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Bin Ni, Hayato Kato

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Institute for Economic Studies, Keio University
2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan
ies-office@adst.keio.ac.jp

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Bin Ni
Faculty of Business Administration,Toyo University
5-28-20 Hakusan Bunkyo-ku Tokyo,112-8606, Japan
jiadaniel@hotmail.com

Hayato Kato
Faculty of Economics ,Keio University
2-15-45 Mita Minato-ku Tokyo, 108-8345, Japan
hayato.kato2@gmail.com

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Bin Ni* Hayato Kato†

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*Corresponding author. Department of Accounting and Finance, Faculty of Business Administration, Toyo University (jiadaniel@hotmail.com).

†Faculty of Economics, Keio University (hayato.kato2@gmail.com).

1 Introduction

Hosting foreign direct investment (FDI) is essential for enhancing economic growth in developing countries. In addition to the positive impacts on local economies, such as growing local sales and employment, technology spillovers to local firms is one of the greatest benefits foreign multinational enterprises (MNEs) could bring. Through transactions and interactions with MNEs, local firms imitate MNEs' sophisticated technology and thereby increase their own productivity. Positive technology spillovers are especially likely when MNEs in downstream sectors source inputs from local suppliers in upstream sectors. For example, MNEs tend to demand high quality inputs and transfer knowledge about how to produce them, which leads local suppliers to improve their technology. Policymakers in developing countries are eager to receive such positive spillovers.

In fact, many empirical studies on FDI spillovers find positive spillovers between vertically-linked sectors (Javorcik, 2004; Blalock and Gertler, 2008; Liu, 2008). Specifically, an increase in FDI in downstream sectors improves local firms' productivity in the supply sectors.[1] Some studies take one step further to investigate how MNEs' characteristics affect the degree of vertical spillovers. Javorcik and Spatareanu (2008), for example, find that ownership structure in FDI projects (100% foreign ownership versus joint domestic and foreign ownership) influences the magnitude of vertical spillovers. Other studies by Javorcik and Spatareanu (2011) and Ni et al. (2015) examine the role of foreign investors' home countries and observe positive spillovers from investors from particular source countries.

Among the many characteristics of foreign investors that affect vertical spillovers, productivity is particularly important. Highly productive foreign investors are likely to set high-standards for inputs and convey technical and managerial knowledge to local suppliers. They encourage local suppliers to exert more effort to improve the quality of their products. For example, the Singer Sewing Machine Company started operations in Taiwan in the 1960s and sent experts to provide technical and managerial guidance to local suppliers (Lall, 1996). The company contributed the development of the sewing machine industry and its supporting sectors in Taiwan enormously.

However, highly productive foreign investors do not necessarily benefit local firms. They require sophisticated inputs that local suppliers are unable to produce, in which case, there is no scope for spillover. In addition, high-productivity foreign firms, which are typically big

[1] By contrast, the literature reports mixed evidences on intra-sector spillovers. In firm-level studies, for example, Kokko (1994) finds negative horizontal spillovers in Mexico, while Aitken and Harrison (1999) find positive ones in Venezuela. See Saggi (2002); Görg and Greenaway (2004); and Smeets (2008) for comprehensive surveys.

players in local markets, tend to have strong bargaining power against local suppliers. They squeeze local suppliers' profit margins and may force some suppliers to shut down (Javorcik et al., 2008). Foreign investors with moderate productivity may generate more positive externalities than high productive ones do. Schumacher (2011) proposes the concept of "intermediate technology" and emphasizes the importance of localized knowledge and small-scale, labor-intensive activities. The level at which foreign investors' productivity drives the most significant positive spillovers is essentially an empirical issue.

This study examines how foreign investors with different productivity levels have different effects on the degree of vertical spillovers. We use a large panel data set for firms operating in Vietnam and focus on foreign investors from Asian countries, which have the most significant spillover effect compared to those from other countries (Ni et al., 2015). According to the productivity thresholds determined by the endogenous structural breaks approach, we rank Asian investors in three groups: high, middle, and low. We find that local firms in upstream sectors experience the most productivity gains from Asian investors with middle productivity in downstream sectors. We check the robustness of the results by including various control variables and different productivity thresholds.

In the literature on FDI spillovers, many studies focus on the role of local firms' or foreign investors' productivity on the degree of spillovers. Theoretical studies have yet to reach a consensus on whether foreign investors with higher productivity transfer more knowledge to local firms. Some studies predict that a larger technology gap between local and foreign firms would give local firms more room for improvement (Findlay, 1978; Wang and Blomström, 1992). They base their argument on the presumption that lagging firms can learn from and catch up with advanced firms quickly. By contrast, other studies argue that local firms benefit from more spillovers if their technological level is close to that of foreign firms (Rodriguez-Clare, 1996; Glass and Saggi, 1998), arguing that local firms should be capable enough to absorb sophisticated knowledge from foreign firms.

Empirical studies also show contradictory results at both the macro and micro levels. Macro-level studies typically examine the impact of FDI on economic growth. Shen and Lee (2010) and Baltabaev (2014) indicate that a large technology gap can enhance positive spillovers from FDI. In addition, some studies suggest that a large technology gap encourages FDI spillovers only when host countries have sufficient absorptive capacity, such as through human capital and financial development (Borensztein et al., 1998; Xu, 2000). However, other studies report that a large technology gap discourages FDI spillovers (Li and Liu, 2005).

