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Foreign direct investment and productivity spillovers: Empirical evidence from Cambodia

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Abstract

This paper investigates productivity spillovers from Foreign Direct Investment (FDI) to the host country. By using firm-level data from Cambodia and by regressing domestic firms' total factor productivity (TFP) and labor productivity on FDI, the study reveals that domestic firms significantly benefit from productivity spillovers when their level of technology is moderately below that of foreign competitors. The finding suggests that promoting FDI in Cambodia is needed when the technology gap exists.

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1. Introduction

In Cambodia, the amount of FDI recently increased from US$ 2.7 billion in 2007 to US$ 5.8 billion in 2009. The most-favored sector is the garment sector, which has the highest number of investment projects, valued at about US$ 90 million in fixed assets in 2009 (ASEAN Japan Center, 2009). In addition to its policies to attract FDI, the Royal Government of Cambodia is also implementing policies to support small and medium-scale domestic enterprises. As the two policies are being implemented simultaneously, examining the relationship between FDI and domestic firms is particularly helpful for policy implication.

Productivity spillover from FDI takes place when foreign firms increase the productivity of domestic firms in a host country, but do not fully internalize the values of these benefits. Horizontal productivity spillovers or within-industry spillovers take place when foreign and domestic firms are in the same industry. Through this channel, productivity spillover can occur in three possible ways. Firstly, in order to compete, domestic firms need to upgrade their technology. Secondly, domestic firms may imitate foreign firms' technology. Finally, workers may quit foreign firms to join domestic firms or set up their own firms (Blomstrom and Kokko, 1998).

Despite theoretical explanation, existing studies have shown a mixed result of either positive or no spillover (Gorg and Greenaway, 2004). What explains these differentials in the findings on productivity spillover? Among all the myriad factors, two important explanations are the *technology gap* and the *absorptive capacity* of domestic firms.

Existing conceptual debates suggest that the technology gap between domestic firms and foreign firms influences the ability of domestic firms to benefit from the productivity spillover, but it is unclear whether a large gap or a small gap is better. Findlay (1978) argues that the rate of technological progress in a relatively "backward region" is an increasing function of the gap between its own level of technology and that of an "advanced region". The gap indicates the existence of new technological information for domestic firms to learn. In contrast, Wang and Blomstrom (1992) and Glass and Saggi (1998) explain that the profit of the domestic firm is negatively related to the technology gap, while that of the multinationals is positively related to the gap. Concomitant with the theoretical prediction, existing empirical studies also report conflicting findings on the effect of the technology gap on productivity spillover (Castellani and Zanfei, 2003; Girma and Gorg, 2007).

On the other hand, how does absorptive capacity affect productivity spillover? Cohen and Levinthal (1989) explain that an organization needs prior related knowledge to assimilate new knowledge. They also postulate that there are costs associated with the imitation of new knowledge, but those costs are minimized by virtue of existing absorptive capacity. Findings of existing studies using different proxies of absorptive capacity also suggest the existence of the impact of absorptive capacity on productivity spillover (Barrios and Strobl, 2002; Griffith et al., 2004; Girma et al., 2008).

By using the firms' survey data from Cambodia, this study aims to examine how the FDI affects the productivity of domestic firms by taking into account the level of the technology gap between domestic and foreign firms and the level of absorptive capacity of domestic firms. This study introduces two proxies of absorptive capacity that may affect productivity spillovers: the

percentage of employed workers with higher education in each firm and the training firms offer their workers.

This paper chooses Cambodia as a case study for three reasons. Firstly, Cambodia has enjoyed impressive economic growth due to the large inflow of FDI. Secondly, along with efforts to attract FDI, the Royal Government of Cambodia is also working hard to promote SMEs. Finally, although there are a few studies that examine the productivity spillover in manufacturing firms in Cambodia (see, for example, Cuyvers et al., 2008) and report positive spillover from FDI, they did not investigate the effect of a firm's absorptive capacity. This paper is organized into five sections: section 2 describes methodology; section 3 describes data and is followed by section 4, which discusses the findings. Section 5 concludes the paper and draws some implications from the findings.

