ARE VERTICAL LINKAGES WITH FOREIGN FIRMS DIFFERENT? EVIDENCE FROM VIETNAM

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ABSTRACT:
Research on vertical linkages with foreign firms has developed along different literature strands and has often produced contradictory and incomplete findings, often as a result of too general assumptions or too aggregate data. In this study we use a unique dataset on Vietnamese foreign and domestic manufacturing firms to investigate the extent and intensity of vertical linkages between local suppliers and domestic and foreign firms inside and outside Vietnam. After controlling for a number of biases, we find that foreign firms in and outside Vietnam tend to develop more linkages with other foreign firms in the country than with domestic firms. Our analysis of the relation between linkages and productivity shows that there is potential for productivity increases for domestic firms from selling to FDI firms, but the necessary conditions need to be created for knowledge intensive linkages to develop. We identify several policy relevant characteristics that would allow for these linkages to develop.

Keywords: Foreign Direct Investment spillovers; Vertical linkages; Extent; Intensity; Productivity analysis; Propensity score matching; Vietnam

JEL Classification: F23; F63; O12; O14

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1. Introduction

Research on the effects of foreign direct investment (FDI) on the host country, and especially on the performance and productivity of domestic firms has spanned over five decades, and has been treated by different strands of economic literature. Governments, especially in developing countries, consider the potential of knowledge transfers and spillovers as one of the major benefits of FDI presence in the country. This has led to an extensive investigation, mostly empirical, of the size, timing, institutional conditions, geographical, industry and firm-level determinants of the effects from FDI (Crespo and Fontura, 2007; Havranek and Irsova, 2011; Perri and Peruffo, 2016).

The majority of studies focusing on externalities from FDI take a standard production function approach, which estimates the inter- or intra-industry effect of FDI presence on the productivity of domestic firms. In order to measure FDI presence in upstream or downstream industries, they rely on Input-Output tables to provide vertical FDI concentration measures at the industry level (Javorcik, 2004; Blalock and Gertler, 2008). However, treating exposure to FDI as an industry-level variable is problematic, because it makes the implicit assumption that all foreign firms in an industry have the same degree of local sourcing. It also assumes that there is no heterogeneity in the degree and type of spillovers from foreign firms, and that these effects have a linear functional form. However, empirical findings, especially from developing and transition countries, do not support these assumptions, and a more disaggregated approach to vertical linkages is required (Giroud et al, 2012).

Several studies from the international business literature address this issue by measuring the scope, quantity, and quality of linkages between foreign and domestic firms along the supply chain (Amendolagine et al, 2013; Giroud and Scott-Kennel, 2009). Although this approach does not have to rely on restrictive assumptions of FDI firms' homogeneity and can shed some light on the actual channels through which knowledge transfer happens, it too suffers from a number of issues. Firstly, the qualitative and quantitative information intensive nature of the data necessary to carry out this kind of analysis has limited the availability of data to specific industries in specific countries (e.g. Gentile-Lüdecke and Giroud (2012) look at the Polish automotive sector), or to small sample studies. This makes the generalisability of findings from these studies difficult.

Secondly, data sources usually consist of surveys and interviews with foreign firms, and therefore the measured quality of linkages is a subjective self-assessment of the multinational enterprises' (MNEs) interactions with domestic suppliers and clients. While some self-reporting issues are inherent to survey-based analyses in general, providing information from the side of both foreign and domestic firms would help to mitigate the self-reporting bias and to provide a more objective measure of linkages (Crone and Roper, 2001). Thirdly, given the nature and scope of the available data, and their focus on foreign firms, it is often impossible for these studies to investigate domestic firm level characteristics that may play an important role in determining the level and quality of linkages with

foreign firms. Furthermore, since there is no information on domestic firms, this makes the final aim of linking their relationships and exposure to foreign firms with performance indicators difficult to estimate. In this paper, we make use of unique survey data from Vietnam, which covers foreign and domestic firms and focuses on both pecuniary and non-pecuniary interactions between them, providing us with a rich set of information. This allows us to answer a set of related research questions, which we outline briefly below.

The first research question we try to answer is whether FDI firms develop different linkages from their domestic counterparts. While both theoretical and empirical evidence has shown that foreign firms enjoy a productivity premium over their domestic counterparts (Melitz, 2003; Javorcik, 2004), it is not clear whether this productivity premium translates into more and better linkages with local firms, and more importantly, whether all local firms are affected in the same way. In order to assess this, we employ propensity score matching analysis to rule out selection bias, and look at the differences between domestic and foreign firms in Vietnam, acting both as suppliers and buyers, in establishing vertical linkages. Moreover, we introduce a third potential source of knowledge transfer along the value chain, namely foreign buyers abroad. Learning opportunities from exporting to foreign buyers abroad are well-documented in the learning by exporting literature (De Loecker, 2013) and have gained even more attention in the upgrading by being part of global value chains literature (Giuliani et al, 2005). Therefore, comparing the types of established linkages with different sorts of suppliers and buyers offers a thorough picture of learning opportunities for domestic firms. This is an important question, especially in terms of policy-relevant implications for developing countries such as Vietnam that are trying to find the most beneficial avenues to increase the productivity of their domestic firms.

A second research question concerns the identification of the types of firm characteristics that determine the level and type of support transmitted along the supply chain. We investigate characteristics that have been prominently pointed out in the literature as having an effect, such as the size, age and technological level of the firms in upstream industries (Jordaan, 2013). We also investigate the geographical dimension of FDI knowledge transfers, and look at the effect of institutional settings, such as special economic zones. Following the argument that these linkages and interactions are characterized by a large degree of heterogeneity, we run multivariate analyses with different kinds of support acting as dependent variables, since we expect the firm characteristics to affect the level of different kinds of support differently.

Through our third and final research question, we link both the quantity and the quality of linkages with foreign firms to the productivity of local firms. We take an instrumental variables approach to correct for possible endogeneity issues and estimate the total factor productivity of local firms by making use of a standard production function approach (Javorcik and Spatareanu, 2009). We estimate

the effect of linkages with foreign firms in the country and abroad. In this way, we provide novel comparative evidence on the productivity outcomes of supplying different types of international firms.

Thus, our contribution to the existing literature on vertical linkages with foreign firms is threefold. Firstly, we link the development and international business strands of literature and make use of both approaches to investigate both the determinants and the impact of vertical linkages between foreign affiliates and their domestic suppliers. To our knowledge, only a few studies have looked into the relationship between heterogeneous firm characteristics that affect the level and quality of linkages and their subsequent impact on domestic firms (Jordaan, 2011; Javorcik and Spatareanu, 2009; Görg and Seric, 2016). Secondly, we refine the argument on firm heterogeneity, by providing evidence on important firm characteristics and different kinds of interactions with foreign firms. Finally, we assess the differences in both the types of linkages and the impact of these linkages on local firms with foreign firms in the country and abroad. Providing answers to these questions is not only important to unify and advance the research on vertical linkages, it also offers clear policy implications for governments of developing countries aiming to upgrade and increase the productivity of the firms in their manufacturing sector.

The rest of the paper is organized as follows. In the next section we go over the treatment that the topic of vertical linkages has received in the literature so far, identify the gaps and introduce our research questions. Section 3 covers data and methodology, Section 4 focuses on the empirical analysis and Section 5 concludes.

2. Literature review

2.1. VERTICAL LINKAGES WITH FOREIGN FIRMS: ARE THEY DIFFERENT?

A robust finding in the literature on foreign direct investment is that foreign firms enjoy a premium over domestic firms in several performance indicators. The theoretical model of Melitz (2003) for exporting firms showed that since exporting involves initial fixed costs that may prove to be prohibitively high for some firms, only the larger, more productive ones self-select into exporting. Since becoming a multinational and starting operations in another country is assumed to involve similar initial fixed costs, this argument is easily extended to FDI. Moreover, this has been confirmed repeatedly by empirical evidence: foreign firms are shown to be larger, more profitable and more productive (Javorcik, 2004). They also pay higher wages to their employees, which Görg et al, (2007) explain through increased labour productivity as a result of on the job trainings.

Given this productivity premium, the potential for knowledge transfers from multinationals to domestic firms through vertical linkages should also be higher. Theoretically, Rodriguez-Clare (1996) shows that the benefits accrued to the host economy from the presence of multinationals depend on whether in equilibrium foreign firms establish vertical linkages with domestic suppliers. This in turn

depends on how intensively foreign firms use intermediate goods in the production process, how close the types of intermediate goods produced by the host and home country are, and how large communication costs between the two countries are. Alfaro and Rodriguez-Clare (2004) test this theoretical model with data from Latin American countries and find that although according to the usual definition of linkages as amount of inputs sourced locally foreign firms established fewer linkages than domestic ones, after controlling for the number of employees they hired this was not the case anymore.

However, additional empirical evidence has shown that the establishment and quality of vertical linkages with foreign firms is conditional on a number of factors. Before considering these factors, it is important to give a more formal definition of vertical linkages. Jindra et al, (2009) define vertical linkages as "all value chain relationships created between MNE subsidiaries and local firms in the host economy" with backward linkages capturing all relationships of foreign firms with local firms in upstream sectors, and forward linkages referring to local customers of foreign firms. They also make the distinction between the *extent* or *quantity* of linkages, as the amount of goods and services bought or sold locally, and the *intensity* or *quality* of linkages, representing the level of interactions and potential knowledge exchanges between foreign and local firms.

When considering the extent of vertical linkages and foreign firms' characteristics, Jindra et al, (2009) find that the level of autonomy of the foreign subsidiaries and the industry are significant determinants. On the side of the host country, Belderbos et al, (2001) find that the size of the industries of the local suppliers and the level of infrastructure of the host country affect the extent of linkages positively, while restrictive trade policies are a hindrance to the development of linkages. When looking at vertical linkages of foreign firms for African countries, Hansen (2014) finds that these are few and shallow, and that they usually represent linkages to local representatives of foreign enterprises. However, he adds that there is potential for more inclusive linkages. Thus, empirical evidence on the extent of linkages is diverging and does not always provide a point of reference (e.g. linkages with domestic customers) as comparison.

