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Firm Heterogeneity, Industry Characteristics and Types of FDI: The Case of German FDI in the Czech Republic*

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In addition to firm and industry characteristics, the heterogeneity of foreign direct investment (FDI) has to be taken into account when analyzing the determinants of outward FDI. We combine two firm-specific datasets on German firms with subsidiaries and joint ventures in the Czech Republic, compared to a control group of German firms without FDI in this host country. The impact of firm and industry characteristics on FDI decisions is assessed by estimating two-step Heckman models. We find that larger, more productive and more experienced firms are more likely to invest in the Czech Republic. Firm characteristics also affect the size of FDI. However, the relevance of firm and industry characteristics differs between the manufacturing and services sectors and depends on whether FDI is horizontal or vertical.

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1 Introduction

There is a vast literature on the determinants of foreign direct investment (FDI), and yet our understanding of what drives FDI has remained seriously deficient. The focus of most previous research is on one particular set of possible FDI determinants, i.e., host-country characteristics that (may) help attract FDI. The other side of the coin, the characteristics of the firms undertaking FDI and the industries to which these firms belong, has only recently become the subject of investigation.[1] Furthermore, earlier empirical studies rarely attempt to differentiate between major types of FDI, even

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1 Kravis and Lipsey (1982, p. 203) provide a notable exception: "Even in a single industry within a single parent country, firms with different characteristics will have very different propensities to produce abroad or to produce in particular countries."

though the relative importance of determinants is unlikely to be the same for horizontal and vertical FDI.

This paper addresses these gaps in the existing literature on the determinants of FDI. We consider firm characteristics to be major determinants of the choice of investing abroad (HELPMAN, MELITZ and YEAPLE 2004). To contribute to the empirical literature on firm-level heterogeneity we combine a largely unnoticed dataset on firm-specific German FDI in the Czech Republic with data for the parent companies as well as a control group of companies without FDI in the Czech Republic. We distinguish between FDI in manufacturing and services and account for important characteristics of the industries to which the German firms belong, including market structure, skill intensity and export orientation. Most notably, we introduce alternative proxies which help us assess differences between horizontal and vertical FDI.

Germany belongs to the most important home countries of FDI,[2] and the Czech Republic represents a host country whose attractiveness to FDI has raised widespread concerns about the repercussions of offshoring in the home countries, particularly in Europe. The bilateral FDI context is clearly relevant for both Germany and the Czech Republic. By the end of 2006, Germany accounted for 21 percent of overall FDI stocks, second only to the Netherlands with 27 percent, according to data from the Czech National Bank.[3] At the same time, the Czech Republic figures prominently as a destination of German FDI. FDI stocks reached almost €19 billion in 2006, compared to €15.5 billion in China and India taken together (DEUTSCHE BUNDESBANK 2008). German firms employed about 250.000 workers in the Czech Republic, more than twice as many as in India and 100.000 more than in Hungary.[4] Apart from quantitative relevance, previous research indicates that German firms have both horizontal and vertical motives to invest in the Czech Republic (e.g., MARIN, LORENTOWICZ and RAUBOLD 2003; BECHERT and CELLARIUS 2004; BUCH, KLEINERT, LIPPONER and TOUBAL 2005). This allows us to assess the relevance of firm and industry characteristics for major types of FDI.

2 It is only the United States and the United Kingdom whose outward FDI stocks clearly exceeded Germany's outward FDI stocks in 2006 (UNCTAD 2007).

3 http://www.cnb.cz/m2export/sites/www.cnb.cz/en/statistics/bop_stat/bop_publications/pzi_books/PZI_2006_EN.pdf (as of July 2009).

4 Note that smaller German investors (affiliates with balance sheets of less than € 3 million) are not covered in the FDI statistics of Deutsche Bundesbank. Hence, FDI stocks as well as FDI-related employment tend to be understated by these figures.

The structure of the paper is as follows. Section 2 provides a short overview of the relevant literature. In Section 3 we describe the firm-specific data used here, and provide some stylized facts on German firms' FDI in the Czech Republic. We employ Heckman selection models to assess the impact of firm and industry characteristics and present the estimation results in Section 4. We find that larger, more productive and more experienced firms are more likely to invest in the Czech Republic. However, the relevance of firm and industry characteristics depends on the sector in which FDI takes place and on whether FDI is horizontal or vertical. Section 5 concludes.

2 Previous literature

Similar to most of the existing literature on FDI determinants, recent studies focusing on host countries in Central and Eastern Europe typically employ aggregate FDI data to assess the importance of location factors that may help attract FDI at the sector, regional or host-country level (e.g., Resmini 2000; Kinoshita and Campos 2003; Carstensen and Toubal 2004; Boudier-Bensebaa 2005). Blonigen (2005, p. 4) stresses that this literature "either ignore(s) … micro-level factors or assume(s) they are controlled for through an average industry- or country-level fixed effect."

Firm heterogeneity plays an important role in the decision to invest abroad, as established by Helpman, Melitz and Yeaple (2004). Consequently, the recent empirical literature increasingly refers to firm-specific data to address host-country characteristics and firm-level controls as possible pull and push factors of FDI. Buch, Kleinert, Lipponer and Toubal (2005, p. 84) apply firm-level FDI data for German companies, accounting for heterogeneity mainly by including "a full set of firm-specific fixed effects." Buch et al. conclude that heterogeneity matters considerably for FDI-related internationalization patterns. However, the database of the Deutsche Bundesbank offers little specific information to account for firm heterogeneity.[5] Javorcik and Spatareanu (2005) explicitly control for firm size and the number of foreign subsidiaries in their Tobit model on FDI flows across 19 European countries. But the degree of firm heterogeneity is reduced considerably by limiting the analysis to the largest European companies.

