Does FDI enhance provincial productivity? A panel data analysis in Vietnam

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Abstract

This study examined foreign direct investment (FDI)-induced productivity spillovers across 60 Vietnamese provinces from 2000 to 2016. Using a Generalised method of moments (GMM) technique, we find that foreign presence has a positive direct effect on TFP. Further, we found a positive association between industrial linkages and productivity spillovers. All of these findings remained robust to alternative model specifications. After accounting for the roles of human capital in the FDI-TFP nexus, we found absorptive capacity, as measured by human capital, to be a key factor influencing the nature of the foreign presence–productivity spillovers nexus in the host province. Specifically, we observed that better human capital enables provinces to better internalise productivity spillovers from foreign presence. This result lends support to the view that human capital must surpass a critical threshold before the host can realise any productivity spillovers brought about by foreign presence.

Keywords: Foreign direct investment, Total factor productivity, human capital, industrial linkages.

JEL classification: C23, D24, F21, F23, F62.

1 Introduction

Innovation and inventions are frequently identified as key driving forces for growth in TFP in many developed countries. For most developing countries, the presence of foreign invested enterprises (FIEs - henceforth foreign presence) from these developed countries has been the primary channel for indigenous firms to access innovation and inventions. Furthermore, it is widely accepted that foreign presence not only leads to technology transfers, but also introduces new production processes and advanced management practices to the host economy (Blomström & Kokko, 1998; Lipsey, 2002; Görg & Greenaway, 2004).

An important source of FDI-induced productivity spillovers can stem from the threats and opportunities posed by foreign presence in the host economy. To visualise this, consider how these spillovers can arise in the horizontal and vertical linkages between FIEs and the domestic firms. Spillovers may occur in horizontal linkages through the imitation/demonstration, competition and labour mobility channels (Caves, 1974, 1996; Blomström & Kokko, 1998). In vertical linkages they may emerge from the interaction between FIEs and the domestic firms in the production network (Blomström & Persson, 1983; Lipsey, 2002).

Numerous studies have examined the relationship between foreign presence and TFP in the host economy. Bitzer and Gorg (2009) found that foreign presence increased productivity in the manufacturing industry in seventeen OECD countries from 1973 to 2001. Using Chinese industry-level data in 1995, Liu and Wang (2003) showed that the level of an industry's TFP is positively correlated with the extent of foreign presence in that industry. This positive relationship has also been confirmed in longitudinal studies at the national level. Woo (2009), for instance, found that higher foreign presence raises TFP after examining data from 92 countries during the period 1970 – 2000. Recently, Baltabaev (2014) reached a similar conclusion based on the evidence from 49 countries spanning the period 1974 to 2008.

Contradictory results, however, point out that foreign presence can actually create negative spillovers for the indigenous firms, particularly in the short run (Aitken & Harrison, 1999). Aitken and Harrison (1999) examined the data of 4,000 Venezuelan firms for the period 1976–1989 and found that foreign presence had a negative effect on the productivity of domestic firms. This is consistent with Konings (2001) who uncovered a negative FDI–TFP nexus in Bulgaria, Romania and Poland after investigating the 2-digit sectoral data from 1993 to 1997. According to these authors, this negative relationship in the host economy can be explained by the fact that many FIEs gain a market share at the expense of the indigenous firms, causing a fall in the output of these firms. This fall in output, in turn, shifts up the short-term average cost curve for these indigenous firms, which is equivalent to a reduction in output per worker or productivity.

The extent to which a host economy is able to internalise foreign-presence spillovers may be contingent upon its absorptive capacity. According to Görg and Greenaway (2004), the origin of such absorptive capacity can range from soft sources such as technology gap and human capital, to hard ones like physical infrastructure. The importance of absorptive capacity is shown by Xu (2000), who investigated the US manufacturing multinationals in forty countries from 1966 to 1994 and concluded that the level of human capital is crucial to the host country's ability to internalise foreign-presence spillovers. In the literature, higher educational attainment is often used as a signal for greater absorptive capacity (Borensztein et al., 1998; Xu, 2000; Elmawazini et al., 2008).

As a former centrally planned economy, Vietnam started its economic reform *Doi Moi* in 1986 and successfully transformed into a market-based economy. Apart from promoting trade liberalization, which was followed by the introduction of a series of bilateral and multilateral trade agreements, the Vietnamese government has improved the investment environment by clarifying the laws and regulations governing FDI. This was further supported by the implementation of bilateral treaties on investment promotion and protection between Vietnam and 45 countries and territories, to date. As a result, foreign presence has become an indispensable force driving changes in Vietnamese economy. Indeed, according to the UNCTAD's (2020) World Investment Report, Vietnam's FDI inflows in 2019 amounted to USD 16,1 billion, an increase from the previous year (USD 15,5 billion in 2018), whereas total realized capital was estimated at USD 211.78 billion in the same year. In addition, in 2019, FDI pledged to the country surpassed US$38 billion, marking a 10-year high and representing a year-on-year increase of 7.2 per cent. In short, these figures confirm that Vietnam is one of the most attractive country in terms of FDI in Asia.

The recent opening of the Vietnamese economy provides a quasi-experimental setting for investigating the effects of foreign presence in a transitional economy. It should be noted that that most of the existing literature on foreign-presence spillovers in Vietnam has focused predominantly at the firm level. To date, there is a lack of a systematic inquiry into the underlying mechanism in which foreign presence exerts effects, if any, on provincial TFP in the country.

With these backdrops, this study sets out to answer the following question: (i) Did foreign presence exert a positive effect on host regions' TFP? And (ii) How local human capital impact nature of FDI – TFP nexus? In order to answer these questions, we use provincial data in Vietnam between the years of 2000 and 2016. By making use of provincial panel data, this study not only contributes to the current body of knowledge on the foreign presence–TFP nexus in Vietnam, but also sheds light on the determinants of provincial TFP in general.

The rest of this paper is organized as follows. Section 2 provides literature review. Section 3 describes the data and discusses estimation strategy. Section 4 presents results, and Section 5 concludes.

2 Literature review

2.1 Theoretical framework:

FDI spillovers occur when the participation by FIEs in the local production network affects the productivity of their surrounding indigenous firms in either a positive or negative way (Dunning, 1993). It is important to note that these spillovers often take the form of pecuniary and technological externalities (Fujita & Thisse, 1996). Specifically, pecuniary externalities are generated through market-based interactions between FIEs and indigenous firms. In contrast, technological externalities, which are non-pecuniary in nature, materialise through non-market interactions that raises the productivity between these firms.

In theory, there are four main channels through which FDI spillovers can raise productivity in the host economy: demonstration, industrial linkages, labour mobility and competition channels (Caves, 1996; Blomström & Kokko, 1998; Gorg & Strobl, 2001). The demonstration channel refers to the learning and/or imitating productivity-enhancing technology from FIEs by the indigenous firms in proximity. According to Fujita and Thisse (1996), if these firms were able to master such technology, it would represent positive foreign-specific technological externalities, given that those contributing FIEs have not been compensated in monetary terms for facilitating the increase in local productivity.

The second channel for FDI spillovers is based on industrial linkages between indigenous firms and FIEs. Specifically, these are backward linkages that force indigenous suppliers to improve their productivity, in order to meet the demand of the more efficient FIEs (Blomström & Sjöholm, 1999; Driffield et al., 2004). In some cases, FIEs may voluntarily offer technical support to their indigenous suppliers as part of total quality management practice. In terms of forward linkages, FIEs may benefit their domestic buyers, by supplying high-quality intermediate inputs or by introducing new management techniques and production processes (Markusen & Venables, 1999).