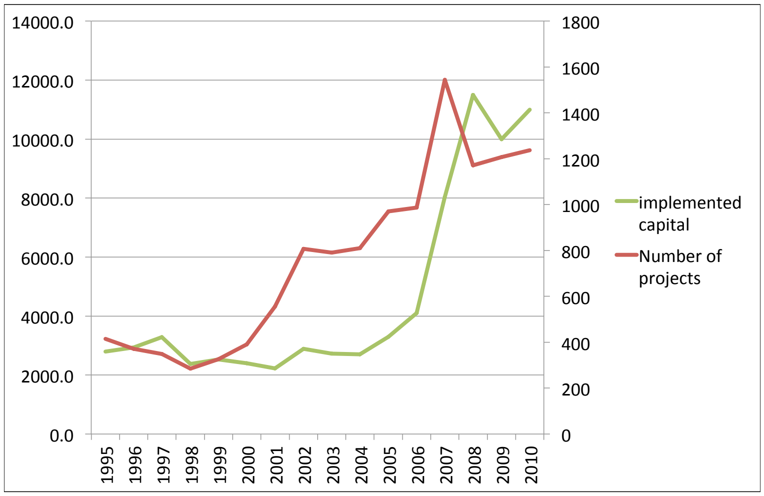
Turning to micro level studies, Liu et al. (2000), for example, find that the technology gap in the UK manufacturing industry has a negative impact. Blalock and Gertler (2009), on the other hand, show that Indonesian manufacturing firms with larger technological gaps gain from FDI. Le and Pomfret's (2011) paper is the closest study to ours in the sense that they consider both vertical spillovers and the technology (measured by labor productivity) gap using data on Vietnamese firms, but their result is inconclusive. Moreover, since they enter the "technology gap" term in the regression model separately from the spillover index itself, they assume that foreign investors with different productivity levels have the same impact on the degree of spillover. In sum, these micro-level studies aggregate foreign investors with different productivity as a single measure and are thus unable to disentangle their heterogeneous impact. Our paper differs from the previous studies in that we allow foreign firms with differing productivity levels to have different impacts on local firms.

The rest of the paper proceeds as follows. Section 2 describes the inward FDI situation in Vietnam and why it is important to investigate this issue in that context. Section 3 describes the data and estimation strategy. Section 4 presents the results and the robustness tests. Section 5 provides a simple model to explain a possible mechanism behind the empirical results. Finally, Section 6 concludes the paper.

2 Foreign direct investment in Vietnam

Vietnam is an ideal setting to investigate the relationship between FDI and technology spillover for several reasons. First, Vietnam experienced remarkable economic growth, mainly due to two major events, the adoption of a major economic reform called Doi Moi in 1986 and accession to the World Trade Organization (WTO) in 2006. According to the "Vietnam Country Profile" by the Library of Congress Federal Research Division, the country had a high growth rate of around 7% from the late 1990s, and this period was also one of a rapid increase in inward FDI (see Figure 3-2). By 2000, China was long the world's most popular destination for FDI; however, the trend has since shifted to emerging South-East Asian countries, among which Vietnam is becoming one of the most successful countries in the region in attracting FDI worldwide. This is due mainly to abundant labor and the low wage rate in Vietnam[2], as well as the successful liberalization of the investment environment.

[2]For example, in the apparel industry, the average wage in Vietnam is approximately half that in China (the Wall Street Journal, May 1st, 2013). Samsung is also shifting their production base to Vietnam to maintain profit margins by saving labor costs as the growth in sales of high-end handsets has slowed down, according to a Bloomberg report in December 2013 (Lee and Folkmanis, 2013).

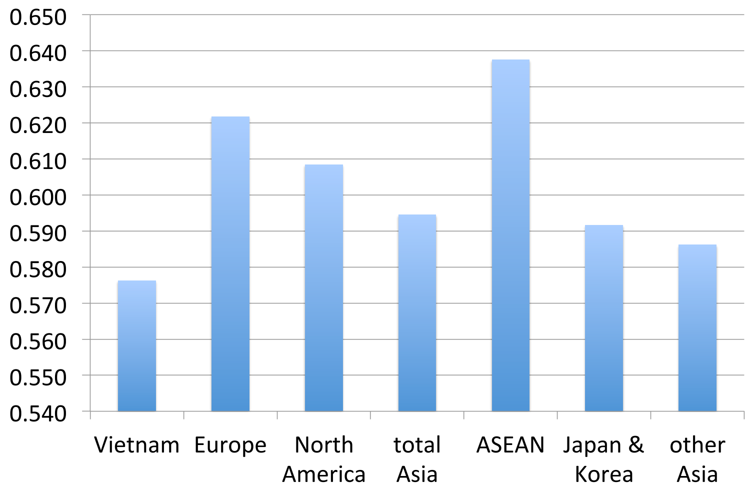


Source: General Statistics Office, Vietnam.

Figure 1: Number of FDI projects and implemented FDI (Bill. Dongs) in Vietnam.

Meanwhile, most foreign investors entering the Vietnamese market have far better technology than their Vietnamese counterparts do in terms of total factor productivity (TFP). Ni et al. (2015) show that the average TFP levels of Asian, European, and North American firms are all higher than that of Vietnamese firms (See Figure 2), and this technology disadvantage gives Vietnamese firms more potential to catch up. Since technology spillover from foreign investors is an important channel to boost the productivity of Vietnamese domestic firms (Nguyen, 2008), Vietnam's government has committed to improving its investment environment and tries to use more policy tools[3] to attract FDI. However, the targets are not limited to foreign investors with advanced technology. For instance, the 2005 Investment Law in Vietnam distinguishes the sectors in which the government encourages FDI, including both labor-intensive and technology-intensive industries. Such actions increase the uncertainty about the kind of FDI that will enter and leads to random technology gaps between new foreign investors and domestic firms, leaving room for us to explore how technology differences can affect spillovers. The findings can thus have possible implications for decision-makers in Vietnam when setting futire policies.

[3]The influence of policy on technology spillover might also be substantial, though it is beyond the scope of the discussion in this paper.



Source: Ni et al. (2015).

Figure 2: Average firm TFP by region.

