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Three Indirect Effects of Foreign Direct Investment: Evidence from the Czech Republic
Tři nepřímé efekty přímých zahraničních investic: evidence z České republiky

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1 Introduction

The Czech Republic, similarly to other Central and Eastern European (CEE) countries, has attracted foreign direct investment (FDI) successfully during 1990s, mainly thanks to privatization, the lack of domestic capital needed for economic transition and EU accession prospects. Later, mainly after 2000, other determinants of FDI, such as wage cost factors, the size and location of the market and FDI policies have gained in importance. Within the economic globalization process, a number of important foreign and multinational firms have selected the Czech Republic as a country to which to relocate the production, logistics and in some cases also some parts of research and development.

Cross-border capital flows in today's globalized world create a number of important challenges for both academic economists as well as policymakers. In general, FDI can bring substantial benefits to the host economy (Jones and Colin, 2006). Looking at the firms level, a foreign-owned company, usually being part of a multinational enterprise, is larger, more capital intensive, has more skilled labour, higher technological knowledge and a greater productivity level compared to domestic companies. In addition, foreign firms have usually better access to financing, either from the parent company or from the banks given their superior performance. Finally, firms that were established within the relocation process in order to supply to parent companies abroad increase export performance of the host country. Thus, attracting FDI brings benefits for the host economy in terms of higher investment, employment and output of these firms, with resulting effect on the overall GDP growth. These effects have been labeled direct effects of FDI.

However, FDI can also have some indirect effects on the host economy, namely on local (i.e. domestically-owned) companies. These indirect effects, in the literature labeled "spillovers",

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emerge due to interactions of foreign and local (i.e. domestic) firms both within an industry as well as across industries, along the production chain. Available evidence and academic literature focuses mainly on productivity spillovers (Blomstrom and Kokko 1998). Productivity spillovers refer to transfer of technology in a broader sense, including organizational and managerial practices and know-how, from foreign firms to domestic firms. Nevertheless, there are additional at least two important spillovers from foreign to domestic firms: the so-called market access spillover and the "financing" spillover.[1] Market access spillover can be found if increased foreign presence in the corporate sector leads to an increase of export performance of domestic firms. Under financing spillover we understand a situation where entry of foreign firms facilitates the access of local firms to external financing.

Foreign direct investment can also introduce some risks into the economy. Companies established within the relocation of production process strengthen the export orientation of the economy and thus increases the dependence of the domestic development on the external environment, which may lead to higher volatility in the economy's performance (Bergin et al., 2006). In addition, transfers of profit from foreign-owned corporations may put pressure on current account and exchange rate of the host economy (Geršl 2007). Moreover, existing empirical literature on productivity spillovers often finds negative effects, suggesting that inflow of FDI can have also detrimental impact on performance of local firms. As regards the impact on financial sector, subsidiaries of foreign firms may rely more on intra-group finance than on financing from local banks, effectively slowing down the development of local financial sector and the depth of domestic financial intermediation (Geršl and Hlaváček 2007).

In this paper, we analyze the three indirect effects (spillovers) of FDI mentioned above, i.e. productivity, market access and financing spillover, using firm-level data on manufacturing industries of the Czech Republic. The motivation to look more in detail into spillovers from FDI helps us understand the results of interaction between foreign and domestic companies, and thus possible consequences of huge inflow of FDI that the CEE countries have been experiencing so far.

In comparison to existing studies on spillovers in the CEE countries (Jarolím 2000; Kinoshita 2001; Javorcik and Spatareanu 2003; Damijan et al. 2003; Javorcik 2004; Merlevede and Schoors 2005, 2006), this paper offers value added in two main areas: first, it analyzes the most recent data, over the period 2000-2005, while most of the available literature focused on the late 1990s. Second, it does not analyze only productivity spillovers as the mentioned studies, but focuses also on the other two spillovers, the market access and the financing spillover. While the former has been already partly researched and discussed in the literature (Aitken et al. 1997), we are not aware of any study focusing on the latter. Thus, this study provides the first attempt to analyze empirically the effect of FDI on financial structure of local companies.

The paper is structured as follows: Section 2 provides an overview of the FDI inflows and FDI inward positions in the Czech Republic in comparison with selected countries of the region. Section 3 reviews the channels through which the three spillovers can work. Secti-

1 *There might be some other "indirect" effects as well: Ayygari and Kosova (2006), for example, look at whether inflows of FDI facilitate domestic entrepreneurship.*

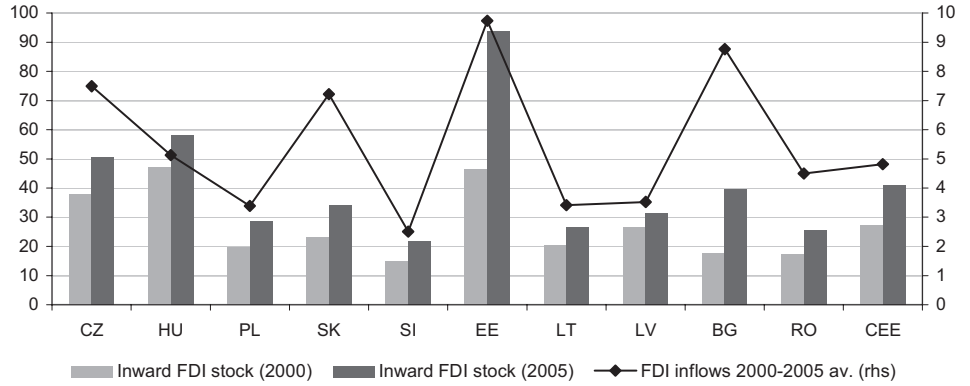
on 4 presents the firm-level data used for the analysis and analyzes the foreign presence in the manufacturing sector. Section 5 reveals the estimation strategy and describes the construction of variables of foreign presence used in the subsequent estimations. Section 6 attempts at estimating the productivity spillovers, using the Levinsohn and Petrin (2003) methodology. Section 7 estimates the extent of market access spillover, taking into account the data limitation. Section 8 focuses on analysis of financing spillover, looking at the effect of foreign presence on the degree of external financing and the level of financing costs of domestic companies. Section 9 concludes.

2 FDI inflows: international comparison and industrial structure

Existing literature identifies two main motives for FDI: market seeking motive and efficiency seeking motive. Market seeking motive means that foreign firms establish their subsidiaries in the host country in order to be closer to potential customers and take advantage of rapidly growing markets. On the other hand, efficiency seeking motive means that foreign companies look for those territories to establish their production units in order to economise on costs. The CEE countries have attracted both types of investments, given the rapid growth of their internal markets as well as wage and other costs advantages relative to developed Europe.