The third channel is related to labour mobility between FIEs and indigenous firms. Often, highly qualified FIE workers are lured by the indigenous firms wanting to tap into these workers' knowledge on the best practices adopted in their previous workplaces (Blomström & Kokko, 1998; Gorg & Strobl, 2005). However, labour mobility can also work in the opposite direction, if FIEs offer higher wages to attract the most productive workers in the area from the indigenous firms (Sinani & Meyer, 2004).

The final channel emphasises how FIEs affect the extent of local competition (Caves, 1996; Aitken & Harrison, 1999; Markusen & Venables, 1999). From the outset, competition should promote input-mix and technological efficiency among indigenous firms. However, Aitken and

Harrison (1999) showed that the increase in foreign presence might have an adverse impact on the market share commanded by the indigenous firms, forcing them to operate at a less efficient scale. In this case, we would observe a negative foreign presence–productivity nexus in the host economy.

Theoretically, geographical concentration of industries provides an ideal environment for fostering various types of agglomeration economies associated with knowledge spillovers, labour-market pooling and intermediate-input sharing (see among others, Krugman, 1991; Fujita & Thisse, 1996; Rosenthal & Strange, 2002; Duranton & Puga, 2003). Geographical proximity among firms, for example, promotes knowledge spillovers through closer and repeated interpersonal contacts, raising the likelihood of new ideas being transmitted from one firm to another. Meanwhile, a pooled labour market improves the probability of a firm finding skilled workers in the immediate surrounding area and vice versa. Last, but not least, co-location allows firms to access a greater variety of specialised inputs and to become suppliers in local production networks.

Geographical concentration also plays an equally important role in determining the nature and extent of foreign-specific spillovers between FIEs and indigenous firms (Girma, 2005; Jordaan, 2005). In fact, these spillovers are likely to be reinforced at a local level for four reasons. Firstly, the demonstration effect is likely to be localised because indigenous firms often imitate new technology and practices from their neighbouring FIEs. Secondly, if a worker switches from an FIE to an indigenous firm or vice versa, he or she would generally prefer to remain in the same locality if possible. Thirdly, FIEs may favour local production networks, which minimises trade cost and facilitates direct communication with their indigenous buyers or suppliers. Fourthly, the co-location of FIEs and the indigenous firms tends to intensify the degree of local competition, with many indigenous firms suffering from reduced productivity as a result of losing their market share to FIEs.

2.2 Previous studies

The literature on FDI-induced productivity spillovers can be divided into the industry-level and country-level studies. Although extensive research has been carried out on FDI-productivity nexus, the evidence on spillovers at the firm or industry level remains mixed. For example, Aitken and Harrison (1999) and Konings (2001) found a negative association between foreign presence and productivity of domestic firms in the host countries. These authors attributed their finding to the competition effect, whereby the more efficient FIEs grow at the expense of the inefficient domestic firms. The presence of FIEs may lead to significant losses of market share for domestic firms, forcing the latter to operate on a less efficient scale by producing at a lower output level. In addition, FIEs may poach skilled workers from their domestic counterparts by offering higher wages and bonuses (Crespo & Fontoura, 2007).

In contrast, taking China for example, Liu and Wang (2003) found positive FDI-induced productivity spillovers in 189 Chinese industrial sectors in 1995. Based on the city-level panel data from the Pearl River Delta and Yangtze River Delta for the 1978–2004 period, Tuan et al. (2009) reached a similar conclusion. Both of these Chinese studies attributed their finding to the role of FIEs as a vehicle for promoting technological progress among domestic firms in the sector. Girma (2005) reached a similar conclusion after analysing data from 7,516 UK manufacturing firms for the period 1989–1999. Notably, he argued that this result only held when the absorptive capacity of the firm had exceeded a critical threshold, showing that there was either zero, or a negative, association between foreign presence and productivity spillovers when the absorptive capacity dropped below a critical threshold.

The complexity of the foreign presence–productivity spillovers nexus is best demonstrated by Jordaan (2008). After examining data from Mexican industries in 1993, he found that FDI-induced productivity spillovers were positive for vertical linkages due to support provided by FIEs to their local suppliers/customers, but negative for horizontal linkages due to competition between FIEs and the domestic firms. Behera (2017) also reached similar findings after examined the productivity spillovers at the firm-level of 22 manufacturing industries across 4 regions in India. However, in another major study, Fujimori and Sato (2015) found that local firms only receive positive vertical spillover effect from FDI in long-term, whereas there is negative spillover from foreign presence to domestic TFP in short-term.

Moreover, FDI may have heterogenous effects on local productivity in terms of industry concentration and capital intensity. For instance, using Korean manufacturing plant-level data covering 1990–2007, Choi and Pyun (2017) concluded that industry FDI has heterogeneous effects on plant productivity in both of industry concentration index and capital intensity. In addition, their study also noted that FDI spillover effects depend critically on the host countries' industrial environments, such as exporting experience. In order to explain why there were prior mixed results concerning about the impact of FDI on productivity of domestic firms in host economies, Anwar and Sun (2019) used a theoretical model of firm heterogeneity to re-examine. Due to the heterogeneous firm capability within the industry, they noted that FDI-related productivity spillovers to domestic firms can be decomposed into direct and indirect effects exerting opposite pressures on productivity of domestic firms.

At the country level, Woo (2009) found positive FDI-induced productivity spillovers in 92 countries, however, failed to find support for absorptive capacity as a determinant of these spillovers. In another panel data study of 62 countries from 1975 to 1995, Alfaro et al. (2009) found positive productivity spillovers through the financial development channel. A major shortcoming of both studies is that neither took into account the endogeneity between foreign presence and productivity spillovers, which exists because FIEs may prefer to invest into host economy which already has high level of productivity. Thus, foreign presence may be endogenously determined by productivity. In assessing this relationship, Baltabaev (2014) applied a one-step system GMM estimator to control potential endogeneity between FDI and

TFP growth. He noted that absorptive capability to be the key determinant of positive productivity spillovers in host countries.

Vietnamese studies on FDI-induced productivity spillovers are mostly based on firm-level survey data. Athukorala and Tien (2012) examined data from manufacturing firms for the 2000–2005 period and found that competition from foreign presence creates negative productivity spillovers for domestic firms. In terms of industrial linkages, Nguyen et al. (2008) found that the competition effect explains negative productivity spillovers in horizontal linkages and forward linkages. In contrast, these authors found productivity improvement for domestic firms sharing backward linkages with FIEs and attributed it to the fact that FIEs often offer technical assistance to their domestic suppliers. Using firm-level data from 2001 to 2005, Thang (2011) also found negative spillovers in horizontal and forward linkages, but positive in backward linkages. Recently, Anwar and Nguyen (2014) showed that foreign presence generates stronger spillovers for vertical linkages in the manufacturing industry. Regarding the importance of absorptive capacity, Anwar and Nguyen (2010) found that, from 1995 to 2005, foreign presence had generated positive productivity spillovers via backward linkages towards Vietnam's manufacturing industries that had a higher stock of human capital. Also using firm-level data from 2000 to 2005, Thang et al. (2016) investigated the role of inter-firm interaction and geographical proximity in the determination of productivity spillover effects from foreign to domestic firms. Their study found that the increase of distance between foreign and domestic firms led productivity spillovers to diminish. However, if foreign firms are located not far from their domestic counterparts, they may create positive backward, negative forward and horizontal spillovers. In another major study, using survey data of over 4,000 manufacturing firms in Vietnam for the period of 2009 – 2012, Newman et al. (2015) untwined indirect vertical spillover effects of FDI from direct vertical spillover via linkages. They found that foreign presence had positive backward spillovers but horizontal spillovers showed a negative pattern.

In addition, they noted that domestic firms may receive positive spillovers via direct linkages with their FDI suppliers.

