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Regional Determinants of German FDI in the Czech Republic

Evidence from a Gravity Model Approach

Johannes Schäffler (IAB), Veronika Hecht (IAB), Michael Moritz (IAB)

On the basis of a unique dataset, the regional distribution of German multinationals and their Czech affiliates is analysed for both countries. The investigation covers market size and agglomeration features, distance issues, and labour market characteristics. Apart from the vital role of large markets and a low transport distance, there are further crucial findings regarding joint foreign direct investment (FDI) projects that can only be revealed by taking a home-host country perspective: the strong position of the common border region and its interconnectedness, the non-relevance of a relatively high wage gap between the site of the headquarters and the location of the affiliate in coincidence with the great importance of the availability of high-skilled employees in the target country, and differences in the significance of sectoral employment shares.

Multinational firms Foreign direct investment Location choice Gravity model
Germany Czech Republic

JEL classifications: F23, R12, F15

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INTRODUCTION

The attractiveness for the location of multinational firms is seen as a crucial issue for the development, prosperity and wealth of regions. Foreign direct investment (FDI) is regarded as a conducive channel for the diffusion of productivity spillovers. Local firms in the host country may be able to improve their productivity as a result of forward or backward linkages with the affiliates of foreign multinationals, the introduction of new technologies, or the hiring of workers trained by foreign-owned firms (BLOMSTRÖM and KOKKO, 1998). As the positive externalities generated by FDI are locally linked to the location of the investment, these regions and their labour markets can particularly profit (DINGA and MÜNICH, 2010). This applies all the more for adjacent countries as they can take advantage of the close geographic proximity. In this regard, one example of thriving FDI relations is the case of Germany and its eastern neighbour, the Czech Republic. The low distance, particularly in the borderlands, should benefit cross-border investments. Figure 1 compares the German FDI stocks in the Czech Republic and Poland, the second bordering country in the east of Germany, to the BRICS countries (Brazil, Russia, India, China and South Africa), that together represent almost three billion people. Interestingly, between the early and late 2000s, though only having a population of roughly 10 million inhabitants, the Czech Republic trumped all these much larger emerging economies in terms of FDI exceeding also the total of Poland that has nearly four times more inhabitants. By 2011, the figures by the Deutsche Bundesbank feature an amount of more than €24 billion of German FDI and around 271,000 employees working for 946 German-owned firms in the Czech Republic (DEUTSCHE BUNDESBANK, 2013).

Insert Figure 1 about here

Figure 1: German FDI in the Czech Republic, Poland and BRICS

Source: Deutsche Bundesbank.

A broad literature deals with the locational determinants of FDI. There are, however, some crucial limitations that constrain the informational value of many investigations. A *first* drawback of various datasets used in the existing literature to analyse FDI consists in the selectiv-

ity of the data with respect to the characteristics of the firms and/or the investment projects included. Most suppliers of information on foreign direct investment set specific thresholds that firms have to surpass in order to be included in the dataset. As a consequence, in the available firm-level data larger firms are overrepresented, leading potentially to biased results in research studies. Surely, as regards the multinational activity of firms, it can be assumed that larger, often more productive firms more likely operate abroad as only they are able to pay the market entry costs (HELPMAN et al., 2004; MELITZ, 2003). The issue of firm size, however, is particularly important in the case of neighbouring countries, where lower transaction costs compared to distant destinations also allow smaller firms to go abroad.¹ As the findings of BUCH et al. (2005) indicate that German FDI in nearby countries is provided for relatively many and relatively small companies, this issue is of vital relevance for the current study. Besides the selectivity of firm-level data, there are further deficiencies in the literature on FDI, mainly arising from the lack of appropriate micro data. As a *second* pressing issue, when looking at home and host countries of FDI, spatial patterns formed by firm headquarters and foreign subsidiaries should not be disregarded. According to PORTER (2003) it is the regional differences, persisting in a way in every country, that can help to find the essential drivers of economic development. Region-specific endowments of economic factors can outplay country-specific effects for the attraction of FDI, as emphasised by PUSTERLA and RESMINI (2007) in a study on the location choice of multinational firms in four central and eastern European countries (CEEC). At that, constituting a *third* weakness, many studies dealing with multinational investments are restricted to the target countries. By not including information on the location of the headquarters, however, some crucial issues, e.g. the role of distance between headquarters and affiliates, network effects in border regions and regional wage differences, can only be analysed to a limited extent. *Finally*, most studies, also for reasons of data availability, focus solely on the manufacturing sector. When highlighting the regional distribution of multinational firms, however, the increasing shift of services abroad must be taken into account as it can be regarded as one fundamental reason for rising FDI relations between countries. As underlined by FEENSTRA (2010), manufacturing industries are not the only branches of economic activity that have experienced relocations to

places outside of metropolitan areas in the highly productive countries. Far less studied is the tendency to relocate service activities. Locational differences between determinants for investments in the manufacturing and in the service sector are largely unexplored yet (see CASTELLANI et al., 2014, for example). According to JONES and WREN (2015), on the one hand, due to vertical linkages, FDI in services may locate close to manufacturing industries (see RAMASAMY and YEUNG, 2010, for example). On the other hand, the location pattern could look quite different if final consumer demand was the dominant driving force of services FDI (see RIEDL, 2010, for example).

To put it in a nutshell, there are few cross-border investigations that consider the total population of firms involved in FDI, inclusive of regional information and the service sector. As a matter of fact, the availability of data restricts the bulk of research studies to focus on the target locations of FDI without taking the straight differences between the characteristics of the source and destination regions into consideration. However, for both the home and the host country, the internationalisation of firms is an important regional policy issue as the location of multinationals may intensify both the emergence of regional disparities and the reinforcement of yet existing regional economic differences. The contribution of this paper to the existing literature fundamentally consists in tackling the above-mentioned research deficiencies by using a uniquely established dataset which focuses on two countries, Germany, the home country of FDI, and the Czech Republic, the host country. The starting point of the investigation is the total population of German multinationals which have affiliates in the Czech Republic, as registered in the Czech Commercial Register by the beginning of 2010. Information is available for the location both of the headquarters in Germany and of the affiliates in the Czech Republic. Adding data on regional characteristics enables the analysis of regional determinants and features of FDI locations in the home and in the host country. Building on theoretical considerations and the existing literature, special attention is put on the role of market size and agglomeration economies, distance and border region issues and labour market characteristics. The selection of the regional variables included in the analysis coincides with the related literature, whereby only few studies use information for both the home

and the host country. HAYTER (1997) differentiates between three main categories of variables for the analysis of the location of economic activity: neoclassical, institutional and behavioural factors. This investigation of regional determinants places the first set of variables in the foreground. Behavioural factors refer to the internal or entrepreneurial nature of the firm, which is not scope of this article. As far as institutional factors are concerned it can be assumed that in the case of a single home and a single host country of FDI most institutional conditions, e.g. the legal system, labour legislation, tariffs and national taxes, are equal throughout one country. The attraction of multinational firms, of course, is potentially affected by differences in regional taxes, investment incentives and the funding of industrial zones in the involved regions. Concerning Germany and the Czech Republic, however, relevant dissimilarities do either not exist at the regional level applied in this study or are captured by variables that are part of the analysis.²

By applying a gravity model, the estimations yield stable results for the core variables of the equation. On the one hand, the economic size in terms of gross domestic product (GDP) is for both sides of the border positively related to the number of FDI projects performed in the involved regions. On the other hand, a negative relationship is observed between the number of joint projects and the transport distance between a German and a Czech region. There are, however, further regional characteristics that play a considerable role in FDI relations. The wage ratio between home and host region of FDI is across the board negatively correlated with the number of common FDI projects, i.e. a relatively low wage level compared to other regions within the Czech Republic cannot be seen as a general pull factor for FDI. More important is the availability of high-skilled personnel in the host regions. Concerning the industrial structure of the involved regions, the headquarters are to a higher extent located in German regions with a relatively high manufacturing share, whereas the affiliates are in a higher quantity located in Czech regions exhibiting a relative specialization in service activities. Though many districts are rather far away from larger urban areas, the common border region is involved in transnational investment projects at an above-average level. Notably the firms located in the German border regions take advantage of the investment opportunities in

the close-by Czech regions, while the interior regions of the neighbouring country are less frequented areas. Summarizing, the results show that favourable regional policies in terms of fostering traffic infrastructure, cross-border networks and education and training conditions can benefit the international economic ties even of regions that are located at the periphery of the national state.

The remainder of the article is organised as follows: the next section provides an overview of the recent literature dealing with FDI and the research hypotheses for potential determinants of cross-border investment relationships. It is followed by a description of the ReLOC gross sample encompassing German multinationals and their affiliates in the Czech Republic. The subsequent explanations shed light on the regional characteristics of German spatial planning regions and Czech NUTS 3 regions. After introducing the gravity model and the Poisson and Negative Binomial specifications used for investigating the location pattern of German headquarters and Czech affiliates, results are presented and discussed for the total of FDI projects, manufacturing FDI and services FDI. The paper concludes with a summary of the findings, their relevance for public policies and an outlook to future research.