The Czech Republic has been one of the most important target countries to attract foreign direct investment. The stock of FDI as a percentage of GDP increased from around 35% in 2000 to 50% in 2005, a third highest figure in relative terms among CEE countries (after Estonia and Hungary). The inflow of FDI has been on average 7.5% of GDP annually over the period 2000-2005 (Chart 2.1).

Chart 2.1: Inflow of FDI and inward FDI stock in CEE countries (in % of GDP)



Source: WIIW, Geršl et. al (2007)

As Geršl et al. (2007) describe, the majority of FDI to CEE countries went into services. This holds also for the Czech Republic. Table 2.1 shows that the industrial structure of the stock of FDI in the Czech Republic corresponds to the structure of total FDI in the CEE countries.

Financial intermediation, trade, real estate and business services and transport and communication account for around 50% of the total FDI inward stock in the Czech Republic, similarly as in total CEE. Inflow of FDI into the services sector was usually motivated by market seeking and supplying cost optimisations, but outsourcing and FDI in export oriented services seem to have become an important factor as well. Most of the FDI in services can be related to past privatisations in the banking sector or telecommunications.

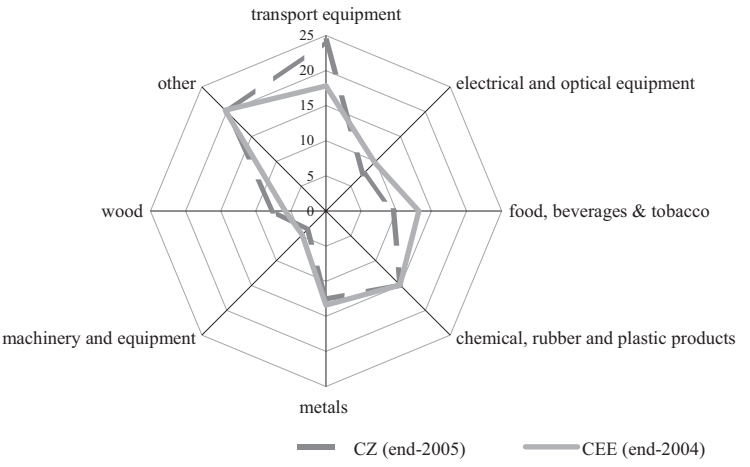
Table 2.1: Industrial structure of the stock of inward FDI
(in % of total inward stock of FDI; Czech Republic as of end-2005, CEE total as of end-2004)

	Czech Republic	CEE total
manufacturing	38.1	40.0
financial intermediation	18.8	16.1
wholesale, retail trade	9.8	14.3
real estate and business activities	12.3	12.1
transport, communication	12.1	7.9
electricity, gas and water supply	5.7	4.9
other	3.2	4.7

Source: WIIW, CNB, Geršl et. al. (2007)

Manufacturing accounts for around 40% of total FDI inward stock both in the Czech Republic and in the CEE total. Inflow of FDI into this sector has been mainly motivated by low input costs and production cost economisation. It is also a sector where the most green-field investments were made. However, some FDI in manufacturing has also been driven by privatization and the market-servicing motive.

Chart 2.2: FDI in manufacturing by sub-industries (in % of total FDI in manufacturing)



Source: WIIW, CNB, Geršl et. al. (2007)

The structure of existing FDI in manufacturing sector in the Czech Republic corresponds to a large extent to the structure across the whole CEE region, the only exception being a relatively important position of motor vehicles and other transport equipments. This is a result of the past privatizations, but also several new, green-field investments in this sub-sector including a number of foreign sub-suppliers to the automotive industry.

3 Channels of indirect effects of FDI on domestic firms

Available literature on spillovers differentiates between horizontal and vertical spillovers (Javorcik 2004; Merlevede and Schoors 2005). If local firms benefit from the presence of foreign companies in their sector, we refer to horizontal spillovers, while if local firms benefit from interaction with foreign firms upstream or downstream in the production chain, we refer to vertical spillovers. In this sense, backward spillovers denote spillovers from the foreign firm to its local sub-supplier (upstream – or backward - in the production chain), while forward spillovers refer to the spillovers from foreign firms to their local customers (downstream – or forward - in the production chain).

Majority of literature on spillovers deals with productivity spillovers (Schoors and van der Tol 2002; Javorcik and Spatareanu 2003; Damijan et al. 2003; Javorcik 2004; Merlevede and Schoors 2005, 2006; Geršl et al. 2007). In this stream of literature, three main channels for horizontal spillovers are identified: demonstration channel, labour market channel and competition channel (Kokko 1992).

Within the demonstration channel, local firms may try to imitate foreign firm's technology. Of course, informed foreign companies will try to prevent technology leakage to the local competitors, so that the potential for the spillover running via this channel may be limited. Another strategy of foreign firms to prevent imitation by local competitors is not to bring their state-of-the-art technologies, but those technologies that are only slightly more advanced than those of the local firms (Glass and Saggi 1998). This would also adversely affect the potential for horizontal spillovers. The labour market channel works via labour turnover from foreign firms' trained workers to local firms (Fosfuri et al. 2001). However, foreign presence can have also detrimental effect on the local firms through this channel, as it can brain drain local talents from the local firms to the foreign affiliates (Balock and Gertler 2004). Within the competition channel, entry of foreign firms increases competition in the host economy and forces local firms to use existing resources more efficiently and to adopt better technologies (Blomstrom and Kokko 1998). On the other hand, if the competition induced by the entry of foreign firms is too high, less productive local firms may be driven out of the market (market stealing effect, see Aitken and Harrison 1999).

Empirical evidence suggests that more potential for spillovers exists in interaction of local and foreign firms within the production chain (vertical spillovers). Backward vertical spillovers emerge when foreign firms intentionally assist local sub-suppliers to deliver high-quality inputs and share with them superior technology. The intentionality of transferring the knowledge and technology is a feature that makes vertical spillovers qualitatively different and in effect probably more powerful. As Geršl et al. (2007) argue, there are two conditions under which the incentive to help local sub-suppliers exists: first, the transportation costs between the home and the host country must be rather high so that the

foreign firm does not have incentive to source its inputs in its home country. Second, the foreign firm must refrain to induce sub-suppliers from its home country to invest in the host country as well, as this would create an isolated enclave of mutually linked foreign firms with limited interaction with the local firms and thus limited potential for spillovers. Being a sub-supplier to a foreign firm provides the local firm with a stable demand for inputs and allows the local firm to invest into appropriate physical capital, build up a stock of experienced workers and accumulate necessary experience, all prerequisites for increased productivity via usage of advanced technology (Merlevede and Schoors 2005). However, if local sub-suppliers are not able to maintain the quality standards for the inputs as required by the foreign customer, backward vertical spillovers may also be negative, as the foreign firm may turn back to its home country sub-suppliers.