5 Furthermore, as noted before, the database of the Deutsche Bundesbank may underreport substantially FDI by smaller German firms.

Another group of studies provides a more detailed account of firm-specific characteristics.[6] However, the analysis is often limited to the second stage of the decision process, i.e., determining the size or form of FDI after the firm has opted for FDI in the first place. For instance, several studies focus on the choice between wholly owned subsidiaries and joint ventures but do not address the selection of firms into the FDI group by including a control group without any form of FDI (e.g., Gomes-Casseres 1989; Blomström and Zejan 1991; Asiedu and Eesfahani 2001; Raff, Ryan and Stähler 2009).

By contrast, Raff, Ryan and Stähler (2007) analyze a sequence of internationalization decisions by Japanese firms, starting with the choice between exporting and FDI. Controlling for industry and host-country characteristics, it turns out that more productive Japanese firms are more likely to choose (i) FDI rather than exporting, (ii) greenfield FDI rather than M&As, and (iii) fully owned subsidiaries rather than joint ventures. Görg, Mühlen and Nunnenkamp (2010) are mainly interested in how India's economic reform programme affected a two-stage decision process of German firms: (i) the choice of whether or not to undertake FDI, and (ii) the share of ownership in foreign affiliates.

Raff, Ryan and Stähler (2007) deliberately confine their analysis to horizontal FDI and restrict their sample of Japanese firms accordingly. Likewise, Raff, Ryan and Stähler (2009) consider only advanced OECD host countries where FDI is most likely to be horizontal. Lower-income host countries are excluded by these authors as FDI in many of those host countries is still subject to restrictive regulations. Under such conditions, it is almost impossible to isolate the firms' autonomous selection of FDI locations as well as their choice of ownership in foreign affiliates in the context of cross-country estimations covering completely open as well as restrictive host countries.

Isolating firms' choices from the effects of host-country regulation may even prove difficult in a country-specific context. In India, for example, FDI and ownership restrictions were relaxed gradually throughout the 1990s which tends to blur FDI-related firm decisions during this period (Görg, Mühlen and Nunnenkamp 2010). However, such problems can largely be ruled out for the case of German FDI in the Czech Republic. While the Czech Repub-

6 For example, Geishecker, Görg and Taglioni (2008) characterize MNEs from twelve European home countries.

lic is a full EU member only since 2004, the so-called Europe Agreement with the EU had been in force since 1995. The Europe Agreements covered not only trade liberalization but also the deregulation of capital flows between EU member countries of the time and accession countries such as the Czech Republic. Almost half of all FDI cases listed in GCCIC (2008) fall into the period 1995–2007, and many previous cases have probably anticipated the conclusion of the Europe Agreement. Note also that the OECD ranks the Czech Republic next to the United States and better than the OECD average with respect to FDI restrictions in 1998–2000 (Golub 2003).

Hence, it can reasonably be assumed that German FDI decisions are not seriously distorted by FDI-related regulations and restrictions imposed by the Czech government. At the same time, the case of the Czech Republic can be expected to offer new insights compared to previous studies covering only horizontal FDI. The Czech Republic appears to be attractive to both horizontal and vertical FDI (Marin, Lorentowicz and Raubold 2003; Bechert and Cellarius 2004; Buch, Kleinert, Lipponer and Toubal 2005). Analyzing German FDI in this host country may thus help overcome the shortage of empirical studies combining firm and industry characteristics as possible driving forces of different types of FDI.

3 Firm-level data and stylized facts

We combine two firm-specific datasets to assess the determinants of German company decisions on FDI in the Czech Republic. The first source, the German-Czech Chamber of Industry and Commerce (GCCIC 2008), provides detailed information on more than 1200 German subsidiaries in the Czech Republic and partnerships of German and Czech firms.[7] The second source, the online databank of Hoppenstedt (2009), a commercial data provider, contains company profiles of German companies with more than ten employees or annual sales of more than one million Euro, including most of the parent firms with engagements in the Czech Republic.

The directory compiled by the German-Czech Chamber of Industry and Commerce covers subsidiaries (Tochtergesellschaften) of German firms in the Czech Republic, partnerships (Beteiligungen) and joint ventures with

7 Note that 1228 observations remain after dropping 163 entries without a German parent or partner given in the GCCIC database.

Czech firms and other (not specified) collaborations. Subsidiaries account for almost 70 percent of all cases listed in GCCIC (2008).[8] The snapshot provided relates to the situation as of 2007. It offers information on the year when the German parent firm engaged in the FDI project as well as annual sales and employment of the subsidiary or joint venture.[9] It is also stated in the source where exactly in the Czech Republic the subsidiary or joint venture is located.

Most subsidiaries and joint ventures with German FDI in the Czech Republic are fairly small. More than 60 percent employ up to 50 workers; only six percent employ more than 500 workers. It is important to note that the unit of observation in GCCIC (2008) is the subsidiary, or joint venture, rather than the German parent or partner company.[10] Some German companies are actually involved in several FDI projects. Examples include major German companies such as Bosch, Lufthansa, Siemens, ThyssenKrupp, and Volkswagen. But there are also various smaller and less known firms that have more than one subsidiary in the Czech Republic, both in the manufacturing and services sectors.

