# German Direct Investments in the Czech Republic – Effects on Domestic Labor Markets

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# 1 Introduction

The economic integration of markets induces a broad variety of new conditions and opportunities for their economic units. Multinational enterprises (MNE) are key players in this regard. The increasing liberalization of trade and capital flows facilitates entries into foreign markets and international fragmentation of production processes. The effects of foreign direct investments (FDI) have yet to be fully investigated. Thus, the impacts of FDI on labor markets continue to be discussed by academics, the public and policy makers. Part of the public and of policy makers have mixed feelings about MNEs. They are associated with numerous characteristics and often provoke highly divergent views. One subject that is frequently addressed is job security. On the one hand, MNEs are appreciated for their competitiveness in the global market, providing well-paid jobs and favorable working conditions. Due to their significance and manifold linkages to other economic units, they are also related to innovation, wealth and attractiveness of regions. On the other hand, they are more able to reorganize their international division of labor, leading to concerns about job losses in the home country. However, are these fears justified? Theoretical considerations do not provide an unambiguous evaluation of the effects of FDI on domestic employment. Empirical studies are therefore urgently required.

Unfortunately, the empirical literature on this subject conducted so far refers to selective databases, which cover only larger parent companies and/or affiliates. This doctoral thesis makes an important contribution to the closure of gaps in the literature on labor market effects of FDI. It uses a unique and comprehensive database based on the full Czech Commercial Register covering the total population of German affiliates in the Czech Republic. The creation of the database and the dissertation itself was conducted within the scope of the IAB project “Research on Locational and Organizational Change” (ReLOC).[1] A cross-border project conducted in collaboration with a research team directed by Daniel Münich of the Economics Institute of the Academy of Sciences of the Czech Republic (CERGE-EI) with fundamental support from Michael Pflüger (University of Würzburg, formerly the University of Passau) and Martin Abraham (University of Nürnberg-Erlangen). It addresses various research questions on German direct investments in the Czech Republic with a primary focus on the effects on German labor markets. The utilization of these data reveals new findings on the regional distribution, the type and the

1 As IAB Research Project it is titled “Labour Market Effects of Cross-Border Outsourcing through EU Enlargement: The Case of Germany and the Czech Republic”.

effects of FDI. The restriction of the analysis to the case of Germany and the Czech Republic can be regarded as a disadvantage. However, it is based on the first database for Germany that is not selective in terms of the size of parent companies or affiliates. Therefore, it permits reliable conclusions to be drawn regarding the impact of FDI in this specific case. Furthermore, it exemplifies the historical integration of the Central and Eastern European countries (CEEC) into the European Union (EU) and reveals outcomes in a setting with favorable conditions for efficiency seeking investments.

The key finding is that there is a clear risk that FDI has negative employment effects. The domestic employment of German MNEs starts to decline after their investment in the Czech Republic. This leads to negative effects when they are compared with firms without FDI. However, these negative effects only apply to the demand for low- and medium-skilled workers. They appear for both service and manufacturing FDI, but they are stronger for the latter, because of the dominance of vertical FDI in this case. The findings of this thesis justify public concerns about offshoring and imply that investments in countries with cheap labor might negatively affect jobs for low-skilled and medium-skilled workers. Yet, there are also positive effects in the regions where the investors are located: the increasing demand for high-skilled employees following the investments and the strong engagement of peripheral border regions that are extending their business activities into the borderlands on the Czech side. As in many other cases, there are winners and losers. Therefore, there are options for policy makers. One is to maintain a well-educated workforce in Germany. This enables to realize advantages, such as increasing competitiveness and new customers for German firms, while at the same time negative effects are diminished. Another implication for policy is the promotion of cross-border projects in peripheral border regions to foster economic strength and to reduce their disadvantages. The large number of investment projects within the common border region reveals the great potential for cross-border investments in such areas. Interestingly, they are not restricted to investments that are intended to reduce the costs of production as they appear to the same extent for both manufacturing and service FDI. This makes it even more attractive for local policy and population, not only on the German but also on the Czech side. Because from the Czech perspective, investments in the Czech service sector are more appealing as the German affiliates operating in the service sector exhibit the same technological, educational and skill intensity as the parent companies. In contrast, manufacturing affiliates provide a lot of manual routine jobs deepening the specialization of the Czech economy in low-tech jobs.

This cumulative thesis is structured as follows: Chapter 2 introduces the topic and includes a review of the literature on the employment effects of FDI with a special focus on Germany and investments in Central and Eastern Europe, which is in parts also addressed in the papers presented in Chapters 4, 5 and 6 due to the cumulative character of this dissertation. Chapter 3 provides a detailed description of the extensive data preparations and new data linkage methods that were developed in this thesis to link firms with the establishment-level data of the Institute for Employment Research (IAB). This generated a worldwide unique database about FDI projects.

Chapter 4 includes an article completed with my co-authors Veronika Hecht and Michael Moritz in which we analyze the regional distribution of German investors and their Czech affiliates using a gravity model approach. This is the first empirical study on the location choice of MNEs that includes not only target region but also home region characteristics. This leads to results that can only be identified by adopting a home-host country perspective. The most interesting finding is the strong position of the common border region and its interconnectedness. Firms residing close to the German-Czech border are particularly attracted to the border region on the Czech side and invest directly at the border, which implies close economic ties within the common border region.

Chapter 5 presents an article written with my co-authors Michael Moritz, Daniel Münich and Martin Srholec. We reveal differences between German parent companies and their Czech affiliates using information on factor requirements from our firm survey. We apply a cluster analysis at the firm level and identify four main groups that divide the sample with respect to sector and by the technological, educational and skill intensity of firm activity: high-tech manufacturers, low-tech manufacturers, high-tech service providers, and low-tech service providers. A more detailed examination of the clustering shows that for service firms the factor requirements of German affiliates are not different from those of their parent companies. Therefore, we conclude that in the service sector, the dominant model of investment is horizontal. For the manufacturing sector, we find remarkable differences. The Czech affiliates are mostly assigned to the low-tech cluster and the German parent companies to the high-tech cluster. Even when compared to Czech firms without a foreign owner, Czech affiliates exhibit a significantly higher probability of being classified as low-tech firms. Consequently, in the manufacturing sector, vertical relationships predominate, entailing a relatively high share of manual-routine workers in Czech locations.

Chapter 6 evaluates whether investments in the Czech Republic lead to employment gains or employment losses in the German parent companies. The date of investment in the Czech

Republic is used to compare the employment trend of firms with Czech affiliates and firms without FDI for the same time spells. The analysis shows that these groups develop differently. One year after the investment, MNEs' employment in the home country declines relative to the employment of the reference group. The relative decline continues for five years. However, whether the domestic workforce is affected negatively depends on the skill level. The multinational firms even increase their stock of high-skilled employees shortly after the investment. In contrast, medium- and low-skilled jobs are reduced. This applies to both manufacturing and service FDI, whereas the negative effects are stronger in case of investments in the Czech manufacturing sector.

Finally, Chapter 7 summarizes the main findings explaining the novel insights of this thesis and policy implications following from them.

# 2 Employment effects of FDI

## 2.1 The international organization of the firm

The labor market effects of FDI represent one of the most important research topics at present. With ongoing trade liberalization and tremendous FDI growth rates, trends that still persist, the impacts of FDI began to become an important subject in the 1990s. Over the last 30 years, foreign direct investment has increased extraordinarily, exceeding the growth of international trade many fold. Reasons given for this are the global elimination of trade and investment barriers and the considerable decline in transport and communication costs. The integration of Central and Eastern European countries (CEEC) and Asia plays a major role in this regard. There was an annual average of 28 billion US dollars (nominal) in global investments abroad between 1970 and 1980, 94 billion between 1980 and 1990, 418 billion between 1990 and 2000 and 1,267 billion between 2005 and 2013. The strongest growth was thus observed during the 1990s, where the annual investment volume more than quadrupled. For comparison, the total trade in goods and services approximately doubled during this period (UNCTAD 2015). The fall of the Iron Curtain in 1989 opened potential investment locations in the Eastern part of Europe. These countries offered new opportunities for market expansion and a relatively low wage level despite their small distance from Western European countries. Unsurprisingly, according to a survey by the German Statistical Office, 60% of relocations made by German companies with 100 or more employees between 2001 and 2006 were conducted in the CEEC (Statistisches Bundesamt 2008).

Trade and FDI are related phenomena, but it is necessary to distinguish among various means by which an enterprise can organize its production of goods and services. The required production steps can be conducted either by firms from the same corporate group or by external suppliers. Both types of acquisitions are available at home and abroad. Within a corporate group, activities can be sourced from domestic and from foreign suppliers. In contrast, as in Pflüger et al. (2013), the term “outsourcing” refers to purchasing services and products from domestic and international firms that are not affiliated with the purchasing firm (see Table 2-1). As the acquisition or establishment of foreign firms entails high fixed costs, only the most productive firms can afford to select this type of business organization (Helpman et al. 2004).

**Table 2-1: Classification of company organisation**

| Activity carried out | **at home** | **abroad** |
|---|---|---|
| **in-house** (affiliated suppliers) | domestic insourcing | **offshoring/integration (horizontal and vertical FDI)** |
| **external** (non-affiliated suppliers) | domestic outsourcing | international outsourcing |

Source: Pflüger et al. 2013.

This dissertation focuses on German direct investments in the Czech Republic and, therefore, on the international organization of activities within a given corporate group. Theoretical approaches to the topic often distinguish between two types of FDI: vertical FDI and horizontal FDI. Vertical FDI describes the fragmentation of production across national borders, whereby the various sites of MNEs focus on the production steps for which they have a comparative advantage (Helpman 1984; Helpman and Krugman 1985). These steps can differ in, for example, technological, skill and task intensity. For parent companies from advanced countries, vertical FDI is expected to cause a relocation of low-skilled, labor-intensive production steps from the home country to foreign markets with lower labor costs. The underlying motive is therefore the cost-minimizing production of goods, which increases the competitiveness of enterprises and enables increased profits. This type of investment can also be used to simply serve the domestic market with lower production costs and without the objective to gain foreign customers. The production of intermediate and end products at various locations increases trade between domestic and foreign business units. Therefore, vertical FDI benefits from reduced trade barriers and transportation costs (Markusen 2002). This type of investment corresponds to past works on MNEs that assume that high-skilled and high-tech activities are concentrated near the headquarters of the corporate group. One example is the “eclectic paradigm” developed by Dunning (1981). The basic idea of his concept is that enterprises invest in a foreign location to better exploit their firm specific assets by taking advantage of foreign location advantages, such as lower costs of labor or better access to raw materials. With relatively low labor costs, at approximately 1/6 and 1/3 of the German level, in 2000 and 2014, respectively (Eurostat 2015), and located near Germany, the Czech Republic provides favorable conditions for vertically oriented investments.

In contrast, horizontal FDI is intended to serve a foreign market on site (Markusen 1984; Markusen and Venables 1998). Horizontal multinationals engage in the same activities in different locations, creating the same type of jobs at home and in the foreign location with the same intermediate input requirements. Compared to the strategy of serving a foreign market via exports, foreign affiliates enable improved market access because transport costs and, consequently, variable product costs are lower. The larger the number of customers, the more the profits exceed the costs of establishing a foreign subsidiary. Therefore, horizontal direct investments are more attractive when transport costs or other forms of trade barriers are high and the market potential is large (Markusen and Venables 1998). The new markets that have emerged next to the EU and their catching-up process attract this type of investment. Taking the example of the Czech Republic, its GDP per capita doubled between 1995 and 2004 and between 2000 and 2011 (Eurostat 2015).

The relative importance of these different types of foreign direct investment remains unclear. A frequently used measure for distinguishing between horizontal and vertical FDI is to compare the industry codes of parent companies and their affiliates. If the affiliate operates in the same industry as the parent company, the investment is classified as horizontal and vertical otherwise. A study on German FDI by Buch et al. (2005), which applies this type of classification, obtains the result that vertical FDI plays a larger role for investments in Central and Eastern European countries than for those in other target regions. They use the MiDi database (Microdatabase Direct Investment) from the German Federal Bank that includes approximately 8,800 foreign affiliates worldwide. However, this measure depends on the level of aggregation. The share of horizontal investment is overstated if the level of aggregation is too high, and the opposite is the case if the classification is too detailed. The main activity also needs to be correctly recognized, which is particularly difficult for large firms such as multinational enterprises. Another approach to classifying FDI as horizontal or vertical is to utilize the export/sales ratio of foreign affiliates. From a survey of the managers of 420 German firms engaging in FDI in Eastern Europe, Marin et al. (2003) calculate the ratio of exports from the affiliate to the parent company to the total sales of the affiliates. The data cover 1,050 investment projects, nearly a quarter of which are sited in the Czech Republic. They conclude that, overall, horizontal FDI dominates, although vertical FDI also plays an important role. Of the countries considered, only the shares for the Baltic States (64%) and for Slovakia (82%) indicate strong support for the dominance of the vertical model.

Using the same database but adopting a different approach, Protsenko (2003) obtains contrary results for the Czech Republic. He defines an investment as vertical when the trade with the parent company accounts for more than 50% of either the inputs or sales of the affiliate; otherwise, an investment is regarded as horizontal. According to this approach, 60% of the investments from German firms to the Czech Republic are classified as vertical and 40% as horizontal. The reason for this different result is outliers, namely, several large companies from the automotive and financial sectors that engage only in minor intra-firm trade. Marin (2006) also employs these survey data and focuses on the identification of offshoring, which corresponds to the vertical model. In contrast to Protsenko (2003), she classifies an investment as vertical when both the parent company and the affiliate are importing goods from one another. Without considering the amount of trade, 76% of German FDI projects in the Czech Republic are classified as vertical. However, when imposing the requirement that at least 20% of foreign sales are exported to the parent company, the share of vertical FDI is only 10%. Therefore, the results are highly sensitive to the amount of intra-firm trade. However, focusing on intra-firm trade to classify the type of investment can also induce an underestimation of vertical FDI because it ignores the fact that multinational corporations are often operating as flagships of widespread production networks. These networks often include many suppliers that are not part of the corporate group but legally linked via long-term contracts. Furthermore, when asking for the amount or share of traded intermediate goods, it is likely that the within-firm trade of services is not fully captured.

Görg et al. (2010) combine information on firm's principal activity with trade flows at the country level. They use data from the German-Czech Chamber of Industry and Commerce (DTIHK) that include information on 1200 German affiliates in the Czech Republic and merge these data with the database of Hoppenstedt, a commercial data provider. To classify manufacturing FDI by type, they employ the concept of revealed comparative advantage, which is based on patterns of bilateral trade. An investment project is regarded as vertical when the principal NACE code of the German parent company corresponds to an industry for which the Czech Republic has a revealed comparative advantage. All other projects are classified as horizontal. When they apply this at the 3-digit NACE level, they find that 177 projects are vertical and 284 projects are horizontal. When they consider the 2-digit NACE level, they classify 284 investments as vertical and 194 as horizontal. However, as the 3-digit NACE level is the most similar to the Standard International Trade Classification (SITC) of goods, the first result is more convincing.

A more direct measurement of the type of investment can be derived from surveys that directly ask managers about their motives for investing abroad. For German FDI, an annual survey of the German Chamber of Industry and Commerce (DIHK) among members from the manufacturing sector reveals a fundamental dominance of horizontal investments (see, for example, DIHK 2008). Between 2000 and 2008, approximately 2/3 of the companies that invested abroad reported having done so primarily to increase their foreign sales; 1/3 cite reducing production costs as their main motive. In recent years, the relevance of cost-motivated investments has decreased. In 2014, only 21% of the surveyed companies cited the reduction of production costs as their main goal (DIHK 2014). Yet, it is also evident that cost motives play a relatively important role for investments in the CEEC, even compared to investments in Asia. In 2008, 43% and in 2014, 33% of firms having invested in countries that became part of the EU in 2004 did so in order to reduce their production costs. Further, in the specific case of German investments in the Czech Republic, cost motives are relatively important. In the ReLOC survey conducted in 2010 among companies with investments in the Czech Republic, 42% of the respondents cited reducing costs as the dominant investment motive (Hecht et al. 2013a). For manufacturing companies, the corresponding figure is 49%, which is clearly a higher share than that in the DIHK surveys. Obviously, the unique combination of a short distance and a relatively low wage level are favorable conditions for vertically oriented investments in the CEEC, particularly in the Czech Republic, as it neighbors Germany.

## 2.2 Labor market effects of FDI – Theory and empirical evidence

Although underlying investment motives affect the impact of FDI on firm's domestic employment, the classification into horizontal and vertical FDI provides no clear predictions of the employment effects (Pflüger et al. 2013). Vertical FDI is often assumed to have an unambiguously labor-reducing effect because it is conducted to reduce firm's labor costs. However, according to Grossman and Rossi-Hansberg (2008), this does not necessarily have to be the case. In their model they focus on tradable tasks and how declining offshoring costs influence factor prices in the home country. They set up a Heckscher-Ohlin-model in which each good is produced with a continuum of different tasks. Some tasks require workers with relatively little education, while other tasks require well-educated workers. In their basic framework, they assume that only tasks for low-skilled workers can be offshored. High-skilled tasks need to be conducted in the home market. They identify three effects of declining offshoring costs on the employees whose tasks can be offshored: the relative-price effect, the labor supply effect and the productivity effect. The relative price effect is the well-known Stolper-Samuelson effect. The labor supply effect describes the redundancy of domestic labor as a result of an expansion of offshoring. The resumption of the freed labor leads to wage cuts. Whereas the Stolper-Samuelson and labor supply effects describe a negative impact on wages, the productivity effect can lead to an overall gain. The productivity effect arises because profitability increases the most in the sector that is relatively intensive in low-skilled labor at the initial factor prices. This sector thus expands relative to the skill-intensive sector, and the demand for low-skilled labor increases. Therefore, even the factor that is most at risk of experiencing wage losses due to increasing offshoring possibilities can benefit. The factor used to conduct non-tradable tasks gains in any case from the relative price effect and from a boost to its marginal product because of the increasing intensity of low-skilled tasks in the production process.

Similar results are derived by Groizard et al. (2014), who set up a model based on the Melitz (2003) framework. In contrast to Grossman and Rossi-Hansberg (2008), they identify the impact on the domestic employment level. Consequently, they do not assume full employment but model labor demand at the firm level, leading to other effects by definition. However, the central conclusions are the same. Different effects lead to an ambiguous prediction regarding the overall effect of offshoring on the labor demand of investing firms. They identify a productivity effect and a relocation effect. The relocation effect reflects the shifting of domestic jobs into the foreign country. With reduced offshoring costs, firms that conduct offshoring increase the fraction of foreign inputs and reduce employment at home. The lower input costs allow them to reduce prices. This leads to an increase in home employment if the elasticity of substitution between inputs is lower than the elasticity between differentiated good varieties, which they term the productivity effect. In addition, in accordance with the Melitz framework there is also a selection effect that affects all firms. The productivity gained through offshoring increases the threshold of firm-level productivity required for staying in the domestic market, akin to the selection effect caused by reduced trade barriers in the basic Melitz (2003) model. This leads to an exit of the least-productive non-offshoring firms. For firms engaging in offshoring, the selection effect is outweighed by their increase in productivity. Therefore, market shares are reallocated from non-offshoring firms to offshoring firms.

Accordingly, the models developed by Grossman and Rossi-Hansberg (2008) and Groizard et al. (2014) show that factor inputs that appear to be negatively affected by increasing offshoring opportunities for firms and industries are not necessarily badly off, as there are always counterbalancing productivity gains.

Similarly, there is no clear prediction regarding the employment effects of horizontal FDI, although the expectation is frequently that there is no negative effect. At first glance, duplicating activities in a foreign country seems to have neutral effects on home employment. However, whether there are neutral, positive or even negative effects depends on the initial situation, repercussions and the international organization of the firm. The investing firm expands its market and thus needs more crucial services, such as management, marketing, and R&D services. If at least some of these headquarters services are conducted by the parent company, the investing company's demand for employees that can perform these tasks, which are more likely to be skill-intensive, increases. In this context, multinational enterprises are exporters of knowledge-based services (Markusen 2002). If the affiliate obtains other inputs and complementary products from the parent company for its production, the labor demand at home also increases. However, if the parent company is constructing manufacturing facilities in a foreign country to save transport costs and serve the new market with an on-site plant, this market-motivated investment can also reduce the size of its domestic workforce when it replaces former exports in the foreign market (Barba Navaretti et al. 2010). The same applies to services that had formerly been used to export the produced goods.

The previous considerations show that the foreign investment might also change the skill composition at home and that, again, there are no clear predictions regarding which skills will benefit most, particularly in the case of horizontal FDI. In the short run, vertical FDI is very likely to reduce the share of the production factor for which the foreign market has a comparative advantage. However, with increasing productivity and sales, this effect can be reversed if new jobs are created that can be conducted by workers whose jobs were initially offshored.

In essence, not all firms are expected to invest in a foreign affiliate. As Helpman et al. (2004) demonstrate, only the most productive firms are expected to decide to serve foreign markets through a foreign affiliate. Among those not being crowded out, the least productive firms sell only on the domestic market. Firms serving the foreign market via exports lie in between. Generally, it can be assumed that the motives underlying FDI are often more complex. It is likely, for example, that vertical and horizontal FDI arise simultaneously (Yeaple 2003a). Furthermore, the actual range of activities is wider than the classification into horizontal and vertical FDI is able to capture. The broad range of underlying motives is also supported by the ReLOC survey (Hecht et al. 2013a) and other surveys (for example, “Going International” by the DIHK (2008)) and “Verlagerung wirtschaftlicher Aktivitäten” by the German Statistical Office (2008)) that directly ask about investment motives. This shows again that it is important to empirically investigate the effects of FDI on domestic employment.

In recent decades, various key issues were addressed in research on FDI: in the 1980s and 1990s, the contribution of international outsourcing on the decreasing demand for low-skilled workers and the impact of the North American Free Trade Agreement (NAFTA) on the US and Mexico, the rise of Asia and the integration of the Central Eastern and Eastern European countries in the 1990s and 2000s, and in recent years, trade in tasks and service offshoring. Many empirical works were conducted based on firm-level, sectoral or regional data to analyze the effects of outward FDI on domestic employment. Following Crinò (2009) and Pflüger et al. (2013), the sizable literature concerning the labor market effects of international outsourcing and offshoring is summarized as below.

First, concerning the effects of FDI on total employment in multinational enterprises at home, most studies report no negative effects and instead often find positive effects. To perform accurate evaluations, studies often compare MNEs with firms without FDI (see Barba Navaretti et al. (2010), Castellani et al. (2008) and Crinò (2010b) for Italian MNEs, Barba Navaretti et al. (2010)

and Hijzen et al. (2011) for French MNEs, Hijzen et al. (2007) for the case of Japan, and Becker and Muendler (2008), Wagner (2011) and Kleinert and Toubal (2007) for Germany). It should be noted, however, that most of this studies are restricted to MNEs that become multinational for the first time.[2] A study that reports negative effects on the domestic employment of MNEs is from Debaere et al. (2010). They find that Korean firms with investments in less advanced countries have smaller employment growth than domestic firms without FDI. For the three-year period following the investment, they estimate a 2% lower annual growth for MNEs relative to the control group. Investments in more advanced countries do not reduce the employment growth of Korean multinationals. Similar results are derived by Jäckle and Wamser (2010). In the three years after having invested abroad for the first time, German MNEs have a 4% lower annual employment growth than firms without FDI. Barba Navaretti et al. (2010) also divide their sample into two types of target countries, developed countries (DCs) and developing and less-developed countries (LDCs). The positive effects for investments in DCs are clearly stronger, but in contrast to Debaere et al. (2010), they find a slightly significant positive effect on the employment level of French and Italian MNEs, even for investments in LDCs. This result is similar to those of Hijzen et al. (2011), who also divide investments from French multinationals into high-income and low-income locations. For investments in high-income countries, there are large positive effects on home employment. For investments in low-income countries, there are only small positive effects in the longer term.