Forward vertical spillovers appear when higher quality inputs produced by foreign firms are used in the production chain by the local firms. In principle, forward vertical spillover may be also negative. For example, if the inputs produced by foreign companies are more expensive and not adapted to the local conditions, in which case they are used only by more productive foreign enterprises that are better equipped to handle the high-quality inputs. This would increase the productivity difference between local and foreign companies.

Given the possible ambivalent net effect of horizontal and vertical productivity spillovers, some studies assume that the spillovers may be non-linear, meaning that the net effect on domestic companies' productivity changes with the degree of foreign presence (Damijan et al. 2003; Merlevede and Schoors 2005, 2006; Geršl et al. 2007). For example, relatively moderate presence of foreign companies may induce positive horizontal spillovers via demonstration channel, but further substantial increase of foreign presence may trigger brain drain and lead to market stealing effect, driving local companies out of the market, meaning negative horizontal spillovers. In other words, foreign presence contributes to an increase in domestic productivity, but if foreign presence increases beyond some threshold, its impact on local productivity turns negative. Recent literature focuses as well on conditions or characteristics that make domestic companies sensitive to spillovers, so-called conditional spillovers (Schoors and van der Tol 2002; Javorcik and Spatareanu 2003; Javorcik 2004; Merlevede and Schoors 2005, 2006). Main characteristics of a firm or industry that affect the conditional spillovers are absorptive capacity of a firm, export orientation, import competition, sectoral competition, firm size and the level and origin of foreign ownership.

Market access spillovers stands for a possibility for local firms to access new markets via marketing and business networks of foreign companies with which local firms interact. As Aitken at al. (1997) put it, "multinational corporations are a natural conduit for information about foreign markets, foreign consumers, and foreign technology, and they provide channels through which domestic firms can distribute their goods. To the extent that multinationals directly or indirectly provide information and distribution services, their activities enhance the export prospects of local firms". In this regards, two channels of market access spillovers might be identified: first, similarly to productivity spillovers, via labour market channel experienced workers from foreign firms may be attracted by local firms, bringing their knowledge and valuable contacts about the foreign distribu-

tion networks. This would hold mainly for horizontal spillovers, but available evidence suggests that labour turnover, especially in sale departments and distribution, occurs to a large extent also vertically. Second - and this holds primarily for backward market access spillovers - foreign companies may again intentionally assist domestic sub-suppliers, opening their home markets for the sub-supplies. Typical sequencing of such spillover is for a foreign company to start with supplies of inputs from a local firm, and after the quality is on a certain level, the foreign company invites the local firm to supply inputs also to the home production facilities or other subsidiaries in other countries.

Clearly, market access spillover may go hand in hand with productivity spillover and reinforce each other, as the chance to compete in the foreign markets puts pressure on the local firms to increase productivity. Moreover, export-oriented firms are used to higher competition on foreign markets and are usually more productive than firms serving only local markets. Thus, they may be better prepared to adapt advanced technologies (productivity spillover).

In contrast, financing spillover differs slightly from the two previous spillovers, as here it is not the foreign firm that transfers "finance" to local firms. However, local firms' interaction with foreign firms may influence the way local companies are financed. First, increased competition in the sector due to entry of foreign firms may put pressure on profitability and performance of local firms (brain-drain effect, competition effect), which would be immediately seen by creditors (banks), leading to either lower willingness to offer external financing or to more expensive financing (interest rate margin). Thus, we should observe negative horizontal spillovers in financing. Second, interaction between local and foreign firms along production chain, mainly via local firms serving as sub-suppliers, creates a need for local firms to invest into new and advanced technologies. However, new investments must be financed, and the fact that a foreign company provides the local firm with stable a large demand for inputs may help the local company to obtain credit from banks more easily or at least at a lower interest rate margin. Foreign company thus transfers a part of its "creditworthiness" onto the local sub-supplier, effectively providing an implicit guarantee to repay the debt if the investment has been relatively specific.[2]

On this issue, there is no theoretical of empirical literature. The impact if FDI inflows on financing of foreign-owned firms is analyzed in Geršl and Hlaváček (2007), who focus on the role of intra-group credit in financing subsidiaries across border. They also focus on general impact of FDI on the credit supply from local banks, arguing that the increased incentive of foreign-owned companies to use intra-group credit could lead local banks to turn to domestic firms often serving as sub-suppliers to foreign firms and thus to increase financing of local companies. Thus, on a more macro-level, they actually argue that there might be an indirect positive effect (spillover) from FDI on financing of local companies.

2 *Anecdotal evidence suggests that a very special relationship emerges between a foreign firm and its local sub-supplier if the local firm is investing into very special assets. Both parties have then interests to keep the business alive even if the local company gets into repayment problems. There have been cases where foreign client has in the end bought out the local sub-supplier in order to safeguard the regularity of needed inputs.*

4 Firm-level data on manufacturing in the Czech Republic

For the analysis of spillovers, we used the database Amadeus provided by Bureau van Dijk (September 2006 release). This database provides firm-level data on European corporate sector and we have extracted the data on Czech firms. The data on companies' balance sheet items, profit and loss account and ownership constitute an unbalanced panel over the period 2000-2005.[3] We focus on manufacturing companies (NACE Rev. 1.1 2-digit industries 15 – 36) with minimum of 10 employees and fixed assets and turnover of at least 10 thousand USD.

Table 4.2 shows the coverage of firms in Amadeus database in comparison to aggregate data on Czech manufacturing sector from WIIW (Vienna Institute for International Studies). The table shows that the Czech sample from Amadeus is a representative sample, as the total turnover from Amadeus reaches 100% of the total manufacturing production from WIIW and almost 90% of employment.[4] At the same time, the industry structure is relatively similar.

Table 4.2: Sample properties

Number of firms	5011	
o.w. foreign firms	618	
Turnover (Amadeus) in % of manufacturing production (WIIW)	104.2%	
Employees (Amadeus) in % of total employment (WIIW)	86.0%	
distribution of manufacturing turnover by NACE sectors in 2004 (in %; Amadeus versus WIIW)		
	Am	WIIW
DA Food products; beverages and tobacco	14.4	11.5
DB Textiles and textile products	2.5	2.8
DC Leather and leather products	0.1	0.2
DD Wood and wood products	1.5	1.9
DE Pulp, paper & paper products; publishing & printing	4.5	4.1
DF Coke, refined petroleum products & nuclear fuel	4.3	2.8
DG Chemicals, chemical products and man-made fibres	6.4	5.9
DH Rubber and plastic products	6.7	6.2
DI Other non-metallic mineral products	5.4	5.3
DJ Basic metals and fabricated metal products	10.9	15.3
DK Machinery and equipment n.e.c.	7.7	7.8
DL Electrical and optical equipment	15.8	15.1
DM Transport equipment	17.2	17.7
DN Manufacturing n.e.c.	2.6	3.4
Average absolute difference	0.9	

Source: WIIW industrial database, Amadeus.