While a plethora of studies examined the FDI-TFP nexus at national level and firm level, evidence on a provincial effect is still scarce, especially in Vietnam (Crespo et al., 2009; Ramasamy et al., 2017). This paper contributes to the empirical literature on FDI-TFP nexus by using panel data from 60 provinces in Vietnam for the period of 2000 – 2016. Furthermore, previous studies on FDI-TFP nexus in Vietnam often assume away simultaneity bias arising from the two-way relationship between productivity and inward FDI (Ramasamy et al., 2017; Li & Tanna, 2019). In this study, we control this endogeneity problem by adopting GMM technique (Wooldridge, 2002)

3 The Model

3.1 Model specification

The first step to examine the FDI–TFP nexus in our study requires that we estimate TFP for each province in our sample. The origin of TFP analysis can be traced to the work of Solow (1957), by now, estimation of TFP consists of growth-accounting (non-parametric) and the regression-based (parametric) methods (Felipe, 1999). While the growth-accounting approach does not require complicated econometric models, it is often plagued by information on the price and elasticity of inputs, which are not directly observable (Park, 2010). For example, the labour-share data is prone to measurement errors due to the exclusion of self-employed workers by the statistical agency. As a result, many empirical studies treated the share and elasticity of an input as essentially the same as each other. [1]

[1] Non-parametric approach is commonly used by Vietnam's General Statistic Office (GSO) to estimate the growth rate of national TFP (Oguchi, 2004).

For avoiding this obstruction, we apply the regression-based approach in this study when estimate provincial TFP. Under this approach, the production function is free to take any functional form. We begin our provincial TFP calculation by taking the natural logarithm of a Cobb-Douglas production function and arrive at the following regression model (Arnold, 2005):

$$\ln(Y_{it}) = \gamma_0 + \alpha_i \ln(K_{it}) + \beta_i \ln(L_{it}) + t_t + u_{it} \quad (1)$$

where Y_{it} denotes total output, K_{it} the total capital input and L_{it} the total labour input. The parameters α and β are, respectively, the elasticity of capital input and labour input. where γ_0 measures the mean efficiency level across provinces and over time, T_t the time-specific effects and u_{it} the stochastic error term.

Despite its flexibility, this approach faces several econometric issues, including possible simultaneity, measurement errors and the specification of the functional form (Newman et al., 2015). First, and foremost, we must control for the fact that the choice of input in the production function is partly determined by the efficiency of the province and vice versa (Felipe, 1999; Van Beveren, 2012). Moreover, the methodological issues emerge when TFP is estimated by applying Ordinary Least Squares (OLS) since there is potential simultaneity problem within production functions (Bernard et al., 2009). Existing literature have proposed methods to address these issues, including semiparametric estimators by Olley and Pakes (1996) and Levinsohn and Petrin (2003) at firm-level data or GMM for aggregate data (Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1998). Here we use GMM approach which is more efficient than the standard instrumental variable (IV) methods and can correct for the endogeneity between inputs and unobserved provincial productivity (Baum & Schaffer, 2003;

Wooldridge, 2009b). [2]

The provincial TFP can be calculated by rewriting the estimated version of equation (1). Specifically, TFP of province *i* at time *t* can be obtained as follows:

$$\ln(\widehat{A_{it}}) = \ln(Y_{it}) - \hat{\alpha}\ln(K_{it}) - \hat{\beta}\ln(L_{it}) \quad (2)$$

where $\ln(\widehat{A_{it}})$ is a natural logarithm of the estimated TFP of province *i* at time *t*. $\hat{\alpha}$ and $\hat{\beta}$ are the estimated values of the population parameters α_i and β_i, respectively.

In the second step, the following model was used to examine the FDI-TFP nexus in Vietnam:

$$TFP_{it} = \beta_0 + \beta_1 FDI_{it} + \beta_k X_{it} + \varepsilon_{it}, i = 1, 2, \ldots, N; t = 1, 2, \ldots, T \quad (3)$$

where the subscript *i* denotes the province and *t* is the time period. TFP and FDI, respectively, represent TFP and foreign presence in the province. X is the set of control variables to be discussed in next section. As usual, ε_{it} refers to the idiosyncratic error term.

3.2 Estimation issues

Our main focus is identifying the relationship between inward FDI and TFP at the province level. In order to estimate Equation (3), the existing literature has suggested that geographical concentration of economic activity and TFP are endogenously determined (Ciccone, 2002; Henderson, 2003; Graham et al., 2010). In the present context, while FIEs are often attracted to high-productivity regions, the entry by these more efficient FIEs further boosts productivity in these regions. This relationship implies that there could be endogeneity among our proposed regressors, such as foreign presence and TFP. In this case, the pooled OLS or Fixed Effects (FE) estimates could be biased.

[2] We provide details of the GMM approach in Section 3.2. The GMM approach provides consistent estimates for short-and-wide panel structure adopted in this study. This has been confirmed in other studies using aggregate data in Vietnam (Hoang et al., 2019; Huynh & Hoang, 2019).

In order to deal with endogeneity concerns in this study, we apply instrumental variable (IV) techniques, based on the principle of GMM. The basic idea of this estimator is that lagged levels and lagged differences are valid internal instruments for the endogenous variables. Introduced by Hansen (1982), GMM is a usual approach today in the presence of heteroskedasticity of unknow form (Wooldridge, 2002; Baum & Schaffer, 2003). In general, IV/GMM estimation works in a similar manner to a standard IV estimator such as 2SLS. The implementation of IV/GMM estimation includes three steps: (i) Estimate the equation using the instrument set, (ii) Estimate the residuals, then estimate the optimal weighting matrix based on the set of moment conditions, (iii) Calculate the efficient estimator coefficients and their variance-covariance matrix using the estimated optimal weighting matrix (Baum & Schaffer, 2003). To test for the validity of instruments, which is the joint hypothesis of correct model specifications and over-identification problems, we carry out the Hansen *J*-statistic test and report it in the results. [3]

A second estimation issue relates to the omissions of unobserved variables, such as time-and regional-specific effects. However, these unobserved variables can be important underlying driving forces behind any observed FDI–TFP nexus. In order to take these variables into account, regional dummies and year dummies were included into Equation (1) and Equation (3) in order to control for time- and regional-specific effects, which capture any macro TFP shocks.

3.3 Data

We examined the panel data consisting of 60 Vietnamese provinces spanning the period 2000 to 2016. All regressors were collected and compiled either published or unpublished data of

[3] The IV/GMM estimator is performed by applying ivreg2 in Stata12. Baum and Schaffer (2003) and Baum et al. (2007) provided details of ivreg2 and routines for estimation.

the General Statistical Office (GSO) in Vietnam. [4] Since several variables were denominated in the local currency, the Vietnamese Dong (VND), we converted the US dollar-denominated annual flow of foreign direct investment (FDI) into VND using the yearly average US dollar-VND exchange rate. All nominal variables were then converted into 1999 constant price using the provincial consumer price index (CPI). Table 1 and 2 provide summary statistics for, and the correlation matrix of, variables included in the estimations respectively. Prior to estimate our models, we employ panel unit root test to examine the time-series properties of the data. The stationary test statistics are also reported in the last two columns of Table 1. They are all stastically significant at 1%, except *POP* is significant at 5%, which suggests that all variables used in our model are stationary. [5] According to Gujarati (2003), a Pearson pair-wise correlation coefficient exceeding 0.6 could be a sign of potential multicollinearity between the variable pair. Therefore, we calculate the variance inflation factor (VIF) and provide it in Table 5 in the baseline results section.

