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in Transition Countries
Empirical Evidence from Panel Data***



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The aim of this annual workshop is to offer a forum for young researchers from the field of International Economics to present and to discuss their current topics of research with other experts. The workshop also provides the opportunity to gain an overview of recent developments, problems and methodological approaches in this field.

Detailed information on past workshops and the planning for the 2005 workshop are available at <http://www.vwl.wiso.uni-goettingen.de/workshop>. Do not hesitate to contact Dr. Carsten Eckel, *CeGE* (carsten.eckel@wiwi.uni-goettingen.de) for further questions.

Foreign Direct Investment, Technology Transfer and Productivity Growth in Transition Countries Empirical Evidence from Panel Data¹

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Abstract

Many governments offer significant inducements to attract inward investment, motivated by the expectation of spillover benefits. Foreign direct investment (FDI) is generally perceived as the best channel for technology transfer, not only across national boundaries but also between firms – in particular, between foreign and domestic companies. This paper tests this hypothesis for five transition countries in Eastern Europe using panel data on more than 8000 plants in the Czech Republic, Poland, Hungary, Romania and Bulgaria. In a log-linear model, the Cobb-Douglas production function is estimated to examine the productivity effect of: (a) foreign ownership in firms, and (b) foreign presence in industries and regions. In the first case, regression coefficients indicate a positive correlation between foreign equity participation and plant productivity. In the second case, the impact of foreign investment on productivity of domestically owned firms turns out to be either negative or insignificant. Thus, the study corroborates the hypothesis that technology is transferred internationally through multinational companies, but provides no evidence of diffusion of technology from foreign to domestic firms.

Keywords: foreign direct investment, transition, productivity, technology spillovers

JEL-Classification: F15, F21, F23, P31, P52

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Introduction

After a period of highly critical, almost hostile, stance towards multinational companies, governments' attitude towards foreign direct investment (FDI) changed radically in early 1990s. Last decade witnessed massive liberalisation of FDI regimes, especially in developing countries. In 2002, out of 248 regulatory changes in 70 countries, 236 facilitated foreign direct investments (UNCTAD, 2003). Many governments offer today various inducements to attract multinational companies (MNCs). From the beginning of 1990s, transition countries, which are in focus of this paper, intensified the competition for foreign direct investments. Gradually all Central and Eastern European governments introduced a wide range of privileges aimed to solicit foreign investments, such as tax and tariffs holidays, labour cost and infrastructure subsidies, exemptions from import duties, etc.

In contrast to earlier stance which was dominated mostly by anti-globalisation activist emphasising negative aspects of globalisation, current discussion on FDI is mainly characterised by expected positive economic effects from direct investments of multinational companies. Especially in connection with chronic capital shortage in developing countries, FDI provide for this indispensable engine of economic growth. However, the most striking feature which distinguishes direct investments through multinational companies from other forms of international capital flows – portfolio investment and foreign aid – is the long-lasting interest of investing company in its subsidiaries abroad. This long-term interest provides not only for pure capital transfer but also for the transfer of product and process technology, know-how and marketing and managerial skills. By definition, multinational companies posses these skills which enable them to compete successfully with domestic firms, that have better knowledge of national market, have established supplier and customer networks, are informed about business practises and informal institutions. If we add to this the fact that the bulk of all innovations today are made in MNCs, it is easy to see how important they are for the international technology transfer. International organisations point to FDI as the best channel for technology transfer, not only across national boundaries but also between firms (UNCTAD, 2003). Namely, as foreign companies enter new markets they disturb the existent market equilibrium, triggering a range of reactions of domestic firms. Additional competition pushes for efficiency improvements, which become necessary if a firm is to keep its market shares. On the other side, domestic firms can learn from foreign companies about new products, process technology and marketing and organisational skills, as well as about foreign

markets. If they succeed to become partners of foreign companies – as the suppliers or distributors – domestic firms may benefit from larger economies of scale, reliable payments and often direct support from foreign partners in upgrading their capital stock and technological level. If such technology transfer really takes place in practice, the improvements in performance of domestic firms will then reflect in their higher productivity.

This paper converts this expectation into a question. Using a methodological approach already taken in the literature I explore empirically the impact of foreign direct investments on productivity of domestic firms in the Czech Republic, Poland, Hungary, Romania and Bulgaria. Using a large firm level panel I address two key questions in the present paper: (1) whether foreign equity participation is positively correlated with plant productivity? (2) whether foreign ownership in an industry affects the productivity of domestic firms – i.e. whether there are positive spillovers to domestic enterprises.

In contrast to many other empirical studies on productivity spillovers in transition countries, a negative or insignificant “net productivity” effect from foreign ownership on domestically owned firms is found here. Introduction of regional presence of foreign firms as a measure of positive spillovers accruing from learning, show some evidence of positive spillovers, but overall impact on performance of domestic firms remains negative.