Second, regarding the skill composition, most studies report evidence of skill-upgrading caused by foreign direct investment (see Head and Ries (2002) for the case of Japanese manufacturing MNEs, Hansson (2005) for the case of Sweden, and Becker et al. (2013) and Wagner (2011) for the case of Germany). For Italian multinationals, Castellani et al. (2008) observe skill-upgrading only for investments in the CEEC. Skill-upgrading is a common finding and is observed irrespective of whether outsourcing takes place within or outside the corporate group. Studies using measures of international outsourcing at the industry level find also an increase in the relative demand for high-skilled labor. Because of the insignificance of international service outsourcing, these studies have long typically been restricted to manufacturing outsourcing (see Egger and Egger (2003) and Feenstra and Hanson (1996, 2003) for the US, Geishecker and Görg (2008) for Germany, Hijzen et al. (2005) for the United Kingdom, and Hsieh and Woo (2005) for outsourcing from Hong Kong to China). There are only a few contradicting studies by Marin (2004,

[2] This applies to Barba Navaretti et al. (2010), Castellani et al. (2008), Hijzen et al. (2011), Kleinert and Toubal (2007), Hijzen et al. (2007), Jäckle and Wamser (2010) and Debaere et al. (2010).

2011). She refers to a survey of 660 German and Austrian investors in Eastern Europe and argues that German and Austrian multinationals are shifting high-skilled jobs and not low-skilled jobs to Eastern Europe. Her argument is based on the large difference between the parent companies and their Eastern European affiliates regarding the share of high-skilled employees.

Third, the effect of international outsourcing on individual employment security is not clear-cut. For Denmark, according to Munch (2010), international outsourcing increases the risks of job-to-unemployment transitions for low-skilled workers, but the effect is quantitatively modest. In case of Germany, Geishecker (2008) finds much larger effects on individual job security, whereby each skill group is negatively affected. For Austrian manufacturing industries, there is evidence from Pfaffermayr et al. (2007) that the probability of remaining in or switching into the manufacturing sector decreases with outsourcing intensity, particularily in industries with a comparative disadvantage. In contrast, in their study on the German labor market, Bachmann and Braun (2011) find a positive impact on overall job stability for both manufacturing and service industries, whereas the effect on job security is larger in the service sector. This is similar to the results of Becker and Muendler (2008). They analyze job stability in German multinational firms after an increase in their FDI stock. The result is a lower separation rate for multinational enterprises compared to firms without FDI. In line with this, in another study on German multinationals, Buch and Lipponer (2010) estimate firm-level labor demand functions for domestic (exporters and non-exporters) firms and MNEs. The central result is that multinational enterprises do not react more strongly to changes in wages and output. The employment of the two types of firms also has a similar degree of persistence.

Fourth, as the international outsourcing of services received particular attention in the early 2000s, some studies focused on the effects of this new phenomenon. Thus far, it seems that there are only minor effects on the domestic workforce (see Amiti and Wei (2005) and Geishecker and Görg (2013) for the UK, and Amiti and Wei (2009) and Liu and Trefler (2008) on outsourcing from the US to China and India). As manufacturing outsourcing, international service outsourcing seems to be related to skill-upgrading (see Crinò (2010a) for the US and Crinò (2010b) for Italy). In his study on different sectors in the US, Crinò’s results indicate that service offshoring increased employment of high-skilled workers, whereas low- and medium-skilled workers were negatively affected when their occupations were classified as tradable. Otherwise, even for the low- and medium-skill groups, employment in occupations classified as non-tradable increased.

Fifth, there is another strand of literature investigating whether the relationship between parent and affiliate employment is substitutive or complementary by estimating cross-elasticities of labor demand between home and foreign locations (see Braconier and Ekholm (2000) for Sweden, Brainard and Riker (1997a, 1997b) for the US, Becker et al. (2005) for Germany and Sweden, Konings and Murphy (2006) for Europe, and Muendler and Becker (2010) and Becker et al. (2013) for Germany). A particular challenging issue for these studies is to retrieve detailed information on the parent companies and on their affiliates. In line with theoretical trade models, they find substitutive relationships between locations in countries with similar factor endowments (i.e., both the parent company and the affiliate are located in a high-income country) and no significant or even complementary relationships between locations in countries with different factor endowments (i.e., the parent company is located in a high-income country and the affiliate in a low-income country). Moreover, for the US, there is evidence that the employment levels of different affiliates of the same parent company are substitutes for one another when they are situated in regions with similar wage levels (Brainard and Riker 1997a, 1997b). In contrast, for Sweden, Braconier and Ekhom (2000) find mainly a complementary relationship among an MNE's affiliates. They argue that compared to US multinationals, Swedish multinationals are more vertically integrated, which explains these different results. Regarding the magnitude of these elasticities, the results are not clear-cut. While the substitution effects found in Braconier and Ekholm (2000) are rather small, the studies by Becker et al. (2005), Konings and Murphy (2006), and Muendler and Becker (2010) suggest stronger responses by multinational firms with respect to wages in home and foreign countries.

Sixth, based on the influential work of Autor et al. (2003) and Levy and Murnane (2004), a growing literature uses the approach of separating occupations and jobs into different task categories. The basic concept is that there is no perfect correlation between job substitutability and skills. Whether jobs can be performed by computers or can be relocated to foreign locations depends in particular on their routine content. There are numerous examples that support this view. There are low-skilled jobs that cannot be replaced because they include personal interactions and physical presence. Therefore, there are many jobs in the low-income segment of the labor market that are not at risk of being relocated to foreign countries, such as cleaning, catering, hairdressing and security services. In contrast, many medium-skilled jobs exhibit a high amount of routine and do not require physical presence. Because of this, some studies classify labor in terms of tasks instead of skill classes or use both types of classifications. The most famous task classification is based on the work of Autor et al. (2003) who create five task categories: analytical tasks, interactive tasks, cognitive routine tasks, manual routine tasks, and manual non-routine tasks. Manual routine and cognitive routine tasks can be substituted by computers or offshored. In contrast, this is not the case for analytical, interactive and manual non-routine tasks. Initially, the task approach was used to explain the polarization observed in the US and UK labor markets, where high- and low-skilled jobs had higher growth rates than did jobs in the middle of the income distribution (Acemoglu and Autor 2011; Autor et al. 2006; Goos and Manning 2007). This extension was then adapted from the offshoring literature, spurring studies on the effects on individual or firm employment. In a study concerning the US, Crinò (2010a) finds that within skill groups, international service outsourcing affects tradable occupations negatively while non-tradable occupations gain from an increasing outsourcing intensity. For Germany, Becker et al. (2013) investigate the response of the onshore workforce composition of German MNEs to a change in their offshore employment levels. An increase in the foreign employment level induces skill-upgrading at home and a relative increase in the number of non-routine and interactive tasks. The skill and task classifications complement one another, as the effects remain significant when both classifications are used in their model. In an analysis of the effects of international outsourcing on the individual risk of leaving a job, Baumgarten (2015) concludes that international service outsourcing increases overall job stability, while the effect of material outsourcing is slightly negative. In this context, task measures provide additional explanatory power, showing that as non-routine and interactive task intensity increases the effects become more beneficial or less adverse. For wage effects, the conclusions are essentially the same. Wage losses are more exposed to routine jobs within each skill group and gains increase in the intensity of non-routine tasks (see Baumgarten et al. (2013) for Germany, Ebenstein et al. (2014) for the US and Hummels et al. (2013) for Denmark).

Seventh, very recently, studies have begun to address the effects of international trade on regions, rooted in well-known studies on the impact of the North American Free Trade Agreement (NAFTA) on regional employment patterns in the US and Mexico. One finding is that this trade liberalization caused a decentralization of economic activity in Mexico because after the trade reform, employment growth in manufacturing industries was higher in regions relatively close to the US (Hanson 1998). According to Hanson (1996, 2001), the growth of export manufacturing industries in Mexican border cities increased manufacturing employment in US border cities. This indicates that there is also shifting of manufacturing activities to border regions on the US side. In the case of Mexico, two issues favor economic development in areas bordering the US: the first is that already richer regions seem to particularly profit from reducing trade barriers. This relationship is also found for some other countries. In China, this is the case for the already richer coastal regions (Kanbur and Zhang 2005). This trend is also observed in Indonesia in the main metropolitan areas of Java (Henderson and Kuncoro 1996) and in the Philippines in the Manila area (Pernia and Quising 2003). The second issue is the proximity to regions with free trade agreements. Here, another corresponding example is that of Austria, where municipalities next to Central and Eastern European markets exhibited higher employment and wage growth after the fall of the Iron Curtain (Brülhart et al. 2012). Regarding the regional impact of the European Union enlargement in 2004, the results are mixed. Braakmann and Vogel (2010) find that small service firms located in German NUTS1 border regions next to the new member states exhibit increased turnover but lower profitability. They interpret this as a positive impact on firm performance and explain the reduction in profits with current costs of expansion. In contrast, there is a negative effect on turnover and export intensity for large firms.

Differentiating the regional effects with respect to skills, another result for the US-Mexico case is that on both sides of the border wages of non-production workers increased relative to those of production workers, who are assumed to be less skilled (Feenstra and Hanson 1996,1997). However, it is unclear whether this is associated with NAFTA because the demand for unskilled labor was relatively high in Mexican regions highly integrated with the US (Chiquiar 2008) and in regions adjoining the US border (Airola and Juhn 2005). Following the influential work of Feenstra and Hanson, Moritz and Gröger (2007) analyze the development of labor markets in the Bavarian-Czech border regions from the fall of the Iron Curtain until 2001. They find no changes in the qualification structure of the Bavarian regions but a decline in the wages of low-skilled employees.

Divergent results are reported in the recent literature on the impact of trade shocks on regions. For India, Topalova (2010) concludes that regions that are more exposed to foreign competition after the 1991 Indian trade liberalization exhibit lower poverty reduction and lower consumption growth. Concerning Brazil's 1987-1995 trade liberalization, Kovak (2013) finds that regions with larger liberalization-induced price declines experienced a larger wage reduction. For the US, Autor et al. 2013 analyze the effect of growing Chinese import competition in the period 1990-2007 on US regions. They conclude that increasing imports from China caused higher unemployment, lower labor force participation, and reduced wages in local labor markets specialized in import-competing manufacturing industries. Yet, there is also a study by Dauth et al. (2014) on Germany that addresses the effects of trade between Germany and the “East” – China and Eastern Europe – between 1988 and 2008. They find that increasing trade with the

East caused job losses in German labor markets specialized in import-competing industries, but this is outweighed by employment gains and lower unemployment in regions specialized in export-oriented industries. Overall, they estimate job gains of approximately 500,000 in Germany.

## 2.3 The case of Germany

As this dissertation addresses the specific case of German direct investments in the Czech Republic, a detailed discussion of the results for Germany with a specific focus on investments in Central and Eastern Europe and the underlying data sources is needed. There are various articles on this subject (see also Pflüger et al. 2013 whose literature review highlights studies pertaining to Germany). Starting with Buch et al. (2007), they have access to data from a survey titled 'Going International' by the DIHK. This survey provides information on the change in employment since the investment in a foreign country. The authors find that the employment development differs depending on the target country. Firms with investments in the new EU member countries are more likely to exhibit reduced employment afterwards. However, in the questionnaire, the firms could only select three categories: employment decreased, remained stable or increased. Moreover, Buch et al. do not have a reference group without FDI at their disposal.

Klodt and Christensen (2007) regress the employment growth of German multinationals on the change in their FDI stock, obtaining a positive and significant correlation. This is also the case for investments in Central and Eastern European countries. They also use the MiDi database, which covers 2,195 parent companies that exhibit a change in their FDI stock between 2002 and 2003. Thus, they only cover a 2-year period. Moreover, they do not compare their results with those for companies that have not invested abroad.

Kleinert and Toubal (2007) link the MiDi data with the Dafne database from Bureau van Dijk. Dafne provides balance sheets for approximately 800,000 German companies, i.e., for 60% of the total population included in the commercial register. The authors compare the employment growth of companies that invested abroad between 1997 and 2003 to that of companies that did not conduct FDI or were already multinationals before 1997. Their estimations reveal a positive correlation between the investment and MNE’s employment growth at home, but in most cases it is not significant. Their sample of investing companies, however, is very small, comprising only approximately 500 companies.

Becker and Muendler (2008) merge the employment histories from the German Federal Employment Agency (BA) with the MiDi database. Moreover, they add information from the Markus database of Bureau van Dijk to cover other German firms that are affiliated to the MNEs in their MiDi data. Accordingly, they try to conduct their analysis on the level of the corporate group. The databases are linked on the basis of firms' names and addresses. As a consequence, they identify only the firm headquarters in the BA data. They estimate the effect of an increase in FDI on the separation rate of employees in the subsequent year. While they calculate the separation rate at the individual level, they include plant characteristics in the propensity score matching. The result is that by increasing their foreign employment, MNEs have a lower separation rate than firms that do not engage in FDI. This holds for white-collar and blue-collar workers and also for investments in the CEEC. Using these data in a more recent study (Becker et al. 2013) that refers to the literature on tasks (Acemoglu and Autor 2010; Autor et al. 2003), the authors observe educational upgrading and an increasing share of non-routine tasks among German multinational firms after expanding their employment abroad from 1998 to 2001. Offshoring to low-income countries is linked to stronger onshore responses, which is in line with the theory on vertical offshoring. Interestingly, this does not apply to investments in Central and Eastern Europe countries.

Temouri and Driffield (2009) estimate labor demand equations for 2,129 German firms with foreign affiliates from 1998 to 2007 and include the wage level of the foreign subsidiary as explanatory variable. The source is the Orbis database from Bureau van Dijk, which contains worldwide affiliates of German firms. They classify the type of investment by comparing the 2-digit NACE codes of the parent company and the affiliate and differentiate between FDI in high-income and low-income countries. Only for parent companies in the manufacturing sector that conduct horizontal FDI in high-income countries they find a negative relationship between the subsidiary wage and the labor demand at home. When they extend their analysis to the wage level of the parent company, they find negative elasticities only for the manufacturing sector. However, the coefficients are very small in magnitude, indicating rather negligible effects on MNEs' wage levels. Again, they do not have a control group to benchmark their results.

After merging the MiDi data with Bureau van Dijk data, Buch and Lipponer (2010) estimate labor demand equations and compare wage and output elasticities of multinational and domestic firms. The two groups do not react significantly differently in terms of changes in output or wages. This result is in line with Peters and Weigert (2013), who examine the labor demand of German multinational enterprises during the current crisis. Using the MiDi data, they find that during the global economic crisis in the years 2008 and 2009, German multinational firms essentially maintained the size of their domestic workforce. The authors also provide evidence that German MNEs reduced employment in their foreign affiliates instead.

Jäckle and Wamser (2010) use a panel of about 1000 firms that become multinational between 1997 and 2001 for the first time. The information on the investment in a foreign country comes from the MiDi database. The starting point of their treatment group are firms with a foreign affiliate covered by the MiDi database (about 38,000) between 1996 and 2001. They merge the data with the USTAN (*Unternehmensbilanzstatistik*) database, which is also from the German Federal Bank and includes balance sheets. They match about 1/4 of the MNEs. Among those, there are about 1,000 firms that become multinational for the first time. They compare the growth of different firm characteristics of these switchers with that of a control sample. Firms from the USTAN database without notification of a foreign affiliate in the MiDi data serve as control group. They find that both productivity and wage growth are higher for firms that become multinational for the first time than for purely national firms. Employment growth is also higher before the switch of the multinational status, but it becomes lower afterwards when controlling for selectivity by means of the Heckman (1978) correction. They estimate for a three-year period after the switch an about 4 percent lower employment growth. These are interesting results, but unfortunately, they do not provide results on MNEs overall, as those not investing for the first time are not considered. Firms becoming multinational for the first time are likely to react different from firms more experienced with FDI.

Mattes (2010) uses the Linked Employer-Employee Panel (LIAB) of the IAB. This database consists of the IAB Establishment Panel linked with administrative data from the BA. The Establishment Panel is an annual survey of approximately 16,000 plants that have at least one employee subject to social insurance contributions. In 2006, the survey included questions on FDI. Approximately 12,500 plants participated, and 342 indicated that their company invested in a foreign country in the previous business year (which usually refers to 2004 or 2005). Mattes compares the labor demand of these plants with that of all other plants and estimates a panel from 2002 to 2007. He does not find that the investment has a negative impact. Instead, the investing plants experienced a better developement. The results are driven by a higher demand for high-skilled and low-skilled employees. In contrast to commercial databases, the IAB Establishment Panel is not restricted to larger firms, which is an advantage. Yet, it is unclear whether plants from the comparison group have no foreign affiliate or merely did not invest in the few years prior to the survey. Furthermore, the FDI information is based on self-reports, which can lead to other types of selection, such as an overrepresentation of headquarters in the FDI sample.

Wagner (2011) has access to data from a survey of the German Federal Statistical Office (Statistisches Bundesamt 2008) on the relocation activities of German firms. He considers any firm that relocated some of its activities abroad for the first time between 2001 and 2003. His sample is restricted to firms from manufacturing industries with more than 100 employees and encompasses 160 firms. Using propensity score matching, he finds no significant differences between relocating firms and a control group without relocations with respect to employment growth.

The impact of FDI on home employment also depends on the relationship between foreign and domestic activities. In the case of German FDI, for regions with a very low wage level – developing countries – Muendler and Becker (2010) and Becker et al. (2005) find no substitutive but instead a complementary relationship when the foreign affiliates are already established. This does not apply to investments in the CEEC. As in affiliates in other Western European countries, subsidiaries in the CEEC are substituting for domestic employment. Apparently, either their wage level is not low enough, or regional proximity to Western European countries constitutes an additional competition characteristic. This again shows that the CEEC, as investment locations, are positioned between Western European countries and developing countries. These studies must be distinguished from those analyzing the initial effects of going abroad. Firms that intend to relocate part of their low-skilled, labor-intensive production are attracted by low-wage regions when they decide where to invest. However, after having founded a foreign affiliate and some years of establishing the international organization of the firm, foreign and domestic activities are complementary when the two sites specialize in different tasks.

Beyond multinational enterprises, there are some studies that use the share of intermediates at the sectoral level as a measure of the effects of offshoring on individual workers. Hence, they do not focus on multinational firms in particular and also include international outsourcing outside the corporate group's boundaries. Using this approach, in their analysis of the German manufacturing sector utilizing SOEP data, Geishecker and Görg (2008) find evidence of a negative effect of outsourcing on the wages of low-skilled employees. In contrast, wages of high-skilled employees are affected positively from international outsourcing. Baumgarten et al. (2013) build on the results of Geishecker and Görg (2008) and combine the SOEP with the German Qualification and Career Survey from 1998/99 to assign occupations a certain task content, as in Becker et al. (2013). They find small negative effects of within-industry variation in international outsourcing intensity on the wages of low-skilled employees. However, when allowing for cross-industry effects, the wage reductions are more significant and depend strongly on the task content of the job. With increasing interactivity and, in particular, non-routine intensity, wage gains within the skill groups are increasing and wage losses are decreasing. For example, low-skilled jobs with the highest degree of non-routine activities do not experience wage losses. In contrast, for low-skilled jobs with the highest routine content, the authors estimate annual wage losses of approximately 2,400 euros. In contrast to Geishecker and Görg (2008) and Baumgarten et al. (2013), Bachmann and Braun (2011) use the IAB Employment Sample (IABS), a 2% random sample of the employment statistics of the Federal Employment Agency. They focus on job security and investigate how employees' labor market transitions are affected by international outsourcing. Their hazard rate models include direct job-to-job transitions, the flow from employment to unemployment and the flow from employment to non-participation. An increasing outsourcing intensity at the industry-level is associated with slightly higher overall job stability in the manufacturing sector. Job-to-job and job-to-unemployment flows are declining in international outsourcing. Only the flow from employment in manufacturing to non-participation is increasing, but in total it is outweighed by the lower transition rates for the two other transition types. For the service sector, the results show clear increases in job stability. Using sector-level data on German manufacturing industries, Geishecker (2004) addresses how international outsourcing affected the relative demand for low-skilled workers in Germany from 1991 to 2000. According to his results, international outsourcing explains between 19% and 24% of the overall decline in the relative demand for low-skilled workers in this period.

Not all studies support the finding of a skill-upgrading process in Germany induced by FDI/international outsourcing. Marin (2004, 2011) analyzes a survey conducted among 660 Austrian and German companies with FDI in Eastern Europe and detects a substantial difference between the share of high-skilled jobs of the parent companies and their Eastern European affiliates. The affiliates tend to have a higher share of high-skilled jobs. This leads her to conclude that German and Austrian multinationals are shifting high-skilled jobs to Eastern Europe. However, this interpretation does not account for basic differences in the education systems between these countries. In particular the dual education system, which is much less established in Eastern European countries lacking practical education within firms, might play a major role here. This could explain the relatively high demand for high-skilled workers in the foreign affiliates. Furthermore, it is unclear whether these high-skilled workers are employed to replace formerly German jobs or to exploit new markets.

## 2.4 Data limitations

To summarize, due to the complexity of investment motives and ambiguous predictions concerning the impact on labor markets, it is crucial to empirically investigate these effects. Most empirical studies do not find a negative overall effect of FDI on the domestic workforce of multinationals. This also applies to studies on Germany, even when there is differentiation in terms of target countries, such as the CEEC and Asia or low-income and high-income countries. However, there is still need for research, as there is no database that includes all foreign direct investments in the country of origin. In Germany, the MiDi database from the German Federal Bank or databases from commercial data providers are highly selective. Commercial data providers, such as Bureau van Dijke, Bisnode/Hoppenstedt and Creditreform, gather their information from annual reports. Yet, before the implementation of the *Elektronische Bundesanzeiger* in 2007, most annual reports were published by large companies. The reason is that, on the one hand, the publication of such reports involved substantial administrative work for companies, while, on the other hand, the risk of prosecution for non-compliance was quite low, as there were almost no objections to the absence of annual statements from smaller firms, which were required for further prosecution by public authorities (Hecht et al. 2013b). For example, in 2006, 6% of small, 24% of medium and 92% of large limited companies published their annual statements (IHK Saarland 2008). Since electronic collection began in 2007, proper submission by firms is automatically monitored. The MiDi database captures only larger foreign investment projects by German companies. Recently, the MiDi database contains only firms that have a foreign subsidiary with a balance sheet total of at least 3 million euros (Pflüger et al. 2013). To see the difference, in 2011, the Bureau van Dijk and MiDi databases contained approximately 1,000 Czech companies with a German owner. In contrast, the ReLOC database contains approximately 3,900 Czech companies with a German owner and includes many more small and medium-sized firms. The reason for this is the direct access to administrative data sources such as the Czech commercial register that includes all Czech companies independent of their size (Hecht et al. 2013b).

