Determinants of linkages between foreign direct investment firms and domestic firms in Vietnam

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A R T I C L E   I N F O

A B S T R A C T

Foreign direct investment (FDI) is an important sector of many developing economies in general and of Vietnam in particular. In Vietnam, the FDI sector contributed up to 27.7% of the average economic growth rate of 6.0% per year from 2010 to 2018. Besides this contribution, operations of FDI in Vietnam reveal many limitations, the most noticeable of which is the weak linkage between FDI and Vietnamese firms. This article examines determinants of FDI-domestic firms linkage in Vietnam. This research looks at all three types of linkage, including horizontal linkage, vertical linkage, and supply-backward linkage. Factors that have a positive impact on linkages are provincial economic growth, firms' technology level, regional factors, being located in industrial zones, and operating in the manufacturing sector. Macroeconomic instability has a negative impact on linkage. The quality of economic governance, as measured by the Provincial Competitiveness Index, is important for attracting FDI, but does not affect linkages.

1. Introduction

FDI is an important source of economic growth for many developing countries. FDI brings in much-needed capital, expands the export market (Nwanna, 1986), trains human resources, and transfers technology to developing countries (Mello, 1999). However, not all countries benefit equally from FDI. Studies have found mixed evidence on the impact of FDI on economic growth (Li and Liu, 2005; Carkovic and Levine, 2005). Countries that benefit more from FDI have better absorptive capabilities (Crespo and Fontoura, 2007). One such absorptive capability is the ability of domestic firms to link with FDI firms. Such linkage can enhance the FDI-economic growth channels mentioned above. Hirschman (1958) argued that in the absence of linkages, foreign investments could have limited or even negative effects on an economy (particularly the so-called 'enclave economies'). Hence, it is important for economists and policymakers to understand what factors can affect linkage.

Vietnam first began opening its economy in 1986, starting a period of economic reform known as "Doi Moi". Over thirty years later, Vietnam stands as an interesting case study of FDI. From a mostly centralized economy with mostly state-owned firms, the economy of Vietnam has been becoming increasingly diverse, with FDI accounting for 23.6% of total capital formation during 2016-2018. FDI also contributes significantly to export, accounting for 70.04% of 243.5 billion USD export volume in 2018 (MPI, 2019). However, similar to many developing countries, the linkage between FDI and domestic firms in Vietnam is weak. The domestic content of electronic telecommunication products, the key export product of Vietnam, is only 15%. This article, using data from Vietnam, provides empirical evidence for factors affecting linkage determinants for FDI-domestic firms. The article looks at all three types of linkages, including horizontal linkage, vertical linkage, and supply-backward linkage.

2. Theoretical framework and Literature review

2.1. Theoretical framework

The linkage between FDI and domestic firms is understood as the establishment of relationships and interactions between FDI firms and domestic firms, both in terms of inputs, outputs, and the product market, with the aim of benefiting both sides. There are three primary forms of linkage, which are:

1. Horizontal linkage: This is the form of linkage between FDI and domestic firms in the same industry. This kind of linkage creates positive effects through several channels: i. Demonstration effect, in which domestic firms simulate/imitate FDI firms regarding technology, management methods, etc., and thereby improve productivity (Blomstrom and Kokko, 1998; Barrios and Stroble, 2002); ii. Competition effect, where rising competition requires domestic firms to enhance productivity, upgrade technology and develop new products (Blomstrom and Kokko, 1998); iii. Human capital spillover effect, where high-quality human resources trained by FDI firms relocate to the domestic sector. UNCTAD (2001) underlined the importance of this spillover channel; iv. Trade effect, occurring when the infrastructure and strategy used to penetrate foreign markets of FDI firms are also utilized by domestic firms, helping them expand the export market (Rhee, 1990; Greenaway et al., 2004).