2. Methodology

2.1. Model Specification

To estimate the productivity spillover, this paper follows the conventional method by regressing domestic firms' productivity on the presence of FDI in the same industries. The effect of productivity spillover is present if the coefficient of FDI is positive. However, this conventional method has problems of unobserved variables and simultaneity bias. This paper deals with these problems by using random and fixed effect models. Following Blalock and Gertler (2009), the below specification is used.

$$lnTFP_{ijt} = \gamma_0 + \gamma_1 FDI_{jt} + \gamma_2 FDI_{jt} * AC_{ijt} + \gamma_3 AC_{ijt} + \gamma_4 FDI_{jt} * TFPGap_{ijt} + \gamma_5 TFPGap_{ijt} + \alpha_i + d_t + \varepsilon_{ijt} \quad (1)$$

where FDI_{jt} is FDI in sector *j* at time *t*, AC is the vector of absorptive capacity, $TFPGap_{ijt}$ is the technology gap, d_t is a dummy for time, $\alpha_i$is firm's fixed effect, and ε_{ijt} is the error term.

As mentioned in the first section, the technology gap indicates the existence of a new technological knowledge for domestic firms to learn. The coefficient $\gamma_4$of the interaction term of TFPGap and FDI will capture the effect of the technology gap on productivity spillover caused by FDI. Similarly, the absorptive capacity affects the ability of domestic firms to benefit from the productivity spillover. The coefficient γ_2 of the interaction term between AC and FDI will capture this effect.

TFP is calculated using the method of Levinsohn and Petrin (2003)[1].

$$TFP_{it} = \exp\left(lnY_{ijt} - \hat{\beta}_1 lnK_{ijt} - \hat{\beta}_2 lnL_{ijt} - \hat{\beta}_3 lnM_{ijt} - \hat{\beta}_4 lnE_{ijt}\right) \quad (2)$$

$\hat{\beta}_i$ is the estimate of β_i of the following production function.

$$lnY_{ijt} = \beta_0 + \beta_1 lnK_{ijt} + \beta_2 lnL_{ijt} + \beta_3 lnM_{ijt} + \beta_4 lnE_{ijt} + \omega_{ijt} + \eta_{ijt} \quad (3)$$

$\omega_{it} = lnTFP_{it}$ is productivity shock that is observed by the firms but not by econometricians, and η_{ijt} is error term. ω_{ijt} is assumed to be uncorrelated with the error term η_{ijt} .

[1] Levinsohn and Petrin (2003) use the intermediate goods as the instrument for estimating production function parameters and the unobserved TFP. They assume that firm will increase its capital and intermediate goods if its productivity increases. For details of the method, see Levinsohn and Petrin (2003) and Levinsohn et al. (2004). The stata code for Levinsohn and Petrin (2003) is available in stata program.

This study employs two proxies of absorptive capacity: the percentage of employed workers who are educated to a level higher than lower secondary level in each individual firm (H) and dummy of training (TR) which equals one if the firm offers training to its workers and zero otherwise. These proxies of absorptive capacity (AC) are valid for two reasons. Firstly, FDI to least-developed countries often brings less complicated technology, especially in the labor intensive and service sectors; hence, domestic firms do not necessarily invest heavily in R&D activities to catch up with foreign firms. The high level of workers' education and additional training may do the work. Secondly, although R&D is probably needed, SMEs may not have a big budget to spend on it. For these reasons, R&D is probably less visible in the case of labor-intensive and service industries.

In order to robust the result, the bootstrap method is used to obtain the standard error for the coefficients in equation (1). The reason for using the bootstrap standard error instead of the usual standard error is that in two-step estimation, to obtain the accurate standard error, the usual standard error needs to be further adjusted. The statistical test of the coefficients in equation (1) depends on residual ($\widehat{lnTFP} - \boldsymbol{x\beta}$) where $\boldsymbol{x}$ is a vector of explanatory variables and $\widehat{lnTFP}$ is estimated from equation (2) rather than the actual residual ($lnTFP - \boldsymbol{x\beta}$). The bootstrap method can provide accurate standard error without having to do the complicated adjustment (see Cameron and Trivedi, 2005, pp.189–190 for details).

2.2 Comparing Results Using TFP and Labor Productivity

While this study uses TFP to measure productivity spillover, some past studies (for example, Dimelis and Louri, 2004) use labor productivity. To robust the result, the study compares the estimated results using TFP with one-step estimation using labor productivity. Following Dimelis and Louri (2004), the below production function is used.

$$Y_{ijt} = L_{ijt}^{\alpha} K_{ijt}^{\beta} M_{ijt}^{\gamma} E_{ijt}^{\theta} e^{w\boldsymbol{Z}} \tag{4}$$

where $\boldsymbol{Z}$ is the vector of exogenous factors including FDI and other factors affecting a firm's output. By taking logarithm of (4), the following equation is obtained.

