

Do Domestic Firms Benefit from Geographic Proximity with Foreign Investors? Evidence from the Privatization of the Czech Glass Industry

Elisa Galeotti*

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Abstract This paper analyzes the effects of geographical proximity and agglomeration of foreign direct investors 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 foreign direct investors to domestic firms in an industrial sector. The econometrical analysis, using original panel data from 1990 to 2006, provides evidence that the geographical proximity to foreign direct investors has a negative and significant effect on the productivity of domestic firms in the glass sector. The effect of agglomeration of foreign direct investors is significant, too. The results support the importance of geographic proximity and the agglomeration of foreign direct investors as a channel of spillovers and it conforms with the evidence that shows that foreign direct investors have produced negative spillovers on domestic firms in transition countries. The analysis shows, however, that spillovers do not play a dominant role for the performance of privatized domestic firms in the glass sector and the importance of taking into account the industrial sector in the study of spillovers.

Keywords FDI, agglomeration economies, panel data, regional location, glass industry

JEL classification C23, F21, F23, L61, O18, R12

1. Introduction

Extensive evidence about spillovers in transition countries shows insignificant or negative generalized spillovers from foreign direct investors. Foreign direct investors 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 foreign investors has affected the productivity of domestic firms, creating negative spillovers to privatized firms.

This paper examines the effects of geographical proximity and agglomeration of foreign direct investors on domestic firms using a population of privatized firms in the glass sector in the Czech Republic. The main contribution of this paper is to analyze

* Ph.D. Candidate, Charles University, Institute of Economic Studies, Opletalova 26, 110 00 Prague 1, Czech Republic. Phone: +420 222 112 328, E-mail: elisagaleotti@seznam.cz.

one channel of spillovers, i.e. the geographical proximity and agglomeration of foreign investors and to provide an explanation for the lack of positive spillovers from foreign investors.

The paper is organized as follows. Section 2 describes the privatization process in the glass sector in the Czech Republic and the reasons behind the choice of this industrial sector. Section 3 summarizes the related theoretical and empirical literature and describes its various contributions and shortcomings. Section 4 describes the data, the methodology and discusses the variables used in the empirical analysis. Section 5 presents the empirical results and compares the findings of this work with those of related studies. Section 6 provides concluding remarks.

2. Foreign investors and privatized glassworks 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.¹ 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.).²

The literature about the privatization and the effects of acquisitions from foreign investors in the Czech Republic is extensive. However, there are no specific studies, according to my research, about the spillover effects of foreign investors on the domestic firms that focus on privatized firms in an industrial sector.

The decision to focus on firms existing in the central planning is done in order to analyze the effects of foreign investors on privatized firms. Moreover, since these firms were connected during central planning, it is plausible that the spillover effects of foreign investors 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 did not go through 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 foreign investors entered during the privatization process and did not enter with greenfield investments as in other industrial sectors.

¹ This information was confirmed from personal interviews with Mr. Vlastimil Beránek, owner of the glasswork Beránek, spol. s.r.o. (on 3rd September 2004), and Mr. Jiří Rückl, owner of the glasswork Rückl Crystal a.s. (on 10th September 2004).

² For an extensive analysis of the AGC Flat Glass Czech case, see Galeotti and Nollen (2008).

Czech glassworks are famous for their products and their long tradition suggests that these companies possessed strong technology in glass manufacturing already during central planning, as shown by the history of Czech glass and by the participation of Czechoslovak glassworks in international exhibitions. For example, Moser won the gold medal at the International Exhibition of Decorative Arts in 1925 in Paris and participated to several international exhibitions before 1989. Glavunion (now called AGC Flat Glass Czech) was among the most productive enterprises in Czech industry during central planning. However, even the most advanced enterprises had to face the transition to a market economy and had to learn how to operate in a new economic system. The case study of the ACG Flat Glass (Galeotti and Nollen 2008) shows that even the most technologically advanced enterprises have benefited from the collaboration with a foreign investor, especially concerning the possibility of accessing to new geographic markets, learning how to manage successfully a company in an international environment and to restructure human capital, as well as in improving sales and marketing policies.