2. Vertical linkage: Vertical linkage exists in two forms, being backward linkage and forward linkage.

Backward linkage occurs when FDI firms buy input goods and services from domestic firms. This form of linkage has the potential to create the greatest spillover effect on domestic firms (Javorcik, 2004). This spillover effect takes place via the following three forms: i. FDI firms support domestic firms in terms of technique and management experience in order to improve the quality of input products for FDI firms themselves (Lall, 1980; Javorcik, 2004); ii. FDI firms hold high standards for the quality of input products and thus create incentives for domestic firms to upgrade technology and improve management processes; iii. Domestic firms supplying to FDI firms have the ability to expand their market share, especially in the export market, through FDI firms and can thus improve efficiency due to economy of scale (Javorcik, 2004).

Forward linkage occurs when FDI firms provide input products and services to domestic firms. With the better quality of input products from FDI firms, domestic firms can improve output quality. Moreover, when the suppliers provide technical support to customers who are domestic firms, these firms can thereby enhance their productivity. In Liang (2017), data from Chinese firms indicated that the spillover effect from forward linkages is even stronger than for backward linkages. Takii and Narjoko (2012) used data from Indonesian firms, found a positive correlation between the forward linkage measure and the productivity of domestic firms.

3. Supply-backward linkage occurs when FDI and domestic firms in the same industry share the same supplier. FDI firms create an indirect positive impact on domestic firms in the same industry via domestic suppliers. When a domestic supplier receives technical support from an FDI enterprise, this supplier will provide better input products for the downstream industry, which consists of both FDI and domestic firms. Markusen and Venables (1999) proved this channel of effect via the theoretical partial equilibrium model. Schoors and Merlevede (2007), Blalock and Gertler (2008), and Jude (2012) proved empirically the importance of supply-backward linkage.

2.2. Literature review

There are many determinants of the linkages between FDI and domestic firms. These determinants can be divided into three groups, including i. Determinants from the FDI firms themselves; ii. Determinants from domestic firms; iii. Determinants from the institutional business environment.

2.2.1. Linkage determinants from the FDI firms

Domestic market-seeking FDI firms create more linkages than export-oriented market-seeking FDI firms. FDI firms oriented toward the domestic market purchase more inputs from domestic firms (Altenburg, 2000). When linkage occurs, these firms also create a larger spillover effect (Farole and Winkler, 2012). Studies by UNCTAD (2000) and Belderbos et al. (2001) also reached similar conclusions. This is because, in developing countries, the domestic market often requires lower technical standards and is more likely to be met by domestic firms.

The ownership structure of FDI firms also affects linkage: joint venture firms tend to have better linkage than 100% foreign-owned firms. Research by Chen and Chang (2011) on FDI inflows in Taiwan; Akyuz (2018) on Turkey; Toth (1998) on Hungary and Sánchez-Martín et al. (2014) on developing countries all indicated that joint venture firms are more dependent on domestic inputs than 100% foreign-owned firms, thus making it easier to create backward linkages. Joint ventures, with knowledge of the domestic supply chain from domestic shareholders, can easily find localized supply. Firms that are 100% foreign-owned need time to learn about domestic supply and therefore opportunities for linkages are reduced.

The characteristics of each industry and field also affect backward and forward linkage. Calculations by Sánchez-Martín et al. (2014) from the IFC-World Bank Group Enterprise Survey data of developing countries showed that the food processing industry needs an on-site supply of ingredients and thereby has a very high backward linkage index of over 65%. In contrast, the apparel and electronics industries that require large-scale and high-quality inputs often have a very low backward linkage index of under 35%. These industries have the highest forward linkage index since domestic firms in developing countries are unlikely to produce large-scale and high-quality input materials, so they often have to buy from FDI firms.

FDI firms formed from mergers and acquisitions have higher linkage than greenfield FDI (Kennel, 2007). These firms have an existing supply chain of input products, as well as an understanding of the

domestic supply chain, compared with newly established FDI firms (Belderbos et al., 2001; UNCTAD, 2000).

