FDI TECHNOLOGICAL SPILLOVERS AND ACCESS TO CREDIT

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Abstract

Using a unique data set from the Czech Republic for 1994-2003, this study examines the relationship between technological spillovers from FDI and firms' access to external finance. The empirical analysis indicates that overall, Czech firms benefit little from technological spillovers from FDI. However, a closer look at the financing of domestic firms suggests that firms that have access to external finance enjoy larger benefits from the presence of foreign firms, through increased productivity. The results highlight the importance of financial sector development and access to external financing to increasing the productivity and competitiveness of domestic firms by benefiting from technological spillovers from FDI. Our finding suggests that well-developed financial markets may be needed in order to take full advantage of the benefits associated with FDI inflows.

1. INTRODUCTION

The role of financial sector development in fostering economic growth has received a lot of attention in recent years. In an influential paper, Rajan and Zingales (1998) provide evidence suggesting that financial sector development reduces the costs of external finance to firms, by demonstrating that industrial sectors that are relatively more in need of external finance grow disproportionately faster in countries with more developed financial markets. A recent string of literature has emphasized the role of access to financing in promoting economic growth by allowing firms to tap into new sources of knowledge by selling in foreign markets or becoming suppliers to multinationals. A recent theoretical model and a calibration exercise undertaken by Alfaro et al. (2010) has suggested that well developed local financial markets are needed in order for host countries to benefit from technological transfers from foreign direct investment. This is because access to financing allows local entrepreneurs to start supplying multinationals and in this way benefit from international technological transfers. In a cross-country growth regression Alfaro et al. (2004) have found that FDI inflows contribute to a faster economic growth only in the presence of well-developed financial markets. Access to financing allows local entrepreneurs to start supplying MNCs and in this way benefit from knowledge spillovers from FDI.

Our study is among the first empirical research to shed light on the relationship between access to credit and technological spillovers from FDI. Technological spillovers from FDI can occur both within and between industries. Within industry, domestic firms can observe MNCs superior technologies and replicate them in their own firms or they can hire workers previously trained by MNCs, thus improving their productivity. Between industries technological spillovers can occur if MNCs source intermediate inputs domestically and thus transfer superior production, management techniques to their local suppliers. Evidence suggests that MNCs have higher requirements for product quality and on-time delivery, which provide incentives to domestic suppliers to upgrade their production management or technology (Javorcik, 2004, Javorcik and Spatareanu, 2008). However, all these improvements are costly and technological spillovers may not happen if firms do not have access to finance. Domestic firms can

undertake costly technological upgrading, invest in R&D or hire workers previously engaged in MNCS only if they have the necessary financial resources. As most of these improvements are costly, they can only be financed through outside financing from banks or other financial institutions. Similarly, inward FDI may also affect firms' productivities through directly impacting credit opportunities for domestic firms (Harrison and McMillan (2003) and Harrison et al. (2004)).

This paper uses unique firm and survey data from the Czech Republic to find that domestic firms do not benefit from technological spillovers from FDI neither through horizontal, nor vertical linkages. However, a closer look at the financing of the firms suggests that only local suppliers to multinationals that have access to external finance benefit from the presence of foreign firms through increased productivity. The paper highlights the crucial role that access to external financing has on domestic firms' performance. Additionally, we distinguish between the effect of FDI on technology transfer and FDI affecting domestic credit opportunities for local firms. For the later we find that it is an important channel through which FDI affect domestic private credit.

As recent literature finds that productivity spillovers from foreign direct investment (FDI) are most likely to take place through contacts between MNCs and their local suppliers (Javorcik 2004, Javorcik and Spatareanu 2008, Blalock and Gertler 2008), our finding suggests that well-developed financial markets may be needed in order to take full advantage of the benefits associated with FDI inflows.

This paper is structured as follows. Section 2 describes the empirical approach. Section 3 introduces the data set and provides some summary statistics. Econometric results are discussed in Section 4 and Section 5 concludes.

