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Do domestic firms benefit from geographic proximity with FDI? Evidence from the privatization of the Czech glass industry

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IES Working Paper: 20/2008

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Bibliographic information:
Galeotti, E. (2008). " Do domestic firms benefit from geographic proximity with FDI? Evidence from the privatization of the Czech glass industry " IES Working Paper 20/2008. IES FSV. Charles University.

This paper can be downloaded at: http://ies.fsv.cuni.cz

Do domestic firms benefit from geographic proximity with FDI? Evidence from the privatization of the Czech glass industry

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September 2008

Abstract:
This paper analyzes the effects of geographical proximity and agglomeration of FDIs (foreign direct investments) on domestic firms in the privatized glass sector in the Czech Republic. The motivation for this research is based on the scant evidence in Central and Eastern Europe of the effects of geographical proximity and agglomeration on the productivity of domestic firms. This study aims to explain how spillovers are transferred from FDIs to domestic firms.
The econometrical analysis, using original panel data from 1990 to 2006, provides evidence that the agglomeration of FDIs has a negative and significant effect on the productivity of domestic firms in the glass sector at a 5% level. The effect of geographical proximity to FDIs is significant at a 10% level but not in all models.
The results support the importance of geographic proximity and agglomeration of FDIs and conform with the evidence that shows that FDIs have produced negative spillovers on domestic firms in transition countries.

Keywords: Foreign direct investments, agglomeration economies, panel data, regional location, Czech Republic, glass industry

JEL: C23, F21, F23, L61, O18, R12.

Acknowledgements
I acknowledge with gratitude Mgr. Eva Ryšavá (Institute of Economic Studies, Charles University), Dr. Andrzej Cieślik (Faculty of Economic Sciences, Warsaw University), PhDr. Adam Geršl PhD. (Institute of Economic Studies, Charles University; Czech National Bank) and an anonymous referee for the useful comments, Prof. Michal Mejstřík for his support.
GA UK grant (2157/2007) is acknowledged as a source of financial support.

Introduction

Extensive evidence about spillovers in transition countries shows insignificant or negative generalized spillovers from FDIs. FDIs have not had positive spillovers as expected. The motivation for this study is based on the results about spillovers that contrast the expectations and on the scant evidence in Central and Eastern Europe of the effects of geographical proximity and agglomeration on the productivity of domestic firms. The aim is to explain how the location of FDIs have affected the productivity of domestic firms, creating negative spillovers to privatized firms.

This paper examines the effects of geographical proximity and agglomeration of FDIs on domestic firms using a population of privatized firms in the glass sector in the Czech Republic. It is organized as follows. Section 1 describes the privatization process in the glass sector in the Czech Republic. Section 2 summarizes the related theoretical and empirical literature and describes its various contributions and shortcomings. Section 3 describes the data, the methodology and discusses the variables used in the empirical analysis. Section 4 presents the empirical results and compares the findings of this work with those of related studies. Section 5 provides concluding remarks.

1. The privatization of the glass sector in the Czech Republic

The privatization of the glass sector was carried out under three different schemes: restitution, small-scale privatization and large-scale privatization. The first two schemes were started in 1990 and were the most prominent in the early years of the transition. Large-scale privatization, by which the largest firms were privatized, began in 1991 and was completed by 1995 (Hanousek et al. 2007).

Smaller glassworks were typically privatized with the restitution programme, and were auctioned off or sold in tenders. However, most of the previous owners of the glassworks had to pay for taking back their family businesses because the state had made some investments in the glasswork during the years of nationalization. This information was confirmed from personal interviews with Mr. Vlastimil Beránek, owner of the glasswork "Beránek, spol. s r. o." (on 3th September 2004), and Mr. Jiří Rückl, owner of the glasswork "Rückl Crystal a.s." (on 10th September 2004).

In rare cases, the privatization of ownership of the glasswork was given to the management, as was the case of the Moser company.

The largest glassworks were privatized with a voucher program, as Vertex a.s. (today Saint-Gobain Vertex a.s.) or sold directly to domestic and foreign investors as in,

respectively, Crystalex a.s. and Glavunion a.s. (today AGC Flat Glass Czech a.s.) (for an extensive analysis of the AGC Flat Glass Czech case, see Galeotti and Nollen 2008).
The literature about the privatization and the effects of acquisitions from FDIs in the Czech Republic is extensive. However, there are no specific studies, according to my research, about the spillover effects of FDIs on the domestic firms that focus on privatized firms in an industrial sector.