3 Data and estimation strategy

3.1 Data

This paper uses a panel dataset constructed from the Vietnam Enterprise Survey at the firm level. The General Statistics Office (GSO) of Vietnam collects this data annually for all industrial sectors as of March 1st of each year. The general objectives of this survey are: (i) to collect the business information needed to compile national accounts; (ii) to gather up-to-date information on business registrations; and (iii) to develop a statistical database of enterprises. This panel dataset covers the ten years from 2002 to 2011, in which Vietnam experienced two major economic changes, namely WTO accession and the global economic crisis. Most firms in the dataset appear in the list of Vietnam Standard Industrial Classification (VSIC) codes[4], including all 22 manufacturing sectors out of 42 in total. The data provides the firms' profiles in terms of ownership, labor, capital stock, turnover, assets, FDI, wage, material inputs, and other information.[5] In our estimation model, we measure capital and labor by fixed assets and total labor at the end of year. We deflate output and capital using annual GDP.[6] Above that, the GSO surveys all MNEs, defined as firms

[4]We use the first 2-digits indicated in VSICcode2007 and VSICcode1993 to identify industries. For simplicity, we aggregate some sectors. See the Appendix for details.

[5]The census is taken for firms with more than 10 employees (over 20 employees in 2010 and 2011).

[6]The Producer Price Index at the sector level is a preferred deflator, but such data are not available for Vietnam.

with foreign capital.[7] An advantage of this dataset is that it also reports the country that represents the ownership of the firm.[8] Each firm has a unique "enterprise code", which is used together with the province code to identify firms and construct the panel dataset.

To achieve more accurate estimation results, we eliminate the missing observations and outliers. Firms in the top and bottom one percentile of all firm-specific output and input variables (in the means of annual growth) were deleted from the sample. Additionally, we exclude the top and bottom 1% of output/capital and output/labor.

3.2 Estimating productivity

TFP is the most common measure of the effect of FDI spillover on a firm's performance in the literature (see, for example, Javorcik, 2004). Although there are many ways to estimate TFP, we choose two alternative approaches that are suitable to our data, namely, stochastic frontier estimation and Levingsohn and Petrin's (2003) firm-level productivity estimation. The former has the advantage of isolating statistical noise from genuine productivity, whereas the latter incorporates the correlation between unobservable productivity shocks and input levels explicitly.

We begin by using the traditional econometric approach to estimate TFP to illustrate the advantages of our approaches. The Cobb-Douglas production function is written as:

$$\ln Y_{it} = \alpha + \beta_k \ln K_{it} + \beta_l \ln L_{it} + \varepsilon_{it}, \tag{1}$$

where Y_{it} represents firm i's net revenue in year t. K and L represent capital and labor, respectively, and ε_{it} is the unobserved error term. Once this model is estimated using ordinary least squares (OLS), TFP is calculated by normalizing the exponential transformation of the residual.[9] The well-known drawback of this approach is its inability to isolate genuine productivity from statistical noise.

Stochastic frontier analysis overcomes this drawback by including two error components representing both (the inverse) technical efficiency and statistical noise. According to Kumbhakar and Lovell (2000), the model is specified as:

$$\ln Y_{it} = \beta_0 + \sum \beta_n \ln x_{ni} + v_i + u_i, \tag{2}$$

[7] The sampling methods varied for private firms across the years.

[8] We count only foreign ownership with the largest share. For example, if Japan's share of investment is the largest, we consider the firm to be a Japanese-invested firm.

[9] The intercept is usually corrected to make the estimated TFP fall within the appropriate range.

where x_{ni} is a vector of inputs. v_i is the noise component and u_i is the non-negative technical inefficiency component. Here, we derive technical efficiency by inverting the technical inefficiency estimate as the measure of TFP. Half normal, exponential, and Gamma distributions are often assumed for u_i to ensure non-negative productivity estimates, whereas a full normal distribution is assumed for v_i because is common for random noise. The conditions for the error components for the normal-half normal model are: (i) $v_i \sim iid \quad N(0, {\sigma_v}^2)$ (ii) $u_i \sim iid \quad N^+(0, {\sigma_v}^2)$ (iii) v_i and u_i are distributed independently of each other and of the regressors.

This model is estimated by maximum likelihood estimation. Once we obtain estimates of u_i from the residual of the model, we can obtain the firm's technical efficiency using:

$$TE_i = \exp(-\hat{u}_i), \tag{3}$$

where $\hat{u}_i$ is $E(u_i \mid \varepsilon_i)$.[10] Alternative distributional assumptions for u_i can be accommodated simply by replacing (ii).

Meanwhile, the Levinsohn and Petrin (2003) method tries to alleviate the bias caused by correlation between unobservable productivity shocks and input levels. Ni et al. (2015) provide a detailed discussion. When the method is applied, however, the lack of data on intermediate input is a critical constraint. We do not have a direct measure of intermediate input; instead, we use work-in-process as a proxy variable for intermediate input. Work-in-process is an appropriate proxy because products not completed in the previous period will be brought into the production line in the current period for completion. In addition, note that we interpolate input variables to avoid losing too many observations due to our use of lagged inputs in the Levinsohn and Petrin model. These caveats may reduce the reliability of our estimation using this structural approach, so we use this model to supplement the stochastic frontier analysis.

3.3 Estimating the spillover effect

We now proceed to the methodology to estimate the effect of FDI on the TFP estimate. We use a standard reduced form where we regress a firm's TFP on measures of FDI spillover and other covariates, as in Javorcik and Spatareanu (2011). We create the FDI spillover variables based on the influence of FDI within the same and downstream industries. Since

[10] $E(u_i \mid \varepsilon_i) = \mu_i^* + \sigma^* \frac{\phi(-\mu_i^*/\sigma^*)}{1-\Phi(-\mu_i^*/\sigma^*)} = \sigma^*[\frac{\phi(\varepsilon_i\lambda/\sigma)}{1-\Phi(\varepsilon_i\lambda/\sigma)} - \frac{\varepsilon_i\lambda}{\sigma}]$, σ and λ are σ_u and λ_v, respectively; and ϕ and Φ are density and cumulative density functions, respectively.