Large-sized FDI firms often have less linkage than small-sized FDI firms. Due to the advantage of economy of scale, large-sized firms can produce low-cost input products themselves (Schackmann-Fallis, 1989; Halbach, 1989; Barkley and McNamara, 1994). In addition, domestic firms are also less able to supply input products in large quantities to FDI firms.

High-tech FDI firms tend to have less linkage with domestic firms than medium-tech FDI firms (UNCTAD, 2001; Martin et al., 2015). These firms often have global supply chains available and place little demand on local suppliers. Moreover, high-tech FDI firms often do not want to link with domestic suppliers, fearing that their technology will be leaked to competitors (Dunning, 1980).

The longer an FDI enterprise exists in the domestic market, the more likely it will create linkages. This is because FDI firms need time to learn about domestic supply chains. This is the case not only in developing countries but also in developed countries. The number of domestic firms supplying to Honda in the US market increased rapidly from approximately 30 suppliers in 1983 to more than 400 suppliers in 1997 (Handfield and Krause, 1999). In addition, after a sufficiently long period, FDI firms will often have greater autonomy as subsidiaries of multinational corporations. This allows those firms to find local supply more easily (Akyuz, 2018; Zaheer, 1995).

The cultural closeness between the country of origin of FDI firms and the host country also positively impacts linkage. This makes Italian FDI firms link more successfully with Turkish domestic firms, compared to French and German firms (Köylü, 2016; Akyuz, 2018). In China, firms from Hong Kong, Macao, and Taiwan are better linked with domestic firms than OECD firms (Zhang, 2005).

2.2.2. Linkage determinants from domestic firms

In China, state-owned firms are more likely to create linkage than private firms (Liu et al., 2009). Nevertheless, in Vietnam, state-owned firms are less capable of creating linkage than private firms (Nguyen, 2018).

As for private firms, joint ventures often have better linkage than 100% domestic firms (Mansfield and Romeo, 1980; Lee and Mansfield, 1996; Ramachandran, 1993). Firms with a higher percentage of foreign ownership tend to deploy newer technologies and conduct more training.

The size of domestic firms influences the ability to enter the supply chain for FDI firms. Larger businesses have the advantage of economy of scale and low production costs. These firms are also more capable of paying the fixed costs of entering the supply chain of FDI firms, such as information, marketing, and technology costs (Nguyen, 2018). FDI firms often find the production capacity of small-sized firms unreliable (UNCTAD, 2018).

The technology level of domestic firms is also one of the determining factors for linkage (Liu et al., 2009). According to UNCTAD (2001), the smaller the technology gap between FDI and domestic firms, the easier it is to create linkage.

The development level of human resources also affects linkage. Kamata et al. (2017) studied differences between Vietnamese firms that provide inputs for FDI versus firms without any linkage. The result shows that the majority of the domestic firms linked with FDI firms conduct labor training at work (91.7%) while few firms without linkages do (33.3%). Employees of linked firms are also required to meet more key indicators for performance (70% of firms require 3-9 key indicators) than firms with no linkage, which usually only require 1-2 key indicators. Additionally, linked businesses often have leaders and managers who have studied or worked abroad or have had working experience in FDI firms.

The closer the geographical distance between FDI and domestic firms is, the more likely that linkages will occur. Geographical remoteness will limit the channels of spillover, demonstration, and human capital spillover (Akyuz, 2018).

2.2.3. Linkage determinants from the institutional side and the business environment

According to the data set of VCCI Provincial Competitiveness Index (PCI) as available on the website http://pcivietnam.org/, up to 20% of FDI firms in Vietnam had contractual disputes with their partners in 2018. The causes of disputes included late delivery or delivery of damaged goods, late payment, and unsatisfactory service. This rate was much higher than the 3.9% of Vietnamese firms that had disputes. However, when a dispute occurred, only 2% of FDI firms wanted to bring it to court for resolution, compared with 39.4% of domestic firms. The feeling of "being unprotected" and the high cost of dispute resolution make FDI firms, intent on minimizing costs and risks, choose to link with other FDI firms instead of domestic ones. Hayat (2019) assessed how the impact of FDI on national growth depends on the quality of institutions. Using data from 104 countries in three groups (low-income, middle-income, and high-income) this study shows that high institutional quality increases the positive effect of FDI on the growth rate of low-income and middle-income countries.

