Types of FDI and Determinants of Affiliate Size: the Classification Makes the Difference*

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Abstract

This paper focuses on the role of classifying types of foreign direct investment (FDI) for analyzing the relevance of productivity for the size of cross-border investments in terms of the foreign subsidiary's workforce. We use a newly established firm-level data set of German multinational firms and their Czech affiliates that allows various categorizations into vertical FDI and horizontal FDI. Apart from data for conventional approaches to classify FDI types, the survey data include a self-assessment of the firms with respect to investment motives, and information on intra-firm trade. In order to correct for sample selection, we apply a two-step Heckman procedure by comparing multinational firms to companies without investment abroad. The results for the direct measures of FDI types confirm theoretical expectations and previous empirical literature and stand in marked contrast to the outcome for indirect measurement concepts. We conclude that one should be more cautious in interpreting differences between vertical and horizontal FDI when using approximative classification concepts.

1. Introduction

This paper deals with the measurement of motives for foreign direct investment (FDI). Due to a lack of information, several indirect measures exist in order to classify multinational firms into the two main types of FDI. While vertical foreign direct investment (VFDI) refers to the international fragmentation of the production process for cost-saving reasons, horizontal foreign direct investment (HFDI) is performed in order to gain access to new markets. Due to a lack of appropriate databases, only little studies analyzing the internationalization process differentiate between the two motives. One common approach to identify the dominant reason for firms to go abroad is to compare the industry affiliation of the investing company in the home country and the subsidiary in the target country. The

question arises as to how reliable this measure is for identifying FDI motives.

The IAB-ReLOC survey allows a profound investigation on the issue of classifying the motives of the firms for going abroad into vertical and horizontal FDI. Apart from industry affiliation data applied in conventional approaches to categorize FDI types, the survey data also include a self-assessment of the firms with respect to the main motive for investing in the neighboring country, and information on intra-firm trade concerning the flow of intermediate inputs between the German headquarters and the Czech affiliates.

Against the background of featuring a well-grounded database, we shed a light on the relevance of productivity in the German-Czech FDI relations. Is productivity not only a main factor for going multinational as proven by many studies (extensive margin), but also for the size of FDI in the host country (intensive margin)? Are differences observable between vertically and horizontally integrated firms? Rather than examining the causal effect of productivity on the size of FDI, we bring the measurement of FDI types to the fore that underlies the interpretation of results.

For both types of FDI the Czech Republic constitutes an attractive target country for German investors. On the one hand, a still substantial wage gap enables firms to cross the border in order to realize labor cost cuttings. On the other hand, the purchasing power of customers has been on the rise since the early 1990s, and thus market development might be a profitable strategy for investments. However, as the two main investment motives substantially differ, one can assume that the relationship between the characteristics of firms and the size of investment is associated with the underlying type of FDI.

We pursue a reference group approach by comparing German multinational firms that have an affiliate in the Czech Republic to German companies without direct investment abroad. The data provided by the German multinationals enable us to investigate the size of FDI under the aspect of the number of employees in their Czech affiliates. By applying a two-step Heckman procedure, we control for sample selection bias: in the first stage, we analyze the extensive margin of FDI, i.e. the probability to select into the group of multinational investors. The second stage examines the relationship between productivity and the intensive margin of FDI. By extending the baseline specification, the main contribution of the study is the application of different methods for the classification of FDI types.

We find evidence that productivity is not only a crucial factor for the decision to invest in the neighboring country, but plays also a relevant role for the number of employees in the Czech subsidiary. Differences are revealed between direct and indirect measures of FDI types. The size of horizontal investments is significantly affected by productivity only in the case of classifications that are based on survey responses. This result confirms theoretical expectations and previous empirical literature by standing in marked contrast to the outcome for indirect measurement concepts. Our finding leads us to the conclusion that one should be more cautious in interpreting differences between vertical and horizontal FDI when using approximative classification concepts.

The remaining paper is organized as follows: Chapter 2 examines the related literature on the relevance of productivity for the foreign market engagement of firms. Chapter 3 provides a description of the IAB-ReLOC data and illustrates

differences to hitherto existing databases with regard to FDI. In Chapter 4, we present classification concepts to distinguish between VFDI and HFDI by using the information from the survey. Chapter 5 outlines the econometric method used for our analyses on FDI size in the Czech Republic. The empirical results are presented and discussed in Chapter 6. Finally, Chapter 7 concludes with a summary concerning the role of classifications in defining types of FDI.

2. Literature Review

2.1 Firm Heterogeneity and FDI

Regarding the extensive margin of FDI, since the introduction of the widely noticed model by Helpman et al. (2004) it is regarded as common knowledge that firm heterogeneity plays an important role in the internationalization process of companies. While the least productive firms are active on the domestic market only, more productive firms also serve foreign markets – depending on their productivity either by exporting or, in the case of the most productive firms, by FDI. Closely connected to our research are analyses that look at the correlation between firm heterogeneity and the size of FDI, i.e. the intensive margin of FDI. Previous studies have applied different ways to capture the size of FDI: the number of employees of the foreign affiliate, the affiliate's sales or the number of affiliates. Yeaple (2009) uses data for U.S. multinational enterprises (MNEs) and shows that firms that become multinational not only differ systematically from firms that export but that this sorting also strikes the scale and scope of MNEs (for patterns of intra-firm trade of multinationals, see Ramondo et al., 2016). More productive firms extend their FDI activities to a broader range of countries and their affiliates are bigger than those of less productive firms. This finding is supported by Hur et al. (2013) for Korean FDI in China as well as by Hyun and Hur (2013) for Korean FDI in general. Based on a sample of German companies with affiliates in the Czech Republic, Görg et al. (2010) find that more productive companies are not only more likely to engage in FDI but that the productivity of the German parent company also affects the size of FDI.