Table 1: Summary statistics

Variable	Definition	Obs	Mean	Std. Dev.	Unit root test	
					adjusted t*	p-value
Y	Output	1020	9.262	1.507	-8.489	0.000
L	Number of employees	1020	10.931	1.116	-10.809	0.000
K	Capital stock	1020	8.365	1.545	-5.741	0.000
TFP	Total factor productivity	1020	1.849	0.237	-11.801	0.000
FDIPC	Volume of registered FDI per capita	1020	1.691	7.706	-10.463	0.000
FDIGPP	Share of registered FDI in provincial GDP	1020	0.153	0.921	-27.929	0.000
GPP	Provincial GDP	1020	9.084	0.953	-10.190	0.000
POP	Provincial population	1020	7.080	0.551	-1.659	0.049
IO	Provincial industrial outputs	1020	1.164	0.512	-3.545	0.000
PHD	Physical infrastructure	1020	5.942	1.383	-8.629	0.000
HSD	Human capital (proportion of enrolled college students)	1020	2.161	1.018	-6.571	0.000
PTW	Human capital (proportion of trained workers)	720	2.707	0.394	-3.031	0.001

[4] Unpublished data includes provincial GDP and provincial CPI.
[5] We performed the Levin-Lin-Chu test proposed by Levin et al. (2002).

Note: This table reports the selected descriptive statistics of variables. The statistics include the variable's number of observations, mean, standard deviation, Levin-Lin-Chu (LLC) test statistics and their p-values.

Table 2: Correlation matrix

	TFP	*FDIPC*	*FDIGPP*	*IO*	*PHD*	*POP*	*GPP*	*HSD*	*PTW*
TFP	1								
FDIPC	0.17	1							
FDIGPP	0.05	0.85	1						
IO	0.01	-0.05	0.04	1					
PHD	0.74	0.08	0.03	0.02	1				
POP	0.68	0.04	-0.01	0.01	0.71	1			
GPP	0.88	0.16	0.03	-0.02	0.77	0.79	1		
HSD	-0.10	0.01	0.05	0.09	0.12	-0.02	-0.10	1	
PTW	0.35	0.06	0.00	-0.01	0.47	0.17	0.31	0.14	1.00

3.4 Measuring TFP

Columns (1), (2) and (3) in Table 3 report the OLS, FE and IV/GMM results, respectively. We include the OLS, FE results for comparison purposes, whereas the IV/GMM estimator corrects for the endogeneity problem. According to the adjusted-R^2 statistic, Equation (1) explains approximately 90% of the variations in dependent variable (Y). Meanwhile, the Hansen J-statistic in column (3) suggests that our instrument set is appropriate. The estimated coefficient of capital is 0.41, which is two-thirds of the labour elasticity of 0.59. Highly significant estimated t-values suggest that both physical capital and labour are important determinants of provincial outputs in Vietnam.

Table 3: Estimations of production function: results from OLS, Fixed Effects and IV/GMM estimations

	OLS (1)	FE (2)	IV/GMM (3)
	Y	*Y*	*Y*
K	0.322^{***}	0.250^{***}	0.416^{***}
	(0.081)	(0.065)	(0.093)
L	0.696^{***}	0.718^{***}	0.588^{***}
	(0.083)	(0.080)	(0.094)
constant	2.201^{***}	2.608^{***}	1.728^{***}
	(0.284)	(0.357)	(0.332)
Observations	1020	1020	840
Year Dummies	Yes	Yes	Yes
Adjusted-R^2	0.906	0.915	0.908
F test	160.145	87.131	193.097

p-value	0.000	0.000	0.000
Hansen J statistic			2.981
p-value			0.225

Notes:
Standard errors in parentheses: * p < 0.10, ** p < 0.05, *** p < 0.01.
Standard errors adjusted for arbitrary heteroscedasticity.
For brevity, the coefficients of time dummies are not reported here.
All estimations reported are performed in Stata 13.
The IV/GMM estimator is obtained using the ivreg2 command, due to Baum and Schaffer (2003).

From column (3) in Table 3, we then calculate provincial TFP according to Equation (2) and use results for estimating Equation (3).

3.5 Foreign presence

The focus of this study is on the effect of foreign presence on provincial TFP in Vietnam. In the existing literature, two alternative measures of foreign presence are commonly employed, namely the share of cumulative stock of registered FDI in provincial GDP (*FDIGPP*) and the cumulative volume of registered FDI per capita (*FDIPC*) (Woo, 2009; Hong & Sun, 2011; Baltabaev, 2014). The main difference between these two measures is that while *FDIGPP* reflects the depth of FDI involvement in the host economy, *FDIPC* controls for the potential heterogeneity across provinces.

3.6 Control variables

3.6.1 Human capital

Existing literature has emphasised the positive role of human capital on productivity growth (Nelson & Phelps, 1966; Mankiw et al., 1992; Kneller, 2005). In part, the underlying assumption is that the workforce must possess a sufficient level of knowledge in order to benefit from on-the-job training, particularly if advanced technology is involved. Following Nguyen (2008) and Tuan et al. (2009), we measure human capital by calculating the ratio of the number of enrolled college students to total population in the province (*HSD*) and expect a positive sign with respect to provincial TFP.

It is a well-established fact that not all host economies benefit equally from foreign-presence spillovers. Yudaeva et al. (2003) found that regions with higher educational attainment in Russia tend to benefit more from foreign presence-induced TFP. Crespo and Fontoura (2007) highlighted the importance of local human capital as a determinant of local absorptive capacity, with respect to foreign presence. In order to capture the effect of this capacity, we constructed two additional interaction terms between foreign presence and human capital and included them, one at a time, in the estimation. Specifically, we constructed the first interaction term by multiplying *FDIGPP* and *HSD,* and the second interaction term by multiplying *FDIPC* and *HSD*. We expect a positive sign for each interaction term.

Since the proportion of college students out of population may not reflect the real human capital, we use the proportion of trained workers per provinces, *PTW*, to check the robustness of our results. [6] However, due to the unavailability of provincial data for this measure, we can only provide results for the period of 2005 – 2016. We also interact this proxy with proxies for foreign presence variable.

3.6.2 Market size

According to Woo (2009) and Baltabaev (2014), populous regions have a greater ability to engage in innovation or adoption of new technology. Furthermore, such regions exhibit a larger market potential that helps firms to realise economies of scale and scope. In line with the existing literature, we introduced provincial GDP (*GPP*) to control for differences in provincial market potential and expect it to have a positive effect on provincial TFP (Woo, 2009; Xu, 2009). [7]

[6] We would like to thank anonymous referees for these helpful comments.

[7] We also consider alternative measures of market access including provincial population size (*POP*) and use this proxy to check the robustness of our results. Some studies suggested to measure market size by using population density per square kilometre of land. However, population density might involve the negative effect of congestion that prevented the agglomeration of firms (Bartik, 1985; Guimaraes et al., 2000). Given this potential interpretation of population density, we decide to use only the level of population in our regression.

3.6.3 Industrial linkages

A distinct advantage of geographical concentration of firms is that it deepens and widens industrial linkages, which promotes the growth of localisation and urbanisation economies in the vicinity. Theoretically, industrial linkages should be decomposed into backward and forward linkages (Jordaan, 2005). However, we were unable to obtain such data at the provincial level in Vietnam. Instead, we used the annual provincial industrial output (*IO*), on the basis that it takes into account the strength and diversity of local manufacturing base (Head & Ries, 1996; Luo et al., 2008). We expect this variable to exert a positive effect on provincial TFP.

3.6.4 Physical infrastructure

The quality of physical infrastructure is another determinant of local absorptive capability (Wooster & Diebel, 2010). Xu (2009) found that physical infrastructure, as measured by the number of telephones per 100 citizens, had a positive effect on local productivity in Chinese cities from 1990 to 1997. Based on the same logic, we used the ratio of the number of telephones to population in the province (*PHD*), as a proxy for physical infrastructure and expect a positive sign.