Positive effects from FDI on domestic firms are more likely to happen when the host country's financial system reaches a certain level of development. This stems from two reasons: i. The developed financial system assists businesses to reduce risks from investment activities, thus helping domestic firms to invest in upgrading technology and receiving technology transfer from FDI firms with lower risks and costs. On top of that, the easy access to finance also helps domestic firms invest in other crucial factors for technology absorption

capacity, such as training, R&D, etc.; ii. The developed finance system in the host country helps FDI firms to transfer technology and link more easily with domestic firms. Often, multinational corporation affiliates are the ones directly carrying out this technology transfer and linkage. Financial resources from the host country supplement the capital that these businesses receive from their parent group (Hermes and Lensink, 2003), helping ensure resources for technology transfer, training, and support for domestic businesses. This explains why FDI has a positive effect on economic growth in many Asian and Latin American countries, where the financial system reaches a certain level of development. In African countries with underdeveloped financial systems, FDI does not have a major impact on growth.

There have been many empirical studies on determinants of linkage between FDI and domestic firms. This article supplements the available studies in several aspects:

- First, this article uses Vietnamese data and is an empirical study on determinants of the linkages between FDI and domestic firms in Vietnam. The paper is one of the very few quantitative studies on this topic in Vietnam. Vietnam is a developing country that has attracted great FDI inflow recently and, therefore, is an interesting case-study for this research topic.
- Second, the article assesses the impact on four linkage measures, which are horizontal linkage, backward linkage, forward linkage, and supply-backward linkage. Most of the empirical studies conducted mainly evaluate the effect on backward linkage. Meanwhile, a number of recent studies and experiments have shown that other forms of linkage are just as important as backward linkage. Research by Liang (2017) using data from Chinese firms indicates that the impact of forward linkage is greater than that of backward linkage. Concerning the supply-backward linkage, the importance of this form of linkage is supported theoretically by Markusen and Venables (1999) and Pack and Saggi (2001). The empirical evidence for the positive spillover of supply-backward linkage is found in Schoors and Merlevede (2007) and Blalock and Gertler (2008).
- Third, the article calculates the impact of the technology level of firms (TFP) of each business on linkage. The explanatory variable TFP is calculated by applying the method of Levinsohn and Petrin (2003), built on ideas first developed in Olley and Pakes (1992). This variable has a great influence on all four linkage measures.

3. Data and methodology

3.1. Data set

The article gathers and processes data from multiple different sources to analyze linkages between Vietnamese firms and FDI firms from many angles. Some of the main datasets used are:

1. The annual Vietnamese enterprise survey data set, which is conducted by the General Statistics Office. This annual enterprise survey is carried out according to a full survey method combined with a sample survey. The data period is from 2010 to 2017.
2. 1AM technology survey data set, which is a set of data collecting information on technology and the use of technology in production. This has been surveyed since 2012 and is only applicable to businesses in the manufacturing and processing industry as selected by the General Statistics Office, in coordination with the Ministry of Science and Technology. Survey data in the 1AM Technology Survey between 2011 and 2016 comprises 21,190 observations taken from 71 state-owned firms, 15,444 private firms, and 5,675 FDI firms.
3. The data set of VCCI Provincial Competitiveness Index (PCI) is available on the website http://pcivietnam.org/. The Provincial Competitiveness Index is used to measure and evaluate the quality of economic governance, the ease and friendliness of the business environment, and administrative reform efforts of the provincial and municipal government in Vietnam, which have the effect of boosting the development of the private economic sector. As a result, the PCI can be taken as a variable representing the policy factors of the state.
4. Provincial statistics such as Provincial Economic Growth (GRDP) and Inflation are collected from the Provincial Statistics Office and the General Statistics Office.
5. The survey data of Japanese firms in Asia and Oceania was conducted by the Japan External Trade Organization (JETRO) in 2017, in which 652 Japanese firms operating in Vietnam participated.