Ni et al. (2015) show that only investors from Asia tend to induce a significant spillover effect, we focus on Asian investors' impact while controlling for investors from other major areas.[11] The estimation model becomes:

$$\ln TFP_{it} = Horizontal\_Group_{jt-1} + Vertical\_Group_{jt-1} + Herfindal_{jt-1} + \alpha_i + X_{it} + \eta_t + u_{it}, \quad (4)$$

where we define the variable $Vertical\_Group$ as:

$$Vertical\_Group_{jt} = \sum_{k \neq j} \alpha_{jkt} Horizontal\_Group_{kt}. \quad (5)$$

$\ln TFP_{it}$ is the logarithm of TFP of a local firm i at time t. Following Javorcik and Spatareanu (2011), we define $Horizontal\_Group$ as the share of the output produced by foreign firms in sector k in year t, and α_{jkt} is the coefficient representing the proportion of sector j's output used by sector k in year t.[12] All coefficients are taken from the Vietnamese Input-Output Table (IO Table) 2007. The "Group" term attached to each spillover variable depends on how we group foreign investors. Since we focus on the effect of the productivity difference among Asian investors, we choose different TFP thresholds, "φ", to divide Asian investors into subgroups. Thus, we can rewrite the equation above as:

$$\ln TFP_{it} = Horizontal\_Group_{jt-1} + \sum_{\varphi=1}^{P} Vertical\_Asia^{\varphi}_{jt-1} + Vertical\_Europe_{jt-1} + Vertical\_NorthAmerica_{jt-1} + Herfindal_{jt-1} + \alpha_i + X_{it} + \eta_t + u_{it}, \quad (6)$$

where P is the number of thresholds. We also include the potential spillover induced by European and North American investors.[13] Since there might be a time lag for spillover to occur, we use the one-year lags of each variable as independent variables.[14] X_{it} represents firm covariates. In particular, we need to control a local firm's own effort to absorb the technology, which we calculate as R&D expenditure/Net turnover. We also include the

[11] For a robustness check, we also include all foreign observations in the estimation and implement the same practice. The results remain unchanged, regardless of the alternative TFP calculation methods.

[12] When we calculate α_{jkt}, we exclude sector j's output sold for final consumption.

[13] Since investors from Asia, Europe, and North America occupy more than 90% of the observations in the dataset, we ignore the influence of investors from other regions at this time.

[14] Kiyota et al. (2008) find that foreign affiliates of Japanese multinationals in Southeast Asia and China develop local backward linkages over time.

industry-level Herfindahl index. We control firm fixed effect α_i and year dummy η_t.

For the industry classification, we follow the IO Table 2007 because we need to explore the industry link to construct vertical spillover variables. However, because the Enterprise Survey follows the VSIC, we had to match the industries in the dataset with those in the IO Table. Finally, this reduced our industry categories from 138 to 42 (see the detailed categories in the Appendix). Furthermore, the VSIC code system changed from VSICcode1993 to VSICcode2007 in 2007, and therefore, we convert the industry codes prior to 2007 in accordance with VSICcode2007 using a 1993-2007 concordance table.[15]

3.4 Grouping Asian investors

To group the Asian investors, we need to choose TFP thresholds that might cause a structural change in the potential influence of investors on the spillover level. To determine these thresholds, we must conduct statistical tests. We adopt a modified Stepwise Chow Test.[16] Suppose we have a baseline estimation model:

$$y_t = \beta_0 + \beta_1 Vertical\_Asia + u_t. \tag{7}$$

We want to verify that apart from the total vertical spillover, whether there is substantial change if we include an additional term that reflects the partial influence of Asian investors. Then, we run an augmented model:

$$y_t = \beta_0 + \beta_1 Vertical\_Asia + \beta_\varphi Vertical\_Asia^\varphi + u_t, \tag{8}$$

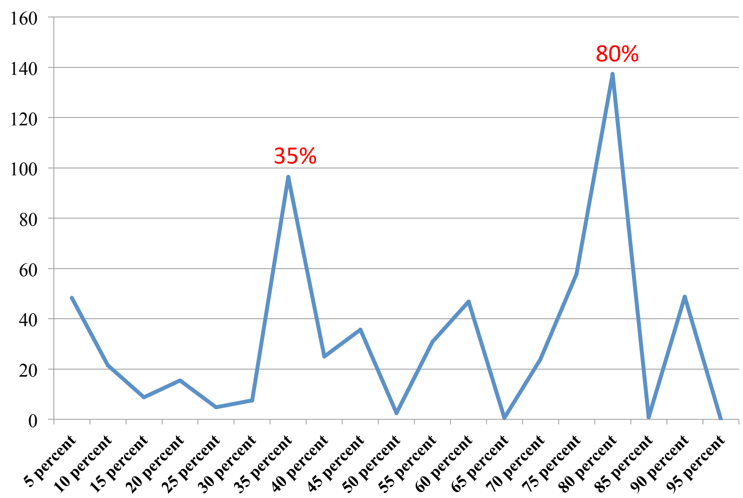
where we use the sum of the squared residuals from equations (8) and (7) to test the null hypothesis $H_0 : \beta_\varphi$. The F statistics are calculated as follows:

$$F = \frac{SSR_1 - SSR_2}{SSR_1} \cdot \frac{N-k}{q}. \tag{9}$$

q is the number of restrictions and k is the number of parameters. We replace the term $Vertical\_Asia^\varphi$ each time we change the value of φ. In practice, we use percentiles of the φ distribution among Asian investors and start from the lowest (i.e. from the 1% cutoff to the 100% cutoff) value in order to determine the largest F statistics and determine the correspondent φ. Figure 3 illustrates the results of this test.