Moreover, there is another potential source of bias: Becker and Muendler (2008) and Becker et al. (2013) only identified the headquarters of each company in the data from the Federal Employment Agency. They do not solve the problem that this data is available at the establishment and not at the firm level. They might miss establishments because companies, particularly larger ones, can consist of several establishments. If the employment at the headquarters and company's other establishments develop differently, the results would be biased. It is highly likely that establishments within a firm are affected differently. Plant characteristics, such as regional location, play a role here. Exploiting differences in productivity and factor prices is less attractive if transport costs are high (Markusen 2002). On the other hand, the productivity effect could be larger when the foreign affiliate is closeby. Also the type of business activity can affect whether the domestic workforce of a plant is competing with workers at the foreign location. It is very likely that the impact on domestic headquarters and the effect on production facilities with a high share of routine jobs are different.

The selectivity issues that arise in studies on foreign direct investment are not restricted to German databases. To name but a few works that are referred to in the following sections and are most comparable to this dissertation, Hijzen et al. (2007) use data from the Basic Survey of Business Structure and Activities from 1994 to 2000, conducted by the Japanese Ministry of Economy, Trade and Industry. This survey is compulsory, but it includes only firms with more than 50 employees and 30 million yen in assets. The firms are operating in manufacturing, mining and commerce industries, whereas they restrict their analysis to the manufacturing sector. The sample of French MNEs in Barba Navaretti et al. (2010) consists of firms from the 2002 version of the database "Enquetes filiales", maintained by the Directorate of Foreign Economic Relations (DREE) of the French Ministry of Economy and Finance. They state that this database provides all affiliates of French firms with 20 employees or more. The number of multinational firms in their database is 602 in 1995 and 787 in 2000. Their Italian sample comes from the "Reprint" database maintained by the Polytechnic of Milan and the Italian Institute for External Trade (ICE). The number of multinational firms is 524 in 2001, for example. This database does not cover the total population of Italian MNEs. They state that Mariotti and Mutinelli (2004) estimate the number of all Italian multinationals in the same period at approximately 1,000. Castellani et al. (2008) also refer to this “Reprint” database and link it to balance sheet and detailed employment data from the Unioncamere Nazionale, which is the Union of the Italian Chambers of Commerce. Their database comprises 108 Italian MNEs with at least 20 employees that invested abroad between 1998 and 2004. Similarly to Barba Navaretti et al. (2010), Hijzen et al. (2011) utilize the “Enquetes filiales” survey for the years 1987 to 1999 and link it to a database with information on business groups, “Liaisons Financieres”, in order to avoid the matching of companies from the same corporate group. Ultimately, their data include 404 manufacturing firms and 349 service firms that went multinational between 1987 and 1999. When they drop firms with missing values, the numbers further decline to 309 switchers in the manufacturing sector and to 185 in the service sector. The most promising data are those of Debaere et al. (2010), who use a full list of South Korean foreign direct investment flows obtained by the Export-Import Bank. However, to obtain additional investor characteristics, they merge the data with balance sheet information from the Korea Information System (KIS). They match approximately half of the multinational firms in manufacturing. Smaller firms are less likely to be matched. The successfully merged firms are responsible for more than 80% of FDI in manufacturing, which indicates substantial selectivity. There are also some studies without further information about the data collection which would help to evaluate the representativeness of the sample. This applies to Head and Ries (2002) who analyse a 25-year panel data set on 1,070 Japanese manufacturing firms and Marin (2004, 2011), for example. Marin reports that her survey includes 660 German and Austrian firms with 2200 investment projects in transition countries during the period from 1990 to 2001. She states that these data represent 100 percent of Austrian and 80 percent of German direct investment in Eastern Europe. The German sample comprises 420 firms and 1,200 investment projects. However, given the numbers from the ReLOC database, it is unclear whether these data represent such a large share of German multinational enterprises and their Eastern Europe affiliates. For comparison only, the ReLOC database includes 2,121 investments in the Czech Republic that were conducted from 1,908 German multinationals between 1990 and 2001. One reason for this difference could be that the ReLOC data includes many more small and medium-sized firms.

In any case, each of these above mentioned studies is urgently required to get a full picture about the employment effects of FDI. Therefore, this chapter is not intended to criticize other studies. It is simply not possible to access a large and fully comprehensive FDI database. As a consequence, a fundamental motivation for this dissertation was to establish a unique, well documented and complete as possible database on German FDI. Although it is limited to investments in the Czech Republic, the enormous amount of work makes an extension to other target countries exceedingly difficult. Instead, we focus on obtaining a complete picture of this specific two-country relationship to provide reliable results that also offer implications for other target areas.

# 3 Data methodology[3]

## 3.1 The ReLOC data

To address the research questions of the ReLOC project properly, various types of data collections and sources were utilized. These include administrative, commercial and survey data. One objective was to create a database that comprises the total population of German affiliates in the Czech Republic and the corresponding parent companies. These data serve as the basis for subsequent data acquisitions by means of a cross-border company survey and the record linkage with the IAB Employment statistics. For certain investigations, such as that on the employment effects, it was necessary to include also a suitable comparison group. Therefore, for the purposes of the ReLOC project, we generally pursued a control group approach. To this effect, there were four clearly differentiated groups for the ReLOC survey (see Figure 3-1):

- MNE group in the Czech Republic (subsample ReLOC-C):

The Czech MNE group consists of 3,875 Czech firms with German equity investments. This category includes GmbHs, AGs, KGs, OHGs[4] and branches. GmbHs, AGs and KGs in which less than 25% of equity shares were German-owned did not qualify for the MNE group. As a basic principle, we only considered firms that were either directly legally connected to a German company or that had a legal connection to a German company via its owner.

[3] Chapters 3.1 and 3.2 reproduce parts of our method report (Hecht et al. 2013b) on the ReLOC project explaining the background and the identification of the multinational firms. Chapter 3.3 consists of the method report on the record linkage with the data from the IAB (Schäffler 2014).

[4] These are German legal forms corresponding to limited liability companies, joint-stock companies, limited partnerships and general partnerships, respectively.

- Reference group in the Czech Republic (subsample ReLOC-R):

This group consists of Czech companies that are entirely Czech-owned and do not even have an indirect foreign owner. This means that even those Czech companies that did not have foreign owners but for which other Czech firms with foreign owners held shares in them were excluded. The “foreign” criterion is defined according to the registered office of the parent company or to the permanent residence of the owner when he is a natural person. Exclusion is possible up to the fourth level. The information concerning the existence of a foreign partner was obtained from the Creditinfo database.

For further illustration: There are five Czech companies, A, B, C, D and E. Company A has a foreign owner. Company A holds shares in Company B, Company B in Company C, Company C in Company D and Company D in Company E. All other owners of companies A, B, C, D and E are permanent residents of the Czech Republic. Companies A, B, C and D would be excluded from the reference group, while Company E would be included.

- MNE group in Germany (subsample ReLOC-G):

The starting point for the German MNE group are the German owners of the 3,875 companies in the Czech MNE group. This resulted in 3,406 firms. The number in the German MNE group is naturally lower because some German owners were involved with more than one Czech company. The ReLOC-G group consists primarily of firms with a direct equity investment in a Czech company or a Czech branch. If a holding or management company domiciled in Germany had shares in the Czech Republic, it was excluded from the MNE group in favor of another German company in the affiliated group that was more active in the core business (see Chapter 3.2 for further details concerning this procedure).

Parallel to the Czech MNE group, German companies for which the owner was a private individual who also owned a Czech company were included in the German MNE group. Only one company was selected for each owner (see Chapter 3.2).

Hence, the MNE group consists of both German companies with a direct investment or branch and German companies with an indirect investment or a sister company in the Czech Republic.

- Reference group in Germany (subsample ReLOC-N):

This consists of German companies that had (as of August 2010) no foreign affiliate (neither direct nor indirect equity investments abroad nor foreign sister companies). This database was purchased from TNS Infratest for the ReLOC Survey. Exclusion was possible up to the first level.

For further illustration:

Exclusion in cases of direct FDI, indirect FDI or foreign sister companies: There are three companies, A, B and C. Company A has an investment in Company B. Company B has an investment in Company C. If Company A has a direct investment in a foreign company, neither Company A nor Company B can be included in the reference group. If only Company C has a location abroad, however, Company A (but not Company B) can be included in the reference group.

**Figure 3-1: The ReLOC data**

| **Record Linkage with the IAB Employment statistics** | |
|---|---|
| **ReLOC survey GER** | |
| **Reference group GER**<br><br>German firms with no foreign affiliate<br><br>**ReLOC-N** | **MNE group GER**<br><br>German firms with a Czech affiliate<br><br>**ReLOC-G** |

↑

Total sample

↓

| **MNE group CZ**<br><br>Czech firms with German equity holders<br><br>**ReLOC-C** | **Reference group CZ**<br><br>Czech firms with no foreign equity holders<br><br>**ReLOC-R** |
|---|---|
| **ReLOC survey CZ** | |

*ReLOC Survey*

The ReLOC survey was conducted by TNS Infratest Sozialforschung in Germany and by TNS AISA in the Czech Republic. In both countries, each company in the reference and MNE sample were contacted and the data acquired in personal interviews (PAPI). The questionnaires were designed to make them suitable for an interview situation, but in such a way that in exceptional cases they can be left with the company for respondents to fill out themselves if they so desire.

The ReLOC questionnaires are based on the IAB Establishment Panel.[5] As this survey has been conducted every year since 1993, the instruments used have been tested and documented accordingly, have proven themselves in the field and have been adjusted to current developments. Parts of the written CORIS survey, the Cluster Oriented Regional Information System, were also used (Möller and Litzel 2008). As far as possible, questions from the current IAB Establishment Panel wave which were thematically useful for the ReLOC Survey were taken word for word. However, not all questions could be transferred in their original form but had to be adapted in various ways. First, ReLOC's cross-border character required a range of items to be adjusted. Deviations between the Czech and the German versions specific to a particular country made terminological and factual adjustments necessary. The employment classifications, for example, have been affected of such adjustments as there is, on the one hand, no equivalent to the German system of marginal employment (400 euro jobs) in the Czech Republic. On the other hand, "self-employed employees", for whom the employer does not have to pay social insurance, are very common there, but do not exist in Germany. Concerning the wage system there have been clear differences, too. The in Germany well known terms "Haustarifvertrag" and "Branchentarifvertrag", referring to the company wage agreement and industry wage agreement, respectively, are incomprehensible in the Czech Republic. In addition to this, collective wage agreements are considerably less common in the Czech Republic than in Germany. "Collective wage agreements of higher order" do exist, but they are only common in traditional industries such as metal processing. Besides, there are many company unions which negotiate company

5 As the units of analysis "establishment" and "company" are one and the same for single-site companies, the information provided by the IAB Establishment Panel participants who have no foreign affiliate can also be used to supplement the ReLOC data for analysis. A question concerning the identification of single-site companies which are relevant for ReLOC is annually included in the IAB Establishment Panel (question no. 83 in the 2010 survey). Accordingly, a new question (no. 84) was included to collect information on an establishment's foreign affiliate.

wage agreements with their employers. These company unions also take on the function of works councils, which are separate institutions in Germany. Thus, the questions concerning employee representatives are different for Germany and the Czech Republic. Further adaptations have been necessary due to the fact that ReLOC is addressing companies, not establishments. In some questions it was enough to change terms and in others structures had to be altered.

Equivalence, which is an essential prerequisite and important attribute of international surveys, is achieved by the approach described above. It minimised the differences in content between the German and Czech versions, whereby attention was also paid to the uniformity of scales and units (with the exception of currency). Here, discussions within the binational team and with the survey institutes in Munich and Prague showed that the differences between the two neighbouring European countries were not very marked in regard to cultural sensibilities toward scaling. Furthermore, the pretests in the two countries showed that the distribution of the scales used in both countries was comparable, which supports the idea that the scales were used equivalently in both countries (Vijver and Leung 1997: 33).

Because of the numerous possible sources of error, evoked by the linguistic and cultural differences as well as the institutional peculiarities of the labour markets in the two countries, all versions of the survey were tested before the fieldwork phase. In various phases of completion, the questionnaires were shown to German and Czech experts from different fields, which was indispensable for identifying possible sources of error (Blair and Piccinino 2005: 20). Several of the experts were native Czechs, so that difficulties in comprehension based primarily on linguistic errors could be avoided. Likewise, experts from the DTIHK were consulted, especially with questions concerning the labour market structures or labour law. The German survey institute focussed especially on the practicability of the questionnaires. Furthermore, pretests were carried out in both countries, their results tested for plausibility and consistency and the questionnaires adjusted accordingly.

For all four survey groups the questionnaires were divided into the following thematic blocks: EU enlargement to the East, employment, foreign involvement (for the reference groups: areas of operation), corporate policy and development, investments and innovations, wages and salaries, company activities and further information concerning the company. Appendix A contains a structural plan of the questions common to the four ReLOC instruments, and of the questions and items specific to each country (emic/etic model, see Harkness et al. 2003).

*Record linkage of the German data*

In a subproject all the address data from both the German MNE group and the reference group was linked to and enriched with the IAB Employment statistics. One aim was to generate a comprehensive longitudinal data set, independent of the survey response, which allows the direct analysis of effects of FDI on employment. Another objective was to enrich the data collected in the survey. This also enabled us to omit some questions in order to disburden respondents and interviewer.

The IAB uses data from the Federal Employment Agency, which is a rich source for employment data. It collects and administers data from the notification process of the social security system. The IAB/BA data comprise the universe of all German employees liable to social security since 1975 with detailed information on their characteristics (wage, skill, age, occupational status, etc.). The social security records are reported on the establishment level. (see Chapter 3.3 for more details).

## 3.2 Identification of MNEs

A special challenge was the composition of the MNE groups. To avoid selectivity in our database and to possibly identify the entire population of German-Czech affiliates, we had to use other data sources than the data products from Bureau van Dijk (Markus, Amadeus, Dafne or Orbis) or the MiDi database from the German Federal Bank. At the time when the survey was prepared these databases included approximately 1,000 German affiliates in the Czech Republic, which was only a small fraction of the total population of German-Czech affiliates. Although these sources are often used in scientific research on FDI, they were selective with respect to the characteristics of the investing firm and/or the foreign affiliate. At present, the MiDi database contains only firms which have a foreign subsidiary with a balance sheet total of at least 3 million euros (Pflüger et al. 2013).[6] Also the data products of commercial data providers had a bias towards FDI of larger firms because many small and medium-sized enterprises did not publish their annual statements,

6 Its selectivity is shown in Buch et al. (2007) by a comparison with the 'Going International survey' from the German Chambers of Industry and Commerce (DIHK 2008).

including information about their FDI, before 2007.[7] This might be one reason for the small number of Czech affiliates that had been designated in commercial databases during the survey preparations in 2009. Furthermore, it is very laborious to identify sister companies which are affiliated via a private person and not via a parent company. These legal connections arise more often among smaller firms. Hence, to identify possibly all German affiliates in the Czech Republic we had to refer to databases that draw directly on the Czech Commercial Register.

Therefore three data sources were used. The first was a data set from the German-Czech Chamber of Industry and Commerce (DTIHK). It holds 3,427 Czech companies with German owners. This data set served to compile the company register "German companies in the Czech Republic" from 2007, created to enable contact with German-Czech companies. One advantage of the data set was that it also included Czech companies where a German company was not the direct owner. For instance, the listed owners were holding companies from Holland, Luxembourg or Switzerland connected to German companies. The second source was a database from Creditinfo (September 2009). This database contained 186,365 active Czech companies independent of the ownership structure (GmbHs, AGs, KGs, OHGs or foreign branches). Regarding that, according to the Czech Statistical Office, there were around 230,000 active Czech companies in December 2008 the Creditinfo database covers a high share of all Czech firms. A database from Čekia (December 2009) was the third source, It contained 74,770 companies obliged to publish their balance sheets. However, this source provided no additional information as nearly all firms were also included in the Creditinfo database. This gave a total of 188,760 evaluable Czech companies.[8]

The Czech Commercial Register was used to verify the existence of a German equity investment between January and August 2010. This register is available free of charge on the Internet and delivers the company number (IČO), name, address and also the names and addresses of the

7 In 2007 the *Elektronischer Bundesanzeiger* for electronic submission of annual statements was introduced in Germany. Before, many small and medium-sized enterprises refrained from it. On the one hand it involved substantial administrative work and on the other hand the risk of prosecution was quite low as hardly anyone objected to the missing annual statements of smaller firms. Since electronic collection proper submission is checked automatically. For illustration, in 2006 6 % of small, 24 % of medium and 92 % of big limited companies published their annual statements (IHK Saarland 2008). However, the coverage of smaller firms is continuously expanded since.

8 The Creditinfo database covered 98.7 % of the data. 1,955 companies were listed in the Čekia database but not in the Creditinfo database. 440 additional companies were recorded in the DTIHK database.

owners (the head office for legal persons and the principal residence for natural persons). This offers the possibility to find out whether a Czech company has a German owner – and this owner can be identified.

After all sources were evaluated, analysed and synchronised, a total of 5,591 Czech companies were shown to have a direct German owner. In addition, 62 companies had an indirect German owner and 47 companies were joint-stock corporations with more than one owner.[9] It was checked if also German companies had shares in them. These 109 special cases come from the DTIHK database. Altogether, there were 5,700 Czech companies which had a direct or an indirect German owner.

<u>*Special cases and Internet research*</u>

Basically, the German owners of these 5,700 companies can be divided into two different groups of approximately the same size: companies and natural persons. Two subgroups of these 5,700 companies posed a challenge to the survey, particularly in Germany.

*Holding and management companies*

The first group consisted of parent companies that functioned as holding or management companies. The pretest in Germany revealed that these companies strongly rejected participation in the survey because they did not see themselves as being suitable for a company survey. The reason for this is, on the one hand, that some of these companies are high-up corporate divisions which have a limited and very specific function, for instance making decisions concerning finance, investment and controlling. On the other hand, they are often very small and have either very few employees or none. As it is the core company which is of interest for the survey, these types of companies were generally not contacted. Instead, by means of Internet research, i.e. with the help of the business register, search engines and firm websites, the one company was selected that would be most likely to stand for the core purpose of the group.

9 For joint-stock corporations with only one owner, this shareholder is listed in the Czech Commercial Register.

Holding or management companies were identified by means of the online firm database FirmenWissen[10], using the company name combined with the main industry. So for all companies that had the term "*Holding*", "*Beteiligung*", "*Verwaltung",* "*Gruppe*" or geographical references such as "*International*" or "*Osteuropa*" in their names[11], the main industry was tested. The most frequent industries listed for the companies investigated (based on the official NACE industry classification) were "activities of head offices" (NACE code M70.1) and "activities of holding companies" (NACE code K64.2). If the project team judged a company's main activity to be solely management, strategic or financing activities, respectively, another potential firm affiliated with the Czech company was sought for. In the marked majority of cases there was a company whose own name and address was identical to that of the company to be substituted and whose name did not contain the above mentioned terms. Often the company was a GmbH & Co. KG[12], which also had the strongest Internet presence in the corporate group and also obviously appeared on the market as a producer of goods or services. In such cases the company to be substituted acted mostly as a general partner of the substitute company.

Example: XYZ Holding GmbH was substituted by XYZ GmbH & Co. KG and both companies are located at the same address. XYZ Holding GmbH is the general partner of XYZ GmbH & Co. KG.

In other cases, either there used to be a still-existing company in the corporate group listed as the owner of the Czech company in the past or the corporate group has a subdivision which carries the same name as the Czech company.

Example: XYZ Holding AG has investments in XYZ Sealing Technology GmbH and XYZ Car Tires GmbH. The Czech subsidiary is called XYZ Těsnící technika, spol. s.r.o. (translated: XYZ Sealing Technology GmbH). XYZ Sealing Technology GmbH is included in the survey.

Owner substitution was effected for 459 Czech firms. To sum up, in 62 % of the cases the name and address of the substituted companies were identical with those of the substitute companies. In 81 %, the two companies shared the name and in 91 % the company name or the address

10 FirmenWissen is a product of the commercial data provider Creditreform. It takes the main industry from the commercial register if no other information has been unearthed through their own research.

11 The terms in English: "holding", "management", "group", "international", "East European".

12 A limited partnership with a limited liability company as general partner.

were identical or both. 17 % of the substitute companies had already owned the Czech company in the past.

*German private individuals*

The second special case concerned Czech firms whose owner proved to be a German private individual and not a German company. A company can choose if it is holding the investment itself or if the person who owns the German company has made the investment in the Czech Republic as a private individual. According to the German-Czech Chamber of Industry and Commerce (DTIHK), this choice does not reliably indicate how closely the German and Czech company are connected to each other. This coincides with the experiences from Internet research. It is not unusual that, despite the fact that a German company posts a Czech location on its website and the connection between the two firms is obviously close, the German owner in the Czech company is a private individual.

As around half of the German-Czech companies showed a German private individual as the owner, the search for suitable affiliated companies – in this case sister companies – revealed a high potential for increasing the coverage of all relevant investments. This raises not only the size but also the representativeness of the survey sample.

In the search for potential affiliated companies in Germany the name and address of the German private individual and also the name, industries and owner history of the Czech company were drawn on. Apart from the use of Google and the German Company Register, the search for individuals was mainly conducted with the help of the people search engine 123people. It bundles the people search results in the FirmenWissen and GENIOS databases, which both include names and addresses of owners and directors of German firms. Both FirmenWissen and GENIOS refer to the data from Creditreform, which comprises information about 3.9 million German firms. Furthermore, GENIOS uses the information from Hoppenstedt, Dun & Bradstreet, bedirect and other providers of personal information (about management activities or other management functions such as Department Manager, for example).[13]

[13] One of the sources used by these commercial data providers are public directories and registers, e.g. the Commercial and the Trade Register. In addition, they conduct their own searches, e.g. in annual statements, business reports, in daily newspapers, on websites and by direct contact.

For 38 % of the Czech companies in question a potential sister company was identified in Germany. Only one German sister company per German private individual was included in the survey. As only those companies located very closely to the domicile of the private individual were selected, we are sure that the assumed sister relationship between the German and Czech companies actually exists in the great majority of cases.

The addresses of these individuals and the German firms and/or the names of the German and Czech companies could be used as criteria for the quality of a link between a private individual and a company. In 49 % of the cases, the individual's residence and head office of the German company researched were in the same street. 43 % showed a noticeable similarity between the names of the companies. For the majority, the similarity between the names occurred as a complete match between the company names, taking into account the different languages. Or important components – generally a specific coinage – appeared in both names. In 3 % of the cases, the German company was the direct owner of the Czech company in the past. As for the similarity of name, same address or past ownership, at least one of the three criteria was fulfilled for 71 % of the cases. Subsequently, out of this group we checked 20 randomly drawn cases and for 19 we found a 100 % equivalence of the names (forename and surname) and address or birth date of the owners of the Czech and the matched German company. So the criteria are suitable to predict the existence of an affiliate relationship. Checking the owners of 50 randomly drawn companies of the remaining 29 % resulted in 41 cases where the name (forename and surname) and address or the name (forename and surname) and birth date of the owners of the Czech and the matched German company were identical. In three cases, the Czech company itself is the owner of the German company. Hence, we can expect that 93% of these affiliate relationships are correct.