3.2. Measuring the dependent variable-the linkage indices

Following the methods of Javorcik (2004), the horizontal linkage is measured by two measures:

1. Share of FDI in an industry (variable FS_{jt}): This ratio shows what percentage of the total capital of industry j at time t is foreign capital. The higher this ratio is in an industry, the greater the participation rate of FDI in that industry.
2. Output market share of the FDI sector (variable Hor_{jt}): This is the share of output generated by FDI in industry j at time t and is calculated by multiplying the proportion of FDI capital in each firm i (FS_{jt}) and the weight of the firm's market share (by output) in the industry according to the Javorcik (2004) method. This ratio indicates the

presence of foreign capital in industry j at time t using the following formula:

$$Hor_{jt} = \frac{FS_{ijt} * X_{ijt}}{\sum_{j=1}^{n} X_{ijt}} \tag{1}$$

where, X_{ijt} is the output of firm i in industry j at time t. Accordingly, this ratio increases with the output of foreign-invested firms and the proportion of foreign equity in those firms.

According to Javorcik (2004), the backward linkage is measured by the ratio of output supplied to FDI firms in industry j (variable Back). This index reflects the degree of cooperation between domestic firms and FDI firms. It is calculated as the total output market share of the FDI sector in industries k that receive input from industry j at time t (weighted by the share of industry j's output sold to industry k) using the following formula:

$$Back_{jt} = \sum_{k \text{ if } k \neq j} \gamma_{jkt} * Hor_{kt} \tag{2}$$

where, γ_{jkt} is the proportion of industry j's output supplied to industry k at time t drawn from the 2012 input-output matrix. Since industry j's products are sold to other sectors as inputs, this γ_{jkt} excludes products sold for final consumption and adds to imported intermediate products. This calculation does not measure the inputs provided by the intra-sector (i.e. k≠j) because this effect is expressed in variable Hor_{jt}. Forward linkage is expressed by the proportion of input products produced by FDI firms (variable For) by calculating the total share of the FDI sector's output in industries l that supply inputs to industry j at time t (weighted by the share of industry j's output purchased from industry l) according to the method of Javorcik (2004). This variable represents the level of participation of FDI firms supplying input materials to domestic firms:

$$For_{jt} = \sum_{l \text{ if } l \neq j} \delta_{jlt} * Hor_{lt} \tag{3}$$

where, δ_{jlt} is the ratio of industry j's input purchased from industry l at time t drawn from the 2012 I-O table. This calculation does not measure the inputs by the intra-sector (i.e., k≠j) because this effect is expressed in variable Hor_{jt}. Supply-backward linkage is measured according to the method of Schoors and Merlevede (2007), Blalock and Gertler (2008), and Jude (2012) and can be characterized as the linkage between FDI firms in industry j with other domestic firms in the same industry via common domestic supplier(s) in industry l. That is, domestic supplier(s) in industry l, who benefit from forward linkage with FDI firms in industry j, start supplying higher-quality input to domestic firms in industry j (variable $Sback_{jt}$).

$$Sback_{jt} = \sum_{l \text{ if } l \neq j} \delta_{jlt} * back_{lt} \tag{4}$$

where, The proportion δ_{jlt} of industry j's input is purchased from industry l at time t. The variable $back_{lt}$ represents the ratio of the backward linkage in upstream industry l. Hence, the $Sback_{jt}$ measure represents the ratio of the supply-backward linkage.

3.3. Econometric model

The model to assess the impact of determinants of linkage between FDI firms with domestic firms is built as follows:

$$Y_{ij,t} = C_{ij,t} + \beta_1 Y_{ij,t-1} + \beta_2 V_{ij,t} + \beta_3 X_{ij,t} + \varepsilon_{ij,t} \tag{5}$$

where, i, j, and t are indices of firm i, industry j, and year t, respectively.