Technology transfer, productivity spillovers and competition

Although concerned with explaining foreign-owned production from very different points of view, the existing literature on multinational companies and foreign direct investment agree upon the fact that companies involved in foreign investments abroad have some “monopolistic” advantages. There are as many kinds of such advantages as there are functions in making and selling a product. The firm’s advantage can be that it can acquire factors of production at a lower cost than other firms; or it may have knowledge or control of a more efficient production function; or the firm may have better distribution facilities or a differentiated product (Hymer, 1960). Besides location and internalisation related benefits, possession of ownership advantages, which largely take form of intangible productive assets such as technological know-how, marketing and managerial skills, export contacts, coordinated suppliers and customers networks and reputation, is condition sine qua non for a firm to be engaged in value-adding activities abroad (Dunning, 1988). Given that national

firms have advantage of better information about their country – its economy, its language, its law, and its politics – and considering the possibility of existence of barriers to international operations arising from discrimination by government³, consumers⁴, and by suppliers, the possession of those firm-specific assets enables multinational companies to compete successfully with domestic firms.

Transaction-cost approach holds a good deal of power in explaining why dispersed plants should fall under common ownership and control rather than simply trade with each other on the open market. The monopolistic advantages are subject to a daunting list of infirmities for being detached and transferred by sale or lease (Caves, 1996). *Inter alia*, the intangible assets are difficult to codify, information asymmetries and market imperfections make technology transfer within firms more efficient than through arms-length contracts. Given this, MNCs can be seen as supplements for markets for technology. Together with the fact that parent companies are interested in economic exploitation of their monopolistic advantages abroad, this implies that foreign subsidiaries abroad have a privileged access to technologies⁵. Since the assets are almost always gained through experience and, at least to some degree are public goods, they cannot be easily licensed to host country firms⁶, but they can be transferred at little extra costs to subsidiaries who locate in host countries. The access to the superior knowledge reflects in better performance of firms with foreign equity participation. This so-called **“own-plant”** or **direct effect** raises automatically the productivity level in FDI receiving country .

In addition to this direct transfer of technology to plants receiving foreign capital, many authors suggest something like a “contagion” effect outgoing from foreign subsidiaries (Findlay, 1978). Although the intangible firm-specific assets may not be licensed, domestic industry might benefit from the presence of foreign firms. In existing literature it belongs almost to stylised facts that there are positive externalities accruing from foreign direct investment and presence of multinational companies (Aitken and Harrison, 1999; Teece,

³Discrimination by government is rather unlikely today. Given the massive inducements aimed to attract foreign direct investments, we can say that multinational companies enjoy very preferable conditions nowadays, even relative to domestic firms.

⁴ The newest example of discrimination of foreign products and foreign companies can be observed in Arab world, where in the face of overall resentment against USA, consumers boycotted US products.

⁵ The term technology means here actually the proprietary assets in all its facets, from product to process technology, trade marks, contacts and networks, marketing and managerial skills, etc.

⁶ This depends also on competition structures on target market and level of development of domestic firms among which multinational firms can pick out eventual partners. Given relative low productivity and technology level in developing countries, foreign subsidiaries are the most probable form of servicing these markets.

1977). Since technology is public good to some extent, host economies can benefit from foreign investment,⁷ even if the MNCs decide to carry out their foreign operations in wholly-owned affiliates. These benefits take form of various types of externalities and are often referred to as **productivity spillovers** (Blomström et al., 2000).

Productivity spillovers

Generally speaking, productivity spillovers are said to take place when the entry or presence of foreign affiliates lead to productivity or efficiency benefits in the host country's local firms, and the MNCs are not able to internalise the full value of these benefits (Blomström et al., 2000). We can think about several possible channels of productivity spillovers or, in other words, of how positive externalities from FDI occur. The most simplest example might be the case where a domestic firm improve its productivity by **imitating** some technology used by foreign affiliates operating in the local market. Getting in touch with new products and process technologies, local firms can learn about them and try to copy them. Also, as experienced workers leave the foreign firms, the accumulated **human capital** becomes available to domestic firms.

Especially high potential for productivity spillovers have positive externalities accruing from direct business linkages between foreign and domestic firms. While in the case of imitation or labour turnover foreign companies as owners of the technology have an incentive to prevent leakage of knowledge and to protect its "monopolistic" advantages over their local competitors, in the case of **backward and forward linkages**, foreign partners often have interest in increasing the productivity of its local suppliers and/or distributors, to provide for high-quality intermediaries or for adequate distribution of products. In these cases they support directly their local partners helping them to set up or upgrade its production facilities, train employees and help in management and organisation. Moreover, foreign firms would increase demand for local inputs and in this way provide for better economies of scale of domestic firms.

With more or less potency, all of these externalities should raise the productivity of domestic companies.

⁷ Other, foremost employment and capital inflows benefits are crucial for a comprehensive assessment of the

Competition

There is still no consensus in the literature on the question if competition pressure arising from entrance of foreign firms should be classified as positive or negative impact on the productivity of other and foremost domestic firms in FDI target market. Blomström et al. (2000) emphasise efficiency improvements in local firms as a positive externality from additional competition, since it “*forces local firms to introduce new technology and work harder*”. Using detailed data on Indonesian establishments the same author finds some empirical evidence for this hypothesis, showing that productivity spillovers were restricted to non-exporting Indonesian firms, in contrast to export-oriented firms, which already faced competitive pressure from the world market (Blomström and Sjöholm, 1998).