2.2 Vertical FDI (VFDI) and Horizontal FDI (HFDI)

Studies dealing with the importance of VFDI and HFDI among overall FDI have come to different results. According to Buch et al. (2005), German FDI is mainly market seeking, but there are some target regions where the cost-saving motive is quite important, e.g. the transition economies in Central and Eastern Europe (see Geršl, 2008). Marin et al. (2003) find that in the Czech Republic 17% of the German affiliates' sales result from exports to the German parent company. Compared to Slovakia (82%), Romania (44%) and Hungary (31%) this share is rather low. Thus, the authors conclude that horizontal FDI is the dominant motive for German FDI in the Czech Republic. In a follow-up paper, however, Marin argues that German FDI in the Czech Republic is mostly motivated by cost savings, as more than 75% of the German parent companies import intermediate goods produced by their Czech affiliates. When a tighter criterion is used requiring that at least 20% of the affiliate's output is imported by the German parent company, only around 10% of

the German parent companies are classified as VFDI (Marin, 2004). The contradicting outcomes show that the importance of the two main motives for FDI strongly depends on the underlying classification concept. This assessment is also confirmed by Alfaro and Charlton (2009) and by Görg et al. (2010). The first study suggests that the prevalence of HFDI in the literature might be due to a misclassification when using aggregated industry-level data. The latter study shows that German FDI in the Czech Republic is predominantly horizontally motivated when using the concept of revealed comparative advantage to distinguish the two motives and predominantly vertical when the industry classification concept is applied.

Evidence on the relation between firm characteristics and investment motives is, however, rare. Although many studies consider the relationship between productivity and FDI, most of them focus on HFDI and only few studies distinguish between different types of FDI in this context. Head and Ries (2003) develop an alternative model to Helpman et al. (2004) that yields the same predictions concerning the productivity ranking of firms in the internationalization process. However, they show that the productivity order can be reversed when the foreign country is a low-cost production site: in this case, the least productive firms engage in vertical FDI. Grossman et al. (2006) show theoretically that heterogeneous firms pursue different FDI strategies. As in previous models, the least productive firms produce in the home market and more productive firms engage in FDI. Among these FDI firms, however, the most productive firms choose to move both intermediate production stages and final assembly abroad. Thus, they engage in vertical and horizontal FDI. The model of Hayakawa and Matsuura (2015) also allows firms to choose between VFDI and HFDI. When plant setup costs differ between VFDI and HFDI, the least productive firms operate in the domestic market, more productive firms engage in VFDI and the most productive firms invest horizontally. The authors empirically confirm their model using Japanese data. Hyun and Hur (2013) obtain similar results for Korean firms: the most productive firms engage in both types of FDI (for market-seeking and cost-saving reasons), while less productive firms solely apply a single FDI strategy (HFDI *or* VFDI). They cannot identify a productivity difference between VFDI and HFDI firms when looking at the extensive margin of FDI. However, looking at the intensive margin, the size of FDI, they find that the correlation of productivity and size of FDI is higher for horizontal FDI than for vertical FDI.

Summing up the literature, up to now only few studies have empirically addressed the question how a firm's productivity is related to engagement in VFDI and HFDI. A reason for this missing evidence may be the lacking information on FDI motives in most data sets. This paper wants to contribute to the closure of this research gap. Based on the IAB-ReLOC data, we examine whether there is a productivity difference between VFDI and HFDI firms – looking at the extensive as well as the intensive margin of FDI. Referring to the literature presented above, we expect that the role of productivity in the firms' internationalization behavior differs between the two main motives – especially what concerns the intensive margin of FDI, measured as the size of the foreign affiliate. The results of previous theoretical and empirical studies suggest that more productive HFDI firms own larger affiliates abroad while this correlation is not so distinct for VFDI firms. In particular, we

address the question whether the results vary between different classifications of VFDI and HFDI.

3. Data

Regarding empirical research with respect to German FDI, it has clearly been noted that there is still a lack of appropriate data that hinders progress (see Pflüger et al., 2013, for example). This data problem has several aspects. First, certain specific characteristics simply cannot be studied by the use of industry-level data, as examinations may suffer from aggregation bias. Second, the lack of adequate data sets limits the applicability of econometric methods which require control groups. Finally, the bulk of data used is selective with respect to the characteristics of the firms or the investment projects. Data suitable for scientific investigations are provided by some commercial suppliers, the Deutsche Bundesbank and various Chambers of Industry and Commerce that make their firm-level surveys available. Unfortunately, in most cases, the data offer only a small part of the population of firms actively operating in the home and in the host country of FDI, or due to thresholds for mandatory reporting of company figures, small and medium-sized firms are strongly underrepresented in these databases. Taking into account that there are many small firms in our German-Czech case, it is not clear, what this bias in favor of large firms exactly implies. This assessment is supported by the finding of Buch et al. (2005) indicating that German FDI in nearby countries is provided for relatively many and relatively small companies. Moreover, though many empirical studies use information at firm level, evidence on the motives behind FDI is quite scarce in the used data sets.

Against the background of the mentioned weaknesses of data sets used to study FDI relations, we base our investigation on the IAB-ReLOC survey, a unique micro data set for German and Czech firms. The survey was conducted by the Institute for Employment Research (*Institut für Arbeitsmarkt- und Berufsforschung – IAB*), whereby the data were collected via face-to-face interviews carried out by a market research institute, *TNS Infratest Sozialforschung* (for more information, see Hecht et al., 2013; Hecht et al., 2019). In this paper, we exploit the information that was provided by German MNEs and Non-MNEs in the survey. The research design of the survey is based on the total population of German multinationals with affiliates in the Czech Republic that were enrolled in the Commercial Register of the Czech Republic at the beginning of the year 2010. As we pursue a reference group approach we also surveyed a group of German companies that in the year 2010 neither had direct nor indirect equity investments abroad nor had they foreign sister companies. It is important to note that before the fieldwork, for reasons of better comparison between the two groups of observation, the distribution of employment size of the Non-MNE group was approximated to the size distribution of the MNE group. Therefore, when composing the reference group, stratified sampling was used on the basis of employment size categories.