2. Theoretical and empirical background

2.1 Evidence about horizontal spillovers in the transition countries

The existence of spillovers from FDI is a natural extension of the Ownership, Location and Internalization (OLI) theory, according to which foreign investors are motivated to enter foreign markets if they have some firm-specific advantages that enable them to outperform local firms. At the same time they possess some intangible asset, such as technology and know-how, that constitutes a potentially important gain for the host country (Dunning 1981).
The research about spillovers from FDI has generated a large strand of empirical studies in the transition countries and the results are opposed to the expectations. The evidence has found insignificant or negative generalized spillovers from multinationals located in the same industry (horizontal spillovers) (UNECE 2001). The studies on the Czech Republic have also found mixed or negative spillovers from FDIs (Djankov and Hoekman 2000, Kinoshita 2000, Damijan et al. 2003a 2003b, Kosová 2006, Stančík 2007, Geršl et al. 2007). Recent studies about spillovers have concerned several transition countries and used large statistical databases (Gorodnichenko et al. 2007), but the evidence about horizontal spillovers remains weak or mixed. Gorodnichenko et al. (2007), analyzing spillovers in 17 emerging countries, have found mostly insignificant horizontal spillovers, except for older firms and firms in the service sector which have positive ones.
Görg and Greenaway (2001 2004) give three potential reasons for empirically failing to find significant spillovers. First, multinational corporations (MNCs) might be very effective in protecting their technology advantages and preventing, in this way, potential spillovers. Second, spillovers may exist and make up some part of the residual that appears in all growth equations, but current statistical methods and datasets are unable to identify them. Third, most of the studies have been carried out at the aggregate level and using cross-sectional studies: there may be much heterogeneity of spillovers and aggregate studies may therefore fail to detect them. Moreover, the poor quality of data, limited samples of firms studied and short panels of firms may be other reasons for failing to find evidence of spillovers (Damijan et al. 2003b). Torlak (2004) points out two further drawbacks of empirical studies. First, the problem of causality, because MNCs may locate in high productive industries and do not improve with their spillovers the industry productivity as usually it is believed. Second, the negative demand effect from FDIs may force less productive domestic firms to exit the market while the MNCs increase their market shares which finally increases the average productivity in the industry.

2.2 Spillover channels and the importance of geographic proximity

According to Marshall (1920) three sources of positive externalities can be identified. Locating near each other provides firms access to specialized input, suppliers and customers, a local market for skilled labour, and technological spillovers through information exchange. The local pool of skilled labour provides a gain for both workers and individual production units by maximising the job-matching opportunities and thus reducing the search costs (Gordon and McCann 2000, Krugman 1991). A localised industry can support more suppliers, which increases the level of specialisation and efficiency of the supply base (Harrison 1992).

The Marshall-Arrow-Romer externalities (defined in this way from Glaeser, Kallal, Scheinkman and Shleifer 1992) are knowledge spillovers external to a firm but internal to an industry and within a geographic region. Because human capital acquisition and imitation are considered important channels for knowledge spillovers, domestic firms located near multinationals may be more likely to benefit than other firms. As the theory from the economic geographic literature predicts, when knowledge is more tacit in nature, face to face interaction and communication are important and geographic proximity may help transmit knowledge more effectively (Von Hipple 1994). While it may be possible to learn certain skills by imitation, it may be extremely costly to imitate without close observation. Many communication processes involve an exchange of information and geographical proximity that may allow the exchange partners to observe each other's behaviour to avoid moral hazard problems. Proximity may facilitate the creation of social networks and lead to informal information-sharing. Personal relations and face-to-face communication between the employees and managers of firms located close to each other may lead to a higher level of knowledge transfer between them (Halpern and Muraközy 2007). Moreover, low mobility of labour can be a strong obstacle for technology spillovers when domestic firms are located far from FDIs. It is commonly argued that European labour markets are very rigid compared to the US labour market and people are less mobile in a geographical sense.

Another spillover channel is competition. Greater competitive pressure faced by local firms may induce them to introduce new technology, to work harder, improving their productivity and production to defend their market share, but may also worsen their situation and push them out from the market. This crowding out effect may dominate in the beginning, but may be reversed in the long run due to the long term positive effects of foreign firms on domestic entrepreneurship as a result of learning, demonstration, networking and linkage effects between foreign and domestic firms (De Backer and Sleuwaegen 2002, Barrios et al. 2005), even if the positive effects may be limited to the more technologically advanced firms or firms belonging to the R&D intensive sector (Sembenelli and Siotis 2005, Hale and Longe 2006).

Numerous econometric studies have focused on the geographic dimension of horizontal spillovers. Jaffe, Trajtenberg and Henderson (1993) show the significance of face-to-face contacts in the process of technological learning, while Audretsch and Feldman (1996) provide evidence that spillovers are geographically bounded and that the cost of transmitting knowledge rises with spatial distance. Adams and Jaffe (1996) and Adams (2002) show that knowledge spillovers are stronger within a given distance. Driffield (2000) examines the role of productivity spillovers from inward investment in the UK using sector-level data and finds positive productivity spillovers from FDI in the same sector and region. Siöholm (1999), using detailed micro-data from the Indonesian manufacturing sector, examines the effect on productivity from