*Final composition of the MNE groups*

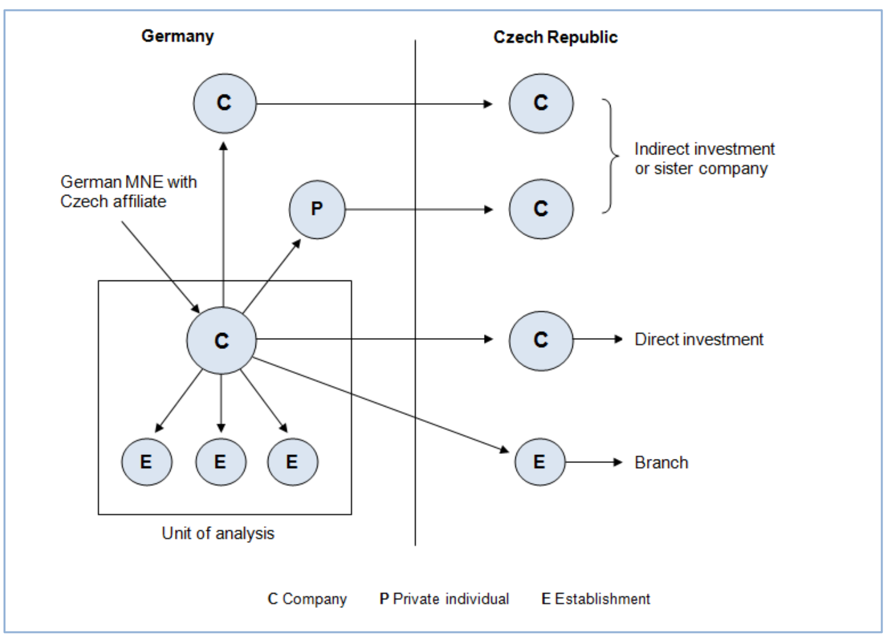
*The Czech Republic*

Figure 3-2 illustrates the possible investment relationships between the German multinational firms and their Czech affiliates. The Czech MNE group comprises 3,875 firms. For 70 % of the companies, at least one German firm had a direct investment or the company was a German branch. 28 % of the companies were owned not by a German company but by a German private individual who also owns a German firm. In 1 % of the cases German companies had an indirect investment in the Czech company, very often via a foreign holding company from Holland, Luxembourg or Switzerland, for example. 1 % were joint-stock companies with more than one owner, so he could not be clearly identified.

*Germany*

The German MNE group includes 3,406 firms. 59 % of companies in the German MNE group had a direct investment. 12 % of the companies were included purely as a result of the substitution of a holding or management company and 29 % were owned by a private individual who also appeared in the Czech Republic as an owner. In total, 59 % of the German MNEs had a direct investment, 41 % had an indirect investment or a Czech sister company.

**Figure 3-2: Representation of possible relationships - German firms with an affiliate in the Czech Republic**




Source: ReLOC questionnaire TNS Infratest Sozialforschung, screener MNE group Germany

## 3.3 Record linkage

As part of the ReLOC project, the problem arose that the FDI firm-level database had to be linked to the IAB's establishment-level data for research questions to be adequately processed. To measure the effects of the investments and connections between German and Czech firms as fully as possible, it was necessary to identify all of the establishments belonging to the German firms investing if possible. As the IAB data does not contain a clear firm identifier, there has been no procedure available as yet to carry out this assignment systematically without the cooperation of the German Federal Statistical Office. For this reason, a new method to link firm-level data with the IAB's establishment-level data was developed in the course of the ReLOC project. It makes use of the fact that in the course of assigning IDs to establishments, the Federal Employment Agency records the name of the associated company. This basically enables the linkage of companies and establishments solely on the basis of the company name and without using an address. Meanwhile, this method is also being applied in other IAB projects and represents an expedient addition considering the current situation in regard to data and legislation. However, the success of this approach depends on the company names being recorded correctly and also on their being unique throughout Germany, so before the data was linked, the correctness and structure of the establishment and company names were closely checked based on the legal requirements for naming companies.

### 3.3.1 Initial situation

The IAB is the research facility of the BA. To fulfill its research tasks, one of the data sources it uses is the registration of employees which employers pass on to the social insurance agencies and thus to the BA as part of the Data Capture and Transfer Regulation (DEÜV). When these registrations are made, a distinct ID number, the establishment number (Betriebsnummer – BNR), is assigned for the establishment where the respective person is employed. In terms of the registration process, an establishment is a defined regional and economic unit with at least one employee who is liable for social insurance contributions or is in marginal part-time employment.[14] In regard to the regional limitation, it is the municipality which is decisive. Therefore, branches[15] of the same firm which are in different locations can be assigned the same establishment number (Betriebsnummern-Service 2013) if they are in the same municipality and show the same business focus. On the other hand, a firm can have more than one establishment number if it consists of at least two branches, and these are distributed in different municipalities or operate in different industrial sectors within one municipality.[16] The BA Betriebsnummern-Service assigns the establishment numbers.[17] Information such as the address of the establishment and a name of it is recorded here, but firm identifiers are not assigned. On the contrary the Business Register System (URS) of the Federal Statistical Office contains a distinct firm number as well as the BA establishment number. However, the assignment of establishments to firms contained in the URS cannot be made available to other institutions due to statutory rules, so it is not possible to link the databases of other institutions with those of the Federal Statistical Office without express consent of the observation units affected (Bender et al. 2007). One project in which a data fusion like this occurred for the first time was the "Combined Firm Data for Germany" (KombiFiD) project (see Spengler and Lorek 2010; Biewen et al. 2012, for example). Here, the data from the IAB, the Federal Statistical Office, and the German Federal Bank was linked, where the URS served as a master file with which all IDs of the same firm were identified in the IAB's establishment-level data. For that project, around 55,000 firms were written to asking for their permission, which was then granted by around 30 percent of them. The aim of the project is, on the one hand, to provide a new, comprehensive database which offers new possibilities for analysis through the combination of the different databases. On the other hand, it is pioneering work in the sense of a feasibility study for future cross-institutional linkage projects. With the aid of a legal opinion, it was also clarified whether a data linkage of this kind is possible without prior consent, and if so, under what conditions (Biewen et al. 2012). The resulting suggestion to extend the scope of application of

14 Marginal part-time employment has only been subject to declaration since April 1, 1999. Prior to that, establishments which only had employees in marginal part-time employment did not require an establishment number.

15 In principle, a firm can consist of one or more local units (branches) which are part of the firm and are not legally separate.

16 This must be distinguished from the term "affiliated group". An affiliated group is an association of firms under one leadership, but where these firms maintain their legal autonomy (Section 18 of the German Corporation Act (AktG)).

17 The Betriebsnummern-Service is located in Saarbrücken and has been responsible for the national assignment and updating of establishment numbers since January 1, 2008. Prior to that the assignment was made locally by the employment agencies in the municipality in which the respective establishments were located.

Section 13a of the Federal Statistics Act (BstatG) to databases of other institutions like the BA and the German Federal Bank has unfortunately not yet led to a change in legislation.

Implementing a procedure such as that used for the KombiFiD project may not be suitable for smaller databases or projects, because for one thing the resource costs of cooperation and gaining consent are very high, and for another, the number of firms giving their consent may be too low for the statistical analysis of some questions to be possible. Furthermore, there is the risk of a selective choice of companies due to a heterogeneous response or consent behavior (Biewen et al. 2012). If the selectivity depends on non-observable variables, it can distort the results in the research analyses based on it. Against this background, the IAB's ReLOC project had to rely on an alternative approach. In the scope of the project, a database consisting of German companies with Czech affiliates was created as the basis for a company survey on both sides of the border (Hecht et al. 2013a). In the Czech Commercial Register, which is publicly accessible, there is information available on the date on which the German companies made the investments. By identifying the German establishments whose companies have invested in the Czech Republic, it is possible to follow their employment trends before and after the investment. Here it is important to identify all the establishments involved if possible, as investment decisions are generally made at the firm level and can influence all of a firm's establishments (Hecht et al. 2013b). Furthermore, the establishments within a firm can be affected differently depending on their size, activity and regional position. Using differences in productivity and factor prices, for example, is not particularly attractive if the transport costs are high (Helpman 1984; Markusen 2002). At the same time, the productivity effect which Feenstra and Hanson (1996), and Grossman and Rossi-Hansberg (2008) identified, can be more marked when the distance to the Czech affiliate is smaller. Establishments on the German-Czech border are therefore subject to different effects and incentives than those that are farther away from their Czech locations. The purpose and activity of a German establishment also have an influence on whether this establishment is competing with the Czech affiliate in regard to the performance of its tasks. If certain tasks can be performed more cheaply in the Czech Republic, this makes it more likely that the number of staff in the German establishment will be reduced. Based on comparative advantages, it is also to be expected that German headquarters carrying out central management, marketing and R&D will be confronted with different effects than those facing production plants with a high percentage of routine tasks. Therefore, identifying the establishments solely on the basis of the official company headquarters can lead to distortions in the measurement of the effect of foreign investments.

## 3.3.2 Databases

### 3.3.2.1 ReLOC database

The ReLOC database which is to be linked consists of 3,406 German companies with a Czech affiliate.[18] The starting point for identifying the German companies is the Czech Commercial Register, which shows the names and addresses of all Czech companies and their owners (including the country). After all German owners were identified in the period from January to August 2010, the current names and addresses of the corresponding German firms were retrieved from commercial company databases like GENIOS and FirmenWissen in particular. These databases offer information such as the company location entered in the German Commercial Register or Register of Cooperatives free of charge, and also refer to the commercial data provider Creditreform (Hecht et al. 2013b).

The multinational firms also formed the basis of a company survey conducted in Germany and the Czech Republic. For this survey, the German firms investing in the Czech Republic were interviewed. Additionally, German firms without a foreign affiliate were interviewed as a reference group. In the Czech Republic, the survey was aimed at the Czech affiliates, and companies without foreign owners were likewise taken as a reference group (Hecht et al. 2013b). After the successful linkage of the German firms with a Czech affiliate, which is explained as an example in this article, the German firms without foreign investments were then linked in the same way.

The 3,406 German firms with Czech affiliates are companies under German private law with the following legal forms (see Table 3-1): *Gesellschaft mit beschränkter Haftung* (*GmbH*) [private limited liability company], *Gesellschaft mit beschränkter Haftung & Compagnie Kommanditgesellschaft* (*GmbH & Co. KG*) [private limited liability company & Co. limited partnership], *Aktiengesellschaft* (*AG*) [stock corporation], *Kommanditgesellschaft* (*KG*) [limited partnership], *eingetragener Kaufmann* or *eingetragene Kauffrau* (*e.K.*) [registered merchant], *offene Handelsgesellschaft* (*OHG*) [general partnership], *Aktiengesellschaft & Compagnie Kommanditgesellschaft* (*AG & Co. KG*) [stock corporation & Co. limited partnership], *eingetragene Genossenschaft* (*eG*) [incorporated cooperative], *Unternehmergesellschaft* (*UG*)

[18] Due to two duplications identified later, there were 3408 companies in number in Hecht et al. (2013a), and Hecht et al. (2013b).

(*haftungsbeschränkt*) [limited liability entrepreneurial company], *Aktiengesellschaft & Compagnie Kommanditgesellschaft auf Aktien* (*AG & Co. KGaA*) [stock corporation & Co. limited joint-stock partnership], Limited Company (Ltd.), *Limited Company & Compagnie Kommanditgesellschaft* (*Ltd. & Co. KG*) [limited company & Co. limited partnership], *Kommanditgesellschaft auf Aktien* (*KGaA*) [limited joint-stock partnership], traders not registered in the Commercial Register, and freelancers (including *Partnerschaftsgesellschaften*).

**Table 3-1: Legal forms of the ReLOC firms**

| Legal form | Number | Percentage |
|---|---|---|
| **Firms with *Kaufmannseigenschaft*** | | |
| GmbH | 2,164 | 63.68% |
| GmbH & Co. KG | 584 | 17.15% |
| AG | 259 | 7.60% |
| KG | 48 | 1.41% |
| e.K. | 25 | 0.73% |
| OHG | 15 | 0.44% |
| AG & Co. KG | 13 | 0.38% |
| eG | 6 | 0.18% |
| UG (haftungsbeschränkt) | 5 | 0.15% |
| AG & Co. KGaA | 4 | 0.12% |
| Ltd. | 3 | 0.09% |
| Ltd. & Co. KG | 1 | 0.03% |
| KGaA | 1 | 0.03% |
| **Firms without *Kaufmannseigenschaft*** | | |
| Traders not registered in the Commercial Register and freelancers | 278 | 8.16% |
| Total | 3,406 | 100.00% |

Source: ReLOC database.

Therefore, a clear majority of the firms (91.84%) are registered in the Commercial Register or Register of Cooperatives, and are consequently characterized as merchants in terms of the German Commercial Code (*Kaufmannseigenschaft*).[19] As will be shown later, this played an important role in the procedure and implementation of the data linkage.

[19] See Section 4.1 for more details on the meaning of the *Kaufmannseigenschaft* and the legal forms from Table 1.

#### 3.3.2.2 The BA's establishment-level data

All establishments with at least one employee who is liable for social insurance contributions or is in marginal part-time employment are stored in the BA's central historized establishment files which contains data such as their establishment number, address, and name. After the initial registration by the BA Betriebsnummern-Service, changes in particular characteristics of the establishment which the employers are obligated to pass on, such as name or address, are stored as a new entry, so that the old statuses of the establishment files can also be restored. For reasons of data privacy, sensitive information like this is not contained in the IAB data used for research purposes. Instead, the establishment number is replaced with a unique, system-independent establishment number for the purposes of anonymization. However, this system-independent establishment number can be connected to the real one by means of an assignment table. This can be used to identify the respective system-independent establishment numbers by linking a company database with the BA's establishment-level data. They can then be correlated to the IAB's establishment-level data in a further step without using sensitive characteristics.

There are three fields available, each containing space for 30 characters, to record the establishment name (see Table 3-2). It is possible to enter information in a field before the previous field has been filled completely. For establishments of a company with *Kaufmannseigenschaft*[20], the first item to be recorded is the legal company name – that is, the company name which is listed in the Commercial Register or Register of Cooperatives.[21] This is sometimes followed by additional information describing the establishment in more detail. This often gives the location or function of the establishment, and, specifically in the case of registered merchants, the first and last name of the owner if their name is not part of the company name. The company name and additional details are not systematically distributed across different fields. However, as the company name comes first, it can be separated from any additional designations when its ending is identified. As a name of a company with *Kaufmannseigenschaft* must always include a designation indicating its legal form, and as this is generally to be found at the end, the

[20] This includes any company that has to be registered in the Commercial Register or Register of Cooperatives, and therefore any *GmbH*, *AG*, *KG*, *OHG*, *eG*, and *e.K.*, as well as any special/mixed form of these legal forms, such as *GmbH & Co. KG*, *KGaA*, *UG (haftungsbeschränkt)*, *SE*, *AG & Co. KG*, *AG & Co. KGaA*, *AG & Co. OHG*, *GmbH & Co. OHG*, *SE & Co. KG*, *UG (haftungsbeschränkt) & Co. KG*, and *Ltd. & Co. KG* (see also Section 3.3.3.1 for more details).

[21] Under the terms of the German Commercial Code, the legal name of a company with *Kaufmannseigenschaft* is the "Firma" (Section 17 HGB).

name can be cut off after this designation so that the company name can be fully identified. This is promoted by laws which ensure that the designation indicating the legal form of the company is either written out in full or is abbreviated such that it is generally comprehensible (see Section 19 HGB [German Commercial Code], Section 4 GmbHG [German Limited Liability Companies Act], Section 4 AktG [German Corporation Act], or Section 3 GenG [German Cooperative Societies Act], for example).

A company name is likewise given for establishments of *Gesellschaften bürgerlichen Rechts* (GbR) [partnership under civil law], *Partnerschaftsgesellschaften*, and associations. In the case of *Partnerschaftgesellschaften* and registered associations (*e.V.*), this is the name which is listed in the pertinent register (Register of *Partnerschaftsgesellschaften* or Register of Associations).

In the case of sole traders which are not recorded in the Commercial Register, freelancers, and farmers, the first and last name of the owner, and often designations concerning industry, activities, establishment or other advertising purposes are recorded. The name[22] of the owner does not necessarily appear first, but is entered in a separate field.

**Table 3-2: Fictitious examples of the establishment names recorded at the BA**

| Field 1 | Field 2 | Field 3 |
|---|---|---|
| Bauunternehmen Meyer GmbH | | |
| Malerwerkstatt Meyer | GmbH | |
| Gebäudereinigung | Hoffmann GmbH | |
| Max Meyer Maschinenbau GmbH | & Co. KG | |
| TKF Bayerische | Elektroinstallations- und | -handels GmbH |
| MMAX Max Mustermann KG | Technischer Großhandel | |
| Werkzeug- und Maschinenbau | Mustermann GmbH | Werk Düsseldorf |
| Mustermann Service Deutschland | GmbH Niederlassung | Berlin |
| Oliver Meyer e.K. | | |
| KTV Maschinentechnik e.K. | Martin Mustermann | |
| Michael Schmidt | Garten- und Landschaftsbau | |
| Restaurant Max's BBQ | Maximilian Meyer | |
| ANL-Anlagentechnik | Andreas Lieberknecht | |
| Thomas Hoffmann | | |

Source: Selected examples from the establishment-level data from the BA statistics department to illustrate the structure and distribution of the name components of establishments appendant to companies under private law.

[22] The first name stands before the last name.

## 3.3.3 Linkage possibilities

In the BA's establishment-level data, the firm name is the only possible identifier for the firm the establishments belong to. Whether this allows them to be combined purely by means of the firm name depends on how unique they are in Germany, and on their having been recorded correctly in the databases to be linked. The basis for these prerequisites and their being fulfilled will be examined in this section.

### 3.3.3.1 Uniqueness of firm names

#### 3.3.3.1.1 Firms without *Kaufmannseigenschaft*

In the case of companies under private law, the regulations concerning the naming of firms and their influence on the uniqueness of firm names basically divide these organizations into two groups: firms with *Kaufmannseigenschaft* and firms without *Kaufmannseigenschaft*. Traders not registered in the commercial register, and freelance entrepreneurs are assigned to the latter category.

A trade that does “not require a business concern to be set up for trading due to its size or type” is not characterized as a merchant in terms of the German Commercial Code, and does therefore not obtain the *Kaufmannseigenschaft* except if it is registered voluntarily in the Commercial Register (Section 1 and Section 2 HGB). For this kind of companies the rules concerning the use of a company name are relatively strict. In business dealings, such small traders should use their first and last name as a matter of principle (IHK Köln 2011). This derives from various specific stipulations. Until March 24, 2009, Section 15b of the German Industrial Code (GewO) comprehensively regulated how traders not listed in the Commercial Register were to present themselves in general business dealings. They had to put their last name and at least one first name written in full on all business letters to a particular recipient. Subsequently, the Third SME Relief Act (MEG III) came into effect to reduce bureaucratic constraints for small businesses in particular, which led to the abovementioned section being declared void. However, even after it was abolished, the Chambers of Industry and Commerce recommend, for example, that traders present themselves with their first and last names in business dealings if their company is not listed in the Commercial Register. This is because there are still statutory sources for required data in business dealings in various specific stipulations. This is mostly in regard to the precontractual duty to provide information. There are examples in the Value Added Tax Act (UStG), the Regulation on the Service Providers' Duty to Inform (DL-InfoV), or the Telemedia Act (TMG). Here, first and last names have to be given in full to comply with the statutory duty to provide information, and it is not sufficient to give only part of the name (IHK Dresden 2013). However, it is permissible to use designations concerning industry, activities, establishment or other designations for advertising purposes (letter combinations, made-up terms, etc.) in addition to the name (IFB Nürnberg 2007; IHK Dresden 2013).[23]

*Examples: "Max Meyer IT-Service", "Max Meyer Café Alphorn", "Max Meyer IT-MMax".*

Another form of an enterprise without *Kaufmannseigenschaft* is freelance activity. Pursuant to Section 18 of the German Income Tax Act (EstG), this particularly includes "a scientific, artistic, writing, or teaching activity performed as a self-employed person". Physicians, architects, lawyers, tax consultants, management consultants, scientists, and artists are typical examples of independent freelance professions.[24] Freelancers only have to include their last name in their company name, and they are also allowed to add additional information (IFB Nürnberg 2007). If two or more freelancers form a *Partnerschaftsgesellschaft*, the company name must include the name of at least one person, the professions practiced in the partnership, and the additional words "und Partner [and partner]" or "Partnerschaft [partnership]", pursuant to Section 2 of the *Partnerschaftsgesellschaftsgesetz* (PartnGG).

*Examples: "Dr. Joseph Meyer Steuerberater [Tax Consultant]", "Meyer Freie Kulturwissenschaftlerin [Cultural Scientist]", "Meyer & Partner Rechtsanwälte [Attorneys]", "Dr. Peters & Meyer Rechtsanwälte in Partnerschaft [Attorneys in Partnership]".*

Trademark protection can play an important role in the choice of the company name. A brand name is protected by a listing in the trademark register (Section 4 no. 1, German Trademark Act (MarkenG)). The protection of a registered brand is valid throughout Germany in the relevant classes of goods and services. If the brand and the company name partly overlap, this increases

[23] In the case of two or more traders forming a partnership under civil law (*GbR*), the recommendations are basically the same. Besides this, a designation indicating the legal form can be added. *Example: "Max Meyer & Andreas Schmidt IT-Service GbR"*.

[24] In 2011 there were around 1.15 million freelancers in Germany (Brehm et al. 2012).

the likelihood of the company name being unique in Germany. The German Trademark Act protects distinctive business identifiers (Section 5 (1) and (2), (MarkenG)) like the name or parts of the name even if they are not registered as a brand. However, this protection is limited to the region if the purpose and location of the company is only intended to be regional and there is no intent to expand the company outside the region. Hotels, guest houses, pharmacies, driving schools, or hairdressing salons are typical examples of this. Furthermore, the protection is only extended to similar sectors (Ströbele and Paul 2012: pp. 163-165, 1004 and 1011-1024). If only the person's name is used as a company name, it is not protected, as entrepreneurs are presenting their companies themselves if they are not listed in the Commercial Register, and it is not possible to forbid others to use their own name (Section 12 German Civil Code (BGB)).

Thus, the national uniqueness of the company names of traders not listed in the Commercial Register, and of freelancers depends on how common the owners' names are, and on the additional terms used. In regard to these forms of enterprise, with their often very limited regional bias and variety of product, the protection of company names by the German Trademark Act is to be estimated as rather low if there is no listing in the trademark register. In view of the large number of these firms, it is therefore to be assumed that the firm names will frequently not be unique. However, as these kinds of enterprises are very small by definition, it is mostly unlikely that they will have several establishments, so in these cases the address can be taken from the BA's establishment file to identify the company.

#### 3.3.3.1.2 Firms with *Kaufmannseigenschaft*

In regard to the naming of companies, the rules for those with *Kaufmannseigenschaft* are not as strict. This includes every business that requires "a business concern set up for trading due to its size or type" (Section 1 HGB). *GmbH*s (Section 13 (3) GmbHG), *AG*s (Section 3 (1) AktG), *KG*s (Section 161 (1) HGB), and *OHG*s (Section 105 (1) HGB) count as commercial companies and are therefore always regarded as merchants in terms of the German Commercial Code (Section 6 (1) HGB). The same applies to companies representing special/mixed types of these legal forms, as for example *GmbH & Co. KG*s, *AG & Co. KG*s, and *Ltd. & Co. KG*s, which are special forms of the *KG*, *KGaA*s, and *AG & Co. KGaA*s[25], mixtures of the *KG* and *AG* (Section 278 *AktG*),

25 The *AG & Co. KGaA* is a special form of the *KGaA*.

and *UG*s, a special form of the *GmbH* (Section 5 *GmbHG*). Pursuant to Section 17 (2) GenG, *eG*s also always receive the *Kaufmannseigenschaft*. Natural persons, on the other hand, only obtain this characteristic if there is a requirement for commercial business operations, or if they opt to be listed in the Commercial Register voluntarily pursuant to Section 2 HGB. In this case they have to add “eingetragener Kaufmann [registered merchant]” or an abbreviation of this phrase, as for example “e.K.”, to their company name (Section 19 (1) HGB).