However, most of the empirical studies based on firm-level panel data fail to find positive correlation between the productivity of domestic firms and the extent of foreign presence in their sector and/or region.⁸ Aitken and Harrison (1999) find an overall negative impact from foreign presence in sector and productivity of domestically owned firms in the same sector. They explain this by the fact that the net productivity effect from FDI is dominated by the negative **market stealing effect** accruing from intensified competition after the entrance of foreign firms. Fixed costs and shrinking market shares result automatically in lower productivity of domestic firms, which are unable to make up otherwise for this productivity loss.

Hence, while on the one hand the foreign presence in an economy may stir some learning process and produce positive externalities for local firms, it results at the same time, especially in developing countries where the gap in productivity between foreign and domestic firms is high, in a negative **demand effect**, which pushes the productivity of local firms automatically downwards. These two offsetting effects were formally modelled by Aitken and Harrison (1994) and are depicted in Figure 1. Positive spillovers cause the domestic plant’s average costs curve to fall from AC_0 to AC_1 . However, the additional competition and shrinking market share forces the domestic plant to reduce output and move upwards its new AC_1 curve.

impact of FDI on receiving economies, but this paper does not touch on this.

⁸ See e.g. Haddad & Harrison (1993) on Morocco, Aitken & Harrison (1999) on Venezuela, Djankov & Hoekman (2000) on the Czech Republic.

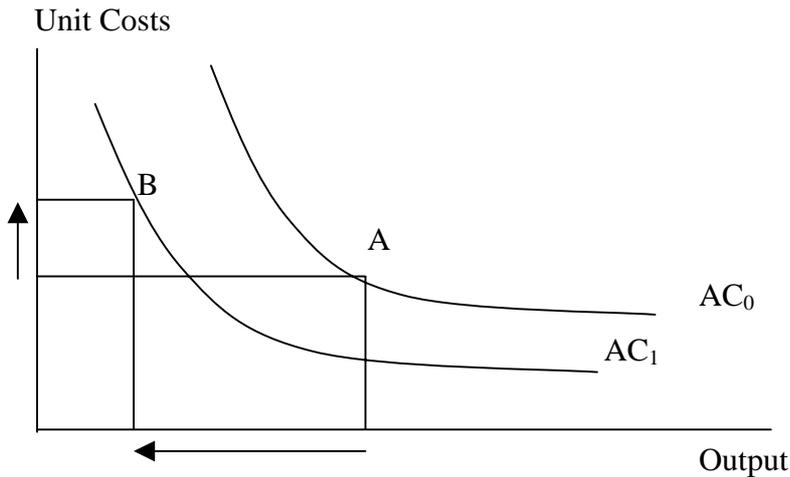


Figure 1. Output response of domestic firms to foreign entrants

Empirical evidence

Since seminal works on foreign direct investment and horizontal productivity spillovers, i.e. spillovers from foreign presence in the same industry, done by Caves (1974) on Australian and by Globerman (1979) on Canadian manufacturing sector, similar studies have been made for many developed and developing countries.⁹ Since most of the studies base on more or less the same methodological framework set up by Caves (1974), the differences in outcomes are much dependent on the data used in the analysis, especially on the data aggregation level.

In this sense most of industry level studies find a positive correlation between foreign presence and sectoral productivity.¹⁰ These studies have two main drawbacks. First, it is difficult to establish the direction of causality. It is possible that this positive association is caused by the fact that multinationals tend to locate in high productivity industries rather than by genuine productivity spillovers (Smarzynska, 2003). Second, already mentioned negative demand effect from FDI may force less productive domestic firms to exit the market while the high productive multinationals increase their market shares, which finally raise the average productivity in the industry.

Indeed, most analyses based on firm-level panel data fail to find evidence on positive correlation between foreign presence and productivity of local firms. This is especially the case for developing countries, as studies by Haddad and Harrison (1993) on Morocco and

⁹ For a survey of the literature see Görg and Strobl (2001)

¹⁰ Beside already mentioned studies by Caves (1974) and Globerman (1979) see also Blomström and Persson (1983), Blomström and Wolf (1994).

Aitken and Harrison (1999) on Venezuela clearly show. The picture seems to be more optimistic in the case of developed countries.¹¹

Studies on productivity spillovers from foreign direct investments in transition countries appeared on FDI research agenda in the last several years. Except for a few industry level studies which find a positive correlation between foreign presence and industry average productivity,¹² the most firm-level data analyses show either negative or statistically insignificant net effect from foreign presence on the productivity of domestic firms in the same sector.¹³ Recent studies by Smarzynska (2003) and Schoors and van der Tol (2002) analyse explicitly the relationship between productivity spillovers and vertical linkages in transition countries. The empirical results show that there are positive spillovers from linkages between foreign and local firms and that they are economically more important than sectoral i.e. horizontal effects. Such results do not comply with findings of a qualitative study on productivity spillovers in Hungary (Günther, 2004). The author found a very limited scope for both horizontal and vertical technology spillovers. Possible explanations the author sees in the substantial gap in technology levels between foreign and local firms and poor capital investments in domestically owned firms.