In a next step, the IAB-ReLOC survey data were enriched by information from the IAB Establishment History Panel (BHP). The BHP covers all establishments in Germany with at least one employee liable to social security registered on the yearly reference date of June 30th. In order to merge the two data

sets, it is necessary to identify the establishments of the BHP that belong to the firms captured by the survey. The assignment of establishments to firms is done by the ReLOC linkage method developed by Schäffler (2014) that is based on the matching of firm names and addresses. Since an unambiguous identification in the BHP failed for some surveyed firms and particularly due to missing information for some variables used in the econometric analysis, the number of cases in the MNE group decreases after the merging process to 230. The reference group of firms without FDI finally includes 650 German firms. Accordingly, the total sample for the analysis in this study contains 880 German companies, covering information that is hardly available for such a number of firms in other data sets. Figure 1 depicts the locations of both multinational and non-multinational firms.

Figure 1 Locations of MNEs and Non-MNEs
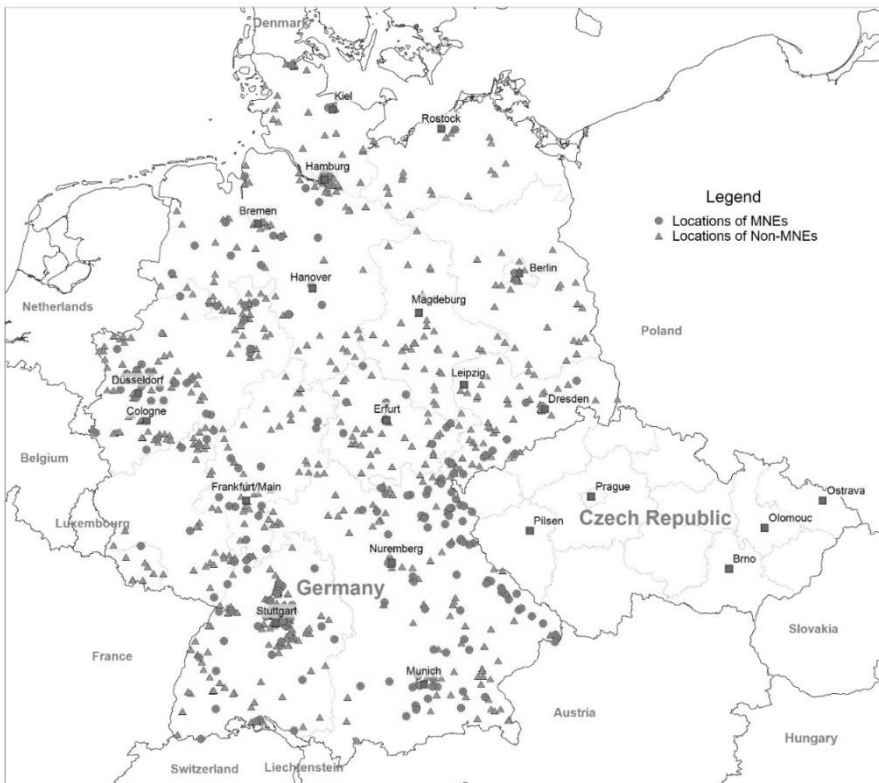
Source: Authors' own calculations from IAB-ReLOC survey.

One of the great advantages of the composed data set is the bulk of information it comprises, especially with regard to the workforce and the international activities of firms. Concerning the subject of our investigation, the size of FDI is measured by the total headcount of employees in the associated Czech affiliate of a German MNE. The multinational companies revealed in the survey their main motive for investing in the Czech Republic as well as information on cross-

border intra-firm trade relations. Therefore, it is possible to contrast the classification of FDI types based on the responses of firms, i.e. direct measures to categorization schemes that are commonly used in the literature, denoted as indirect measures (see Chapter 4 below).

Our explanatory variable of main interest is the productivity of the multinational firms. To capture productivity, we include the turnover per full-time equivalent employee in our analysis. Following the results of previous theoretical and empirical studies (see Chapter 2 above), we expect that productivity is not only positively correlated with the extensive margin of FDI, i.e. a firm's probability to invest abroad but also with the intensive margin of FDI represented by the size of the foreign affiliate. As recent theoretical and empirical evidence suggests (Hyun and Hur, 2013; Hayakawa and Matsuura, 2015), we expect productivity to be more important for the internationalization of firms in the case of HFDI compared with VFDI. To identify the effect of productivity, we include a wide range of control variables in our analysis. With our rich data set we can analyze the structure of the foreign firms in more detail than most previous investigations.

As there is theoretical and empirical evidence that not only more productive but also bigger companies are more likely to be engaged in FDI, we control for the *number of employees* of the German company. The composition of the reference group by considering employment size categories of the multinational group helped to mitigate the difference between the two groups of observation regarding the number of employees in Germany. Nevertheless, the average full-time equivalent workforce in Germany is still significantly larger in multinational firms compared to the number of employees in non-multinational firms. By using the logarithmic form of the variable in the regressions, the significant difference vanishes. Against the background of our stratified sampling, we expect therefore that the number of employees in the German mother company is not a key factor for explaining foreign market entry, but is a decisive determinant of the FDI size abroad (see Görg et al., 2010, for example). To account for the industry affiliation of the firms we include the dummy variable *services* denoting 1 if the firm is active in the services sector and 0 otherwise, that is if the firm belongs to the manufacturing sector. We expect firms operating in the service sector to invest rather horizontally, while the investments of the firms belonging to the manufacturing sector should rather be attracted by lower labor costs as it was found out for German multinationals in general by Buch et al. (2005) and explicitly for the target country Czech Republic by Münich et al. (2014). Another dummy variable reflects whether a firm has a *works council* or not. As a works council decentralizes a firm's decision power, which boosts the costs of organizing an activity within a firm, it can be assumed that the bargaining power of a works council both decreases the probability to be engaged in FDI and the size of FDI. In order to account for the wage formation process in a firm, the information on the application of a *collective agreement* is included in our analysis. As there is already evidence that firms active in research and development (R&D) are more likely to become multinational (Cainelli et al., 2014; Tomiura, 2007), we include a dummy variable reflecting the existence of a *R&D department*. A unique feature of the IAB-ReLOC data is the information on the firm's *position in the value-added chain*. In the survey, the firms were asked to indicate their position in the value-added chain by classifying themselves on a seven-point scale ranging from 1 for