$Y_{ij,t}$ represents the linkage between FDI and domestic firms through linkage channels. The variable $Y_{ij,t-1}$ is a lagged variable of the dependent variable $Y_{ij,t}$. This variable is added to the model because the increase or decrease in the linkage between FDI firms and domestic firms will also rely on the previous degree of linkage. In addition, adding the lag of the dependent variable aims to minimize the autocorrelation and variance of error in the model.

$V_{ij,t}$ is a set of variables representing macroeconomic factors of the economy. The representative variables comprise The Provincial Economic Growth, Inflation, Provincial Competitiveness Index, and the Regional variable representing the region's characteristics, in which the economic growth and inflation variables show macroeconomic stability. The regional variables are taken as dummy variables that illustrate the characteristics of different regions that affect or do not affect the linkage of FDI and domestic firms. The provincial competitiveness index is taken as a variable representing the policy factors of the state. These variables are collected at the provincial level.

$X_{ij,t}$ is a set of variables representing characteristics of an enterprise, including:

i. The technology level of firms (TFP)(The explanatory variable TFP is calculated by applying the method of Levinsohn and Petrin (2003), built on the idea first developed in Olley and Pakes (1992));

ii. The size of the enterprise's capital;

iii. Years of enterprise's operation;

iv. Whether the enterprise is located in an industrial zone or not. Whether firms located in an industrial zone equal to 1 or vice versa, equal to 0;

v. Industrial concentration index of the industry (HHI); participation by the enterprise in import and export activities;

vi. Characteristics of the enterprise's manufacturing industry and business;

vii. The industry-specific dummy variable is equal to 1 if the firm is in the processing and manufacturing industry, or equal to 0 if it is not.

$C_{ij,t}$ and $\varepsilon_{ij,t}$ are the constant and noise of the model, respectively.

3.4. Description of the variables

Descriptions of these variables are shown in Table 1.

4. Model results

Table 2 presents the results of estimating the impact of determinants of linkage channels of FDI firms with domestic firms, in which models 1, 2, 3, 4, and 5 respectively demonstrate the dependent variables which are the linkage channels FS, HOR, BACK, FOR and SBACK.

Table 1: Some statistical descriptions of the variables in the period 2010-2017

The variables	No. of observations	Average	Standard errors	Min	Max
Participation rate of FDI firms	87283	0.1679	0.1857	0.0000	0.9835
Horizon linkage–Hori	87283	0.0004	0.0065	0.0000	0.9128
Backward linkage–Back	84725	0.0005	0.0148	0.0000	2.6045
Forward linkage-For	84725	0.0003	0.0059	0.0000	0.8329
Supply-backward linkage -sback	84725	0.0005	0.0140	0.0000	2.3765
Log of GDP	3232248	11.8016	1.3375	7.9412	13.3974
Log of CPI	3232248	0.3189	0.1236	-0.0319	0.5733
Log of capital	3211702	8.2556	1.6781	-2.9957	22.9860
Industrial concentration index	3232248	0.0367	0.0836	0.0009	0.8520
Provincial Competitiveness Index	3232248	60.5136	3.3895	45.1171	73.5300

Table 2: Model results assess the impact of determinants of linkage between domestic and FDI firms