3 *Unfortunately, a given release of the Amadeus database does not include history of ownership information, thus the most recent information about the ownership status is used (i.e. as of September 2006) and assumed to be valid over the whole period of analysis.*

4 *Figures higher than 100% are possible as the industrial manufacturing production in WIIW database includes only sales of goods classified as manufacturing, while the turnover data for firms in Amadeus represent total turnover, including also revenues from sales of non-manufacturing products and services.*

In the analysis, foreign companies are defined as companies with the global ultimate owner from a country outside the host country, or with immediate shareholders of the company from countries outside the host country which have a share of at least 51% of company's capital. This definition differs from traditional definition of FDI (10% of shareholder funds), but is in line with literature on spillovers. Moreover, empirical evidence shows that important foreign companies that could have some effect on local companies are in most emerging markets majority-owned (Geršl and Hlaváček 2007).

Foreign companies account for about 12 % of all firms, but their relevance in terms of total assets, turnover, investment and employment is much higher (Table 4.3). They account for around 40% of total manufacturing assets, turnover and investments and for around 25% of total manufacturing employment. This suggests that foreign companies are on average bigger, have higher stock of investments, more employees and higher turnover. The firm-level data from Amadeus also show that foreign companies are more productive (as measured by labour productivity) and more profitable. However, the gap in productivity and profitability between foreign and local companies is not that large.[5]

Table 4.3: Relevance of foreign firms in the Czech manufacturing sector (as of 2004)

% of foreign firms in no of firms	12.3%
% of foreign firms in total assets	38.9%
% of foreign firms in turnover	37.1%
% of foreign firms in stock of investment	41.3%
% of foreign firms in employment	23.4%

average total assets (in mil CZK)	foreign firms	887
	local firms	195
average stock of investment (in mil CZK)	foreign firms	463
	local firms	92
average employment (No of employees)	foreign firms	335
	local firms	155
average turnover (in mil CZK)	foreign firms	1348
	local firms	321
average RoE (return on equity, in %)	foreign firms	23.9
	local firms	19.4
average labour productivity (ln real value added on employee)	foreign firms	7.0
	local firms	6.6

Source: Amadeus

Given that we focus also on market access spillover and financing spillover, it might be interesting to look at the export performance and financial structure of the Czech corporate sector. Table 4.4 shows that out of total exports of manufacturing sector into EU25 countries, products from the sectors electrical and optical equipment as well as transport equipment are the most important export articles of the Czech Republic. This corresponds to the industry structure of inward FDI, suggesting that indeed a large part of inward FDI has been due to relocation of production and subsequent export of the output into

5 *Geršl et al. (2007) show that the relevance of foreign firms differs across CEE countries and that in some countries the gap in profitability is much bigger.*

foreign markets. However, exports represent also a large share of total output of other industries such as textiles and leather, machinery or chemicals.

Table 4.4: Distribution of exports to EU25 (as of 2004)

	in % of total exports to EU25	in % of sectoral output
DA Food products; beverages and tobacco	3.1	14.7
DB Textiles and textile products	5.3	103.4
DC Leather and leather products	0.5	125.3
DD Wood and wood products	1.5	42.6
DE Pulp, paper & paper products; publishing & printing	3.2	41.9
DF Coke, refined petroleum products & nuclear fuel	1.1	22.1
DG Chemicals, chemical products and man-made fibres	5.8	52.3
DH Rubber and plastic products	5.3	45.7
DI Other non-metallic mineral products	3.1	31.6
DJ Basic metals and fabricated metal products	13.6	47.3
DK Machinery and equipment n.e.c.	12.7	86.5
DL Electrical and optical equipment	21.4	75.8
DM Transport equipment	19.6	59.1
DN Manufacturing n.e.c.	3.7	58.4
Manufacturing total	100.0	53.5

Source: WIIW, Amadeus

Not all the exports of industries with high foreign relevance might be because of foreign firms if there are market access spillovers and local firms also increased their exports. Unfortunately, the Amadeus database does not include the data on export performance of individual companies in the Czech Republic. Thus, for estimation of market access spillovers we will have to find a proxy for export performance of local companies (see section 7).

Table 4.5 presents the financial structure of foreign versus local firms. Domestic companies are more indebted than foreign companies, which might reflect the initial capital provided to foreign subsidiaries by their parent companies. Nevertheless, foreign companies have on average more long-term debt in their liabilities, while domestic firms rely more on short-term debt (short-term loans and creditors).

Table 4.5: Financial structure of manufacturing firms (as of 2004)

	foreign companies	domestic companies
Capital (shareholder funds)	42.8%	40.4%
Debt	57.2%	59.6%
Long-term debt	9.4%	8.0%
Short-term loans	5.3%	5.9%
Creditors	15.7%	16.7%
Other liabilities	26.9%	29.0%

Source: Amadeus

5 Estimation strategy

The main objective of this study is to find out whether domestic companies benefit from foreign presence in the same sector (horizontal spillovers) and in the upstream or downstream sectors (vertical spillovers). Within the vertical spillovers, more emphasis is put on backward spillovers, as the channel of sub-supplier linkages might be more relevant given both the anecdotic evidence as well as some partial studies from automotive industry. Thus, we estimate the impact of appropriately defined "foreign presence" variables on several performance indicators of domestic firms, taking into account other factors of influence using a number of control variables.

As regards the performance variables, we have selected following dependent variables following the above discussion about three possible spillovers, i.e. productivity, export performance and financing. For productivity estimation we use as dependent variable the total factor productivity, for export performance we use exports to EU-25 countries, and finally for financing we use the ratio of debt to total assets as well as the interest rate paid by domestic corporations (detailed definitions are given in the respective Sections 6-8).

Unfortunately, available data do not include information about interaction between local and foreign companies. However, there is a way how to capture at least a "potential" or "probability" that there will be some interaction that would have effects on local firms. Foreign presence in the same sector is captured by the variable $horizontal_{jt}$ and it is defined as the share of foreign firms' output in total industry output:

$$horizontal_{jt} = \frac{\sum_{i \in j} foreign_{it}\, x\ \ turnover_{it}}{\sum_{i \in j} turnover_{it}} \qquad (1)$$

The variable *foreign* is a dummy variable that equals 1 if the company *i* is a foreign company, and 0 otherwise. The higher the value of output produced by foreign firms and the higher the number of foreign firms in the sector *j*, the higher is the variable *horizontal* and thus the potential for horizontal spillovers. Indeed, if a local firm produces in an environment where there are many other foreign firms in the same industry, some interaction is inevitable and the local firm will have to adapt (i.e. for example it will raise its productivity in order to withstand possible competitive pressure etc.).