Evidence on the quality or intensity of linkages is even more difficult to assess, as there is no unifying definition of quality and the concept can be defined to include a myriad of measurement alternatives. Giroud et al (2012) use a self-perception variable of foreign firms as a source of technological knowledge for their suppliers to measure the intensity of backward linkages. They find that the technological capability of foreign affiliates affects the intensity of backward linkages positively. Jordaan (2011a) looks at the supportive activities of foreign firms in the case of Mexican maquiladoras and finds that foreign firms are more supportive than domestic ones, but this finding is conditional on a number of firm characteristics, including the absorptive capacity and technology gap between foreign and domestic firms (Jordaan, 2011b).

Thus, a clear pattern of heterogeneity of domestic and foreign firms arises, in terms of determinants of the extent and intensity of vertical linkages they establish. Several factors could help to explain this heterogeneity, and by running a propensity score matching analysis, we can control for them, in order to be able to single out the true differences between foreign and domestic firms. Hence, to answer our first research question we compare the extent of backward linkages of domestic and foreign firms, controlling for the propensity of being a foreign affiliate. We also control for the propensity of local firms to develop linkages with foreign firms and estimate differences in the level of support received by local firms with different ownership types, which is our measure of intensity of linkages. In order to provide information on both suppliers and buyers, we perform the analysis from the perspective of each and juxtapose the results to highlight the differences in their perceptions.

2.2. What determines the level of support to local suppliers?

In this paper, we measure the intensity of backward vertical linkages by the level of support that firms in upstream industries receive from firms (both foreign and domestic) in downstream sectors. We define supportive activities to include a number of interactions that could lead to the transfer of knowledge from customers to suppliers, from help in upgrading the quality of the products and the efficiency of the production process, to the transfer of technology and know-how. In order to account for these types of interactions, information on the quality of linkages is necessary. Due to data limitations, studies with access to this sort of information are few and the data they make use of is selective.

In early 2000s most of the research on this topic came from the international business strand, and was focused on foreign firms only. Crone and Roper (2001) find that multinationals in Northern Ireland report providing knowledge transfer services to local suppliers, but that the weak local supply chains leave room for more knowledge transfer potential. Potter et al (2003) look at multinationals in the UK and find that they report helping local suppliers through active mechanisms, such as visits to the suppliers and passive ones, such as contract arrangements. A common denominator of these studies is their focus on developed economies, and on the perspectives and characteristics of foreign firms. Although they helped to provide some more qualitative refinements to the literature on the quality of vertical linkages, further research made it clear that these supportive activities were conditional on a number of factors as well. In this vein, Veugelers and Cassiman (2004) investigated technology diffusion by foreign subsidiaries in Belgium, and found that although foreign firms were indeed found to acquire more technology internationally, once their access to superior technology sources was controlled for, there was no significant difference between them and domestic firms in terms of technology diffusion along the supply chain.

Other studies have focused on host country characteristics to explain heterogeneity in the levels and types of support given by foreign firms. Xu (2000) emphasizes the importance of the host country's

level of human capital. In a study of technology diffusion by US multinationals, he finds that least developed countries (LDCs) do not meet the threshold level of human capital necessary to benefit from technology diffusion, while developing countries (DC) do. On the other hand, Görg and Seric focus on sub-Saharan Africa and find that local suppliers of foreign firms conduct more process innovation activities if they receive assistance from either the multinational or the government.

Another important dimension that may explain the level of support through vertical linkages is the geographical proximity between customers and suppliers. In order to benefit from agglomeration economies, we would expect foreign firms to locate close to their local suppliers or to have a higher propensity to create vertical linkages with local suppliers in their proximity. But even after controlling for the level of vertical linkages, local suppliers that are geographically closer to their customers are expected to receive more support. Since supportive activities usually involve some sort of contact or other physical component, smaller distances between firms along the supply chain increase the chance of receiving support. This argument has also been shown empirically. Sanfilippo and Seric (2016) show this in a firm level study of domestic and foreign firms in 19 sub-Saharan African countries. They find that domestic firms that locate close to multinationals exhibit increases in their productivity.

Finally, literature on productivity spillovers from FDI focuses extensively on the importance of supplier firms' absorptive capacity in being able to benefit from the presence of multinationals in downstream sectors. However, supplier characteristics that determine absorptive capacity are also important in determining the level of support they receive from their customers. For example, Saliola and Zanfei (2009) find that higher technical capabilities of domestic suppliers are associated with more knowledge intensive types of linkages with foreign firms.

In light of these arguments, we try to answer our second research question on the determinants of support to local suppliers by running multivariate analyses and controlling for a range of supplier characteristics. We differentiate between different types of support because we expect the characteristics of suppliers to affect the different types of support they receive from their buyers differently. We also differentiate between different types of buyers, namely foreign buyers in Vietnam, outside Vietnam and domestic buyers, in order to be able to demonstrate ownership differences in the provision of support. Finally, we control for both institutional settings (proxied by firms being part of an industrial zone) and geographical proximity. In order to highlight the determinants of support from the side of the suppliers, we control for important supplier characteristics (size, age, ownership, and technological level), which previous literature has shown to play a determining role.

2.3. How do the extent and intensity of linkages with foreign firms affect productivity?

The eventual aim of research on FDI spillovers is to link the channels through which spillovers occur to the effects that they have on the performance of domestic firms. However, the approaches used to estimate these effects are also diverging along different literature strands and conditional on the

available information. The mainstream approach to the estimation of FDI spillovers in the literature is by introducing an industry level of FDI presence and estimating its effect on a given performance indicator at the firm level. For intra-industry spillovers FDI presence is measured as the share of output (employees) in the industry, that is produced (employed) by foreign firms. For inter-industry spillovers, backward (forward) FDI presence in an industry is measured as the sum of weighted shares of foreign output or employment in downstream (upstream) sectors. To construct the weights, most studies use supply and buy relationships between pairs of industries, retrieved from national Input-Output tables.

Although findings from empirical research that has adopted this approach have been diverging and inconclusive, several patterns have arisen over time, as more evidence has been accumulating. There is less convincing evidence of intraindustry spillovers, which is attributed to the fact that foreign firms are protective of their technology advantage and try to limit knowledge spillovers to domestic competitors. For example, Blalock and Gertler (2008) find no horizontal spillovers across the manufacturing sector in Indonesia. Aitken and Harrison (1999) find that domestic firms may even experience productivity decreases, as fierce competition with more superior foreign firms drives them out of the market. The picture is more positive when considering vertical spillovers, especially to upstream domestic suppliers. Javorcik (2004) and Blalock and Gertler (2008) find positive backward spillovers, which could be explained by the fact that foreign firms intentionally transfer knowledge to their suppliers to increase their productivity, improve the quality of their inputs etc. Consequent research has refined these findings further by providing evidence on how firm heterogeneity plays a role in determining which firms benefit from FDI spillovers. Damijan et al (2013) study FDI spillovers in 10 transition countries and find that size, productivity, technology gap and absorptive capacity of firms all play a role.

The issue with trying to estimate FDI spillovers at the firm level by measuring FDI presence at the industry level is that it assumes that all domestic firms are affected by FDI at the same degree. However, as the previous two sections argue, firms differ greatly in terms of linkages they develop with foreign firms. As a result, we would expect their performance to be dependent on the extent and intensity of the linkages they develop. Gorodnichenko et al, (2015) show that using Input-Output tables to measure FDI presence underestimates FDI spillovers. This is also in part because these effects are rather localized and proximate, a dimension which cannot be captured by using national Input-Output tables.

Another strand of research tries to account for this by controlling for vertical linkages. Based on data from a survey of foreign affiliates and domestic suppliers, Gentile-Ludecke and Giroud (2012) find that linkages are indeed important for knowledge transfer. Potter et al (2003) make the same finding with data from a survey of foreign firms and their domestic suppliers in the UK. However, both

studies measure the effect on performance as a self-reported measure from the suppliers, instead of an objective measure of productivity. Thus, it could be that the variation in impact is not necessarily a result of actual variation in performance, but rather a reflection of the variation in the subjective perceptions of different suppliers.

By incorporating the extent and intensity of linkages in the estimation of the effects of FDI on the productivity of domestic firms, we correct for both issues in answering our third research question. We also make use of a large firm dataset, covering the entire manufacturing sector. Empirical research using this methodology is sparse. Görg and Seric (2015) and Sanfilippo and Seric (2016) both make use of data from an Investor Survey in sub-Saharan African countries and estimate the effect of linkages on labour productivity and total factor productivity, respectively. Görg and Seric (2015) also estimate the effect of linkages on suppliers' product and process innovation. We add to this existing literature by looking not only at the effects of foreign firms in the country in isolation, but by comparing this to the effect of linkages with foreign firms abroad. Thus, our findings can shed light on the consequences of different ways of participating in global value chains for domestic firms in developing countries such as Vietnam.

2.4 The case of Vietnam

Given its economic history in the last thirty years, especially in terms of the development patterns of FDI, Vietnam makes a great case study to investigate FDI knowledge transfers through vertical linkages. In 1986 Vietnam introduced its Doi Moi policy, which was set in place to implement policies that would make the transition of the country from a planned economy to a market economy. The three main objectives of the Doi Moi were trade liberalisation, FDI promotion and recognition of private ownership (Giroud, 2002). The initial policy reforms and consequent developments, such as the signing of bilateral investment treaties, simplification of the trade system, becoming a member of ASEAN in 1995 and its accession to the WTO in 2007 all helped to transition Vietnam from a low income country with a centralized economy in the 1980s to an open, lower middle income economy in 2011(World Bank, 2013). Following the example of other countries in the South East Asian region, growth rates in Vietnam in the last 25 years have been very high, despite a slowdown during the global crisis. Vietnam has also undergone a structural change, upgrading from an agricultural economy to an industrialized one.

FDI inflows in the country have also experienced a remarkable development since the start of the liberalization reforms. FDI reached a record $15.8 billion in 2016 (Reuters, December 2016) and in 2011 it accounted for 20% of Vietnam's GDP (Dinh, 2014). It has also contributed to a great extent to the industrialization of the country, as most FDI flows go to the manufacturing sector. Despite the overall positive contribution of FDI to economic growth, several key features of foreign investment in Vietnam have not allowed it to reap full benefits from such high levels of investment. Firstly,

investment has mainly been focused in low productivity sectors. With the increase of wage levels in China, foreign investors have turned to Vietnam to make use of cheap labour for the production of light manufacturing goods, like textile and apparel. Even major investors in more productive, high technology industries like electronics (e.g. Sony and Samsung) use their Vietnamese affiliates mostly for assembly of parts and components produced elsewhere, which does not require or lead to any knowledge creation. In the same line, the fact that most international firms use their Vietnamese subsidiaries simply as assembly points means that most value-adding parts of the production process do not happen in the country. Instead, raw materials and intermediate inputs are imported from abroad, assembled in Vietnam and final products are exported. This reduces the chances of developing linkages with local suppliers. Finally, even among local suppliers foreign affiliates in Vietnam usually create linkages with other foreign firms and do not engage with domestic ones. Thus, despite the high levels of FDI inflows in the country, the potential for knowledge transfers from FDI to domestic firms is certainly not a given.