FDI. He shows that domestic firms benefit from FDIs, but the effect differs between groups of industries and spillovers from FDIs are found in sectors with a high degree of competition. However, he does not find evidence of spillovers at the regional level. Some studies have found positive spatial spillovers of FDIs (Bernstein and Mohnen 1998, Branstetter 2001) and positive productivity spillovers at the regional level (Griffith et al. 2002), but others have found no or negative spillovers taking into account the regional component (Aitken and Harrison 1999, Zucker and Darby 1998, Ke and Luger 1996). Girma and Wakelin (2002) find evidence for positive spillovers from FDIs in the same region and sector in the United Kingdom, but the results are significant only for firms that have a low technology gap compared to multinationals.
There is only one study, according to my knowledge, about the effects of geographic proximity with FDI on domestic firms in transition countries. Halpern and Muraközy (2007) analyze spillovers in Hungary: first, they find no evidence of horizontal spillovers, but when they take distance into consideration, they find positive horizontal spillovers for domestic firms close to foreign-owned firms. The distance between foreign and domestic firms matters and plays an important role in determining the magnitude of the spillover effect: horizontal spillovers decrease with distance. They conclude that spillovers via labour mobility may play an important role over small distances, while competition is the dominant channel over long distances (Halpern and Muraközy 2007 p. 801).
Domestic firms that are located along the national borders might benefit from spillovers from foreign investors located in neighbour countries. Cieślik (2005) analyzes the effect of border effects for the location of foreign firms in Poland using a regional data set from the 1990s. His study finds that regions located along the Polish segment of the Eastern frontier of the enlarged European Union are less attractive to foreign investors compared to other Polish regions. I have not found empirical studies that take into account the effect of distance from the national border and the closest country on the productivity of domestic firms.

On the basis of the existing theory and empirical research, as discussed above, I propose the following hypotheses:

Hypothesis 1: The distance from FDI is positively associated with domestic firm's performance

Hypothesis 2: The density of FDI in the region is positively associated with domestic firm's performance

3. Data and Methodology

I have chosen a population of privatized firms in one industrial sector because in this way I can control for some relevant differences between privatized and new firms and it is possible to reduce firm's heterogeneity and variance.
The data used in this analysis come from different sources: the companies' annual reports available for the public in the business register, the Magnus Database, the Aspekt Reports, and the National Property Fund of the Czech Republic. This analysis is focused on firms in the Czech Republic in sector 26100, according to the Industrial Classification of Economic Activities (CZ-NACE code), i.e. firms engaged in the manufacturing of glass and glass products. The panel includes only firms that existed before 1989 and for which financial data are available, which allows for an

unbalanced panel of 42 firms with data from 1990 to 2006. The decision to focus on firms existing in the central planning is done in order to analyze the effects of FDIs on privatized firms. Moreover, since these firms were connected during central planning, it is plausible that the spillover effects of FDIs will be stronger; foreign investors will have stronger effects on their neighbour domestic firms because of their common past and experiences. New firms in the glass sector have not experienced the privatization process and might not experience such strong effects. I have chosen the glass sector because this sector has a long tradition in the Czech Republic and for this reason FDIs entered during the privatization process and did not enter with greenfield investments as in other industrial sectors.
Some glassworks have more processing plants. For my analysis, I have taken into account the location of headquarters and not of the processing plants. The reasons for this choice are the following. First, most of the financial data available pertain to the whole company concern and are not available for the single productive plants. Second, even if spillovers might spill from the productive plant to the neighbourhood area, usually information about the production, products and technology move from the production plants to the headquarters through the management and communications between the firm's departments. Finally, usually the production plants are located close to the headquarters and when a company has several plants, it is difficult to choose one of them for the location of spillovers.

In the international technology diffusion literature (see Keller 2002), the effect of geographical proximity is measured by physical distance (a continuous variable) between countries. On the contrary, the FDI literature studies the impact of multinationals on the productivity of domestic firms within regions of a country by using discrete measures of FDIs (for example dichotomizing the total amount of FDI in the region and outside the region).
In this paper I measure geographical proximity using the distance in kilometers of each firm from the closest FDI and the density of FDIs at regional level using the employment of foreign firms in the region.

It is necessary to specify that I do not measure spillovers directly, as many empirical studies have tried to do it with different proxies, using - for example - the relationship between the level of foreign involvement in an industry (measured by the share of labor force in the industry employed by foreign firms or by the extent of foreign ownership) and the total factor productivity growth in the sector. Because of the difficulties in measuring spillovers and the various mechanisms which underlie them, an analysis of the processes how spillovers occur is more relevant.

To eliminate the effect of inflation, I adjust variables measured in Czech crowns to inflation using price indices of the glass sector (sector 26100) provided by the Czech Statistical Office.

3.1 The Dependent Variable

Performance

I use the level of productivity (measured as total sales per employee) of domestic firms.