The choice of the glass sector in the Czech Republic allows for study a type of spillover that is harder to measure but very important. Instead of focusing on technology spillovers, even if foreign investors might bring an improvement in the technology as well, I focus mainly on knowledge or informational spillovers.

3. Theoretical and empirical background

3.1 Evidence about horizontal spillovers in the transition countries

The existence of spillovers from foreign investors 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 foreign investors 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 foreign investors (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.³ Second, the negative demand effect from foreign investors 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.

3.2 The importance of geographic proximity and agglomeration on spillovers

According to Marshall (1920) three sources of agglomeration 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 Hippel 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 foreign investors. 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.

³ This criticism applies to older cross-sectional or industry-level studies. More recent firm panel studies usually control for industry fixed effect while using firm fixed effect estimators.

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 foreign investors in the same sector and region. Siöholm (1999), using detailed micro-data from the Indonesian manufacturing sector, examines the effect on productivity from foreign investors. He shows that domestic firms benefit from foreign investors, but the effect differs between groups of industries and spillovers from foreign investors 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 foreign investors (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 foreign investors 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 foreign investors 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. Cieřlik (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. The analysis of the effect of distance from the national border and the closest country on the productivity of domestic firms are not shown in this paper since they probably refer to vertical spillovers (relationship with customers and suppliers) and a deep analysis would require more data that are not available. This paper focuses on horizontal spillovers and on the role of foreign investors in the Czech Republic.

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

Hypothesis 1: The distance from foreign investors is positively associated with domestic firm's performance.

Hypothesis 2: The density of foreign investors in the region is negatively associated with domestic firm's performance.

4. Data and methodology

The choice of the population of privatized firms in one industrial sector allows for control of some relevant differences between privatized and new firms and reduces the 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 population of the privatized glass firms is small compared to large databases that are used in much empirical research about spillovers in transition countries. However, the population is narrow because of the nature of the object of the research (privatized firms in the glass sector) and the availability of financial data. Therefore, the small number of firms fully represents the population of privatized glassworks but cannot be considered representative for the whole glass industry.

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.

The analysis focuses on domestic firms. When a domestic firm is acquired from a foreign investor, e.g. in the case of Glavunion a.s. — today AGC Flat Glass Czech a.s. (Galeotti and Nollen, 2008), this company is designated as foreign and is excluded from the panel data used for the statistical analysis. A company is considered “foreign” if more than 50% of the ownership belongs to foreign investors: I have chosen this percentage as threshold to distinguish foreign from domestic firms because with a lower percentage foreign investors might have a fairly limited effect on the management of the company.

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 literature on foreign investors studies the impact of multinationals on the productivity of domestic firms within regions of a country by using discrete measures of foreign investors (for example dichotomizing the total amount of foreign investments 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 foreign investor and the density of foreign investors 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.

In this paper, I use a panel data analysis. Panel data are a very useful instrument because of their double dimension (that is, firms, industries or countries and time dimension). Panel data allow to taking into account firm’s heterogeneity and, at the same time, the time dimension. Moreover, the introduction of specific effect enables to take into consideration the influence of unobservable characteristics on the dependent variable. The population of the privatized firms in the glass sector in the Czech Republic is particularly suitable for panel data analysis because the population of firms is small but data are available for a long number of years.

4.1 The dependent variable

Performance I use the level of total factor productivity in model 1 and 2, measured as

$$TFP_{it} = \frac{Value\ Added_{it}}{Capital_{it}^{\alpha} Labour_{it}^{1-\alpha}},$$

where α denotes capital’s share of the value added. It is often assumed that a reasonable estimate for α is between 0.25 (Prescott 1998) and 0.35 (Collins, Bosworth and Rodrik 1996). In our analyses α is set to 0.3 (Caselli 2005).

As an alternative measure of performance, I use the level of labour productivity (measured as total sales per employee) of domestic firms in model 3 and 4.