Foreign direct investment in transition countries

In spite of a decline in global FDI flows for the last several years, FDI inflows to Central and Eastern Europe reached a new high of \$29 billion in 2002 (Table A). The stability in FDI inflows in 2001-2002 in spite of slow economic growth in biggest FDI home countries can be attributed to the positive impact of the anticipated EU enlargement on investment. The steady performance of FDI in CEECs suggests that it is viewed as a stable and promising region for FDI, especially within division of labour across the integrating European continent, improving the efficiency of operations in Europe as a whole (UNCTAD, 2003). High inflows in several countries as Czech Republic, Slovakia and Slovenia were driven by a few big privatisation-related foreign investment. Stagnation of FDI inflows, observable in Hungary for the last years, can be expected also in other accession countries once the current wave of privatisation deals is over. At the same time non-accession countries may benefit from being a “new frontier” for efficiency seeking FDI.

¹¹ See, for example, Haskel et al. (2002) on UK, Aitken et al. on Mexico, Venezuela and USA (1996)

¹² See Barrell and Holland (2000), Bedi and Cieslik (2002).

Although the main recipient of FDI in CEECs is still automobile industry, there is an overall trend, especially in EU-accession countries, toward services sector. This shift to more knowledge-intensive corporate services – such as regional headquarters, call centres and back offices – is one more explanation for stagnating FDI inflows in some CEE countries. Although favoured in the light of technology upgrading in transition countries, knowledge intensive investments do not contribute a lot to the volume of FDI inflows, because they can be established with small capital investments (UNCTAD, 2003).

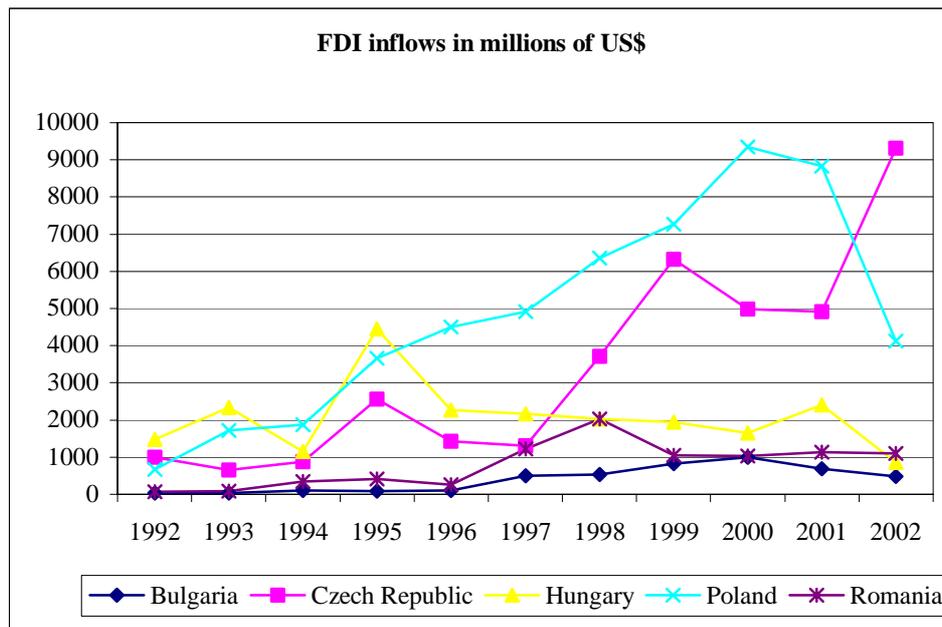
Table A. FDI inflows into CEECs

	FDI inflows (millions of US\$)											FDI instock 1995		FDI instock 2000	
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	mn US\$	as % of GDP	mn US\$	as % of GDP
Bulgaria	42	40	105	90	109	505	537	819	1002	689	479	445	3	3162	26
Czech Rep.	1003	654	869	2562	1428	1300	3718	6324	4986	4916	9319	7350	14	21644	43
Estonia	82	162	215	202	150	267	581	305	387	538	307	674	14	2645	53
Hungary	1471	2339	1146	4453	2275	2173	2036	1944	1643	2414	854	11919	27	19804	43
Latvia	29	44	213	178	382	521	357	348	408	201	396	615	13	2081	29
Lithuania	10	30	31	73	152	355	926	486	379	446	732	352	6	2334	21
Poland	678	1715	1875	3659	4498	4908	6365	7270	9342	8830	4119	7843	6	33603	21
Romania	77	94	341	419	263	1215	2031	1041	1025	1137	1106	1150	3	6517	18
Russian Fed.	700	1211	690	2066	2579	4865	2761	3309	2714	2540	2421	5465	2	19255	8
Slovakia	100	168	245	195	251	220	684	390	2075	1475	4012	810	4	4634	24
Slovenia	111	113	128	177	194	375	248	181	176	442	1865	1763	9	2809	15
Ukraine	200	200	159	267	521	624	743	496	595	772	693	910	2	3843	12