Given the estimation issues and proposed proxies discussed, we modified Equation (3) and proposed the following specification:

$$TFP_{it} = \beta_0 + \beta_1 FDIPC_{it} + \beta_2 HSD_{it} + \beta_3 GPP_{it} + \beta_4 IO_{it} + \beta_5 PHD_{it} + \eta_t + \varepsilon_{it} \quad (4)$$

where *FDIPC* denotes the foreign presence, *HSD* the human capital, *GPP* the market size, *IO* the industrial linkages and *PHD* the physical infrastructure. Also, η_t refers to time-specific dummies.

4 The Results

4.1 The baseline results

Table 4 shows the estimated pooled OLS and IV/GMM results for Equation (4). We use *FDIPC* as measure for foreign presence in column (1) – (2), then replace it by *FDIGPP* in column (3) – (4). According to the adjusted-R^2 statistic, independent variables in Equation (4) explain over 80% of the variations in provincial TFP. In addition, the F-statistics indicate that explanatory variables are jointly different from zero, in all columns. In order to save space, we have not listed the estimation results of time dummies. However, it is worth noting that the inclusion of these dummies increased the fit of the estimated model, since greater number dummies were significant at conventional levels. Therefore, we continue to employ these dummies in the next section, as well as in the robustness check section.

In column (1) and column (3), the pooled OLS estimates are consistent with our expectations. In particular, the pooled OLS results show that foreign presence (*FDIPC*), market size (*GPP*), human capital (*HSD*), industrial linkages (*IO*) and infrastructure (*PHD*) have positive effects on provincial TFP. However, these results may be biased as discussed in above section. Therefore, we switch to the IV/GMM estimates in order to obtain robust and unbiased results. Results of IV/GMM estimates in columns (2) of Table 4 show that the control-variable set is largely consistent with our a priori expectations. Specifically, a 10% improvement in industrial linkages (*IO*) increases provincial TFP by 0.14%. Meanwhile, the coefficient on market size (*GPP*) suggests that a 1% increase in market size raises provincial TFP by 0.17%. Finally, we find that a 10% increase in physical infrastructure (*PHD*) boosts provincial TFP by 0.14%. It should be noted that human capital (*HSD*) in both columns (2) and (4) did not exhibit any significant direct effect on provincial TFP. Meanwhile, the Hansen *J*-statistics at the bottom of columns (2) and (4) suggest that there is no over-identification in the internal instrument set. Taken together, GMM estimates appear to perform well and the proposed instrument set is appropriate.

Table 4: The impact of FDI on provincial TFP: 2000-2016

	OLS (1) *TFP*	IV/GMM (2) *TFP*	OLS (3) *TFP*	IV/GMM (4) *TFP*
FDIPC	0.013***	0.024***		
	(0.001)	(0.003)		
FDIGPP			0.018***	0.035***
			(0.002)	(0.003)
GPP	0.181***	0.172***	0.187***	0.182***
	(0.006)	(0.006)	(0.006)	(0.006)
IO	0.013**	0.014***	0.013**	0.014***
	(0.005)	(0.004)	(0.005)	(0.004)
PHD	0.016***	0.014***	0.015***	0.012***
	(0.004)	(0.005)	(0.004)	(0.004)
HSD	0.009***	0.000	0.009***	-0.002
	(0.004)	(0.005)	(0.004)	(0.005)
Constant	0.130***	0.242***	0.120***	0.247***
	(0.045)	(0.052)	(0.044)	(0.052)
Observations	1020	840	1020	840
Year Dummies	Yes	Yes	Yes	Yes
Adjusted-R^2	0.814	0.791	0.815	0.784
F test	188.594	200.064	188.325	195.474
p-value	0.000	0.000		0.000
Hansen J statistic		0.349		0.044
p-value		0.555		0.834

Notes:
Standard errors in parentheses and *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.
Standard errors adjusted for arbitrary heteroscedasticity.
Instrument sets in column (2) and column (4) include lag2 and lag2 difference of independent variables.
For brevity, the coefficients of year dummies are not reported here.

As to our principal variable of interest, we found that foreign presence exerts a positive effect on provincial TFP. In general, columns (2) and (4) show that for every 1% rise in the foreign presence in a province, provincial TFP increase by roughly 0.03%. It is important to point out that while our result contradicts Thang (2011), Athukorala and Tien (2012) and Anwar and Nguyen (2014), it is consistent with Nguyen (2008) and Trinh (2013), where both found a positive foreign presence–TFP nexus in Vietnam. The positive effect of provincial foreign presence on TFP suggests that Vietnam's global integration policy that attracted massive FDI inflows into host regions has surged TFP and consequently the regional economic growth.

Table 5: VIF calculation

Variable	VIF	1/VIF	Variable	VIF	1/VIF
FDIPC	1.43	0.70	*FDIPC*	1.26	0.79

GPP	3.08	0.33	*GPP*	2.98	0.34
IO	1.07	0.93	*IO*	1.07	0.93
PHD	3.21	0.31	*PHD*	3.21	0.31
HSD	2.27	0.44	*HSD*	2.27	0.44
Year dummies			Year dummies		
Mean VIF	2.07		Mean VIF	2.05	

Sources: Author's estimation.

To ascertain that our model is free from multicollinearity we also calculate the variance inflation factor (VIF) for our estimates. According to Wooldridge (2009a), if the value of VIF exceeds 10, we may conclude that the estimations might suffer from potential multicollinearity. The VIF results in Table 5 suggest that multicollinearity is not an issue in this study.

4.2 Robustness checks

We do several checks for robustness of our preliminary results. First, we add the interaction term between foreign presence variable and human capital variable into Equation (4). Second, we use alternative measure of market access, provincial population (*POP*), to replace the provincial GDP used so far. Finally, some provinces in Vietnam may perform better than the others because of their geographical regions (Anwar & Nguyen, 2014). In order to capture the region-specific effect, we introduce a total of six regional dummy variables into Equation (4) based on the climate, culture and dialect of the province; these include the Red River Delta (*Red*), the Northern Midlands and Mountain Areas (*North*), the South East Areas (*South*), the Central Coast (*Central*), the Central Highlands (*High*) and the Mekong River Delta (a base dummy). [8]

Although human capital *per se* does not have a significant impact on provincial TFP, it is likely that human capital may play a role in the channel through which positive TFP responses are accrued from FDI. In order to test this assertion, following Alfaro et al. (2009), an interaction

[8] We also perform a dynamic model from Equation (4) to account for the underlying dynamics in TFP (Li & Tanna, 2019). Overall, the coefficients' signs are robust to the baseline model, however independent variables such as foreign presence, market size, infrastructure and industrial linkages become insignificant. Hence, we do not report them here in order to save space.

term, $(FDIPC * HSD)_{it}$, between foreign presence (*FDIPC*) and human capital (*HSD*) was introduced to Equation (4). In constructing this term we demeaned both *FDIPC* and *HSD* before multiplying them by each other. Some studies included only the interaction term and omitted the original variables used to construct the interaction term from the model to avoid multicollinearity. However, Aiken et al. (1991) and Jaccard and Turrisi (2003) argued that including the original variables, as well as the interaction term, enables one to disentangle the main effects from the interaction effect. Adhering to their advice, we include both the interaction term and the original variables used to construct it, to ensure that the interaction term does not capture either the foreign-presence or human-capital effects. With the interaction term, we can restate Equation (4) as follows:

$$TFP_{it} = \beta_0 + \beta_1 FDIPC_{it} + \beta_2 (FDIPC * HSD)_{it} + \beta_3 HSD_{it} + \beta_4 GPP_{it} + \beta_5 IO_{it} + \beta_6 PHD_{it} + \eta_t + \varepsilon_{it} \quad (5)$$

Columns (1) and (2) in Table 6 presents the IV/GMM results from Equation (5) with interaction term $(FDIPC * HSD)_{it}$ and $(FDIGPP * HSD)_{it}$, respectively. In columns (3) and (4), we use provincial population as alternative measure for market size, *POP*, which exhibits a positive and statistically significant. The Hansen-*J* statistics in bottom line of Table 6 suggest that the IV/GMM estimator is appropriate and free from instrument proliferation. The adjusted R-square results and F-test statistics are similar to the baseline model, confirming the goodness-of-fit of our models.