As these types of companies have to be registered in the Commercial Register or Register of Cooperatives, where the legal circumstances are apparent, such as the owners, they have much greater freedom of choice in regard to their company name. This consists of several components (IHK Köln 2011):

- a designation which can contain a name, a factual term, or a made-up term, and can consist of one or more words,
- the designation indicating the legal form, and
- other additional words where required.

*Examples: “Max Meyer GmbH”, “Max Meyer IT-Service GmbH”, “Max Meyer GmbH IT-Service”, “MMax Meyer GmbH”, “KTV IT-Service GmbH”, “Meyer IT-Service Berlin GmbH”.*

However, to guarantee that the company is identifiable, and that the contracting partner is assigned unambiguously, there are also limitations here concerning the choice of name. According to Section 18 (1) HGB, the firm name must be distinctive. Thus, in regard to the firm name, anything distinctive would be permitted. It does not have to make sense (a “*YXCVBN GmbH*” would be permitted, for example), and nor does it necessarily have to include the name of the owner, the location, or the activity. However, general names or descriptions of activities are not sufficient to achieve distinctiveness: a “*Handwerker* [Craftsman] *GmbH*”, for instance, would not reveal any features distinguishing it from the businesses of other craftsmen. A company name which only consists of a description of an activity and a region (“*IT-Service Berlin GmbH*”, for example) would not be sufficiently distinctive either. In cases like these it would be possible to achieve the necessary level of distinction by adding one more word (such as “*Meyer IT-Service Berlin GmbH”,* or “*KTV Handwerker GmbH”*) (IHK Köln 2011).

However, a firm name may also not be admissible even if it is basically distinctive, as a new firm name has to be clearly distinct from all firm names in the same municipality which already exist and which are listed in the Commercial Register or Register of Cooperatives (Section 30 (1) HGB). In contrast to companies not listed in the Commercial Register, this also applies if the firm name next to the designation indicating the legal form only consists of the first and last names of the owner (Section 30 (2) HGB). In a case like this, an additional term must be added to the person's name to make it distinctive. Simply adding a different designation to indicate the legal form would not however suffice (IHK Köln 2011). However, the influence of Section 30 (1) HGB on the national uniqueness of a firm name is likely to be rather small due its limitation to the municipality.

The German Trademark Act explained in Section 3.3.3.1.1 also applies to these forms of enterprise of course, so there are several regulations and incentives for companies with *Kaufmannseigenschaft* which work toward a name which is unique throughout the country. These include the distinctiveness of a name, its uniqueness within the municipality, its protection through the German Trademark Act, and the fundamental interest in a name with recognition value. Nevertheless, the same firm name can be assigned several times, so the greater the sphere of the company's influence is, and the larger the company itself is, the more likely it is to be nonambiguous. The larger the company, the greater the degree of familiarity and variety of products will tend to be, and therefore the protection of the name and the likelihood of a brand being listed in the trademark register will also tend to increase. As the ReLOC database contains multinational companies, which tend to be larger, there is likely to be a relatively high degree of protection in regard to company names.

## 3.3.4 Checking the databases to be linked

### 3.3.4.1 Uniqueness of firm names

In the previous section the legal principles for naming companies were clarified. To gain insight into the actual national uniqueness of the company names in the database to be linked, a random sample of 250 companies with *Kaufmannseigenschaft* was pulled from the ReLOC database, and the frequency of these names was tested using the German Commercial Register and Register of Cooperatives.[26] As the linkage of the database should be effected via all establishment numbers used since the reporting process was introduced (January 1, 1973), all names that have ever been recorded in the Commercial Register or Register of Cooperatives were included.

Altogether, 18 company names were identified which appeared at least twice in the Commercial Register or Register of Cooperatives, which means that 7.2 percent of the companies did not have a name that was unique. Here, in 11 cases the name next to the legal form only consisted of one word, and in 10 cases this word consisted of a maximum of six letters. In the remaining seven cases, the name of the company always included a person's last name, and in three of these cases, it also contained the first name in full.

As is to be expected, the uniqueness of the company name increases with its length and complexity. If it consists of more than one word, the designation of the legal form aside, and does not include a person's name, it is unique throughout the country. The risk is greatest when it only consists of one short word aside from the designation of the legal form. If part of a person's name is used, the danger of the company name being assigned several times also increases. This is also influenced by how common the person's name is, and by other possible words added, of course.

If there is only interest in the corporate group level and not in the firm level, the risk of a firm name occurring several times is reduced, as research on the internet and in annual statements showed that in seven of the 18 cases the firms with identical names belonged to the same corporate group.

#### 3.3.4.2 Mistakes in the name of the establishment/firm

As the ReLOC database was edited before the survey began, the correctness of the establishment names was of foremost importance. Accordingly, in a random sample taken from the ReLOC database, consisting of 100 firms with *Kaufmannseigenschaft*, the names were

26 With the exception of the Register of *Partnerschaftsgesellschaften*, there is no central register for companies without *Kaufmannseigenschaft*, so these were excluded from this test from the start.

completely identical to their counterparts in the Commercial Register and Register of Cooperatives in 97 percent of the cases.

A sample of 100 establishments was likewise taken from the BA's establishment-level data. The population was restricted to establishments which had at least one employee who was liable for social insurance contributions or was in marginal part-time employment on June 30, 2009, and which can be classified as belonging to a company with *Kaufmannseigenschaft* in accordance with the designation indicating their legal form. The establishment names were researched in the Commercial Register and Register of Cooperatives, and completely identical company names were found in 85 cases. Here, what is known as preprocessing, the standardizing and editing of the establishment names as applied later in the process of data linkage (see Section 3.3.5), had already been taken into account. It also appears that preprocessing, where the name is cut off after the designation of the legal form, is very important for data linkage, as 22 (25.9%) of the 85 establishment names contained additional words after the designation of the legal form, and in 19 cases (22.4%) these words were not a component of the actual firm name.

Strategies for data linkage can also be derived from an analysis of the mistakes made in recording names. Therefore, in the case of each of the 15 establishments/firms recorded incorrectly in the BA establishment-level data, in the Commercial Register and Register of Cooperatives the firm name was sought to which they were most likely to be assigned. Thus, most frequently one or more words were left out, added, or put in the wrong place (see Table 3-3). It was considerably less common for words to be changed, either due to spelling mistakes, or the intentional shortening of a word, or the incorrect designation of the legal form.

**Table 3-3: Mistakes in the BA's establishment/firm names**

| Type of mistake | Frequency |
|---|---|
| Word(s) left out | 7 |
| Order of words mixed up | 4 |
| Spelling mistakes | 3 |
| Word(s) added | 2 |
| Word(s) shortened | 2 |
| Incorrect legal form | 1 |

Source: Establishment-level data from the BA statistics department (Nuremberg 05/2012): Random sample of 100 establishment numbers with at least one employee liable for social security contributions or in marginal part-time employment on June 30, 2009; multiple indications are possible.

The main problem is therefore that there are either too many or too few words in incorrect establishment/firm names, so to calculate the similiarity between the names it would therefore make sense to choose a measure of distance which does not penalize missing or superfluous name components too strongly, and where their precise position only plays a small role. One good alternative here would be to use *n*-grams, where the name is divided up into character groups of *n* length. The number of matching character groups in the names compared decides their similarity.

*Example of bigrams (n=2) using padding*[27]*: Similarity between "AHAB Hausbau" and "AHAB Bau" when blank spaces are deleted and all letters are capitalized.*

*"AHABHAUSBAU" is turned into the 12 character groups "_A", "AH", "HA", "AB", "BH", "HA", "AU", "US", "SB", "BA", "AU", and "U_". "AHABBAU" is turned into the eight character groups "_A", "AH", "HA", "AB", "BB", "BA", "AU", and "U_". This results in seven matching character groups ("_A", "AH", "HA", "AB", "BA", "AU", and "U_"), and a Dice coefficient of 0.7 as the measure of similarity.*[28]

The advantage of *n*-grams is that they do not only look for the components of a name in the environment of a particular place when comparing two names. In the example given above, this can be seen clearly in the bigrams "BA", "AU", and "U_". These occur in both names, but because the word "HAUS" is missing from "AHABBAU", these bigrams occur in different positions in the two examples. Nevertheless, they increase the Dice coefficient. Although the similarity is also reduced because the missing word affects the adjacent character groups (here, "BB" instead of "BH" or "SB"), no added weighting is given to the exact position of the *n*-grams in regard to the counting of the matching character groups. The greater the value of *n* that is chosen, the more strongly the fact that a word is missing will reduce the Dice coefficient, because when *n* is greater, the missing characters appear more often in the character groups created, while the number of character groups created decreases at the same time. In general, the only measure that is fully independent from the position of both name's characters are unigrams (n=1). However, unigrams are not suitable here, as their implementation would result in a relatively low discrimination between correct and incorrect names. If one were to use unigrams, even two names consisting of characters which were the same but all in different positions would result in a Dice coefficient

27 In the case of padding, the beginning and ending of the expression are considered by adding a blank space to the first and last characters.

28 Dice coefficient: number of matched pairs*2/(number of base pairs in the first sequence + number of base pairs in the second sequence) = 7*2/(12+8) = 0.7.

of one. Experience with the IAB data has shown that with unigrams the ratio of false to true matches becomes too large for checking them manually. Of course, one could choose a sufficient high dice coefficient for matches to be included in a final check. However, many true matches wouldn’t be able to surpass this threshold, because this value needs to be very high for limiting the cases in a feasible way. In this regard, bigrams showed a good balance between discriminating wrong and true matches and the feasibility of subsequent manual checks. For this reason, bigrams are used later to calculate the similarity of establishment/firm names.

### 3.3.5 Data linkage

The previous paragraphs clearly show that it is possible to link a firm-level database with the BA’s establishment-level data solely based on the firm names. As the firm name had not been correctly recorded in full for some establishments, and there was the further problem of firm names not being unique throughout Germany, the linkage was performed in two steps:

In the first step, both the names and addresses of the ReLOC firms were compared with those in the establishment-level data. Accordingly, in this step the search was for establishments at the location of the company headquarters.

In the second step, all the establishments whose names correlated to those of firms from the ReLOC database were identified. To do this, the addresses of the firms and establishments were not used. At the same time, the names of firms for which an establishment had been found were tested in regard to their national uniqueness by consulting the Commercial Register and Register of Cooperatives. If this was not the case, the establishment was subsequently excluded.

The advantage of the first step is that also those establishments which company names are not recorded correctly or which have no unique name throughout Germany can be identified.

The record linkage took place between August and December of 2012. The BA’s establishment-level data contains all the establishment numbers which had ever been used for the registration process until May 31, 2012, which is around 11.8 million. The names and addresses from the establishment file were updated in keeping with their status on December 31, 2009. In the case of establishment numbers which were not assigned until after December 31, 2009, the first status of the names and addresses recorded was used.

The ReLOC database consists of 3,128 companies with *Kaufmannseigenschaft*, and 278 companies without *Kaufmannseigenschaft*. This differentiation is important for the following linkage steps, as the two groups were treated differently in part because of the different regulations concerning the naming of a company (see Section 3.3.3.1). Therefore, the second linkage step, which was made solely on the basis of the names of the companies and establishments, was only carried out for companies with *Kaufmannseigenschaft*. The establishments of companies without *Kaufmannseigenschaft*, on the other hand, were always identified by including their names as well as their addresses.

Linking the establishment and company databases only makes sense if preprocessing is implemented. Preprocessing was applied using a Stata do-file. In this case I accessed a Stata do-file created by Tanja Hethey-Maier and Anja Gruhl (Biewen et al. 2012) with additional modifications by Matthias Dorner, and integrated my own changes.

Preprocessing the establishment[29] and firm names involved the following consecutive steps which built on those preceding them:[30]

1. Quotation marks, brackets, and hyphens were replaced by blank spaces.
2. Commonly known abbreviations of or within designations of legal forms were identified and written out correctly in full:

   *Examples: "GmbH" was written as "Gesellschaft mit beschränkter Haftung", "KG" as "Kommanditgesellschaft", "AG" as "Aktiengesellschaft", "OHG" and "oHG" as "offene Handelsgesellschaft", "KGaA" as "Kommanditgesellschaft auf Aktien", "StG" as "stille Gesellschaft", "eG", "e.G.", and "e. G." as "eingetragene Genossenschaft", etc.*
3. Standardizing *"und"*:

   *"u.", "und", "u", "and", and "+"* were *replaced by "&".*

[29] The establishment name is comprised of the three consecutive fields available for recording the name (see Section 3.2): Field 1 + blank space + Field 2 + blank space + Field 3.

[30] Between the steps, blank spaces at the beginning or end of the establishment/company name were deleted, and multiple consecutive blank spaces replaced by a single one where necessary.

4. The following punctuation marks were replaced by blank spaces:

   Periods, exclamation marks, commas, colons, forward slashes, back slashes, and “greater than, less than” signs (“<” and “>”).

5. Capitalizing all letters

6. Standardizing umlauts:

   *Examples: “Ä” changes to “AE”, “Ü” to “UE”, “ß” to “SS”, etc.*

7. Deleting accents:

   *Examples: “Á” to “A”, “À” to “A”, “Â” to “A”, etc.*

8. Designations of legal forms which are only partly written out in full were written in their full and correct form:

   *Examples: “GESELLSCHAFT MIT BESCHR HAFTUNG” was changed to “GESELLSCHAFT MIT BESCHRAENKTER HAFTUNG”, “KOMMANDITGESELL” to “KOMMANDITGESELLSCHAFT”, “AKTIENGES” to “AKTIEN-GESELLSCHAFT”, “EINGETR KAUFM” to “EINGETRAGENER KAUFMANN”, and “OFFENE HANDELSG” to “OFFENE HANDELSGESELLSCHAFT”, etc.*

9. The full designations of legal forms were identified, and saved in a new variable in abbreviated form.

10. All characters appearing after the (identified) designation of the legal form in the establishment/firm name were removed. The resulting name was saved in a new variable.

11. All blank spaces were deleted.

In these steps, the following variables were generated for the firm/establishment names from the ReLOC database, and for the BA’s establishment-level data (see Table 3-4):

- *Name_without_legal_form*: edited establishment/firm name up to the designation of the legal form, which is excluded from this variable however.
- *Legal_form*: standardized designation of the legal form in abbreviated form.
- *Name_with_legal_form*: edited establishment/firm name up to the designation of the legal form, which is also contained in this variable.

**Table 3-4: Fictional examples of preprocessing**

| Establishment/firm name before preprocessing | Variables after preprocessing | | |
|---|---|---|---|
| | ***Name_without_legal_form*** | ***Legal_form*** | ***Name_with_legal_form*** |
| AKB Fräs-Technik GmbH Niederlassung Berlin | AKBFRAESTECHNIK | GmbH | AKBFRAESTECHNIKGmbH |
| AKB Fräs-Technik Gesell. mbH | AKBFRAESTECHNIK | GmbH | AKBFRAESTECHNIKGmbH |
| René Muster IT Service | RENEMUSTERITSERVICE | | RENEMUSTERITSERVICE |
| Rene Muster IT-Service eingetr. Kaufmann | RENEMUSTERITSERVICE | e.K. | RENEMUSTERITSERVICEe.K. |
| Rene Muster IT-Service e.K. Berlin | RENEMUSTERITSERVICE | e.K. | RENEMUSTERITSERVICEe.K. |
| "Insigno" Immobilienges. mbh | INSIGNOIMMOBILIEN | GmbH | INSIGNOIMMOBILIENGmbH |
| Klaus+Peter Meyer KG Technischer Großhandel | KLAUS&PETERMEYER | KG | KLAUS&PETERMEYERKG |
| Klaus & Peter Meyer Kommanditges. Zentrale Berlin | KLAUS&PETERMEYER | KG | KLAUS&PETERMEYERKG |
| Klaus u. Peter Meyer KG | KLAUS&PETERMEYER | KG | KLAUS&PETERMEYERKG |

Different ways of writing the following legal forms were taken into account: *GmbH, AG, KG, OHG, e.K., eG, GmbH & Co. KG, KGaA, UG (haftungsbeschränkt), Ltd., GbR, e.V., StG, SE, AG & Co. KG, AG & Co. KGaA, AG & Co. OHG, GmbH & Co. OHG, UG (haftungsbeschränkt) & Co. KG, Ltd. & Co. KG,* and *SE & Co. KG.*

Based on the abovementioned background in regard to the establishment and firm names, variables were formed for them where all characters coming after the designation of the legal form were removed (Step 10), because otherwise the additional words or phrases coming after the firm name, some of which were to be found in the establishment-level data (see Section 3.3.2.2), would have distorted the similarites calculated, and reduced the number of correct linkages. If the name of a firm ends with the designation of the legal form – this is the case for 96 percent of the firms with *Kaufmannseigenschaft* in the ReLOC database –, the firm name is fully identified in the BA's establishment names, as long as it had been recorded correctly.

The identification of designations of the legal form which were completely abbreviated (Step 2), or only partly written out in full (Step 8) was done separately. The information content of periods and the use of upper or lower case letters could therefore be used for the abbreviations, while in the case of the legal forms that were only partly written out in full, the danger of their designation not being recognized was reduced by the preprocessing steps made previously.

Street and city names were also standardized. Here also, all punctuation, accents, and blank spaces were deleted, letters capitalized, and umlauts standardized. In regard to street names, the numbers were also separated from the streets. This gave rise to the *Street* variable, which contained the edited street without the number, and the *City* variable, with the edited information in regard to the city. Here I used Tanja Hethey-Maier's Stata do-file without own changes (Biewen et al. 2012).

#### 3.3.5.1 Use of names and addresses

The data was first linked on the basis of names and addresses, where a gradual loosening of the name and address criteria was permitted. Loosening the criteria in regard to the address makes sense due to possible mistakes in the address information for one thing, and for another, there may also be other establishments belonging to the firm located in the vicinity of its headquarters.

Without preprocessing, there were very few companies in the ReLOC database with the same name, the same street, and the same three-digit ZIP code as an establishment from the establishment file (see Table 3-5). Establishments with identical features were only found in the cases of 460 (14.7%) companies with *Kaufmannseigenschaft*, and eight (2.9%) without it. Thus, it was urgently necessary to preprocess the establishment and firm names, and the address data. This increased the number of companies with *Kaufmannseigenschaft* for which at least one establishment number was identified to 1,904, which corresponds to a share of 60.9 percent. For firms without *Kaufmannseigenschaft*, the number with at least one linkage remained low. This can be explained by the fact that these companies were very small by definition. There were fewer of them with an employee liable for social security contributions or in marginal part-time employment, and therefore fewer with an establishment number.

**Table 3-5: Result of the exact comparison of names and addresses**

| Model | Matching criteria | Number of valid linkages | | | |
|---|---|---|---|---|---|
| | | **with *Kaufmannseigenschaft*** | | **without *Kaufmannseigenschaft*** | |
| | | establishment no. | firms | establishment no. | firms |
| **1** | **Without preprocessing**<br>Name, street, and 3-digit ZIP identical | 489 | 460 | 8 | 8 |
| **2** | **With preprocessing**<br>*Name_with_legal_form*, *Street,* and 3-digit ZIP identical | 2,305 | 1,904 | 17 | 16 |

Source: ReLOC database and establishment-level data of the BA statistics department (Nuremberg 05/2012).

As a large percentage of firms remained for which no valid linkage with the establishment-level data was found in Models 1 and 2, in the next models the exact comparison was replaced by an error-tolerant similarity function (see Table 3-6). The similarities in regard to establishment/firm names and street names were calculated using bigrams, whereby the legal form was not included in the calculation. The index consulted to evaluate the similarity was a result of the aggregated Dice coefficients of the establishment/firm names and street names. As the Dice coefficient for the variables to be compared showed a maximum of one, if there was a complete match between a firm and an establishment in regard to their name and streetname, this gave a value of two. The calculations were done using the Record Linkage Software Merge Toolbox (MTB) V0.73, which was developed at the University of Duisburg (Schnell et al. 2005).[31] Blocking was also implemented here. This meant that the only observations from the two databases that were compared with each other were those that also showed the same value in the corresponding blocking variable that had been determined.

In Model 3, the companies are only compared to establishments with either the same three-digit ZIP code or the same city. All pairs with a similarity index of at least 1.4 were checked manually, and classified as a match or non-match. Although the legal form was excluded from the calculation of the similarity index, it was included in the evaluation of whether or not it was a correct match. In this way 2,908 establishment numbers were assigned to 2,422 companies with *Kaufmannseigenschaft*, and 174 establishment numbers to 161 companies without *Kaufmannseigenschaft*. This increased the linkage quota of the companies to 77.4 percent and 57.9 percent, respectively. The increase in the quota was particularly marked for companies without *Kaufmannseigenschaft*, as the names in the two databases differed more strongly with these types of companies, particularly in regard to the recording of industry, activity, establishment or other advertising identifiers. There is no obligation for these to be included in the company name, and they are therefore not always given or used consistently. Accordingly, in Model 3 the average similarity index for companies without *Kaufmannseigenschaft* was 1.71, while it was 1.95 for companies with *Kaufmannseigenschaft*.[32]

The street names were not taken into account in Models 4 and 5. Thus, the similarity index was consistent with the Dice coefficient for the establishment/firm names and was therefore able to

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31 The software can be downloaded free of charge at: http://record-linkage.de.

32 Although the Dice coefficients for the street names are also included in the similarity index, this does not explain this large difference.

reach a maximum value of one. As the number of possible linkages increased as a result, Model 4 only includes linkages with a similarity value of at least 0.7 in the classification as a match or non-match. In Model 5, the ZIP code districts were extended, and therefore the number of linkages to be tested increased, so the threshold value was set at 0.8. A further difference in regard to the previous models was that Models 4 and 5 were only used for firms with *Kaufmannseigenschaft*, as the fact that the street was left out of the similarity criteria meant that there was an increased probability that firms whose names were not unique in Germany would be linked incorrectly. As this particularly affects companies without *Kaufmannseigenschaft*, and there is no central register for this types of enterprises which makes it possible to test whether a name is used multiple times, these were excluded from Models 4 and 5.

In Model 4, the number of valid linkages increased by 175 to 3,083, and in Model 5, this number was increased by a further 813 to 3,896. The number of firms for which at least one establishment number was identified was increased by 94 to 2,516 by Model 4, and by a further 47 to 2,563 by Model 5. The stronger increase in valid linkages was therefore a result of Model 5, while the number of firms assigned increased more strongly in Model 4. This is explained by the fact that the establishments of several firms of above-average size which were located in metropolitan areas were included in Model 5 due to the expansion of the ZIP code districts.

**Table 3-6: Result of the error-tolerant matching of names and addresses**

| Model | Blocking variable | Variables | Dice-coefficient based on | Number of valid linkages | | | |
|---|---|---|---|---|---|---|---|
| | | | | with *Kaufmannseigenschaft* | | without *Kaufmannseigenschaft* | |
| | | | | establishment no. | firms | establishment no. | firms |
| 3 | 3-digit ZIP **or** *City* | *Name_without_legal_form* and *Street* | Bigrams | 2,908 | 2,422 | 174 | 161 |
| 4 | 3-digit ZIP **or** *City* | *Name_without_legal_form* | Bigrams | 3,083 | 2,516 | | |
| 5 | 2-digit ZIP **or** *City* | *Name_without_legal_form* | Bigrams | 3,896 | 2,563 | | |

Source: ReLOC database and establishment-level data of the BA statistics department (Nuremberg 05/2012).