2. EMPIRICAL APPROACH

To examine the effect of financial sector development, access to credit on technological transfers we estimate the following relation:

$$\ln \text{TFP}_{i,t} = \alpha_i + \beta_1 \, l.\text{Tech\_Transfer\_Horizontal}_{j,t} + \beta_2 \, l.\text{Tech\_Transfer\_Vertical}_{j,t}$$
$$+\beta_3 \quad l.\text{Tech\_Transfer\_Horizontal}_{j,t} \quad * \quad l.\text{Access\_Credit}_{i,t} \quad + \quad \beta_4$$
$$l.\text{Tech\_Transfer\_Vertical}_{j,t} * l.\text{Access\_Credit}_{i,t} + \beta_5 \, l.\text{Access\_Credit}_{i,t} + \beta_6 \, \text{Age} +$$
$$\beta_7 \, \text{Size} + \alpha_t + \varepsilon_{i,t}$$

where subscripts i, j and t refer to firm, industry and time, respectively. $\text{TFP}_{i,t}$ stands for firm total factor productivity, α_i and α_t capture firm and year effects, respectively. Access to credit measures the easiness of firms accessing external sources of funds. We use two proxies: the share of non-current liabilities, long term debt to total assets and the leverage ratio. To capture the impact of MNCs on domestic firms' productivities we include in the regression measures of technological transfers through foreign presence in the same sector (Tech_Transfer_Horizontal) as well as in downstream sectors (Tech_Transfer_Vertical), which are defined as follows. $\text{Tech\_Transfer\_Horizontal}_{j,t}$ measures intra-industry technological spillovers. It is defined as the share of an industry j's output produced by firms with at least ten percent foreign equity, calculated for each industry. The variable $\text{Tech\_Transfer\_Vertical}_{j,t}$ is a proxy for the foreign presence in downstream sectors (i.e., sectors supplied by the industry to which the firm in question belongs) and thus is intended to capture the effect multinational customers have on domestic suppliers. It is defined following Javorcik (2004) in the following way:

$$\text{Vertical}_{j,t} = \Sigma_k \, \alpha_{j,k} \, \text{Horizontal}_{k,t}$$

where $\alpha_{j,k}$ is the proportion of sector j's output used by sector k taken from the detailed Czech an input-output matrix.

The interaction terms between Tech_Transfer and Access_Credit allow firms with better access to finance to benefit more from the presence of foreign firms. Less financially constrained firms have the resources to adopt the superior technologies brought by MNCs, and to improve their production process. They may also be less affected by reductions in the availability of domestic credit due to increased demand for loans coming from foreign firms.
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Further, we employ various methods to calculate total factor productivity (TFP): the OLS method as well as the the semi-parametric approach suggested by Olley

and Pakes (1996) and modified by Levinsohn and Petrin (2003) to control for the possibility that a firm's private knowledge of its productivity (unobserved by the econometrician) may affect its input choices thus leading to biased estimates of the coefficients on factor shares. This method allows for firm-specific productivity differences that exhibit idiosyncratic changes over time and thus addresses the simultaneity bias. Since our study relies on correctly measuring firm productivity, obtaining consistent estimates of the production function coefficients is crucial to our analysis.

Finally, standard errors are clustered to account for possible correlations within industry and year.

3. DATA

In order to conduct the analysis we use a unique data set collected by the World Bank through two surveys of domestic and foreign companies operating in the Czech Republic in 2003 and 2004. The surveys were carried out by a professional polling company by means of face-to-face interviews with senior managers taking place at respondents' workplaces. All respondents were guaranteed full anonymity. The data was collected for 857 Czech firms and 256 foreign owned firms operating in the country. In the analysis, we rely only on data for Czech firms. The focus of the first survey was on manufacturing firms, i.e. firms operating in sectors 15-36 according to NACE classification, while the second one covered both manufacturing and services industries. About 1/5th of the respondents were located in the capital city of Prague, while the rest was distributed across all regions in the country.

The survey responses are supplemented with panel data on firms' balance sheets and profit and loss statements from the Amadeus database, maintained by Bureau Van Dijk. Thanks to doing so, we created a unique data set which allows us to examine the relationship between access to external finance and productivity spillovers from FDI. Our data set spans the period 1994-2003 and includes 319 Czech firms in manufacturing sector.

The summary statistics are presented in Table 1. We find that foreign owned firms are larger, older and more productive. They are also somewhat larger in terms of

employment, tend to invest more (relative to their capital stock), have a higher debt (relative to their capital stock) and a higher leverage ratio.