This reality has also been reflected in the empirical evidence on linkages with FDI and FDI spillovers in Vietnam. Several studies have focused on Vietnam to study these topics in recent years, with sometimes diverging findings. Newman et al, (2015) find that when controlling for direct linkages between foreign and Vietnamese firms, positive effects are found that would usually be missed by using the standard definition of FDI spillovers. Interestingly, they also find evidence of positive effects of forward linkages, meaning that domestic firms receiving supplies from foreign suppliers experience a productivity increase as well. However, Anwar and Nguyen (2014) find that these productivity effects are only to be found for domestic suppliers in certain regions of Vietnam where economic activity is focused, while in other provinces they are not materialized. Finally, Kubny and Voss (2014) focus on Chinese investment in Vietnam and find that although they develop more forward linkages than foreign firms from developed countries, the potential for productivity benefits from these linkages is limited. As reasons for this they point out the fact that foreign investors develop few linkages with local firms and usually those that are developed concern the sourcing of low technology, low value added goods. According to their study, this comes as a result of domestic firms' lack of capacity. Thus, they confirm the observations of Dinh (2014). In this paper, we go a step further, by highlighting the characteristics that determine the establishment of linkages, the chance of receiving support through these linkages and the effects on productivity.

3. DATA AND METHODOLOGY

3.1 DATA

The data used for the analysis is a firm level cross-sectional dataset from the Vietnam Investor Survey, conducted by the United Nations Industrial Development Organisation (UNIDO) in 2010. The survey

covers 1493 foreign and domestic enterprises across 9 provinces in Vietnam. It provides detailed information on the operations of firms in all the 2 digit ISIC subsectors of the manufacturing sector, as well as a small number of firms in service sectors that assist manufacturing. However, we focus on the manufacturing sector in our analysis and leave out the firms in the service sector. This reduces the number of firms to 1426. Figure 1 shows the division of firms in the sample by sector and ownership type.

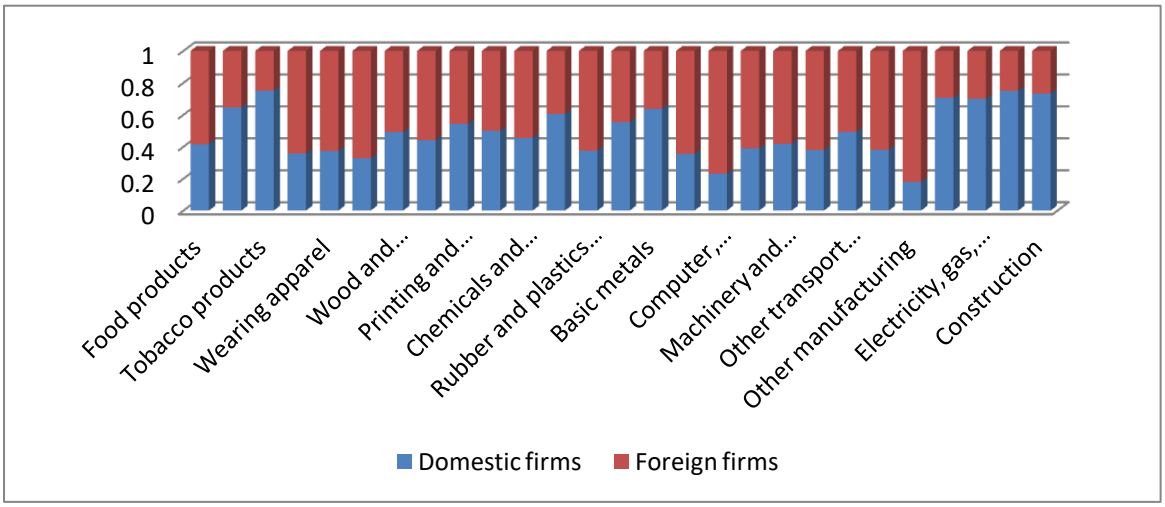

Figure 1: Share of firms in sample by type of ownership (Source: authors' calculations)

As can be seen in Figure 1, the focus of the Survey on foreign investment is clearly reflected in its sampling methodology, which is not representative of the number of foreign firms in the entire firm population of Vietnam. According to the Vietnam Industrial Investor Report (2012), foreign firms constitute the majority of firms in the sample (namely 51.7%), while the share of foreign firms in the population from the 2009 Census conducted by the General Statistics Office (GSO) is estimated at 2.6%. Part of the discrepancy arises from different definitions of foreign ownership: while GSO uses a stricter definition, the Industrial Investment Report (2012) follows the definition used by OECD and IMF and considers a firm to be foreign if 10% or more of its equity belongs to foreign owners. In our analysis, we follow the definition of the report.

Province	Domestic	Foreign	Total
Hanoi	131	79	210
Vinh Phuc	8	15	23
Bac Ninh	14	17	31
Hai Phong	63	47	110
Da Nang	17	14	31
Binh Duong	92	283	375
Dong Nai	39	184	223
Ba Ria Vung Tau	18	15	33
Ho Chi Minh City	208	182	390
Total	590	836	1,426

Table 1: Number of firms by province and foreign ownership (Source: Vietnam Investment Survey, 2011)

Moreover, the focus on foreign firms also means that the geographical distribution of firms in the sample is not representative of the true population geographical distribution, since regions where foreign firms are more concentrated are overrepresented in the sample. Thus, the majority of firms in the sample are located in the Hanoi and Ho Chi Minh areas. However, we believe that having a higher share of foreign firms in the sample than in the population is not a problem in our case, since it allows us to get more in-depth information on the types of linkages that foreign firms and local suppliers establish.

The survey provides detailed information on a number of key variables that allow us to estimate both the extent and the intensity of vertical linkages. To measure the extent of linkages with buyers or suppliers, we can rely on both the absolute number of buyers (suppliers), or the share of inputs (output) bought (sold) to a certain type of buyer (supplier). We measure the intensity of linkages by using the respondents' self-reported measure of received or given support across six categories: product quality upgrade, production process efficiency upgrade, access to finance, worker trainings, technology transfer and joint product design. For each of these categories, each firm acting as a supplier reports a value of 1 if they have received support from their buyers and each firm acting as a buyer reports a value of 1 if they have given support to their suppliers. Based on these answers, we also build an additional measure of the overall level of support received (given) by a supplier (buyer) as a sum of the zeros and ones reported in the six categories. Since most firms in the manufacturing sector serve as both buyers and suppliers along the value chain, most firms report being on both the giving and the receiving end of support from vertical linkages.

We also have information on a number of firm characteristics, such as age, size, skill ratio of employees, exporter status, and level of exports. To control for their level of technology we make use of the OECD technological classification of manufacturing sectors (OECD, 2005). Thus, we are able to identify the determinants of vertical linkages. Table 2 shows some summary statistics of the main firm characteristics by type of ownership. As expected, foreign firms are on average larger, both in terms of the number of employees and the level of production. They are also more capital intensive, have higher value added and export several times more than domestic firms. On average, they are younger than domestic firms. A table describing all the variables is available in the appendix.

	Mean Domestic	Mean Foreign	Overall Mean
Labour (No. of employees)	425	708	587
Log(output)	15.36	15.811	15.615
Log(capital)	14.346	15.046	14.74
Log(value added)	13.991	14.726	14.397
Total Exports (Millions)	2.629333	19.767	13.2312
Age (years)	18.27	10.3	13.71

Table 2: Characteristics of firms in the sample, by ownership type

3.2 Methodology

3.2.1 Differences between foreign and domestic firms in linkage extent and intensity

To answer our first research question on whether foreign and domestic firms differ in the extent and intensity levels of linkages they develop, we consider local firms both in their role as buyers, and as suppliers.

To compare the extent of linkages that local suppliers develop with domestic and foreign buyers, we measure the difference in the mean number of foreign buyers between foreign and domestic firms. However, as Table 2 in the previous section showed, foreign firms in the country are different from domestic ones with regards to several important characteristics, which could be affecting their chances of developing linkages with foreign buyers. Therefore, in order to isolate the effect of foreign ownership on the number of foreign buyers, we need to control for these characteristics. Although this can also be done using a simple OLS framework, this would be imposing a linear relationship between these characteristics and the outcome variable (Caliendo and Kopeinig, 2005). Based on the arguments in the previous section on the non-linearity of these relationships, instead of controlling for these characteristics by means of OLS, we employ propensity score matching analysis, where we start by treating foreign ownership as a treatment variable. Thus, by controlling on a number of observed covariates we estimate a firm's propensity of being foreign (Inggrid, 2015). We then proceed to match domestic and foreign firms with similar propensity scores and estimate the difference in the average number of foreign buyers they have. We also compare the level of support local suppliers receive by matching them on their propensity to become suppliers to foreign firms.

We perform the same analysis from the perspective of buyers. We control for the buyer's propensity of being foreign, and compare the difference in the average number of linkages with domestic suppliers. To measure differences in the intensity of linkages, we extend the analysis to the level of support foreign and domestic buyers offer to their local suppliers. Thus, by matching foreign and domestic firms on their propensity to be foreign, we isolate the true difference in the level of support that foreign and domestic firms offer to their suppliers. By using reports of support from both sides, we can also see if there are differences in the way firms in different positions along the supply chain perceive giving and receiving support.

3.2.2 Determinants of linkage intensity: types and levels of support

Since the ultimate goal of our analysis is to investigate the link between the extent and intensity of vertical linkages to the productivity of local suppliers, for the remainder of the analysis we focus on the perspective of suppliers. In this section, we investigate how different firm characteristics affect the types of support suppliers receive from their buyers. Thus, our dependent variables are dummy variables for different types of support. Therefore, we build a logit model to estimate the effect of supplier characteristics on the logarithm of the probability of receiving a certain type of support.