CONCEPTUAL BACKGROUND AND RESEARCH HYPOTHESES

Determinants for the location of FDI have been discussed using various research methodologies, whereby two sorts of models have emerged as basic econometric tools in empirical investigations (ARAUZO-CAROD et al., 2010). A standard approach in order to analyse how the characteristics of a region affect the probability to be chosen as investment location is the use of discrete choice models which go back to MCFADDEN (1974) and are widely applied in the literature (BASILE et al., 2009; DISDIER and MAYER, 2004; GUIMARÃES et al., 2000; HEAD et al., 1995, 1999; ZVIRGZDE et al., 2013). As this paper deals with information at the regional level in order to identify the determinants of FDI locations, the scope is closer to a second strand in the literature, the use of count data models (ARAUZO-CAROD and VILADECANS-MARSAL, 2009; BARBOSA et al., 2004; BLONIGEN, 1997; COUGHLIN and

SEGEV, 2000; WU, 1999). By focusing on the spatial distribution in both the home and the host country, a gravity model approach is favoured. Originally, extended versions of Newton's law of universal gravitation were applied in order to analyse trade flows between nations or regions (ANDERSON and VAN WINCOOP, 2003; MCCALLUM, 1995). As trade relations can be investigated by a gravity model, so can FDI flows (BLONIGEN et al., 2007; BRAINARD, 1997; BUCH et al., 2003; KANDILOV and GRENNES, 2012). The vast majority of studies on FDI that apply discrete choice models or count data models concentrate on the U.S. and western Europe. Investigations with respect to other parts of the world, namely popular destination regions like the CEEC, are yet scarce. In the following, hypotheses are derived concerning the factors which are potentially relevant for regional FDI relations.

Market size and agglomeration features

Gross Domestic Product (GDP): A wide range of explanatory variables in location studies refers to the impact of market size and agglomeration economies on the regional distribution of FDI (see the overview in ARAUZO-CAROD et al., 2010: 701 f.). It can be assumed that, due to a higher market potential, multinational enterprises are to a higher extent located in regions with larger markets in terms of the GDP level. Therefore, a positive impact of this variable is expected on the number of investment projects. Similarly, target regions exhibiting a larger GDP level should attract more FDI projects as a larger market size in terms of overall GDP is supposed to have a superior potential for foreign investors.

Gross Domestic Product (GDP) per capita: The number of cross-border investments should be positively correlated to the regional GDP per capita, closely linked to labour productivity, in both the domestic and the target country. The locations of multinationals at home are supposed to be positively associated with the wealth of the regions of origin. As far as the host regions are concerned, investors should be attracted by relatively rich regions due to the greater spending power of consumers (RESMINI, 2000).

Population Density: Due to economies of scale, it can be assumed that companies both in the home and in the host country of FDI are found to a higher extent in agglomerative areas.

Urbanisation economies that are external both to firms and to sectors may generate positive externalities (JACOBS, 1969) and are usually proxied by population density (ARAUZO-CAROD and VILADECANS-MARSAL, 2009; BHAT et al., 2014; CASTELLANI et al., 2014; COUGHLIN and SEGEV, 2000; HE, 2002). Population density can, however, also serve as a proxy for land price, for which, like in many previous studies, a direct measure is not available at the regional level used in this investigation. It can be assumed that the land price is highest in regions with a high population density as land is relatively scarce there compared to regions with a low population density. In the home region, this second interpretation goes in line with the assumption that population density is positively correlated with the number of multinationals as a high land price could be a reason for investing abroad. In the target country, however, a high population density could as a consequence have a negative impact on the location decision, too.

Sectoral structure: Besides the overall economic activity in a region, the spatial concentration of firms belonging to the same sector may also generate positive externalities. Advantages emerge from sharing inputs, knowledge spillovers and labour market pooling providing the firms with workers qualified in the specific skills they need. Due to these localisation economies it is supposed that the spatial distribution of multinational companies is linked to the regional employment structure. Depending on the target sector of the investment the number of FDI projects is assumed to differ with regard to the composition of the regional workforce. Having a strong position in specific industries implicates a comparative advantage for providing/receiving capital for the related activities. Regions with a relatively high share of employees in the manufacturing (service) sector should especially register a higher number of investors operating in the respective sector. Previous studies confirm that regions specialised in the sector of the investment attract more foreign investments. This holds true both for western European countries (BARRIOS et al., 2006; HEAD and MAYER, 2004) and for the CEEC (GAUSELMANN and MAREK, 2012). In a study on the location choice of foreign firms in Romania, HILBER and VOICU (2010) identify service agglomeration as a main factor for the attractiveness of a region. The authors argue that especially when investing in transition

economies foreign investors depend on professional services as there they face more non-core business problems than in developed countries.

East Germany: When investigating the locations of German multinationals it is important to refer to the differing conditions between the western and the eastern part of Germany. Since the economic system in the New Laender, simultaneously as in the Czech Republic, turned from plan to market just about 20 years ago, there are fewer headquarters of companies in eastern Germany compared to the western federal states. Actually, in the framework of the Council for Mutual Economic Assistance (Comecon) profound economic relations existed between the former German Democratic Republic and the Czechoslovak Socialist Republic. This head start of the New Laender over the Old Federal States in trading with the Czech Republic, however, disappeared in the early 1990s (ALECKE et al., 2003). Consequently, it seems reasonable to assume that the number of investment projects of firms with headquarters in eastern Germany should be lower. Furthermore, the proximity to Poland, which represents an alternative investment location particularly for eastern German firms, might lower the likelihood for investments in the Czech Republic.

Prague: Concerning the FDI destination country of this analysis, the metropolis of Prague constitutes the country's undisputed centre of economic activities, the most innovative Czech region (BERNARD et al., 2014), that serves as a hub for banks and financial services providers. The question is whether this particular target region attracts FDI projects by reason of its idiosyncratic characteristics (e.g. extraordinarily high economic strength, large proportion of high-skilled workers and the service sector), or whether there is a specific capital-city effect regarding the acquisition of investment projects.

Distance features

Distance: Generally, the distance between two countries as a proxy for transport costs often exhibits a negative impact on bilateral FDI. PORTES and REY (2005) attribute this to the negative effect of distance on information costs. BUCH et al. (2005) emphasise the cultural distance as an important factor influencing information and communication costs. BUCH et

al. (2003) estimate a gravity model with different FDI features of German companies abroad as variables to be explained. According to their results, the average size of the foreign partners in a country increases with distance. At the same time the number of affiliates increases with the proximity to the German market. In a study based on a survey to assess the attractiveness of Czech regions for foreign investors, SPILKOVÁ (2007) finds that a region's attractiveness declines with its distance to the capital of Prague as well as to the Bavarian border. MÜHLEN and NUNNENKAMP (2011) conclude that distance-related transaction costs are generally discouraging for the entry of German investors in the Czech market.

Border: Concerning the research area of interest in this study, the relationship between distance and foreign direct investment should be of specific importance when different regions of neighbouring countries are investigated. The border regions between the domestic and the host country feature specific advantages for the cross-border exchange of goods and services that go beyond the mere benefit of low transport costs. In regions close to the border, transaction costs in terms of cross-cultural communication should be especially low which makes investments attractive also for small and medium companies, that otherwise are not able to bear high fixed costs in order to become multinational. Typically, a higher share of the population living there has language skills of the other country and is familiar with the local customs what would reduce the foreign market entry costs. This could lead to enlarged foreign direct investment, apart from the advantageous lower transport costs that are captured by the driving time. Furthermore, cross-border projects received special priority in the funding policy of the European Union, in particular with the establishment of the INTERREG programmes. Thus, low information costs and convenient conditions for network effects foster investment possibilities in border regions (BERGIN et al., 2009; FEENSTRA and HANSON, 1997; HANSON, 1998). For the case of Poland, after controlling for economic and social characteristics, Polish regions next to Germany are significantly more attractive for foreign investors than regions in the central and the eastern part of the country (CIEŚLIK, 2005a, b).

Labour market features

Wage: One essential indicator characterising the regional labour market is the wage level. Concerning the distribution of the multinationals in the home country, a higher wage level refers to a higher productivity in the region which in turn could be correlated with the presence of a larger number of multinationals. Moreover, the reduction of labour costs ranges among the most important relocation motives in different international surveys (ALAJÄÄSKÖ, 2009; HANSON et al., 2001; YEAPLE, 2003). Consequently, high labour costs in the home region could be an incentive for companies to invest abroad. In the Czech Republic, the relationship between the location of multinational affiliates and regional wages is theoretically ambivalent. While higher wages, reflecting a higher consumer purchasing power, play into the hands of multinationals that want to open up new markets, other investors are explicitly looking for low-wage sites for fragmenting their production processes. RESMINI (2000) emphasises the importance of wage differentials as an essential determinant for FDI in manufacturing industries in ten CEEC. BEVAN and ESTRIN (2004) find that, apart from market size and proximity, labour costs are the most important factor for FDI from western Europe in the CEEC.

Unemployment: Another attribute of the labour market of home and host regions is constituted by the regional unemployment rates. As for the domestic regions a low unemployment rate stands for a favourable economic situation and potentially for the scarcity of labour supply that prompts the expansion of firm activities abroad, a negative correlation is supposed between the unemployment rate and the number of investors. Regarding the destination country, the relationship is fairly ambiguous. On the one hand, high unemployment rates signal the availability of workers that possibly attracts investors in search of labour cost savings. On the other hand, high levels of unemployment are typically associated with laggard regions where weak economic structures and pending social problems rather distract investments. In the Czech Republic, regional unemployment rates are also used as parameter for the provision of job creation grants and training and retraining grants. These have only been provided in regions with an unemployment rate that is at least 50% higher than the average unem-

ployment rate in the Czech Republic (CZECHINVEST, 2013). Insofar, we take also account for institutional regional differences in this regard.