3.2 Explanatory variables

I use the following variables: the distance in kilometers from the closest FDI, the natural logarithm of the number of employees in foreign firms in the region. As control variables I include firm's characteristics as firm size, the number of years from privatization, the percentage of machine-made production and capital intensity. Moreover, I include variables that measure the competition effect, as the Lerner index and the density of domestic firms at regional level, measured by the natural logarithm of the number of employees of domestic firms in the region. I also consider, in different models, the minimum distance from the national border and the closest neighboring country.

3.2.1 Geographical proximity and agglomeration of FDIs

Distance from FDI

I measure the distance in kilometers from the closest FDI in the glass sector. The distance is measured using road-distance data (from the web-site www.mapy.cz). No distinction is made for this variable between firms that produce hand-made or automatic glass, since spillovers from FDIs to domestic firms might happen in the technological process of glass production, but also in the management of the company and in other economical aspects that affect the firms' productivity. However, for a sensitivity analysis, this distinction will be taken into account in separate regression models.

I expect this variable to have a negative sign if FDIs have positive spillovers on the productivity of domestic firms.

Density of foreign firms in the region

I measure the agglomeration of FDI in a region with the natural logarithm of the number of employees working in foreign firms in the glass sector in a region.

I expect this variable to have a positive sign if FDIs have positive spillovers on the productivity of domestic firms in the region.

Distance from the border and closest country

I measure the distance in kilometers from the closest border among all the possible borders of Czech Republic (a list of borders is available at http:www.steane.com/egtre/borders/xings.php?country=CZ).. The distance is measured using road-distance data (from the web-site www.mapy.cz). Four dummies are created for each neighbor country (Germany, Austria, Poland, Slovak Republic) and indicate the foreign country to which a domestic firm is closest, using the minimum distance calculated as shown above.

3.2.2 Firm's characteristics

Firm size

I use the natural logarithm of the number of employees as firm size. Existing studies present opposing results about the effect of firm size on firm performance. Larger firms might be more profitable than small firms because of the advantages associated with economies of scale and scope (Kang and Stulz 1997) and outperform them in terms of technology and competitiveness, as the studies from Wagner (1993) and Nguyen Van, Laisney and Kaiser (2004) suggest. On the other hand, small firms might have an advantage over large enterprises because they are more flexible and they can adapt quicker to a changing economic environment (Nguyen Van, Laisney

and Kaiser 2004). However, according to Desai et al. (2003) markets with better economic institutions and lower levels of capital rationing are characterized by a higher number of small firms that can enter and survive in the market and average firm size is expected to be smaller. This last hypothesis is partly supported from the evidence. American firms enter, on average, at a smaller scale and with lower productivity, many firms exit shortly after entering while the firms who survived quickly converge to the industry average size and productivity level; in Africa, on the contrary, the largest and most productive firms have the highest growth rate and are more likely to survive (Van Biesebroeck 2005). Other studies in less developed countries show a negative relation between firm size and growth rate, such as in the studies of Sleuwaegen and Goedhuys (2002) and Mead and Liedholm (1998).
I expect a positive effect of firm's size on the performance of domestic firms because the advantages associated with economies of scale and the scope in the glass sector appear to be especially relevant in an sector that is characterized, internationally, by the existence of an oligopolistic market.

Age

I use the number of years from the foundation of the firm. The literature shows that, because of learning-by-doing effects, older firms might grow faster than younger firms. However, this positive effect might be counteracted by "organizational geriatrics" (Agarwal and Gort 1996), which derives from the obsolescence and depreciation of firm's initial human capital and physical capital. Because of these conflicting effects, the literature on the impact of age on firm's performance is inconclusive and the results depend on data and on the estimation method used (Sutton 1997). In a transition country, older firms might be disadvantaged compared to younger firms, because they had to overcome the transition process, which implies learning new habits and new ways of doing business. On the other hand, the glass sector has a long tradition and the Czech Republic has been historically prominent in the glass manufacturing, so that the expected sign of the coefficient of firm's age is not clear.

Privatization

I measure the impact of privatization with the number of years from the privatization (for state-owned enterprises this variable, with a negative sign, indicates the number of years before the privatization).
Most surveys of the earlier empirical studies about privatization have suggested that a change from state to private ownership tends to improve economic performance (Djankov and Murrell 2000 2002, Megginson and Netter 2001). However, Hanousek et al. (2007) show that the earlier studies suffer from serious data problems and inadequate treatment of endogenity of ownership. They use a panel data on a majority of the medium and large firms that went through mass privatization in the Czech Republic. They found that the performance effects of privatization in the Czech Republic are on the whole limited and that many types of private owners do not have a performance that is different from that of firms with state ownership (Hanousek et al. 2007). The only exceptions are concentrated foreign and domestic owners.
I might expect a positive effect of the time passed from the privatization on the performance of domestic firms. However, since I have a long panel data with data until 2006, I expect my results to align with that from Hanousek et al. (2007) in concerning the effect of privatization on the performance of domestic firms.