In addition to GCCIC (2008), we use Hoppenstedt's company profiles to obtain information on the German parent firms (HOPPENSTEDT 2009). From this online database we draw: (major and minor) line(s) of business with NACE industry code(s) (version 1.1), annual sales, number of employees, and number of foreign affiliates. Stand-alone companies clearly dominate our sample of German parents with FDI in the Czech Republic. Less than one third of all German parents employ more than 500 workers. Apart from stand-alone companies, HOPPENSTEDT also presents data on employees and sales for (i) specific firms belonging to a company group or conglomerate ("Konzern") and (ii) the company group as a whole. We do not use data for company groups in order to avoid a heavily skewed sample. However, we complement the data on stand-alone companies by firm-level data available from HOPPENSTEDT for 77 parents in the Czech FDI sample that belong to a company group in Germany.

8 In line with conventional definitions, we assume that a subsidiary is a firm in which the parent corporation owns at least a majority of the shares and has full control. By contrast, ownership shares and control tend to be less in partnerships and joint ventures.

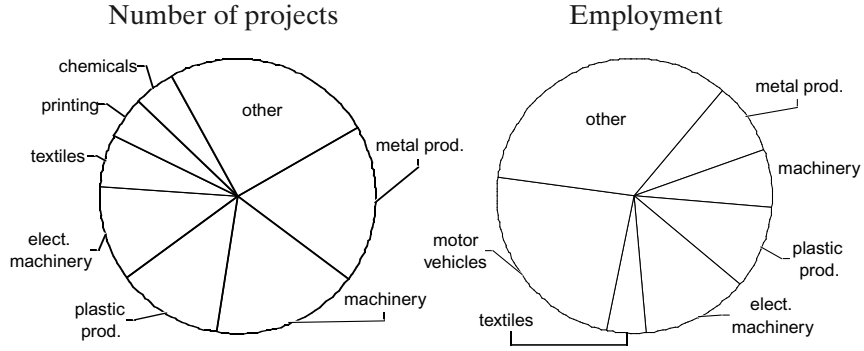
9 Employment data are missing for only 79 out of 1228 observations. By contrast, annual sales are available for just about half the overall sample.

10 The same applies to the data used by MARIN, LORENTOWICZ and RAUBOLD (2003) as well as RAFF, RYAN and STÄHLER (2007).

As concerns the distribution across sectors of German FDI in the Czech Republic, the primary sector (agriculture and mining) accounts for just one percent of all FDI projects. FDI in services (including construction and public utilities) dominates over FDI in manufacturing with regard to the number of projects (55 and 44 percent, respectively). However, FDI projects in services industries tend to be smaller than those in manufacturing. Consequently, FDI-related employment in Czech manufacturing exceeds FDI-related employment in the services sector by a factor of 1.5. German FDI is concentrated also within the manufacturing and services sectors (Figure 1). Four industries (plastic products [25], metal products [28], machinery [29], and electrical machinery [31]) account for almost 60 percent of all FDI projects in manufacturing.[11] Wholesale trade [51] alone contributes 30 percent of projects in the services sector, followed by "other business activities" [74] with 16 percent and construction [45] with 12 percent. Again, the ranking of industries changes once the average size of FDI projects is taken into account. Most notably, the production of motor vehicles [34] ranks at the top with regard to FDI-related employment in manufacturing, even though it contributes just four percent to the number of projects. In the services sector, post & telecommunications [64] is second only to wholesale trade in terms of FDI-related employment, while there are just five projects in this industry.

Figure 1a: Distribution of German FDI across Czech Manufacturing and Services Industries[a]

a) Manufacturing



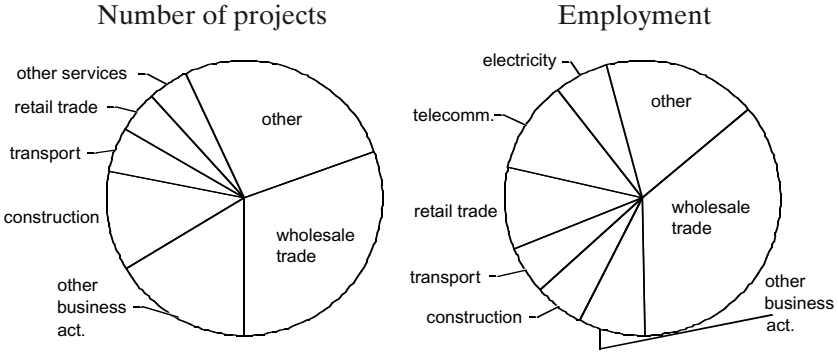
a Panel a) manufacturing = 100; Panel b) services, including construction and public utilities = 100.

Source: GCCIC (2008).

11 NACE 1.1 industry codes in square brackets.

Figure 1b: Distribution of German FDI across Czech Manufacturing and Services Industries[a]

b) Services



a Panel a) manufacturing = 100; Panel b) services, including construction and public utilities = 100.
Source: GCCIC (2008).

In order to assess the determinants of German firms' choices to invest in the Czech Republic, we compare the firms listed in GCCIC (2008) with a similarly large group of German firms without FDI in the Czech Republic. This control group has been selected randomly from the universe of about 250.000 German firms listed by Hoppenstedt. More precisely, the control group principally consists of every 200th entry in this alphabetically ordered database.[12] The list of variables collected from Hoppenstedt for the control group is exactly the same as for the sample of German parent companies with FDI in the Czech Republic.