4.2 Explanatory variables

I use the distance in kilometers from the closest foreign investor to measure the geographical proximity to foreign direct investors while I use the number of employees in foreign firms in the region to measure the agglomeration of foreign investors. As control variables, I include the firm's characteristics such as firm size, firm's age, a variable which indicates if the company was privatized or if it still state-owned, the percentage of machine-made production and the capital-labour ratio. Moreover, I include variables that measure the competition effect, as the Lerner index and the density of domestic firms at regional level, the latter measured by the number of employees of domestic firms in the region.

Geographical proximity, agglomeration of foreign investors and competition

Distance from foreign investors I measure the distance in kilometers from the closest foreign investor in the glass sector. The distance is measured using road-distance data.⁴ No distinction is made for this variable between firms that produce hand-made or automatic glass, since spillovers from foreign investors to domestic firms are expected mainly to happen in the management of the company and in other economical aspects that affect the firms' productivity, and not in the technological process of glass production, as explained previously.

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

Density of foreign firms in the region I measure the agglomeration of foreign investments in a region with the number of employees working in foreign firms in the glass sector in a region. An alternative measure for agglomeration effects is "the number of foreign firms in the region." However, this alternative measure does not take into account the weight of the foreign firm: a small foreign firm has probably a smaller impact than a larger foreign firm in the geographic area. A measure of agglomeration that uses "the number of employees in the region" captures also a *crowding-out* effect on the regional labor market, since the competition of foreign firms might discourage domestic firms and send them out from the market. When domestic firms exit the market, the laid-off employees might start working for a foreign firm. But the opposite could happen. Domestic workers could work for some time for a foreign firm and later leave the foreign firm and start working for a domestic firm: this choice could positively affect the productivity of domestic firm in a long period. Since this *crowding-out* effect on the regional labor market can be considered a negative spillover of foreign firms, I believe that the number of employees working in foreign firms in the glass sector in a region is an appropriate measure of agglomeration of foreign investments in the region.

⁴Data obtained from the web-site www.mapy.cz.

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

Competition This variable captures differences in the market-power between firms in different subsectors and in the competition in the glass sector.

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). The Lerner index is an inverse measure of competition, a greater index means lower competition, and it is defined as:

$$CPM_{it} = \frac{Sales_{it} + \Delta Inventories_{it} - Payroll_{it} - Material Cost_{it}}{Sales_{it} + \Delta Inventories_{it}}$$

As an alternative specification of competition, I use a variable that indicates the density of domestic firms in the region, measured with 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 also derives from the agglomeration in an industrial sector at the regional level. In order to separate the effects of the competition of foreign investors from the competition of domestic firms, I measure the competition from local firms with the density of domestic firms in the region.

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 the knowledge effect might prevail. In these cases this variable will have a positive sign. However, an excess of domestic density or congestion in the region, might create a stealing effect and therefore a negative effect on productivity will be expected.

Firm's characteristics

Firm size I use 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 (Sleuwaegen and Goedhuys 2002; 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 in the Czech Republic, which has been historically prominent in the glass manufacturing, so that is likely to be connected with some relevant characteristics of the glasswork such as the prestige of the brand and the long tradition. Older glassworks have a long tradition in the manufacturing sector and have famous brands (like Moser, Crystalex, Sklo Bohemia). However, I have not found an appropriate measure that allows to order or to distinguish the glassworks according to the prestige deriving from the brand/mark and tradition. I have found the following rankings "Czech Sector Award" and "ČEKIA-CRA Ranking" provided from Česká kapitálová informační agentura, a.s. and CRA Rating Agency a.s.⁵ The first ranking is available only from 1993 to 1998, while the latter one is available from 1993 to 2003. I have added this index in some regressions, even if the sample is reduced – because of the lack of this index from 2004. But even if the rank would be available for 2004-2006, it would not be an appropriate indicator for prestige from the brand/mark and tradition. The reason is that these rankings rank firms

⁵<http://www.ckia.cz/?idf=csa-ranking>

according to financial criteria and therefore these ranks are likely to be the consequence of better economic performance (the dependent variable in my regressions) rather than a cause. These indexes therefore do not explain the advantages of some Czech firms compared to others. However, I have included a dummy variable for a higher ranking from the above indexes in some regressions. The result is, as expected, that this variable is significant (firms that received a high ranking had a higher firm's performance) but the variable "age" does not lose significance. For the above reasons, I have not included the variable for "financial ranking" and I have kept the variable "age" in the regressions.