activities at the beginning of the chain, such as the extraction of raw materials, product design and prototype testing, to 7 representing the final stage, when the product or service is delivered to the end consumer with the total value added. According to theory, vertical investments are implemented in order to offshore production steps to the host country for further processing (Helpman, 1984). If the downstream activities close to the final product and the end consumer are not performed in the home country, it can be assumed that the company's domestic activities are rated at lower positions in the value-added chain. In case of horizontal FDI, a higher position in the value-added chain is expected, as the same products are sold to the end consumer in both the host and the home country (Markusen, 1984). To account for the composition of the workforce, the share of employees performing occupations that require engineering, academic or managerial skills is included. With this variable, we have the possibility to test whether a higher share of these *non-routine cognitive (NRC) occupations* relates to a higher probability to have a foreign affiliate as well as to the size of FDI (Acemoglu and Autor, 2011; Goos et al., 2014). Although there are some "born globals", i.e. firms that at a very young age become multinational, the international business is usually the domain of large, well-resourced enterprises (Madsen and Servais, 1997; Engel et al., 2013). Thus, *age* referring to the time since the foundation of a firm on the domestic market should have a positive effect on a firm's likelihood to become multinational and on its extent of FDI. In order to account for the specific closeness of border regions, we use the proportion of firms that are located in the two German federal states that share a direct border with the Czech Republic, *Bavaria* in Western Germany and *Saxony* in Eastern Germany (for the role of the common border region in German-Czech FDI relations, see also Schäffler et al., 2016; Hecht, 2017). Our general assumption is that transaction costs not only affect a firm's probability to invest abroad, but also the size of FDI. There is evidence that the probability to undertake FDI increases with the international experience of a firm (Vernon, 1979). As companies gain international experience by exporting, we control for the *export share* (measured as the export share in total turnover). In Table 1, descriptive figures for the variables that are relevant in our study are shown.

Table 1 Descriptive Statistics on German MNEs and Non-MNEs

Variable	MNEs (N=230)		Non-MNEs (N=650)		p-value (diff)
	Mean	SD	Mean	SD	
No. of employees in Czech affiliate	71	161			
Turnover/employee (in 2009, in thousand €)	475	626	246	389	0.0000
No. of employees in Germany (in 2009)	187	637	114	150	0.0065
Services (0: no; 1: yes)	0.37	0.48	0.40	0.49	0.3129
Works council (0: no; 1: yes)	0.36	0.48	0.35	0.48	0.8158
Collective agreement (0: no; 1: yes)	0.32	0.47	0.43	0.50	0.0048
R&D department (0: no; 1: yes)	0.71	0.45	0.32	0.47	0.0000
Position in the value-added chain (1…7)	4.90	1.33	5.21	1.59	0.0088
Non-routine cognitive occ. (in 2009, share)	0.10	0.13	0.06	0.13	0.0009
Age (in years)	47.04	43.55	44.91	45.25	0.5352
Bavaria (0: no; 1: yes)	0.36	0.48	0.14	0.35	0.0000
Saxony (0: no; 1: yes)	0.05	0.22	0.08	0.27	0.2079
Exports in turnover (share)	0.35	0.28	0.14	0.22	0.0000

Notes: Unless otherwise indicated, data refer to 2010.
Source: Authors' own calculations from IAB-ReLOC survey & Establishment History Panel (BHP).

4. Classifications of FDI Types

The application of different approaches of assigning multinational firms to types of FDI is one of the main aims of our study. By using the information from the IAB-ReLOC survey, we have the possibility to compare different VFDI/HFDI measures. The discrepancies that come up when using the various classifications will be shown in this chapter.

One approach in order to circumvent the lacking evidence on the motive for FDI in firm-level data sets is to make a distinction between VFDI and HFDI on the basis of differences in the industry affiliation of the parent company and the affiliate abroad (Alfaro and Charlton, 2009; Buch et al., 2005; El-Sahli et al., 2018; Görg et al., 2010; Temouri and Driffield, 2009). According to this course of action, FDI is classified as vertical if the two companies operate in different industries and classified as horizontal if the parent company and the foreign affiliate operate in the same industry. Though widely used in the literature, this classification method has the disadvantage that it depends on the number of industry subdivisions used to classify the mother firm's and the affiliate's activities as either same or different. If the number of subdivisions is low, vertical fragmentation of production might take place within each of these subdivisions and what appears as HFDI should be categorized as VFDI. The opposite is the case when the number of subdivisions becomes very high. In this case, the principal activity of the parent company and the affiliate could be very similar, but categorized as different. From survey responses we know about the industry affiliation of the parent company corresponding to the Statistical Classification of Economic Activities in the European Community (NACE), and from the Czech business register about the industry the Czech affiliate is mainly operating in. We construct two measures based on this information, the first one following a structure of 18 NACE classes (*VFDI industry18* and *HFDI*

industry18), and a second one following a structure of 43 NACE classes (*VFDI industry43* and *HFDI industry43*).

An alternative measure is connected to the concept of the export-to-sales ratio to distinguish between VFDI and HFDI (Hayakawa and Matsuura, 2015; El-Sahli et al., 2018; Marin et al., 2003). This differentiation considers whether goods and services produced by the foreign affiliate in the host country are mainly exported back to the home country or sold on the host country's market. As in case of VFDI products are exported back to the home country for further processing, FDI is classified as vertical according to the export-to-sales ratio as soon as a certain share of the affiliate's sales results from exports to the home country of FDI. In contrast, if the products stay in the affiliate's country, the investment is classified as HFDI. Based on information from the IAB-ReLOC survey, we are able to create a more exact measure as German multinationals assessed the share of intermediate inputs in total intermediate inputs that comes directly from their Czech affiliates. The investment of a German MNE is classified as vertical (*VFDI inputs*) as soon as it imports intermediate products from its Czech affiliate. If intermediate goods are imported only to a negligibly small extent or not at all from the affiliate, FDI of the parent company is defined as horizontal (*HFDI inputs*).

