Less than expected – The minor role of MNEs in upgrading domestic suppliers – the case of Vietnam

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Abstract:

The impact analysis of FDIs on developing countries have captured attention of many researchers. Especially, the link between FDI and domestic firms is increasingly in the focus. Amongst the different spillover channels, backward linkages are believed to have a positive impact on upgrading local firms' technological and organizational capabilities. This study, therefore, draws on the backward spillover effects from the supplier perspective based on the Vietnam Enterprise Survey conducted by the General Statistical Office and our in-depth interviews with domestic suppliers. By using the Malmquist Index, we are able to decompose the total factor productivity (TFP) growth into technical progress and efficiency change. The overall analysis for Vietnam using the propensity score matching method shows the positive impact of being a supplier to MNEs on the TFP growth and technical progress. However, the finding at the regional level presents a different picture. Contrastingly to the overall result for Vietnam and the most dynamic region of the country, the Southeast with Ho-Chi-Minh City, our econometric finding for the Red River Delta (RRD) indicates that the TFP growth between suppliers and non-suppliers are not statistically different. Our in-depth interviews with domestic suppliers in the RRD detect that being a supplier is one mode to enhance business performance, but this mode does not always work, especially for firms supplying standardized simple products with low added value. Indeed, effects of MNEs on domestic suppliers in the RRD are much more indirect and limited due to weak technological and absorptive capabilities expressed in low level of R&D activities and human capital.

I. Introduction

A number of developing and transition economies have given a high priority in their agenda to attract FDIs with the hope that inward FDIs directly or indirectly lead to economic growth. Particularly, FDIs could bring in new technology, new know-how and could help domestic firms to increase the productivity and competitiveness (Javorcik 2004). Not surprisingly, Vietnam has encouraged foreign firms to invest by offering favorable conditions like fiscal incentives or physical infrastructure (UNIDO 2011).

Theoretically, the presence and entry of MNEs might cause spillover effects through different mechanisms and as a consequence the productivity growth of local firms (Bloström and Kokko 1998, Dunning and Lundan 2008). For example, domestic manufacturers may imitate technology or recruit employees trained by foreign firms. Even competitive pressure caused by the presence of MNEs could be seen as a motivation for domestic counterparts to introduce new technology and enhance their competences (Blomström and Kokko 1998). However, in contrast to the belief on the positive spillover effect from FDIs, a range of empirical studies show an opposite picture (Rodrik 1999). Studies of Görg and Greenaway (2004) and Javorcik (2004) conclude that there is no strong evidence about a gross positive spillover effect from FDIs. Plausible reasons for the negative spillover effects from MNEs could be the low absorptive capacity of domestic firms or the unwillingness of MNEs to share know-how and technology.

According to Javorcik (2004), while spillovers are more likely to take place in backward linkages in which input of MNEs are from firms in upstream industries, the impact of MNEs on domestic suppliers have not been captured properly. Similarly in Vietnam, where, there are few studies covering the issue on backward spillover effects of MNEs on Vietnamese firms. Results of previous studies are mixed. While Nguyen et al. (2005), Le (2008), Nguyen et al. (2008), Nguyen (2008), and Newman et al. (2015) observe positive spillover effects through backward linkages in manufacturing firms, Giroud (2007) and UNIDO (2011) find limited linkages and spillovers between MNEs and domestic manufacturers. The mix results might imply that being a supplier to MNEs is not a sufficient condition for upgrading. The aim of our paper is to examine to what extent the presence of MNEs accelerates the productivity growth of domestic suppliers in Vietnam either driven by efficiency gains and/or technological progress. In line with most studies in the field, we take the total factor productivity (TFP) growth as a proxy for the process upgrading of firms. However, by applying the data envelopment analysis (DEA) methodology to estimate Malmquist productivity indices, we can decompose the TFP growth into efficiency change and technical progress. As such, it is possible to explore factors contributing to productivity changes

(Färe et al. 1994). Additionally, different from most previous studies which rely on input-output matrices to measure interactions amongst sectors (Javorcik 2004, Godart and Görg 2013), we have data that enables us to recognize an individual firm as a supplier of MNEs or not. Apparently, suppliers who have a direct linkage to MNEs should be influenced by MNEs differently than non-suppliers. To the best of our knowledge, Javorcik and Spatareanu (2009), Godard and Görg (2013), and Newman et al. (2015) are among the first to study quantitatively the difference in economic performance between suppliers and non-suppliers of MNEs in the host country. Based on the firm level data for Czech Republic, Javorcik and Spatareanu (2009) find that suppliers are more productive than non-suppliers. Similarly, Newman et al. (2015) find the evidence for positive backward spillovers from MNEs to domestic suppliers in Vietnam. In contrast, using a dataset covering more than 1000 firms from 25 emerging economies, Godard and Görg (2013) prove that being a supplier of MNEs does not necessarily automatically help domestic firms to increase their productivity. Only those who get more demanding requirements from MNEs are more likely to gain a higher productivity growth. However, according to Potter et al. (2010), quantitative studies are unable to provide detailed information on the processes through which such spillover effects occur (Potter et al. 2010). Blomström and Kokko (1998) as well as Ivarsson and Alvstam (2005) suggest that the study on the relationship between the business performance development of local firms and the presence of MNEs requires both detailed qualitative and quantitative micro data. Therefore, we decided to conduct in-depth face-to-face interviews with 15 domestic suppliers from different manufacturing industries, 3 MNEs from automobile and electronic industries, and 1 training center in the RRD to further support the results of empirical analysis using the Viet Nam Enterprise Survey carried out by the General Statistical Office of Viet Nam (GSO).

Focusing on domestic suppliers, our paper assesses the TFP growth as a result of their business interaction with MNEs. We provide answers to two main research questions:

(i) Are domestic suppliers of MNEs better off in terms of TFP growth than non-supplying domestic firms? If so, is this result valid throughout Vietnam or are there regional differences?

(ii) What characteristics of domestic suppliers are conducive to productivity enhancement?

Vietnam is an important case for studying the impact of MNEs' backward linkages on local firms' productivity. As an emerging economy Vietnam became the second most popular FDI destination after China in Pacific Asia in 2014 (Fingar 2015). Our empirical analysis for whole Vietnam proves a significant difference in the productivity growth between domestic suppliers who have a direct linkage with MNEs and non-suppliers. This is also true for the Southeast Region

with Ho-Chi-Minh City as economic center. However, in the Red River Delta, that difference is not statistically significant. Based on in-depth interviews with domestic suppliers, we reveal that in the RRD, effects of MNEs on the productivity upgrading of domestic suppliers are indirect and limited while internal factors like absorptive capacities are more important for the productivity growth.

This paper looks first at the literature about the impacts of MNEs on the productivity and upgrading of domestic suppliers. The next section introduces the applied methodology. Then we examine the empirical evidence of the comparison of TFP growth between suppliers and non-suppliers of MNEs and analyze the competence of domestic suppliers in productivity upgrading. Our final section concludes and draws some implications for policy.