Thus, altogether, at least one valid linkage was found for 81.9 percent of the companies with *Kaufmannseigenschaft*. As expected, the quota for companies without *Kaufmannseigenschaft* was considerably lower, at 57.9 percent.

### 3.3.5.2 Only using the names

In the second step, only the establishment and firm names were used to identify valid linkages. The address of a firm or establishment therefore had no influence at all. Thus, all the establishments from the BA's establishment-level data whose names correlated with those of firms from the ReLOC database were identified. This name matching was performed using the *Name_with_legal_form* variable. Only those linkages where an establishment and a firm showed an exact match in regard to this variable, hence a Dice coefficient of one, were recognized as valid.

*A fictitious example: The establishments assigned to the firm "KTV IT-Service GmbH" ("KTVITSERVICEGmbH") are "KTV IT-Service GmbH Berlin" ("KTVITSERVICEGmbH") and "KTV IT Service Ges. mbH" ("KTVITSERVICEGmbH"), but not "KTG IT-Service GmbH" ("KTGITSERVICEGmbH") or "KTV IT-Service e.K." ("KTVITSERVICEe.K.").*

Hence, the preprocessing explained in Section 3.3.5 is particularly important here, as no error tolerance exceeding this can be permitted. Although an error-tolerant procedure was tested by calculating the similarities between all establishment and firm names using bigrams, it crystallized that when the similarity of the names decreased, there was a much stronger increase in the number of false linkages than in the number of correct ones, and that it would be much too labor-intensive to test these linkages due to the size of the establishment file. Thus, in this stage of linkage, errors in the recording of names which were not included in preprocessing led to valid linkages not being identified.

The linkages resulting from the exact name matching were tested for the uniqueness of the respective firm name behind it by means of the Commercial Register and Register of Cooperatives.[33] As the linkage was made using the entire set of establishment numbers, names which had already been deleted from these registers again counted as well. The uniqueness of the firm name was not tested for all firms however, but only if the (unedited) name before the designation of the legal form consisted of only one word, or contained a person's last name. This procedure was derived from the insights described in Section 3.3.4.1, as from the sample presented, it was only those firm names showing these characteristics that were not unique. If a

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33 These registers are also used by the Chambers of Commerce to find out whether the names desired by new companies are already in use.

firm name was used multiple times throughout Germany, the linkage was marked as not valid, and was not used further. This served to avoid incorrect assignments of establishments to firms. On the other hand, it is to be assumed that larger firms are not affected by this problem as often (see Section 3.3.3.1), which means that they and their establishments may be slightly over-represented in the final version of the database.

As in Models 4 and 5, for the reasons mentioned, the names were only matched for firms with *Kaufmannseigenschaft*. A total of 53,779 establishment numbers were found for 2,502 of the 3,128 (80.0%) firms (see Table 3-7). However, 3,017, or 5.6 percent of the establishment numbers assigned, and 185, or 7.4 percent of the firms with at least one linkage did not fulfill the criterion of name uniqueness. This left 50,762 establishment numbers which were distributed over 2,317 firms, and were also still in use.

**Table 3-7: Name uniqueness of potential linkages**

| Firm name unique in Germany | Establishment no. | Firms |
|---|---|---|
| Yes | 50,762 | 2,317 |
| No | 3,017 | 185 |
| Total | 53,779 | 2,502 |

Source: ReLOC database and establishment-level data of the BA statistics department (Nuremberg 05/2012); name uniqueness was checked with the aid of the German Commercial Register and Register of Cooperatives (accessed from: www.handelsregister.de).

#### 3.3.5.3 Result of the two linkage steps

Table 3-8 shows the final number of valid linkages. The firms from the ReLOC database were assigned a total of 51,539 establishment numbers. Of these, 3,293 were identified both in the procedure using the names and addresses of the establishments/firms and in the procedure which only used the names of the establishments/firms for matching purposes. In contrast, 777 establishment numbers were only linked in the first step, and 47,469 only in the second. Therefore, the first step, which takes mistakes in the establishment/firm names into account due to the similarity function, led to a considerable gain. What could not be clarified with this procedure was the number of establishment numbers which were not found at all. To do this, it would have been necessary to have a key like that of the Business Register System (URS) of the Federal Statistical Office, which enables establishments to be fully assigned to companies correctly.

**Table 3-8: Source of valid linkages**

| | | Name only | | |
|---|---|---|---|---|
| | | not identified | identified | total |
| Name and address | not identified | not known | 47,469 | 47,469 |
| | identified | 777 | 3,293 | 4,070 |
| | total | 777 | 50,762 | 51,539 |

Source: ReLOC database and establishment-level data of the BA statistics department (Nuremberg 05/2012).

The 51,539 establishment numbers are distributed across 2,903 companies. Therefore, at least one establishment number exists for 85.2 percent of the companies. Differences arise if a distinction is made again between companies with and without *Kaufmannseigenschaft*. Thus, at least one valid linkage was found for 2,742 of the 3,128, and thus 87.7 percent of the firms with *Kaufmannseigenschaft*. For the 278 firms without *Kaufmannseigenschaft*, at least one valid linkage was found for 161, and therefore 57.9 percent of them.

The ReLOC database was linked with the BA's complete base of establishment numbers. However, the number of a firm's active establishments can change over the course of time, as new establishments can be opened or old ones closed down. An establishment's registrations of employees can be used to evaluate its actual activity. Table 3-9 shows the number of establishment numbers per firm, limited to establishments with at least one employee liable for social security contributions or in marginal part-time employment on June 30, 2009. Companies that showed no employees are therefore not represented here. 69.04 percent of the companies without *Kaufmannseigenschaft* had an "active" establishment number. 12.55 percent possessed two "active" establishment numbers, and 5.63 percent even had more than nine. Thus, in this database the share of companies with only one establishment (single-site companies) is relatively low. In comparison, according to the German Federal Statistical Office, around 98 percent of all firms with at least one employee liable for social security contributions or with taxable turnover on December 31, 2002, were single-site companies (Nahm und Phillip 2005). Likewise, in the BA's establishment-level data, around 97 percent of the edited establishment names (*Name_with_legal_form*) limited to establishments with at least one employee liable for social security contributions or in marginal part-time employment on June 30, 2009 only appeared once. The share of single-site companies, on the other hand, is more like that of the KombiFiD project.

Here, the percentage lay between 71.7 percent and 77.5 percent, depending on the year of observation and the version, and in this project the database likewise consisted of companies of above-average size (Biewen et al. 2012).

**Table 3-9: Establishment numbers per firm**

| Establishment no. per firm | Firms | | | |
|---|---|---|---|---|
| | with *Kaufmannseigenschaft* | | without *Kaufmannseigenschaft* | |
| | number | share | number | share |
| 1 | 1,687 | 69.04% | 97 | 97.98% |
| 2 | 307 | 12.55% | 2 | 2.02% |
| 3 | 118 | 4.82% | | |
| 4 | 62 | 2.53% | | |
| 5 | 42 | 1.72% | | |
| 6 | 35 | 1.43% | | |
| 7 | 24 | 0.98% | | |
| 8 | 22 | 0.90% | | |
| 9 | 10 | 0.41% | | |
| >=10 | 138 | 5.63% | | |
| Total | 2,445 | 100.00% | 99 | 100.00% |

Source: ReLOC database and establishment-level data of the BA statistics department (Nuremberg 05/2012): establishments with at least one employee liable for social security contributions or in marginal part-time employment on June 30, 2009.

### 3.3.6 Summary and outlook

Linking the ReLOC database with the IAB's establishment-level data enables an in-depth analysis of the effects of German investments on the companies investing and their establishments, and also shows a new method of linking firm-level data with establishment-level data. This does not require the key of the German Federal Statistical Office and could therefore offer an expedient alternative for many projects. This procedure was very profitable for the linkage of the ReLOC database with its multinational companies, as, unsurprisingly, its share of single-site companies is very small. Using the establishment and firm names alone multiplies the number of establishment numbers assigned by about 13. As not all firm names are unique in Germany and are not always recorded correctly, it can also make sense to include the addresses in the data linkage in a separate step, even though this means accepting that company headquarters will be over-represented. However, as has been shown, due to different regulations concerning the naming of firms, companies with *Kaufmannseigenschaft* and companies without *Kaufmannseigenschaft* should be treated differently.

The procedure presented here also offers starting points for further development, such as the possible use of further variables to assign establishments to firms. This could mean that an error-tolerant assignment procedure which goes beyond simple preprocessing could be applied more strongly. A promising variable would be the number or percentage of employees who change from one establishment to another over the course of time. In some ways this is similar to the procedure developed by Hethey and Schmieder (2013) to identify establishments that are started up or closed down. Establishments with names that are similar but not identical, and a higher than average exchange of employees could then also be assembeled to a firm. In the case of firms with names that are not unique, this could also be used to connect establishments identified with the help of the firm address with other establishments which share not only the same name but also a significant number of employees. However, the best alternative would still be a change in the legislation to make the combination of administrative data beyond the institutional limits more viable, as it was suggested in the course of the KombiFiD project (Biewen et al. 2012). A permanent linkage of the URS with the establishment-level data of the IAB would enable future projects to account for the firm level with relatively little effort. However, as long as the legislation remains as it is, new approaches whereby the assignment is made on the basis of the establishment/firm name constitute a worthwhile improvement.

# 4 Regional determinants of German FDI in the Czech Republic – New evidence on the role of border regions

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**Abstract**

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 labor 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.

**JEL classifications:** F23; R12; F15

**Keywords:** Multinational firms, Foreign direct investment, Location choice, Gravity model, Germany, Czech Republic

# 4.1 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 labor 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, which was in the last decades the major target for German FDI among the Central and Eastern European (CEE) countries (Pflüger et al., 2013). The low distance, particularly in the borderlands, should benefit cross-border investments.

Figure 4-1 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 German Federal Bank 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 4-1 about here*

**Figure 4-1: German FDI in the Czech Republic, Poland and BRICS**

Source: German Federal Bank.

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 selectivity 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. 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). Moreover, in a cross-border case like that of Germany and the Czech Republic, the involvement of border regions could differ between the two economic sectors. For German manufacturing firms, the short physical as well as cultural distance to the Czech Republic allows to exploit the huge labour cost differences by splitting up their value chain and establishing plants in the nearby Czech borderlands. For services firms, however, such a splitting-up of the value chain is not as straightforward as here a trade in intermediate products is not possible in the same way as with the manufacturing sector. In contrast to the manufacturing sector, service products often require a personal contact between buyer and seller (Braakmann and Vogel 2010). As a consequence, services are often non-tradable, and, in comparison to manufacturing FDI, services FDI is more intended to get new customers. Therefore, services FDI could rather be attracted by agglomeration factors than by the border regions in the Czech Republic.

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 distance and border region issues, market size and agglomeration economies, and labor market characteristics.

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. 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 by them. 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. 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.

## 4.2 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 for both the domestic and target regions, 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.

A crucial determinant for the explanation of location choices of multinational investors is distance. Generally, the physical distance between two countries as a proxy for transport costs exhibits a negative impact on bilateral FDI. While Portes and Rey (2005) attribute this to the negative effect of distance on information costs, Huber (2003) considers distance as a proxy for the costs of controlling agents. 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. To sum up, several studies find evidence for a decreasing number of FDI projects with rising physical distance to the location of the parent company. However, not only physical distance, measured e.g. as linear distance or driving time, but also cultural and social distance can influence the location choice of FDI. Concerning the cross-border nature of neighbouring countries, the relationship between foreign direct investment and distance should be of specific importance with regard to the common borderlands. After a long period of separation among countries with different levels of development the process of economic re-integration is expected to start in border regions (Gerling and Schmidt 1998). By investing in the neighbouring country especially firms located near the border can benefit from wage differentials as the short distance keeps transaction costs at a low level and thus strengthens their competiveness (Smallbone et al. 2012). 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). Moreover, according to market size considerations from New Economic Geography models, border regions benefit the most from increasing access to foreign markets as their geographical position becomes less peripheral. Economic entities which are already residing in border regions face improving conditions (Niebuhr and Stiller 2004). 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-sized companies, that otherwise are not able to bear high fixed costs in order to become multinational. Buch et al. (2005), for instance, emphasise the cultural distance as an important factor influencing information and communication costs. Furthermore, regions along a permeable border represent contact zones that enable everyday encounters between different traditions and mentalities (Krätke 1996). Thus, in border regions typically a higher share of the population has language skills of the other country and is familiar with the local customs what should reduce the foreign market entry costs. The possibility of frequent face-to-face contacts helps to generate an atmosphere of trust and control which is essential for building up networks (Boschma 2005; Welter et al. 2012). Furthermore, as trans-border cooperations are regarded as principal means to remove barriers between border regions (Cappellin 1993), the creation of networks received special priority in the structural policy of the European Union, in particular with the establishment of the INTERREG and PHARE programmes. The regional integration of border regions aims at improving their economic performance and at limiting economic drawbacks of market barriers. In order to foster cross-border cooperation, Euroregions have been founded along the Czech-German border in the early 1990s. Initially created to improve cooperation at a political and institutional level in the spheres of spatial and infrastructural planning and environmental protection (Krätke 1996), these regions also contributed to a greater awareness of shared identity in the border regions what positively influenced the fields of economy and trade, culture and sports as well as tourism (Jouen 2001). A bulk of studies confirms the positive impact of information costs and convenient conditions for network effects on investment possibilities in border regions (Bergin et al. 2009; Feenstra and Hanson 1997; Hanson 1998).

Against this background, the following hypotheses for the common border regions of the integrating economies of Germany and the Czech Republic can be derived: Cultural proximity and the existence of cross-border networks should especially foster FDI projects targeting from the German border region to the Czech border region. In this context the question arises how the border regions of one country are involved in FDI relations with the non-border regions of the neighbouring country. Goes the attractiveness of the Czech border region for German investors located in German non-border regions beyond the mere benefit of low distance? And do Czech non-border regions constitute attractive target regions for investors from the German border region? In general, the lowest investment activity is expected among German and Czech non-border regions. To analyse the involvement of the different types of regions in FDI relations, a set of border-region dummy variables is incorporated into the model specification.

Apart from distance issues, there are further factors which are potentially relevant for regional FDI relations. 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, labor 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. 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. As a consequence of the lack of regional variability in terms of subsidies, we favour the inclusion of the underlying original variables, such as a dummy for Prague and the regional unemployment rate.

***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 labor 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 labor 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 noncore 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.

***Labor market features***

*Wage*: One essential indicator characterising the regional labor 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 labor costs ranges among the most important relocation motives in different international surveys (Hanson et al. 2001; Yeaple 2003b). Consequently, high labor 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, labor costs are the most important factor for FDI from western Europe in the CEEC.

*Unemployment*: Another attribute of the labor 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 labor 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 labor 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 unemployment 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 labor. 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.

Before turning to the econometric analysis, a brief description of the firm-level and regional data is given in the next section.

## 4.3 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 Hecht et al. 2013b 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 4-2 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).

*Insert Figure 4-2 about here*

**Figure 4-2: Regional distribution of German headquarters and Czech affiliates (total FDI projects)**

Source: Authors' own calculations from ReLOC data.

A more coherent analysis of the border regions reveals an interesting finding. Namely that the border regions on both sides are strongly interconnected. From 594 investors located in the German spatial planning regions adjacent to the Czech Republic 422 have an affiliate in the Czech Nuts 3 regions Pilsen, South Bohemia, Karlsbad and Aussig, which are also situated directly at the German-Czech border (see Table 4-1). In contrast, from the remaining 3,300 German investors the clear majority (2,369) are investing in the Czech non-border regions.

*Insert Table 4-1 about here*

**Table 4-1: Number of FDI projects between border and non-border regions**

Source: Authors' own calculations from ReLOC data.

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 (see Figure 4-3) appear quite similar. Distinguished differences are observable, however, in the case of manufacturing FDI (see Figure 4-4). 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 (*Plzeň*) has established a dominating position. The relative large number of investment relations within the common border region applies for both manufacturing and service FDI. The ReLOC data includes 226 investments in the Czech manufacturing sector where the investor is situated in the border region on the German side. In 172 of these cases, the Czech affiliate is located in the border region too. For service FDI, there are 323 investments that come from the German border region. In 214 cases, both the investor and the affiliate are residing in the German-Czech border areas.

*Insert Figure 4-3 about here*

**Figure 4-3: Regional distribution of German headquarters and Czech affiliates (manufacturing FDI)**

Source: Authors' own calculations from ReLOC data.

*Insert Figure 4-4 about here*

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

Source: Authors' own calculations from ReLOC data.

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. 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%).

***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, labor market characteristics. The summary statistics of regional variables are depicted in Table 4-2 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 – representing a share of 2% of the 1,344 combinations – and 0 otherwise. The additional dummies *Border_GER* and *Border_CZ* account for the cases in which in the former case, only the German spatial planning region (4%) and in the latter case, only the Czech NUTS 3 region (27%) has a direct border with the other country, and 0 otherwise. Hence, the reference category is formed by two thirds of the combinations where both regions are not situated at the border. This set of border dummy variables examines whether the borderlands are primarily affected by German-Czech FDI projects due to the strength of geographically dense cross-border networks and whether these regions are to an above-average extent connected to more remote areas of the neighbouring country.

Concerning labor 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 labor 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 4-2 about here*

**Table 4-2: Descriptive statistics for the 1,344 German-Czech regional combinations**

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

## 4.4 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. 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 $\mathrm{GDP_i}$ and $\mathrm{GDP_j}$, have a positive impact on the volume of foreign direct investment $\mathrm{FDI_{ij}}$ between the units. Concerning the transport distance $\mathrm{Dist_{ij}}$ 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

$$\mathrm{FDI_{ij}} = \alpha_0 \mathrm{GDP_i^{\alpha_1}} \mathrm{GDP_j^{\alpha_2}} \mathrm{Dist_{ij}^{\alpha_3}} \varepsilon_{ij}, \tag{1}$$

where $\alpha_0$, $\alpha_1$, $\alpha_2$ and $\alpha_3$ represent parameters to be estimated and the error term $\varepsilon_{ij}$ is assumed to be statistically independent of the regressors with

$$\mathrm{E}\left(\varepsilon_{ij} | \mathrm{GDP_i}, \mathrm{GDP_j}, \mathrm{Dist_{ij}}\right) = 1. \tag{2}$$

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

$$\ln \mathrm{FDI_{ij}} = \ln \alpha_0 + \alpha_1 \ln \mathrm{GDP_i} + \alpha_2 \ln \mathrm{GDP_j} + \alpha_3 \ln \mathrm{Dist_{ij}} + \ln \varepsilon_{ij}. \tag{3}$$

This course of action, however, gives cause for criticism. First, due to Jensen's inequality $\mathrm{E}(\ln \mathrm{y}) \neq \ln \mathrm{E}(\mathrm{y})$, 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 $\mathrm{FDI_{ij}} + 1$ 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 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 mean occurence rate μ.

$$\Pr[Y = y] = \frac{e^{-\mu}\mu^{y}}{y!} \quad (4)$$

The only parameter μ describes both the mean and the variance of Y.

$$E(Y)=Var(Y)=\mu \quad (5)$$

In a Poisson regression model for the analysis of count data, $y_i$ given $x_i$ is Poisson-distributed with density

$$f(y_i|x_i) = \frac{e^{-\mu_i} \cdot \mu_i^{y_i}}{y_i!}, \qquad y_i = 0,1,2,\ldots \quad (6)$$

In the log-linear version of the model the mean parameter is parameterized as

$$\mu_i = \exp(x_i'\beta). \quad (7)$$

The log-linear form warrants that $\mu_i$ is larger than 0. Equations 6 and 7 jointly define the Poisson (log-linear) regression model. The model implies heteroscedasticity as both the expected value and the variance of $y_i$ is a function of the explanatory variables. The coefficient vector β can be estimated consistently by the Maximum Likelihood Method.

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

$$\mu_i = E[y_i|x_i] = Var[y_i|x_i] \quad \text{(equidispersion)} \quad (8)$$

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

Assuming that the variance of y is a multiple of the expected value (NB1 variance)

$$(Var[y_i|x_i] = (1 + \alpha) \cdot E[y_i|x_i]), \quad (9)$$

the standard errors can be corrected subsequently as the necessary weighting factor $\alpha$ is estimated consistently via Pearson's Chi-Quadrat statistic (divided by the degrees of freedom). Therefore, the variance can be weighted correspondingly by a Generalized Linear Model (GLM). This model is referred to as Poisson GLM with NB1 variance.

Under the assumption that

$$\mathrm{Var}[y_i|x_i] = \mathrm{E}[y_i|x_i] \cdot (1 + \alpha \cdot \mathrm{E}[y_i|x_i]), \tag{10}$$

a Negative Binomial model (NEGBIN) with corresponding variance function (NB2 variance) has to be estimated, again using the Maximum Likelihood Method. This model is referred to as NEGBIN2 model.

In order to evaluate the models it is useful to estimate a Negative Binomial model with NB1 variance function (NEGBIN1). By comparing the likelihood of the NEGBIN1 and the NEGBIN2 model it can be decided whether to select the model with NB1 or NB2 variance (in both models the same number of parameters is estimated). In contrast to the Poisson GLM with NB1 variance, the NEGBIN1 model does not yield consistent estimates if the assumption with respect to the NB1 variance is not fulfilled. Therefore, the NEGBIN1 model serves only the purposes of model comparison. Moreover, within the scope of a NEGBIN1 model and NEGBIN2 model also the assumption of equidispersion is tested (H0: $\alpha = 0$; corresponding to equation 9 for the NEGBIN1 and equation 10 for the NEGBIN2 model). The parameter $\alpha$ indicates the absolute value of the dispersion parameter. If $\alpha$ is significantly different from 0, the equidispersion assumption is violated. In all of the described options the t-statistics follow a normal distribution and can be interpreted in the usual way.

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,…,96) and a Czech affiliate being located in a specific Czech NUTS 3 region j (j = 1,…,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.[34] 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), labor 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).

## 4.5 Results

Table 4-3 to 4-5 show the results for total, manufacturing and services FDI projects. In comparison to the NEGBIN1 model, the Negative Binomial regressions with NB2 variance yield the best fit and in all NEGBIN2 estimations *alpha* is significantly different from zero. Therefore, the results presented here are based on the NEGBIN2 specification, whereby the outcomes of the Poisson model and the Poisson GLM model with NB1 variance are not fundamentally different.[35] As apart

34 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.

35 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) (see Cameron and Trivedi 1998). 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

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 4-3.

*Insert Table 4-3 about here*

**Table 4-3: Estimation result of Negative Binomial regressions for total FDI projects**

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.