Source: UNCTAD, FDI/TNC Database (<http://www.unctad.org/fdistatistics>)

Chart below shows FDI inflows in five CEE countries which are in focus of the present work. Dominance of Hungary as FDI recipient in the first half of 1990s diminished steadily over the last years. While FDI inflows in Hungary reached the peak already in 1995, big privatisation projects pushed FDI inflows in Poland and the Czech Republic to their highs as recently as in 2000 and 2002 respectively. Also in terms of FDI stock as percent of GDP played FDI an important role in Hungarian industry already in 1995, making almost the third of Hungarian gross domestic product. Although it steadily grew in all five countries studied, the foreign sector in the Hungarian and the Czech economy reached a much higher share than in the other countries. Hence, bigger foreign sector relative to the domestic one and longer FDI presence in Hungary than in other countries covered in this study may make difference in respect to productivity spillovers from FDI.

¹³ See Djankov and Hoekman (2000), Kinoshita (2001); Bosco (2001), Konings (2001) and Damijan et al. (2001) for horizontal spillovers in transition countries



Data and methodological framework

The data used in this study constitute an unbalanced panel with annual information on more than 8000 manufacturing firms in five transition countries: the Czech Republic, Hungary, Poland, Romania and Bulgaria. The years covered are 1993 through 1999 (for Hungary from 1994 until 2000). The data have been retrieved from the financial database Amadeus. In addition to standard financial information, the database gives details on a number of variables such as firm's equity ownership position, industry classification and region in which the firm is registered.

Table 1 shows most important summary statistics for 1999 according to ownership. Foreign firms are defined as firms with any foreign share in the total capital.¹⁴ Average firm's sales, which approximate firm's output, are in all countries several times higher for foreign firms than for their domestic counterparts. The employees numbers show that the panel covers foremost middle-size enterprises with average number of employees not exceeding 800 employed persons. In contrast to sales figures, the difference in average employment in foreign and domestic firms turns out much more moderate, what indicates a higher

¹⁴ This did not make any significant difference in total number of foreign firms compared to mostly used 10 per cent threshold suggested by OECD definition of foreign direct investment.

productivity of domestic firms. The higher productivity in foreign firms may partially be explained by higher average capital stock, measured by tangible fixed assets, i.e. by higher capital intensity.

Table 1. Summary statistics according to ownership for 1999

	No of firms		Sales		No of employees		Capital stock	
	Dom	For	Dom	For	Dom	For	Dom	For
Czech Republic	1277	273	14567 (40792)	55622 (233860)	427 (734)	712 (1674)	6532 (29531)	23903 (70853)
Hungary	747	442	23769 (144292)	58301 (305501)	413 (1211)	439 (868)	8052 (74734)	25188 (191068)
Poland	2159	381	22792 (120148)	65910 (136725)	432 (714)	615 (871)	10407 (75315)	20600 (43410)
Romania	1381	604	4112 (18102)	7568 (20811)	558 (1125)	554 (975)	2584 (22943)	4073 (23279)
Bulgaria	1447	164	2403 (9539)	15360 (68314)	282 (623)	540 (848)	1480 (8615)	7186 (16682)

Note: Variables are mean values. Standard deviations are in parenthesis. All financial variables are expressed in thousands US\$.

To examine the correlation between firm's productivity and foreign ownership or foreign presence in the same industry and region, the approach taken by the earlier literature is followed, in particular the model employed by Aitken and Harrison (1999). A log-linear production function is estimated at the plant level to examine two main questions: (1) whether foreign equity participation is associated with an increase in the plant's productivity, and (2) whether foreign ownership in an industry affects the productivity of domestically owned firms in the same industry – i.e. whether there are positive or negative “spillovers” to domestic plants. Both questions can be nested in the following general specification:

$$Y_{ijt} = C + \alpha_1 FS_Plant_{ijt} + \alpha_2 FS_Sector_{jt} + \alpha_4 X_{ijt} + \varepsilon_{ijt}$$

The log output Y_{ijt} for the plant i in the sector j at the time t is regressed on a vector of inputs X_{ijt} and two measures of foreign ownership. To examine the correlation between firm's productivity and foreign capital participation, FS_Plant is defined as (1) the share of foreign capital in the plant's total capital or (2) dummy variable. Positive coefficient on FS_Plant would confirm the hypothesis of higher productivity of firms with foreign capital. To the extent that the productivity advantages spill over to domestic firms, the coefficient on FS_Sector should be positive. FS_Sector measures the intensity of impact of foreign firms in a 2-digit NACE sector and is defined as weighted foreign share in total sector's output.

Alternative specification of sectoral foreign participation as weighted foreign share in industry's employment gave basically the same results.

Inputs vector X_{ijt} consists of materials M_{ijt} approximated by material costs, labour L_{ijt} measured by number of employees and capital stock K_{ijt} approximated by firm's stock of tangible fixed.

The panel was estimated using OLS estimator.