High-Skilled: The share of high-skilled employees in a region serves as a proxy for the relative endowment with human capital that relates also to research and development activities and the innovativeness of a region. Therefore, as far as the home country is concerned, a higher proportion of high-skilled employees should be associated with a larger number of multinational investors. The availability of a highly qualified workforce can be a locational advantage for regions in the target country competing for FDI, if foreign investors search for a creative and innovative business environment. An above-average share of high-skilled employees could, however, also be opposed to the demands of multinational companies. This would be the case, if less skill-intensive production steps are offshored which require a relatively large supply of low-skilled workers. With regard to the activities of German multinationals in eastern European countries, MARIN (2004) finds evidence that investments are not only motivated by the search for lower costs but also by seeking qualified labour. Concerning the Czech Republic, SPILKOVÁ (2007) confirms that Czech regions with a higher educational level and with higher wage levels are preferred location sites for foreign direct investment.

Summarizing the literature, it can be concluded that, concerning the determinants of FDI in the CEEC, a broad range of studies exists. Not least to data limitations, however, the bulk of investigations on FDI deals with nation-to-nation comparisons, predominantly using regional information, if at all, only for the receiving country and is restricted to the manufacturing sector. A gap exists for studies that carry out an in-depth analysis focusing on FDI relations between countries by considering regional differences in both countries inclusive of the service sector. The aim of this paper is to shed light on these shortcomings on the basis of hitherto unexploited data for Germany and the Czech Republic. The examination of regional FDI determinants is built on the use of a gravity model by focusing on market size and agglomeration variables, the role of distance and borderlands and labour market characteristics. By taking a cross-border viewpoint, the variables that cover information from both countries are

of special interest. On the basis of home-host combinations a set of potential determinants of FDI that is excluded from investigation in most studies can be analysed in detail. Herein lies the main contribution of this study. Furthermore, the issue is addressed whether there are different regional determinants for FDI projects aimed at the Czech manufacturing sector in contrast to the Czech service sector. Before turning to the econometric analysis, a brief description of the firm-level and regional data is given in the next section.

DATA AND DESCRIPTIVE STATISTICS

The ReLOC sample

In this paper, a newly established unique database is used, the gross sample of the ReLOC project comprising information on the basic population of German multinationals and their affiliates in the Czech Republic (see [name deleted to maintain the integrity of the review process] for a comprehensive description of the data compilation process and the associated firm survey). The dataset allows to take a closer look on the regional determinants of FDI by focusing on both the home and the host country. The great advantage of the ReLOC data in comparison with other samples used for research on FDI is the number of observations and the availability of information on both sides of the border. The original basis of the dataset is an extract of the Czech Commercial Register covering 5,700 Czech firms which are at least partly financed by a German investor (by the beginning of 2010), i.e. the total population of actively operating Czech companies with capital provided by German investors. By not taking into account the Czech firms where only a German individual person but no firms could be identified as investor, 3,894 investment projects with capital participation by a German firm of at least 25% remain. There are fewer mothers (3,378) than daughters because some German owners were involved with more than one Czech company. For the Czech part, after merging information on the sectoral affiliation of the firms which is provided by the Czech commercial data supplier ČEKIA, we are able to split the sample in FDI investments that are aimed at the manufacturing sector, which results in 1,274 FDI projects, and at the service

sector (including commerce), comprising 2,431 FDI projects. The address information of German headquarters and Czech affiliates is available in the Czech Commercial Register that is maintained by the Czech Statistical Office (CZSO). Figure 2 to 4 show the regional distribution of German investors in 96 spatial planning regions (*Raumordnungsregionen*) and their Czech affiliates in 14 Czech NUTS 3 regions. The choice of the regional levels in both countries was driven by reasons of a good comparability with regard to the regional size. The headquarters of the multinationals are predominantly located in spatial planning regions that comprise Germany's largest cities, above all the metropolitan areas of Munich, Stuttgart, Frankfurt am Main and the Rhine-Ruhr region around Düsseldorf. Apart from that, mother firms are highly concentrated in the Bavarian and Saxon borderlands. With respect to the Czech Republic, the subsidiaries of the multinationals can be found particularly in the capital city of Prague and in the regions close to Germany and Austria. The strong representation of German FDI in these regions was already observed in the 1990s by REHNER (1998) and later by SPILKOVÁ (2007). As about two-thirds of the FDI projects are directed at the Czech service sector, the spatial patterns for the total of FDI projects and for services FDI appear quite similar. Distinguished differences are observable, however, in the case of manufacturing FDI. While the regions close to the Czech Republic persistently hold a strong position, the metropolitan regions of Germany's two largest cities, Berlin and Hamburg, play only a moderate role as a location for headquarters of German multinationals. Relatively few affiliates operating in the manufacturing sector are situated in Prague. Of more importance are the districts around the capital city in central Bohemia and western Bohemia, whereby the region of Pilsen (*Píseň*) has established a dominating position. At the heart of the investigation are the regional combinations of German-Czech FDI projects, i.e. the number of headquarters in one of the German spatial planning regions and their affiliated companies in one of the Czech NUTS 3 regions. The number of realized FDI projects is calculated for 1,344 combinations (96 German regions of origin x 14 Czech target regions). The distribution of regional combinations ranges between zero observations and three-digit numbers, e.g. there is a total of 120 FDI projects with headquarters in the Frankfurt region and affiliates in Prague.³

Insert Figure 2 about here

Figure 2: Regional distribution of German headquarters and Czech affiliates (total FDI projects)

Source: Authors' own calculations from ReLOC data.

Insert Figure 3 about here

Figure 3: Regional distribution of German headquarters and Czech affiliates (manufacturing FDI)

Source: Authors' own calculations from ReLOC data.

Insert Figure 4 about here

Figure 4: Regional distribution of German headquarters and Czech affiliates (services FDI)

Source: Authors' own calculations from ReLOC data.

Regional characteristics

Regional data made available by the statistical offices of Germany (Federal Statistical Office Germany) and the Czech Republic (Czech Statistical Office) are merged to both the 96 German spatial planning regions and the 14 Czech NUTS 3 regions. Corresponding to the date of identifying the German multinationals in the Czech Republic, the data refer to the year 2009 providing information on a set of regional variables which are classified into the three categories introduced above: first, market size and agglomeration economies, second, issues related to distance and borderlands, and third, labour market characteristics. The summary statistics of regional variables are depicted in Table 1 that additionally displays the good comparability of German spatial planning regions and Czech NUTS 3 regions in terms of the average population size.

The variables *GDP_GER* and *GDP_CZ* are incorporated in the regression as a measure of dimension and economic size of a region and denote the regional gross domestic product (GDP, in millions of euros) in the German region of origin and the Czech destination region. The GDP per capita (*GDPpc_GER* and *GDPpc_CZ*) represents the economic strength of a region. The figures for GDP and GDP per capita reflect the still existing differences in both market size and market strength between the two countries. The level of urbanisation is specified by the population densities *PopDens_GER* and *PopDens_CZ* and is on average quite similar in Germany and the Czech Republic. Considering localisation economies, the manufacturing/services ratio (*Manu/Serv_GER* and *Manu/Serv_CZ*) indicates the relative specialisation in manufacturing or service activities in the home and host regions. The ratio is calculated as the relation between the number of employees working in manufacturing industries and employees working in service industries, whereby the German regions exhibit a higher orientation on services. Two dummy variables account for the specific economic situation of two areas: *East_Germany* stands for spatial planning regions in the eastern federal states of Germany, denoting 1 if the German spatial planning region belongs to the New Laender (including Berlin), and 0 otherwise. *Prague* represents the capital of the Czech Republic as one of 14 NUTS 3 regions. The dummy variable denotes 1 for combinations with the FDI target region Prague, and 0 otherwise. Almost one quarter of the German regions are situated in eastern Germany, whereas the combinations with Prague as the target region of FDI account for 7% of all cases.

Taking into account the two-country case of this study, the following variables represent issues related to distance and borderlands. *Distance* is computed by means of the route planning software *map & guide calculate 2009* and measures the calculated driving time (in minutes) of a heavy-goods vehicle between the capitals of each German spatial planning region and each Czech NUTS 3 region assuming a speed of 75 km/h on motorways, 45 km/h on federal highways, 40 km/h on country roads and 30 km/h on urban roads. Three dummy variables are incorporated in order to capture the potential relevance of locations in the German-Czech borderlands. The basic border region dummy *Border_GER_CZ* only takes the

value 1 if both the German home region and the Czech target region of a FDI project are located in the frontier areas, and 0 otherwise. With 6% of German and 29% of Czech regions belonging to the border regions, the intersection where both the German and the Czech region are part of the borderlands leads to a share of 2% of the 1,344 combinations. In addition, *Border_GER* and *Border_CZ* denote 1 if, in the former case, only the German spatial planning region or, in the latter case, only the Czech NUTS 3 region has a direct border with the other country, and 0 otherwise. This set of border dummy variables examines whether the borderlands are primarily affected by German-Czech FDI projects on the strength of geographically dense cross-border networks or if these regions are to an above-average extent connected to more remote areas of the neighbouring country.