As already mentioned above, one of the great advantages of the IAB-ReLOC data is the detailed information collected in the survey. Especially for the distinction between vertical and horizontal FDI, rich information is available that enables a basic measure for the classification of FDI types: a direct question in the survey gives evidence on the motives of German investments in the Czech Republic. Firms have to choose whether FDI was predominantly undertaken for cost-saving reasons reflecting vertical FDI (*VFDI survey*) or in order to get market access (*HFDI survey*). The advantage of this method is the direct self-assessment of the companies on their objectives of investments. As a consequence of the information gained in the survey, we do not have to rely only on indirect and thus potentially inaccurate measures for differentiating between VFDI and HFDI. Table 2 gives an overview of the number of observations assigned to VFDI and HFDI on the basis of the four different measurement concepts. Table 3 presents the correlation matrix opposing the four different classifications to each other.

Table 2 Overview of the Four Classifications of FDI Types

	survey		*inputs*		*industry18*		*industry43*	
	N	*share in %*	*N*	*share in %*	*N*	*share in %*	*N*	*share in %*
VFDI	144	42.73	152	52.05	148	43.27	187	54.68
HFDI	193	57.27	140	47.95	194	56.73	155	45.32
Total	337	100	292	100	342	100	342	100

Notes: The number of observations differs between the classifications due to the deviating number of missings.
Source: Authors' own calculations from IAB-ReLOC survey.

Table 3 Correlation Matrix of the Four Classifications

	survey	*inputs*	*industry18*	*industry43*
survey	1.0000			
inputs	0.2298	1.0000		
industry18	-0.0337	0.0442	1.0000	
industry43	0.0048	0.1014	0.7984	1.0000

Source: Authors' own calculations from IAB-ReLOC survey.

5. Econometric Analysis

The analysis on the size of FDI is based on German firms that have done investments in the Czech Republic. Thereby, a bias may occur if the selection into the MNE group is not considered. The size of FDI may be affected indirectly by unobserved factors that determine the decision of a company to invest in the Czech Republic without being captured in the regression on FDI size. In order to prevent selection bias, we apply a two-step regression developed by Heckman (1979).[1] This approach allows us to correct for the bias by determining the probability of firm i being selected into the MNE group in the first stage. In a probit model, the dependent variable equals 1 if the firm decided to invest in the Czech Republic, and 0 in case of firms without FDI (Equation 1).

$$Prob(FDI_i = 1) = \beta_1 productivity_i + \beta_2 X_i + \beta_3 exclusion_i + \varepsilon_i \qquad (1)$$

The probability of firm i for having FDI in the Czech Republic is assumed to depend on the firm's $productivity_i$, other firm characteristics denoted by X_i, an exclusion variable and the error term ε_i. The explanatory variables in X_i are based on the merged data set of the IAB-ReLOC survey and the BHP described in Chapter 3 (see Table 1). In order to mitigate the problem of reverse causality, we lag the variables productivity, number of employees in Germany and the share of non-routine cognitive occupations by one year. For reasons of model identification, one variable in the first stage should strongly affect the selection into the MNE group, but not the size of FDI. According to Vernon (1979), exporting companies gain more international knowledge compared to companies without experience abroad, and thus are more likely to undertake FDI. This prediction is in line with the findings of Kimura and Kiyota (2006) who conclude that while exporters do not always engage in FDI, most firms that engage in FDI are exporters. After testing several firm characteristics for significance in the first and second stage to identify the most suitable exclusion variable, we find robust evidence that the share of turnover generated by exports of the company significantly affects the selection into the group of multinational firms, whereas there is no significant impact of the export share on the size of FDI. Hence, we choose the share of exports in a firm's total turnover as exclusion variable in the probit estimation.

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[1] See also Görg et al. (2010) and Mühlen and Nunnenkamp (2011), who use the Heckman selection model for a similar research topic.

The second stage includes only the multinational firms. The logarithm of the size of FDI is regressed on $productivity_i$, the same set of variables X_i as in the first stage, plus the inverse Mills' ratio λ_i representing the probability of a German firm i to be selected into the MNE group. The error term is denoted by ν_i (Equation 2).

$$ln\,FDI\_size_i = \alpha_1 productivity_i + \alpha_2 X_i + \alpha_3 \lambda_i + \nu_i \qquad (2)$$

Analogously to Görg et al. (2010) and Mühlen and Nunnenkamp (2011), we measure the size of FDI by the number of employees in the Czech affiliate. After the investigation of total FDI projects, the analysis on the size of FDI is extended by the differentiation into VFDI and HFDI. Thereby, the firms are grouped according to the classification methods elaborated in Chapter 4.

6. Results

6.1 Baseline Model

The baseline model is presented in Table 4, column (1) and shows the results for the estimation of the size of FDI. In the selection equation, the coefficient of the exclusion variable, the export share in total turnover, is highly significant, denoting the higher export orientation of MNEs. The coefficient of the inverse Mills' ratio, λ, marginally misses the 10% significance level, i.e. there is only weak evidence for a selection bias. Concerning the explanatory variables for selection into the MNE group, the significantly positive coefficient for productivity at the 1% level corresponds to theoretical expectations and former empirical results on the higher productivity of multinational firms (see, for example, Helpman et al., 2004; Head and Ries, 2003). The close-to-zero result of the coefficient for employment size in Germany can be explained by the stratification of the reference group as already mentioned before. Firms operating in the service sector exhibit ceteris paribus a significantly higher probability to select into the MNE group than manufacturing firms. While there is no significant difference between the two groups regarding the application of a collective agreement in the firm, the existence of an employee-elected works council decreases the likelihood of selection into the multinational group. Potentially, this outcome points to the easier implementation of a foreign subsidiary if the workforce at home has a rather weak representation in the firm. As in previous studies, the coefficient for the existence of a R&D department is positive and highly significant, i.e. firms performing R&D in Germany have a higher probability of being involved in investments abroad compared to firms without a R&D department (see Cainelli et al., 2014, for example). The coefficient for the value-added chain being negatively significant at the 10% level indicates that firms engaged in lower positions are more likely multinationals. The results for the share of non-routine cognitive occupations and the age of the company are insignificant in the first stage of the estimation process. The federal states of Eastern and Western Germany that border on the Czech Republic are involved to different extents in cross-border FDI relations. While the outcome for Saxony is insignificant, the dummy variable for Bavaria yields a highly significant positive coefficient indicating above-average representation in the MNE group. Thus, regarding the closeness to

foreign markets, an East-West divide in the locational pattern of firms is still observable. In an alternative specification, column (2), we substitute the regional dummies by the distance of the German headquarters to Prague. Not surprisingly, the highly significant negative coefficient gives evidence that distance obviously matters for the locational pattern of MNEs investing in a neighboring country.