II. MNEs and productivity upgrading of domestic suppliers

FDI has long been considered a major vehicle for technological and managerial knowledge transfer to firms in developing countries (Dunning 1993, Lall 2003, Fu and Gong 2010). These spillovers from foreign firms could lead to productivity growth in local firms (Fu and Gong 2010). Spillovers occur through different channels. For example, local firms imitate the technology, learn knowledge of MNEs through being in the close proximity to MNEs or being their suppliers and/or customers, or hire former MNE employees. Even if MNEs invest in labor intensive sectors, they are able to attract better qualified workers and/or train their workers internally so that the workers are better qualified than the average worker. By hiring the employees who have worked for MNEs, domestic firms have a chance to acquire knowledge carried by these laborers and therefore could improve the firm productivity (Görg and Greenaway, 2004). Similarly, Berger and Revilla Diez (2008) and Poole (2013) argue that labor mobility from MNEs to domestic firms could make knowledge and skills spread through the host economy. Former employees of MNEs may also use the know-how they learned to start up their own business (Berger and Revilla Diez 2008). Additionally, the increasing competition caused by the presence of MNEs force local firms to use existing technology and resources more efficiently or introduce new technology (Blomström and Kokko 1998). The increased performance of domestic firms caused by the presence of MNEs in the same sector is referred to as a horizontal spillover. The transfer to the domestic firms in other sectors than that of MNEs is a vertical spillover which includes forward spillovers to buyers of MNEs and backward spillovers to their domestic suppliers (Dunning and Lundan 2008).

Amongst spillover channels, the backward spillover is likely to be most significant because while MNEs are motivated to prevent knowledge leakage to their competitors, MNEs may benefit when their suppliers enhance their productivity, achieve better delivery response, save costs, and improve product quality (Javorcik 2004, Blalock and Simon 2009, Potter et al. 2010). In other words, the backward linkage is more likely to lead to spillovers of expertise and know-how from MNEs to domestic suppliers (Blomström and Kokko 2001, Giroud and Scott-Kennel 2009, Pavlinek and Zizalova 2016). Blalock and Gertler (2009) point out that domestic suppliers who have a strong relationship with MNEs are likely to access crucial information about products, processes, and international standards. In line with this argument, McDermott and Corredoira (2010) as well as Simona and Axele (2011) suggest that the strong linkages between domestic firms and their MNE customers is particularly beneficial for their upgrading. The productivity spillovers through backward linkages could be created in the following cases (Meyer 2004, Javorcik 2004):

(i) MNEs provide assistance in technology, training of employees, finance, management and organization, or purchasing raw material (see more in table 1);

(ii) MNEs set demanding requirements on product quality and production processes which put pressure on local suppliers to improve the productivity;

(iii) Higher demand on intermediates goods of MNEs could lead to scale economies of suppliers.

Table 1. Possible assistances provided by MNEs to domestic suppliers

TRANSFERRING TECHNOLOGY
Product technology
Provision of proprietary product know-how
Transfer of product designs and technical specifications
Technical consultations with suppliers to help them master new technologies
Feedback on product performance to help suppliers improve performance
Collaboration in R&D
Process technology
Provision of machinery and equipment to suppliers
Technical support on production planning, quality management, inspection and testing
Visits to supplier facilities to advise in layout, operations and quality
Formation of 'cooperation clubs' for interacting with or among suppliers on technical issues
Assistance to employees setting up their own firm
Organizational and managerial know-how
Assistance with inventory management and the use of just-in-time and other systems
Assistance in implementing quality assurance systems
Introduction to new practices such as network management or financial, purchase and marketing techniques
PROVIDING TRAINING
Training courses for suppliers' personnel
Offering access to internal training programs in affiliates or abroad
Sending teams of experts to suppliers to provide in-plant training
Promotion of cooperative learning among suppliers
SHARING INFORMATION
Informal exchanges of information on business plans and future requirements
Provision of annual purchase orders (for precocious planning)
Provision of market information (particular on foreign markets)
Encouraging suppliers to join business associations

PROVIDING FINANCIAL SUPPORT
Providing special or favorable pricing for suppliers' products
Helping suppliers' cash flow (e.g. through advance purchase and payment etc.)
Longer-term assistance through provision of capital, guarantee for bank loans, leasing, etc.

Source: UNCTAD, 2001: pp.142

Even though studies on impacts of MNEs on host countries are plentiful, there is no consensus on the benefits and drawbacks the MNEs bring to domestic firms (for reviews, Blomström and Kokko 2003, and Javorcik 2004). Explanation on the apparent contradictions between empirical results also varies. According to Bloström and Kokko (2003) and Görg and Greenway (2004), the technical development level as well as locational characteristics of the host region or country may matter for the occurrence of spillovers. Consequently, differences on the spillover effects of MNEs among countries and regions should be expected (Bloströn and Kokko 2003). Pavlinek and Zizalova (2016) argue that whether linkages have positive or negative impacts on domestic firms depends on what Cohen and Levinthal (1989) called a firm's 'learning' or 'absorptive' capacity. Blomström and Kokko (2003) conclude from the mixed finding of earlier studies that the motivation and capacity of domestic firms to absorb knowledge and skills are crucial to realize whether domestic firms are able to learn from MNEs or not. Similarly, Fu and Gong (2010) discuss that spillovers do not take place automatically as it requires an effective customer-supplier linkage, absorptive capacity and human capital in local firms. As such, absorptive capacity is considered to be crucial for effective technological learning and benefiting from MNEs (Kim 1999, Meyer 2004, Berger 2007). The study of Aitken and Harrison (1999) for the manufacturing sectors in Venezuela find no evidence of positive spillovers from MNEs due to the limitation on absorptive capacity of domestic firms. Absorptive capacity is conceptualized by Cohen and Levinthal (1989, pp.569) as the ability of firms to 'identify, assimilate and exploit knowledge from the environment'. Therefore, absorptive capacity is strongly related to R&D capabilities of firms which is strengthened by R&D investment (Cohen and Levinthal 1989). For instance, Kathuria (2000) explores that spillovers in India depend largely on the investment level of firms on R&D activities and learning. Absorptive capacity is a multi-dimensional concept (Schmidt 2008) in which its development is determined by various firms' characteristics such as the level of prior related knowledge, organizational factors, intensity of effort, and human capital (Kim 1999, Cohen and Levinthal 1990, van den Bosch et al. 2003, Berger 2007). Concerning the intensity of the effort, the capability of managers play a crucial role for devoting resources to R&D activities and absorptive capacity improvement (UNIDO 2014).