(1) Foreign equity participation and productivity

Tables 2a and 2b report results for analyses of impact of foreign ownership on the total factor productivity. The log of real output Y_{ijt} is regressed on its inputs X_{ijt} and foreign equity participation. Regression include annual time dummies and two-digit industry dummies to control for time and industry specific productivity differences. Table 2a shows regression results for the case when FS_Plant is defined as a dummy variable, with value 1 if a firm has received any foreign capital, and 0 otherwise. Estimation coefficients for FS_Plant are, as expected, positive and statistically significant. Productivity advantages associated with foreign ownership are especially pronounced in Poland, Romania and Bulgaria.

Table 2a. Comparison of the level of total factor productivity between foreign and domestically-owned firms (dependent variable: log output)

	Czech Republic	Hungary	Poland	Romania	Bulgaria
FS_Plant_{ij}	0.036*	0.088*	0.426*	0.245*	0.293*
(0/1)	(0.008)	(0.020)	(0.033)	(0.011)	(0.024)
$\log(M_{ijt})$	0.818*	0.772*	0.409*	0.622*	0.588*
	(0.003)	(0.008)	(0.012)	(0.004)	(0.006)
$\log(L_{ijt})$	0.121*	0.105*	0.188*	0.283*	0.277*
	(0.004)	(0.011)	(0.018)	(0.006)	(0.012)
$\log(K_{ijt})$	0.048*	0.072*	0.153*	0.011*	0.076*
	(0.003)	(0.009)	(0.011)	(0.004)	(0.007)
Industry dummies	yes	yes	yes	yes	yes
Annual time dummies	yes	yes	yes	yes	yes
Adjusted R^2	0.96	0.92	0.72	0.92	0.87
Included observations	6791	1655	3036	8664	6479

Standard errors in parentheses. (*): significance at 1% level

Alternative specification of *FS_Plant* as share of total capita which is foreign owned i.e. as a continuous variable taking value between 0 and 100, corroborates the previous results (Table 2b).

Table 2b. Comparison of the level of total factor productivity between foreign and domestically-owned firms (dependent variable: log output)

	Czech Republic	Hungary	Poland	Romania	Bulgaria
<i>FS_Plant_{ijt}</i>	0.0003* (0.0001)	0.001* (0.0002)	0.005* (0.0004)	0.003* (0.0001)	0.004* (0.0004)
$\log(M_{ijt})$	0.819* (0.003)	0.773* (0.008)	0.407* (0.012)	0.624* (0.004)	0.586* (0.007)
$\log(L_{ijt})$	0.119* (0.004)	0.106* (0.011)	0.187* (0.019)	0.285* (0.006)	0.286* (0.012)
$\log(K_{ijt})$	0.047* (0.003)	0.071* (0.009)	0.153* (0.011)	0.011* (0.004)	0.073* (0.007)
Industry dummies	yes	yes	yes	yes	yes
Annual time dummies	yes	yes	yes	yes	yes
Adjusted R ²	0.96	0.92	0.71	0.92	0.86
Included observations	6701	1643	2970	8659	6169

Standard errors in parentheses. (*): significance at 1% level.

(2) Productivity spillovers

If foreign firms i.e. their productivity advantages emit any externalities for domestic firms or, in other words, if domestic firms benefit somehow from the superior technology in foreign firms, then this productivity spillovers should be larger if the foreign presence in an industry is larger. That means that the productivity of domestic firms in those sectors in which foreign presence measured by their share in total output or employment is larger should be higher. Hence, the coefficient with *FS_Sector* defined as weighted share of foreign output in the total industry's output should be positive. To test for this, the following equation was estimated:

$$\log Y_{ijt} = C + \alpha_1 FS_Sector_{jt} + \alpha_2 \log M_{ijt} + \alpha_3 \log L_{ijt} + \alpha_4 K_{ijt} + \alpha_5 D_t + \alpha_6 f_j + \varepsilon_{it}$$

The foreign presence variable *FS_Sector* is defined at 2-digit NACE level as:

$$FS_{jt} = \frac{\sum_i FS_{ijt} * Y_{ijt}}{\sum_i Y_{ijt}}$$

The estimation results are presented in Table 3. The coefficients for *FS_Sector* are, contrary to expectations, either negative and statistically insignificant. Negative and statistically significant results for Romania and the Czech Republic indicate that domestic plants in sectors with more foreign ownership are significantly less productive than those in sectors with less foreign investment. Coefficient for foreign presence catches a net impact of foreign presence on domestic firms at 2-digit level sectors.

Table 3. Impact of foreign investment in 2-digit industry on productivity of domestic firms. Dependent variable - Log output produced by domestically-owned firms

	Czech Republic	Hungary	Poland	Romania	Bulgaria
<i>FS_Sector_{jt}</i>	-0.001*** (0.001)	0.001 (0.001)	-0.004 (0.003)	-0.002* (0.0004)	-0.002 (0.0015)
log (<i>M_{ijt}</i>)	0.82* (0.004)	0.765* (0.010)	0.411* (0.014)	0.616* (0.005)	0.581* (0.007)
log (<i>L_{ijt}</i>)	0.125* (0.005)	0.123* (0.013)	0.170* (0.020)	0.306* (0.007)	0.312* (0.013)
log (<i>K_{ijt}</i>)	0.040* (0.003)	0.050* (0.011)	0.166* (0.012)	0.003*** (0.005)	0.067* (0.007)
Industry dummies	yes	yes	yes	yes	yes
Annual time dummies	yes	yes	yes	yes	yes
Adjusted R ²	0.96	0.92	0.71	0.92	0.86
Included observations	5202	973	2524	6305	5809

Standard errors in parentheses. (*): significance at 1 per cent level; (**): significance at 5% level; (***): significance at 10% level.