For a firm *i* and type of support *j* from the six types of support we mentioned in the previous section, the dependent variable of our model would be:

$$Support_{ij} = \begin{cases} 1 \; if \; firm \; i \; reported \; receiving \; support \; type \; j \; from \; at \; least \; one \; type \; of \; buyer \\ 0 \; otherwise \end{cases}$$

Thus, in the first part of the regression analysis we do not distinguish between the different types of buyers, but instead test whether supplier heterogeneity is important to determine the type of support they receive from buyers. The logit model we estimate is:

$$\ln\left(P_{support_{ij}} \Big/ 1 - P_{support_{ij}}\right) = \beta_0 + \beta X_i + \varepsilon_i$$

where $P_{support_{ij}}$ is the probability that firm *i* has received support *j*. X_i is a vector of firm-specific variables consisting of ownership type, age, a dummy for being part of an industrial zone, a dummy for geographical proximity to the main buyer, size, sector-specific technological level and employee skill ratio, to capture human capital. We estimate the logit model by means of maximum likelihood estimation and report the effects of these firm-level determinants on the logit (log of odds) value.

As a second step, we answer the question of whether suppliers receive different levels of support from different types of buyers, and control for supplier characteristics that could explain these differences. Thus, we estimate the following regression model:

$$Support_{ik} = \beta_0 + \beta X_i + \varepsilon_i$$

where $Support_{ik}$ is the level of overall support firm i has received by type of buyer *k*. We distinguish between domestic buyers, foreign buyers in Vietnam and foreign buyers abroad. Overall support is measured as the sum of zeros and ones that firm *i* has reported on the six support categories. Thus, for a firm that reports receiving support on e.g. product upgrade and technology transfer, but no support on any of the other categories from foreign buyers in Vietnam, $Support_{i,Foreign\ buyers\ in\ Vietnam} = 2$. We also build a variable to measure the level of support received from all types of buyers across all categories, thus ranging from 0 for a firm that reports not getting any type of support from any type of buyer to 18 for firms that report receiving all types of support from all types of buyers. Since our measures of support are artificially constructed categorical variables, they may suffer from data censoring issues and exhibit unusual distribution patterns. The histograms in Figure 2 show that they are highly left-censored around 0. This reflects the fact that many firms receiving various degrees of little support choose to report it as no support. Additionally, we see that support by foreign buyers in and outside Vietnam are also slightly right-censored, since we put an artificial ceiling of 6 to the level of support they receive by construct. To correct for these issues, in addition to the OLS analysis, we perform a double-censored Tobit analysis, which assumes that some of the dependent variable values are clustered around some limit value and takes this into account when estimating the parameter

coefficients (McDonald and Moffitt, 1980). We show the results from both types of estimations in the next section.

X_i is a vector of firm characteristics as in the previous regressions. However, in addition to the other variables, we control for the log of the number of buyers and the ownership type of the main buyer. We expect the number of buyers to be positively correlated to the level of support that suppliers report, so in order to be able to say something about the relationship between firm characteristics and support from different types of buyers, we need to control for the overall number of buyers.

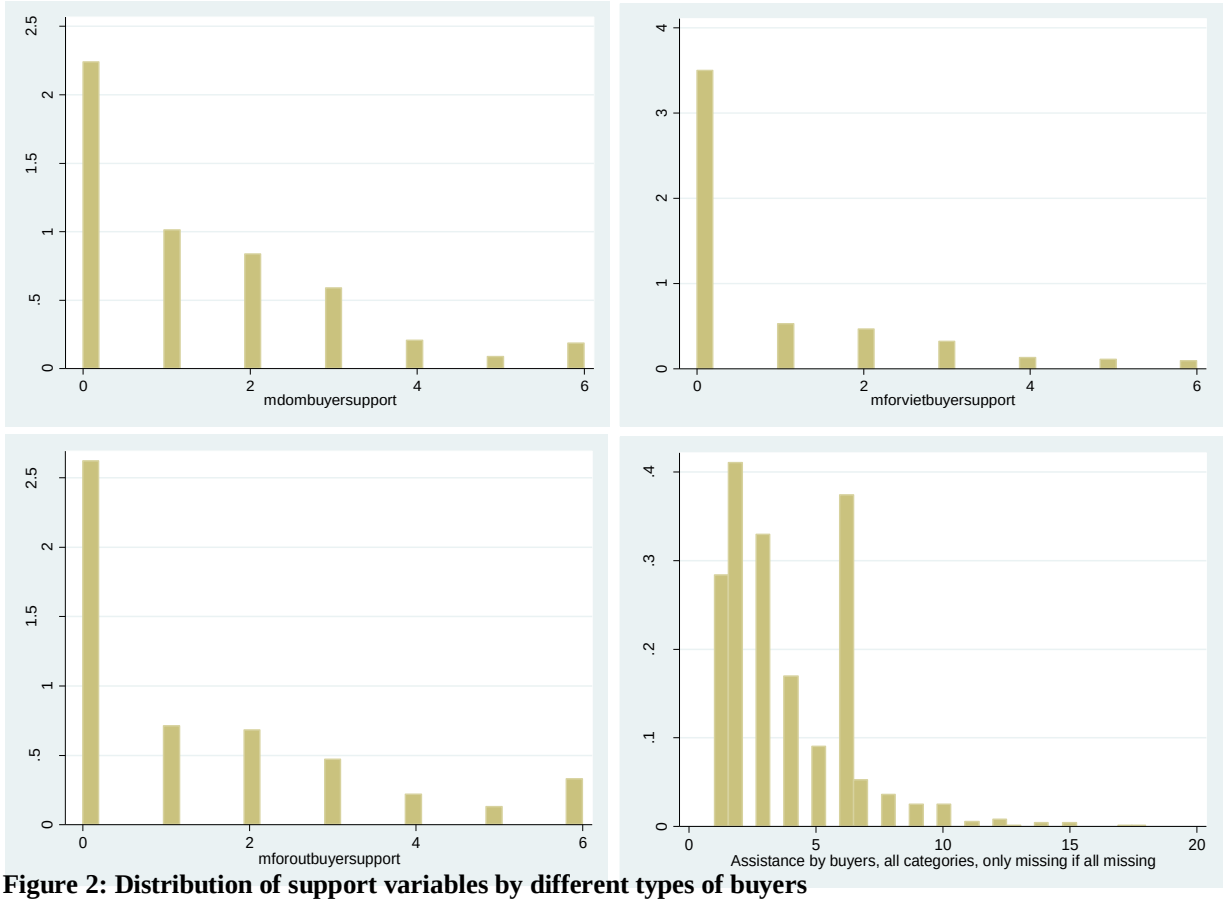

Figure 2: Distribution of support variables by different types of buyers

3.2.3 Extent and intensity of vertical linkages with foreign firms and productivity

To estimate the effect of linkages with foreign firms on the productivity of local suppliers, we start by estimating a simple OLS regression, where the main independent variable is the share of foreign buyers in the total number of buyers. We perform the analysis for linkages with foreign buyers inside Vietnam and abroad separately, because controlling for both simultaneously greatly reduces our number of observations, since part of the firms that serve foreign markets abroad do not sell to foreign firms in the country. Since our main independent variable is expressed as a percentage, we also control for the total number of buyers. To account for the intensity of linkages with foreign buyers we introduce a dummy variable that takes the value of 1 if the firm receives any type of support from the type of foreign buyers whose effect we are investigating and 0 otherwise. Thus, we estimate the following equation:

$$\log(TFP)_i = \beta_0 + \beta_1 \log(buyers)_i + \beta_2 foreignbuyershare_i + \beta_3 supportfrombuyers_i + \beta X_i + \varepsilon_i$$

where $\log(TFP)_i$ is the natural logarithm of the total factor productivity of firm i, which we estimate by using a simple Cobb-Douglas function, controlling for labour, capital, raw materials and energy:

$$Y = AL^{\alpha}K^{\beta}M^{\gamma}E^{\delta}$$

Due to the cross-sectional nature of the data, unfortunately we cannot control for the endogeneity of inputs choice in estimating total factor productivity (Ackerberg, Caves and Frazer, 2015). However, we are able to control for productivity differences at the sector level, since we estimate the TFP residual for each 2-digit ISIC sector separately. We also control for a number of other firm characteristics that may affect the productivity level, including foreign ownership, size, age, skill ratio, productivity gap, and the technological level of the sector.

In addition to endogeneity in input choice, our main independent variables may also be suffering from endogeneity issues. Since foreign firms may choose to develop linkages with more productive suppliers or suppliers self-select into supplying foreign firms, this could be reflected in the correlation between productivity and our variables of interest. In this case, estimates from the OLS analysis would be biased. To correct for the potential bias in our cross-sectional analysis, we use instrumental variable methods (Javorcik and Spatareanu, 2009, Godart and Görg, 2013). Following Javorcik and Spatareanu (2009), we use the general level of backward FDI at the sectoral and province level as an instrument for the share of vertical linkages with foreign buyers in Vietnam. We expect the level of linkages to foreign firms of each local supplier to be positively correlated with the sector's level of backward FDI, since firms in industries that supply more to foreign firms in downstream sectors have a higher chance of becoming suppliers to foreign firms. On the other hand, we assume that after controlling for sector-level variation in productivity when estimating TFP, each individual domestic supplier is too small to affect the industry level of backward FDI. Thus, our instrument should fulfil both conditions of relevance and exogeneity. To measure backward FDI at the industry and province level we follow the prevailing definition in the literature, where

$$Backward\ FDI_{jr} = \sum_k \alpha_{jk} Horizontal\ FDI_{kr} \quad \text{and} \quad Horizontal\ FDI_{kr} = \frac{\sum_{i \in kr} Foreign\ output_i}{\sum_{i \in kr} Output_i}$$

However, in calculating the backward FDI variable we diverge from the usual method of excluding own industry. Lenaerts and Merlevede (2011) argue that backward FDI analysis should not exclude own industry, especially in the case of aggregated data, since within highly aggregated sectors many firms develop supplier-buyer relationships with foreign firms, that should be accounted as vertical FDI concentration. Since we only have information at the 2 digit ISIC level, we believe that it makes sense to include own sector in our measure of backward FDI, especially since we are not controlling for horizontal FDI.