Since age is taken as an indicator for prestige from the brand and from the long tradition of the glasswork, a positive sign from the coefficient of this variable is expected.

Privatization I measure the impact of privatization with a binary variable that indicates if the glasswork was privatized or if it is still state-owned (the dummy has value 1 if the glasswork was privatized, 0 if it is still state-owned).

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 endogeneity 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 that privatized firms perform better than state-owned 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 order to control for capital deepening, I have introduced a variable that indicates the capital intensity of the firm (capital *per* worker), measured as the ratio of total assets to the number of employees. 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.

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

Table 1 shows the descriptive statistics for the sample used in the regressions. There is high variability among the total factor productivity and labour 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 37% and the variability in the percentage of automatic production and in the capital-labour ratio 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.

Table 1. Descriptive statistics

	Mean	Std. Dev.	Min	Max	Within variation
Total factor productivity	50.28	12.90	12.39	90.48	10.04
Labour productivity	428.72	145.15	28.65	857.40	73.39
Distance in km from the closest foreign investor	95.47	33.81	0	176.00	15.06
Number of employees of foreign investor in the region	29.63	119.58	0	584.00	23.14
Firm size: number of employees	911.02	1032.69	57.00	4971	305.86
Age	161.90	127.48	38.00	562.00	3.12
Dummy for the privatization	0.962	0.191	0	1.00	0.173
Capital labour ratio	678.01	275.61	109.95	1440.87	139.46
Machine-made production (%)	37.12	35.81	0	100.00	2.39
Market power (Lerner index)	0.025	0.19	-0.78	0.84	0.12
Number of employees of domestic firms in the region	4567.28	3136.30	80.00	9551.00	1442.85

Source: Author's calculation based on companies annual reports.

Note: $N = 138$. Labour productivity given in thousands of Czech koruna.

4.3 The estimation model

The basic estimated equations are the following:

$$TFP_{it} = \alpha + \beta_1 Distance_{it} + \beta_2 DensityFDI_{it} + \beta_3 Size_{it} + \beta_4 Age_{it} + \beta_5 DumPriv_{it} + \beta_6 CapLabRatio_{it} + \beta_7 MachineProd_{it} + \beta_8 MarketPower_{it} + \beta_9 DensityDOM_{it} + Dum_t + f_i + \varepsilon_{it},$$

$$LabourProductivity_{it} = \alpha + \beta_1 Distance_{it} + \beta_2 DensityFDI_{it} + \beta_3 Size_{it} + \beta_4 Age_{it} + \beta_5 DumPriv_{it} + \beta_6 CaplabRatio_{it} + \beta_7 MachineProd_{it} + \beta_8 MarketPower_{it} + \beta_9 DensityDom_{it} + Dum_t + f_i + \varepsilon_{it},$$

where f_i represents an individual effect, Dum_t year dummies, and ε_{it} is an error term. Time dummies are included in the equations because they help control for aggregate macroeconomic shocks, e.g. business cycles, political reforms, international crises.

The Hausman test suggests that the fixed effect model is the more appropriate for the theoretical model and the panel data, and the results of the specification tests support the fixed effect model in all models. 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 foreign investors on each domestic firm over time.

In order to choose between the pooled OLS model and the fixed effect model, Baltagi (2005, p. 13) advises 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 and the correlation table is available in the Appendix.

5. Empirical results

I explore the impact of geographical proximity and agglomeration of foreign investors on the productivity of domestic firms in the privatized glass sector in the Czech Republic. I have estimated four different models of fixed effect regressions using two different dependent variables: two models with total factor productivity (models 1 and 2), and two models with labour productivity (models 3 and 4). Since the agglomeration of domestic firms and the agglomeration of foreign firms might be related, I have made two models where only the agglomeration of foreign firms is included (models 1 and 3), and two models where the agglomeration of domestic and foreign firms are both included (models 2 and 4).