As discussed, one of the most promising interactions that can lead to positive spillovers to local firms is via sub-supplier linkages. Ideally, one would need the share of local firm's output sold to foreign firms. As this information is not available, we follow the current practice in the literature on spillovers and use input-output tables to trace inter-industry supply linkages. Thus, we proxy the share of firm's output sold to foreign companies by the share of sector's output for intermediate consumption within the domestic economy sold to foreign companies in downstream sectors. The input-output tables reveal the information about the amount supplied by the sector *j* to its sourcing sector *k*. In addition, we

employ the information about the foreign presence in sector *k* (the variable *horizontal*). Thus, we define a variable $backward_{jt}$ as

$$backward_{jt} = \sum_{k\ if\ k \neq j} \gamma_{jkt} horizontal_{kt} \tag{2}$$

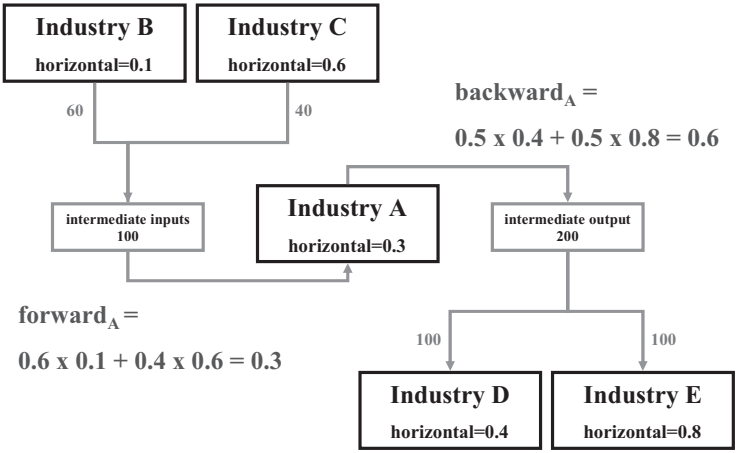
where γ_{jkt} is the proportion of sector *j*'s output supplied to sourcing sectors *k* and is calculated using the input-output table for domestic intermediate consumption (i.e. excluding imports).[6] In addition, intra-industry supplies are not accounted for, as this effect is captured by the variable *horizontal*. This proxy thus shows the "potential" or "probability" that a local firm will interact with (supply its inputs to) a foreign firm in the downstream sector.

Similarly, we define a variable $forward_{jt}$ that captures the potential for forward vertical spillovers to local firms that buy inputs from foreign firms. This proxy is defined as

$$forward_{jt} = \sum_{l\ if\ l \neq j} \delta_{jlt} horizontal_{lt} \tag{3}$$

where δ_{jlt} is the proportion of sector *j*'s inputs purchased from upstream sectors *l*. Nor in this case is it accounted for intra-industry supplies, as this effect is captured by the variable *horizontal*. Note that for both cases, the weights γ_{jkt} and δ_{jlt} are calculated using the proportion in total output for intermediate consumption (or total input used), not only the output (input) supplied to (bought from) the manufacturing sectors (thus, the sum of γ_{jkt} or δ_{jlt}, respectively, is not equal to 1). Chart 3 shows an illustrative example of how both proxies for vertical variables are computed.

Chart 3: Quantifying relevance of foreign firms in vertically-linked industries (example)



6 *Ideally, one should use a series of I-O tables to capture the dynamics of inter-industry trade. Due to data limitation, we employ the last available I-O table for domestic intermediate consumption for the Czech Republic, namely for the year 2003. As this year is actually in the middle of the time span of our firms' panel, it can be considered as a relatively representative picture of the inter-industry trade.*

In the following sections, we relate the performance indicator of a local firm *i* in the NACE 2-digit sector *j* and in the period *t* to the above constructed foreign presence variables (horizontal, backward and forward) and other control variables (determined separately for estimations of productivity, market access and financing spillover), estimating an unbalanced panel of local firms.[7]

$$performance_\text{var}iable_{ijt} = \alpha_0 + \alpha_1 horizontal_{jt} + \alpha_2 horizontal^2_{jt} + \alpha_3 backward_{jt} + \\ + \alpha_4 backward^2_{jt} + \alpha_5 forward_{jt} + \alpha_6 forward^2_{jt} + control_\text{var}iables_{ijt} + \varepsilon_{ijt} \quad (4)$$

6 Estimating productivity spillovers

Typical approach to an analysis of productivity is to estimate a production function and use the residuals not explained by the input factors (capital, labour) as a proxy for total factor productivity (Solow residuals). However, as Levinsohn and Petrin (2003) point out, when estimating the production function, one must account for the correlation between input levels and productivity. The reason is that profit-maximizing firms respond to increase in productivity by increased volume of factor inputs. Thus, methods that ignore this endogeneity (such as OLS or the fixed-effects estimator) inevitably lead to inconsistent estimates of the parameters of the production function.

In line with recent literature, we employ a semi-parametric approach suggested by Olley and Pakes (1996) and modified by Levinsohn and Petrin (2003). This method allows for firm-specific productivity differences that exhibit idiosyncratic changes over time. The technique is described in detail in the Box. Using this technique, we estimate a log-linear transformation of a Cobb-Dougals production function:

$$va_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \varepsilon_{it} \quad (5)$$

where va_{it} is log of value added of a firm *i*, l_{it} is log of labour input, k_{it} is log of capital. In order to be able to compare the resulting productivity across industries, the estimation is done using all domestic firms across individual 2-digit NACE industries.[8] Value added enters the equation as real value added, computed as real turnover minus real material costs. The data on operating turnover were deflated by the producer price index for the corresponding 2-digit NACE sector, while material costs were deflated by unweighted average of total manufacturing producer price index and import price index. Labour input refers to number of employees. For capital input, the stock of fixed assets was used, deflated by the average of the deflators for the following NACE sectors: machinery and equipment

7 *Most studies on spillovers use fixed effects estimator, both due to economic reasoning (heterogeneity among firms) and econometric assumptions (possible correlation between regressors and firm effects). A notable exception is Jarolím (2000) who uses random effects model. The appropriateness of using fixed-effects model has been tested for individual regressions via Hausman test.*

8 *Other studies such as Arnold et al. (2006) or Geršl et al. (2007) estimate the total factor productivity separately for individual industries, or group of similar industries. However, in such a setting the comparison across industries should be ideally made in terms of changes over time.*

(29), office machinery and computing (30), electrical machinery and apparatus (31), motor vehicles, trailers and semi-trailers (34) and other transport equipment (35).[9]