To instrument vertical linkages with foreign buyers outside Vietnam, we use the ratio of an industry's output that went to exports in 2009. Thus:

$$Exportshare_j = \frac{Exports_j}{Output_j}$$

Although the export share of an industry's total output captures both exports of intermediate and final goods, we believe that there is a positive correlation between an industry's share of output that is exported abroad and a local supplier's share of foreign buyers abroad in its total number of buyers. Moreover, we do not expect the industry's export share to be heavily affected by any individual local firm. Therefore, we expect our instrument to be relevant and exogenous. The information used to build the instrumental variables was taken from the Input-Output table for Vietnam, provided by the OECD database for Structural Analysis (OECD, 2017). We estimate the equation by using two stage least squares and present the results from both stages in the following section.

4. Analysis

4.1 Extent and intensity of linkages

4.1.1. From the perspective of firms as suppliers

We start our empirical analysis by looking at some descriptive statistics from the perspective of local suppliers. Table 3 shows the extent of linkages with different types of buyers, where extent is measured as the percentage of sales sold to each type of buyer. We find that overall the highest percentage of sales produced by local suppliers is going to foreign buyers abroad (44.39%). However, this average is driven mostly by the high representation of foreign firms in the sample. When we compare foreign and domestic firms, we see that there is a clear division between the two types of suppliers: domestic firms sell the majority of their output to other domestic firms (48.4%), while foreign firms are mostly producing to export abroad (52.23%). By conducting a simple pairwise mean comparison test, we find that the differences in the mean shares of output to different types of buyers are all significant: domestic suppliers in Vietnam on average sell a higher share of their supplies to other domestic firms than foreign firms. On the other hand, foreign firms in Vietnam sell more to other foreign firms (in the country and abroad) than domestic ones. Thus, this helps to confirm earlier findings by Dinh (2014) that although foreign firms produce a substantial part of the country's output, they are not very integrated with domestic firms and most of their output is exported abroad.

Next, we consider the intensity of linkages, by looking at the differences in the types and levels of support that local suppliers report receiving from different types of buyers. We find that local suppliers report receiving on average most support from foreign buyers outside Vietnam and the least support from foreign buyers in Vietnam. For simplicity we have grouped the six types of support according to the areas they aim to improve. We find that across all types of buyers, most of the support is going

toward product quality and efficiency upgrade. Thus, all buyers are first and foremost interested in offering support in the areas that would affect their inputs more directly. There are some differences among domestic and foreign buyers with respect to the other types of support they provide: whereas domestic buyers are reported of giving more support in terms of access to finance and employee training, foreign buyers (in Vietnam and abroad) offer more support in terms of technology transfer and joint product designs.

	Overall Mean	Obs.	Mean Domestic	Obs.	Mean Foreign	Obs.	Difference (Std. Error)
Percentage of sales sold to long-term domestic buyers	39.76	857	48.4	469	29.31	388	19.09*** (-2.432)
Percentage of sales sold to long-term foreign buyers in Vietnam	21.18	598	12.24	235	26.97	363	-14.73*** (-2.307)
Percentage of sales sold to long-term foreign buyers outside Vietnam	44.39	768	28.63	255	52.23	513	-23.60*** (-3.073)

Table 3. Extent of linkages with different types of buyers, by ownership type of suppliers

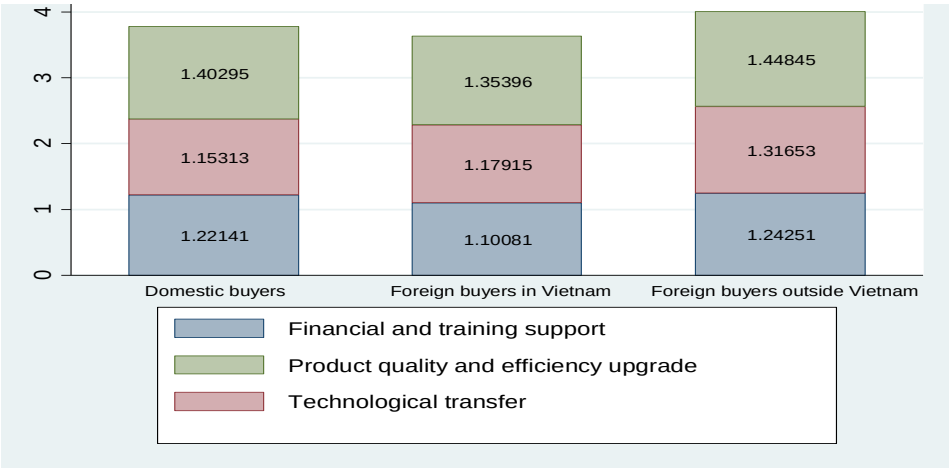

Figure 3: Intensity of linkages by type of support and types of buyers

After considering general patterns of the extent and intensity of linkages, we move on to propensity score matching analysis. We use four different kinds of matching algorithms (kernel matching, nearest neighbour matching with 1 and 2 nearest neighbours, and radius matching) and choose the one that performs best. For each particular case this is chosen based on their performance in terms of bias reduction, matched and unmatched variance ratio and other post-estimation statistics. After choosing the matching algorithm, we compute bootstrapped standard errors of the outcome variable over 500 bootstraps. Our outcome variable is the average treatment effect (ATE). In every table we also show the number of observations off common support and regression coefficients of the explanatory variables used in the propensity score probit estimations.

Table 4 shows the results from the PSM analysis for the extent of linkages. We treat foreign ownership (according to the OECD and IMF threshold of 10%) as our treatment variable and compare the

outcome variables between matched domestic and foreign firms. We find that among matched foreign and domestic firms, foreign firms have on average a higher absolute number of foreign buyers in Vietnam (ATE is equal to 8.76, meaning that on average foreign firms have 8.76 more foreign buyers than domestic firms with similar characteristics). This effect is significant. However, when the outcome variable includes the number of foreign buyers both inside and outside Vietnam, the matched difference between foreign and domestic firms is not significant anymore. Thus, after controlling for firm characteristics, foreign ownership affects only the extent of linkages with foreign firms in the country. Thus, the previous finding of foreign firms that are not fully integrated in the local economy still holds. From the propensity score estimation regression we see that age, exporter status, capital and productivity are all firm characteristics that matter for the prediction of foreign ownership.

Treatment variable	>10% foreign ownership	>10% foreign ownership
Outcome variable	No. of foreign buyers in Vietnam	No. of foreign buyers overall
No. observations	607	894
Off common support	22	37
Unmatched difference	10.4606896	9.56917605
ATE	8.758875***	5.867239
S.E.	2.958719	3.633739
Z-value	2.96	1.61
P-value	0.003	0.106
Matching algorithm	Kernel matching	Kernel matching
Propensity score Probit regression explanatory variables		
Age	-0.0600074***	-.0618382***
Size	-0.0146271	.0192678
Exporter	1.116624***	1.010287***
Log(capital)	0.1730304***	.1420371***
TFP	0.1564667	.1763819**

Table 4: Extent of linkages by ownership type of suppliers: Propensity score matching analysis

Next, we turn to the intensity of linkages, and in order to measure these we use a variable constructed as the overall support by buyers, ranging from 0 to 18. In column 1 of Table 5 the treatment variable is foreign ownership. Thus, when comparing foreign and domestic firms with similar propensity scores for being foreign, we find that foreign firms receive on average more support than similar domestic firms. In columns 2-5 we control for a firm's propensity of becoming a supplier to foreign buyers or its propensity of supplying more foreign than domestic buyers. Through the former "treatment", we estimate the effect that having any foreign buyers has on the support that local firms receive. We find that having at least one foreign buyer in the country does not lead to a significant difference in support. However, firms that have at least one foreign buyers overall receive more support than similar firms that only have domestic buyers. Thus, while having linkages with FDI in the country may not lead to a premium in the intensity of linkages, linkages with foreign buyers overall helps to bring in more support. The same findings apply when we compare firms with more foreign than domestic buyers. Thus, it seems that in terms of support, foreign firms abroad are more supportive than

domestic and foreign firms, even after controlling for the propensity of becoming their supplier in the first place.

Treatment variable	>10% foreign ownership	At least one foreign buyer in Vietnam	At least one foreign buyer overall	More foreign than domestic buyers	More foreign buyers overall
Outcome variable	Support by the buyers	Support by the buyers	Support by the buyers	Support by the buyers	Support by the buyers
No. observations	957	1140	1278	1112	1112
Off common support	13	0	86	2	2
Unmatched difference	0.566541635	0.511678353	1.25434671	-0.111214518	0.227155551
ATE	0.3903693**	0.4578947	0.8044575**	0.1053114	0.4260581***
S.E.	0.1959423	1.21582	0.351585	0.2024269	0.158217
Z-value	1.99	0.38	2.29	0.52	2.69
P-value	0.046	0.706	0.022	0.603	0.007
Matching algorithm	Kernel matching	Nearest Neighbour (1)	Nearest neighbour(2)	Nearest neighbour(2)	Kernel matching
Propensity score Probit regression explanatory variables					
Foreign ownership	-	0.2486037***	0.9701103***	-0.2989528 ***	-0.2377764**
Exporter status	1.212493***	0.2774576***	-	-0.5012777***	-0.4445244***
Size	0.0445048	-	0.30029***	-0.1190167**	-0.055837
Log(capital)	0.1429385***	-	-0.0949487***	0.0704081***	0.0585365**
Age	-0.0596227***		-	0.0022001	.0018557

Table 5: Intensity of linkages from suppliers' perspective: PSM analysis

4.1.2. FROM THE PERSPECTIVE OF FIRMS AS BUYERS

As was mentioned in section 3, since most of the analysis on the extent and especially on the intensity of vertical linkages is based on the perceptions of the respondents, it is important to consider these measurements from the side of suppliers, as well as buyers. Since most of the firms in our sample act as both suppliers and buyers of goods in the value chain, we repeat the analysis from section 4.1.1 from their perspective as buyers and look at the level of linkages and support they give to their local suppliers.

	Overall Mean	Obs.	Mean Domestic	Obs.	Mean Foreign	Obs.	Difference (Std. error)
Percentage of inputs provided by domestic suppliers	33.09	942	40.82	493	24.6	449	16.22*** (-2.066)
Percentage of inputs provided by foreign suppliers in Vietnam	16.94	679	11.46	254	20.22	425	-8.752*** (-1.924)
Percentage of inputs provided by foreign suppliers outside Vietnam	31.83	774	18.78	271	38.86	503	-20.08*** (-2.497)

Table 6: Extent of linkages with different types of suppliers, by ownership type of buyers

Table 6, which shows the share of inputs that local buyers source from different types of suppliers confirms the analysis in section 4.1.1. Foreign firms in Vietnam receive the majority of their inputs from suppliers abroad (38.86%), while on average domestic firms receive most of their supplies domestically (40.82%). Moreover, the differences between domestic and foreign firms in terms of percentages of inputs provided by different types of suppliers are all significant and in the expected direction: domestic firms source a significantly higher share of their inputs domestically than foreign firms, while foreign firms have significantly higher shares of inputs provided by foreign suppliers (in Vietnam and abroad) than domestic firms. This helps to solidify our previous findings of a lack of embeddedness of foreign firms in the domestic economy.