The results presented in Table 2 show that geographic proximity and agglomeration of foreign investors have a significant effect on the total factor productivity and on the labour productivity of privatized domestic firms in the glass sector. Domestic firms that are close to foreign investors have a lower total factor productivity and labour 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 foreign investor, significant at 5% level. Increasing distance from foreign investors by 1 km would increase the total factor productivity of an average domestic firm by 13.5%, taking into account the effect of the density of domestic firms as well (model 2). Increasing distance from foreign investors by 1 km would increase the labour productivity of an average domestic firm by 86.9% (model 4). The stronger effect of distance from foreign investors on labour productivity is consistent with the hypothesis that foreign investors in the neighbourhood have a stealing effect; foreign investors might attract the best and most productive workers, which would decrease

the labour productivity of domestic firms, or might steal a part of the market share of domestic firms.

Table 2. Results of fixed effect regressions

	Total factor productivity		Labour productivity	
	Model 1	Model 2	Model 3	Model 4
<i>Geographical proximity and agglomeration of foreign investors</i>				
Distance in km from the closest foreign investor	0.137** (0.064)	0.135** (0.063)	0.852** (0.385)	0.869** (0.383)
Number of employees of foreign investor in the region	-0.057* (0.031)	-0.061* (0.031)	-0.405* (0.219)	-0.405* (0.216)
<i>Competition effect</i>				
Market power (Lerner index)	20.94*** (7.095)	22.65*** (7.086)	-8.076 (52.19)	-8.994 (51.64)
Number of employees of domestic firms in the region		-0.013* (0.001)		-0.011** (0.005)
<i>Firms characteristics</i>				
Firm size: number of employees	0.006* (0.003)	0.008** (0.004)	0.044* (0.025)	0.062** (0.026)
Age	2.890*** (0.485)	2.554** (0.516)	16.84*** (3.231)	15.12*** (3.522)
Privatized company	-1.693 (5.624)	0.108 (5.657)	-50.73 (37.77)	-31.85 (38.63)
Capital labour ratio	0.006 (0.009)	0.008 (0.009)	0.141** (0.067)	0.127* (0.067)
Machine-made production (%)	-0.051 (0.353)	-0.216 (0.361)	-3.101 (2.308)	-3.673 (2.308)
Constant	-431.0*** (75.98)	-370.9*** (82.43)	-2366*** (511.2)	-2039*** (567.7)
R ² (within)	0.514	0.529	0.534	0.569
N	138	138	135	135
F statistic	***	***	***	***

Source: Author's calculation based on companies annual reports.

Note: Time dummies are included in all models. Standard errors in parentheses. *, **, *** denote significance at 10%, 5%, 1% level, respectively.

The number of employees in foreign firms has a significant negative effect at 10% level on the total factor productivity and labour productivity of domestic firms in the region. The effect of the density of foreign investors in the region is also stronger on labour productivity than on total factor productivity. The signs of these two variables are coherent with the existence of negative horizontal spillovers from foreign investors 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 foreign investors.

Looking at firms' characteristics that could affect firm's performance, the firm's age has a significant positive effect at 1% significance level. 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. The significance of age of the company is probably connected with the fact that older glassworks have a higher mark-up achieved thanks to using a traditional brand. However, a more appropriate variable for measuring the prestige deriving from using a traditional brand was not found. The age of the company has a positive effect on the total factor productivity and on the labour productivity. The effect of age is stronger on labour productivity than on total factor productivity.

Firm size, expressed by the number of employees, is significant at 10% level in all models: larger domestic firms have a higher total factor productivity and a higher labour productivity than smaller firms.

The role of capital-labour ratio is interesting. This variable has significant positive effect at 10% level on the firm's labour productivity, but it does not affect the total factor productivity. Glassworks with a higher capital-labour ratio have higher sales *per* employee. The capital-labour ratio, however, does not affect significantly the total factor productivity.

The percentage of machine-made production does not have a significant effect on the productivity of Czech glassworks. The 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).

The Lerner index has a positive effect on total factor productivity at the 1% level but it is not significant on labour productivity. This suggests that the firm's market power does not affect significantly the labour productivity, as the quality of the labour force can do, or the amount of capital used in the manufacturing of glass. On the other hand, the firm's market power, which is an indication of inverse competition, strongly affects the total factor productivity.