Variables	(1) FS	(2) HOR	(3) BACK	(4) FOR	(5) SBACK
Lag *FS*	0.21*** (0.00)				
Lag *Hor*		0.35*** (0.00)			
Lag *Back*			0.33*** (0.00)		
Lag *FOR*				0.37*** (0.00)	
Lag *SBACK*					0.30*** (0.00)
Economic growth	-0.07*** (0.01)	0.02* (0.01)	0.11*** (0.01)	0.02* (0.01)	0.10*** (0.01)
Inflation	-1.08*** (0.17)	-1.09*** (0.23)	-0.33 (0.24)	-1.17*** (0.24)	-0.36 (0.24)
TFP	0.26*** (0.01)	0.90*** (0.01)	0.78*** (0.01)	0.87*** (0.02)	0.75*** (0.01)
Capital size	-0.15*** (0.01)	-0.12*** (0.01)	-0.05*** (0.01)	-0.10*** (0.01)	-0.03*** (0.01)
Years of enterprise's operation	-0.07*** (0.01)	-0.11*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)
In the industrial zone	0.32*** (0.01)	0.17*** (0.02)	0.07*** (0.02)	0.16*** (0.02)	0.07*** (0.02)
Sector	-0.03*** (0.00)	-0.00 (0.00)	0.02*** (0.00)	-0.01*** (0.00)	0.01*** (0.00)
Industrial concentration index	0.10*** (0.00)	0.02*** (0.01)	-0.01** (0.01)	0.01* (0.01)	-0.01*** (0.01)
Region	0.03*** (0.00)	0.02*** (0.01)	0.01 (0.01)	0.02*** (0.01)	0.01 (0.01)
PCI	-0.83*** (0.21)	-0.46 (0.31)	0.28 (0.31)	-0.44 (0.32)	0.24 (0.31)
Constant	3.66*** (0.81)	-11.88*** (1.22)	-16.28*** (1.25)	-11.71*** (1.26)	-15.94*** (1.25)
The number of observations	49,824	45,294	43,753	43,753	43,753
The number of groups	14,506	13,150	12,793	12,793	12,793

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; The variables: The participation rate of FDI firms (FS), Horizontal Linkage *(Hor),* Backward linkage *(Back),* and Forward linkage *(For)* are calculated based on the method in Section 3.2

This result shows several highlights as follows:

- First, the factors relating to the characteristics of firms:

The model's estimation results indicate certain effects of variables representing enterprise's characteristics on the linkage between FDI firms and domestic firms. Specifically, the coefficients of the variable TFP representing the technology level of firms are statistically significant and positive in all models. Thus, it can be seen that the technology level of firms positively affects the linkage between FDI firms and domestic firms. Accordingly, the better the technology level of FDI firms is, the better linkage they have with Vietnamese domestic firms.

The coefficients of the variable of capital size are statistically significant and negative in all models.

The firm's capital size represents the firm's scale of operation. However, the coefficients of these variables are negative, which is an inverse effect. This implies that the larger the capital size of FDI firms, the less linkage they have with Vietnamese domestic firms. This result is consistent with the mentioned theory and similar to previous studies, such as Masry (2015).

The coefficients of the variable of years of firms' operation are statistically significant and negative in all models. This indicates that young or newly established firms will have a better degree of linkage with FDI firms than older ones. This result contradicts the theory and can be explained by the fact that in Vietnam, start-ups or young businesses often have young leaders who are more dynamic and able to integrate, thereby actively and proactively applying new technologies to production. They therefore better meet the requirements of FDI firms to establish linkage. In contrast, long-standing and traditional firms which often use traditional business methods may find it more difficult to adapt to the integration and requirements of FDI firms.

The coefficients of the variable of the industrial zone are statistically significant and positive in all models. This implies that firms located close to each other, such as those located in the same industrial zone, often have a better linkage between FDI and domestic firms. This theoretically confirms that distance is an essential factor in establishing linkages.

In respect of the variable of characteristics of industry, manufacturing, and business is statistically significant in all models. This indicates that different manufacturing industries' characteristics will lead to different linkages between FDI firms and domestic firms. In terms of Vietnam, the processing and manufacturing industry has a significantly better linkage between FDI and domestic firms than other industries.