Concerning labour market features, the database allows to directly consider differences between the locations of the headquarters and the affiliates. For each combination, the variable *Wage_Ratio* denotes the relation between the wage level in the German home region and the corresponding wage level in the Czech host region. On average, the wage level in German regions is 3.5 times higher than in Czech regions. The inclusion of regional unemployment rates for both countries (*Unemployment_GER* and *Unemployment_CZ*) indicates labour availability and business conditions. Besides, the Czech unemployment rate can be interpreted as a proxy for job creation and training incentives that preferably are granted in underdeveloped regions. The relative endowment of the regions with human capital is captured by the share of high-skilled employees *High_Skilled_GER* and *High_Skilled_CZ*. Both unemployment rate and share of high-skilled workers are on average slightly higher in the Czech Republic.

Insert Table 1 about here

Table 1: Descriptive statistics for the 1,344 German-Czech regional combinations

Source: Federal Statistical Office Germany; Czech Statistical Office; authors' own calculations.

ESTIMATION METHOD AND SPECIFICATIONS

The econometric investigation of the central research topic of this study, the regional pattern of German mothers and Czech daughters, builds on the application of the gravity equation. In general, this approach rests on the hypothesis that the volume of trade between two regions can be explained in large parts by the size or economic strength of the regions and the distance between them. The basic form of the equation is derived from Newton's law of universal gravitation saying that the gravitational force between any two objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres. TINBERGEN (1962) brought this approach forward to "social physics" in order to analyse trade flows between countries. Apart from estimating trade flows, gravity equations are also an instrument for the investigation of FDI relations between countries. In a basic version of the gravity equation, it is assumed that the GDP of both investing and receiving unit (country, region) i and j with respect to a specific observation, denoted by GDP_i and GDP_j , have a positive impact on the volume of foreign direct investment FDI_{ij} between the units. Concerning the transport distance $Dist_{ij}$ between the involved countries or regions, a negative impact is supposed due to rising transport costs as distance increases. Thus, the basic equation can be written as

$$FDI_{ij} = \alpha_0 GDP_i^{\alpha_1} GDP_j^{\alpha_2} Dist_{ij}^{\alpha_3} \varepsilon_{ij}, \quad (1)$$

where α_0 , α_1 , α_2 and α_3 represent parameters to be estimated and the error term ε_{ij} is assumed to be statistically independent of the regressors with

$$E(\varepsilon_{ij} | GDP_i, GDP_j, Dist_{ij}) = 1. \quad (2)$$

Typically, in the literature OLS is used to estimate the parameters of the log-linearised form of the gravity equation, i.e.

$$\ln FDI_{ij} = \ln \alpha_0 + \alpha_1 \ln GDP_i + \alpha_2 \ln GDP_j + \alpha_3 \ln Dist_{ij} + \ln \varepsilon_{ij}. \quad (3)$$

This course of action, however, gives cause for criticism. First, due to Jensen's inequality $E(\ln y) \neq \ln E(y)$, the estimation of the log-linearised gravity equation produces inconsistent results in the presence of heteroscedastic error terms. Second, in cases where there are no FDI flows between two units of observation, the zeros in the dependent variable pose a problem for the estimation of the log-linear specification. Alternative approaches like dropping the zero observations, taking $FDI_{ij} + 1$ as the dependent variable or using a Tobit model lead to inconsistent parameter estimates.

In order to tackle these problems SANTOS SILVA and TENREYRO (2006) suggest to estimate a Poisson Pseudo-Maximum Likelihood (PPML) model that is robust to heteroscedasticity and accounts for zero observations in the case of data situations and research questions like the present. Poisson models are classically used for dealing with count data that indicate the number of occasions of a certain event (for a detailed discussion of count data see CAMERON and TRIVEDI, 1998). An approximate Poisson distribution of the number of events exists if the probability of success is low and the number of trials is high. Y denotes a random variable indicating how many times an event occurs, thereby following a Poisson distribution with the parameter μ . In a Poisson regression model for the analysis of count data, y_i given x_i is Poisson-distributed with density

$$f(y_i|x_i) = \frac{e^{-\mu_i} \cdot \mu_i^{y_i}}{y_i!}, \quad y_i = 0, 1, 2, \dots \quad (4)$$

and the expected value of y_i is a function of explanatory variables

$$E[y_i|x_i] = \mu_i = \exp(x_i' \beta). \quad (5)$$

The model implies heteroscedasticity as both the expected value and the variance of y_i is a function of the explanatory variables. The log-linear form warrants that μ_i is larger than 0. The coefficient vector β can be estimated consistently by the Maximum Likelihood Method.

The Poisson model assumes the equality of expected value and variance:

$$\mu_i = E[y_i|x_i] = \text{Var}[y_i|x_i] \quad (\text{equidispersion}) \quad (6)$$

If this assumption is not fulfilled, $\hat{\beta}$ will be estimated consistently, but the standard errors of $\hat{\beta}$ are biased.

Under the assumption that

$$\text{Var}[y_i|x_i] = E[y_i|x_i] \cdot \{1 + \alpha \cdot E[y_i|x_i]\}, \quad (7)$$

a Negative Binomial model (NegBin) with corresponding variance function has to be estimated, again applying the Maximum Likelihood Method. This model is referred to as NegBin II model. Within the scope of a NegBin II model the assumption of equidispersion is tested: *alpha* indicates the absolute value of the dispersion parameter. If *alpha* is significantly different from zero, the equidispersion assumption is violated and the estimation of the NegBin II model is preferred. Alternatively, if *alpha* is not statistically different from zero, the estimation of a Poisson regression with robust standard errors is favoured. In both cases, the coefficients are estimated consistently and the t-statistics follow a normal distribution and can be interpreted in the usual way. Different models can be compared by means of selection criteria and the likelihood.

In this study, the dependent variable denotes the number of German-Czech FDI projects as a combination of having a German headquarters in a certain German spatial planning region i ($i = 1, \dots, 96$) and a Czech affiliate being located in a specific Czech NUTS 3 region j ($j = 1, \dots, 14$). This variable takes the value zero or positive, integer values. The information on the sectoral affiliation of the Czech firms involved in the FDI projects, available from the ČEKIA database, allows a distinction between investments dedicated to the Czech manufacturing sector and to the Czech service sector by splitting up the dataset.⁴ The number of German-Czech FDI projects is regressed on the set of variables that have been introduced above. In the first specification, only the core variables of the gravity model are included, i.e. the regional GDP values of Germany and the Czech Republic and the distance between home and host region (1). In a next step, besides economic size and distance a set of dummy variables is added to the model (2). On the one hand, the descriptive figures give reason to account for the idiosyncratic economic conditions in eastern Germany and Prague.

On the other hand, the specifics of the borderlands in the two countries, which impact the investment climate beyond the effect of transport distance, are reflected by respective binary variables. In the succeeding estimation version (3), labour market conditions are considered in the regressions by including the wage ratio as well as the regional unemployment rates and high-skilled shares of both countries. The final specifications are characterised by the incorporation of further explanatory variables which relate to agglomeration economies. As, for the Czech part, the additional variables population density, GDP per capita and the manufacturing/services ratio show a relatively high correlation with the Prague dummy, two versions are estimated, one with (4) and one without (5) the observations where Prague is the target region of FDI (representing 96 combinations with German regions of origin).

RESULTS

Table 2 to 4 show the results for total, manufacturing and services FDI projects. In all estimations, *alpha* is significantly different from zero. Therefore, the results presented here are based on Negative Binomial regressions, whereby the outcomes of the Poisson regressions are not fundamentally different.⁵ As apart from the dummies, the explanatory variables enter the equation in log form, the coefficient values represent elasticities. The discussion first focuses on the results for the overall sample of FDI projects as presented in Table 2. Concerning both headquarters in the German region of origin and affiliates in the Czech target region, cross-border FDI projects are preferably located in economically large regions. The coefficient for German GDP is close to 1 in all specifications, i.e. in the case of estimation version (1) a 1% rise of GDP in a German region implicates an increase of 1.11% in cross-border FDI projects performed in the corresponding Czech NUTS 3 region. A higher level of Czech regional GDP by 1% involves a growth in the number of FDI projects by 0.74%. In the final two specifications the coefficient of the Czech regional GDP decreases to around 0.4 but remains significant throughout all estimation versions. Across the board, the transport distance in terms of driving time is negatively correlated with the number of FDI projects joining

a German spatial planning region and a Czech NUTS 3 region. This outcome indicates that proximity is a favourable factor for foreign direct investment. In estimation version (1), an increase of the driving time by 1% between the German and the Czech region is connected with a 1.95% decrease of common FDI projects. This relation remains stable throughout all specifications. Thus, the results for the core variables of the gravity model, GDP and distance are fairly near the theoretical basics of the model and can be regarded as main determinants for German-Czech FDI relations, as it was found out by BEVAN and ESTRIN (2004) in a study on European transition economies.