III. Data and methodology

1. Data

In order to address the formulated research questions we apply a mix method approach, combining quantitative and qualitative analysis. Firstly, this paper utilizes the Viet Nam Enterprise Census Surveys (VN-Census) 2013 and 2015 which were conducted compulsorily and nationwide by GSO. This data covers detailed information at the micro level like type of ownership, business sector, location, level of employment, and business performance. Additionally, we also deploy the sub-survey of the VN-Census 2013 focusing on production technology. This sub-survey is conducted on the random basis for manufacturing firms. It provides information on whether firms supply to MNEs or not. Therefore, we merge this data source to the VN-Census 2013 and 2015 to observe the business performance of domestic suppliers and non-suppliers of MNEs. After merging, we drop observations in the sub-survey which started or ended in the period from 2013 to 2015 because the estimation of the Malmquist Index using data envelopment analysis (DEA) requires a balanced dataset. The final dataset consists of 5,764 firms.

Even though VN-Census allows us to observe the business performance of firms and identify an individual firm as a supplier to MNEs, it lacks detailed information about the collaboration between MNEs and domestic suppliers as well as necessary characteristics of domestic suppliers in order to understand their absorptive capacity. Then after conducting our quantitative analysis, we recognized that while the presence of MNEs accelerates the TFP growth of domestic suppliers in Vietnam as a whole and the Southeast, it is not the case in the RRD. Therefore, the RRD was chosen as an in-depth case study for understanding the unexpected result. In addition to the quantitative analysis the paper draws on face-to-face interviews with 15 domestic suppliers of MNEs, 3 MNEs, and 1 training center in the RRD. We select domestic firms out of the sub-survey of VN-Census 2013 who are identified as suppliers of MNEs. Interviews were hold with business manager or owners of firms and lasted between one to two hours. Interviews cover the following issues: business performance, collaboration with MNEs, technological capabilities, R&D investment, and training.

2. Methodology

Our analysis is conducted through the following steps:

(i) Firstly, we estimate the TFP growth (Malmquist index) using DEA and decompose it into technical progress and efficiency change;

(ii) Then, we apply the propensity score matching method to compare the TFP growth and its decomposed components between domestic suppliers and non-suppliers of MNEs;

(iii) Finally, the interviews will be used to explore in more detail about the extent of backward linkages and absorptive capacity of domestic suppliers.

Total factor productivity growth estimation using the Malmquist productivity Index

The Malmquist productivity index (MI) is one of the important indices for estimating the relative productivity change of observations over time. Following the methodology of Färe et al. (1994), we combine input and output information of observations for both time t and t+1 to specify whether the TFP change is driven by technical progress (Techch) or efficiency change (Effch). Technical progress is caused by technological innovation, technology diffusion, and the introduction of new machines whilst the better management of production processes, resource allocation, and scale efficiency lead to efficiency change (UNIDO 2014).

TFP growth is given by a geometric mean of two Malmquist productivity indices and estimated based on the ratios of distance functions of observation at time t and t + 1. Färe et al. (1994) specify the Malmquist TFP growth index as follow:

$$M_0(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left(\frac{D_0^t(x_0^{t+1}, y_0^{t+1})}{D_0^t(x_0^t, y_0^t)}\right)\left(\frac{D_0^{t+1}(x_0^{t+1}, y_0^{t+1})}{D_0^{t+1}(x_0^t, y_0^t)}\right)\right]^{\frac{1}{2}}$$

When M_0 equals to 1 that means no change in productivity from t to t+1. M_0>1 indicate productivity growth while M_0<1 shows the opposite trend.

The Malmquist index could be decomposed into technical progress and efficiency change. In particular, the change in the distance that the observed production is far from the maximum potential production is efficiency change. Technical change is measured by shifts in the technological frontier. As such, an equivalent way of showing M_0 is:

$$M_0(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)} * \left[\left(\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})}\right)\left(\frac{D_0^t(x^t, y^t)}{D_0^{t+1}(x^t, y^t)}\right)\right]^{\frac{1}{2}}$$

Where efficiency change = $\frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)}$

And technical change = $\left[\left(\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})}\right)\left(\frac{D_0^t(x^t, y^t)}{D_0^{t+1}(x^t, y^t)}\right)\right]^{\frac{1}{2}}$

Similar to M_0, the value of efficiency change or technical change larger than 1 means improvement, while the value less than 1 shows deterioration in performance. It should be noted that these components of Malmquist indices may move in opposite directions. For instance, a Malmquist index greater than 1 may have a technical change less than 1 and an efficiency change greater than 1.

Like Färe et al. (1994) we measure Malmquist indices using nonparametric programming methods. The input for our model includes the number of employees, capital (net fixed assets), and intermediate cost. The output is the total firm output.

Propensity score matching

The average treatment effect on being a supplier of MNEs follows the model of Heckman and Navarro-Lozano (2004):

$$ATT = E(Y_{1i} - Y_{0i}) \,|\mathrm{D} = 1) = E(Y_{1i}|\mathrm{D} = 1) - E(Y_{0i}|\mathrm{D} = 1)$$

in which ATT denotes the average treatment effect on the treated, which measures the impact of being a supplier of MNEs on the TFP growth of domestic firms. D is a binary dummy variable which is equal 1 if a firm is a supplier of MNEs in 2013 and 0 other wise. Y_{1i} and Y_{0i} are outcomes of firm i in the case of being a supplier and not being a supplier respectively. Nonetheless, we are not able to measure the outcome of a supplier in case it was not a supplier$(Y_{0i}|\mathrm{D} = 1)$. Our solution is to apply PSM which is introduced by Rosenbaum and Rubin (1983). The propensity score matching allows us to form matched sets of treated and untreated observations who have a similar value of the propensity score (Rosenbaum and Rubin 1983). In our paper, the treated groups are firms being suppliers of MNEs and the untreated groups are non-suppliers. Then, the effect of treatment (hereafter it is being a supplier of MNEs) on outcomes (hereafter are TFP growth, technical progress, and efficiency change) is estimated by comparing outcomes directly between treated and untreated observations (Greenland, Pearl, and Robins 1999). By doing so, we can observe whether the firms in two groups who share the similar characteristic in 2013 would enhance their TFP differently or not.

Characteristic variables we use to estimate the propensity score are: firm size, TFP at the year 2013[1], training for employees, presence of MNEs in a given district, proportion of MNEs' employees in a given industry. We include the density of MNEs in the district as well as a

[1] TFP of firms is estimated through a method proposed by Levinsohn and Petrin (2003)

proportion of MNEs' employees in a given industry into the model to control for spillovers caused by the geographical proximity or the competition with MNEs. We apply nearest neighborhood and the Kernel matching method to estimate the difference in outcome between being suppliers of MNEs and not.