The coefficients of the variable of industrial concentration index (HHI) are statistically significant and positive for the variables FS, HORI, and FOR and negative for the variables BACK and SBACK. This indicates that industries with few firms occupying a large market share have a better degree of horizontal linkage and forward linkage between FDI and domestic firms. The rationale is that industries with few firms occupying a large market share are often highly competitive, which enhances the capacity of domestic firms via the competition effect and demonstration effect as explained in Section 2.1.

• Second, the macro factors:

Two macro factors showing economic stability are the two variables of provincial economic growth and inflation. The results show that the coefficients of the variable GRDP are positive and statistically significant, so the provincial economic growth exerts a positive impact on the linkage of FDI firms with domestic firms. In particular, the provinces with better growth will create a more positive effect on the linkage of FDI firms with domestic ones.

Meanwhile, the variable of inflation is statistically significant for variables FS, HORI, and FOR and statistically insignificant for variables BACK and SBACK. The variable of inflation is one of the factors affecting the level of macroeconomic stability. When inflation increases considerably, the macro environment is unstable, and this results in FDI firms being afraid to invest. Furthermore, the rise in inflation causes increased input costs, which leads to the fact that businesses, instead of buying domestic inputs, will import inputs for manufacturing and business.

The coefficients of the regional variable are of statistical significance, showing that there is a difference in the linkage of FDI firms with domestic firms among regions, mainly due to the distinction in regional features.

The coefficients of the PCI variable are statistically significant and positive only for the case of the FS variable. This illustrates that the policies of the provinces of Vietnam over the past years have had an impact on FDI attraction. In particular, provinces that have better policies will better attract FDI, so the proportion of the capital of the FDI sector will also rise.

5. Conclusion

In summary, the results of the econometric model show that there are many factors affecting the linkage of FDI and domestic firms in Vietnam. As for macroeconomic factors, aspects that help increase the linkages between FDI and domestic firms include provincial economic growth, technology level, regional factors, firms being located in industrial zones, and the policies of each province. On the other hand, factors such as inflation have a negative impact on this linkage. This implies that when the macroeconomy enjoys impressive and stable growth, favorable policies, and a positive business environment, it will facilitate FDI attraction as well as increase the linkage of FDI firms with domestic firms.

In addition, factors such as the manufacturing characteristics of the industry or economic area also affect the linkage of FDI firms with domestic firms. The manufacturing and processing industry is among the most highly linked industries. Therefore, the trend of continuing to take advantage of free trade agreements to facilitate attracting FDI to the processing and manufacturing sectors has been the right path to take for Vietnam in recent years and should continue.

The variables of geographical distance such as regional factors and whether firms are located in industrial zones or not are statistically significant in all models. This stresses the importance of planning in investment-attraction activities. The planning process carried out in sync with investment-attraction activities will at the same time achieve two policy objectives: i. Creating industrial clusters

and zones with FDI and domestic firms operating in the same industry/sector located in geographical close proximity to each other and thus increasing linkages; ii. Creating the advantage of economy of scale in providing social infrastructure and serving industrial zones with facilities such as kindergartens, hospitals, etc. The imbalance between the development of industrial zones and urban infrastructures has been a limitation in FDI attraction in recent years. Industrial zones have sprung up but lacked attached social infrastructure, such as kindergartens, schools, hospitals, social housing for workers, etc., which triggers overloading of infrastructure and potential risks of social instability (MPI, 2019).

This paper investigates determinants of linkage between FDI and domestic firms in Vietnam. To complete our understanding of the FDI-economic growth relationship, further investigation of the quality of linkage is needed. Kohpaiboon (2009) used a firm-level dataset from Thailand, highlights the importance of linkage quality. A policy that heavily taxes imported intermediate goods certainly increases linkage quantity in the short-run, as FDI firms find it cheaper to source locally. However, Kohpaiboon (2009) observed technology spillovers in liberalized industries rather than protected industries, which means that such policy could be counter-productive to productivity. Therefore, over-emphasizing the number of linkages and policies to enhance thereof could be misleading. To best design FDI attraction policies, studies of the quantity of linkage, as well as the quality of linkage, are both needed.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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