[15]We construct the table based on the content description for the sector.

[16]We refer to Lai et al. (2009).



Source: Author's own calculation based on Vietnamese Enterprise Survey data.

Figure 3: Chow F statistics by TFP percentage (Asian).

As we can see, a large spike occurs at the 80% cutoff, indicating the potential structural change starting from this value. At the 35% cutoff, we find another spike, but it is less steep. Thus, we first use the 80% TFP cutoff as our main criteria, and divide Asian investors into “>80%” and “<80%” groups. Then we need to construct the vertical Asian spillover indexes based on the observations within each range. In the next attempt, we use the 35% cutoff to further divide the “<80%” group into lower and middle subgroups. We show both estimation results in the following section.

4 Estimation results

4.1 Results using the 80% TFP cutoff

	(1)	(2)	(3)	(4)
		Stochastic	Frontier	
Dependent Variable	LnTFP	LnTFP	LnTFP	LnTFP
Horizontal_total (lag 1)	-0.0425***		-0.0136	
	(0.00804)		(0.00843)	
Vertical_Asia (lag 1) (>80%)	0.00937*	0.0127**	-0.00173	-0.00390
	(0.00477)	(0.00501)	(0.0183)	(0.0195)
Vertical_Asia (lag 1) (<80%)	0.0330***	0.0277***	0.0370***	0.0371***
	(0.00873)	(0.00819)	(0.00957)	(0.00991)
Vertical_Europe (lag1)	-0.149*	-0.116	-0.0123	-0.0283
	(0.0896)	(0.0876)	(0.104)	(0.106)
Vertical_NorthAme (lag1)	0.338	0.332	-0.151	-0.0426
	(0.338)	(0.337)	(0.321)	(0.339)
Own_effort	-8.09e-05	-0.000105	-7.37e-06**	-7.32e-06**
	(0.000142)	(0.000148)	(3.50e-06)	(3.59e-06)
Herfindal Index	0.224**	0.269***	-0.139	-0.0271
	(0.0912)	(0.0980)	(0.145)	(0.125)
Observations	421,438	420,810	421,535	420,908
R-squared	0.044	0.044	0.055	0.055
Horizontal_origin control	No	Yes	No	Yes
Time FE	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes

Note: Standard errors in parentheses, clustered at industry level.
*** p<0.01, ** p<0.05, * p<0.1
Horizontal_origin includes Horizontal_EU, Horizontal_NorthAme, Horizontal_Asia (<80%) and Horizontal_Asia (>80%).

Table 1: Baseline grouping (80% TFP cutoff).

Table 1 reports the baseline estimation results using equation (6). We observe negative signs for $Horizontal\_Group$ throughout the models, indicating the presence of a strong replacement effect by investors in the same industry. For the variable of interest, vertical_Asia, only the model constructed using the "<80%" group of samples shows consistent and significant results. Additionally, the coefficient is larger than that of the spillover index induced by the ">80%" group. This reveals that the Asian investors with a relatively lower TFP level have the most spillover effect on their upstream Vietnamese suppliers.

4.2 Result using both 35% and 80% TFP cutoffs

	(1)	(2)	(3)	(4)
		Stochastic Frontier		
Dependent Variable	LnTFP	LnTFP	LnTFP	LnTFP
Horizontal_total (lag 1)	-0.0445***		-0.0104	
	(0.00832)		(0.00767)	
Vertical_Asia (lag 1) (<35%)	-0.375**	-0.486***	-0.373**	-0.386**
	(0.145)	(0.149)	(0.150)	(0.152)
Vertical_Asia (lag 1) (35~80%)	0.0486***	0.0471***	0.0278**	0.0276**
	(0.0139)	(0.0135)	(0.0118)	(0.0119)
Vertical_Asia (lag 1) (>80%)	0.00528	0.00886*	-0.0111	-0.0123
	(0.00501)	(0.00534)	(0.0190)	(0.0194)
Vertical_Europe (lag1)	-0.160*	-0.115	0.0109	0.00443
	(0.0881)	(0.0849)	(0.103)	(0.100)
Vertical_NorthAme (lag1)	0.567*	0.525	0.0913	0.101
	(0.330)	(0.325)	(0.325)	(0.333)
Own_effort	-3.69e-05***	-3.71e-05***	5.78e-06	5.56e-06
	(5.91e-06)	(6.11e-06)	(6.36e-06)	(6.30e-06)
Herfindal Index	-0.176***	-0.0975*	-0.0208	-0.0156
	(0.0573)	(0.0553)	(0.0576)	(0.0721)
Observations	421,450	420,822	421,428	420,801
R-squared	0.043	0.044	0.054	0.054
Horizontal_origin control	No	Yes	No	Yes
Time FE	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes

Note: Standard errors in parentheses, clustered at industry level.

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

Horizontal_origin includes Horizontal_EU, Horizontal_NorthAme, Horizontal_Asia (<35%), Horizontal_Asia (35%~80%) and Horizontal_Asia (>80%).

Table 2: Baseline grouping (35% and 80% TFP cutoffs).

When we decompose the "<80%" group by adding the 35% TFP cutoff, the result is even more explicit. As Table 2 shows, among the low-, middle-, and high-TFP Asian investor groups, only those in the middle TFP range (35%-80%) induce the most positive and significant vertical spillover. Asian investors within the low TFP range (<35%) have a negative impact on Vietnamese suppliers' TFP. This is because Asian investors with technology most similar to that of local firms are likely to purchase the same parts that local firms will also use. Under certain circumstances, it is difficult for spillovers to occur, and on the contrary, these Asian investors will pose as a "threat" to their local suppliers and thus suppress the latter's TFP growth.