Before turning to our empirical model in the next section, a simple inspection of the data reveals some interesting features of our sample of German firms with FDI in the Czech Republic (FDI group), in comparison with the control group. Measuring firm size by the number of employees, firms in the FDI group are by far larger than firms in the control group (Table 1). At the same time, the median of labour productivity for all firms in the FDI group exceeds the corresponding figure for the control group by 30 percent. The difference in labour productivity essentially remains the same when restricting the FDI group to German subsidiaries, i.e., excluding joint ventures and partnerships in which the German equity share tends to be

12 Note that we skipped multiple entries for various branches of the same company. For instance, Hoppenstedt lists about 6000 entries under "Sparkasse", i.e., local savings banks, including various branches without data on employment and turnover.

lower. Note also that firms with FDI continue to be more productive when narrowing the huge difference in average size between the FDI and control groups.[13] The FDI and control groups have in common that firm size is smaller and labour productivity is higher in the services sector than in manufacturing. In both sectors, however, the labour productivity in the FDI group exceeds that in the control group by a similar margin.

Table 1: Size and Labour Productivity of German Firms with and without FDI in the Czech Republic[a]

	All firms		21-500 employees		Manufacturing		Services[d]	
	FDI group[c]	Control group	FDI group	Control group	FDI group	Control group	FDI group	Control group
#employees	230 (280)	22	140	50	260	30	120	17
Labour productivity[b]	0.195 (0.196)	0.150	0.181	0.134	0.181	0.133	0.275	0.194

a Median based on firm-specific data for 2006 or closest year available.
b Turnover per employee.
c Subsidiaries (Tochtergesellschaften) in parentheses.
d Including construction and public utilities.

Source: Hoppenstedt online databank.

4 Methodology and Results

Baseline approach and results

In our empirical analysis we model the FDI decision of German firms in the Czech Republic as a two-step problem. First, firms decide whether or not to invest in the Czech Republic. This zero/one decision is supposed to depend on firm *(i)* and industry *(j)* characteristics,

$$Pr(FDI_i) = \beta_1 X_i + \beta_2 Z_j + \beta_3 Div_i + e_i \qquad (1)$$

Equation (1) is estimated using data for the German investors as well as the control group as defined in the previous section. For those firms that

13 By limiting both groups to firms with 21–500 employees, the FDI group is reduced by about 300 observations, 75 percent of which fall into the size class of >500 employees. By contrast, the control group is reduced by about 400 observations, almost 95 percent of which fall into the size class of <21 employees.

do invest in the Czech Republic, we can then also model the choice of the size of the foreign affiliate,

$$Size_i = \alpha_1 X_i + \alpha_2 Z_j + \lambda_i + v_i \quad (2)$$

where *Size* is the number of employees employed in the foreign affiliate of firm *i*.

This model is estimated using the HECKMAN (1979) two-step procedure. X_i denotes a vector of firm characteristics, and Z_j a vector of industry characteristics. The parameter λ_i in equation (2) captures the probability of firm *i* being observed in this second step (inverted Mills ratio in Heckman's parlance) and v_i is the remaining error term. Equation (1) includes the same set of variables in the selection equation as well as one additional variable to aid identification. The additional variable Div_i is a proxy for the degree of diversification of firm *i,* i.e., the number of industries (5-digit NACE) in which the firm is active, affecting the selection but not the size of FDI projects (see also below).[14] We argue that the degree of diversification can be interpreted as an indicator of sunk costs of investment at the level of the firm, where more diversified firms are revealed as having lower sunk costs. This implies that more diversified firms should be more likely to select into FDI.

Vector X_i includes size (measured in terms of employment of the German parent), productivity (measured as labour productivity), and the number of existing foreign affiliates (as a measure of experience in foreign markets). Productivity is highlighted in theoretical and empirical work by RAFF, RYAN and STÄHLER (2007, p. 2009). We control for firm size, "the company attribute that has most frequently been identified as determining the propensity to produce outside the home country" (KRAVIS and LIPSEY 1982, p. 203). Again in line with earlier studies, previous experience with foreign affiliates is supposed to affect current FDI decisions, even though the effect may not be strictly positive if the sample largely consists of relatively small parent firms that tend to be constrained financially.

The firm-specific variables X_i are complemented by variables Z_j at the industry level. The baseline model includes a proxy for skill intensity as well

14 Strictly speaking, identification of the two-step estimation does not hinge on this additional variable. If there were no additional variable in the first step, identification would be solely on the different functional form of the two equations. We also experimented with including Div_i in the second step, but the variable turned out to be statistically insignificant.

as a measure of market structure.[15] Skill intensity is defined as gross (annual) wages and salaries per employee (1000 Euro). Its impact on FDI decisions is theoretically ambiguous. Skills may reflect higher productivity at the industry level and, thus, increase the likelihood of FDI. However, skill intensive industries may also have weaker incentives and less pressure to undertake vertical FDI to save costs. Moreover, the measure of skill intensity suffers from the (data enforced) shortcoming that it increases also if average wages for all skill categories are relatively high in a particular industry.[16] Market structure is measured by the number of firms in an industry per 1000 Euro of gross value added (at factor costs) of that industry. On the one hand, the incentive to undertake FDI, in particular vertical FDI, might be stronger in more competitive industries. On the other hand, foreign investors belonging to industries that are populated by a large number of small firms might be financially constrained when deciding on FDI.