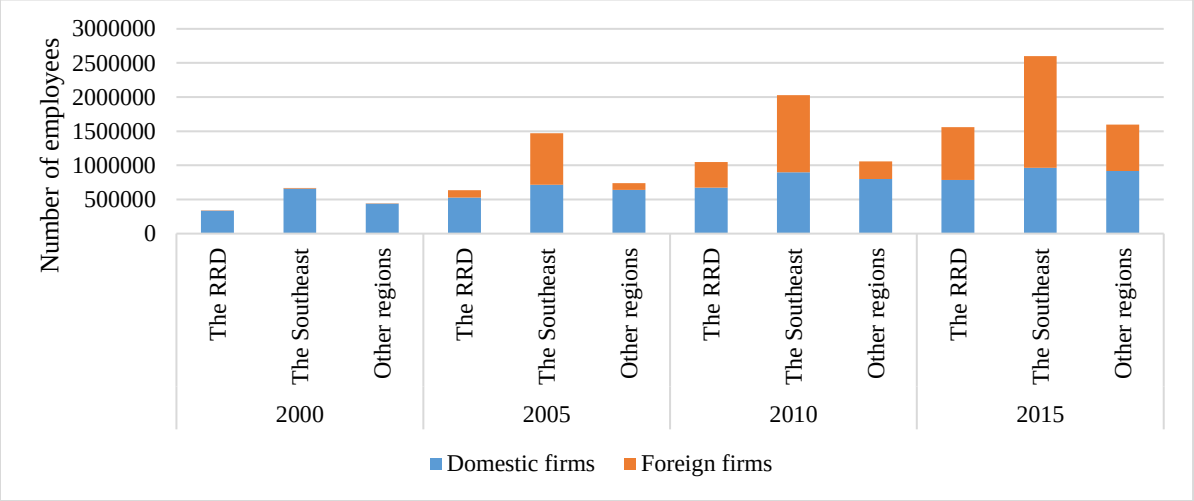
Analysis of the interviews

We follow the principles of qualitative content analysis suggested by Schreier (2013). The data was coded through coding guidelines with terms derived from the theoretical framework (Schreier 2013) based on the possible supports of MNEs to domestic suppliers (UNCTAD 2001), backward spillovers (Dunning and Lundan 2008), and absorptive capacity of firms (Cohen and Levinthal 1990). In order to explore supports from MNEs and the extent of backward linkages, we identify the following aspects: (i) supports of MNEs to domestic suppliers, and (ii) sources for the new technology and knowledge of domestic suppliers. Regarding absorptive capacity of domestic firms, we cover these issues: firm specific (i) technological capabilities, (ii) R&D activities, (iii) and human resource policies. These firms are from different manufacturing sectors and produce different kind of products, like shell transformers, threaded connectors, jigs and molds, packaging foam, or plastic products. Almost all firms are small and medium sized, except for two firms with the total number of employees around 400. The overview of 15 interviewed domestic firms and the summary about the interview results are presented in appendix 1 and 2 respectively.

IV. Some characteristics of the industrial development in the Red River and the Southeast

Since the start of a market-oriented economic reform (Doi Moi) in 1986, the Vietnamese government has attempted to attract foreign direct investment through a series of laws, policies and instruments. As a consequence, the inward FDI into Vietnam has increased dramatically and up to 2011 there have been 13600 FDI projects (UNIDO 2011). The geographical distribution of FDI projects, especially manufacturing ones, is highly concentrated in the Southeast region and the Red River Delta. In 2015, the Southeast and the RRD accounted for 45% and 27% respectively of FDI manufacturing employees in Vietnam (see more in Figure 1). The better economic development and the higher attractiveness to MNEs of the Southeast compared to the RRD and other regions in Vietnam is widely explained by its more market-friendly business environment due to its longer exposure to the market economy until the reunification of Vietnam in 1975 (Cung et al. 2004).

Figure 1. Industrial development by regions in Vietnam, 2000-2015



Source: Author's calculation based on VN-Census

Additionally, before Doi Moi the light industries predominated in the Southeast while the Red River Delta was strongerly focusing on heavy industry (McCarty 1993). These different historical trajectories have still some weight. As can be seen in table 1, the heavy industries like the manufacturing of non-metallic mineral products with the dominance of domestic firms has remained its importance in the industrial development of the Red River Delta. Additionally, the recent years has remarked the emergence of the high technology industry, the manufacture of radio, television and communication equipment, introduced overwhelmingly by MNEs. In the meanwhile, table 2 indicates that the Southeast has still focused on the light industries like manufacture of wearing apparel or tanning and dressing of leather which account for more than 50% of manufacturing MNE employees in 2015.

Table 2. Most important manufacturing industries in the RRD, 2000 - 2015

Year	Manufacturing sector	Total number of employees	Industrial composition	Share of domestic firm employment	Share of MNE employment
2015	Wearing apparel	376010	24%	47%	53%
	Radio, television and communication equipment	180311	12%	4%	96%
	Tanning and dressing of leather	121280	8%	54%	46%
	Non-metallic mineral products	99701	6%	88%	12%
2010	Wearing Apparel	224308	21%	48%	52%
	Tanning and dressing of leather	90606	9%	70%	30%
	Other non-metallic mineral products	90960	9%	91%	9%
	Other transport equipment	78912	8%	50%	50%
2005	Wearing apparel	122017	19%	74%	26%
	Tanning and dressing of leather	77833	12%	89%	11%
	Textiles	64539	10%	89%	11%
	Non-metallic mineral products	66613	10%	93%	7%
2000	Tanning and dressing of leather	55796	17%	100%	0%
	Wearing apparel	47025	14%	100%	0%
	Textiles	45232	13%	100%	0%
	Non-metallic mineral products	40443	12%	100%	0%

Source: Author's calculation from VN-Census

Table 3. Most important manufacturing industries in the RRD, 2000 – 2015

Year	Business sector	Total number of employees	Industrial composition	Share of domestic firm employment	MNE employment share
2015	Tanning and dressing of leather	651491	25%	82%	18%
	Wearing apparel	519720	20%	64%	36%
	Furniture	313919	12%	64%	36%
	Food products and beverages	190033	7%	36%	64%
2010	Tanning and dressing of leather	442229	22%	75%	25%
	Wearing apparel	408350	20%	59%	41%
	Furniture	232715	11%	61%	39%
	Food products and beverages	166777	8%	32%	68%
2005	Tanning and dressing of leather	395905	27%	69%	31%
	Wearing apparel	270768	18%	51%	49%
	Food products and beverages	140197	10%	25%	75%
	Furniture	131379	9%	62%	38%
2000	Tanning and dressing of leather	189805	28%	0%	100%
	Wearing apparel	120138	18%	3%	97%
	Food products and beverages	78208	12%	2%	98%
	Textiles	49509	7%	0%	100%

Source: Author's calculation from VN-Census

V. Total factor productivity growth of domestic suppliers of MNEs versus other non-suppliers

The descriptive results presented in table 2 show that in general domestic firms increase their TFP. This means that for a given level of input, the domestic firms are able to produce more output in 2015 than in 2013. Regarding technical change, the relative high value indicates that domestic firms experience technical progress. Actually, almost all manufacturing firms in our dataset are in low-value added sectors. Berger and Revilla Diez (2008) argue that suppliers from developing countries are normally labor intensive; therefore, they tend and need to increase their basic technological capabilities before conducting profound R&D activities and innovation. Following, we expect that the observed technical progress in domestic firms might be based on the focus of firms in introducing new machines rather than innovations in order to improve the business performance. Relative to efficiency change, the mean values of both supplier and non-supplier groups less than 1 suggest the worsening of the efficiency.