A measure of log of total factor productivity tfp_{it} - a performance variable that is subsequently used in the estimation of spillovers - is obtained as the difference between log of value added and log of capital and log of labour, multiplied by their estimated coefficients:

$$tfp_{it} = va_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it\,t} \qquad (6)$$

Box: The Levinsohn and Petrin (2003) estimator of productivity

The Levinsohn and Petrin (2003) technique assumes a Cobb-Douglas production technology:[10]

$$v_t = \beta_0 + \beta_l l_t + \beta_k k_t + \omega_t + \eta_t$$

where v_t is log of value added, l_t is log of freely variable labour input, k_t is log of the state variable capital. The error has two components, the transmitted productivity component ω_t and an error term η_t that is uncorrelated with input choice. The key difference between ω_t and η_t is that the former is a state variable and thus impacts the firm's choice of inputs. As ω_t is not observed by the econometrician but is known to the firm, it leads to the simultaneity problem in production function estimation and yields inconsistent results.

Olley and Pakes (1996) developed an estimator that uses investment as a proxy for this unobservable shock. However, Levinsohn and Petrin (2003) argue that investment is very lumpy and thus the investment proxy may not smoothly respond to productivity shocks under substantial adjustment costs. Instead of investment, Levinsohn and Petrin (2003) suggested that intermediate inputs can better serve as a proxy for productivity shocks, as they are not typically state variables and are easily available from computation of value added (while investment is often truncated to zero in many datasets and thus not available).

Levinsohn and Petrin (2003) assume that the demand for the (log of) intermediate input, materials m_t, depends on the firm's state variables k_t and ω_t:

$$m_t = m_t(k_t, \omega_t)$$

Making mild assumptions about the firm's production technology (Levinsohn and Petrin 2003, Appendix A), the demand function is monotonically increasing in ω_t. This allows inversion of the intermediate demand function, so ω_t can be written as a function of k_t and m_t:

$$\omega_t = \omega_t(k_t, m_t)$$

The unobservable productivity term is now expressed solely as a function of two observed inputs. Final identification restriction assumes that productivity follows a first-order

9 This approach follows Javorcik (2004). Alternatively, the capital could be deflated using the GDP deflator, see Damijan et al. (2003), or even capital stock deflator if available, see Arnold et al. (2006).

10 This part draws heavily from Levinsohn et al. (2003) and Geršl et al. (2007).

Markov process:

$$\omega_t = E[\omega_t \mid \omega_{t?1}] + \xi_t$$

where ξ_t is an innovation to productivity that is uncorrelated with k_t. Thus, the production function can be rewritten as)

$$v_t = \beta_l l_t + \varphi_t(k_t, m_t) + \eta_t$$

where

$$\varphi_t(k_t, m_t) = \beta_0 + \beta_k k_t + \omega_t(k_t, m_t)$$

By substituting a third-order polynomial approximation in k_t and m_t in place of $\varphi_t(k_t, m_t)$, it is possible to consistently estimate parameters of the production function using OLS as

$$v_t = \delta_0 + \beta_l l_t + \sum_{i=0}^{3}\sum_{j=0}^{3-i} \delta_{ij} k_t^i m_t^j + \eta_t$$

where β_0 is separately identified from the intercept of $\varphi_t(k_t, m_t)$. Out of this first stage of the estimation, an estimate of β_l and an estimate of $\hat{\varphi}_t$ (up to the intercept) are available. The second stage of the estimation begins by computing the estimated value for $\hat{\varphi}_t$ using

$$\hat{\varphi}_t = \hat{v}_t - \hat{\beta}_l l_t = \hat{\delta}_0 + \sum_{i=0}^{3}\sum_{j=0}^{3-i} \hat{\delta}_{ij} k_t^i m_t^j - \hat{\beta}_l l$$

For any candidate value β^*_k, one can compute (up to a scalar constant) a prediction for ω_t for all periods *t* using

$$\hat{\omega}_t = \hat{\varphi}_t - \beta_k^* k_t$$

Using these values, a consistent (non-parametric) approximation to $E[\omega_t \mid \omega_{t-1}]$ is given by the predicted values from the regression

$$\hat{\omega}_t = \gamma_0 + \gamma_1 \omega_{t-1} + \gamma_2 \omega_{t-1}^2 + \gamma_3 \omega_{t-1}^3 + \varepsilon_t$$

which will be called $\hat{E}[\omega_t \mid \omega_{t-1}]$. Given $\hat{\beta}_l$, β_k^*, and $\hat{E}[\omega_t \mid \omega_{t-1}]$, the estimate $\hat{\beta}_k$ is defined as the solution to minimization of squared sample residuals of the production function

$$\min_{\beta_k^*} \sum_t (v_t - \hat{\beta}_l l_t - \beta_k^* k_t - \hat{E}[\omega_t \mid \omega_{t-1}])^2$$

Standard errors are estimated via bootstrap procedure, but may be also derived analytically.[11]

We estimate the equation (4) via fixed-effects estimator. To capture possible non-linear impact of all three variables representing foreign presence on productivity of local firms (Merlevede and Schoors 2005), we in addition include squared *horizontal*, *backward* and *forward*. As control variables, we use firm and year fixed effects as well as the Herfindahl

11 *Levinsohn and Petrin (2003) methodology is available as an ado file for Stata program where a bootstrap technique is used to derive standard errors, see Levinsohn et al. (2003).*

index as a proxy for the level of concentration and thus competition within the sector.[12] Sectoral competition can also push firms to increase their productivity regardless whether the competitors in the sector are foreign-owned or not.[13]

In order to test the robustness of the estimation results, we also calculated the total factor productivity alternatively using real depreciation (deflated by the same price indices as capital stock) instead of stock of capital (Jarolím 2000) and real wage bill (deflated by consumer price index) instead of number of employees (Arnold et al. 2006). Table 6.6 shows the results:

Table 6.6: Productivity spillovers – estimation results

	(1)	(2)	(3)	(4)
horizontal	0.667*	0.667**	0.184	0.43
horizontal^2	-1.298***	-1.148***	-0.827**	-1.135***
backward	4.907***	5.055***	2.790*	3.065**
backward^2	-12.219***	-12.64***	-8.216**	-9.201***
forward	2.144**	2.379**	2.548***	2.704***
forward^2	-7.164**	-6.846**	-7.612**	-7.440**
hhi	0.522**	0.390*	0.521**	0.535**
constant	6.617***	6.212***	3.825***	3.592***
Observations	11386	11325	11910	11848
Firms	3850	3835	3925	3910
R-squared	0.01	0.01	0.01	0.01

Dependent variable: ln TFP; * significant at 10%; ** significant at 5%; *** significant at 1%.