What should catch the attention in all specifications beyond the basic gravity model are the results for the border dummies. The significantly positive coefficient for the basic border dummy *Border_GER_CZ* 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 more than two times more projects compared to combinations with both the German and the Czech region not belonging to the borderlands (corresponding to 211.13%=exp(0.7473) when the full set of variables is used in specification 4). The outcome shows the attractiveness of the Czech

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 all these models are available from the authors upon request.

borderlands for nearby investors in particular, as the coefficient of the additional dummy for combinations, in which only the German headquarters is situated in the borderlands, is negatively significant. There are nearly three and a half times more investments within the common border regions than from German border regions into Czech non-border regions (corresponding to 348.96%=exp(0.7473+0.5025) in specification 4). 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 dummy *Border_CZ* turns insignificant when all explanatory variables are included. Accordingly, there are ceteris paribus two times more investment projects within the common border region than from German non-border regions into Czech border regions. Thus, what Buch et al. (2003) in their study based on micro data on German outward FDI from the German Federal Bank found out for the national level – that a common border increases the FDI flows between two countries – applies also for the regional level. Despite the long-term separation by the Iron Curtain, the common border region provides some locational advantages that go beyond the mere benefit of low transportation costs. Some authors have been very critical what concerns the economic integration in the borderlands of Germany and the former socialist countries (for an overview see Leick 2012, for example). Though the western Polish regions exhibit above-average FDI levels (Cieślik 2005a, b), German investments predominantly come from western German firms, resulting in a lack of trans-border cooperations within the common German-Polish border areas. This missing economic integration in the German-Polish border region is ascribed to the structural deficiencies of the eastern German regions next to Poland (Krätke 1999; Krätke and Borst 2007). However, this result cannot be transferred one to one to the case of the Czech-German border region. This study shows that at least what concerns cross-border FDI flows between Germany and the Czech Republic, the common border region is more integrated than the non-border regions. This confirms that in the context of international investment flows economic forces are able to foster the regional integration of border regions. This positive outcome might also be related to the EU programmes INTERREG and PHARE that supported in particular public authorities, interest associations and non-profit organisations in peripheral regions to cooperate across borders and thus the creation of cross-border networks and cultural proximity.

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 -73.04%=exp(-1.3109)-1 in specification 4). This outcome confirms the diminishing importance of eastern Germany in economic relations with former Comecon nations (see Alecke et al. 2003). Against the backdrop of the above-mentioned structural shortcomings at least in part of the eastern German regions (see Blien et al. 2016, for example), their low commitment in the Czech Republic is not surprising. 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.

Turning to the labor market variables, special attention should be put on the results for the wage ratio, which is included in specification 3, 4 and 5. The variable's coefficient is negative significant in all specifications, with higher values in the final two estimations where the agglomeration variables are included.[36] Thus, although previous studies that included different countries in the analysis of the regional determinants of FDI identified cheap labor force as an important location determinant 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 important 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

[36] When the German and the Czech regional wage level are included separately, the coefficient for the Czech wage is not significant, while the coefficient for the German wage is negative significant. Thus, German FDI comes to a higher extent from low-income regions. This explains the negative significant coefficient of the wage ratio.

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' labor 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.

When looking separately at projects in the Czech manufacturing sector and the Czech service sector, the location patterns of German headquarters and Czech affiliates evidently differ to some extent, as descriptively depicted in Figure 4-3 and Figure 4-4. Nonetheless, the estimation of the gravity model yields quite similar results for the two major economic sectors (Table 4-4 and Table 4-5). This applies to distance and border region issues in particular. Neither the coefficients for the distance variable nor for the border dummies reveal remarkable differences. Accordingly, the ties within the common border region are not only a matter of investments that are intended to reduce the costs of production. Apart from those crucial variables, some differences become apparent. 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. Another interpretation of this result is that investors in the manufacturing sector are attracted by investment subsidies as 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. Concerning the wage ratio, the difference in the coefficient's value (around -2.5 for manufacturing FDI and below -4 for services FDI) indicates that services FDI is more attracted by Czech high-wage regions than manufacturing FDI. The results for the other variables are very similar in both subgroups of FDI projects. In summary, slight differences exist in the relevance of location factors for services FDI compared to the determinants for manufacturing FDI, as they are found in other studies (Jones and Wren 2015; Riedl 2010). Deviations between the two economic sectors cannot be confirmed, however, for the role of border regions.

*Insert Table 4-4 about here*

**Table 4-4: Estimation result of Negative Binomial regressions for manufacturing FDI projects**

*Insert Table 4-5 about here*

**Table 4-5: Estimation result of Negative Binomial regressions for services FDI projects**

## 4.6 Conclusions

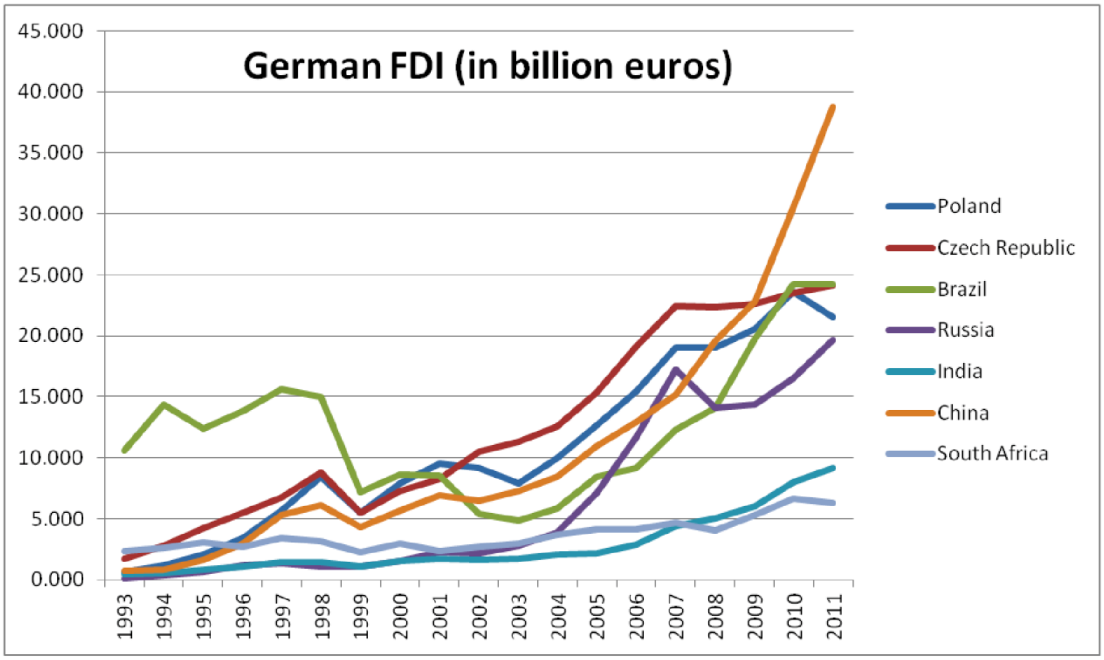
Many studies deal with the reasons for the rise in FDI, as the activities of multinational firms are likely to influence the interregional allocation of productive resources and wealth. Due to limited data availability, however, the bulk of investigations are restricted to larger firms from the manufacturing 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: distance and border regions, market size and agglomeration economies, and labor 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 interconnectedness 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. Notably without providing specific investment incentives, the Czech border regions perform considerably well as destination for FDI from all over Germany. 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 labor 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 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 labor markets.

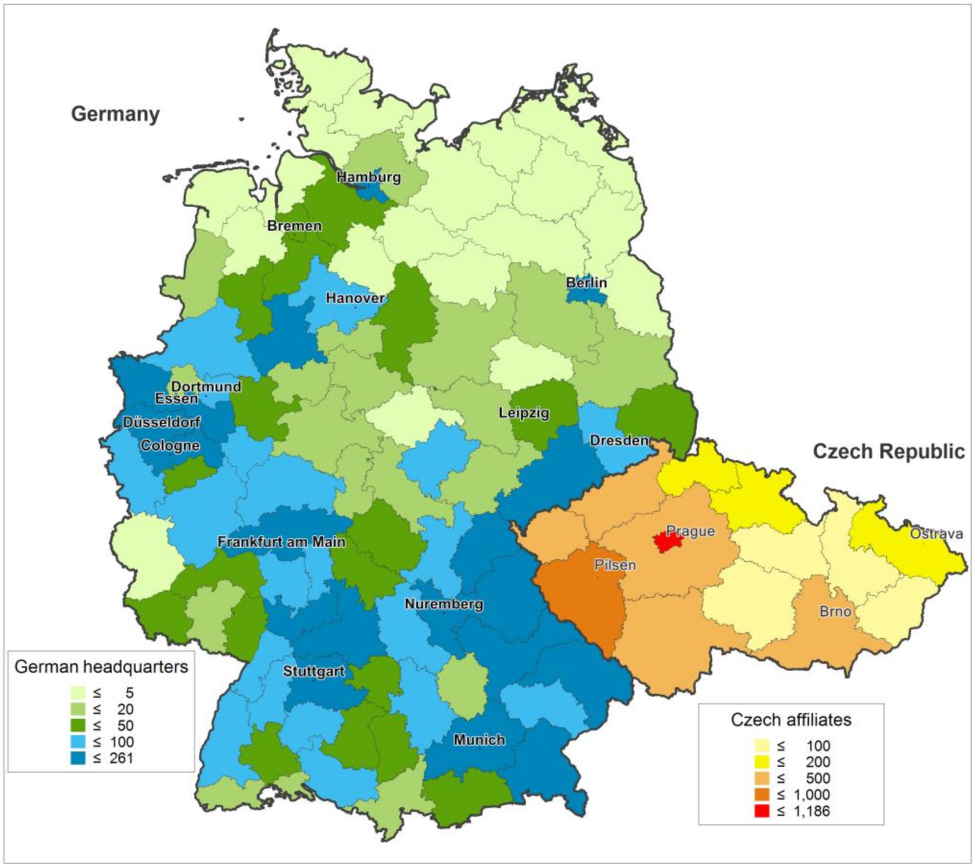
# Appendix to Chapter 4

**Figure 4-1: German FDI in the Czech Republic, Poland and BRICS**



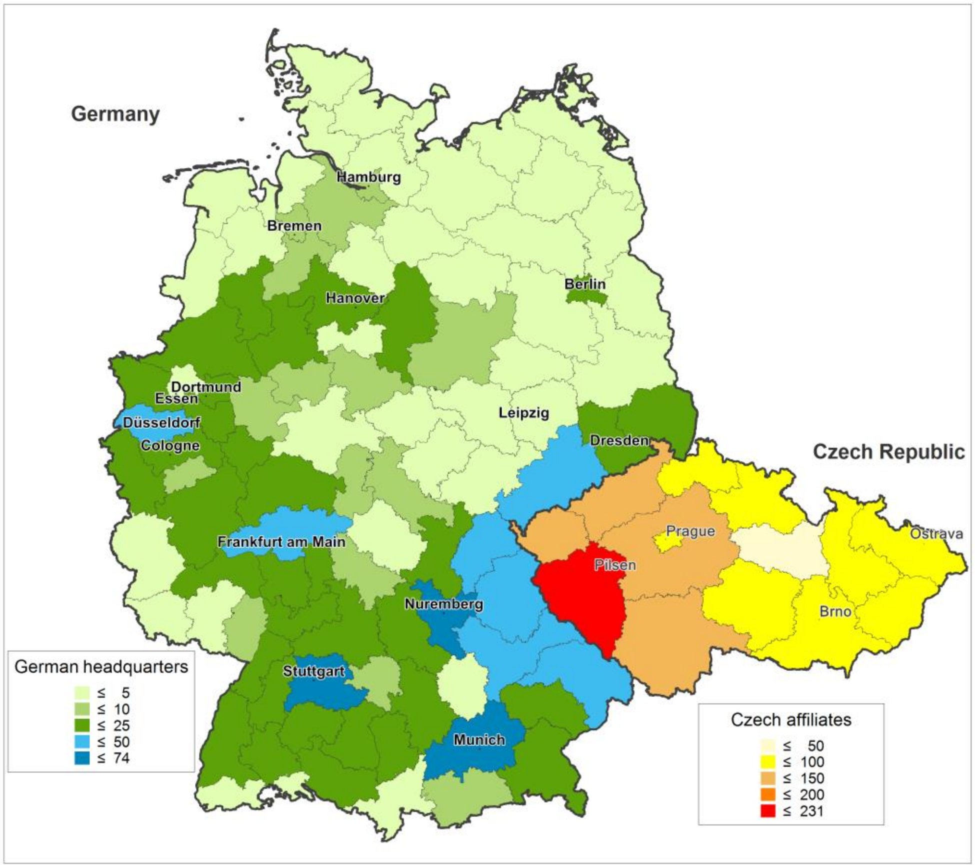

Source: German Federal Bank

**Figure 4-2: Regional distribution of German headquarters and Czech affiliates (total FDI projects)**



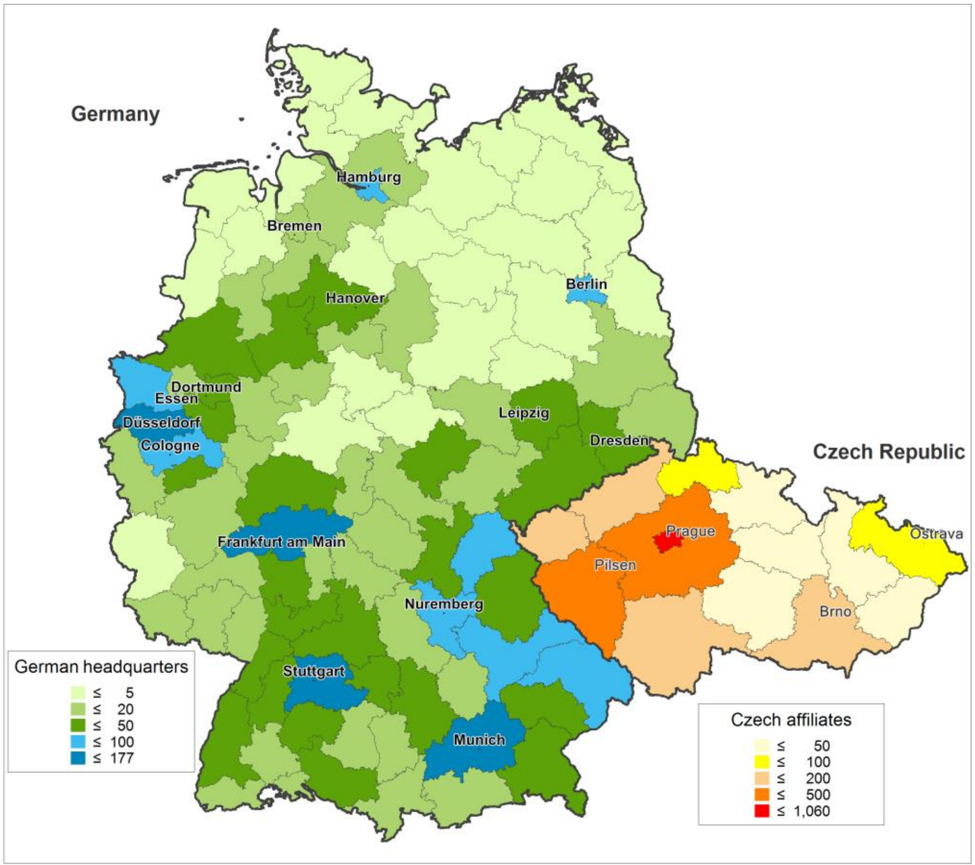

Source: Authors' own calculations from the ReLOC data

**Figure 4-3: Regional distribution of German headquarters and Czech affiliates (manufacturing FDI)**




Source: Authors' own calculations from the ReLOC data

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




Source: Authors' own calculations from the ReLOC data

**Table 4-1: Number of FDI projects between border and non-border regions**

| | | Czech Republic | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total FDI projects | | | Manufacturing FDI | | | Services FDI | | |
| | | Border | Non-border | Total | Border | Non-border | Total | Border | Non-border | Total |
| Germany | Border | 422 (10.8%) | 172 (4.4%) | 594 (15.3%) | 172 (13.5%) | 54 (4.2%) | 226 (17.7%) | 214 (8.8%) | 109 (4.5%) | 323 (13.3%) |
| | Non-border | 931 (23.9%) | 2,369 (60.8%) | 3,300 (84.7%) | 415 (32.6%) | 633 (49.7%) | 1,048 (82.3%) | 466 (19.2%) | 1,642 (67.5%) | 2,108 (86.7%) |
| | Total | 1,353 (34.7%) | 2,541 (65.3%) | 3,894 (100%) | 587 (46.1%) | 687 (53.9%) | 1,274 (100%) | 680 (28.0%) | 1,751 (72.0%) | 2,431 (100%) |

Source: Authors' own calculations from the ReLOC data

**Table 4-2: Descriptive statistics for the 1,344 German-Czech regional combinations**

| | Variable | Mean | Std. Dev. | Expected sign |
|---|---|---|---|---|
| market size and agglomeration | GDP Germany (millions of euros) | 24,969.79 | 23,887.94 | + |
| | GDP Czech Republic (millions of euros) | 10,103.64 | 7,998.76 | + |
| | GDP per capita Germany (euros/inhabitant) | 27,203.18 | 5,638.97 | + |
| | GDP per capita Czech Republic (euros/inhabitant) | 12,485.71 | 4,588.16 | + |
| | population density Germany (inhabitants/km²) | 330.11 | 498.81 | + |
| | population density Czech Republic (inhabitants/km²) | 299.61 | 627.93 | +/- |
| | manufacturing/service ratio Germany | 0.30 | 0.14 | +/- |
| | manufacturing/service ratio Czech Republic | 0.49 | 0.14 | +/- |
| | Dummy East Germany | 0.23 | 0.42 | - |
| | Dummy Prague | 0.07 | 0.26 | + |
| labour market | wage ratio Germany/Czech Republic | 3.50 | 0.48 | + |
| | unemployment rate Germany | 0.08 | 0.03 | - |
| | unemployment rate Czech Republic | 0.10 | 0.03 | +/- |
| | share of high-skilled Germany | 0.09 | 0.03 | + |
| | share of high-skilled Czech Republic | 0.12 | 0.04 | +/- |
| distance and border | distance between German and Czech region (minutes) | 566.75 | 168.62 | - |
| | Dummy Border | 0.02 | 0.13 | + |
| | Dummy Border Germany | 0.04 | 0.21 | +/- |
| | Dummy Border Czech Republic | 0.27 | 0.44 | +/- |
| | *population Germany* | *852,862.40* | *624,671.70* | |
| | *population Czech Republic* | *747,681.60* | *316,710.80* | |

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

**Table 4-3: 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 | | |
| 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 |
| distance and border | 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 | | | **1.1430*** ** | 0.1905 | **0.9637*** ** | 0.1953 | **0.7473*** ** | 0.2031 | **0.6480*** ** | 0.2026 |
| | 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 |
| | Constant | **-5.0415*** ** | 0.7277 | **-4.2927*** ** | 0.9761 | **0.5517** | 2.2004 | **7.6152** | 10.0323 | **11.2239** | 10.1089 |
| | N | 1,344 | | 1,344 | | 1,344 | | 1,344 | | 1,248 | |
| | 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*** | |

**Table 4-4: Estimation result of Negative Binomial regressions for manufacturing 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 | **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 | | |
| 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 |
| distance and border | 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 | | | **1.0341*** ** | 0.2238 | **0.9153*** ** | 0.2323 | **0.8274*** ** | 0.2435 | **0.7476*** ** | 0.2449 |
| | 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 |
| | Constant | **-0.8567** | 0.9723 | **-1.9631** | 1.2516 | **0.2539** | 2.8657 | **17.7621** | 12.7915 | **19.1712** | 12.8824 |
| | N | 1,344 | | 1,344 | | 1,344 | | 1,344 | | 1,248 | |
| | 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 | 0.909o*** | | 0.4812*** | | 0.4256*** | | 0.3345*** | | 0.3306*** | |

**Table 4-5: Estimation result of Negative Binomial regressions for services 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 | **1.1840***** | 0.0565 | **1.0883***** | 0.0496 | **1.2721***** | 0.0827 | **1.1398***** | 0.0934 | **1.1245***** | 0.1054 |
| | ln_GDP_CZ | **1.0570***** | 0.0556 | **0.9636***** | 0.0882 | **0.6635***** | 0.1069 | **0.5298**** | 0.2094 | **0.5026**** | 0.2121 |
| | ln_GDPpc_GER | | | | | | | **0.1874** | 0.3839 | **0.0901** | 0.4383 |
| | ln_GDPpc_CZ | | | | | | | **-1.3713** | 1.3809 | **-1.5324** | 1.3815 |
| | ln_PopDens_GER | | | | | | | **0.4411***** | 0.0814 | **0.4441***** | 0.0930 |
| | ln_PopDens_CZ | | | | | | | **-0.1422** | 0.2779 | **-0.1834** | 0.2768 |
| | ln_Manu/Serv_GER | | | | | | | **0.4192***** | 0.1103 | **0.5214***** | 0.1245 |
| | ln_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 | | |
| labour market | ln_Wage_Ratio | | | | | **-1.9550***** | 0.7278 | **-4.1956***** | 0.8727 | **-4.8298***** | 0.9587 |
| | ln_Unemployment_GER | | | | | **0.2159** | 0.1531 | **-0.0686** | 0.1899 | **-0.0707** | 0.2133 |
| | ln_Unemployment_CZ | | | | | **0.3590** | 0.2284 | **-0.1427** | 0.3702 | **-0.0319** | 0.3698 |
| | ln_High_Skilled_GER | | | | | **-0.1462** | 0.1820 | **-0.0373** | 0.1822 | **-0.0470** | 0.2039 |
| | ln_High_Skilled_CZ | | | | | **1.2142***** | 0.2382 | **0.7382**** | 0.3259 | **0.7778**** | 0.3272 |
| distance and border | ln_Distance | **-2.1338***** | 0.1051 | **-1.9478***** | 0.1295 | **-2.2472***** | 0.1546 | **-2.2003***** | 0.1581 | **-2.2370***** | 0.1675 |
| | Border_GER_CZ | | | **1.2746***** | 0.2201 | **1.0315***** | 0.2261 | **0.7448***** | 0.2424 | **0.5985**** | 0.2466 |
| | 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 |
| | Constant | **-8.1143***** | 0.8560 | **-7.4943***** | 1.2196 | **1.5755** | 2.6605 | **12.5711** | 13.0940 | **17.1690** | 13.3297 |
| | N | 1,344 | | 1,344 | | 1,344 | | 1,344 | | 1,248 | |
| | Pseudo-R² | 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*** | |

# 5 Mothers and daughters: heterogeneity of German direct investments in the Czech Republic

Joint with Michael Moritz, Daniel Münich and Martin Srholec

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**Abstract**

Much has been written on the distinction between vertical and horizontal foreign direct investment. However, most of the empirical literature relies on indirect and aggregated measures only. The aim of this paper is to help fill this gap by examining the differences between German affiliates in the Czech Republic and their mother companies in Germany on the basis of direct evidence on factor requirements. Using a cluster analysis on firm-level data from the unique ReLOC survey, we identify four main groups of firms that partition the sample by broad sectoral lines and by technological, educational and skill intensity of their operations within each of them. More detailed analysis of the clustering reveals that the vertical model dominates in manufacturing, while the horizontal model of investment prevails in the service sector.

**JEL classification:** D21; L16; F23; O23

**Keywords:** Multinational enterprise, foreign affiliate, vertical investment, cluster analysis, Germany, Czech Republic.