	Overall Mean	Obs.	Mean Domestic	Obs.	Mean Foreign	Obs.	Difference (Std. error)
Product and quality upgrade to local suppliers	0.7015	1491	0.765	638	0.654	853	0.111** -0.0417
Financial and training support to local suppliers	0.2716	1491	0.312	638	0.242	853	0.0704* -0.0309
Technology transfer to local suppliers	0.3413	1491	0.395	638	0.301	853	0.0937** -0.0308

Table 7: Intensity of linkages, by type of support

Table 7 shows the differences between the different types of support offered to local suppliers, as reported by domestic and foreign firms acting as buyers. Interestingly, the level of support reported by buyers is consistently lower than the level of support reported by suppliers across all types of support. Thus, there are interactions between suppliers and buyers along the supply chain that are not perceived as supportive from the buyers, but are perceived as such by the suppliers. This type of unintentional knowledge transfer is an example of knowledge spillovers from buyers to suppliers. However, the other striking finding from table 7 is that on average, foreign firms report giving significantly less support to local suppliers than domestic firms over all support areas. Yet, the PSM analysis in section 4.1.1 showed no significant differences in support levels that local firms with domestic buyers only and local firms with foreign buyers in Vietnam report receiving. Thus, it seems that not only do buyers in general underestimate the level of support they pass along to their local suppliers (both intentionally and unintentionally), but foreign buyers in Vietnam underestimate this more than domestic buyers. Thus, comparing both perspectives is important, as these "knowledge spillovers" would not have come to light if we focused on the perspective of foreign buyers only. Finally, the differences in support across the three different areas are consistent with our previous findings: buyer firms report giving by far the most support in product quality and efficiency upgrade. This is followed by technology transfer and financial and employee training.

Results from the PSM analysis in Table 8 show that even after controlling for a number of other variables that might affect the ownership status and the development of vertical linkages (age, size, exporter status, capital and productivity), foreign firms still seem to develop fewer linkages with local

suppliers than their domestic counterparts. In this case a domestic counterpart would be a counterfactual domestic firm with (roughly) the same size, age, capital intensity and productivity as the foreign firm and therefore, with the same probability of being foreign. This is supportive of our earlier finding that foreign firms receive most of their supplies abroad. They also have a significantly lower absolute number and share of domestic suppliers. When the outcome variable concerns the domestic subset of local suppliers, the differences between foreign and domestic buyers become even more significant at 1% level of significance. Thus, the extent of linkages with domestic suppliers for foreign firms remains lower than that of domestic firms, even after controlling for the propensity of being foreign. In terms of linkage intensity, we find that once we control for the propensity of being foreign, foreign firms provide significantly less support to local suppliers than similar domestic firms. However this difference is only significant at the 10% level and is not very large in economic terms (-0.21 on a 0 to 18 scale).

Treatment variable	>10% foreign ownership	>10% foreign ownership	>10% foreign ownership	>10% foreign ownership
Outcome variable	No. of local suppliers in Vietnam	Share of domestic suppliers	Share of inputs by dom. suppliers	Assistance to local suppliers
No. observations	965	943	659	1034
Off common support	34	31	20	11
Unmatched difference	-3.49479531	-27.9066936	-15.5811947	-0.12610019
ATE	-18.32323*	-26.36311***	-13.850***	-0.2108073*
S.E.	10.65721	2.338	2.787	0.1224608
Z-value	-1.72	-11.270	-4.970	-1.72
P-value	0.086	0.000	0.000	0.085
Matching algorithm	Kernel matching	Nearest neighbour(1)	Kernel matching	Kernel matching
Propensity score Probit regression explanatory variables				
Age	-.0623568 ***	-0.0613836***	-0.0561599 ***	-0.0616***
Size	.0081869	.0041697	-0.0134368	0.0374729
Exporter	1.20261***	1.195411 ***	1.156418***	1.197239 ***
Log(capital)	0.1558609 ***	0.1528035 ***	0.1863843 ***	0.1444227***
TFP	0.2016057 **	0.189028**	0.1450194	0.1573205**

Table 8: Extent and intensity of linkages from buyers' perspective: PSM analysis

Thus, our analysis has shown that there are differences in the way that buyers and suppliers perceive the intensity of linkages they develop along the value chain. Moreover, foreign firms in Vietnam seem to develop fewer linkages with local firms (and especially with domestic firms) than domestic firms. They also seem to provide less support, when compared to both domestic firms and foreign firms abroad. But in order to understand what drives these differences in levels of support, we need to investigate the determinants of support.

4.2 SUPPLIER CHARACTERISTICS AS DETERMINANTS OF LINKAGE INTENSITY

Table 9 shows the results from the multivariate logit analysis, where we regress the probability of a firm receiving a certain type of support from any of its buyers on its characteristics. From the analysis, we see that there is heterogeneity in the determinants that affect the type of support that suppliers receive from their buyers. In terms of product quality and efficiency upgrade, we see that all else equal, foreign suppliers receive on average less support, possibly an indication that foreign firms need less support in these aspects. However, this is in contrast to our previous finding that foreign firms receive on average more support than similar domestic firms. This shows the importance of being able to distinguish between different types of support, since heterogeneity of support also plays a role in the types of linkages that firms develop. Furthermore, we find that being an older firm leads to receiving more support, a finding which holds for all kinds of support from all types of buyers. In the case of product quality upgrade, being part of an industrial zone seems to have a moderately significant positive effect, whereas for efficiency upgrades, it is the more skill-intensive firms in more high-tech sectors that receive more support, as efficiency upgrade could be of more importance to the buyers in these sectors.

Support from buyers in the form of trainings provided to employees seems to be higher for supplier firms inside industrial zones, and on average, older firms seem to benefit more from this type of support (column 3). As is to be expected, firms with lower skill intensity receive more support in terms of employee trainings. In terms of financial support, the previous descriptive analysis showed that this is the least provided kind of support and our regression analysis proves this further, since none of the determinants under investigation here seems to play a significant role in making buyers provide access to finance to their suppliers (column 4).

In terms of technology transfer, we find that on average more technology is being transferred to foreign suppliers (column 5). This could be driven by the fact that for foreign suppliers, the majority of buyers are other foreign firms (both in Vietnam and abroad), which have a technology premium in comparison to domestic buyers. We also find that lower skill intensity increases the chances of receiving technology transfers. Interestingly, being part of an industrial zone increases the chances of receiving technology transfers, while being in the same province as the main buyer decreases these chances. This helps to confirm our argument above that technology transfers are mainly provided by foreign buyers, especially those located abroad. Since being part of an industrial zone increases the chances of developing linkages with foreign buyers abroad and consequently receiving technology transfers from them (as is shown further in the analysis below, when we look at support from different kinds of buyers) we would expect them to receive more support from foreign buyers abroad. On the other hand, being in the same province as the main buyer could to some extent serve as a proxy that the firm is mainly supplying to domestic buyers, thus reducing the chances of receiving technological transfers from foreign buyers abroad. The positive effect of being in an industrial zone on receiving

technological support is made stronger when looking at support in terms of joint product designs (column 6). The finding of older, less skill-intensive firms receiving more support holds for these kinds of support as well.

VARIABLES	(1) Product quality	(2) Efficiency upgrade	(3) Worker training	(4) Financial support	(5) Technology transfer	(6) Product design
foreign10	-0.567***	-0.330**	-0.0718	0.0655	0.344**	-0.0931
	(0.169)	(0.139)	(0.147)	(0.143)	(0.158)	(0.138)
sameprovib	0.0406	-0.115	0.00222	0.110	-0.255**	-0.0709
	(0.134)	(0.114)	(0.119)	(0.115)	(0.126)	(0.112)
dindzone	0.296*	0.191	0.292**	0.0162	0.281*	0.328**
	(0.160)	(0.136)	(0.142)	(0.140)	(0.145)	(0.137)
skillratio	-0.00175	-0.0119***	-0.00849*	-0.00132	-0.00817*	-0.0112***
	(0.00482)	(0.00417)	(0.00445)	(0.00423)	(0.00469)	(0.00402)
2.dage	0.273	0.264	0.495***	0.167	0.279	0.0723
	(0.182)	(0.164)	(0.183)	(0.172)	(0.182)	(0.164)
3.dage	0.549***	0.00615	0.492***	0.204	0.287	0.329**
	(0.190)	(0.165)	(0.187)	(0.173)	(0.186)	(0.168)
4.dage	0.424	0.0657	0.590**	0.0772	0.0308	0.230
	(0.273)	(0.225)	(0.249)	(0.235)	(0.271)	(0.226)
Size dummy	Yes, no effect	Yes, no effect	Yes, no effect	Yes, no effect	Yes, no effect	Yes, no effect
3.techlevel	0.120	0.00511	0.306*	0.348**	0.131	0.0878
	(0.185)	(0.152)	(0.157)	(0.153)	(0.163)	(0.151)
4.techlevel	-0.0438	-0.390***	-0.0519	-0.0478	-0.218	0.0559
	(0.157)	(0.135)	(0.141)	(0.139)	(0.146)	(0.133)
5.techlevel	-1.192**	-0.0782	0.0487	-0.849	-0.834	-0.544
	(0.527)	(0.488)	(0.545)	(0.643)	(0.801)	(0.527)
Constant	1.117***	0.671***	-1.114***	-0.900***	-1.183***	0.168
	(0.273)	(0.231)	(0.256)	(0.237)	(0.258)	(0.228)
Observations	1,426	1,426	1,426	1,426	1,426	1,426

Table 9: Supplier characteristics as determinants of received support, by type of support

Table 10 shows the results from the OLS and Tobit analsysis on the effect that different supplier characteristics have on the level of support they receive from different types of buyers. An initial finding is that correcting for the censored nature of the data does not change the results substantially in terms of coefficient sign and significance, but the magnitudes change considerably.