Capital intensity and type of production

In the glass sector there exist different subsectors that differentiate firms. Glassworks manufacture different products with various techniques. The main difference between glassworks firms is automatic versus hand-made production. I include a control variable that indicates the percentage of automatic or machine-made production. As an alternative specification, I use a variable that indicates the capital intensity, measured as the ratio of net fixed assets to total assets in different regressions.

I expect a positive sign for the coefficient of both these variables on the performance of domestic firms.

Competition

This is another control variable that captures differences in the competition and in the market-power between firms in different subsectors.

As a measure of competition or market power, I have computed the Lerner index for a firm *i* using total costs and revenues, i.e., the cost-price margin, as in Domowitz et al. (1986):

$$CPM_i \equiv \frac{Sale + \Delta Inventories - Payroll - Material\cos t}{Sale + \Delta Inventories}$$

The ratio ranges from 0 to 1. Firms that are in perfect competition show ratios close to zero, firms that are perfect monopolists show ratio close to 1.

As an alternative specification of competition, I use a variable that indicates the density of domestic firms in the region, measured with the natural logarithm of the number of employees of domestic firms in the region.

The effect of competition can be twofold: greater competitive pressure faced by local firms may induce them to introduce new technology, to work harder, to improve their market share, but may also push them out from the market. However, this crowding out effect may be reversed in the long run (De Backer and Sleuwaegen 2002, Barrios et al. 2005), at least for the more technologically advanced firms or firms belonging to the R&D intensive sector (Sembenelli and Siotis 2005, Hale and Longe 2006).

The competition derives also from the agglomeration in an industrial sector at the regional level. In order to separate the effects of the density of FDI, I measure with a separate variable the density of domestic firms. Agglomeration in industrial clusters or at regional level has positive as well as negative effects; the positive expected effects are potential knowledge spillovers, since proximity magnifies the opportunities of learning, and stimulates innovation by competition on human capital. Negative effects are, for example, the limitation of product innovation that needs new ideas and differentiation (Callois 2008).

The cited literature suggests an expected positive sign for the coefficient of the Lerner index variable. I expect that domestic firms that have a higher monopoly position have a higher productivity than the others. The sign of the density of domestic firms present in the region can have both signs, depending on the type of dominant effect and on the behaviour of domestic firms. Domestic firms in the region might have a collusion behaviour among them which would increase their performance at the expenditures of consumers. Or a knowledge effect might prevail. In these cases this variable will have a positive sign. However, an excess of domestic density, congestion, might brings to a stealing effect and therefore a negative effect on productivity will be expected.

Table 1: Descriptive statistics

	N	Mean	Std. dev.	Min.	Max.
Productivity (in Th. CZK)	372	890.578	924.663	2.693	5227.533
Distance in Km from the closest FDI	315	104.782	34.244	0	176
Logarithm of the number of employees of FDI in the region	348	0.821	2.224	0	8.388
Firm size: Logarithm of the number of employees	374	5.898	1.256	1.386	8.689
Age	358	139.025	106.200	31	590
Years from the privatization	439	6.694	4.594	-8	16
Capital intensity	385	0.448	0.182	-0.085	1.775
Machine-made production (percent)	438	48.013	44.747	0	100
Market power (Lerner index)	288	0.081	0.663	-10.47	0.83
Logarithm of the number of employees of domestic firms in the region	327	8.099	1.339	3.912	9.164
Distance in km from the closest national border	344	47.884	40.577	0.3	150.4
Dummy for the closest border to Germany	344	0.508	0.500	0	1
Dummy for the closest border to Austria	344	0.290	0.454	0	1
Dummy for the closest border to Poland	344	0.032	0.176	0	1
Dummy for the closest border to Slovak Republic	344	0.168	0.375	0	1

*Source***:** author's calculation based on companies annual reports

The Table 1 shows that there is high variability among the productivity of Czech firms in the glass sector. The dataset includes glassworks that have a long history in the Czech Republic, some of them were privatized early, while others not. The average domestic glasswork has a machine-made production of 48% and a capital intensity of 0.448, and the variability in the percentage of automatic production and in the capital intensity of the sample is also high. The Lerner index ranges theoretically from 0 to 1. However, this ratio might be also negative, if some firms have higher costs than revenues from sales, as it is the case for some domestic glassworks.

The estimation model

The Hausman test suggests that the fixed effect model is the more appropriate for the theoretical model and the panel data at a 5% significance level, and the results of the specification tests support the fixed effect model in all models.
However, some variables cannot be included in the fixed effect model because they do not vary over time: the variable that measures the distance in km from the closest national border and the four dummies for the closest neighbour country. Because of the characteristic of these variables, it is not possible to run a fixed effect model and a

specification test. Therefore, these variables will be included in a random effect model to test their effect and results will be presented later.