While the mean levels of TFP growth, efficiency change, and technical progress of supplier groups in whole Vietnam as well as in the Southeast are higher than of the non-suppliers, in the Red River Delta non-suppliers experience a higher TFP growth. From this preliminary result, it is expected that spillover effects from MNEs to domestic firms are different amongst regions. The longer experience with light industries might help firms in the Southeast gain more benefits from the presence of MNEs in the region who are also mainly in light industries. Additionally, an interesting question arises whether being a supplier of foreign investors really helps domestic firms to gain the competitive advantages against non-suppliers firms or not. The following analysis based on the propensity score matching method partly reveals an answer to this question. Results for the propensity score matching quality test for both before and after matching are presented in appendices 3-5. The low value of Pseudo and mean standardized bias, the high bias reduction as well as the insignificant p-values of the likelihood ration test after matching indicate the balance in the distribution of covariates between two studied groups (Shiferaw et al. 2014).

Table 4. Description of outcome and matching variables

(Mean value)	The whole of Vietnam			The Southeast			The RRD		
	Full sample	**Suppliers of MNEs**	**Non-suppliers**	**Full sample**	**Suppliers of MNEs**	**Non-suppliers**	**Full sample**	**Suppliers of MNEs**	**Non-suppliers**
Output variables									
TFP at the year 2013	2.1465	2.4403	2.0936	2.4176	2.6538	2.3432	1.9821	2.2301	1.9267
TFP growth	1.7914	2.2625	1.7067	2.5691	3.0697	2.4115	1.2735	1.2940	1.2689
Efficiency change	0.4611	0.5216	0.4503	0.5851	0.6826	0.5543	0.3390	0.2770	0.3528
Technical progress	4.7871	5.1564	4.7207	4.8378	4.9306	4.8087	5.0797	5.5786	4.9682
Firm characteristics									
Firm size (number of employees)	236.14	338.6	204.71	323.39	343.84	310.3	200.27	281.87	176.97
Training for new employees (0 – No, 1 –Yes)	0.41	0.56	0.36	0.50	0.57	0.45	0.44	0.59	0.39
Location characteristics									
Logarithm of FDI employees in the district	3.3249	4.1314	3.0770	4.5989	4.7510	4.5016	3.2847	3.6665	3.2039
Proportion of FDI employees in a given industry	0.3607	0.4256	0.3407	0.4381	0.4594	0.4245	0.3832	0.4133	0.3747
	5764	**1353**	**4411**	**1835**	**716**	**1119**	**1927**	**428**	**1499**

Source: Author's calculation based on an additional survey of VN-Census 2013

Table 5. Average treatment effects: Propensity score matching, Vietnam

Outcome variables	Matching algorithm	Suppliers	Non-suppliers	Difference in average outcome	S.E.	T-stat
Technical change	NNM	5.1713	4.8281	0.3432	0.1243	2.76
	Kernel	5.1713	4.8087	0.3626	0.0928	3.91
Efficiency change	NNM	0.5211	0.4260	0.0951	0.1069	0.89
	Kernel	0.5211	0.4490	0.0721	0.0680	1.06
TFP growth	NNM	2.2673	1.6002	0.6670	0.3021	2.21
	Kernel	2.2673	1.7834	0.4839	0.2765	2.89

NNM: Nearest-Neighborhood Matching

Kernel: Kernel Matching

Table 6. Average treatment effects: Propensity score matching, the Southeast

Outcome variables	Matching algorithm	Suppliers	Non-suppliers	Difference in average outcome	S.E.	T-stat
Technical change	NNM	4.9306	4.5960	0.3346	0.1908	2.75
	Kernel	4.9306	4.7365	0.1940	0.1403	2.38
Efficiency change	NNM	0.6826	0.5496	0.1329	0.1524	0.87
	Kernel	0.6826	0.5510	0.1315	0.1415	0.93
TFP growth	NNM	3.0697	2.1884	0.8812	0.6765	2.30
	Kernel	3.0697	2.3701	0.6996	0.6436	2.09

NNM: Nearest-Neighborhood Matching

Kernel: Kernel Matching

Table 7. Average treatment effects: Propensity score matching, the Red River Delta

Outcome variables	Matching algorithm	Suppliers	Non-suppliers	Difference in average outcome	S.E.	T-stat
Technical change	NNM	5.5947	4.9733	0.6213	0.2297	2.70
	Kernel	5.5929	5.1018	0.4910	0.1594	3.08
Efficiency change	NNM	0.2730	0.5097	-0.2367	0.2501	-0.95
	Kernel	0.2737	0.3559	-0.0822	0.0562	-1.46
TFP growth	NNM	1.2898	1.4423	-0.1525	0.3396	-0.45
	Kernel	1.2924	1.2663	0.0260	0.1955	0.13

NNM: Nearest-Neighborhood Matching

Kernel: Kernel Matching

Tables 5, 6, and 7 present the average treatment effects estimated by nearest neighboring matching and Kernel matching methods for whole Vietnam, the Southeast, and the RRD respectively. For Vietnam as a whole and the Southeast (tables 3 and 4), there is a significant difference in the TFP growth and the technical change between domestic suppliers of MNEs and non-suppliers. In other words, being a supplier to MNEs has a positive impact on the TFP growth and the technical progress of domestic firms. Apparently, the overall result and the result for the Southeast confirm the theoretical expectation that suppliers of MNEs should have a better chance to approach new know-how and technology and are more productive than non-suppliers as a consequence. However, it should be noted that the efficiency change of suppliers in our study is not statistically different from that of non-suppliers.

Contrary, in the RRD the supplier group has not proved to gain a higher TFP growth even though their technical change is significantly higher. This insignificant difference in TFP growth might indicate that the suppliers are not more efficient than other local firms. We should read this result with care. It could be the case that being a supplier of MNEs does not automatically lead to the increase of productivity like in the study of Godart and Görg (2013). But alternatively, another case could be that under the pressure of competing and catching up (Berger and Revilla Diez 2006) with firms who already are suppliers of MNEs, non-suppliers try to improve their performance by applying new technology and enhance their efficiency. Regardless of the explanation we use, it is necessary to discover to what extent the linkage with MNEs contributes to the productivity upgrading of firms and why domestic suppliers of MNEs in the RRD are not that efficient. The analysis of in-depth interviews with suppliers of MNEs in the RRD in the following section enables us to give an appropriate answer.