$$lnY_{ijt} = \lambda + \alpha lnL_{ijt} + \beta lnK_{ijt} + \gamma lnM_{ijt} + \theta lnE_{ijt} + w\boldsymbol{Z} + \xi_{ijt} \tag{5}$$

Equation (5) can be re-written as follows:

$$lnY_{ijt} = \lambda + \alpha lnL_{ijt} + \beta lnK_{ijt} + \gamma lnM_{ijt} + \theta lnE_{ijt} + \nu FDI_{jt} + \varphi FDI_{jt} * AC_{ijt} + \mu AC_{ijt} + \rho FDI_{jt} * TFPGap_{ijt} + \pi TFPGap_{ijt} + \xi_{ijt} \tag{6}$$

where Y_{ijt}, L_{ijt}, K_{ijt}, M_{ijt} and E_{ijt} are output, labor, capital, materials and energy and electricity of firm *i* in sector *j* at time *t* respectively. ξ_{ijt} is the error term.

By subtracting lnL_{ijt} from both sides of the equation and controlling for time dummy d_t and firms' fixed effect a_i, the equation (6) can be rewritten as:

$$ln\left(\frac{Y_{ijt}}{L_{ijt}}\right) = \lambda + \alpha ln\left(\frac{K_{ijt}}{L_{ijt}}\right) + \gamma ln\left(\frac{M_{ijt}}{L_{ijt}}\right) + \theta ln\left(\frac{E_{ijt}}{L_{ijt}}\right) + (\alpha + \beta + \gamma + \theta - 1)lnL_{ijt} + \nu FDI_{jt} + \varphi FDI_{jt} * AC_{ijt} + \mu AC_{ijt} + \rho FDI_{jt} * TFPGap_{ijt} + \pi TFPGap_{ijt} + d_t + a_i + \xi_{ijt} \tag{7}$$

By setting $\delta = \alpha + \beta + \gamma + \theta - 1$ equation (7) can be re-written as:

$$ln\left(\frac{Y_{ijt}}{L_{ijt}}\right) = \lambda + \alpha ln\left(\frac{K_{ijt}}{L_{ijt}}\right) + \gamma ln\left(\frac{M_{ijt}}{L_{ijt}}\right) + \theta ln\left(\frac{E_{ijt}}{L_{ijt}}\right) + \delta lnL_{ijt} + \nu FDI_{jt} + \varphi FDI_{jt} * AC_{ijt} + \mu AC_{ijt} + \rho FDI_{jt} * TFPGap_{ijt} + TFPGap_{ijt} + d_t + a_i + \xi_{ijt} \quad (8)$$

3. Data and Main Variables

In this paper, data from a firm survey conducted in 2006 by the World Bank is used. Although the total sample size of the survey is 502 firms, only 416 firms with complete information are used. The surveyed firms consist of both manufacturing firms and nonmanufacturing firms. The survey includes information on sales and input use in 2005 and 2006. If the foreign share exceeds 50 percent, the firm is regarded as a foreign firm. This classification is based on the Company Law of Cambodia[2]. Appendix 1 presents the distribution of domestic and foreign firms in each sector.

To estimate equation (1) and (8), the following main variables are defined. *Y* is the gross output measured by sales. Labor *L* is the number of permanent workers. Capital *K* is measured by spending on investment in land, building and equipment. The spending on investment is chosen to represent capital because there is no panel data on the book value of fixed assets. Material *M* and energy *E* are directly taken from firms' expenditure on material and energy. The main variables are deflated using the consumer price index.

The horizontal FDI is calculated by following Blalock and Gertler (2009) as:

$$FDI_{jt} = \frac{\sum_{i \in j} Foreign\_Y_{ijt}}{\sum_{i \in j} Y_{ijt}} \quad (9)$$

where $i \in j$ indicates the summation taken over firms in a given sector j. $Foreign\_Y_{ijt}$ isequal to the amount of output Y_{ijt} of firm *i* if this firm is foreign and 0 otherwise. Appendix 2 presents the FDI index of each sector.

To estimate equation (1), the technology gap is defined as the difference between a firm's average total factor productivity over the two-period (2005 and 2006) and that of all foreign firms in the same sector. The technology gap $TFPGap_{ij}$ of firm *i* in sector *j* is calculated as:

$$TFPGap_{ij} = \frac{Mean\left(TFP_j^*\right) - Mean(TFP_{ij})}{Mean(TFP_j^*)} \quad (10)$$

where TFP_{ij} is the total factor productivity of firm i in sector j. TFP_j^* is the mean of total factor productivity of all foreign firms in sector j. A positive technology gap means that the firm's productivity is below that of foreign firms. Similarly, for the estimation of equation (8) technology gap is calculated by using equation (10) and replacing TFP with labor productivity. Appendix 3 presents the mean values of the technology gap and proxies ofabsorptive capacity for each sector. It shows that a large majority of firms are below the international frontier with the exception of the garment, plastic, construction and IT sector.