Regarding the dummy variables, FDI projects with investors that have their headquarters in eastern Germany are, not surprisingly, represented significantly below average. The number of cross-border projects that are initiated in the New Laender lies, dependant on the estimation version, between 69.13% and 74.59% below the ceteris paribus level of combinations with western German headquarters (corresponding to e.g. $e^{\beta(EastGermany)} - 1 = e^{-1.1753} - 1 = -0.6913$). This outcome confirms the diminishing importance of eastern Germany in economic relations with former Comecon nations (see ALECKE et al., 2003). The coefficient for the dummy variable capturing the capital city effect with respect to the outstanding position of Prague is significantly positive at the 5% level in column (2). However, this can be regarded as a form of omitted variable bias since this result is not robust when further variables are included. In column (3) and (4), the coefficient turns negative but is not significant. Thus, the capital city of the Czech Republic, Prague, does not allure German multinational investors through individual factors that go beyond its outstanding characteristics captured by the other variables. This result is in line with the outcome for Bucharest as capital of Romania (HILBER and VOICU, 2010) but contrasts the findings of GAUSELMANN and MAREK (2012) who in their study on the location choice of FDI in eastern Germany, Poland and the Czech Republic identify a positive capital city effect. What should catch the attention are the results for the border dummies. In addition to the transport distance variable, these variables account for cultural and social distance issues. The basic border dummy *Border_GER_CZ* captures regional combinations where both the German and the Czech region are situated in

the borderlands. The significantly positive outcome means that beyond the driving time between locations of mother and daughter company, there is a specific location advantage in the areas close to the neighbouring country with *ceteris paribus* more than three and a half times more projects compared to combinations with both the German and the Czech region not belonging to the borderlands (corresponding to e.g. 251.31% or $e^{1.2565} - 1 = 2.5131$). This can be traced back to the relatively low threshold to invest across the border caused by network and spillover effects, tacit knowledge or the above-average opportunities of transnational exchange in border regions. What BUCH et al. (2003) in their study based on micro data on German outward FDI from the Deutsche Bundesbank found out for the national level – that a common border increases the FDI flows between two countries – thus applies also for the regional level. It might also reveal the special promotion of cross-border projects by the funding policy, as it was induced for example by the INTERREG programmes starting in 1989, with the objective to stimulate cross-border cooperations especially in the border areas of the European Union. The significantly positive coefficient seems to show particularly the attractiveness of the Czech borderlands, as the additional dummy for combinations, in which only the German headquarters is situated in the borderlands, takes negative values that are in all cases at a significant level. This result sheds light on asymmetries with regard to the locations in the German-Czech borderlands indicating that multinationals with headquarters in the German border region are primarily investing in nearby Czech regions, but relatively few of them operate affiliates in regions farther away. In contrast to that, there is no significant difference for the Czech regions close to Germany with respect to the attraction of FDI from German non-border regions, as the pure Czech border dummy turns insignificant when all explanatory variables are included.

Turning to the labour market variables, special attention should be put on the results for the wage ratio. Though the variable's coefficient is not significant in specification (3), it turns significantly negative in the final two estimations where the agglomeration variables are included. Thus, although previous studies that included different countries in the analysis of the regional determinants of FDI identified cheap labour force as an important location determi-

nant for FDI (PUSTERLA and RESMINI, 2007; RESMINI, 2000), this does not hold for locational determinants of German FDI within the Czech Republic. While the remarkably lower wage level in the Czech Republic may contribute to the German investor's basic decision to locate in the neighbouring country, a low regional wage level within the Czech Republic is not among the most crucial location factors for German investors. Unemployment rates obviously do not play an overwhelming role for the explanation of the regional FDI pattern both in the home and in the host country. The marginally significant coefficient for the Czech regions disappears when the full set of variables is used. The findings for the high-skilled share are more clear-cut in the Czech case, where a significantly positive relationship with the number of investors is found in all estimation versions for the total sample. This outcome confirms the results of other studies (GAUSELMANN and MAREK, 2012; MARIN, 2004; SPILKOVÁ, 2007). Furthermore, this corresponds to the observation of BUCH et al. (2005) that the Czech Republic is an attractive target region for German multinationals due to the "highly trained and 'cheap' labour force" and is generally in line with the impression of ARAUZO-CAROD et al. (2010) stating in their review of the literature that investors prefer locations with an on average more educated, but less paid workforce.

With regard to the agglomeration determinants, the significantly positive coefficient for the population density in Germany implies the advantageous role of agglomerative areas for multinational headquarters. For both countries, the regional GDP per capita does not yield significant results. The outcome for the manufacturing/services ratio differs between the two countries. The coefficient for Germany is positive, the one for the Czech Republic is negative, both at highly significant levels. Thus, even when controlling for GDP, population density and education levels etc., headquarters are *ceteris paribus* concentrated in German regions with a relatively high specialisation in manufacturing. In the Czech case, the regions with a relative specialisation in the service sector are to a higher extent involved in FDI projects. As exemplified below, this result is quite understandable, based on the high proportion of investments in the Czech service sector. In spite of the by European standards high relevance of the manufacturing sector in the Czech Republic, this outcome corresponds also to the

findings of HILBER and VOICU (2010) who identify that service agglomeration is a main determinant for the attraction of FDI to Romanian regions as well as to the study of CIEŚLIK (2013) on the location choice of FDI in Poland, where service agglomeration is the only agglomeration effect that is identified.

As shown in Figure 3 and Figure 4, the location patterns of German headquarters and Czech affiliates evidently differ to some extent when looking separately at projects in the Czech manufacturing sector and the Czech service sector. Nonetheless, the estimation of a gravity model yields quite similar results for the two major economic sectors (Table 3 and Table 4). If only investments in the Czech manufacturing sector are subject to the analysis, the coefficient for Czech regional GDP in the basic specification (1) is also positive, but statistically insignificant. The insignificant result, however, is formidably driven by the capital of Prague where total GDP is high, but FDI in manufacturing is performed by a relatively low number of German multinationals. In specifications (2) and (3), the coefficient for Prague is even significantly negative. Not surprisingly, Czech regions with a relative specialisation in the service sector attract significantly more services FDI, while the coefficient for the manufacturing/service ratio is insignificant for manufacturing FDI. The result for the Czech unemployment rate varies with the underlying sample of investment projects. While the coefficient is insignificant for services FDI, it is in all specifications positive and slightly significant in the case of manufacturing FDI. One interpretation of this result is that investors in the manufacturing sector prefer regions with a high availability of workers. With the adoption of an investment incentive law in the Czech Republic in the year 2000, the provision of job creation grants and training and retraining grants has been connected to regional unemployment rates. Thus, another interpretation of this result could be that investors in the manufacturing sector are attracted by investment incentives. This interpretation would support the findings of DINGA (2011) who has shown that investment incentives contribute to the reallocation of FDI within the Czech Republic. Concerning the wage ratio, the difference in the coefficient's value (around -2.5 for manufacturing FDI and below -4 for services FDI) might indicate that service FDI is more attracted by Czech high-wage regions than manufacturing FDI. The re-

sults for the other variables are very similar in both subgroups of FDI projects. Hence, specific location factors for services FDI that deviate from the main determinants for manufacturing FDI and are found in other studies (JONES and WREN, 2015; RIEDL, 2010) cannot be confirmed in the case of German FDI in the Czech Republic.

Insert Table 2 about here

Table 2: Estimation result of Negative Binomial regressions for total FDI projects

Source: Authors' own calculations from ReLOC data.

Insert Table 3 about here

Table 3: Estimation result of Negative Binomial regressions for manufacturing FDI projects

Source: Authors' own calculations from ReLOC data.

Insert Table 4 about here

Table 4: Estimation result of Negative Binomial regressions for services FDI projects

Source: Authors' own calculations from ReLOC data.

CONCLUSIONS

Many studies deal with the reasons for the rise in FDI, as the activities of multinational firms are likely to influence the interregional allocation of productive resources and wealth. Due to limited data availability, however, the bulk of investigations are restricted to larger firms from the manufacturing sector and country-by-country comparisons that disregard regional information for home and host locations. As a consequence, the non-consideration of small and medium-sized firms, the service sector and regional issues can lead to biased results in identifying determinants for the cross-border distribution of FDI. The research goal of this paper was to take a closer look on the two-country case of German multinationals in the Czech

Republic which is one of the major attractors of FDI among the central and eastern European countries. By focusing on a single home and a single host country three categories of potential regional determinants of FDI are examined for the investing and for the receiving country on the basis of theoretical considerations and the related literature: market size and agglomeration economies, distance features and labour market issues. The analysis from a cross-border perspective is enabled by a newly established database in the framework of the RELOC project which covers the total population of German multinationals and their affiliates in the Czech Republic.

The findings of this study reveal new insights about the regional distribution of FDI locations for the German-Czech case illustrating potential options for policy measures both in the home and in the host country. The results indicate the importance of regional interconnectivity for the location of multinationals beyond the relevance of transport costs. Surely, an improvement of traffic infrastructure could facilitate a larger cross-border FDI involvement of more remote regions. Investments from eastern German firms, for instance, could be pushed by lower transport costs to the Czech market, thereby strengthening the international competitiveness of the New Laender. In turn, bringing Czech regions in the eastern part of the country closer to Germany should enhance their attractiveness. But FDI relations are not only an issue of pure distance in terms of traffic accessibility. This concerns in particular investments from the German borderlands, where lots of firms are apparently well engaged in FDI, but for the main part only directly across the border and not in regions farther away. Direct borders apparently foster cross-border investments of firms that otherwise possibly would not be able to invest abroad if higher transaction costs would have to be borne. Therefore, the support of transnational networks that could be enhanced by corresponding policies at the national and at EU level seems to be a promising option to boost the internationalisation of firms even in rather sparsely populated areas. Though the wage level in the Czech Republic is still considerably lower than in Germany, investors are not preferentially looking for location conditions where the regional wage level is as low as possible. Obviously, a well-educated labour supply in the target region is more important for promoting investments. This

outcome points to the relevance for the educational system to assure educational opportunities also away from the large cities.