Table 6: FDI-induced TFP: human capital interaction effect

	IV/GMM (1) TFP	IV/GMM (2) TFP	IV/GMM (3) TFP	IV/GMM (4) TFP
FDIPC	-0.073***		-0.092**	
	(0.028)		(0.037)	
FDIGPP		-0.035		-0.076
		(0.063)		(0.088)
*FDIPC*HSD*	0.032***		0.045***	
	(0.009)		(0.011)	
*FDIGPP*HSD*		0.028		0.050*

		(0.019)		(0.027)
GPP	0.151***	0.166***		
	(0.007)	(0.007)		
POP			0.153***	0.154***
			(0.013)	(0.014)
IO	0.015***	0.014***	0.013***	0.010**
	(0.004)	(0.005)	(0.004)	(0.005)
PHD	0.025***	0.021***	0.038***	0.046***
	(0.004)	(0.005)	(0.006)	(0.007)
HSD	-0.035**	0.002	-0.087***	-0.019
	(0.017)	(0.056)	(0.021)	(0.079)
Constant	0.519***	0.418**	0.920***	0.822***
	(0.086)	(0.183)	(0.107)	(0.266)
Observations	840	840	840	840
Year Dummies	Yes	Yes	Yes	Yes
Adjusted-R^2	0.789	0.765	0.650	0.565
F test	199.024	181.765	123.474	97.380
p-value	0.000	0.000	0.000	0.000
Hansen J statistic	0.019	0.707	0.143	1.317
p-value	0.991	0.702	0.931	0.518

Notes:
Standard errors in parentheses and *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.
Standard errors adjusted for arbitrary heteroscedasticity.
Instrument sets include lag2 and lag2 difference of independent variables.
For brevity, the coefficients of year dummies are not reported here.

As can be observed from the Table 6, the inclusion of the interaction terms, $(FDIPC * HSD)_{it}$ and $(FDIGPP * HSD)_{it}$, does not markedly change the magnitude and sign of the estimated coefficients of industrial linkages (*IO*), market size (*GPP*) and physical infrastructure (*PHD*) on provincial TFP. Importantly, the estimated coefficients of the interaction term in columns (1)-(4) indicate that provincial human capital and FDI are complements and would have has a positive effect on provincial TFP, lending support to the view that the host province can realise foreign-specific positive spillovers only if it already possesses a certain level of human capital (Xu, 2000). This conclusion was also highlighted by Vu et al. (2008) and Anwar and Nguyen (2014) when they examined productivity spillovers in Vietnam. Overall, Table 6 shows that our results are not sensitive to the way in which market size are measured.

Table 7: FDI-induced TFP: regional effect

	IV/GMM (1) *TFP*	IV/GMM (2) *TFP*	IV/GMM (3) *TFP*	IV/GMM (4) *TFP*
FDIPC	-0.043		-0.079**	
	(0.029)		(0.037)	
FDIGPP		0.052		-0.030

	(1)	(2)	(3)	(4)
		(0.071)		(0.091)
*FDIPC*HSD*	0.024***		0.041***	
	(0.009)		(0.011)	
*FDIGPP*HSD*		0.006		0.038
		(0.021)		(0.027)
GPP	0.147***	0.166***		
	(0.008)	(0.008)		
POP			0.147***	0.146***
			(0.012)	(0.014)
IO	0.016***	0.014**	0.016***	0.013**
	(0.005)	(0.006)	(0.005)	(0.006)
PHD	0.017***	0.012**	0.027***	0.034***
	(0.005)	(0.005)	(0.006)	(0.007)
HSD	-0.051**	-0.069	-0.010	0.051
	(0.021)	(0.065)	(0.026)	(0.083)
Constant	0.674***	0.755***	0.809***	0.770***
	(0.095)	(0.219)	(0.116)	(0.285)
Observations	840	840	840	840
Year Dummies	Yes	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes	Yes
R^2	0.798	0.767	0.691	0.615
adj. R^2	0.792	0.760	0.682	0.604
F test	191.439	176.750	127.267	105.493
p-value	0.000	0.000	0.000	0.000
Hansen J statistic	0.033	0.885	0.171	1.457
p-value	0.983	0.643	0.918	0.483

Notes:
Standard errors in parentheses and *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.
Standard errors adjusted for arbitrary heteroscedasticity.
Instrument sets include lag2 and lag2 difference of independent variables.
Regional dummies include *Red, North, Central, High, South* and *Mekong* (base dummy).
For brevity, the coefficients of year dummies and regional dummies are not reported here.

In order to check the regional-specific effect on our results, we add regional dummies into Equation (5) and estimate it with IV/GMM estimate. Table 7 shows that the net results remain largely unchanged from Table 5-7. The coefficient of the foreign presence (*FDIPC*) is negative and statistically significant at conventional level in column (3), indicating a negative foreign presence–TFP nexus in Vietnam. However, the significance of this foreign presence effect disappears in columns (1), (2) and (4). Also, the coefficients of interaction terms between foreign presence and human capital are positive and significant at the 1% level in columns (1)-(3) of Table 7, suggesting that foreign-specific spillovers on provincial TFP depend on provincial human capital. Furthermore, the magnitude of coefficients for industrial linkages, market size and physical infrastructure has only changed slightly comparing to Table 5 and

Table 6. Overall, Table 7 shows that our results are not sensitive to the inclusion of regional dummies

4.3 Sensitivity check for measures of human capital

In order to check the sensitivity of the measures of human capital, we re-estimate Equation (5) with new proxy for human capital, which is the proportion of trained workers per provincial labour force, *PTW*. Table 8 presents the results including interaction terms between human capital and foreign presence. We see that the key results are robust to new proxy of human capital; coefficients' sign and significant remain unchanged. We find evidence for negative effects of foreign presence on provincial TFP. We also find that the interaction between foreign presence and provincial human capital is positive and statistically significant when we control for time and region dummies. This suggests that our proxy for human capital, proportion of enrolled college students, has a close correlation with the variable of interest.

Table 8: Sensitivity check for human capital proxy, 2005 – 2016

	IV/GMM (1) TFP	IV/GMM (2) TFP	IV/GMM (3) TFP	IV/GMM (4) TFP
FDIPC	-0.101***		-0.179***	
	(0.033)		(0.036)	
FDIGPP		-0.203**		-0.318**
		(0.103)		(0.147)
*FDIPC*PTW*	0.052***		0.087***	
	(0.013)		(0.014)	
*FDIGPP*PTW*		0.098**		0.149***
		(0.039)		(0.057)
GPP	0.122***	0.151***		
	(0.011)	(0.011)		
POP			0.109***	0.129***
			(0.016)	(0.020)
IO	0.047	0.031	0.014	0.002
	(0.029)	(0.044)	(0.035)	(0.056)
PHD	0.018***	0.010	0.022***	0.020*
	(0.006)	(0.007)	(0.008)	(0.011)
PTW	0.065***	0.313***	0.119***	0.506***
	(0.019)	(0.108)	(0.023)	(0.152)
Constant	0.438***	-0.310	0.637***	-0.356
	(0.104)	(0.270)	(0.114)	(0.378)
Observations	540	540	540	540
Year Dummies	Yes	Yes	Yes	Yes

Regional dummies	Yes	Yes	Yes	Yes
Adjusted-R^2	0.000	0.000	0.000	0.000
F test	0.764	2.170	0.671	2.124
p-value	0.682	0.338	0.715	0.346
Hansen J statistic	0.764	2.170	0.671	2.124
p-value	0.682	0.338	0.715	0.346

Notes:
Standard errors in parentheses and *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.
Standard errors adjusted for arbitrary heteroscedasticity.
Instrument sets include lag2 and lag2 difference of independent variables.
Regional dummies include *Red, North, Central, High, South* and *Mekong* (base dummy).
For brevity, the coefficients of year dummies and regional dummies are not reported here.