Excluding the variables that concern the border effect, the fixed effect model is preferred because the Hausman test rejects the null hypothesis that the random effect model is more efficient than the fixed effect model that is less efficient but consistent. The fixed effect model uses the time variation in the dependent variable and in the independent variables "within" each cross-sectional observation (Wooldridge 2002), allowing to analyze the effect of geographical proximity and agglomeration of FDIs on each domestic firm over time.

In order to choose between the pooled OLS model and the fixed effect model, Baltagi (2005 p. 13) advices to run a F-test, which is a Chow test with the restricted residual sums of squares (RRSS) being that of OLS on the pooled model and the unrestricted residual sums of squares (URSS) being that of the LSDV (Least Square Dummy Variable) regression.

The results of the F-test indicate that the firms´ dummies are jointly significant and that OLS estimates which omit these firms dummies suffer from an omission variables problem rendering them biased and inconsistent.

Among the necessary assumptions of the model, multi-collinearity must be checked. Although multi-collinearity does not bias the coefficients, it does make them more unstable and it is hard to get good estimates of their distinct effects on some dependent variables. Moreover, with multi-collinearity standard errors may get large, and variables that appear to have no significant effects individually may actually have quite strong significant effects as a group (Wooldridge 2003). I have checked for multi-collinearity effects using a Pearson correlation matrix.

Table 2: Correlation matrix for variables used in the analysis

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Productivity (in Th. CZK)	1.000														
2	Distance in Km from the closest FDI	0.064	1.000													
3	Logarithm of the number of employees of FDI in the region	0.402	-0.333	1.000												
4	Logarithm of the number of employees	0.135	-0.038	-0.142	1.000											
5	Age	-0.161	-0.146	0.062	0.307	1.000										
6	Years from the privatization	0.307	-0.317	0.135	-0.276	-0.136	1.000									
7	Capital intensity	0.229	0.033	0.076	0.001	-0.154	0.022	1.000								
8	Machine-made production (percent)	0.514	-0.268	0.365	0.175	-0.092	0.218	0.040	1.000							
9	Market power (Lerner index)	0.069	0.066	0.027	0.233	-0.027	-0.031	-0.125	0.080	1.000						
10	Logarithm of the number of employees of domestic firms in the region	-0.173	0.460	-0.687	0.142	0.048	-0.354	-0.130	-0.202	0.036	1.000					
11	Distance in km from the closest national border	0.108	-0.107	0.076	0.187	-0.187	0.232	0.302	0.063	0.069	-0.338	1.000				
12	Dummy for the closest border to Germany	0.153	-0.634	0.429	0.078	0.279	0.155	0.068	0.266	0.472	-0.349	-0.023	1.000			
13	Dummy for the closest border to Austria	-0.096	0.097	-0.151	0.177	-0.068	0.089	0.283	-0.141	0.038	0.093	0.639	-0.458	1.000		
14	Dummy for the closest border to Poland	-0.009	0.626	-0.339	-0.216	-0.230	-0.208	-0.214	-0.168	-0.080	0.353	-0.435	-0.651	-0.458	1.000	
15	Dummy for the closest border to Slovak Republic	-0.133	-0.398	0.181	0.006	0.018	0.000	-0.145	0.089	0.013	-0.316	-0.063	-0.116	-0.081	-0.185	1.000

*Source***:** author's calculation based on companies annual reports

A variable that is highly correlated with some independent variables is the logarithm of the number of employees of domestic firms in the region. The logarithm of the number of employees of domestic firms in the region is highly correlated with the distance in kilometres from the closest FDI (0.460) and especially with the logarithm of the number of employees of FDI in the region (-0.687). These high correlation coefficients depend on the fact that the geographical distribution of Czech and foreign investors depends on the outcomes of the privatization process and on some common determinants. Therefore, I do not use this variable in all the models, and I will check if adding this variable will strongly change the results, as I expect.

4. Empirical results

I explore the impact of geographical proximity and agglomeration of FDIs on the productivity of domestic firms in the privatized glass sector in the Czech Republic.

I have estimated eight different models of fixed effect regressions using various specifications for some variables and adding, in some models, time dummies. These different models allow to check the stability of the coefficients and to see if,

measuring some variables in a different way, or adding time dummies, significantly changes the results.

Table 3: Results of fixed effect regressions
Dependent variable: Productivity in the Czech privatized glass sector of domestic firms (in Th. CZK)