EQUATION	VARIABLES	(1) Overall buyer support	(2) Overall buyer support	(3) Domestic buyer support	(4) Domestic buyer support	(5) Foreign buyer in Vietnam support	(6) Foreign buyer in Vietnam support	(7) Foreign buyer out Vietnam support	(8) Foreign buyer out Vietnam support
		Tobit	OLS	Tobit	OLS	Tobit	OLS	Tobit	OLS
model	logbuyers	0.157***	0.140***	0.505***	0.237***	0.441***	0.114***	-0.382***	-0.187***
		(0.0566)	(0.0486)	(0.0446)	(0.0250)	(0.0794)	(0.0250)	(0.0693)	(0.0313)
	dmainbuyer	0.133	0.144	0.883***	0.436***	-0.112	-0.0322	-0.352	-0.0782
		(0.173)	(0.151)	(0.139)	(0.0851)	(0.243)	(0.0832)	(0.214)	(0.0966)
	foreign10	0.484**	0.448**	-1.722***	-0.975***	1.279***	0.360***	1.606***	0.603***
		(0.211)	(0.181)	(0.173)	(0.104)	(0.310)	(0.0933)	(0.260)	(0.112)
	sameprovib	-0.0642	-0.0604	0.132	0.0150	1.050***	0.304***	-0.993***	-0.440***
		(0.172)	(0.149)	(0.141)	(0.0848)	(0.249)	(0.0874)	(0.218)	(0.0938)
	skillratio	-0.0159**	-0.0119**	0.000562	-0.00167	-0.0272***	-0.00900***	-0.0152*	-0.00656*
		(0.00652)	(0.00538)	(0.00486)	(0.00303)	(0.00964)	(0.00278)	(0.00815)	(0.00335)
	dindzone	0.565***	0.445**	-0.0882	-0.0343	1.159***	0.422***	0.424*	0.212*
		(0.199)	(0.174)	(0.179)	(0.0856)	(0.280)	(0.102)	(0.236)	(0.122)
	2.dage	0.487**	0.404**	0.149	0.0545	0.620*	0.190*	0.486	0.241*
		(0.235)	(0.198)	(0.209)	(0.101)	(0.372)	(0.114)	(0.300)	(0.141)
	3.dage	0.435*	0.352*	0.349	0.115	0.234	0.0838	0.744**	0.298**
		(0.245)	(0.205)	(0.216)	(0.110)	(0.391)	(0.117)	(0.310)	(0.145)
	4.dage	0.448	0.367	0.134	0.0101	-0.162	0.0629	0.845*	0.354**
		(0.329)	(0.272)	(0.255)	(0.165)	(0.537)	(0.145)	(0.444)	(0.172)
	2.dsize	0.204	0.150	0.208	0.130	0.166	0.0121	0.141	0.0459
		(0.218)	(0.188)	(0.181)	(0.109)	(0.323)	(0.104)	(0.285)	(0.122)
	3.dsize	0.169	0.148	-0.342**	-0.135	0.00798	-0.0351	0.684***	0.320***
		(0.195)	(0.167)	(0.160)	(0.0886)	(0.277)	(0.0883)	(0.243)	(0.112)
	3.techlevel	0.605***	0.565***	0.345*	0.156	0.385	0.170	0.370	0.165
		(0.221)	(0.198)	(0.178)	(0.106)	(0.304)	(0.110)	(0.290)	(0.133)
	4.techlevel	-0.325*	-0.233	-0.00851	-0.0489	-0.385	-0.0613	-0.166	-0.143
		(0.193)	(0.166)	(0.162)	(0.0908)	(0.280)	(0.0906)	(0.247)	(0.114)
	5.techlevel	-0.356	-0.160	-0.268	-0.243	0.857	0.309	-0.766	-0.411
		(0.841)	(0.655)	(0.638)	(0.398)	(1.196)	(0.385)	(0.984)	(0.265)
	Constant	2.492***	2.801***	-0.546**	1.054***	-4.146***	0.0823	0.0757	1.504***
		(0.354)	(0.295)	(0.277)	(0.157)	(0.561)	(0.162)	(0.444)	(0.200)
sigma	Constant	2.730***	2.801***	2.179***	1.054***	3.434***	0.0823	3.228***	1.504***
		(0.0859)	(0.295)	(0.0799)	(0.157)	(0.142)	(0.162)	(0.117)	(0.200)
	Observations	1,263	1,263	1,369	1,369	1,369	1,369	1,369	1,369
	R-squared		0.055		0.273		0.081		0.151

Table 10: Supplier characteristics as determinants of received support, by type of buyer

We find that when looking at all types of support together, controlling for the extent of linkages is important, since we find that having a higher number of buyers overall leads to significantly more support. However, when looking at support from foreign buyers outside Vietnam, having more buyers overall leads to a lower level of support from foreign buyers abroad. This means that foreign buyers outside Vietnam offer more support to firms that develop sales relations with few other buyers, hinting at some sort of longer term, exclusive supplier-buyer relationships. In terms of other firm characteristics that affect the overall level of support, we find that being foreign, being part of an industrial zone and having a lower skill ratio all lead to receiving a higher level of support.

Zooming in on the type of buyers reveals that while having a higher number of buyers overall and a majority of domestic buyers leads to more support from domestic buyers, being a foreign supplier has the opposite effect. Thus, even after controlling for other factors, we find that being foreign has a strong negative effect on the level of support received from domestic buyers (columns 3 and 4). We also see that being in an industrial zone or in the same province as their supplier do not seem to affect the level of support that domestic buyers offer, indicating that they are more aware of the production networks within the country and better integrated and are not as confined to geographical clusters as foreign buyers. Finally, we find that larger firms get more support, and so do firms in medium technology sectors.

The level of support that suppliers received from foreign buyers in Vietnam depends positively on the overall number of buyers and on foreign ownership. However, having a majority of foreign or domestic main buyers does not affect the level of support from foreign buyers significantly. Being in the same province as the main supplier and being in an industrial zone affects the level of support positively. Thus, the geographical component is more important for foreign firms, since they are not as embedded in the local economy as domestic ones and rely more on physical proximity to develop linkages and to offer support. Overall, less skill intensive firms receive more support (columns 5 and 6).

Finally, when focusing on support from foreign buyers outside Vietnam, the Tobit analysis reveals that having more buyers overall decreases the level of support, but it does not matter if the majority of buyers are domestic or foreign. Instead, being a large firm, having foreign ownership, being located in an industrial zone, and having a lower ratio of skilled to unskilled workers (indicating more light manufacturing industries) all increase the level of support from foreign firms. Older, more established firms receive more support as well. On the other hand, if the main buyer is in the same province as the supplier, this lowers the levels of support from foreign buyers abroad, an indication that foreign buyers outside Vietnam focus their support on firms that do not serve mainly to the domestic market.

This analysis shows clearly that all factors that would lower the barriers of becoming a supplier to foreign firms outside Vietnam (being larger, foreign, older and part of an industrial zone) would also

increase the level of support from foreign buyers abroad. It also highlights the fact that like foreign firms in Vietnam, foreign firms outside Vietnam have to rely on institutional settings such as industrial zones to find local suppliers. However, as is to be expected, geographic proximity has different implications for foreign firms inside and outside Vietnam, whereas it affects domestic buyers less. Having gone in-depth into the determinants of the intensity of linkages, we turn to our final question of linking linkages with foreign firms to the productivity of domestic firms.

4.3 LINKAGE EXTENT AND INTENSITY AND PRODUCTIVITY OF DOMESTIC FIRMS

We start the productivity analysis by looking at the effect of having linkages with foreign buyers and receiving support from them on the suppliers' level of log (tfp) in a cross-sectional OLS framework. In columns 1 and 3 we look at the effect of linkages and support from foreign buyers in Vietnam and abroad respectively in isolation (without controlling for additional factors). Our main independent variables for measuring linkages to foreign firms are forvietbuyershare and foroutbuyershare. Already in this specification, we see that neither the share of linkages, nor receiving support from foreign buyers has a significant effect on the productivity of local suppliers. We find that the effect of the overall level of linkages is significant: the more buyers overall, the higher the productivity of local supplier firms.

However, when controlling for other factors that may affect the level of productivity, we find that this effect of overall linkages disappears as well and the only firm characteristics that affect total factor productivity are the skill intensity, the productivity gap and age. We also don't find an effect of the technological level of the sector, but this can be explained by the fact that we estimated TFP by sector and therefore already accounted for sector effects on productivity. Older, larger firms are more productive. Since we expect the results from the OLS analysis to be biased due to endogeneity issues, we proceed by showing the results from our 2 Stage Least Square analysis with the instrumental variables we explained in Section 3.

Table 11 shows that when we correct for endogeneity issues, linkages to foreign firms in Vietnam affect the productivity of local firms positively at a 5% significance level. Furthermore, having a higher level of linkages overall is also positively correlated to total factor productivity. These results hold after controlling for a number of other covariates as well. However, we find that all else equal, a higher level of support from foreign firms in Vietnam is negatively correlated to TFP. However, this finding is not very puzzling, since we do not have an instrument for support and therefore cannot control for simultaneity bias there. It is probably the case that a negative sign indicates that less productive local suppliers receive more support from foreign buyers in Vietnam, thus leading to a negative bias. The analysis also shows that more buyers overall lead to higher productivity and older, more skill-intensive firms are more productive. A larger productivity gap to the industry average has a positive effect on productivity as well, indicating a catch-up effect at work.

VARIABLES	(1) tfp	(2) tfp	(3) tfp	(4) tfp
logbuyers	0.0240*	0.0224	0.0339**	0.0219
	(0.0131)	(0.0141)	(0.0141)	(0.0139)
forvietbuyershare	0.112	0.0928		
	(0.0790)	(0.0876)		
dforvietsupport	-0.0265	-0.0388		
	(0.0451)	(0.0425)		
foroutbuyershare			-0.0162	-0.000359
			(0.0716)	(0.0751)
dforoutsupport			0.0644	0.0498
			(0.0452)	(0.0447)
foreign10		0.0381		0.0749*
		(0.0488)		(0.0419)
skillratio		0.00374**		0.00621***
		(0.00168)		(0.00171)
prodgapisprov		0.00593***		0.00171
		(0.00190)		(0.00170)
2.dage		0.206***		0.229***
		(0.0651)		(0.0686)
3.dage		0.144**		0.166**
		(0.0729)		(0.0730)
4.dage		0.0809		0.118
Size dummy		Yes, no effect		Yes, no effect
Technological level dummy		Yes, no effect		Yes, no effect
Constant	-0.122**	-0.373***	-0.156***	-0.495***
	(0.0592)	(0.0904)	(0.0601)	(0.0998)
Observations	629	627	782	780
R-squared	0.006	0.077	0.012	0.058

Table 11: Effect of linkage extent and intensity on TFP: OLS analysis

The findings from the analysis with foreign buyers outside Vietnam reveal that even after correcting for endogeneity issues, the share of linkages to foreign buyers and their support do not have a significant effect on the level of productivity of local suppliers. In fact, the only variables that seem to affect productivity are the age and skill intensity of employees. Older firms and firms with a higher skill ratio have a higher productivity.