5 Summary and conclusion

While there is ample evidence relating impact of inward FDI on productivity at firm and country level, far less attention has been paid to its effect at provincial level, especially in less developed countries which has received a surge in FDI inflows in recent decades. Based on the provincial data, this study sheds new insight on the FDI-induced TFP growth in Vietnam for the period 2000 – 2016. The results suggest that foreign presence, on average, has a positive effect on provincial TFP.

Although our results suggest a positive FDI-TFP nexus, there is strong indirect effect that operates via interaction effects of FDI with human capital. Specifically, the results indicate that provinces need to have better human capital in order to realize FDI-induced spillovers. Additionally, industrial linkages exert a positive effect on provincial TFP. These findings suggest that spatial concentration of economic activity in a host economy must be taken into account when examining the determinants of provincial TFP.

In short, the Vietnamese government has to find ways to improve provincial human capital in order to internalize FDI-induced spillovers. Thus, it needs to increase real spending on education and training in order to improve the quality of the labour force, which is the precondition for narrowing the technology gap between FIEs and indigenous firms. This, coupled with investment in infrastructure, can help boost provincial TFP in the long term.

It is worth mentioning that the lack of available data forced this study to refer to the aggregated figures for all industries within the provinces. Therefore, our result can also be further investigated to assess FDI spillovers to include, among the other things, the possibility that the externalities from foreign presence are not equal between sectors.

References

Aiken, L. S., West, S. G., & Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions*: Sage.

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

Alfaro, L., Kalemli-Ozcan, S., & Sayek, S. (2009). FDI, Productivity and Financial Development. *World Economy, 32*(1), 111-135.

Anwar, S., & Nguyen, L. P. (2010). Absorptive capacity, foreign direct investment-linked spillovers and economic growth in Vietnam. *Asian Business & Management, 9*(4), 553-570.

Anwar, S., & Nguyen, L. P. (2014). Is foreign direct investment productive? A case study of the regions of Vietnam. *Journal of Business Research, 67*(7), 1376-1387.

Anwar, S., & Sun, S. (2019). Firm heterogeneity and FDI-related productivity spillovers: A theoretical investigation. *The Journal of International Trade & Economic Development, 28*(1), 1-10.

Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies, 58*(2), 277-297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error component models. *Journal of Econometrics, 68*(1), 29-51.

Arnold, J. M. (2005). Productivity estimation at the plant level: A practical guide. *Unpublished manuscript, 27*.

Athukorala, P.-c., & Tien, T. Q. (2012). Foreign Direct Investment in Industrial Transition: the Experience of Vietnam. *Journal of Asia Pacific Economy, 17*(3), 446-463.

Baltabaev, B. (2014). Foreign Direct Investment and Total Factor Productivity Growth: New Macro-Evidence. *The World Economy, 37*(2), 311-334.

Bartik, T. J. (1985). Business location decisions in the United States: Estimates of the effects of unionization, taxes, and other characteristics of states. *Journal of Business & Economic Statistics, 3*(1), 14-22.

Baum, C. F., & Schaffer, M. E. (2003). Instrumental variables and GMM: Estimation and testing. *The Stata Journal, 3*(1), 1-31.

Baum, C. F., Schaffer, M. E., & Stillman, S. (2007). Enhanced routines for instrumental variables/ GMM estimation and testing. *The Stata Journal, 7*(4), 465-506.

Behera, S. R. (2017). Regional foreign direct investment and technology spillover: evidence across different clusters in India. *Economics of Innovation and New Technology, 26*(7), 596-620.

Bernard, A. B., Redding, S. J., & Schott, P. K. (2009). Products and productivity. *Scandinavian Journal of Economics, 111*(4), 681-709.

Bitzer, J., & Gorg, H. (2009). Foreign Direct Investment, Competition and Industry Performance. *The World Economy, 32*(2), 221-233.

Blomström, M., & Kokko, A. (1998). Multinational Corporations and Spillovers. *Journal of Economic Surveys, 12*(3), 247-277.

Blomström, M., & Persson, H. (1983). Foreign investment and spillover efficiency in an underdeveloped economy: evidence from the Mexican manufacturing industry. *World Development, 11*(6), 493-501.

Blomström, M., & Sjöholm, F. (1999). Technology transfer and spillovers: Does local participation with multinationals matter? *European Economic Review, 43*(4), 915-923.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics, 87*(1), 115-143.
Borensztein, E., Gregorio, J. D., & Lee, J.-W. (1998). How does foreign direct investment affect economic growth? *Journal of International Economics, 45*(1), 115-135.
Caves, R. E. (1974). Multinational firms, competition, and productivity in host-country markets. *Economica, 41*(162), 176-193.
Caves, R. E. (1996). *Multinational enterprise and economic analysis*: Cambridge university press.
Choi, B. Y., & Pyun, J. H. (2017). Industry FDI and the Distribution of Plant Productivity: Analysis Using Korean Plant-Level Data. *The Developing Economies, 55*(2), 105-129.
Ciccone, A. (2002). Agglomeration effects in Europe. *European Economic Review, 46*, 213-227.
Crespo, N., & Fontoura, M. P. (2007). Determinant factors of FDI spillovers - What do we really know? *World Development, 35*(3), 410-425.
Crespo, N., Fontoura, M. P., & Proenca, I. (2009). FDI spillovers at regional level: Evidence from Portugal. *Papers in Regional Science, 88*(3), 591-607.
Driffield, N., Munday, M., & Roberts, A. (2004). Inward investment, transaction linkages and productivity spillovers. *Papers in Regional Science, 83*(4), 699-722.
Dunning, J. H. (1993). *Multinational Enterprises and the Global Eonomy*: Harlow: Addison-Wesley.
Duranton, G., & Puga, D. (2003). *Micro-foundation of Urban Agglomeration Economies* (Vol. 4): North-Holland.
Elmawazini, K., Manga, P., & Saadi, S. (2008). Multinational enterprises, technology diffusion, and host country absorptive capacity: A note. *Global Economic Review, 37*(3), 379-386.
Felipe, J. (1999). Total factor productivity growth in East Asia: A critical survey. *Journal of Development Studies, 35*(4), 1-41.
Fujimori, A., & Sato, T. (2015). Productivity and technology diffusion in India: The spillover effects from foreign direct investment. *Journal of Policy Modeling, 37*(4), 630-651.
Fujita, M., & Thisse, J.-F. (1996). Economics of Agglomeration. *Journal of the Japanese and International Economies, 10*, 339-378.
Girma, S. (2005). Absorptive capacity and productivity spillovers from FDI: A threshold regression analysis. *Oxford Bulletin of Economics and Statistics, 67*(3), 281-306.
Görg, H., & Greenaway, D. (2004). Much Ado About Nothing? Do Domestic Firms Really Benefit from Foreign Direct Investment? *The World Bank Research Observer, 19*(2), 171-197.
Gorg, H., & Strobl, E. (2001). Multinational companies and productivity spillovers: A meta-analysis. *Economic Journal, 111*(475), F723-F739.
Gorg, H., & Strobl, E. (2005). Spillovers from foreign firms through worker mobility: An empirical investigation. *Scandinavian Journal of Economics, 107*(4), 693-709.
Graham, D. J., Melo, P. S., Jiwattanakulpaisarn, P., & Noland, R. B. (2010). Testing for Causality Between Productivity and Agglomeration Economies. *Journal of Regional Science, 50*(5), 935-951.
Guimaraes, P., Figueiredo, O., & Woodward, D. (2000). Agglomeration and the location of foreign direct investment in Portugal. *Journal of Urban Economics, 47*(1), 115-135.
Gujarati, D. N. (2003). *Basic Econometrics*. New York: McGraw-Hill Higher Education.
Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econemetrica, 50*(4), 1029-1054.