Nevertheless, there is enough space left for follow-up studies. The interdependence between transaction costs and the motives of firms for going abroad should be taken under closer scrutiny. In particular, the locational comparative advantage of border regions might be considered as an important matter of investigation. Spatial autoregressive relationships could be analysed if data for smaller regional units were available. There may be differences between the location of brownfield and greenfield investments, a topic where also the time dimension could play a crucial role. Last but not least one of the most cardinal issues for future research in international economics might be the impact of FDI on regional labour markets.

NOTES

1. With regard to the quoted database of the Deutsche Bundesbank, the reported thresholds have been changed several times in recent years. At present, only foreign subsidiaries of German firms are included which have a balance sheet total of at least €3 million. This might appear not to be very restrictive. However, taking into account that, according to the Czech Commercial Register, the firms registered by the Deutsche Bundesbank represent only about one fourth of the German FDI projects performed in the Czech Republic, it is not clear, what this bias in favour of large firms exactly implies. Therefore, while the numbers in Figure 1 evidentially manifest the rise of German FDI for the illustrated countries, they also reveal one of the greatest impediments concerning research on cross-border FDI relations. It seems plausible to assume that investments of German firms that do not reach the threshold of at least €3 million in terms of balance sheet total are easier to perform and therefore more frequent in the neighbouring Czech Republic than in countries farther away like the BRICS. Thus, the relative impact of the threshold on the recorded total sum of German FDI in the Czech Republic might also have been higher than in these countries. The shortcoming of not including a significant part of small

and medium-sized enterprises applies also for commercial suppliers of suitable data for scientific investigations, as the databases are usually based on balance-sheet information (see the assessment by BUDD et al., 2005, for example).

2. Business taxes are raised at nationwide or municipal level and as far as subsidies are concerned, investment incentives rest upon economic indicators like GDP level and unemployment rate or are restricted to specific geographic areas like, for instance, border regions or eastern Germany. Particularly with respect to the Czech Republic, many funding schemes are based on figures of economic performance and distinguish between investments in Prague and in the rest of the country. Thus, the Prague dummy captures also the differences in the subsidy level. As a consequence of the lack of regional variability in terms of subsidies, we favour the inclusion of the underlying original variables.
3. Concerning the total sample, in around 40% of cases no FDI projects exist between a specific German and a particular Czech region. For projects in the manufacturing (service) sector the proportion of zeros increases to 59% (56%).
4. We also split the dataset according to the firm size, in order to investigate whether there are differences in the location pattern between small (< 6 employees, 35.95% of all cases), medium-sized (6-49 employees, 37.45%) and large affiliates (> 49 employees, 26.59%). However, the results, that are available from the authors upon request, are for all subsamples very close to the basic outcome, so that we do not find evidence for a determining role of the affiliate size in the location decision process.
5. The Poisson estimation results are available from the authors upon request. In order to take account of the relatively high proportion of zeros, we also performed several robustness checks by estimating a Zero-Inflated Negative Binomial model (ZINB) on the basis of distance, population, GDP or combinations of these variables as explaining predictors of zero common FDI projects between two regions. The results are very close to the outcome of the conventional Negative Binomial model. Conceptually, ZINB models assume that there are two sorts of zeros. Bearing in mind that the lack of FDI flows is not based

on a separate data-generating process that produces excess zeros, i.e. no regional combinations are by definition barred from the execution of joint FDI projects, as it would be the case, for instance, if administrative restrictions of a specific region banned investment relations, we prefer to present the results of the non-inflated model. The results of the zero-inflated model are also available from the authors upon request.

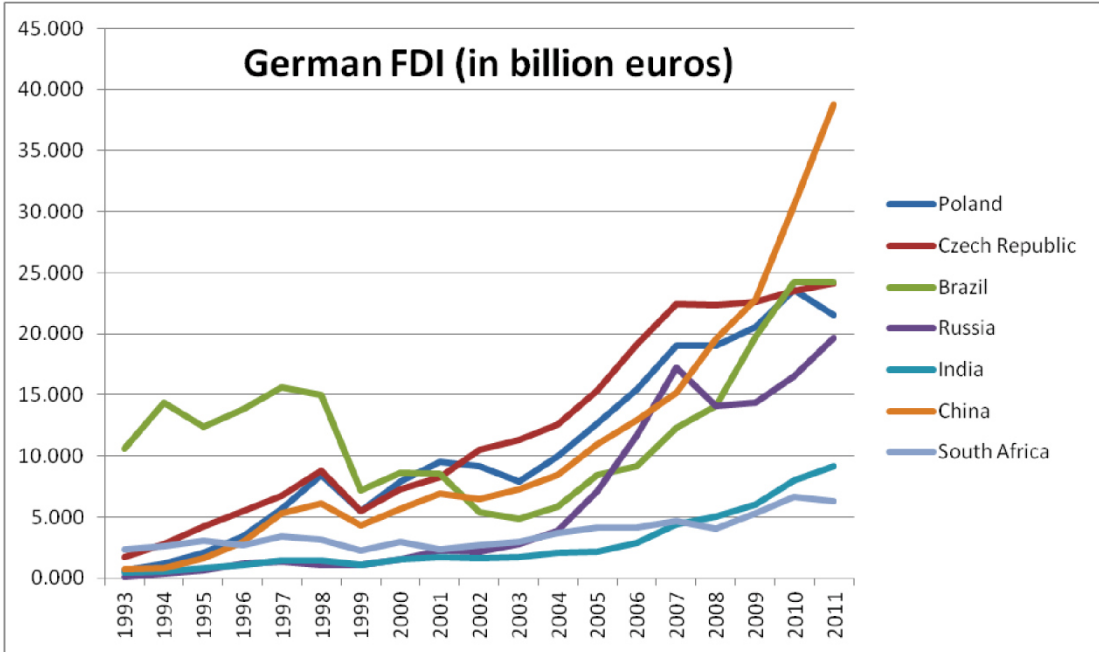
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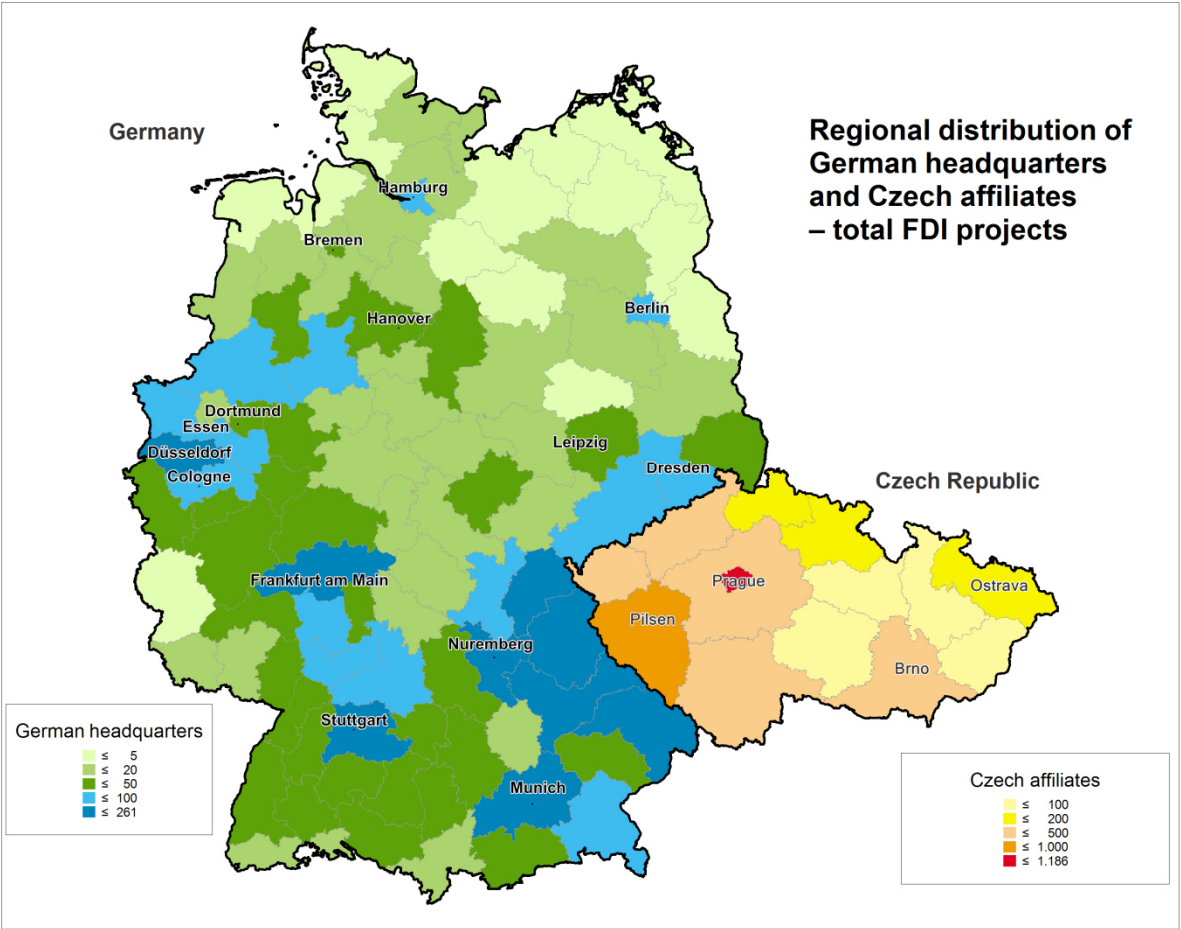
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Figure 1: German FDI in the Czech Republic, Poland and BRICS