4.3 Robustness checks

Several issues are worth extra scrutiny to confirm the robustness of our findings. One might argue that the difference in spillover impact is due to geographical heterogeneity. For instance, Vietnam has close business connections with Japan and China, and this special bond would enhance the interaction between investors from these countries and local suppliers. However, this is not the case for investors from other Asian regions. If the distribution of Asian investors within the 35%-80% range is not random, then it will contaminate our estimation of the influence of only the technology gap on the vertical spillover.

To alleviate this concern, we list the Asian investors in the "middle" subgroup. As Table 3 shows, investors with mid-level TFP are not limited to a particular country; rather, they are scattered, ranging from East to South Asia. This gives us reason to believe that geographical (or cultural) difference might not be as serious as we thought, though future research is required to justify this point.

Countryname	Countrycode	Number of firms	Percent (%)
Taiwan	1320	5,306	34.33
Korea, Republic	1311	3,106	20.1
Japan	1307	2,906	18.8
Singapore	1108	1,218	7.88
China	1304	1,009	6.53
Hongkong	1305	647	4.19
Malaysia	1105	591	3.82
Thailand	1109	384	2.48
Philippine	1107	90	0.58
Indonesia	1103	47	0.3
India	1306	41	0.27
Brunei	1101	22	0.14
Israel	1204	21	0.14
Bangladesh	1302	14	0.09
Sri Lanka	1318	13	0.08
	Total	15,415	

Source: General Statistics Office, Vietnam.

Table 3: List of Asian investors between the 35% and 80% TFP cutoffs.

Another issue is that foreign investors' ownership can affect the spillover they induce in domestic firms, since joint ventures may have a lower cost to find local suppliers of intermediates and thus be more likely to engage in local sourcing than wholly owned foreign subsidiaries (Javorcik and Spatareanu, 2008). We thus generate new vertical spillover indexes based on foreign investors' ownership (full or partial) and include them in equation (6). The estimation results remain unchanged[17].

In addition, there might be a concern about the measurement error of the TFP cutoffs. To confirm this, we use 25% or 50% TFP cutoffs to replace 35% when dividing the <80% group. We arrive at the same result, regardless of the cutoff value we use: Asian investors with mid-level TFP induce the most significant vertical spillover to their Vietnamese suppliers.

In summary, we find a non-linear correlation between Asian investors' technology level and their potential vertical spillover to local suppliers, which we depict in Figure 4. The horizontal axis indicates the average TFP level of Asian investors (or as a percentile), and the vertical axis reveals the induced vertical spillover. The vertical spillover keeps increasing, but is insignificant until φ reaches point a. Before φ reaches b, the vertical spillover will be significant or even maximized at some point above the line "L." Considering that most Asian investors have a higher average TFP level than Vietnamese suppliers do, we can describe the relationship between the technology gap (for Asian investors and Vietnamese suppliers) and the vertical spillover as an inverted-U shape.

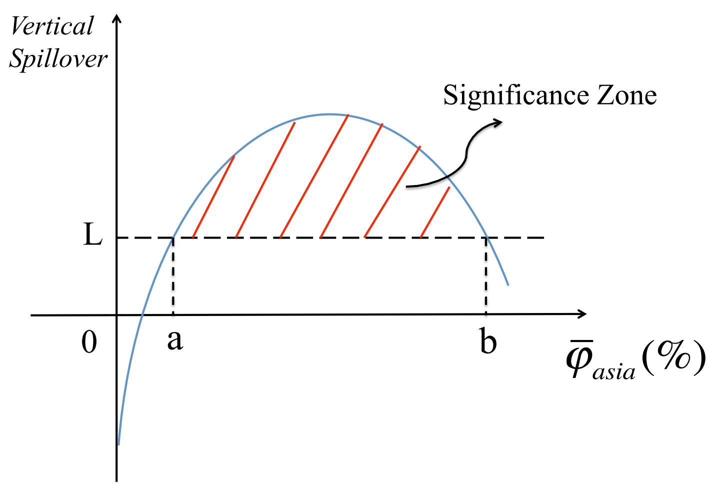


Figure 4: Concept of implication.

5 Simple model

Our empirical findings show that Asian investors with different productivity levels have different effects on local firms' productivity. To explain the finding, we propose a stylized

[17]We do not include the results due to space constraints, but they are available upon request.

model that captures the basic channel linking the productivity of foreign downstream industries with that of local upstream firms. Our model focuses on the role of managerial effort by local firms as a channel.

A local firm i's production function takes the form of

$$Q_i = A_i L_i^{\alpha} K_i^{\beta} M_i^{\gamma},$$

where A_i is a parameter capturing the technological level; L_i and K_i are labor and capital inputs, respectively; and M_i is managerial input. From this, we can derive the TFP as

$$\begin{aligned} TFP_i &= \frac{A_i L_i^{\alpha} K_i^{\beta} M_i^{\gamma}}{L_i^{\alpha} K_i^{\beta}} \\ &= A_i M_i^{\gamma}. \end{aligned}$$

The firm's managers divide their effort between administrative word (e.g., monitoring and coaching employees) and managerial innovation (e.g., reconsidering plans and meeting with MNE buyers). Thus, we decompose managerial input into

$$M_i = m_i^{\delta}[B(\overline{m} - m_i)]^{1-\delta},$$

where $\delta \in (0, 1)$, B and $\overline{m}$ are exogenous to the firm. Of all managerial resources $\overline{m}$, the managers of firm i devote m_i to administration and $\overline{m} - m_i$ to innovation, allocating their effort to maximize the output level Q_i, or equivalently, TFP_i.

We suppose that the presence of foreign MNEs has two effects on local firms. First, local firms learn from the management practices of foreign investors thorough direct and indirect transactions, and hence increase their management quality. Let V denote the foreign presence (adjusted by their productivity), which implies that managerial resources $\overline{m}$ are increasing in V. We parameterize it as $\overline{m}(V) = \exp(V)$.