Table 1. Summary statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Domestic firms					
Foreign share	5916	0.005	0.137	0.000	4.280
TFP OLS	3324	0.961	0.535	0.658	5.936
TFP LevPet	1916	1.200	0.438	0.319	2.869
Size	5238	4.779	1.283	1.000	8.798
Age	5681	7.638	9.601	1.000	76.000
Liabilities_totalassets	4440	0.114	0.173	0.000	2.101
Leverage ratio	4436	0.897	5.607	0.000	359.139
Horizontal spillovers	5916	0.127	0.167	0.000	0.897
Vertical spillovers	5916	0.018	0.022	0.000	0.227
Foreign Firms					
Foreign share	509	77.502	24.761	12.000	100.000
TFP OLS	263	1.050	0.572	0.272	3.704
TFP LevPet	180	1.406	0.496	0.000	2.447
Size	491	5.297	1.260	1.792	8.455
Age	499	8.248	2.181	2.000	15.000
Liabilities_totalassets	383	0.133	0.229	0.000	2.037
Leverage ratio	383	1.015	1.089	0.000	9.718
Horizontal spillovers	509	0.245	0.219	0.000	0.862
Vertical spillovers	509	0.026	0.020	0.000	0.108

4. ECONOMETRIC RESULTS

We start our analysis by focusing on domestic firms only and by estimating a firm fixed effects regression, where firm's total factor productivity is regressed on its size and age; time dummies are included in the regression to account for year specific effects. We find that, as expected, larger and older firms are more productive. We then add a proxy for the intra- industry technological spillovers and we find that the presence of foreign firms within the industry has no

statistically significant effect on domestic firms' TFP. However, when we next introduce in the regressions proxies for firm's access to credit and well as interactions between Tech_Transfer_Horizontal and access to credit, we find that only domestic firms that have access to credit benefit from the presence of foreign firms in their own industries though the intra-industry technological spillover channel, i.e. the interaction between the horizontal technological transfers and access to external credit is statistically significant.

In order to insure that our results are robust to alternative definitions of access to credit, we use two proxies: the share of non-current liabilities, long term debt to total assets and the leverage ratio. Both variables proxy for access to outside credit, and are hypothesized to enhance technological spillovers from FDI. Domestic firms can undertake costly technological upgrading, invest in R&D or hire workers previously engaged in MNCS only if they have the necessary financial resources. As most of these improvements are costly, they can only be financed through outside financing from banks or other financial institutions. The results confirm the importance of access to external credit, the interaction terms are positive and statistically significant and hold regardless of the measure of access to credit we use.

We also calculate TFP both as a residual from an OLS regression and by using the method developed by Oley and Pakes (1996) and Levinsohn and Petrin (2003) and re-estimate the regressions. We find again that the results are robust to alternate definitions of TFP, so we are confident in the validity of our results.

Next, we turn our attention to possible spillovers through vertical linkages. We introduce in the regression our proxy for the presence of MNCs in downstream sectors (Tech_Transfer_Vertical$_{j,t}$), i.e. sectors to which the domestic firm would be supplying. As many MNCs source intermediate inputs domestically, there is a possibility that domestic suppliers to MNCs would benefit from this relationship through increased productivity. We find some evidence that domestic firms located in sectors that supply MNC heavy downstream sectors enjoy higher TFP. In other words, there might be technological transfers between MNCs operating in the Czech Republic and their potential suppliers located in upstream sectors. Since