The second stage investigates the impact of the explanatory variables on the size of FDI in the multinational firms in terms of the number of employees in the Czech affiliates. Using the logarithm for the dependent variable as well as for explanatory variables enables the interpretation of the results as elasticities. A 1% increase in productivity implicates a 0.24% increase in the number of employees in the Czech Republic. This outcome confirms previous findings that productivity is not only important for the extensive but also for the intensive margin of FDI (see Yeaple, 2009, for instance). While the result that more productive firms employ more people in their Czech affiliate is significant at the 10% level, the size of the German mother company is highly significant with a 1% rise leading to a 0.23% larger daughter firm – a result in line with the findings of Görg et al. (2010). The differences between the manufacturing and the service sector are not significant. The sign for works council changed from the first to the second stage. Hence, the existence of a works council obviously impedes only the fundamental decision of a firm to internationalize. Concerning the size of the investment abroad, it is not a hindering factor anymore, but rather promotes the number of employees in the Czech affiliate. On the contrary, the application of a collective agreement is negatively associated with the size of the Czech workforce. The existence of a R&D department in the mother company significantly boosts the number of employees in the Czech Republic. Thus, doing R&D in Germany is not only an outstanding characteristic of the MNE group, but also indicates a larger size of FDI. The significantly negative impact of the firm's position in the value-added chain on the size of FDI implies that the domestically performed activities of MNEs are accomplished farther away from the end customer. The share of non-routine cognitive employees, however, lessens the size of the affiliate significantly, whereas the age of a company is no factor of relevance for the size of FDI. We observe also in the second stage different results for firms in the Eastern and in the Western German border states. While Bavarian MNEs have a significantly larger workforce in their Czech subsidiaries, this is not the case for Saxon affiliates. In our alternative specification, we observe again a significantly negative coefficient for the distance to Prague. The higher the distance, the smaller is the FDI size in terms of employees in the Czech affiliate. Thus, distance is not only a determinant for the selection into the multinational group, but also for the size of the workforce. The coefficient, however, is significant only at the 10% level.

Table 4 Baseline Model

	Dependent variable: number of employees in CZ, ln			
	(1)		(2)	
2nd stage: FDI size	Coef.	Std. Err.	Coef.	Std. Err.
Productivity (ln)	0.2401 *	0.1440	0.2690 *	0.1457
Number of employees (GER, ln)	0.2335 ***	0.0815	0.2401 ***	0.0819
Services	-0.3847	0.2567	-0.3858	0.2560
Works council	0.6608 **	0.2890	0.6217 **	0.2892
Collective agreement	-0.4394 *	0.2418	-0.4238 *	0.2416
R&D	0.8500 **	0.3912	0.8544 **	0.3849
Value-added chain	-0.1881 **	0.0801	-0.1792 **	0.0759
NRC occupations	-2.2058 ***	0.8208	-2.1792 ***	0.8251
Age (ln)	0.1571	0.1154	0.1835	0.1153
Distance to Prague			-0.0016 *	0.0009
Bavaria	0.5812 **	0.2731		
Saxony	0.2332	0.4755		
Constant	-0.2399	1.4910	0.3465	1.3308
1st stage: Selection				
Productivity (ln)	0.2673 ***	0.0584	0.2908 ***	0.0579
Number of employees (GER, ln)	0.0068	0.0408	0.0056	0.0405
Services	0.4169 ***	0.1278	0.4219 ***	0.1267
Works council	-0.2421 *	0.1440	-0.2833 **	0.1426
Collective agreement	-0.1013	0.1192	-0.1071	0.1182
R&D	0.9385 ***	0.1293	0.9459 ***	0.1279
Value-added chain	-0.0625 *	0.0362	-0.0439	0.0355
NRC occupations	0.5469	0.4047	0.5136	0.4036
Age (ln)	-0.0405	0.0602	0.0011	0.0600
Distance to Prague			-0.0018 ***	0.0004
Bavaria	0.6990 ***	0.1239		
Saxony	0.1333	0.2206		
Export share	1.3093 ***	0.2185	1.3921 ***	0.2182
Constant	-2.6560 ***	0.4441	-2.0616 ***	0.4447
Statistics				
Mills lambda	0.6801	0.4353	0.6720	0.4088
Observations	880		880	
Uncensored observations	230		230	

Notes: */**/*** significant at the 10/5/1 percent level.

Source: Authors' own calculations from IAB-ReLOC survey & Establishment History Panel (BHP).

6.2 Vertical FDI vs. Horizontal FDI

Table 5 and Table 6 show the results for the separate consideration of vertical and horizontal FDI. Four classifications of VFDI are contrasted with the four corresponding classifications of HFDI. In the first stage, the bulk of variables do not essentially differ across the classifications. The export share as exclusion variable for the selection into the MNE group is highly significant in every single estimation version. Like in the baseline model, a higher productivity is a significant

characteristic of multinational firms, independently of the underlying investment motive. Concerning our control variables, firms with a R&D department have across all classifications a higher probability to be found in the MNE group. A clear distinction is noticeable with regard to economic sectors. For factor cost-saving investments (VFDI) in the Czech Republic, the affiliation to the manufacturing or the service sector does not play a significant role in the selection process. Concerning investments primarily motivated by market access factors, however, the coefficient for the service dummy is highly significant for all four definitions of HFDI. Thus, we can state that horizontal FDI is strongly associated with the service sector. The highly significant coefficient values for the Bavarian dummy shows the strong position of this federal state in the group of MNEs. The dummy for Saxony, in contrast, is only significant in two out of eight estimations.