It should be stressed that we draw on cross-section data. Without convincing instruments, it is therefore difficult to control for possible endogeneity. The firm-level variables included, in particular productivity and size, may be jointly determined with the decision to invest in the Czech Republic and /or the size of those investments. However, there is little reason to be concerned about reverse causality running from German FDI in the Czech Republic to parent firm characteristics. As noted before, most German FDI projects are fairly small, involving no more than 50 local workers. Still, in order to mitigate the problem, we follow Raff, Ryan and Stähler (2009) and lag firm size and productivity in equations (1) and (2).

Table 2 presents the estimations of the baseline model in columns (1) and (2). The selection equation in column (1) includes the degree of firm-level diversification as the exclusion variable which is significantly positive at the five percent level. The two industry characteristics – skill intensity and market structure – are statistically insignificant in both steps of the baseline estimation for the overall sample of almost 1200 German firms.[17] By contrast, firm characteristics turn out to be highly significant in both steps of the FDI

15 Skill intensity is at the 4-digit NACE level if available, 2-digit level otherwise. All industry-level data are from Stastistisches Bundesamt (2009) (http://www.destatis.de/jetspeed/portal/cms/; accessed: December 2009). Note that the German *Warenverzeichnis* (WZ 2003) corresponds with NACE revision 1.1. Ideally, one would of course refer to skill intensity at the firm level. However, these data are generally not available; see Marin, Lorentowicz and Raubold (2003) for related survey data on German FDI projects in Eastern Europe. See below for further industry characteristics included in an extended specification.

16 For instance, this applies to the German automobile industry (Nunnenkamp 2006).

17 Note that the number of observations underlying the estimations decreases compared to the basic data described in Section 3, due to missing values for some firm and industry characteristics.

decision. In line with previous research, larger German parent firms are more likely to self-select into the FDI group, and they also engage in larger FDI projects in the Czech Republic. Likewise, productivity of the German parent matters in both steps; the effect is significantly positive at the five percent level. Selection into the FDI group, but not the size of FDI, also depends positively on previous experience in operating abroad, proxied by the number of foreign affiliates of the German parent. While the positive effect of experience was to be expected, it may be more surprising that FDI selection is *more* likely for more diversified firms.[18] As will be shown next, the latter effect holds only for FDI in the services sector.[19]

Sector-specific FDI

In columns (3)–(6) of Table 2, we split the overall sample into FDI projects in the manufacturing and services sectors. Splitting the sample in this way may be considered a first, though admittedly crude, attempt to differentiate between horizontal and vertical FDI. UNCTAD (2004, p. 108) noted recently that "most services FDI is still market-seeking," whereas manufacturers have increasingly pursued vertical specialization across countries.

Some of our baseline results carry over to FDI in both sectors. The relevance of the two industry characteristics continues to be limited. This applies especially to our proxy of skill intensity at the industry level. As for market structure, we do not find evidence that the incentive to invest in the Czech Republic is relatively strong for German parents in more competitive (manufacturing or services) industries, proxied by the number of firms normalized by gross value added generated in this industry.[20] Rather, a larger population of firms in an industry is negatively correlated with the likelihood of FDI in the services sector and the size of FDI projects in manufacturing. The former result may be due to FDI in trading activities. Competition in trade appears to be fierce even though a limited number of large firms may dominate the industry. At the same time, large trading companies were highly likely to undertake FDI in order to penetrate new Czech markets. The latter result on the size of FDI in manufacturing is plausible given that higher values of our market structure variable imply that parent firms are on

18 Earlier studies find that more diversified parent firms are less likely to engage in wholly owned or majority owned foreign affiliates (Blomström and Zejan 1991; Asiedu and Esfahani 2001).

19 Note that the insignificance of the exclusion variable for FDI in manufacturing is not a major problem. As reflected in the p-values in Tables 2–4, the inverse Mills ratio is insignificant in essentially all estimations for sub-samples. The estimations are thus unlikely to suffer from serious selection bias.

20 The underlying argument is that a sufficiently large number of firms in an industry prevents collusion.

average smaller in this industry, in terms of gross value added. In other words, FDI projects tend to be smaller in manufacturing industries populated by smaller firms.

Turning to parent characteristics, results for the manufacturing and services sectors are similar in two major respects. As was to be expected, firm size of the German parent enters positive and significant (at the five percent level or better) for the selection as well as the size of FDI in both sectors. More surprisingly perhaps, the parent's labour productivity matters only at the second stage of deciding on the size of FDI, while the selection of FDI in both sectors is not affected in a statistically significant way. In services some ambiguity may be due to the combination of a limited number of uncensored observations and the tremendous variety of firms belonging to this sector. As noted in Section 3, this sector is broadly defined, ranging from business services and trade to public utilities and construction. In manufacturing the prevalence of different motives for FDI may render the effect of the parent's productivity on selection ambiguous. In particular, less productive parents may be under pressure to self-select into the FDI group in order to cut costs by means of vertical FDI.

At the same time, Table 2 reveals some striking differences between sectors as concerns the relevance of firm characteristics in the two-step decision of German firms on FDI in the Czech Republic. As already noted, it is only in the services sector that more diversified parents are more likely to undertake FDI. This may be attributed to relatively strong incentives of engaging in horizontal FDI when the product lines of the parent cover a broader spectrum of profitable market opportunities in the host country.

