.225**	− 0.452***	− 0.667***	− 0.255***	− 0.484***
	(0.0937)	(0.0960)	(0.0930)	(0.0955)	(0.0953)	(0.0989)
HorizontalFDIj		− 0.992***			− 0.978***	− 0.822***
		(0.0626)			(0.0621)	(0.0645)
BackwardFDIj		0.218***			0.229***	0.236***
		(0.0274)			(0.0272)	(0.0274)
ForwardFDIj		0.662***			0.648***	0.561***
		(0.0508)			(0.0504)	(0.0516)
ACLij			0.0164***		0.0164***	
			(0.000370)		(0.000369)	
ACLj				0.0896***		0.0792***
				(0.00700)		(0.00728)
Constant	2.701***	2.652***	2.687***	2.659***	2.635***	2.596***
	(0.0256)	(0.0274)	(0.0254)	(0.0258)	(0.0272)	(0.0279)
#observation	206,158	206,158	206,156	206,157	206,156	206,157
R-squared	0.263	0.265	0.274	0.264	0.276	0.266
#firm	71,498	71,498	71,497	71,498	71,497	71,498

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Relationship between absorptive capacity that measured with ATFP and productivity of domestic firms

	(5)	(6)	(9)	(10)
VARIABLES	lnYij	lnYij	lnYij	lnYij
lnKij	0.144***	0.0928***	0.141***	0.0904***
	(0.00219)	(0.00292)	(0.00218)	(0.00292)
lnLij	0.636***	0.524***	0.643***	0.530***
	(0.00365)	(0.00487)	(0.00364)	(0.00487)
lnMij	0.269***	0.392***	0.258***	0.383***
	(0.00247)	(0.00328)	(0.00248)	(0.00330)
HHIj	−0.0509	−0.385***	0.174**	−0.194**
	(0.0699)	(0.0936)	(0.0714)	(0.0959)
HorizontalFDIj			−0.910***	−0.963***
			(0.0465)	(0.0625)
BackwardFDIj			0.464***	0.227***
			(0.0204)	(0.0273)
ForwardFDIj			0.464***	0.645***
			(0.0378)	(0.0508)
ACLKij	2.074***		2.080***	
	(0.00633)		(0.00631)	
ACLKj		0.229***		0.228***
		(0.0139)		(0.0139)
Constant	0.977***	2.461***	0.882***	2.406***
	(0.0198)	(0.0294)	(0.0211)	(0.0312)
Observations	206,154	206,157	206,154	206,157
R-squared	0.590	0.265	0.594	0.267
Number of tco	71,498	71,498	71,498	71,498

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3. Nonlinear relationship between Absorptive Capacity and Spillover Effect

Effect of absorptive capacity should be non-linear (Girma, 2005) and change the speed when their productivity is closer to FDI firm. The data description shows that mean value of absorptive capacity is less than 1 implies that domestic firm has lower productivity than FDI firms. Spillover effect should increase where absorptive capacity is low, the speed of this rising is slowdown and will decrease after reaching the vertex. The relationship between absorptive capacity and spillover effect maybe quadratic function and is presented as follow:

Table 4: Non-linear relationship between absorptive capacity and productivity of firms

	(1)	(2)	(3)	(4)
VARIABLES	lnYij	lnYij	lnYij	lnYij
lnKij	0.0859***	0.0885***	0.159***	0.0919***
	(0.00285)	(0.00292)	(0.00182)	(0.00292)
lnLij	0.585***	0.534***	0.678***	0.527***
	(0.00478)	(0.00487)	(0.00304)	(0.00486)
lnMij	0.364***	0.378***	0.214***	0.388***
	(0.00322)	(0.00330)	(0.00208)	(0.00331)
HHIj	−0.192**	−0.421***	0.401***	−0.0827
	(0.0934)	(0.0990)	(0.0596)	(0.0958)
HorizontalFDIj	−0.988***	−0.778***	−0.932***	−0.934***
	(0.0609)	(0.0646)	(0.0389)	(0.0624)
BackwardFDIj	0.269***	0.250***	0.561***	0.248***
	(0.0266)	(0.0274)	(0.0170)	(0.0273)
ForwardFDIj	0.610***	0.519***	0.378***	0.612***
	(0.0494)	(0.0517)	(0.0316)	(0.0507)
ACLij	0.0735***			
	(0.000845)			
ACLij2	−3.27e−05***			
	(4.37e−07)			
ACLj		0.171***		
		(0.0110)		
ACLj2		−0.0200***		
		(0.00180)		
ACLKij			3.061***	
			(0.00665)	
ACLKij2			−0.136***	
			(0.000561)	
ACLKj				0.728***
				(0.0259)
ACLKj2				−0.0580***
				(0.00254)
Constant	2.575***	2.543***	0.199***	1.944***
	(0.0267)	(0.0283)	(0.0178)	(0.0371)
Observations	206,156	206,157	206,154	206,157
R-squared	0.305	0.267	0.717	0.270
Number of tco	71,497	71,498	71,498	71,498