The results for the second stage are for some variables straightforward across all classifications. The position of the company in the production chain shows different coefficients for vertical and horizontal FDI. The coefficient signs are significantly negative for all four VFDI measures, but for none of the HFDI measures. Hence, firms with vertical FDI tend to have larger affiliates in the Czech Republic if they are positioned lower in the production chain. This result supports the hypothesis that vertical FDI is linked to trade in intermediate inputs, and thus companies at home are positioned in earlier production stages. The two dummies for Bavaria and Saxony again show differences between the Eastern and Western border areas. While the location of the headquarters in Saxony is persistently insignificant for the size of FDI, Bavarian firms with slightly significant coefficient values have a larger workforce in the Czech Republic in the case of horizontal FDI. For the employment size of the Czech affiliate, transaction costs are obviously of minor importance for vertical investments. Accordingly, the significant outcome for the role of transaction costs in the baseline specification is driven by firms that invest for reasons of market development. For this type of FDI, communication and monitoring costs are apparently a decisive factor that can be reduced if mother and daughter firms are located close to each other, at least along the Czech border with Bavaria. Generally, it can be said that low transaction costs are a more relevant factor for the extensive margin of FDI. Our results are in line with the findings by Buch et al. (2005) that state that many small firms prefer to locate their foreign activities in regions close by to the home country.

Concerning our key topic, the estimation results reveal, however, that the method of classifying firms into groups of FDI types matters. Using the classifications that are based on our preferred measure, the self-assessment of the firms, and on the cross-border flow of intermediate inputs, productivity is found to be a significant determinant for the size of the affiliate in the Czech Republic for horizontal investments, but not for vertical FDI. This result is in line with the previous findings of Hayakawa and Matsuura (2015) and indicates that the theoretically predicted rising productivity from VFDI to HFDI firms might be more important for the size of FDI than for a firm's multinationality itself. The relation between productivity and the FDI size is reverse, however, for the classifications referring to the industry affiliation. The indirect measures identify the productivity as slightly significant characteristic for the size of VFDI, whereas the coefficient for

productivity remains insignificant for HFDI. These results are clearly contradicting theoretical expectations.[2]

7. Conclusions

The central aim of this paper was to focus on the differentiation between vertical and horizontal direct investment projects and raise the awareness of the importance how to define types of FDI. We investigate the relationship between productivity and both the extensive and the intensive margin of FDI by using a newly established data set. To sum up the results considering the separation into VFDI and HFDI, we find robust evidence that the classification method makes a difference with respect to key determinants of FDI, particularly concerning productivity. Surely, across the board, high productivity is found to be a major factor for the multinationality of firms. It depends on the classification measure, however, whether productivity is also identified as main characteristic at firm level affecting the size of FDI. The use of direct information from the survey data exhibits results that are considerably more in line with theoretical and empirical research than the application of rather approximate indirect measures. First, the regression results for different classifications show that it is important to consider the motives behind the FDI decision for accurate interpretation. Second, not only the differentiation of vertical and horizontal investments should be considered, but also the concept of classification. As a consequence, we conclude that by using indirect, rather coarse classification measures for types of FDI, one should be more cautious in interpreting distinguished outcomes for vertical and horizontal investments. Larger databases are required to allow future research to gain deeper insights in FDI motives and structures of different FDI segments.

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[2] We performed several robustness checks by applying different specifications. The results do not change fundamentally, when (1) using a different measure for regional proximity by substituting the dummies for Bavaria and Saxony by the distance to Prague, (2) leaving out regional dummies, (3) extending the dummy for Bavaria to Baden-Württemberg and the dummy for Saxony to the whole of Eastern Germany, (4) restricting the analysis to Western Germany with a dummy for Bavaria, (5) using the stock of FDI instead of the number of employees in the Czech Republic as dependent variable. Unfortunately, the number of observations is too small for restricting the analysis to Eastern Germany or different sectors, e.g. manufacturing vs. services.