Manufacturing and services FDI also differ with respect to the role of previous foreign experience. Previous experience with operating foreign affiliates does not significantly affect FDI in the services sector. This indicates that horizontal FDI was a reasonable option to penetrate neighbouring Czech markets even for German firms that had been reluctant to enter more distant markets through FDI. This may apply especially to German parent firms located in Saxony, most of which were quite familiar with market conditions across the border though being newcomers in terms of FDI.

By contrast, the selection of FDI in the manufacturing sector depends positively on previous foreign experience. In the second step of deciding on the size of manufacturing FDI, however, the number of foreign affiliates enters significant with a negative sign. This may be due to financial constraints of

German parent firms. As noted in Section 3, most parent firms in our sample belong to the so-called *Mittelstand* with a median of little more than 200 employees (Table 1). Many of these firms tend to command limited resources to finance several foreign affiliates. Nonetheless they opted for FDI after the regime change in the Czech Republic, but for relatively small FDI projects.

Table 2: Baseline Results and Sector-specific FDI in Manufacturing and Services

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline estimation Heckman		Manufacturing Heckman		Services Heckman	
	Selection	Size of FDI	Selection	Size of FDI	Selection	Size of FDI
Firm variables						
ln(size)	0.457***	0.217***	0.515***	0.251***	0.358***	0.218**
	(0.037)	(0.061)	(0.050)	(0.074)	(0.054)	(0.108)
ln(productivity)	0.363**	0.497**	0.273	0.974**	0.234	0.466*
	(0.156)	(0.225)	(0.398)	(0.442)	(0.177)	(0.251)
# affiliates	0.243***	-0.030	0.191***	-0.044**	6.031	0.036
	(0.048)	(0.020)	(0.048)	(0.021)	(270.227)	(0.052)
diversification	0.089**		0.047		0.161**	
	(0.044)		(0.059)		(0.067)	
Industry variables						
ln(skill intensity)	0.036	0.918	0.913	-0.984	-0.636	4.115
	(0.985)	(1.407)	(1.216)	(1.627)	(2.303)	(3.446)
ln(market structure)	-0.095	-0.317	0.342	-0.873***	-0.334**	-0.078
	(0.179)	(0.231)	(0.339)	(0.322)	(0.167)	(0.248)
Observations	1194		743		451	
uncensored obs	608		479		129	
Wald test (p-value)	0.000		0.000		0.000	
Mills ratio (p-value)	0.046		0.260		0.316	

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Regressions (1)–(4) include three-digit industry dummies. Regressions (5) and (6) include two-digit industry dummies.

Vertical versus horizontal FDI in manufacturing

Given the limited number of uncensored observations for which the required data on firm and industry characteristics are available in the services sector we focus on the manufacturing sector for the subsequent estimations. Excluding services allows for an extended specification of equations (1) and (2) by considering an additional industry characteristic, i.e., the export orientation of the German industry to which the parent firm belongs.[21]

21 Data on export shares are available from STATISTISCHES BUNDESAMT at the 4-digit level. The export share in each industry is defined as the share of turnover abroad in total turnover.

Including export intensity in the model accounts for the well know product cycle hypothesis of VERNON (1979), according to which firms undertake FDI on the basis of previous export experience. For a start, we therefore replicate the estimation of the Heckman model for manufacturing as a whole. It is reassuring that the results for all variables included in the baseline specification (Table 2, columns 3 and 4) are essentially unaffected when adding the export share to the set of industry characteristics (Table 3, columns 1 and 2).[22] The export share enters significantly positive at the five percent level in the first stage, while remaining insignificant in the second stage. We will return to this finding after introducing the distinction between horizontal and vertical FDI in manufacturing.

We pursue alternative ways of distinguishing between vertical FDI and horizontal FDI for the subsample of German manufacturing firms. The first option is to draw on patterns of bilateral trade between Germany and the Czech Republic.[23] We make use of the concept of revealed comparative advantage (RCA) to categorize all FDI cases as either vertical or horizontal.[24] More precisely, FDI cases are assumed to be vertical (horizontal) when the German parent is operating in an industry j for which the Czech Republic's RCA is positive (negative):

$$RCAC_{z,j} = (XC_{z,j} - MC_{z,j}) / (XC_{z,j} + MC_{z,j}) \qquad (3)$$

with X and M denoting Czech exports to Germany and, respectively, Czech imports from Germany in industry j.[25] This is clearly an imperfect indicator, but arguably informative as vertical FDI leads to bilateral trade, notably from the host to the home country of multinational companies (MARKUSEN 2002). Classifying the type of German FDI in the Czech Republic according to equation (3) results in 177 cases of vertical FDI and 284 cases of horizontal FDI.

Columns (3)–(6) in Table 3 present the results when estimating the extended specification of the Heckman model for the two types of FDI in

22 This also holds when extending the specification further by adding R&D intensity to the list of industry characteristics. We do not report these results in detail since R&D intensity typically turned out to be insignificant for both types of FDI.