VI. Knowledge transfer channels and competences of domestic suppliers

This section provides a qualitative analysis on knowledge transfer channels between domestic firms and their foreign firm customers and on absorptive capacity of domestic suppliers in the RRD.

6.1. Knowledge transfer channels from MNEs to domestic suppliers

Most of the interviewed firms argue that the presence of MNEs brings business chances to them. Nevertheless, when coming up to the issue of collaboration with MNEs, only two firm receive direct supports in finance and training. One of them (firm A) who supplies shell transformers is provided financial support from its main MNE customer (around 1% of sales contract). This amount must be used to reinvest in technology in firm A and this firm has to submit the audited balance sheet to its customer at the end of the financial year. Additionally, the customer forces firm A to train employees who are involved in producing the product supplied to the customer. The revenue from the main MNE customer accounts to 25% of firm A's revenue. Almost all other firms report that in order to meet the requirements from the MNE customers, they have to upgrade technology themselves without support from MNEs. Corresponding to this finding, most interviewed firms are limited to simple manufacturing and provide standardized products like plastic components for car or gearbox parts based on detailed customer specifications. The production of simple standardized products does not require leading-edge technology. According to De Gregorio and Lee (1998), spillovers take place if there is a sufficiently small technology gap and a sufficiently high human capital stock. Additionally, a closer look at the additional survey of the VN-Census 2013 shows that less than 10 % of foreign investors in the RRD have a local procurement. This could mean that the integration of MNEs with domestic firms in the RRD seems to be still very limited regarding both the value added level of product and the number of suppliers. In other words, for high value added intermediates, MNEs have a demand on imported products and products supplied by Vietnam-based foreign suppliers instead of input supplied by Vietnamese firms. The interviewed managers from leading MNEs confirm that their firms only purchase simple products with low value added from local suppliers. They explained that they fail to find suitable domestic suppliers because they produce highly-specialized products which require a very high quality. This could hardly allow domestic suppliers in general to gain from potential economies of scale (Aitken and Harrison 1991, Bloström and Kokko 1998) which importantly contribute to the efficiency gains of firms. This could partly explain our empirical finding that the

efficiency change of both domestic suppliers and non-suppliers of MNEs was worsening (see table 2).

Despite the limited direct support, it could not be denied that some domestic suppliers can still learn from MNE customers about technology, quality management methods, or working skills and attitude through visiting and observing MNE customers (four cases) or recruit employees who used to work for their MNEs customers or other MNEs in the same sectors (one case). Those who do not receive direct or indirect assistance from MNE customers learn about new technologies through joining technological exhibitions, taking part in short courses, and visiting suppliers abroad. Amongst these firms, the director of firm B actively acquires knowledge about production technology and management skills by attending short courses and exhibitions in Japan, Singapore, and China. Not surprisingly, firm B has observed a TFP growth and increased its size over years from 8 when it was established in 1999 to more than 400 employees in 2013. Another example is firm C where a director had been working in Japan and Vietnam-based Japanese firms before establishing his own company. He applied acquired business knowledge and technology in his own firm, and one of the customers is his former Japanese employer in Vietnam. 10 years after the establishment in 2005, his firm has increased the number of employees from 10 to 130. Based on these success stories of two domestic suppliers we argue that the source of new technology and knowledge is not limited to MNEs if domestic suppliers and their managers devote effort in upgrading their productivity. In addition, two directors said that they visit their customers' factory quite often, but they could not apply or imitate the technology applied in the MNEs. This implies that domestic firms cannot depend totally on technology of MNEs for technological upgrading and that their endogenous competence is more important (Fu and Gong, 2011). However, due to demanding requirements of MNE customers on quality standards, delivery, or production organization, many interviewed firms have been motivated to upgrade machines or adapt with new management methods, therefore backward linkages are still expected very important (Berger and Revilla Diez 2008), but not effective yet.

6.2. Absorptive capacity of domestic suppliers

Indeed, the presence of linkages between MNEs and their suppliers is a necessary condition for the occurrence of spillovers, but they are not sufficient to guarantee the spillovers (Görg and Greenway 2004, Pavlinek and Zizalova 2016) as well as the productivity upgrading of domestic suppliers. The development of domestic suppliers depends much on their absorptive capacity

(Görg and Greenway 2004). Through our interviews, we can recognize that because of the difference in their engagement in innovation or human capital development strategy some suppliers have been able to benefit from direct and indirect spillovers while others have not.

In general, our interviews with suppliers of MNEs in the RRD reveal that while investment on updated machines is taking place, engagement in R&D activities is rare and few resources are devoted to innovation. This is in line with our expectation based on the quantitative analysis that the technical progress of domestic firms we observed is limited to the introduction of new machines rather than own innovation. Additionally, only four out of fifteen interviewed firms consider skills and qualifications of labor to be important criteria in their recruitment policies. The reasons given by these firms for this issue are twofold. On one hand, some managers state that the supply of skilled labor is short due to the low quality of the education system in Vietnam (Wrana and Revilla Diez, 2016) and that skilled labor is attracted by MNEs who offer much better working conditions and higher salary. Therefore, they focus on internal training for employees after recruitment, and some firms make use of external training courses in Vietnam or abroad. It is in line with the report of MOIT and UNIDO (2011) that many firms have to retrain their workers at high cost because the level of skills produced by Vietnam's current educational and vocational training system is not adequate. On the other hand, several firms argue that their products are simple and standardized so that it is not necessary to hire highly skilled or qualified workers. Especially for firms with TFP decline, training activities seem not to be given a proper concern.

Along with the low quality of employment in interviewed firms, their application of quality management systems remains relatively limited. Several firms said that it is difficult for them to engage comprehensively in management methods like 5S[2] or Kaizen[3] because their employees are locked in unprofessional working routines. One director explained that he faced difficulties in applying 5S in his firms because it was difficult for him to change the mindset of his employees. Noticeably, firms who face difficulties in applying international standard management methods normally do not have R&D activities as well as do not invest much on training. Surprisingly, these directors acknowledge the low quality level of their human capital but through our interview we do not see their endeavor or motivation to change the situation. Our interview with a manager from a foreign firm also reveals this fact. He said that '*We provide domestic suppliers training on quality*

[2] 5S are techniques which help to increase the efficiency of firm
[3] Kaizen is a Japanese word for improvement. It is a method of performance improvement in a company.

management issues. However, for Vietnamese enterprises they understand, but it is not easy for them to apply'. In his opinion, the difference in culture hinders domestic suppliers from the implementation of the management methods from developed countries. He mentioned that '*For managers who receive trainings, they understand and can adapt but it is very hard for them to change their employees'.* One training center who closely corporates with foreign firms to provide training courses about Kaizen for domestic firms shares the same view. After every course, they conduct a survey to evaluate the implementation of Kaizen in the firms of the participants. They also send an expert from the foreign firm to consult them on how to implement Kaizen. However, after many training courses, they conclude that some managers learn and know about these advanced management methods but they do not apply for their firms.