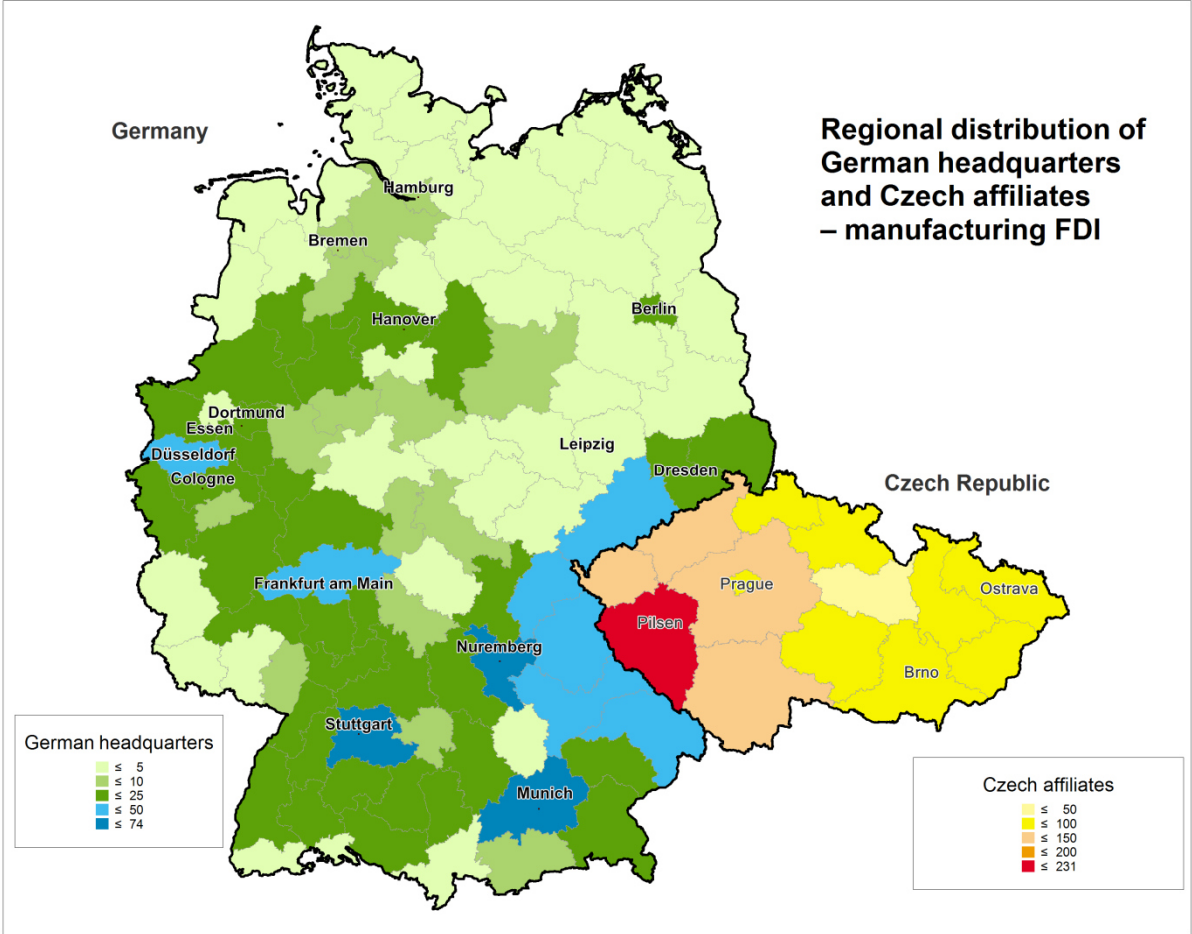
Source: Deutsche Bundesbank

Figure 2: Regional distribution of German headquarters and Czech affiliates (total FDI projects)



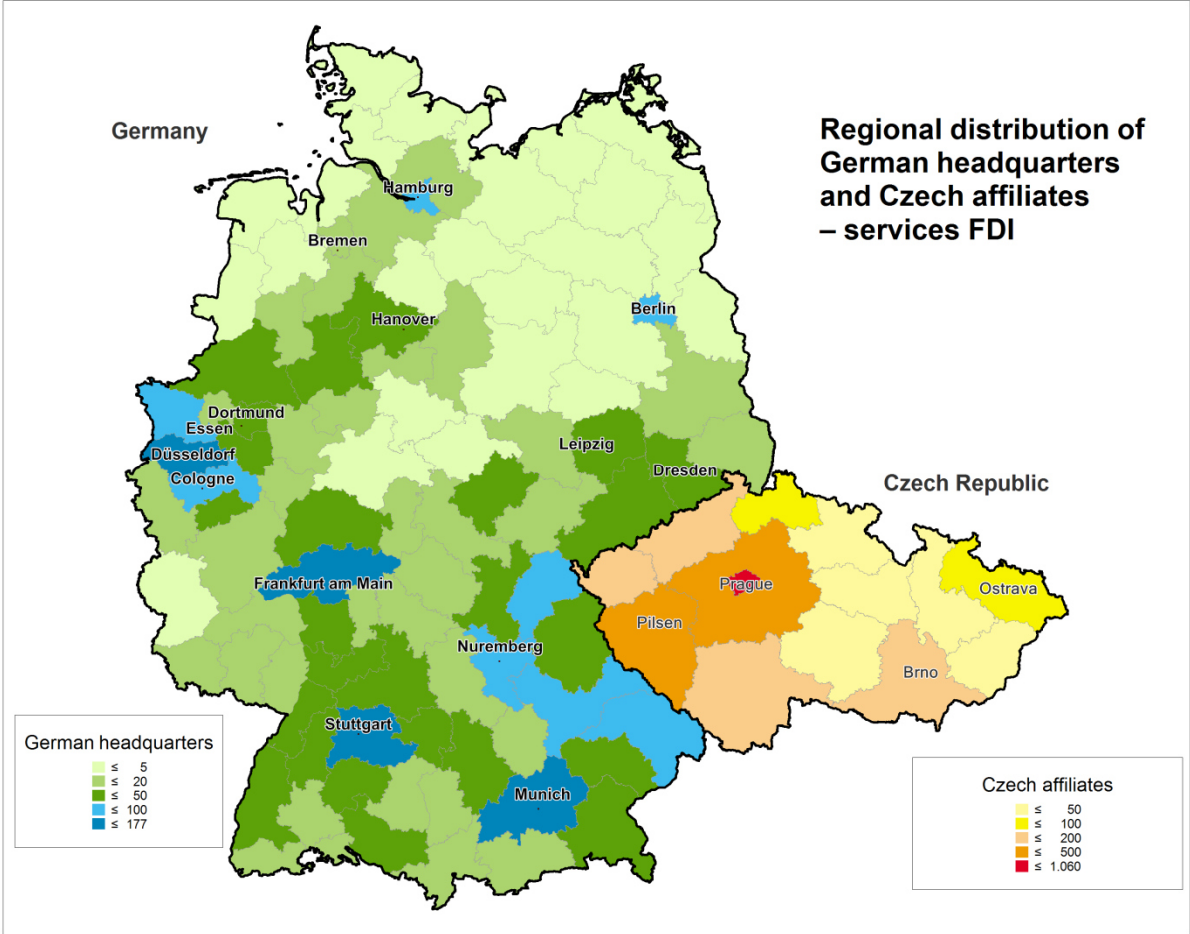
Source: Authors' own calculations from the ReLOC data

Figure 3: Regional distribution of German headquarters and Czech affiliates (manufacturing FDI)



Source: Authors' own calculations from the ReLOC data

Figure 4: Regional distribution of German headquarters and Czech affiliates (service FDI)



Source: Authors' own calculations from the ReLOC data

Table 1: Descriptive statistics for the 1,344 German-Czech regional combinations

	Variable	Obs	Mean	Std. Dev.	Min	Max	Expected sign
market size and agglomeration	GDP Germany (millions of euros)	1,344	24,969.79	23,887.94	4,227	124,527	+
	GDP Czech Republic (millions of euros)	1,344	10,103.64	7,998.76	3,072	35,778	+
	GDP per capita Germany (euros/inhabitant)	1,344	27,203.18	5,638.97	18,416	47,541	+
	GDP per capita Czech Republic (euros/inhabitant)	1,344	12,485.71	4,588.16	10,000	28,800	+
	population density Germany (inhabitants/km ²)	1,344	330.11	498.81	46	3,852	+
	population density Czech Republic (inhabitants/km ²)	1,344	299.61	627.93	66	2,558	+/-
	manufacturing/service ratio Germany	1,344	0.30	0.14	0.09	0.77	+/-
	manufacturing/service ratio Czech Republic	1,344	0.49	0.14	0.10	0.67	+/-
	Dummy East Germany	1,344	0.23	0.42	0	1	-
	Dummy Prague	1,344	0.07	0.26	0	1	+
distance	distance between German and Czech region (minutes)	1,344	566.75	168.62	82.65	1006.34	-
	Dummy Border	1,344	0.02	0.13	0	1	+
	Dummy Border Germany	1,344	0.06	0.24	0	1	+/-
	Dummy Border Czech Republic	1,344	0.29	0.45	0	1	+/-
labour market	wage ratio Germany/Czech Republic	1,344	3.50	0.48	2.05	4.75	+
	unemployment rate Germany	1,344	0.08	0.03	0.03	0.15	-
	unemployment rate Czech Republic	1,344	0.10	0.03	0.04	0.14	+/-
	share of high-skilled Germany	1,344	0.09	0.03	0.04	0.18	+
	share of high-skilled Czech Republic	1,344	0.12	0.04	0.07	0.26	+/-
	<i>population Germany</i>	<i>1,344</i>	<i>852,862.40</i>	<i>624,671.70</i>	<i>215,678</i>	<i>3,434,581</i>	
	<i>population Czech Republic</i>	<i>1,344</i>	<i>747,681.60</i>	<i>316,710.80</i>	<i>308,403</i>	<i>1,250,255</i>	

Source: Federal Statistical Office Germany; Czech Statistical Office; authors' own calculations.