23 For a similar approach, see GÖRG, MÜHLEN and NUNNENKAMP (2010).

24 BALASSA (1965) suggested that a country's comparative advantage is "revealed" by observed trade patterns.

25 See GREENWAY and MILNER (1993: 181–208) for a review of alternative RCA measures. For the measure defined in equation (3), the Czech RCA may range from –1 (XCz,j = 0) to +1 (MCz,j = 0). Trade data are from the OECD's International Trade by Commodities database. We use data for 2006. The matching of trade data according to SITC, Revision 3 with the NACE codes for which our sample contains German FDI cases is mostly at the 3-digit NACE level.

manufacturing as just defined. The relevance of firm characteristics is fairly similar for the selection of both types of FDI. Parent size enters highly significant in columns (3) and (5), while the parents' productivity remains insignificant as for the selection in total manufacturing before. However, the relevance of industry characteristics differs strikingly in one major respect between the selection of vertical FDI and the selection of horizontal FDI. The selection of horizontal FDI depends on the German industry's export orientation, with higher export shares increasing the likelihood of horizontal FDI in the Czech Republic at the one percent level of significance. As concerns vertical FDI, the export share tends to enter the selection equation with a negative sign, though remaining insignificant at the ten percent level.

The different role of export orientation at the industry level for selecting horizontal and vertical FDI appears to be plausible when recalling the product cycle hypothesis of VERNON (1979). Accordingly, firms tend to "move from home-based innovation to the possibility of exports and ultimately of overseas investment" (p. 265). The international environment has changed in too many respects for this hypothesis still to command general validity. In particular, multinational companies with an established international network of vertically integrated production facilities are unlikely to follow the traditional sequence of FDI replacing exports. However, smaller firms with less international experience and being primarily interested in exploiting the potential of neighbouring markets may turn to FDI only after having established themselves as successful exporters. Many German firms with FDI in the Czech Republic tend to belong to the latter category, as indicated by the stylized facts reported in Section 3 above.

In the second step of deciding on FDI, industry characteristics play no role for the size of horizontal FDI. The negative effect of the market structure variable on the size of vertical FDI resembles the finding in column (2) for total manufacturing. If the reasoning above that FDI projects tend to be smaller in industries populated by smaller firms applies mainly to vertical FDI, this could also explain why the parents' size has a relatively weak impact for this type of FDI. The coefficient of parent size is small for vertical FDI (column 4), compared to horizontal FDI (column 6), and almost fails to pass the ten percent level of significance. Another striking difference between the two types of FDI concerns the correlation of parent firms' productivity with the size of FDI projects. The correlation is significantly positive only for the size of horizontal FDI, whereas the correlation turns out to be insignificant for the size of vertical FDI. It thus appears that the link between parent productivity and FDI is blurred at both stages of deciding on

vertical FDI. As indicated above, this could be due to vertical FDI being driven by the incentive of less productive firms to improve their competitive position in this way, rather than higher productivity being a precondition for FDI.

Table 3: Extended Manufacturing Model and Vertical vs. Horizontal FDI

	(1)	(2)	(3)	(4)	(5)	(6)
	Extended Manufacturing Model Heckman		Vertical FDI Heckman		Horizontal FDI Heckman	
	Selection	Size of FDI	Selection	Size of FDI	Selection	Size of FDI
Firm variables						
ln(size)	0.530***	0.245***	0.672***	0.166*	0.471***	0.390***
	(0.051)	(0.075)	(0.118)	(0.096)	(0.063)	(0.103)
ln(productivity)	0.272	1.013**	-0.024	1.368	0.067	1.158**
	(0.398)	(0.442)	(1.004)	(0.982)	(0.460)	(0.492)
# affiliates	0.182***	-0.044**	0.487**	-0.095***	0.180***	0.009
	(0.048)	(0.021)	(0.231)	(0.032)	(0.061)	(0.030)
diversification	0.048		0.031		0.110	
	(0.060)		(0.115)		(0.086)	
Industry variables						
ln(skill intensity)	0.547	-1.100	4.260	-8.080*	-1.836	1.228
	(1.249)	(1.630)	(6.492)	(4.328)	(1.652)	(1.885)
ln(market structure)	0.436	-1.012***	-0.372	-1.550***	0.446	-0.112
	(0.346)	(0.337)	(1.343)	(0.538)	(0.528)	(0.527)
ln(export share)	0.581**	-0.626	-1.791	0.145	0.899***	-0.546
	(0.271)	(0.401)	(1.478)	(1.264)	(0.342)	(0.464)
Observations	742		254		418	
uncensored obs	478		177		284	
Wald test (p-value)	0.000		0.000		0.000	
Mills ratio (p-value)	0.240		0.037		0.472	

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions include three-digit industry dummies.

In Table 4, we re-estimate the extended Heckman model for the two types of FDI in manufacturing by distinguishing in an alternative way between vertical and horizontal FDI. We follow the conventional assumption that FDI is horizontal if the foreign affiliate operates in the same industry abroad as the parent firm at home (e.g., ALFARO and CHARLTON 2009). FDI is assumed to be vertical whenever the main line of business differs between the home and the host country.

It is difficult to decide which of the two classifications is closer to reality.[26] The disadvantage of classifying FDI according to the RCA concept is that

26 Ideally, one would refer to the relevance of intra-firm trade and/or the share of affiliate output that is sold in the host country or in the parent's home country. However, this information is typically not available.

this measure is industry-based, rather than firm-specific as the comparison of main lines of business at home and abroad. Nevertheless, we regard the weaknesses of the latter approach to be more serious than those of the RCA measure. For instance, FDI in the Czech Republic by German automobile producers appears to be horizontal when comparing lines of business; the final good, finished cars, is the same at home and abroad. Yet the RCA measure may correctly reflect this to be vertical FDI, considering that German automobile producers tend to relocate the production of lower-segment cars to Central European countries offering cost advantages (Nunnenkamp 2006). On the other hand, the RCA measure would correctly rate FDI to be horizontal if a parent undertook FDI to promote sales of its home-based production in the host country or to improve after-sales services for local customers.[27] More generally, the RCA measure is probably less affected by the level of industry aggregation. Alfaro and Charlton (2009) argue that the importance of horizontal FDI may be overstated systematically when the industry aggregation is relatively high. An opposite bias might be introduced if the distinction between horizontal and vertical FDI were based on very specific business lines.