In models 2 and 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 the 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 variables that indicate the geographical proximity and agglomeration of foreign investors do not lose significance. The effect of domestic density in the region is significant at 5% on the labour productivity and at 10% on the total factor productivity. 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 poten-

tial clients and market shares from each other. The difference in the significance level of this variable on the total factor productivity and labour productivity might be explained by the fact that domestic firms steal the best or more productive workers from other firms in the region.

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 foreign investors on horizontal spillovers in Hungary. Being closer to a foreign investor located in the Czech Republic has a negative effect on the productivity of privatized domestic firms. However, the role of spillovers from foreign investors seems to be less important than the role of firm's characteristics, such as firm's age, connected with the prestige of the brand and of the glasswork, firm size and firm's market power for total factor productivity.

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 foreign investors do not always have the expected positive effects on domestic firms.

6. Conclusions

This paper analyzes the effects of geographical proximity and agglomeration of foreign investors on domestic firms in the privatized glass sector in the Czech Republic. This paper focuses on horizontal spillovers and on the role of foreign investors in the Czech Republic.

I have investigated whether the geographical proximity to foreign investors 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 presented different regression models that show that the geographical proximity to foreign investors has a negative and significant effect on the productivity of domestic firms at a 5% significance level and that the agglomeration of foreign investors has a significant but negative effect on the productivity of domestic firms at a 10% significance level. The density of domestic firms at the regional level has a negative and significant effect at 5% level on the labour productivity of domestic firms and at 10% level on the total factor productivity.

The results of the econometrical analysis give 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 foreign investors have chosen the best firms, as shown by Galeotti and Ryšavá (2008), and can be due also to congestion effects of domestic firms in some regions. The economic crisis that the glass sector experienced after 2001 in the Czech Republic is another reason. It would be interesting to analyze the effect of geographic proximity with foreign investors in the 1990s and after to check if the effect of foreign investors in the beginning of the transition is different than in a later period. However, the split of the population in two samples would create problems of robustness to the statistical results, therefore this

procedure is not feasible with this data.

This study does not find the positive effects of agglomeration and geographical proximity to foreign investors in the Czech Republic as the knowledge spillovers that the literature suggests. Foreign investors in the Czech Republic do not have positive spillovers on domestic firms in the same industrial sector. However, the role of spillovers from foreign investors in the glass sector seems to be less important than the role of firm's characteristics, such as the firm's age, which indicates the prestige of the brand and of the glasswork, firm size and firm's market power.

Following the above discussion and taking into account the results of models 1–4 for horizontal spillovers, the results support the Hypothesis 1 and 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 mechanisms of spillovers and the need of further research about this topic in other industrial sectors in transition countries.

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Appendix

Table A1. Correlation matrix for variables used in the analysis (N=135)

Variables	1	2	3	4	5	6	7	8	9	10	11
1 Total factor productivity	1.000										
2 Labour productivity	0.570	1.000									
3 Distance in km from the closest foreign investor	0.078	0.112	1.000								
4 Number of employees of foreign investor in the region	-0.047	-0.044	-0.301	1.000							
5 Number of firms employees	-0.073	0.228	0.022	-0.170	1.000						
6 Privatized company (dummy)	0.167	0.082	-0.031	0.049	-0.461	1.000					
7 Age	0.044	-0.002	-0.097	0.068	0.683	-0.335	1.000				
8 Capital labour ratio	0.352	0.787	0.082	-0.169	0.186	0.156	0.097	1.000			
9 Machine-made production (%)	-0.009	0.136	-0.124	0.023	0.118	-0.088	-0.028	-0.005	1.000		
10 Market power (Lerner index)	0.181	0.158	0.093	-0.031	0.322	-0.187	0.117	0.062	-0.244	1.000	
11 Number of employees of domestic firms in the region	-0.207	-0.305	0.152	-0.347	0.286	-0.217	0.166	-0.344	0.320	0.009	1.000

Source: Author's calculation based on companies' annual reports.