Productivity spillovers vs. demand effect

Still negative coefficient for foreign share on sectoral level does not preclude the possibility that some technology transfer from foreign to domestic firms does occur. Considering the already mentioned channels for technology diffusion it can be expected that technology transfer takes place at local level. Whether trained workers leave the joint venture to work at nearby domestic firm, or whether the joint venture demonstrates a product, process or market previously unknown to domestic owners, the benefits are likely to be received by

neighbouring domestic firms first, before they diffuse to other, more distant domestic firms. More important, the back- and forward linkages between foreign and domestic firms are probably to develop at regional level. Regional aspect might be particularly important in Central and Eastern European Countries. Regional concentration of foreign direct investment in capital and most western regions was one of the most striking characteristics of FDI flows in the most European transition countries, so that the whole impact intensity is focused on only several regions. At the same time, it is reasonable to assume that negative demand effect may be observed at national level, since foreign and domestic firms compete at national markets.

To test for possible positive effects from FDI at the local level, the analyses are extended to include a variable which measures foreign presence in industry within each NUTS 2¹⁵ region. This variable is calculated as the share of the industry j 's output in the region s produced in foreign firms located in the industry and the region.

Table 4a. Impact of sectoral and regional foreign investment on productivity of domestic firms. Dependent variable - log output produced by domestically-owned firms

	Czech Republic	Hungary	Poland	Romania	Bulgaria
FS_Sector_{jt}	-0.0014** (0.0007)	0.0014*** (0.001)	-0.004 (0.003)	-0.002* (0.0004)	-0.002 (0.0015)
$FS_Sector\&Region_{jst}$	0.0004** (0.0002)	0.0002 (0.001)	0.001** (0.001)	0.0003 (0.0002)	-0.0004 (0.0005)
$\log(M_{ijt})$	0.82* (0.004)	0.764* (0.010)	0.411* (0.014)	0.616* (0.005)	0.581* (0.007)
$\log(L_{ijt})$	0.125* (0.005)	0.123* (0.013)	0.172* (0.020)	0.306* (0.007)	0.312* (0.013)
$\log(K_{ijt})$	0.040* (0.003)	0.050* (0.011)	0.166* (0.012)	0.003*** (0.005)	0.067* (0.007)
Industry dummies	yes	yes	yes	yes	yes
Annual time dummies	yes	yes	yes	yes	yes
Adjusted R ²	0.96	0.92	0.71	0.92	0.86
Included observations	5202	973	2524	6305	5809

Standard errors in parentheses. (*): significance at 1 per cent level; (**): significance at 5% level; (***): significance at 10% level.

¹⁵ NUTS is European classification of regions.

As the regression results presented in Table 4a. show, inclusion of the industrial foreign share at regional level does not affect the negative net impact observed for Romania and the Czech Republic. The coefficient for *FS_Sector* for Hungary is now positive and statistically significant. The net impact for Poland and Bulgaria is negative, but statistically insignificant. Evidence for productivity spillovers at regional level can be found for the Czech Republic and Poland.

As further suggested by Aitken and Harrison (1999), foreign firms may be attracted to regions with higher productivity to benefit from agglomeration economies or better infrastructure. In this case, the coefficient on *FS_Sector&Region* would overestimate the positive impact of location-specific foreign investment on productivity. To control for these location-specific variations in productivity due to agglomeration economies or other region-specific effects, an additional variable was introduced: total number of firms in a region.¹⁶ The results of the regressions after this variable was taken into account are shown in Table 4b.

Table 4b. Impact of sectoral and regional foreign investment on productivity of domestic firms. Dependent variable - log output produced by domestically-owned firms

	Czech Republic	Hungary	Poland	Romania	Bulgaria
<i>FS_Sector_{jt}</i>	-0.001** (0.001)	0.002*** (0.001)	-0.003 (0.003)	-0.002* (0.0004)	-0.002 (0.0015)
<i>FS_Sector&Region_{jst}</i>	0.0003** (0.0002)	-0.0004 (0.001)	-0.001 (0.001)	0.0003 (0.0002)	-0.001** (0.0005)
log (<i>M_{ijt}</i>)	0.82* (0.004)	0.758* (0.010)	0.411* (0.014)	0.616* (0.005)	0.576* (0.007)
log (<i>L_{ijt}</i>)	0.125* (0.005)	0.132* (0.013)	0.170* (0.020)	0.306* (0.007)	0.318* (0.013)
log (<i>K_{ijt}</i>)	0.040* (0.003)	0.050* (0.011)	0.166* (0.012)	0.003*** (0.005)	0.068* (0.007)
Firms No Industry dummies	-0.00005** (0.00002)	0.0001* (0.00002)	0.0002* (0.00003)	0.00001 (0.00002)	0.0005* (0.00005)
Annual time dummies	yes	yes	yes	yes	yes
Adjusted R ²	0.96	0.92	0.71	0.92	0.86
Included observations	5202	973	2524	6305	5809

Standard errors in parentheses. (*): significance at 1% level; (**): significance at 5% level; (***): significance at 10% level.