Applying the alternative classification at the 2-digit NACE level, the number of vertical FDI cases in our sample increases from 177 in Table 3 to 284 in Table 4. Nevertheless, several results prove fairly stable when comparing the estimation results in Table 4 with those in Table 3.[28] The selection equation for vertical FDI is essentially unaffected by applying the alternative classification of FDI. The same is true for the selection of horizontal FDI; in particular, the finding holds that German parents in export-oriented industries are more likely to undertake horizontal FDI in the Czech Republic. Finally, horizontal FDI projects continue to be larger when undertaken by larger and more productive German parents, whereas results turn out to be more ambiguous in the second step of the decision process on vertical FDI.

27 Raff, Ryan and Stähler (2007) explicitly refer to FDI by Japanese manufacturers in wholesale and retail affiliates to identify exporters in their sample of horizontal FDI cases.

28 The most notable exception refers to the impact of market structure on the size of FDI. The argument that FDI projects tend to be smaller when parents operate in industries populated by a large number of small firms now applies to horizontal FDI, rather than vertical FDI.

Table 4: Alternative Results for Vertical vs. Horizontal FDI

	(1)	(2)	(3)	(4)
	Vertical FDI Heckman		Horizontal FDI Heckman	
	Selection	Size of FDI	Selection	Size of FDI
Firm variables				
ln(size)	0.590***	0.262***	0.516***	0.255***
	(0.063)	(0.099)	(0.069)	(0.102)
ln(productivity)	-0.080	0.710	0.929	1.047*
	(0.486)	(0.655)	(0.590)	(0.552)
# affiliates	0.191***	-0.041	0.187***	-0.031
	(0.050)	(0.030)	(0.062)	(0.031)
diversification	0.110		-0.014	
	(0.072)		(0.081)	
Industry variables				
ln(skill intensity)	0.331	4.375	1.094	-2.611
	(1.697)	(3.733)	(1.466)	(1.651)
ln(market structure)	0.638	0.274	0.401	-1.345***
	(0.447)	(0.670)	(0.417)	(0.351)
ln(export share)	0.493	-0.485	0.622**	-0.531
	(0.369)	(0.803)	(0.309)	(0.393)
Observations	548		458	
uncensored obs	284		194	
Wald test (p-value)	0.000		0.000	
Mills ratio (p-value)	0.688		0.248	

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions include three-digit industry dummies.

5 Summary and conclusion

We combine a largely unnoticed dataset on firm-specific German FDI in the Czech Republic with data for the parent companies as well as a control group without FDI in order to estimate two-step Heckman models on the determinants of FDI. We address an important gap in the empirical literature on firm-level heterogeneity and FDI by differentiating between major types of FDI. In particular, we take into account that the relative importance of firm and industry characteristics is likely to differ between horizontal and vertical FDI.

The case of German FDI in the Czech Republic corroborates some earlier findings on firm heterogeneity and FDI. Larger, more productive and more experienced firms are more likely to self-select into the FDI group for the full sample of German firms. Parent size and productivity also affect the size of FDI projects in the manufacturing and services sectors.

However, the relevance of parent characteristics and also the relevance of industry characteristics depend on the sector in which German FDI takes

place and on whether FDI is horizontal or vertical. Parent productivity no longer matters for selection once FDI decisions in the services and manufacturing sectors are analyzed separately. Its impact appears to be blurred by the variety of motives for FDI, notably in manufacturing. Less productive manufacturing firms may have incentives to undertake FDI in order to save costs. This could also explain why parent productivity turns out to be insignificant as a push factor of vertical FDI in both steps of deciding on this type of FDI.

Furthermore, we find striking differences between horizontal and vertical FDI concerning the role of industry characteristics. In line with VERNON's (1979) product cycle hypothesis, German firms typically take the step of undertaking horizontal FDI on the basis of previous export success. By contrast, we do not find evidence that competitive pressure in the industry to which the German parent belongs strengthens the incentive to self-select into the vertical FDI group. It rather appears that our market structure variable often captures financial constraints that parent firms are facing in industries populated by a large number of small firms.

Clearly, the findings from a single case study do not allow for rash generalizations. Comparable studies are required to gain deeper insights into the relevance of firm and industry characteristics as push factors of different types of FDI. German FDI in the Czech Republic may be specific because of the dominance of small- and medium-sized parent companies. The selection of German parents into the horizontal and vertical FDI groups may also change with rising geographical distance, compared to neighbouring Czech Republic. Furthermore, it would be desirable to refine the dichotomy between horizontal and vertical FDI, e.g., by introducing export-platform FDI as another category.

Two further extensions shall be explored. The limitations of cross-section studies could be overcome by panel analyses once surveys such as GCCIC (2008) were repeated in comparable formats from time to time. Also, firm and industry characteristics could be combined with location characteristics as pull factors of FDI. A more comprehensive approach including location factors does not necessarily require cross-country coverage. It may also be applied to regionally diverse host countries that attract both horizontal and vertical FDI.

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