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Model:

$$lnY_{ijt} = \beta_0 + \beta_1 X_{ijt} + \beta_2 FDILinks_{jt} + \boldsymbol{\beta_3 AC_{ijt/jt}} + \boldsymbol{\beta_3' AC_{ijt/jt}}^{\boldsymbol{2}} + fe_t + fe_j + \varepsilon_{ijt} \qquad (10)$$

The parameter β_3 should be positive while β_3' should be negative as my assumption and the parabola can open down.

Table 4 displays the estimation result of (10). For all type of AC (at firm level or industry level, measured by labor productivity or ATFP), the AC is significantly positive and AC^2 is significantly negative, and this relationship confirms the open down parabola relationship between absorptive capacity and productivity of firm. As a related finding of the relationship of absorptive capacity and productivity, Girma (2005) discovers the presence of nonlinear threshold effects: the productivity benefit from FDI increase with absorptive capacity until some threshold level beyond which it becomes less pronounced. Stock, Greis, and Fischer (2001) also find that an "inverted_U" shape suggests diminishing returns for absorptive capacity.

4.4. Instrument variables

Although it is included in the right hand side of the regressions, AC might not be exogenous. For instance, AC may rise as a result of high-sale of firm. To solve the endogeneity problem, the following two variables are used as instrument variables (IV).

These instruments are the share of foreign capital in total registered capital of Thailand by industries (FShareT2), and share of Foreign Capital in total capital of the FDI projects in Thailand by Industries (FShareT1). These two variables can safely be regarded as exogenously given for current sales adjusted for change in inventory (Y) of firms in Vietnam in the same industry but are likely to be correlated with AC from the following reasons. First, structure of FDI inflow to Thailand and to Vietnam is very similar particularly in manufacturing industry. Thailand and Vietnam are located inside the South-East Asia while Thailand is rival of Vietnam in terms of FDI attractiveness. Three biggest FDI home countries in Vietnam, Korea, Japan, and Singapore also invest in Thailand and these investors are concerned with the whole market within the region not only Vietnam. The foreign investor looking for labor or resource in Vietnam may find the market or same resource in Thailand. The FDI inflows may have relationship with AC of Vietnam.

Model:

First-stage:

$$\boldsymbol{AC_{jt}} = \gamma_0 + \gamma_1 X_{ijt} + \gamma_2 \boldsymbol{ThaiFDI_{jt}} + \epsilon_{ijt}$$

Second-stage:

$$lnY_{ijt} = \beta_0 + \boldsymbol{\beta_2 AC_{jt}} + \beta_3 X_{ijt} + \varepsilon_{ijt}$$

Second, Thailand and Vietnam are two competitors in attracting FDI because their locations are close, and they have same economic development level and manufacturing structure. Vietnam is trying to learn from Thailand how to upgrade the manufacturing industry as well as use foreign direct investment as an important source of capital to push the development of domestic firms. These common features raise the idea that FDI inflows into Vietnam may be affected by FDI inflows into Thailand. In other word, FDI inflows into Thailand could be good instrument variable for FDI inflows into Vietnam. The idea to choose IV in this research is inspired from the research of Jordaan (2011) which shows the intra-industry FDI presence measured by

Table 5: Relationship between Absorptive Capacity instrumented variable and productivity of firms.