We introduce a simplified classification of interviewed firms based on their TFP changes and their linkage with MNE customers. (i) Type 1 firms have TFP increase. They receive limited or no supports from MNE customers. (ii) Type 2 firms are supported by MNE customers and experience a modest TFP growth. (iii) Type 3 firms experience TFP decline. They do not receive supports from MNEs customers at all. Among our 15 interviewed domestic suppliers, 9 firms belong to group 1, only 1 firm is from type 2, and 5 firms are type 3. In general, firms from type 1 are more active in training and R&D activities than firms in types 2 and 3.

In order to explore more deeply the characteristics which enable domestic suppliers to gain a better performance and to see whether the direct support from MNEs matters to firms in the RRD or not, we choose the extreme examples (four firms A, C, D, and E) from these three types of firms to make a comparison analysis. They are referred to as follows:

- Firm A produces shell transformers. For almost ten years, annually it receives financing support from its main MNE customer. The TFP change of this firm is around the mean level of the RRD. Its resources devoted to training and R&D activities are limited.
- Firm C produces jigs and molds. It does not receive any support from MNE customer. TFP change of this firm is the second highest amongst interviewed firms. The firm is active in R&D activities as well as enhancing the quality of its labor force.
- Firm D produces engine pylons. It receives limited training supports from MNE customers. TFP change of this firm is the highest amongst interviewed firms. Similar to firm C, firm D has paid attention to R&D and human resources.

- Firm E produces packaging foam. It receives no support from MNE customers. Its TFP change is worst amongst interviewed firms. This firm does pay attention to neither R&D nor training for employees.

Table 8. Characteristic of selected domestic suppliers

	Highest TFP growth		Strong support from MNEs	Negative TFP change
	Firm D	**Firm C**	**Firm A**	**Firm E**
TFP change	1.67	1.59	1.081	0.335
Number of employees	65	130	166	100
Products supplied	Engine pylons	Jigs and mold	Shell transformer	Packaging foam
Support from MNE customer	Yes	No	Yes	No
- *Finance*	No	No	Yes	No
- *Technology*	No	No	Yes	No
- *Training*	Yes	No	Yes	No
Invest on new machines	Yes	Yes	Yes	Yes
Introduce new product	Yes	Yes	No	No
Innovation activities				
- *R&D department*	Yes	Yes	No	No
- *R&D activities*	Yes	Yes	No	No
- *R&D partner outside*	No	No	No	No
Human capital development				
- *Internal training*	Yes	Yes	Yes *	Yes
- *External training in Vietnam*	Yes	Yes	No	No
- *External training abroad*	No	Yes	No	No
- *Recruitment strategy*	Experienced workers in MNEs	Experienced workers	x	x
Quality management systems	Yes	Yes	Yes*	No

*: as a requirement of MNE customer

As can be seen from table 6, even though firm A gets direct support from its main MNE customer, its TFP change (1.081) is lower than the average value of domestic suppliers in the RRD (1.273). The two highest TFP growth firms (firm C and firm D) amongst the interviewed ones have received limited or no direct support or knowledge transfer from MNE customers. Both firms have introduced new products. One factor that explain the different growth patterns amongst these firms is the difference in how active they are in increasing their absorptive capacity. Actually, both firm C and firm D pay attention on R&D by establishing R&D departments and on training programs for their employees. They are the only two firms in our interviews which have a R&D department. Our finding is in line with the survey performed by NASATI in Vietnam in 2008 that Vietnamese firms devote only few resources to R&D and innovation. The low level of R&D

suggests a low absorptive capacity of firms (UNIDO 2014). Without R&D activities, it seems plausible that firm A just follows instructions of its main customer and is not able to create its own know-how. This prevents firm A from benefitting from direct spillover and makes firm A depend on its main customer. The director of firm A also said that they just provide training to workers who involve in production supplied to its main customer and implement quality management systems for a workshop producing these products. If a firm depends heavily on its main customers for information and upgrading assistance, it is more likely to be locked into the relationships and in danger of being replaced by the emerging lower-cost rivals (Humphrey 2003). In contrast, firm D has a short term plan to export its products, and firm C has diversified its product portfolio and started producing precise components. The investment on R&D partly allows either firm C or firm D to develop independently and supply to different MNEs.

Additionally, we also observe a notable difference in the human capital development strategy amongst these firms. Firm C and firm D put a lot of effort in recruiting and training employees. For instance, firm C not only provides internal and external training courses to all employees but also sends key staff to short courses about QC (Quality Control) and QA (Quality Assurance) in Japan. In the case of firm D, besides training courses its recruitment strategy gives a higher priority to people who have working experience in foreign firms like Samsung, ABB, or Canon. As such, these employees might introduce new technology or working skills to these two firms on one hand and might help to increase their absorptive capacity on the other hand. This provides an interesting example that MNEs superior ability to attract highly skilled workers seems to impede knowledge flows via labor mobility. Apart from this, they endeavor to create favorable working conditions to attract and keep high skilled labor. In contrast, similar to some other interviewed domestic suppliers, firm A complains that they lost many qualified and skilled workers. It seems that these firms have no proper solutions to this brain drain issue and they have to accept this fact. That is a reason why firm A only chooses loyal employees to involve in the production of product supplied to its main customers and provide training courses for them. For firm E and some other firms who have no demand on high skilled workers, they do not face the issue of brain drain. In their opinion, their employees have no chance to be recruited by MNEs because they lack of many skills and qualifications normally required by MNEs. One director said '*There are only few employees moving to other firms. My firm is a Vietnamese firm so that we can understand Vietnamese workers. In my firm, the working time is more flexible than foreign firms. For example, when you work for foreign firms, you must come to work in time. However, in my firm, it is still fine if*

employees come to work late. We do not have a great working condition but we provide flexible working time'. Actually, the lack of skilled labor and the non-appropriate working attitude and routine of labor hinder the benefit of domestic suppliers from new technology and business knowledge. As a consequence, they fail in enhancing their productivity. For instance, firm E has upgraded the technology through investment on the updated machines, but failed in applying quality management programs or management methods due to the limited absorptive capacity.