Estimated with firm and year fixed effects.

Note: ln TFP (dependent variable) computed using (1) capital and labour, (2) depreciation and labour, (3) capital and wage bill, (4) depreciation and wage bill

Despite the low performance of the model as documented by low R-squared, the results in all specifications can be interpreted as follows: first, the productivity spillovers tend to be significant and positive, at least to some degree of foreign presence (positive sign of coefficients of horizontal, backward and forward). This has not been always found in the empirical studies on CEE countries. Geršl et al. (2007) who analyze ten CEE countries show that in many countries the spillovers are insignificant or even negative.[14] Second, the results suggest that vertical effects tend to be higher and thus economically much more important than horizontal effects. This is in line with findings by Geršl et al. (2007), Merlevede and Schoors (2005, 2006) or Javorcik (2004). Third, both horizontal and vertical spillovers tend to be highly non-linear. The effect is positive up to a certain level of foreign presence, but turns negative after the foreign presence exceeds a certain threshold (around 50%). Non-linear effects are reported also by Merlevede and Schoors (2005) and Geršl et al. (2007), but the latter find that in some

12 *Herfindahl index was computed as a sum of squared shares of individual firms in the sectoral output. It thus ranges from almost 0 (no concentration) to 10 000 (maximum concentration, i.e. one firm produces the whole sectoral output - 100% squared).*

13 *The Hausman test showed that the hypothesis of no correlation between regressors and individual effects can be rejected, thus fixed-effects model is appropriate.*

14 *Negative or insignificant spillovers have been found by Damijan et al. (2003) or Torlak (2004).*

countries, the effect is opposite to the effect found for the Czech Republic (i.e. the spillover is negative for low foreign presence and turns positive after a certain threshold level is reached). Our findings thus indicate a potential for the market stealing effect after 2000 and some crowding-out of the domestic firms, but they might also be reflecting continued FDI inflow in these countries (i.e. purchases of more productive local firms by foreign companies). The coefficient of concentration as measured by Herfindahl index is significant and positive, suggesting that higher concentration (i.e. lower competition) is – a bit counter-intuitively - beneficial for productivity.

The results also indicate the largest effect on productivity is due to being a sub-supplier to a foreign company, albeit the effect is positive only for sectors with relatively low foreign presence. This is in line with some anecdotic evidence about supply networks such as automotive or ICT industries in Central Europe (European Commission 2003).

7 Estimating market access spillovers

Market access spillover is difficult to estimate precisely given the unavailability of data on export performance of individual companies. Thus, we construct a proxy for export performance, assigning a share of total exports to EU25 to individual firms in the same proportion as their share in industry (2-digit NACE) output. Clearly, this proxy overestimates the export performance of local firms, as foreign firms will probably export more of their output than local firms if they cam out of the relocation of production motive.

We estimate the equation (4), using fixed-effects estimator. As control variables, we used imports as a share of industry output, turnover and year fixed effects. The results are shown in Table 7.7.

Table 7.7: Market access spillovers – estimation results

	(1)	(2)
Imports	0.729***	0.728***
Turnover	0.131***	0.131***
horizontal	496.6***	680.3***
horizontal^2		-365.9
backward	1235**	1366
backward^2		-2381
forward	81.69	615.3
forward^2		-1646
constant	-297.0***	-296.4***
Observations	17180	17180
Firms	4976	4976
R-squared	0.7	0.70

* significant at 10%; ** significant at 5%; *** significant at 1%.

Estimated via fixed-effect estimator.

The results suggest that to the extent our proxy is a reliable estimate of export performance, there might be important horizontal and backward market access spillovers. However, the bias introduced by our proxy should be counterbalanced by the coefficient for horizontal spillovers that captures the effect of foreign companies on export of the total sub-industry. Thus, the coefficient of the variables backward and forward should be less biased, indicating that being a sub-supplier has important foreign market access implications. The regression using also non-linear effects did not prove to lead to significant estimates.

8 Estimating financing spillovers

As discussed above, foreign firms may influence the prospects for local firms to get external financing. In order to test for this financing spillover, we estimate again the equation (4) on the panel of domestic companies, using fixed-effect estimator.[15] As dependent variable, we use three alternative variables for leverage, i.e. the degree to which a company uses external debt financing: (a) the total debt to total liabilities (total debt), (b) short-term loans and long-term debt (bank debt)[16], (c) bank debt. Total debt includes long-term debt, short-term loans, creditors and other liabilities. As control variables, we use standard variables that are frequently used in the capital structure literature (Rajan and Zingales 1995; Bauer 2004), such as size of the company (log of total assets and log of total sales), profitability (return on assets), tangibility (ratio of tangible assets to total assets) and non-debt tax shield (proxied by depreciation over total assets).[17]

Table 8.8: Financing spillovers (access to credit) – estimation results

	Total debt	Bank debt	Long-term debt	Liabilities to creditors
Log of turnover	0.00985***	-0.000623	-0.000998	0.00541*
Log of total assets	-0.00809	0.0269***	-0.000429	-0.000667
RoA	-0.00413***	-0.000936***	-0.000472***	-0.00110***
Tangibility	-0.0905***	0.0493***	0.0396***	-0.125***
Non-debt tax shield	1.707***	-0.0437	-0.0669**	0.655***
horizontal	-0.0608*	-0.0271	-0.0233	-0.0307
backward	0.807***	-0.0739	-0.158	0.482***
forward	-0.173*	-0.0425	-0.0284	-0.407***
constant	0.480***	-0.145***	0.107***	0.125**
Observations	18009	18009	18009	18009
Firms	4937	4937	4937	4937
R-squared	0.17	0.01	0.01	0.04

Estimated via fixed-effect estimator. * significant at 10%; ** significant at 5%; *** significant at 1%.

15 The Hausman test indicates that fixed-effect estimator is appropriate.

16 Bank debt can of course include loans and other loan-type instruments (including bonds issued) from non-bank financial institutions (financial leasing etc.) and non-financial corporations (intra-group loans); we label the variable bank debt as probably majority of such debt is bank credit.

17 We have also tested for non-linearity of spillovers by including squared variables of foreign presence.

The results indicate that there is a positive and significant effect on the total debt of being a sub-supplier to foreign firms (Table 8.9). Thus, the results partly confirm the hypothesis that local firms involved in interactions with foreign firms along production chain have easier access to credit.