[2] See article 283 of the Cambodian Law on Commercial Enterprise (2005).

4. Estimation Results

The two-year panel data are used to estimate equation (1) and (8). To deal with unobserved effects, the study adopts random effect (RE) and fixed effect (FE) estimations. The Hausman test is run to test the consistency of RE against the FE estimator. Table 1 presents the results of estimated coefficients as well as the Hausman test. It shows that the null hypothesis is strongly rejected. Therefore, FE is preferred to RE.

Based on the results of FE estimation, we examine the interaction terms between the technology gap or absorptive capacity and FDI in Table 1. The coefficient of TFPGap*HFDI is positive and statistically significant. However, the coefficient of the interaction terms between FDI and education H (H*HFDI) and between FDI and training TR (TR*HFDI) are not statistically significant. The positive and statistically significant coefficient of the interaction term TFPGap*HFDI suggests the potential role of the technology gap in enabling horizontal productivity spillover. The existence of a technology gap indicates an available learning opportunity for domestic firms. The statistically insignificant coefficients of the interaction term between FDI and proxies of absorptive capacity may be explained as follows. It may be caused partly by the relatively small variations in H (the percentage of workers with higher education) and TR (training dummy). In addition, the survey used in this study reports that less than 50 percent of domestic firms offer training and almost 70 percent of the surveyed firms face a problem of skill shortage, which is caused by insufficiency in the skills of their workers (World Bank Survey, 2006). These situations are likely to weaken the effects of these proxies of absorptive capacity on productivity spillover despite the increased FDI.

5. Conclusions and Policy Implications

This paper studies the effects of productivity spillover from FDI to domestic firms. Through its use of the panel data of 416 firms in Cambodia, the study lends support to findings of existing studies on the effects of the technology gap on productivity spillover. The estimation results show that FDI leads to productivity spillover only under the condition of a positive technology gap. On the other hand, this study did not find significant effects of education and training on productivity spillover from FDI.

The finding on the effect of the technology gap provides significant policy implications for the Cambodian government. Similar to most developing countries, domestic firms in Cambodia still have a technology gap when compared with foreign competitors. Therefore, with the existence of the technology gap, the Cambodian government should aim at policies that attract FDI.

To produce a better estimation result, future research should focus on the following issues. Firstly, due to the small sample size, this paper estimates productivity spillover by pooling firms across sectors. The findings can be enriched by estimating each sector separately using a large sample. Secondly, this paper uses a simple fixed effect and random effect model to deal with potential endogeneity. Future studies should consider time variant unobservable variables too. Finally, since deflators for each sector are not available, the overall consumer price index (CPI) is used to deflate the main variables. Although deflating with overall CPI may provide better estimated coefficients than those without deflating, future studies should use deflators for each sector to provide better results.

Table 1 Estimation Results of Equation (1) and (8)

Equation (1)			Equation (2)		
Independent Variables	ln(TFP)		Independent Variables	ln(Y/L)	
	RE	FE		RE	FE
Constant	4.27 (0.34)*** [0.37]***	4.70 (0.10)*** [0.12]***	Constant	3.36*** (0.25)	5.31*** (0.49)
			lnL	-0.02 (0.04)	-0.45*** (0.14)
			ln(K/L)	-0.00 (0.02)	0.05 (0.06)
			ln(M/L)	0.24*** (0.02)	0.07 (0.06)
			Ln(E/L)	0.20*** (0.03)	0.19** (0.07)
FDI	0.77 (0.62) [0.82]	-1.39 (1.02) [1.11]	FDI	0.17 (0.46)	-0.52 (1.08)
H	0.14 (0.37) [0.36]		H	0.39 (0.25)	
TR	0.07 (0.19) [0.16]		TR	0.02 (0.13)	
TFPGap	-0.16 (0.01)*** [0.05]***		TFPGap	-0.56*** (0.06)	
H*FDI	-0.83 (0.70) [0.86]	1.24 (1.15) [1.17]	H*FDI	-0.13 (0.51)	0.11 (1.17)
TR*FDI	0.37 (0.41) [0.34]	0.41 (0.54) [0.44]	TR*FDI	0.16 (0.32)	0.27 (0.54)
TFPGap*FDI	0.08 (0.02)*** [0.08]	0.07 (0.02)*** [0.03]**	TFPGap*FDI	0.09 (0.13)	0.37** (0.17)
N	568	568	N	568	568
R^2		0.06	R^2		0.19
Hausman test of RE against FE			Hausman test of RE against FE		
Chi-Square Boot	18.64		Chi-Square	29.54	
P-Value Boot	0.00				
Chi-Square	20.32		P-Value	0.00	
P-Value	0.00				