Head, K., & Ries, J. (1996). Inter-City Competition for Foreign Investment: Static and Dynamic Effects of China's Incentive Areas. *Journal of Urban Economics, 40*(1), 38-60.
Henderson, J. V. (2003). Marshall's scale economies. *Journal of Urban Economics, 53*(1), 1-28.
Hoang, H. T., Huynh, L. T. D., & Chen, G. S. (2019). How new economic geography explain provincial wage disparities: a generalised methods of moments approach. *Ekonomika Regiona [Economy of Region], 15*(1), 205-215.
Hong, E., & Sun, L. (2011). Foreign Direct Investment and Total Factor Productivity in China: A Spatial Dynamic Panel Analysis. *Oxford Bulletin of Economics & Statistics, 73*(6), 771-791.
Huynh, L. T., & Hoang, H. T. (2019). Effects of exchange rate volatility on bilateral import performance of Vietnam: A dynamic Generalised method of Moments panel approach. *International Economic Journal*, 1-23.
Jaccard, J., & Turrisi, R. (2003). *Interaction effects in multiple regression* (Vol. 72): Sage.
Jordaan, J. A. (2005). Determinants of FDI-induced externalities: New empirical evidence for Mexican manufacturing industries. *World Development, 33*(12), 2103-2118.
Jordaan, J. A. (2008). Intra- and Inter-industry Externalities from Foreign Direct Investment in the Mexican Manufacturing Sector: New Evidence from Mexican Regions. *World Development, 36*(12), 2838-2854.
Kneller, R. (2005). Frontier technology, absorptive capacity and distance. *Oxford Bulletin of Economics and Statistics, 67*(1), 1-23.
Konings, J. (2001). The effects of foreign direct investment on domestic firms - Evidence from firm-level panel data in emerging economies. *Economics of Transition, 9*(3), 619-633.
Krugman, P. (1991). Increasing Returns and Economic Geography. *Journal of Political Economy, 99*(3), 483-499.
Levinsohn, J., & Petrin, A. (2003). Estimating Production Functions Using Inputs To Control For Unobservables. *The Review of Economic Studies, 70*(2), 317-341.
Li, C., & Tanna, S. (2019). The impact of foreign direct investment on productivity: New evidence for developing countries. *Economic Modelling, 80*, 453-466.
Lipsey, R. E. (2002). *Home- and Host-Country Effects of Foreign Direct Investment*. Retrieved from National Bureau of Economic Research:
Liu, X., & Wang, C. (2003). Does foreign direct investment facilitate technoligical progress?: Evidence from Chinese industries. *Research Policy, 32*(6), 945-953.
Luo, L., Brennan, L., Liu, C., & Luo, Y. (2008). Factors Influencing FDI Location Choice in China's Inland Areas. *China & World Economy, 16*(2), 93-108.
Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A Contribution to the Empirics of Economic-Growth. *Quarterly Journal of Economics, 107*(2), 407-437.
Markusen, J. R., & Venables, A. J. (1999). Foreign direct investment as a catalyst for industrial development. *European Economic Review, 43*(2), 335-356.
Nelson, R. R., & Phelps, E. S. (1966). Investment in humans, technological diffusion, and economic growth. *The American Economic Review*, 69-75.
Newman, C., Rand, J., Talbot, T., & Tarp, F. (2015). Technology transfers, foreign investment and productivity spillovers. *European Economic Review, 76*, 168-187.
Nguyen, L. P. (2008). Productivity spillovers from foreign direct investment: Evidence from Vietnamese firm data. *Available at SSRN 1101203*.
Oguchi, N. (2004). Integrated report. *Total Factor Productivity Growth: Survey Report*, 3-29.
Olley, G. S., & Pakes, A. (1996). The Dynamics of Productivity in the Telecommunications Equipment Industry. *Econometrica, 64*(6), 1263-1297.

Park, J. (2010). Projection of long-term total factor productivity growth for 12 Asian economies. *Asian Development Bank Economics Working Paper Series*(227).
Ramasamy, M., Dhanapal, D., & Murugesan, P. (2017). Effects of FDI spillover on regional productivity: Evidence from panel data analysis using stochastic frontier analysis. *International Journal of Emerging Markets, 12*(3), 427-446.
Rosenthal, S. S., & Strange, W. C. (2002). Evidence on the NAture and Source of Agglomeration Economies. *Handbook of Urban and Regional Economics, 4*.
Sinani, E., & Meyer, K. E. (2004). Spillovers of technology transfer from FDI: the case of Estonia. *Journal of Comparative Economics, 32*(3), 445-466.
Solow, R. M. (1957). Technical change and the aggregate production function. *The Review of Economics and Statistics*, 312-320.
Thang, T. T. (2011). Productivity Spillovers from Foreign Direct Investment: What If Productivity is No Longer a Black Box? *South East Asian Journal of Management, 5*(1), 1-18.
Thang, T. T., Pham, T. S. H., & Barnes, B. R. (2016). Spatial spillover effects from foreign direct investment in Vietnam. *The Journal of Development Studies, 52*(10), 1431-1445.
Trade, U. N. C. o., & Development. (2020). World investment report 2020: International production beyond the pandemic. In: United Nations New York, NY.
Trinh, N. H. (2013). Agglomeration Economies and the Location of Foreign Direct Investment: Empirical Evidence from Vietnam. *Asian Economic and Financial Review, 3*(4), 512-531.
Tuan, C., Ng, L. F., & Zhao, B. (2009). China's post-economic reform growth: The role of FDI and productivity progress. *Journal of Asian Economics, 20*(3), 280-293.
Van Beveren, I. (2012). Total Factor Productivity Estimation: A Practical Review. *Journal of Economic Surveys, 26*(1), 98-128.
Vu, T. B., Gangnes, B., & Noy, E. I. (2008). Is Foreign Direct Investment Good for Growth? Evidence from Sectoral Analysis of China and Vietnam. *Journal of the Asia Pacific Economy, 13*(4), 20.
Woo, J. (2009). Productivity Growth and Techonological Diffusion Through Foreign Direct Investment. *Economic Inquiry, 47*(2), 226-248.
Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Massachusetts, London, england: The MIT Press.
Wooldridge, J. M. (2009a). *Introductory Econometrics: A Modern Approach*. the United States of America: South-Western Cengage Learning.
Wooldridge, J. M. (2009b). On estimating firm-level production functions using proxy variables to control for unobservables. *Economics letters, 104*(3), 112-114.
Wooster, R. B., & Diebel, D. S. (2010). Productivity Spillovers from Foreign Direct Investment in Developing Countries: A Meta-Regression Analysis. *Review of Development Economics, 14*(3), 640-655.
Xu, B. (2000). Multinational enterprises, technology diffusion, and host country productivity growth. *Journal of Development Economics, 62*(2), 477-493.
Xu, Z. (2009). Productivity and Agglomeration Economies in Chinese Cities. *Comp Econ Stud, 51*(3), 284-301.
Yudaeva, K., Kozlov, K., Melentieva, N., & Ponomareva, N. (2003). Does foreign ownership matter? The Russian experience. *Economics of Transition, 11*(3), 383-409.