¹⁶ Other variables such as real wage for skilled workers or electricity prices as used by Aitken and Harrison (1999) might better control for location-specific advantages, but data limitations did not allow for use of these variables in the present work.

After controlling for location-specific advantages, positive coefficients on regional foreign investment in Table 4a tend to sink, as shown in Table 4b. Positive and statistically significant coefficient on productivity spillovers can now be observed only for the Czech Republic. In the case of Bulgaria, this coefficient is even negative. For other countries it is statistically insignificant. The negative net impact from foreign presence on Czech and Romanian firms remained robust after inclusion of regional variable. Although there is no evidence of positive productivity spillovers at regional level, those Hungarian firms operating in sectors with more foreign investment are more productive than those domestic firms in sectors with less foreign presence.

Positive and statistically significant correlation between the number of firms in a region and firms' productivity confirm the observation that foreign investment are likely to locate in those regions where they can benefit from agglomeration economies and better infrastructure.

Conclusions

Using an unbalanced panel of more than 8000 firms in five transition countries: Hungary, Poland, Romania, Bulgaria and the Czech Republic, two main effects from foreign direct investment on firm's productivity in host country can be observed. The first question addressed in this paper – if firms' productivity is associated with foreign equity participation – can be answered positively. Coefficients on foreign capital participation are positive and statistically significant for all countries covered in this study. Productivity advantage associated with foreign ownership is much more pronounced in firms with some foreign ownership in Poland, Romania and Bulgaria than in Hungary and the Czech Republic. This might be explained by low initial productivity level in firms receiving foreign capital, but more detailed research is needed to see if this productivity advantage holds for both joint ventures and wholly foreign owned companies.

Despite all expectations, estimation results do not provide strong evidence for positive spillovers from foreign direct investment in a sector on domestic firms in the same sector. To the extent that domestic and foreign firms compete on national markets, there is a weak evidence to support the hypothesis that technology is transferred locally from foreign to domestic firms. In fact such evidence was found only for the Czech companies. In other countries, the positive correlation between higher domestic firms productivity and regional

foreign presence can be better explained by the fact that foreign companies are attracted to regions with highest productivity, to benefit from agglomeration economies, than by productivity spillovers from foreign to domestic firms.

More important is the evidence that even if some technology transfer and some positive externalities arise from foreign direct investment, net impact from foreign presence in sector on the productivity of domestic firms in the same sector seems to be dominated by the negative demand effect. Robust evidence for this provide negative and statistically significant coefficients on foreign presence in industry for the Czech Republic and Romania.

Positive and statistically significant coefficient on the overall productivity effect from foreign investment in Hungary is interesting. At the first site it seems to negate the previous results. However, a more careful view at the results give us further insights into dynamics of foreign direct investment, competition and productivity spillovers. As the Table A and the Chart on FDI Inflows in CEECs show, Hungary received the bulk of its foreign direct investment already by the middle 1990s. In 1995 foreign sector made almost one third of GDP. Hence in the case of Hungary we might observe a long term effect from foreign direct investments on productivity. Given a large productivity and technology gap between foreign and domestic firms in Hungary, negative demand effect triggered by the entrance of foreign firms already at the begin of 1990s, forced less productive Hungarian firms to exit the market, before they managed to developed a knowledge base that would enable them to learn from foreign counterparts. At the same time, the explicit evidence for productivity spillovers in Hungary is missing. Thus it seems that the dynamics of the impact of FDI on productivity are characterised by the immediate and direct market stealing effect and long-term and conditional learning process.

Altogether, the presented results show that there are clear benefits from foreign investment, but such benefits are internalised by joint ventures i.e. firms receiving foreign investment and fully foreign owned firms. Domestic owned firms may learn from foreign companies to some extent and in this way improve their performance. But, before they start learning from foreign counterparts, they might be forced to exit the market, unable to resist the competition pressure from companies with foreign capital.

Although the present study uses the same database for several transition countries, which have more or less the same macroeconomic and legal framework, surprising and in part contradictory results obtained, make any generalisations very difficult. How domestic firms react on foreign presence might depend on a whole range of country, industry, region and last but not least firm specific factors. Initial productivity level, learning capability, R&D efforts and export-orientation determine a firm's response on additional competition and the extent to which it might benefit from foreign companies. On the other side, industry structure, openness of economy, level and forms of foreign investment and especially the integration of foreign sector into host economy through linkages with domestic firms influence the aggregate productivity effects at macro level. These and similar questions leave space for further research.

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