Table 5 Vertical FDI

Vertical FDI	VFDI survey		VFDI inputs		VFDI industry18		VFDI industry43	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
2nd stage: FDI size (number of employees in CZ, ln)								
Productivity (ln)	0.3196	0.2062	0.1786	0.2154	0.6206 *	0.3116	0.5073 *	0.2786
Number of employees (GER, ln)	0.4318 ***	0.1199	0.3194 **	0.1289	-0.0339	0.1477	0.1774	0.1258
Services	-0.6429 *	0.3836	-0.2317	0.3819	0.5425	0.4468	0.1576	0.3882
Works council	0.5283	0.3964	0.6182	0.4162	0.0190	0.5065	0.2442	0.4441
Collective agreement	-0.0882	0.3095	-0.8708 **	0.3582	-0.9101 **	0.4240	-0.9509 **	0.3917
R&D	0.5629	0.5374	1.0960 **	0.5446	2.1306 **	0.9405	1.5278 *	0.7809
Value-added chain	-0.2809 ***	0.1063	-0.2618 **	0.1230	-0.4610 ***	0.1483	-0.4748 ***	0.1301
NRC occupations	-1.6845	1.4064	-2.2318 **	1.1343	-1.3338	1.4838	-1.8838	1.3049
Age (ln)	0.0908	0.1308	0.0774	0.1684	0.6401 ***	0.2420	0.2217	0.1980
Bavaria	0.7742 *	0.4063	0.6496	0.4148	0.7078	0.5239	0.5119	0.4430
Saxony	-0.8014	0.6045	-0.1777	0.8213	-0.9048	1.2366	-1.0717	1.2462
Constant	0.1864	2.1497	0.1793	2.1914	-5.2310	3.3444	-2.5127	2.9100
1st stage: Selection								
Productivity (ln)	0.2050 **	0.0807	0.1901 **	0.0748	0.2436 ***	0.0787	0.2692 ***	0.0731
Number of employees (GER, ln)	-0.0739	0.0531	-0.0733	0.0513	-0.0756	0.0516	-0.0384	0.0482
Services	-0.1599	0.1748	0.2230	0.1614	0.2166	0.1637	0.2062	0.1522
Works council	-0.3477 *	0.1855	-0.1408	0.1762	-0.2997	0.1849	-0.1680	0.1709
Collective agreement	-0.0865	0.1513	-0.1513	0.1466	-0.0628	0.1550	-0.1540	0.1439
R&D	0.9237 ***	0.1657	0.9074 ***	0.1601	1.0074 ***	0.1689	0.9115 ***	0.1531
Value-added chain	-0.0510	0.0460	-0.0683	0.0447	-0.0671	0.0459	-0.0772 *	0.0426
NRC occupations	0.2390	0.5876	0.2725	0.4971	0.9456 **	0.4655	0.8782 **	0.4441
Age (ln)	-0.0020	0.0733	0.0094	0.0736	0.0115	0.0820	-0.0340	0.0736
Bavaria	0.5810 ***	0.1574	0.6905 ***	0.1504	0.5431 ***	0.1565	0.4849 ***	0.1478
Saxony	0.2466	0.2761	0.0051	0.3034	-0.4320	0.3983	-0.6076	0.3938
Export share	1.2490 ***	0.2746	1.3637 ***	0.2617	0.9985 ***	0.2800	0.9611 ***	0.2639
Constant	-2.3869 ***	0.5910	-2.4046 ***	0.5578	-2.6883 ***	0.5967	-2.5530 ***	0.5534
Statistics								
Mills lambda	0.4155	0.5584	0.8238	0.5682	2.3039 **	0.9573	1.9059 **	0.8883
Observations	752		765		752		776	
Uncensored observations	102		115		102		126	

Note: */**/*** significant at the 10/5/1 percent level.
Source: Authors' own calculations from IAB-ReLOC survey & Establishment History Panel (BHP).

Table 6 Horizontal FDI

Horizontal FDI	HFDI survey		HFDI inputs		HFDI industry18		HFDI industry43	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
2nd stage: FDI size (number of employees in CZ, ln)								
Productivity (ln)	0.5184 ***	0.1986	0.5062 **	0.2152	0.1183	0.1545	0.1824	0.1582
Number of employees (GER, ln)	0.3056 ***	0.1094	0.1629	0.1215	0.3650 ***	0.0972	0.3456 ***	0.1021
Services	0.9778 **	0.4229	0.0618	0.4288	-1.2862 ***	0.2974	-1.3093 ***	0.3319
Works council	0.6244 *	0.3723	0.3458	0.4475	0.9871 ***	0.3336	0.9703 ***	0.3580
Collective agreement	-0.5058	0.3232	0.1108	0.3709	-0.2569	0.2618	-0.2368	0.2828
R&D	1.3907 ***	0.5172	1.2530 **	0.6254	0.2621	0.3917	0.3791	0.4175
Value-added chain	-0.0944	0.1037	-0.0422	0.1231	-0.0126	0.0871	0.0106	0.0970
NRC occupations	-1.5240	0.9460	-1.1800	1.3693	-1.4563	1.0250	-1.1970	1.1733
Age (ln)	0.1377	0.1767	0.3730 *	0.2064	-0.0066	0.1208	0.0529	0.1389
Bavaria	0.7994 **	0.3512	0.7326 *	0.4422	0.5385 *	0.3174	0.5638 *	0.3397
Saxony	0.9974	0.6150	0.7341	0.6903	0.2238	0.4679	0.2773	0.4877
Constant	-5.1664 **	2.2220	-4.4876 *	2.6492	1.0477	1.6949	0.2503	1.7593
1st stage: Selection								
Productivity (ln)	0.2956 ***	0.0685	0.3126 ***	0.0742	0.2769 ***	0.0689	0.2639 ***	0.0738
Number of employees (GER, ln)	0.0671	0.0500	0.0485	0.0535	0.0594	0.0500	0.0500	0.0535
Services	0.7912 ***	0.1551	0.6145 ***	0.1673	0.5244 ***	0.1541	0.6247 ***	0.1683
Works council	-0.1996	0.1713	-0.3403 *	0.1881	-0.2299	0.1707	-0.3489 *	0.1846
Collective agreement	-0.1092	0.1447	0.0817	0.1566	-0.0826	0.1394	0.0108	0.1503
R&D	0.8815 ***	0.1585	0.9642 ***	0.1745	0.8277 ***	0.1548	0.8907 ***	0.1709
Value-added chain	-0.0499	0.0438	-0.0221	0.0470	-0.0489	0.0429	-0.0298	0.0465
NRC occupations	0.6823	0.4436	0.7805	0.5054	0.1596	0.5189	0.0304	0.5743
Age (ln)	-0.0753	0.0763	-0.1099	0.0829	-0.0581	0.0701	-0.0270	0.0776
Bavaria	0.7217 ***	0.1471	0.7002 ***	0.1598	0.7841 ***	0.1457	0.8686 ***	0.1551
Saxony	0.0871	0.2712	0.2661	0.2750	0.4291 *	0.2337	0.6331 ***	0.2390
Export share	1.2212 ***	0.2607	1.1519 ***	0.2755	1.3657 ***	0.2507	1.4722 ***	0.2654
Constant	-3.4770 ***	0.5386	-3.6454 ***	0.5893	-3.2827 ***	0.5263	-3.6421 ***	0.5668
Statistics								
Mills lambda	1.3842 **	0.5866	0.9463	0.6381	-0.0821	0.4248	0.0227	0.4077
Observations	775		745		777		753	
Uncensored observations	125		95		127		103	

*Note: */**/*** significant at the 10/5/1 percent level.*
Source: Authors' own calculations from IAB-ReLOC survey & Establishment History Panel (BHP).

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