Table 2: Estimation result of Negative Binomial regressions for total FDI projects

Total FDI projects		1		2		3		4		5	
		Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
market size and agglomeration	ln_GDP_GER	1.1138***	0.0479	1.0053***	0.0415	1.1842***	0.0678	1.1220***	0.0781	1.1143***	0.0844
	ln_GDP_CZ	0.7426***	0.0487	0.7483***	0.0702	0.5536***	0.0859	0.4114**	0.1617	0.4031**	0.1621
	ln_GDPpc_GER							0.0973	0.3207	0.0009	0.3497
	ln_GDPpc_CZ							-0.5505	1.0460	-0.6742	1.0393
	ln_PopDens_GER							0.3775***	0.0687	0.3588***	0.0753
	ln_PopDens_CZ							-0.1777	0.1984	-0.1943	0.1967
	ln_Manu/Serv_GER							0.6319***	0.0913	0.7529***	0.0986
	ln_Manu/Serv_CZ							-0.8279***	0.2055	-0.8375***	0.2042
	East_Germany			-1.1753***	0.0935	-1.2758***	0.1807	-1.3109***	0.1833	-1.3700***	0.1954
	Prague			0.2790**	0.1359	-0.2370	0.2156	-0.9069	1.0621		
distance	ln_Distance	-1.9472***	0.0862	-1.8930***	0.1064	-2.0659***	0.1261	-2.0080***	0.1293	-2.0355***	0.1342
	Border_GER_CZ			1.2565***	0.2115	1.2041***	0.2060	1.2372***	0.1951	1.1733***	0.2029
	Border_GER			-0.2822*	0.1485	-0.4656***	0.1522	-0.5025***	0.1489	-0.5263***	0.1607
	Border_CZ			0.1687**	0.0791	0.2252***	0.0811	0.0126	0.1167	0.0011	0.1159
labour market	ln_Wage_Ratio					-1.1677**	0.5938	-3.3867***	0.7135	-3.7094***	0.7541
	ln_Unemployment_GER					-0.0273	0.1255	-0.0742	0.1569	-0.0371	0.1693
	ln_Unemployment_CZ					0.4136**	0.1907	0.3183	0.2873	0.3776	0.2857
	ln_High_Skilled_GER					-0.2697*	0.1491	-0.0825	0.1509	-0.0628	0.1624
	ln_High_Skilled_CZ					0.9258***	0.2020	0.6581**	0.2637	0.6996***	0.2629
Constant	-5.0415***	0.7277	-4.2927***	0.9761	0.5517	2.2004	7.6152	10.0323	11.2239	10.1089	
N	1344		1344		1344		1344		1248		
Pseudo-R ²	0.1648		0.2069		0.2124		0.2289		0.2065		
Loglikelihood	-2334.0108		-2216.3431		-2200.9710		-2154.8786		-1881.7414		
Alpha	0.7415***		0.4437***		0.3990***		0.3350***		0.3284***		

Source: Authors' own calculations from the ReLOC data

Table 3: Estimation result of Negative Binomial regressions for manufacturing FDI projects

Manufacturing FDI projects		1		2		3		4		5	
		Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
market size and agglomeration	ln_GDP_GER	0.9681***	0.0597	0.8759***	0.0531	1.0834***	0.0903	1.1514***	0.1061	1.1465***	0.1106
	ln_GDP_CZ	0.1022	0.0711	0.4814***	0.0899	0.3342***	0.1103	0.3638*	0.2072	0.3832*	0.2086
	ln_GDPpc_GER							-0.3727	0.4413	-0.3099	0.4608
	ln_GDPpc_CZ							-1.0937	1.3300	-1.1952	1.3316
	ln_PopDens_GER							0.2924***	0.0958	0.2671***	0.1012
	ln_PopDens_CZ							-0.1638	0.2455	-0.1691	0.2455
	ln_Manu/Serv_GER							0.8773***	0.1244	0.9944***	0.1302
	ln_Manu/Serv_CZ							-0.1187	0.2605	-0.1059	0.2607
	East_Germany			-1.4340***	0.1333	-1.2401***	0.2447	-1.4484***	0.2511	-1.5105***	0.2618
	Prague			-1.0137***	0.2032	-1.3230***	0.2979	-0.5183	1.3502		
distance	ln_Distance	-1.5984***	0.1054	-1.7888***	0.1345	-1.8668***	0.1581	-1.8856***	0.1630	-1.9453***	0.1669
	Border_GER_CZ			1.1324***	0.2570	1.1087***	0.2509	1.1583***	0.2369	1.1359***	0.2450
	Border_GER			-0.1580	0.1932	-0.3210	0.1977	-0.4169**	0.1937	-0.4672**	0.2046
	Border_CZ			0.0596	0.0991	0.1277	0.1026	0.0860	0.1460	0.0789	0.1461
labour market	ln_Wage_Ratio					-0.8980	0.7809	-2.5745***	0.9350	-2.5329***	0.9641
	ln_Unemployment_GER					-0.2754*	0.1665	-0.1181	0.2125	0.0091	0.2223
	ln_Unemployment_CZ					0.4987**	0.2529	0.6960*	0.3688	0.7400**	0.3694
	ln_High_Skilled_GER					-0.3510*	0.1959	-0.0379	0.1997	-0.0266	0.2085
	ln_High_Skilled_CZ					0.8097***	0.2644	0.9556***	0.3349	1.0040***	0.3357
	Constant	-0.8567	0.9723	-1.9631	1.2516	0.2539	2.8657	17.7621	12.7915	19.1712	12.8824
	N	1344		1344		1344		1344		1248	
	Pseudo-R ²	0.1153		0.1694		0.1747		0.1943		0.1977	
	Loglikelihood	-1557.3166		-1462.1765		-1452.6849		-1418.2341		-1312.7070	
	Alpha	0.9090***		0.4812***		0.4256***		0.3345***		0.3306***	

Source: Authors' own calculations from the ReLOC data

Table 4: Estimation result of Negative Binomial regressions for services FDI projects

Service FDI projects		1		2		3		4		5	
		Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
market size and agglomeration	In_GDP_GER	1.1840***	0.0565	1.0883***	0.0496	1.2721***	0.0827	1.1398***	0.0934	1.1245***	0.1054
	In_GDP_CZ	1.0570***	0.0556	0.9636***	0.0882	0.6635***	0.1069	0.5298**	0.2094	0.5026**	0.2121
	In_GDPpc_GER							0.1874	0.3839	0.0901	0.4383
	In_GDPpc_CZ							-1.3713	1.3809	-1.5324	1.3815
	In_PopDens_GER							0.4411***	0.0814	0.4441***	0.0930
	In_PopDens_CZ							-0.1422	0.2779	-0.1834	0.2768
	In_Manu/Serv_GER							0.4192***	0.1103	0.5214***	0.1245
	In_Manu/Serv_CZ							-1.5502***	0.2596	-1.5652***	0.2594
	East_Germany			-1.0575***	0.1139	-1.5451***	0.2224	-1.4972***	0.2240	-1.5432***	0.2468
	Prague			0.5664***	0.1566	-0.3746	0.2542	-1.8113	1.4118		
distance	In_Distance	-2.1338***	0.1051	-1.9478***	0.1295	-2.2472***	0.1546	-2.2003***	0.1581	-2.2370***	0.1675
	Border_GER_CZ			1.3697***	0.2473	1.2946***	0.2397	1.2751***	0.2260	1.1785***	0.2451
	Border_GER			-0.3686**	0.1826	-0.5933***	0.1863	-0.5663***	0.1820	-0.5851***	0.2061
	Border_CZ			0.2735***	0.0994	0.3301***	0.1021	0.0361	0.1529	0.0052	0.1529
labour market	In_Wage_Ratio					-1.9550***	0.7278	-4.1956***	0.8727	-4.8298***	0.9587
	In_Unemployment_GER					0.2159	0.1531	-0.0686	0.1899	-0.0707	0.2133
	In_Unemployment_CZ					0.3590	0.2284	-0.1427	0.3702	-0.0319	0.3698
	In_High_Skilled_GER					-0.1462	0.1820	-0.0373	0.1822	-0.0470	0.2039
	In_High_Skilled_CZ					1.2142***	0.2382	0.7382**	0.3259	0.7778**	0.3272
	Constant	-8.1143***	0.8560	-7.4943***	1.2196	1.5755	2.6605	12.5711	13.0940	17.1690	13.3297
	N	1344		1344		1344		1344		1248	
	Pseudo-R ²	0.1972		0.2365		0.2457		0.2638		0.22	
	Loglikelihood	-1738.7974		-1653.7495		-1633.8167		-1594.5861		-1336.5701	
	Alpha	0.8262***		0.4747***		0.4053***		0.3226***		0.3278***	

Source: Authors' own calculations from the ReLOC data