However, the regressions using other definitions of dependent variable show that there is no significant effect on bank or long-term debt, i.e. credit that would be suitable for financing of long-term investments. Thus, the remaining part of the total debt, i.e. current liabilities to creditors, is driving the results. Local companies that sub-supply to foreign firms do much more use financing from creditors. That could indicate that being a sub-supplier to foreign firms does not help in obtaining long-term credit from banks, but because sub-suppliers have to invest in order to be able to stay in the business with foreign clients, they use to a large extent short-term sources of finance (liabilities to creditors) for financing their activities. At the same time, the results suggest that horizontal financing spillovers are negative. Thus, local companies that are exposed to increased competitive pressure and brain-drain effects can have difficulties with access to credit. Thus, we do not confirm the hypothesis raised by Geršl and Hlaváček (2007).

Even if the data do not reveal any significant spillovers in the area of the access to long-term credit, the effect might go via cost of credit. Sub-supplier to foreign firms might get cheaper financing on loans, benefiting from the fact that being a sub-supplier stabilizes the demand for local firm's output and provides the local firm with expert knowledge and assistance from the foreign firm. Moreover, if there is also an effect on productivity of the local firms (productivity spillover), banks might be ready to regard such a local firm as a less risky client.

Table 8.9: Financing spillovers (interest rate charged) – estimation results

	Interest rate (total debt)	Interest rate (bank debt)
Total debt	-0.00549***	9.194
Tangibility	0.0119***	9.17
Cash flow to assets	-0.00561***	-4.59
Debt structure	-0.00137	-5.773
horizontal	0.0123**	43.72
backward	0.231***	290.3
forward	-0.0355**	-59.44
constant	-0.00298	-43.87
Observations	10135	8101
Firms	3725	3205
R-squared	0.02	0.00

Estimated via fixed-effect estimator. * significant at 10%; ** significant at 5%; *** significant at 1%.

Thus, we estimate again the equation (4), using as a dependent variable the interest rate. As the data do not include the level of interest rate individual companies are charged, we use the implicit interest rate computed in two alternative specifications: (a) interest rate paid over total debt, (b) interest rate paid over bank debt (i.e. short-term loans and long-

term bonds). As control variables, we use the standard determinants from the corporate finance literature (Horváth 2006), such as the total debt, liquidity (cash flow over assets), debt structure (share of long-term debt in total debt) and the available collateral (tangibility). Table 9 shows the results.

The results of the first regression show negative horizontal and backward vertical financing spillovers, i.e. higher presence of foreign companies increases the interest rate paid by local firms. For horizontal effect, this might be explained by the increased competitive pressure and brain-drain effects. However, the results for backward spillovers are a bit counterintuitive. The reason could be that local firms that serve as sub-suppliers run certain risks that are reflected in the interest rate margin charged by banks, for example client concentration (supplying only one foreign customer that could, however, change the sub-supplier in later stages). Anecdotic evidence indeed suggests that supplying only limited number of firms with specific products can leads to over-specialization that might become a risky strategy in case the foreign company relocates the production to other countries, for example.

9 Conclusions

The objective of this study has been to analyze three types of possible indirect effects from FDI on local companies in the Czech Republic, namely productivity spillovers, market access spillovers and financing spillovers. The firm-level data on performance and financing of manufacturing companies from the database Amadeus were analyzed in order to detect whether foreign presence in the same sector and in the industries along the production chain has any impact on productivity, export performance, leverage and cost of finance of local firms. Existing literature offers contradictive results, often finding both positive and negative effects.

Our results show that there are important positive productivity spillovers to local firms, both on the horizontal level (in the same industry) as well as on vertical levels (along production chain), but they have a non-linear shape. After the foreign presence reaches a certain threshold, the effects turn negative, a sign of brain-drain or too-high-competition effects. In any case, the vertical spillovers seem to be much more important than horizontal, suggesting that being a sub-supplier pays off.

As to market access spillovers, taking into account the limited information on exports, the results indicate that especially backward market access spillovers are significant. Thus, again, local companies that are engaged in providing supplies and inputs to foreign companies could access new markets via marketing and business networks of their clients.

Finally, we found that foreign presence does not increase the prospects of local companies to access long-term credit or get cheaper financing. On the contrary – foreign presence in the same sector as well as in downstream sectors increases the reliance of local companies on short-term finance (especially liabilities to creditors) and increases the cost of finance. Thus, we do not confirm the hypothesis of Geršl and Hlaváček (2007) that FDI inflows may help local firms to get external finance more easily.

However, all results are of course subject to caution, given the firm-level data limitations as well as imperfect capture of interaction between local and foreign firms. Thus, the effects of FDI inflows on the host economies remains a topic to be further researched more in detail and stays in the agenda of policymakers and economists in today's globalized world.

Abstract

Foreign direct investment has been one of the main drivers of economic developments over the past few years in Central and Eastern Europe (CEE). Within the ongoing globalization and international division of labor, a large number of foreign companies have established production units in CEE countries to benefit from low labor costs and other advantages. This study looks both in theoretical and empirical terms at whether large foreign presence has also affected domestic firms. Foreign firms might both intentionally and unintentionally influence the productivity, financing and export performance of local firms within the same industry or across industries along the production chain via sub-supplier and client linkages. Economic theory does not suggest unambiguous answer to a question whether the influence is positive or negative. For answering the question, both firm-level and industry-level data on performance, financing and exports and interactions of firms within production chain in the Czech Republic are analyzed.

Keywords

foreign direct investment; productivity; corporate finance; export performance

JEL classificiation / JEL klasifikace

F21, D24, L60, G32, F40

Souhrn

Přímé zahraniční investice jsou jedním z hlavních faktorů pozitivního ekonomického vývoje v zemích střední a východní Evropy v posledních letech. V rámci postupující globalizace a mezinárodní dělby práce přesunula řada zahraničních firem své produkční kapacity do zemí střední a východní Evropy, aby využila nižších mzdových nákladů a dalších výhod tohoto regionu. Tato studie se teoreticky i empiricky zabývá nepřímými dopady silného zahraničního zastoupení v podnikovém sektoru na domácí podniky. Zahraniční firmy mohou záměrně i nezáměrně ovlivnit produktivitu, exportní výkonnost i financování domácích firem ve stejném odvětví i v odvětvích propojených prostřednictvím dodavatelsko-odběratelských vztahů. Ekonomická teorie však nedává jednoznačnou odpověď na to, zdali je výsledný efekt pozitivní či negativní. Pro zodpovězení této otázky jsou analyzována data na podnikové i odvětvové úrovni zachycující výkonnost, financování a vzájemnou propojenost podniků v ČR.

Klíčová slova

přímé zahraniční investice; produktivita; podnikové financování; exportní výkonnost

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Od roku 2001 působí v České národní bance, v současnosti jako hlavní ekonom v samostatném odboru ekonomického výzkumu a finanční stability. Je držitelem Ceny Karla Engliše, což je Cena rektora Univerzity Karlovy v Praze pro nejlepší absolventy společenskovědních oborů.

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