	Model 1	Model 2	Model 3	Model 4
	Coeff. (Standard errors)	Coeff. (Standard errors)	Coeff. (Standard errors)	Coeff. (Standard errors)
Geographical proximity and agglomeration of FDIs				
Distance in Km from the closest FDI	0.615* (0.372)	0.616* (0.372)	0.618* (0.376)	0.626* (0.367)
Logarithm of the number of employees of FDI in the region	-182.141** (93.056)	-186.910** (92.103)	-169.394** (92.149)	-166.462** (91.288)
Firms' characteristics				
Firm size: Logarithm of the number of employees	-4.202 (19.258)	-5.543 (24.134)	0.743 (19.160)	2.847 (24.126)
Age	20.252** (8.537)	20.414** (8.653)	21.259** (8.444)	21.387** (8.538)
Years from the privatization	-4.541 (8.808)	-4.692 (9.009)	-4.619 (8.699)	-5.330 (8.881)
Capital intensity	-19.318 (59.325)		26.688 (62.539)	
Machine-made production (percent)		0.696 (3.032)		0.372 (3.032)
Competition effect				
Market power (Lerner index)	-36.775 (48.725)	-38.128 (51.146)	-44.408 (48.395)	-43.314 (50.455)
Logarithm of the number of employees of domestic firms in the region				
Constant	-2810.626** (1340.188)	-2792.605** (1398.766)	-3028.102** (1327.536)	-3044.046** (1383.564)
Time dummies	NO	NO	YES	YES
R-Square (within)	0.477	0.476	0.499	0.496
Sample size	135	136	135	136
F statistic	***	***	***	***

*Note***:** * significant at 10%; ** significant at 5%; *** significant at 1%;
*Source***:** author's calculation based on companies annual reports

The results presented in Table 3 show that geographic proximity and agglomeration of FDI have a significant effect on the productivity of domestic firms in the glass sector. The logarithm of the number of employees in foreign firms has a significant negative effect at 5% level on the productivity of domestic firms in the region. Domestic firms

that are close to FDI have a lower productivity than domestic firms that are more far away from them, as expressed from the positive coefficient of the variable that measures the distance in kilometers from the closest FDI, significant at 10% level. The signs of these two variables are coherent with the existence of negative horizontal spillovers from FDIs on the productivity of domestic firms and with the view that a crowding out effect and negative consequences of competition prevail, instead of the potential benefits from being close to FDIs.

Looking at firms' characteristics that could affect firm's performance, only the firm's age has a significant positive effect. The long tradition of the glass manufacturing in the Czech Republic explains why a learning-by-doing effect dominates and why younger firms might be disadvantaged compared to older ones. Firm size, expressed by the natural logarithm of the number of employees, and capital-intensity or the percentage of machine-made production, do not have a significant effect on the productivity of Czech glassworks. The number of years from privatization is also not significant, coherently with the most recent empirical studies about privatization, that found low or no effects of privatization on firm's performance (Hanousek et al. 2007). Adding time dummies or using a different specification for capital intensity does not modify the results of the variables significantly.

Table 4: Results of fixed effect regressions
Dependent variable: Productivity in the Czech privatized glass sector of domestic firms (in Th. CZK)

	Model 5	Model 6	Model 7	Model 8
	Coeff. (Standard errors)	Coeff. (Standard errors)	Coeff. (Standard errors)	Coeff. (Standard errors)
Geographical proximity and agglomeration of FDIs				
Distance in Km from the closest FDI	0.559 (0.369)	0.518 (0.369)	0.570 (0.374)	0.491 (0.373)
Logarithm of the number of employees of FDI in the region	-184.949** (91.934)	-192.867** (90.718)	-173.140** (91.461)	-174.138** (90.478)
Firms' characteristics				
Firm size: Logarithm of the number of employees	7.656 (20.015)	19.314 (26.552)	10.342 (19.909)	24.817 (26.480)
Age	23.763*** (8.632)	25.619*** (8.873)	24.150*** (8.565)	26.050*** (8.796)
Years from the privatization	-10.804 (9.301)	-13.343 (9.781)	-9.962 (9.237)	-13.109 (9.695)
Capital intensity	-13.207 (58.689)		26.977 (62.053)	
Machine-made production (percent)		1.791 (3.211)		2.544 (3.209)
Competition effect				
Market power (Lerner index)	-45.500 (48.348)	-60.235 (51.444)	-50.998 (48.190)	-65.615 (51.169)
Logarithm of the number of employees of domestic firms in the region	-58.111** (30.489)	-67.223** (32.052)	-49.645** (30.563)	-60.636** (31.944)
Constant	-2944.961** (1325.717)	-3534.515** (1396.105)	-3119.373** (1318.398)	-3463.806** (1387.208)
Time dummies	NO	NO	YES	YES
R-Square (within)	0.495	0.497	0.512	0.515
Sample size	135	135	135	136
F statistic	***	***	***	***

*Note***:** * significant at 10%; ** significant at 5%; *** significant at 1%
*Source***:** author's calculation based on companies annual reports

In Table 4 I have added a variable that indicates the density of domestic firms at the regional level. I have included this variable among the variables that indicate a competition effect. The literature has shown that the effect of proximity in industrial clusters can be both positive and negative. In some cases a concentration of firms in the same sector and area can bring to several positive externalities, as knowledge spillovers and reduction of fixed costs. However, product innovation can be limited,

because for creating new products new ideas and diverse firms are essentials (Callois 2008).