	(1)	(2)	(3)	(4)
	IV 1st	IV 2nd	IV 1st	IV 2nd
VARIABLES	ACLKj	lnYij	ACLKij	lnYij
lnKij	− 0.00460***	0.0471***	− 0.0371***	0.123***
	(0.000235)	(0.00377)	(0.000857)	(0.00608)
lnLij	0.0163***	0.596***	− 0.0217***	0.705***
	(0.000293)	(0.00557)	(0.00107)	(0.00535)
lnMij	− 0.00940***	0.562***	0.103***	0.278***
	(0.000294)	(0.00503)	(0.00108)	(0.0140)
HorizontalFDIj	− 0.114***	0.457***	− 0.303***	0.754***
	(0.00435)	(0.0740)	(0.0159)	(0.0830)
BackwardFDIj	− 0.0768***	1.302***	− 0.184***	1.493***
	(0.00176)	(0.0264)	(0.00646)	(0.0298)
ForwardFDIj	0.132***	− 2.167***	0.358***	− 2.539***
	(0.00331)	(0.0557)	(0.0121)	(0.0675)
HHIj	− 0.404***	2.144***	− 0.755***	2.652***
	(0.00655)	(0.122)	(0.0242)	(0.140)
FShareT1	− 0.117***		− 0.118***	
	(0.00186)		(0.00682)	
FShareT2	0.161***		0.219***	
	(0.00184)		(0.00673)	
ACLKjhat		3.382***		
		(0.177)		
ACLKijhat				2.463***
				(0.132)
Constant	0.942***	− 1.587***	0.356***	0.684***
	(0.00221)	(0.187)	(0.00805)	(0.0731)
Observations	79,434	77,800	77,798	77,800
R-squared	0.210	0.691	0.133	0.691

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

employment share of foreign-owned firms within each industry in Mexico is one endogenous variable that is affected by the US FDI intensity.

In this research, the FDI participation at firm level $ACLK_{ijt/jt}$ is treated as instrumented variable which can be impacted by Thailand FDI inflows. The data of Thailand FDI is aggregated from the FDI report by BOI

Thailand. The data of Thailand includes statistics of number of projects, investment (million Baht), registered capital (million Baht), and employment at industry level through year 2007 to year 2010. Projects are those to be approved by BOI by year and classified by sub-sector. Investment is total foreign investment capital by projects with foreign capital of at least 10% (million Baht). Registered capital is additional registered capital amount (not registered capital of whole company) for projects approved by BOI investment promotion which can be either new or expansion projects. In many cases, firms do not invest new capitals for their expansion project. Registered capital is divided into Thailand and Foreign capital. Employment is number of labors for the incremental projects including Thailand labors and foreign labors.

IV estimation results are reported in Table 5. In the first-stage regression, all the right hand side variables are used. The problem of weak instrument is not affected and that is confirmed by tests of endogeneity, weak instrument and over identifying restriction.

As the most important point to note from the second-stage regressions in this table, even after instrumenting absorptive capacity with foreign capital share of Thailand in each industry, I confirm that absorptive capacity is significantly positively related with the output of firm, either at firm-level or industry-level. Consequently, the robustness of my main findings reported in the previous section is confirmed by this IV estimation.

5. Concluding remarks

Flowing into Vietnam for about three decades, even the linkages of FDI firms and domestic firms are not too strong, this linkages almost have positive impact on the productivity of domestic firms particularly the forward and backward linkages. FDI enterprises choose higher productivity firms to be their supplier or distributors. At the same time, on the other hand, during being customers or suppliers of foreign firms, domestic enterprises increase their productivity through learning-by-doing process to meet the requirement of FDI firm.

The reason why horizontal linkages effect significantly negatively on the output of domestic firms is because if FDI firms choose domestic market as their main market in industry such as making accessory providers, or retail sectors, they have stronger competition power than domestic firms and may kick them out of the market or reduce their market share.

The most important and new variable in this research is absorptive capacity of domestic firm or domestic industry relatively with average productivity of FDI firm. If domestic firm has higher absorptive capacity, it will have higher productivity. This relationship is strong and positively significant at all firm or industry levels as well as different measurement based on labor productivity or average total factor productivity. The measurement of absorptive capacity in this research is new. Non-linear relationship is also confirmed, which means that the higher absorptive capacity of domestic firm, the higher their productivity. However, the U-inverted quadratic function shows that until threshold point, even AC is higher, productivity of domestic firm got the maximum point and goes down.

The endogeneity problem which may take place in the regression function is eliminated by instrumented absorptive capacity with presence of foreign direct investment in Thailand because the similarity of FDI capital through industries between Thailand and Vietnam. The IV instruments variable confirms the positive

relationship between AC and productivity of domestic firms.

While this finding is strong with new AC variables, there still remain several important issues. For example, the linkages between domestic and foreign firms should be measured not only at industry level but also at firm level. As yet another extension, absorptive capacity with different home countries will reveal additional policies suggestions for discussion on FDI spillover effects.

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