Second, local firms must allocate more effort to innovation as foreign investors are more predominant. For example, foreign producers in downstream industries require more sophisticated inputs, detailed contracts, better working conditions for employees, and so on. Local suppliers must allocate time to meet their standards. In the model, this corresponds to B decreasing in V; we specify this as $B(V) = [B_0 + \exp(V)]^{-\eta}$ where $\eta \in (0, 1 - \delta)$.

The optimal choices are given by $m_i = \delta\overline{m}$; $\overline{m} - m_i = (1 - \delta)\overline{m}$. Substituting these into the objective function gives

$$TFP_i = A_i \left[(\delta \overline{m})^{\delta} \left\{ B(1-\delta)\overline{m} \right\}^{1-\delta} \right]^{\gamma}$$
$$= A_i \Theta \left(\overline{m} B^{1-\delta} \right)^{\gamma}$$
$$= A_i \Theta \left[\exp(V)(B_0 + \exp(V))^{-(1-\delta)/\eta} \right]^{\gamma},$$

where $\Theta \equiv \delta^{\delta}(1-\delta)^{1-\delta}$ is a bundle of parameters.

Figure 5 draws a typical pattern of TFP for different levels of V. V first increases TFP because it helps improve overall management quality (larger $\overline{m}(V)$). As V further increases, managers are required to put a disproportionally large effort toward innovation to meet foreign investors' requirements (larger $B(V)$). Thus, the marginal contribution of V to TFP falls and can be negative if V is extremely large. This theoretical result rationalizes the empirical finding that only Asian investors with intermediate productivity levels have a significant effect on local firms.

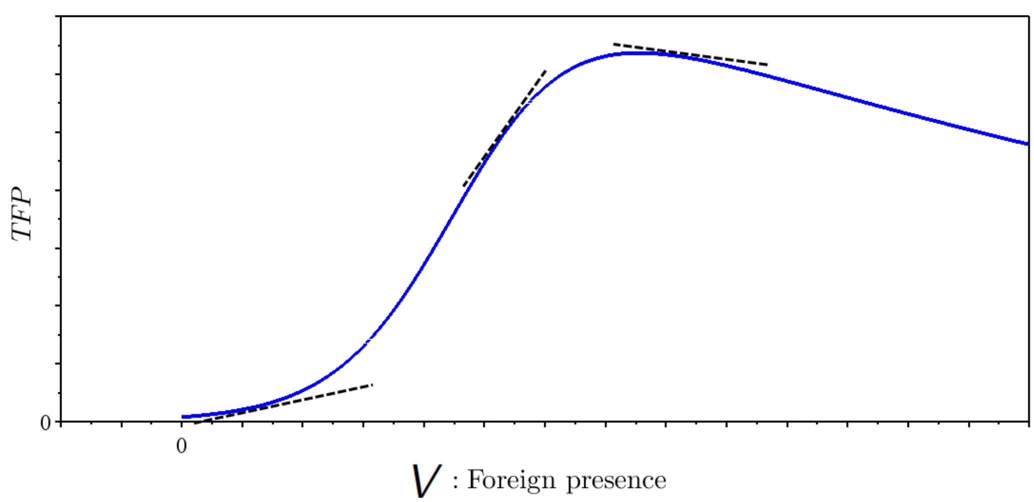


Figure 5: Vertical spillovers.

6 Conclusion

The spillover impact of FDI has been widely investigated in existing literature. In this study, we examine the correlation between the productivity gap and vertical spillover in Vietnam. In particular, we focus on Asian investors, who are most likely to induce vertical spillovers to local suppliers, as the previous literature shows. After applying statistical methods, such as the stepwise Chow test to divide Asian investors by different TFP cutoffs, we show that the relationship between the productivity gap and vertical spillover has an inverted-U shape, that is, Vietnamese suppliers can achieve the most TFP gains from the diffusion of the Asian investors with mid-level TFP.

The empirical results are robust to several sensitivity checks, thus providing evidence that not all foreign investors with the most advanced technology benefit local firms in Vietnam. To clarify the results, we propose a simple theoretical model to highlight a possible mechanism. The model focuses on managerial effort in local firms as a production input, which econometricians cannot observe. Local firms' observable productivity is determined by two types of managerial effort: one for production (e.g., administration and monitoring) and the other for innovation (e.g., organizational meetings and learning the latest management practices). Foreign investors affect the allocation of managerial effort. Low-productivity foreign investors do not contribute much to an increase in managers' skills, and thus bring little improvement in local firms' productivity. Highly productive foreign investors transfer their knowledge, but require a substantial managerial effort for innovation rather than for production. This distorts the allocation of managerial effort and does little to help local firms. Mid-level productivity foreign investors allow local managers to absorb managerial skills and achieve the best allocation of their effort between the two purposes. Although we believe that our mechanism is of great importance, our data does not enable us to test it. We leave the empirical investigation of the exact mechanism through which mid-level productivity affects local firms for future research.

Appendix

TFP scores	N	mean	sd	max	min
OLS	513913	0.001	0.004	1	0
SF	513913	0.513	0.165	0.81	0.008
LP	513913	0.028	0.046	1	0

Source: Author's own calculation based on Enterprise Survey, GSO, Vietnam

Table A.1: TFP comparison using different methods.

References

Aitken, B. J. and Harrison, A. E. (1999) "Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela", American Economic Review, 89(3): 605-618.

Baltabaev B. (2014) "Foreign Direct Investment and Total Factor Productivity Growth: New Macro-Evidence", The World Economy, doi: 10.1111/twec.12115.

Blalock, G. and Gertler, P. J. (2008) "Welfare Gains from Foreign Direct Investment Through Technology Transfer to Local Suppliers", Journal of International Economics, 74(2): 402-21.