Notes:

1) In RE and FE, time dummy and firm fixed effect are taken account.
2) *,**,***: significant at 10, 5 and 1%;
3) Hausman test with null hypothesis H0: RE gives a consistent estimator.
4) ( ): asymptotic standard errors, [ ]: bootstrapped standard error.

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Appendix 1: Distribution of Domestic and Foreign Firms in Each Sector

Industries	Code	Sectors	N1	FOR	DOC	FOR %	DOC %
MANU-FACTURE	101	Foods	9	2	7	0.22	0.78
	102	Textile	6	5	1	0.83	0.17
	103	Garments	73	65	8	0.89	0.11
	105	Plastics and Rubber	5	2	3	0.40	0.60
	109	Other Manufacturing	14	3	11	0.21	0.79
TRADE	201	Wholesale (include export service)	29	7	22	0.24	0.76
	202	Retail	61	2	59	0.03	0.97
TOUR	301	Hotels and Restaurants	103	9	94	0.09	0.91
	302	Other services (travel agencies, tour)	20	3	17	0.15	0.85
OTHER	401	Construction	9	2	7	0.22	0.78
	402	Transport	21	9	12	0.43	0.57
	403	IT	5	1	4	0.20	0.80
	404	Others	61	22	39	0.36	0.64
TOTAL			416	132	284	0.31	0.69

Note: DOC is number of domestic firms; FOR is number of foreign firms; N is sample after removing observation with missing value. The distribution of firms in the sample indicates that this survey data is very suitable for analysis as it represents the whole population of firms in Cambodia very well. The table shows that the sector that has the largest number of foreign firms is the manufacturing industry (77 firms). Garment products absorb the highest number of foreign firms (65 firms). Totally, there are 132 foreign firms (31%) and 284 domestic firms (69%). There are two types of foreign firms: 100 percent owned (113 firms) and joint-ventured (19 firms).

Source: World Bank Survey on Business and Investment Climate in Cambodia (2006)

Appendix 2: FDI Indexes by Sector

Name of Sector	FDI2005	FDI2006
Foods	0.68	0.63
Textile	0.99	0.99
Garments	0.92	0.93
Plastics and Rubber	0.68	0.63
Other Manufacturing	0.85	0.84
Wholesale (include export service)	0.25	0.24
Retail	0.10	0.10
Hotels and Restaurants	0.20	0.21
Other services (travel agencies, tour)	0.33	0.37
Construction	0.60	0.73
Transport	0.68	0.66
IT	0.11	0.07
Others	0.59	0.23

Source: Author's Calculation

Appendix 3: Means of Two Proxies of Absorptive Capacity and Technology Gap

Name of Sector	Number of Firms	TR	H	TFPGap (1)	TFPGap (2)
Foods	9	0.33	0.66	-0.77	0.53
Textile	6	0.83	0.54	0.16	0.13
Garments	73	0.46	0.41	0.02	-0.01
Plastics and Rubber	5	0.60	0.54	-1.42	0.12
Other Manufacturing	14	0.57	0.68	0.44	0.45
Wholesale (include export service)	29	0.68	0.87	0.01	0.00
Retail	61	0.34	0.90	0.23	0.66
Hotels and Restaurants	103	0.47	0.78	-0.99	0.38
Other services (travel agencies, tour)	20	0.60	0.98	0.10	0.49
Construction	9	0.44	0.67	0.23	-0.33
Transport	21	0.52	0.95	0.34	0.50
IT	5	0.60	1.00	-0.16	-0.93
Others	61	0.55	0.88	-1.46	0.29

Notes:

1. The variable TR denotes a dummy variable which indicates whether or not firms offer training to their workers. The variable H denotes the percentage of workers with lower secondary education (grade 7th or higher) employed by each firm.
2. TFPGap (1) is calculated based on TFP and TFPGap (2) is calculated based on labor productivity.