When I include the variable of density of domestic firms in the region, the coefficient of the variable that indicates the distance in kilometres from the closest FDI becomes not significant. The effect of domestic density in the region is stronger than the effect of the geographical distance from the closest FDI. A higher domestic density in the region has a negative effect on the productivity of domestic firms. This might mean that domestic firms in the glass sector do not help each other with exchange of knowledge spillovers, but that a congestion of firms in the same region reduces the profit and performance of the whole sector, stealing potential clients and market shares from each other.

The domestic density in the region and the distance in kilometres from the closest FDI both have a negative effect on domestic firm's productivity. These two variables are related because they are both a consequence of the privatization process and of the geographical choice of investment of FDIs. Therefore, I can use both as indicators of geographical spillovers, even if the density of domestic firms is also an indicator of competition between domestic companies and it is included therefore in this part of variables.

Then, I have run the same eight models presented in Tables 3 and 4 adding the variables that concern the border effect and using the random effect model. Since the aim of these models is only to check the significance of these variables, all the coefficients will not be presented here. The results of this analysis show that the variable that indicates the distance in km from the closest national border is significant with a positive sign in all models at least at a 10% significance level. The dummies for the closest neighbor country, added in each model separately, are not significant.

The significance of the distance in km from the closest national border indicates the existence of advantages for glassworks located along the national border and the existence of positive spillovers from the foreign country to these firms.

Finally, for a sensitivity analysis, I have run all the models taking into account the minimum distance from the FDI that belongs to the same subsector of the glasswork (hand-made or automatic). Since some firms have both hand-made and automatic production, I have separated these firms according to the majority of production. The results of this analysis, not shown here (but available on request), support the significance of geographical proximity at a 5% significance level, and the significance of the distance by FDIs in some models at a 10% significance level.

If I compare my results with the evidence in other transition countries, this study contrasts the results from Halpern and Muraközy (2007) which found a positive effect of distance from FDI on horizontal spillovers in Hungary. Being closer to a FDI located in the Czech Republic has a negative effect on the productivity of domestic firms. Only domestic firms that are near the national borders benefit from their geographical location and this could be explained by the presence of vertical spillovers (relationships with buyers and sellers). The results of this study depend on the chosen industrial sector and cannot be generalized to other sectors. However, these results align with the previous empirical evidence that has found negative horizontal spillovers in transition countries and supports the view that FDI do not always have the expected positive effects on domestic firms.

5. Conclusions

This paper analyzes the effects of geographical proximity and agglomeration of FDIs on domestic firms in the privatized glass sector in the Czech Republic.

I have investigated whether the geographical proximity to FDIs and the agglomeration of foreign investors have a positive effect on the productivity of domestic firms using a data set from 42 privatized firms in the glass sector. I have also analyzed if domestic firms benefit from being located close to the national borders and could receive spillovers from foreign firms. Even if these types of spillovers are not the aim of this paper that focuses on spillovers from FDI in the Czech Republic in the same sector, this secondary analysis suggests the existence of different types of geographic spillovers and a possible future research path with different data.

I have presented different regression models that show that the agglomeration of foreign investors has a significant but negative effect on the productivity of domestic firms, at a 5% significance level. The geographical proximity to FDIs has a negative and significant effect on the productivity of domestic firms at a 10% significance level when the density of domestic firms at the regional level is not taken into account (models 1-4). When the density of domestic firms at the regional level is included in the model (models 5-8), the geographical proximity to FDIs has a negative but not significant effect on the productivity of domestic firms.

The significance of the distance in km from the closest national border indicates the existence of advantages for glassworks located along the national border and the existence of positive spillovers from the foreign country to these firms at a 10% significance level.

The results of the econometrical analysis give strong evidence that in the glass sector the spatial distribution of domestic and foreign firms following the privatization has not been beneficial to domestic firms. The explanation may be that FDI have chosen the best firms, but can be due also to congestion effects of domestic firms in some regions. This study does not find the positive effects of agglomeration and geographical proximity to FDI in the Czech Republic as the knowledge spillovers that the literature suggests. Only the location of glassworks close to the national borders has a positive effect on the productivity of domestic firms at a 10% significance level. Foreign investors in the Czech Republic do not have positive spillovers on domestic firms but domestic firms receive positive effects from being located close to the national borders. This suggests that foreign investors in the Czech Republic in the glass sector could steal a market share from domestic firms, while foreign firms along the borders could transfer their knowledge to the Czech firms located close to them. The positive spillover effect could be due to vertical relationships (with customers and buyers) but cannot be analyzed in this study because of limitations in the data.

Following the above discussion and taking into account the results of models 1-8 for horizontal spillovers, the results partly support the hypothesis 1 and strongly support hypothesis 2.

The evidence of this paper aligns with the previous empirical studies about spillovers that have found mostly negative or insignificant horizontal spillovers. The results about border effects represent a possible future research path.

The choice of an industrial sector hinders the generalization of these results to other sectors. However, I believe that this study points out the relevance of the mechanism of spillovers and the need of further research about this topic in other industrial sectors in transition countries.

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