So, overall, we can conclude that while foreign firms abroad provide support for their domestic suppliers, they do not seem to have a big effect on the level of productivity of the local firms. On the other hand, developing a higher share of linkages with foreign firms in Vietnam leads to higher productivity. This finding could also be an indication of the importance of geographical proximity: not only does geographical proximity lead to more linkages and higher levels of support to foreign firms, but linkages with foreign firms in the country have a higher potential of translating into higher productivity benefits for local suppliers than linkages to firms abroad.

VARIABLES	(1) first forvietbuyershare	(2) second tfp	(3) first forvietbuyershare	(4) second tfp	(5) first foroutbuyershare	(6) second tfp	(7) first foroutbuyershare	(8) second tfp
forvietbuyershare		0.956**		1.407**				
		(0.374)		(0.645)				
foroutbuyershare						2.588		1.288
						(14.12)		(1.953)
dforoutsupport					0.329***	-0.792	0.296***	-0.335
					(0.0209)	(4.647)	(0.0213)	(0.588)
dforvietsupport	0.211***	-0.231**	0.184***	-0.298**				
	(0.0196)	(0.106)	(0.0206)	(0.139)				
logbuyers	-0.0423***	0.0610***	-0.0255***	0.0532**	-0.123***	0.353	-0.105***	0.158
	(0.00579)	(0.0206)	(0.00722)	(0.0216)	(0.00535)	(1.730)	(0.00612)	(0.208)
foreign10			0.167***	-0.210			0.0445*	0.0192
			(0.0198)	(0.136)			(0.0234)	(0.0989)
skillratio			-0.000654	0.00505**			-0.00256***	0.00960*
			(0.000683)	(0.00217)			(0.000695)	(0.00552)
prodgapisprov			0.000424	0.00539***			-0.000266	0.00205
			(0.000463)	(0.00196)			(0.000375)	(0.00200)
2.dage			-0.0267	0.236***			-0.0115	0.246***
			(0.0344)	(0.0821)			(0.0322)	(0.0864)
3.dage			-0.0649*	0.236***			-0.0148	0.188**
			(0.0345)	(0.0903)			(0.0330)	(0.0924)
4.dage			0.00318	0.0898			-0.0745*	0.218
			(0.0359)	(0.0910)			(0.0383)	(0.184)
2.dsize			-0.0585**	0.124*			0.0299	0.0304
			(0.0259)	(0.0715)			(0.0273)	(0.0939)
3.dsize			-0.0266	0.0351			0.0654***	-0.0741
			(0.0245)	(0.0608)			(0.0231)	(0.146)
Technological level			Yes, no effect	Yes, no effect			Yes, no effect	Yes, no effect
pallbackfdiy10	0.245***		0.167***					
	(0.0367)		(0.0386)					
indexposhare					-0.0110		0.0577	
					(0.0513)		(0.0535)	
Constant	0.111***	-0.315***	0.0743*	-0.578***	0.543***	-1.562	0.466***	-1.130
	(0.0264)	(0.0995)	(0.0413)	(0.136)	(0.0309)	(7.617)	(0.0480)	(0.974)
Observations	629	629	627	627	782	782	780	780
R-squared	0.280		0.356		0.543		0.586	

Table 11: Effect of linkage extent and intensity on TFP: 2SLS analysis

5. CONCLUSION

This paper looked at the extent and intensity of vertical linkages that local firms in Vietnam develop with domestic firms, foreign firms in Vietnam and foreign firms abroad in downstream sectors. We use data from a unique dataset collected by UNIDO in 2011 by surveying foreign and domestic firms in the main economic regions of Vietnam. The rich amount of information provided by the survey on vertical linkages allows us to answer several related research questions on the differences between different types of firms and the linkages that they develop with local suppliers.

Firstly, we use descriptive statistics and propensity score matching analysis to determine if there are indeed differences between the linkages that foreign and domestic firms develop, once we control for a number of characteristics that could be driving these differences otherwise. We find that after controlling for the propensity of being foreign, foreign local suppliers develop still have a higher number of foreign buyers than domestic firms with similar observed characteristics. Moreover, local firms that sell to foreign buyers receive more support than similar firms that serve the domestic market alone. When we consider the perceptions of firms that act as buyers, most of these findings are supported. However, there is a discrepancy in the level of support that suppliers and buyers report receiving and giving, hinting at a potential for unintentional knowledge transfers, i.e. knowledge spillovers. Thus, this analysis reveals that the potential of knowledge intensive linkages with foreign firms is possible, but foreign firms need to develop more linkages with domestic firms.

We then turn to analyze the necessary conditions that need to be fulfilled for domestic firms to receive support from different types of buyers. We find that there is heterogeneity in the types of support that buyers offer and supplier characteristics affect these differently. When we consider the level of support from different types of buyers, we can identify the necessary characteristics that increase the chances of receiving support. Our OLS and Tobit analysis shows that foreign firms in Vietnam are less embedded in the local economy than domestic firms. Therefore, they establish more linkages and offer more support to older, larger, more established local firms. They also tend to offer more support to firms in their geographic proximity, or in industrial zones. Domestic firms are more embedded in the economy and as a result are less affected by these factors in their provision of support to suppliers. Finally, foreign firms abroad rely on the network of foreign firms in the country or on industrial zones to establish linkages and offer support to local suppliers. However, they prefer to offer support to local suppliers with few other customers.

We also analyze the effect that the extent and intensity of linkages with foreign firms have on the productivity of local suppliers. We correct for possible endogeneity issues by using instrumental variables and conclude that simple OLS analysis yields biased results. After correcting for endogeneity, we find that having a higher share of foreign buyers in Vietnam affects the productivity

level of local suppliers positively, even after controlling for a number of other variables. On the other hand, linkages with foreign firms outside Vietnam do not translate into productivity increases. These finding emphasize the importance of providing the right conditions to develop linkages with FDI in the country: after correcting for endogeneity, there is potential for a productivity increase for domestic firms, as long as they are able to increase the extent of linkages with foreign firms in downstream sectors in Vietnam.

However, our study has several limitations. The main limitation is the cross-sectional nature of the data. Even after using instrumental variables to correct for the endogeneity of the extent of linkages, our measure of linkage intensity is not instrumented and is still biased. Moreover, we cannot control for the endogeneity in input choice, which could also bias our estimation of productivity. Another issue that arises from the nature of our data is that while it provides excellent information on the linkages with foreign firms, it also overestimates the presence of foreign firms in the population of firms in Vietnam. Instead, it is necessary to provide a measure of FDI presence representative of each industry's output or employment share provided by FDI. These issues highlight the necessity of reliable data that manages to encompass the qualitative richness of survey information within a longitudinal, representative sample of firms. Therefore, the continuation of such surveys over a longer period and their extension to cover more countries (especially developing countries) is of utmost importance for the advancement of applied research on inclusive and sustainable industrial development.

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APPENDIX - VARIABLE DESCRIPTION

logy	Log(output)
logk	Log(capital)
labour	Total number of full-time employees
logm	Log(materials)
loge	Log(electricity)
logva	Log(value added)
tfp	Total factor productivity, by industry
totexp	Total exports (Section A harmonized with export section)
dage	Age of company categorical variable (1: 0-5 yrs, 2: 6-10 yrs, 3: 11-20 yrs, 4: >20 years)
dsize	Size group in terms of number of full-time employees (S-M-L, I part)
techlevel	Technological classification of the manufacturing sector (Based on OECD definition
foreign10	Ownership Structure D-F (0-10-100, from question 7)
nosupviet	Number of domestic suppliers or foreign suppliers based in Vietnam
domsupshare	Share of domestic suppliers(%)
sameprovib	=1 if At least one main buyer in the same province as the firm
dindzone	Dummy for industrial/export processing zone, computed from q49
skillratio	Techical, administrative & managers staff over total workers (%)
dmainbuyer	1=main buyer is domestic
pallbackfdiy10	Backward FDI by output share, 10% threshold, province level, including self
indexposhare	Industry Export Share
Overall buyer support	Sum of different types of support from different types of buyers, ranging from 0 to 18. If a supplier has reported receiving all 6 types of support from all 3 types of buyers (domestic, foreign in Vietnam and foreign abroad), buyersupport=18.
Domestic buyer support	Sum of different types of support from domestic buyers, ranging from 0 to 6. Variables only coded as missing value if supplier did not check any type of support, otherwise coded as 0.
Foreign buyer in Vietnam support	Sum of different types of support from foreign buyers in Vietnam, ranging from 0 to 6. Variables only coded as missing value if supplier did not check any type of support, otherwise coded as 0.
Foreign buyer out Vietnam support	Sum of different types of support from foreign buyers outside Vietnam, ranging from 0 to 6. Variables only coded as missing value if supplier did not check any type of support from any type of buyer, otherwise coded as 0.
Product quality	Assistance with product upgrade from all types of buyers (domestic, foreign in Vietnam, foreign abroad)– if no assistance reported, assistance is coded as 0
Efficiency upgrade	Assistance with upgrade of production efficiency from all types of buyers (domestic, foreign in Vietnam, foreign abroad)– if no assistance reported, assistance is coded as 0
Worker training	Assistance with employee training from all types of buyers (domestic, foreign in Vietnam, foreign abroad)– if no assistance reported, assistance is coded as 0
Financial support	Assistance with financial support from all types of buyers (domestic, foreign in Vietnam, foreign abroad)– if no assistance reported, assistance is coded as 0
Technology transfer	Technology transfer from all types of buyers (domestic, foreign in Vietnam, foreign abroad)– if no assistance reported, assistance is coded as 0
Product design	Assistance with product design/joint product design from all types of buyers (domestic, foreign in Vietnam, foreign abroad)– if no assistance reported, assistance is coded as 0