In short, the qualitative analysis shows that almost all firms state the need to invest on more updated machines to be more competitive and meet requirements of MNEs, but few of them pay attention to human capital or R&D activities which might help domestic suppliers gain the more effective production. That is a reason why we observe the technical progress due to the new machines but the efficiency decline of domestic firms in our quantitative analysis. Our observation about the low absorptive capacity of domestic suppliers is consistent with the argument of Arnold et al. (2000) and Berger and Revilla Diez (2008) that most small and medium size enterprises face difficulties to acquire technician and craft skills and capabilities for technology absorption. As one of exceptions, one interviewee stated that '*Our technical staff must be very innovative and we have conducted some R&D activities. Therefore, we can take full advantage of the current technologies while still supply the quality products to the customers'*. Actually, this firm (firm L) currently lacks of capital to enhance its production facilities and equip the updated machines in all their workshops. For the long-term development, they have been upgrading technology gradually and have a long-term plan to improve the infrastructure. However, with the special efforts to R&D, training activities, and following the management methods from Japan, they still meet the requirements of MNEs and gain TFP. There is a separate department in firm L on quality control and on how to apply 5S and Kaizen. The responsibility of this department is to make sure that everybody in the firm follows 5S, Kaizen, and ISO. Besides the two success stories of firm C and firm D, the stable development of firm L could also be a useful lesson for other Vietnamese small and medium firms who face the limitedness in capital.

VII. Conclusion and policy implications

The number of MNEs investing in Vietnam has been increasing over the years. Accordingly, domestic firms might have a chance to be suppliers of MNEs and get access to the state of art technology and know-how of foreign firms. As a consequence, firms who are chosen to be suppliers are expected to enhance their productivity. This expectation is valid for Vietnam in general and for the Southeast region in particular. However, it is necessary to note that the TFP growth of domestic firms is contributed by the technical change rather than the efficiency change. It might indicate that if domestic firms pay more attention to their production management improvements, resources allocation, or scale economies, they are more likely to gain a higher TFP.

Contrastingly, our empirical analysis for the RRD shows that there is no significant difference in the TFP growth between domestic suppliers and non-suppliers of MNEs. This finding partly implies that domestic suppliers do not always benefit from the presence of MNEs. The explanation for this fact based on our in-depth interviews with domestic suppliers is twofold. Firstly, due to the 'lock-in' into the simple standardized production, domestic suppliers seem not to receive strong supports from MNE customers. Secondly, low absorptive capacity hinder many domestic suppliers in achieving productivity gains.

All in all, being a supplier of MNEs might bring domestic firms a chance to enhance their business performance. However, while linkages with MNEs are important for domestic firms, they are by no means decisive. Whether domestic firms can take full advantage of this chance or not, especially in developing countries like Vietnam where the effects from MNEs are indirect and limited, depends on the internal competence of firms. The most striking feature of domestic suppliers in the RRD is their weak absorptive capacity. Therefore, in order to gain the TFP growth, domestic firms should not only invest in updated machines, but also put efforts into enhancing their absorptive capacity.

In order to profit from MNEs presence the question is how to acquire the potential benefits to upgrade the productivity as well as upgrade to higher stages in the value chain of MNEs. Our finding draws two important implications for policy makers. Firstly, since the absorptive capacity of domestic firms is considered the main driver, we highlight the need to invest not only in the basic education, but also in higher level education and technical training based on industry demands. Secondly, there should be programs to raise the awareness of domestic firms about the

importance of R&D and innovation to create their own know-how. To do so, it requires a strong linkage between higher education and vocational training centers, government research institutes, and firms. In parallel, similar to other Asian countries like Singapore, South Korea, Taiwan, Thailand, or Malaysia, the Vietnamese government should provide incentives to encourage endogenous technology upgrading and R&D activities in domestic firms.

Of course, our paper is not without limitations. Our quantitative micro data only covers a period of three years while the learning process might take time. Therefore, we hope that in the next few year the same data is available for the following period of time so that we are able to conduct similar research for a longer period. Additionally, the future research might further examine indirect spillover channels from MNEs such as labor mobility from MNEs to domestic firms or spin-off.

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APPENDIX 1. An overview of interviewed domestic suppliers

Code	Products	TFP change	Firm size	R&D Department	Support from MNEs	Qualitative management system
A	Shell transformers	1.08	166	No	Finance	Yes
B	Steel products	1.22	420	No	No	Yes
C	Jigs and mold	1.59	130	Yes	No	Yes
D	Engine pylons	1.67	65	Yes	Training	Yes
E	Packaging foam	0.36	100	No	No	No
F	steel boxes	0.93	401	No	No	Yes
G	wheel blocks	1.03	120	No	No	Yes
H	metal products	0.96	23	No	No	No
I	metal products	0.68	48	No	No	No
J	industrial fans components	1.15	35	No	No	No
K	Threaded connectors	1.34	140	No	No	Yes
M	Plastic products	1.23	301	No	No	Yes
L	gearbox parts	1.75	75	No	No	Yes
N	Pressure equipment	0.30	40	No	No	Yes
O	Steel plating	1.24	46	No	No	Yes

APPENDIX 2. Summary of in-depth interviews

	TFP Growth (Total: 10 firms)	TFP Decline (Total: 5 firms)
Direct support from MNEs	2	0
Introduce new products	2	1
External training	7	1
No training activities	0	2
Demand on high skilled workers	4	0
R&D department	2	0
R&D activities	6	1
R&D partner outside	0	0
Invest on updated machines	10	2
Apply quality management system	7	2

APPENDIX 3. Propensity score matching: quality test, the Red River Delta

Matching algorithm	Pseudo R^2 before matching	Pseudo R^2 after matching	LR X^2 (p-value) before matching	LR X^2 (p-value) after matching	Mean standardized bias before matching	Mean standardized bias after matching	Total % |bias| reduction
NNM	0.102	0.003	638.40 (p=0.000)	10.54 (p=0.61)	36.1	4.9	70
Kernel	0.102	0.001	638.40 (p=0.000)	5.35 (p=0.374)	36.1	2.8	74

NNM: Nearest-Neighborhood Matching

Kernel: Kernel Matching

APPENDIX 4. Propensity score matching: quality test, the Southeast

Matching algorithm	Pseudo R^2 before matching	Pseudo R^2 after matching	LR X^2 (p-value) before matching	LR X^2 (p-value) after matching	Mean standardized bias before matching	Mean standardized bias after matching	Total % |bias| reduction
NNM	0.031	0.001	76.49 (p=0.000)	1.43 (p=0.656)	20.9	2.4	36
Kernel	0.031	0.001	76.49 (p=0.000)	1.51 (p=0.912)	20.9	2.5	36

NNM: Nearest-Neighbor

hood Matching

Kernel: Kernel Matching

APPENDIX 5. Propensity score matching: quality test, the Red River Delta

Matching algorithm	Pseudo R^2 before matching	Pseudo R^2 after matching	LR X^2 (p-value) before matching	LR X^2 (p-value) after matching	Mean standardized bias before matching	Mean standardized bias after matching	Total % |bias| reduction
NNM	0.054	0.005	61.94 (p=0.000)	3.28 (p=0.656)	25.2	5.9	40
Kernel	0.054	0.001	61.94 (p=0.000)	0.49 (p=0.993)	25.2	2	53