Table 2. Fixed Effects Regressions, domestic firms

Variables	TFP OLS	TFP OLS	TFP OLS	TFP OLS	TFP LevPet	TFP LevPet	TFP LevPet	TFP LevPet	TFP OLS	TFP OLS	TFP OLS	TFP LevPet	TFP LevPet	TFP LevPet	TFP OLS	TFP OLS	TFP OLS
Size	0.0876***	0.0735***	0.0607***	0.0621***	-0.00266	-0.00228	-0.000312	0.000249	0.0733***	0.0611***	0.0612***	-0.00272	-0.000424	0.000411	0.0738***	0.0625***	0.0628***
	[0.0168]	[0.0167]	[0.0159]	[0.0156]	[0.0163]	[0.0162]	[0.0166]	[0.0168]	[0.0166]	[0.0158]	[0.0159]	[0.0163]	[0.0169]	[0.0170]	[0.0166]	[0.0157]	[0.0156]
Age	0.0253***	0.0259***	0.0267***	0.0270***	0.0244***	0.0221***	0.0225***	0.0224***	0.0251***	0.0242***	0.0243***	0.0246***	0.0244***	0.0241***	0.0232***	0.0246***	0.0248***
	[0.00368]	[0.00404]	[0.00403]	[0.00394]	[0.00287]	[0.00311]	[0.00302]	[0.00302]	[0.00383]	[0.00400]	[0.00392]	[0.00288]	[0.00280]	[0.00274]	[0.00399]	[0.00410]	[0.00397]
l.Horizontal		0.0494	-0.0618	-0.171***		0.0833**	0.0257	-0.0274							0.0633*	-0.0684*	-0.150**
		[0.0329]	[0.0406]	[0.0582]		[0.0361]	[0.0407]	[0.0586]							[0.0326]	[0.0411]	[0.0626]
l.Horizontal_Liab_Toas			**0.406****				**0.295***									**0.568****	
			[0.171]				**[0.167]**									**[0.184]**	
l.Liab_Toas			-0.0264				0.0136			0.0107			0.0375			-0.003	
			[0.0430]				[0.0327]			[0.0412]			[0.0313]			[0.0413]	
l.Horizontal_Leverageratio				**0.212****				**0.110****									**0.200****
				[0.0738]				**[0.0557]**									**[0.0812]**
l.Leverageratio				-0.0106**				-0.00501			0.00145			0.00104			-0.0101*
				[0.00512]				[0.00402]			[0.00202]			[0.00139]			[0.00557]
l.Vertical									0.631***	0.681**	0.019	-0.0574	-0.133	-0.635**	0.699***	0.871***	0.385
									[0.212]	[0.274]	[0.365]	[0.265]	[0.244]	[0.267]	[0.214]	[0.292]	[0.388]
l.Vertical_Liab_Toas										-1.091			-0.382			-2.671*	
										[1.364]			[0.920]			[1.430]	
l.Vertical_Leverageratio											**0.781***			**0.744****			**0.284**
											[0.427]			**[0.300]**			**[0.452]**
Constant	0.184**	0.244***	0.303***	0.297***	1.096***	1.104***	1.085***	1.087***	0.248***	0.308***	0.307***	1.096***	1.075***	1.076***	0.255***	0.299***	0.303***
	[0.0931]	[0.0923]	[0.0918]	[0.0886]	[0.0888]	[0.0889]	[0.0915]	[0.0915]	[0.0917]	[0.0912]	[0.0902]	[0.0891]	[0.0929]	[0.0924]	[0.0921]	[0.0910]	[0.0890]
Nr. Obs.	2,212	2,024	1,846	1,846	1,599	1,599	1,434	1,434	2,024	1,846	1,846	1,599	1,434	1,434	2,024	1,846	1,846
R-squared	0.24	0.242	0.241	0.247	0.253	0.256	0.279	0.281	0.243	0.241	0.243	0.253	0.276	0.279	0.244	0.245	0.249

Robust standard errors in brackets

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

this is, as found in the literature, the most important channel for technological transfers from FDI, we want to test next whether access to credit, or lack of, may impact the degree to which domestic firms benefit from foreign firms presence in downstream sectors. We introduce in the regressions the interaction terms and find that access to external credit is a crucial determinant of the ability of domestic firms to enhance their productivity as a result of linkages with MNC clients. This finding highlights the importance of financial sector development which allows better access to external finances to domestic firms.

Next, we re-estimate our regressions and include both domestic and foreign firms in the regression. The results are different than in previous regressions, the interaction terms between foreign presences in the same industry and in downstream industries and access to credit are now mostly insignificant. We find that it does indeed matter if firms are domestic versus foreign owned as technological spillovers to foreign firms are not necessarily constrained by access to external sources of credit. Firms with foreign capital may indeed have an easier time financing their investments and benefitting from technological spillovers from FDI as they can easily tap into MNC parents' financing and thus do not have to rely on domestic sources of financing. The results so far highlight the importance of access to external financing for domestic firms in order to benefit from an important channel of international technology transfers from MNCs.

5. CONCLUSIONS

This paper investigates the importance of access to external credit for technological spillovers from inward FDI. It uses detailed firm level data from the Czech Republic and finds that access to external credit has a significant impact on the extent to which domestic firms benefit from technological spillovers from FDI. We find that only firms that have access to bank loans benefit from the presence of MNCs in their own industry as well in the downstream sectors. This finding is important as many countries around the world compete in attracting FDI, believing that foreign investors besides bringing in new capital also serve as a channel of technology transfer across international borders. Our paper highlights the importance of financial sector development which allows better access to external finances to domestic firms' ability to take full advantage of FDI technological spillovers.

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