Blalock, G. and Gertler, P. J. (2009) "How Firm Capabilities Affect Who Benefits from Foreign Technology", Journal of Development Economics, 90(2): 192-99.

Blomstrom, M. and Kokko, A. (1998) "Multinational corporations and spillovers", Journal of Economic Surveys, 12(3): 247-277.

Borensztein, E., Gregorio, J. D. and Lee, J. W. (1998) "How Does Foreign Direct Investment Affect Economic Growth?", Journal of International Economics, 45(1): 115-135.

Caves, R. E. (1996), Multinational Enterprise and Economic Analysis", Second Edition. New York, NY: Cambridge University Press.

Findlay, R. (1978) "Relative Backwardness, Direct Foreign Investment, and the Transfer of Technology: A Simple Dynamic Model", Quarterly Journal of Economics, 92(1): 1-16.

Glass, A. J. and K. Saggi. (1998) "International Technology Transfer and the Technology Gap", Journal of Development Economics, 55(2): 369-398.

Görg, H. and Greenaway, D. (2004) "Much Ado About Nothing? Do Domestic Firms Really Benefit from Foreign Investment?", World Bank Research Observer, 19(2): 171-197.

Javorcik, B. S. (2004) "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages", American Economic Review, 94(3): 605-631.

Javorcik, B. S. and Li, Y. (2013) "Do the Biggest Aisles Serve a Brighter Future? Global Retail Chains and their Implications for Romania", Journal of International Economics, 90(2): 348-363.

Javorcik, B. S., W. Keller, and J. Tybout. (2008) “Openness and Industrial Response in a WalMart World: A Case Study of Mexican Soaps, Detergents and Surfactant Producers”, The World Economy 31(12): 1558-1580.

Javorcik, B. S. and Spatareanu, M. (2008) “To Share or Not to Share: Does Local Participation Matter for Spillovers from Foreign Direct Investment?”, Journal of Development Economics, 85(1-2): 194-217.

Javorcik, B. S. and Spatareanu, M. (2011) “Does it Matter Where you come from? Vertical Spillovers from Foreign Direct Investment and the Origin of Investors”, Journal of Development Economics, 96(1): 126-138.

Kiyota, K., Matsuura, T., Urata, S., and Wei, Y. (2008). “Reconsidering the backward vertical linkages of foreign affiliates: Evidence from Japanese multinationals”. World Development, 36(8), 1398-1414.

Kokko, A. (1994) “Technology, Market Characteristics, and Spillovers”, Journal of Development Economics, 43(2): 279-293.

Kumbhakar, S. C. and Lovell, C. A. K. (2000) “Stochastic Frontier Analysis”, Published by the Press Syndicate of the University of Cambridge.

Lai, M. Y., Wang, H. and Zhu, S. J. (2009) “Double-edged Effects of the Technology Gap and Technology Spillovers: Evidence from the Chinese Industrial Sector”, China Economic Review, 20(3): 414-424.

Le, H. Q. and R. Pomfret. (2011) “Technology Spillovers from Foreign Direct Investment in Vietnam: Horizontal or Vertical Spillovers?”, Journal of the Asia Pacific Economy, 16(2): 183-201.

Levinsohn, J. and Petrin, A. (2003) “Estimating Production Functions Using Inputs to Control for Unobservables”, Review of Economics Studies, 70(2): 317-341.

Li, X. and Liu, X. (2005) “Foreign Direct Investment and Economic Growth: An Increasingly Endogenous Relationship”, World Development, 33(3): 393-407.

Liu, X. M., Siler, P., Wang, C. Q. and Wei, Y. Q. (2000), “Productivity Spillovers from Foreign Direct Investment: Evidence from UK Industry Level Panel Data”, Journal of International Business Studies, 31(3): 407-425.

Liu, Z. (2008) “Foreign Direct Investment and Technology Spillovers: Theory and Evidence”, Journal of Development Economics, 85(1/2): 176-93.

Ni, B., Spatareanu, M., Otsuki, T., Yamada, H. and Manole, V. (2015) “How Will the Origin of FDI Affect Domestic Firms’ TFP? Evidence from Vietnam”, FREIT Working Paper, No. 74.

Nguyen, L. P. (2008) “Productivity Spillovers from Foreign Direct Investment: Evidence from Vietnamese Firm Data”, Available at SSRN: http://ssrn.com/abstract=1101203

Perez, T. (1997) “Multinational Enterprises and Technological Spillovers: An Evolutionary Model”, Evolutionary Economics, 7(2): 169-192.

Rodriguez-Clare, A. (1996) “Multinationals, Linkages, and Economic Development”, American Economic Review, 86(4): 852-873.

Saggi, K. (2002) “Trade, Foreign Direct Investment, and Technology Transfer: A Survey”, The World Bank Research Observer, 17(2): 191-235.

Shen, C.-H. and Lee, C.-C. (2010) “What Makes International Capital Flows Promote Economic Growth? An International Cross Country Analysis”, Scottish Journal of Political Economy, 57(5): 515-46.

Sleuwaegen, L. and De Backer, K. (2003) “Does Foreign Direct Investment Crowd Out Domestic Entrepreneurship?”, Review of Industrial Organization, 22(1): 67-84.

Smeets, R. (2008) “Collecting the Pieces of the FDI Knowledge Spillovers Puzzle”, World Bank Research Observer, 23(2): 107-138.

Schumacher, E. F. (2011) Small is Beautiful: A Study of Economics as if People Mattered. Random House, 2011.

Wang, J. Y. and Blomström, M. (1992) “Foreign Investment and Technology Transfer”, European Economic Review, 36(1): 137-55.

Xu, B. (2000) “Multinational Enterprises, Technology Diffusion, and Host Country Productivity Growth.” Journal of Development Economics, 62(2): 477-493.