## 5.1 Introduction

Much has been written on the distinction between vertical and horizontal foreign direct investment; for comprehensive surveys see, for instance, Barba Navaretti and Venables (2004) and Faeth (2009). But a major difficulty that besets empirical studies on this topic is the lack of relevant micro data. Most of the existing studies rely on indirect classification criteria or on aggregated proxy variables of relative factor endowments. However, these indirect measures largely leave us in the dark with regards to the difference between the foreign investor, henceforth the "mother" company, and the local affiliate, henceforth the "daughter", in terms of their respective portfolios of activities, which is at the heart of this distinction. More detailed micro evidence directly comparing technological, educational, skill and possibly other qualities of mothers and their daughters remains extremely scarce. The aim of the paper is to help fill this gap by empirically examining the vertical versus horizontal thesis of investment in a more direct way than the existing literature on this topic has done so far. For this purpose we organized a large survey, which collected rich original data on the activities of German daughters in the Czech Republic, their mother companies in Germany, and on the control groups of other firms in the respective countries. To the best of our knowledge, this is the most extensive endeavor to investigate the characteristics of German-Czech, cross-border investment. And most probably this survey is the only source of micro data that allow a direct qualitative comparison of mother and daughter companies using methodology harmonized on both sides of the border. Germany is the second most important, only after the Netherlands, home country of direct investors in the Czech Republic. By the end of 2010, according to the CNB (2012), Germany accounted for 13.8% of the total inward stock reaching 17.7 billion USD and 8.9% of GDP. At the same time, according to the German Federal Bank (Deutsche Bundesbank 2012), the Czech Republic ranks in the top ten destinations of German direct investment outside of the eurozone, ahead of such large countries as Japan, India, and Russia and figures as the most attractive destination in Central and Eastern Europe. The Czech Statistical Office (CZSO 2012) estimates that there are about 3,500 to 4,000 affiliates of German firms in the Czech Republic, including major investors such as Volkswagen, RWE, Siemens, AEG, Continental, Linde, Deutsche Telekom, and Robert Bosch, but many small businesses must not be overlooked either. Hence, cross-border investment has, on the whole, a large impact on labor markets and economic development in both countries.

The next section briefly reviews the literature on multinational enterprises, outlines the main theoretical arguments, and draws attention to the measurement problem particularly in light of the deepening fragmentation of production across national borders. The empirical analysis starts with a presentation of the survey and a short descriptive overview of the dataset, which highlight the main patterns. In the next step, the data are explored more analytically with the help of a cluster analysis. The results indicate that vertical investment dominates in manufacturing, whereas there is actually little difference, and hence the horizontal thesis prevails, in the service sector. Finally, the evidence is scrutinized in an econometric framework, which confirms this interpretation. The concluding section pulls the strands together and outlines an agenda for future research.

## 5.2 Theory, concepts and evidence

Arndt and Kierzkowski (2001) identified the deepening fragmentation of production across national borders, which refers to the separation of individual activities within a value chain in space, ownership, or both, as the key distinguishing feature of the contemporary global economy. Some aspects of fragmentation have been earlier described as integration of trade and the disintegration of production by Feenstra (1998), "slicing up the value chain" by Krugman (1995, p. 333), or simply outsourcing by Kogut (1985). Fragmentation is not new by any means. What is unprecedented, however, is the scale and scope of this process today. The "fragmentability" of production has increased with advances in communication and transport technologies, while the scope of production networks has turned increasingly global with the liberalization of investment, trade, and with the easing of political divides between countries, of which the fall of the Iron Curtain is one of the prime examples. An important implication of fragmentation is that firms increasingly focus on exploiting the core elements of their competitive advantage and outsource the rest. Firms grouped under the umbrella of a multinational enterprise become specialized in different fragments of production, which makes them more dissimilar to each other in terms of the portfolio of activities in which they engage in – even if they may nominally operate in the same industry. Specialization in assembly of otherwise "high-tech" electronics products is intensive on different inputs, such as cheap labor, than the design of a new generation of integrated circuits and possibly more similar to assembly activities in other lines of business. As a consequence, the particular fragments tend to gravitate towards different geographical areas matching the local endowments. Upon the fragmentation premise builds the theoretical model of vertical direct investment established by Helpman (1984) and Helpman and Krugman (1985). Vertical multinationals locate different stages of production at home and abroad; they geographically separate fragments of the production process. The main motivation is to exploit the differences in relative factor endowments, and hence relative factor costs, as the fragments have different input requirements. Since vertical investment involves a connection in the production chain, which induces trade in inputs, this kind of investment is likely to decrease with increasing transport costs and other barriers. From this follows the “vertical thesis”, according to which the mothers and their daughters specialize in a widely different portfolio of activities in terms of technological, educational, and skill intensity. According to Eurostat’s (2012) figures in 2010, hourly labor costs in the business sector were estimated at 29 EUR as compared to 10 EUR, and business R&D expenditure as the proportion of GDP amounted to nearly 2% as compared to 1% in Germany and the Czech Republic, respectively, just to briefly indicate the relative factor costs and endowments. Moreover, the geographical distance is short, transport costs are low, and formal barriers do not exist anymore. Vertical investment is expected to be directed to technologically inferior activities with the primary goal of cost saving. A typical example of vertical investment is when the mother relocates low-skilled, labor intensive production, such as assembling, from the home base to a country with lower labor costs. Arguably, the vertical model is likely to account for the bulk of direct investment from Germany to the Czech Republic.

Yet this is not the full story. Markusen (1984), Brainard (1993), and Markusen and Venables (1998) represent pivotal contributions to the theoretical model of horizontal direct investment. Horizontal multinationals engage in the same activities in different locations. The main motivation for horizontal investment is to reduce transportation costs, or access a market that for whatever reason is not economical (or impossible) to serve from abroad; hence, this kind of investment increases with trade barriers. Another reason for investment that fits this definition but goes beyond the basic model is to move closer to foreign sources of knowledge; the investor is driven by agglomeration effects and attracted by knowledge externalities in the sense of Fujita et al. (1999). Either way horizontal investment is expected to appear between areas with similar factor endowments. From this follows the rival “horizontal thesis”, according to which the mother duplicates a similar portfolio of activities in the daughter, generates the same kind of jobs at home and in host countries, and therefore there should not be a significant difference between them in terms of the input requirements.

The vertical thesis is consistent with the early literature on multinational enterprises, which expected technologically advanced, high-skilled, labor intensive activities to remain concentrated near the headquarters of the mother company. The idea that firms invest abroad to take advantage of assets developed in their home base is central to the "eclectic paradigm" by Dunning (1981), is implicit in the model of multinational business presented by Caves (1971), and can be even traced back to the product cycle theory of international technology diffusion by Vernon (1966). According to this view, the daughters are expected to engage in any sort of advanced activities, such as research and development (R&D), only if necessary to facilitate the implementation of technology developed at the home base and only for the purpose of utilizing already existing assets. Nevertheless, more recent literature postulates that dispersion winds for the location of advanced activities are in place as well. The traditional perspective has been challenged by the observation of Kogut and Zander (1993) that the technological bases of multinational enterprises are increasingly not limited to any single country but rather emerge from a variety of sources on a global scale. Cantwell (1995) argues that firms need to invest in R&D abroad to tap into technology competencies embedded in foreign locations. At the heart of this perspective is the argument that important aspects of technology are tacit and "sticky", which makes them less costly (or otherwise impossible) to transfer within a firm's ownership boundaries rather than through market transactions. Hence, a horizontal investment of R&D-intensive mothers to R&D-intensive daughters is likely. Dunning and Narula (1995) and Kuemmerle (1997) dubbed the former reasons asset (or home base) exploiting motives, while the latter have been labeled as asset (or home base) augmenting motives. It is important to realize, however, that the host country needs to reach a certain minimum threshold of location-specific technology factors such as a pool of highly educated labor, specialized suppliers, and a state-of-the-art scientific infrastructure, access to which foreign firms seek to internalize, to attract the augmenting investment in order for the investors to go beyond the cheap labor exploiting strategy. Even if multinationals develop networks of augmenting daughters in multiple locations, this kind of investment is likely to be concentrated in a relatively limited number of technologically advanced areas particularly near the headquarters of rival multinational enterprises.

Overall, the existing evidence indicates that the vertical model accounts for a much larger share of German direct investment in Central and Eastern Europe than in other major destinations. Buch et al. (2005), based on a firm-level data set of about 8,800 German foreign affiliates worldwide from the German Federal Bank and aggregate data from other sources, found that the horizontal market access motive is predominant, but they regarded the vertical cost saving motive to be frequent in some manufacturing sectors and suggested that this motive is likely to play a particularly prominent role in transition economies; however, unfortunately few specifics were said about the Czech Republic in this study. Marin et al. (2003) conducted a survey among the top managers of German investors in Central and Eastern Europe which provided data from a sample of 420 firms with 1,050 investment projects where nearly a quarter was located in the Czech Republic. Using information on the proportion of inputs imported from the mother company and sales exported back to the mother, they found strong evidence for the vertical model suggesting that the investors are, by and large, outsourcing production to exploit lower wages in this region. But the intensity on intra-firm trade appeared relatively low in the Czech Republic, on the basis of which they concluded that specifically in this country horizontal investment dominates. Looking more closely at the Czech data from the same survey, however, Protsenko (2003) reached a somewhat different conclusion. He classified an investment project as vertical if trade with the mother accounted for more than 50% of either the inputs or sales of the daughter, respectively. All other projects were classified as horizontal. On the basis of these criteria, the vertical model accounted for 60.3% of the investment projects, but as a consequence of several very large investments in the financial and automotive sectors, only for 23.3% of the amount of investment. Hence, there were major outliers driving the total figures. Marin (2006) reconsidered the previous findings in a follow-up paper that concentrated on the identification of offshoring, defined as a relocation of activity abroad that remains inside the firm, thus essentially the vertical model. Offshoring investment was deemed to be a project that both imports input goods from the mother and exports the output back after refinement at the same time, regardless of the amount of trade. About 76% of German projects in the Czech Republic were classified in the offshoring category, but she noted that using a slightly tighter criterion that required at least 20% of sales directed back to the mother, the proportion of offshoring projects in the Czech Republic were reduced to 10% only. Hence, the results seem extremely sensitive to the threshold. Görg et al. (2010) used micro data from the German-Czech Chamber of Industry and Commerce, but for a lack of relevant variables, the classification of investment by type must have relied on information about the industry. Based on a comparison of the indexes of the revealed comparative advantage derived from bilateral trade between Germany and the Czech Republic and the principal activity of the German mother at the 3-digit NACE level, they classified 177 projects as vertical and 284 cases as horizontal, while based on the (mis)match between the reported principal activity of the mother and the daughter at the 2-digit NACE level, they identified 284 vertical and 194 horizontal projects; they gave more weight to the first result. In any case, the evidence seems to be mixed with roughly 60% to 40% proportion in favor of one or the other type of investment depending on the measure.

Gauselmann et al. (2011) reported evidence on foreign investment projects in Central and Eastern Europe, including 185 cases in the Czech Republic, based on the IWH-FDI-Micro database. Even though they do not explicitly consider the vertical versus horizontal dichotomy and do not focus on German investors, this paper needs to be mentioned here because the survey provides rare evidence on the strategic motives of investors. The main finding is that the motive of tapping localized technology is significantly more important in the Czech Republic compared with other countries, and that managers of the Czech daughters are significantly more satisfied with the potential for technological cooperation with local science institutions than elsewhere in the region.

From this follows that the Czech Republic seems to be an attractive destination for both vertical and horizontal investment of German firms; the share of vertical investment is probably high in the German-Czech, cross-border context by international standards although the augmenting modus operandi of the Czech daughters cannot be ruled out either. But the micro evidence is scant, limited to a handful of papers, which employ hardly any comparable methodologies, and most importantly, the results with regards to the relative share of both the vertical and horizontal models differ by a large margin, even if based on the same source of data. Hence, the existing literature is ambiguous, and the lack of thorough evidence begs for more examination.

Admittedly, a major reason for limited progress in empirical research along these lines, despite much theoretical reasoning, is the lack of relevant micro data. Official statistics do not differentiate between the types of investors, and hence, researchers interested in this topic either collect data by independent surveys, which suffer from low response rates; merge data from various sources, which often results in a massive loss of observations; and/or rely on poor proxy variables to identify the distinction not to mention the studies that resort to using aggregate or industry-level data that completely ignore the underlying micro heterogeneity. Buch et al. (2005), for instance, rely on the assumption that the investment is horizontal if the daughter operates in the same industry abroad as the mother at home and vertical otherwise. At first, this method sounds appealing, but as Görg et al. (2010) also realized, this hinges on the level of aggregation. The share of horizontal investment is overstated if the aggregation is too high, and the opposite bias is likely if the distinction is based on a very detailed classification as the principal activity of the mother and daughter can be very similar but categorized in nominally different, possibly neighbouring, industry codes. Moreover, the principal activity of both the mother and daughter needs to be correctly recognized, but this is well-known to be difficult for large, multi-plant and multi-product firms, typically multinational enterprises. Further, this criterion ignores intra-industry differences in quality, and thus in endowment requirements, which are central to the distinction.

Another way to identify vertical investment that has been already mentioned is to obtain information on intra-firm trade, namely the import of intermediate goods from the mother to the daughter and the output of the daughter purchased by the mother, assuming that this kind of trade involves a connection between different fragments of production. Surely, intra-firm trade is a symptom of fragmentation, and hence signals the vertical model, but fragmentation goes much beyond investment. Production is fragmented not only in space but also in ownership; multinational enterprises not only offshore but also outsource, and not only the mother but also other suppliers become entangled with her daughters in production networks. If the vertical linkage between the mother and daughter is indirect, if other firms process the inputs along the route between them, the daughter becomes classified as horizontal according to this criterion even though the investment project is a textbook example of the vertical case.

Available evidence on the global spread of production networks indicates that looking solely at intra-firm trade to identify the distinction is likely to entail a severe downward bias in the extent of vertical investment. Ernst and Kim (2002) and Gereffi et al. (2005) point to the fact that multinational enterprises increasingly operate as flagships of extended production networks, part of which they directly own, but which also comprises independent suppliers affiliated to the network by long-term contracts, such as the original equipment manufacturing framework. As a result, the production network becomes a complex matrix of input-output relationships spanning far outside of the mother's group; intermediate goods streaming along the route. This blurs the distinction of what is an internal and external exchange. Furthermore, considering the import of intermediate goods, typically processed materials, industrial supplies, and manufacturing components, grossly underestimates the vertical investment in the service sector. Although the offshoring of services is relatively new, multinational enterprises increasingly relocate activities abroad, such as call centres, accounting and information services, which involve little or no exchange in intermediate goods between the mother and daughter. All that matters, of course, is exactly how the question is specified in the survey, but typically firms are asked about the import of goods only, not covering service procurement, as the latter is far more difficult and possibly sensitive to report. It might well be that a good part of what has been deemed horizontal investment in the data used by Marin et al. (2003), Protsenko (2003) and Marin (2006), which includes daughters both in manufacturing and services, actually refers to a vertical relocation of services.

Görg et al. (2010) in concordance with many studies based on aggregate data used wages to proxy for skill intensity. But average wage is a crude measure of factor requirements because the wages of all skill categories of workers can be relatively high in a particular firm, industry, or country for reasons independent of skills, such as collective bargaining, market structure, macroeconomic conditions and their unobserved qualities. Using wage differences to infer the type of project rests on the assumption that horizontal investors pay equivalent wages for the same kind of jobs at home and in the host country, which is clearly elusive. After all, using the wage differential would probably lead us to conclude that the vast majority of German-Czech investment is vertical, just because there is a large aggregate difference, even if adjusted by purchasing power parity.

As documented by Blomström and Kokko (1998), there is, furthermore, extensive literature on the possibility of various spillover effects between foreign affiliates and the host economy. Despite strong theoretical reasons to expect spillovers, however, the evidence is mixed at best. Görg and Greenaway (2004) point out that the empirical literature, typically using indirect measures of technology in the production function framework, finds strong support for direct technology transfer from the parent to the foreign affiliate, but evidence for technology spilling over to the host country is rare, and rather, the crowding out of non-affiliated firms is often detected. Stancik (2007) confirms that domestic companies tend to be negatively affected by the presence of foreign companies in the Czech Republic, especially in upstream sectors. However, Havranek and Irsova (2011) testify to the fact that the more recent literature focusing on vertical spillovers tends to be somehow more positive in this respect. A more direct measurement of the distinction between horizontal and vertical, not simply based on the industry classification of the firms, can also prove fruitful for tackling the spillovers issue.

## 5.3 An overview of the dataset

The empirical analysis is based on original micro (firm) level data collected by the "Research on Locational and Organizational Change" (ReLOC) survey. First, we identify firms involved in offshoring, hence those firms which carry out their activities in-house abroad and their foreign business units. Next, these firms are compared with a control group of German companies without foreign direct investment and Czech firms without a foreign owner. From this follow four survey groups:

(T_CZ) Treatment group in the Czech Republic: German daughters, which refer to firms registered in the Czech Republic owned by German companies. By combining information on ownership from the Creditinfo database, the Čekia database, the German-Czech Chamber of Industry and Commerce, and the Czech Commercial register 3,875 relevant survey participants have been identified.[37] If there were two or more German affiliates which had the same residence and owner, only one, randomly drawn, had been included in the survey. After this reduction 3,651 affiliates had been selected for the survey. Moreover, based on information collected in the survey, we are able to distinguish the mode of entry: i) Greenfield daughters (T_CZ1) had German owners from the outset, while ii) Merger & acquisition (M&A) daughters (T_CZ2) acquired German owners sometime during their lifetime.

(C_CZ) Control group in the Czech Republic: Firms registered in the Czech Republic, which are purely Czech-owned; they neither have a direct nor an indirect foreign owner. Czech companies which did not have foreign owners but where other Czech firms with foreign owners held shares in them were also excluded. The information concerning the existence of a foreign owner was obtained from the Creditinfo database and additionally checked with each company before conducting an interview.

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37 As a basic principle, we only considered daughters which were either legally connected to a German company or where there was a legal connection between a German company and its owner. Therefore, not all of the 5,700 Czech firms with German owners turned out to be relevant to the survey because nearly half of them were not directly owned by a German firm but by a German private individual, of which only daughters with a German individual owner who also owned at least one German firm were considered. However, the database remains much larger in comparison with other sources. For example, the Amadeus database of Bureau van Dijk contained only 1,150 Czech companies with German owners in the February 2011 edition. In particular, smaller affiliates have been grossly under-represented in previous studies.

(T_DE) Treatment group in Germany: German mothers, which are firms registered in Germany with an affiliate in the Czech Republic. The starting point is the German owners of the 3,875 companies in the Czech treatment group of which 3,274 were selected for the survey after identifying their full address. There are less mothers than daughters because some German owners were involved with more than one Czech company.

(C_DE) Control group in Germany: Firms registered in Germany, which did not have a foreign affiliate. This information was derived from the database of Heins & Partner and additionally checked with each company before conducting an interview.

The survey was conducted by TNS Infratest Sozialforschung in Germany and by TNS AISA in the Czech Republic from September 2010 to May 2011. The data were collected via personal interviews using written questionnaires. The sampling frame was a census of the total population of mothers and daughters (T_CZ and T_DE) and a sample stratified by industry and number of employees of the two control groups (C_CZ and C_DE); the latter were stratified to match the composition of the respective treatment group, which meant comparable data for the groups within each country were obtained. For more details on the survey methodology see Hecht et al. (2013a).

Excluding companies which were identified as not existing anymore, not reachable, or did not exhibit the characteristics of the respective group when contacted, the response rates were 14.9% in the Czech treatment group, 12.9% in the Czech control group, 18.5% in the German treatment group and 19.1% in the German control group. It is well acknowledged that the representativeness of the data is a thorny issue. Yet we should not judge this data by the standards of official surveys, answering to which is often compulsory by law. Moreover, the survey brings unique detailed evidence on the operation of mother and daughter companies, for which micro data remain extremely scarce, and the few original surveys on this topic that have been conducted previously ended up with similar or even much worse response rates. [38]

[38] See, for instance, the IWH-FDI-Micro database of foreign investors that has been collected by telephone interviews; it is based on a response rate of about 10% in the Central and East European countries (Günther et al. 2011). Another example is the “Going International survey”, a postal survey carried out by the “Deutscher Industrie- und Handelskammertag” with a response rate of 8% only (Buch et al. 2007).

The size of the firm is measured by the total headcount of employees, excluding agency and other external workers, in June 2010. The age of the firm refers to the number of years since the firm has been established in the respective country. The industry affiliation is identified by the self-reported principal activity of the firm the structure of which broadly corresponds to the Statistical Classification of Economic Activities (NACE, rev. 2). On the basis of this information, we derive a broad sectoral dummy variable with the value 1 for firms classified in the mining, manufacturing, and utility sectors, henceforth "manufacturing" for simplicity, and with the value 0 for firms operating in the service sector, i.e. 05-39 and 41-96 categories at the 2-digit level of NACE, rev. 2, respectively. Besides the traditional information on the industry, firms further identified their position in the value chain, which provides us with an insight about the primary activity of the firm from a different angle. Firms were asked to classify 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 consumer with the total value-added increasing in a snowball manner along the route. Hence, we are able to see how far the firm operates from the final user. Structural patterns like these are relevant, but even more important is to have direct evidence on the underlying factor requirements. R&D is the traditional and for a long time the only seriously considered data on investment in technology. Firms were asked to identify whether R&D belongs to major business functions conducted by the company, which can be perhaps interpreted as the presence of an internal R&D department. From this follows a dummy variable with the value 1 for firms that answered affirmatively and with the value 0 otherwise. The purpose of this variable is to capture a general commitment of the firm to R&D activity. Next, the respondents were asked to evaluate the technological level of their company in terms of the physical equipment, i.e. production lines, machinery, tools, etc. in comparison with other firms in the same industry on a seven-point Likert scale ranging from -3 for absolutely obsolete, 0 for the average level, to +3 indicating state-of-the-art technology. Indeed, this variable gives us an invaluable insight about the perceived technological position of the firm vis-à-vis direct competition, and hence hints on the business strategy, whether the firm is a technology leader or rather a follower, and whether the firm competes on quality or rather on low costs. Yet the factor endowment of the firm is about more than just spending on R&D and modern machinery; so, we need to keep an eye on broader indicators, too. For this purpose the data on educational attainment (or qualification) of employees, which represent a rough proxy of human capital, come in as handy. More specifically, the respondents were asked to divide their labor force into three broad categories as follows: i) Low educated labor, which refers to employees, who conduct simple activities not requiring specialized education/training; ii) Medium educated labor, referring to employees, who conduct qualified work, for which vocational education or equivalent specialized training and job experience are required; and iii) Highly educated labor, which refers to employees, who conduct qualified work, for which tertiary education is necessary. And even better, to include the modern refinements brought by the literature on tasks (see Acemoglu and Autor 2011; Autor et al. 2003), the firms were asked to evaluate the skill requirements of the tasks actually performed by the employees; they reported the percentage share of different kinds of tasks involved in the process, in which the main product or service is produced. Five task categories were distinguished: i) routine manual tasks, which refer to manual work consisting of simple repetitive operations, for example packaging, sorting, copy making, etc.; ii) non-routine manual tasks, which refer to manual work not consisting of simple repetitive operations only but also including operations that require reactions to changes of the working conditions, for example driving, maintenance, serving in restaurants, etc.; iii) routine non-manual tasks, which consist of simple repetitive operations, for example proofreading, measurement, bookkeeping, etc.; iv) interactive tasks, which do not consist of simple repetitive operations, for example negotiating, consultancy, or lecturing; and v) analytical tasks, which refer to operations that are not repetitive and require innovative solutions and independent thinking of the employee, such as research, evaluation, planning.

After omitting observations with missing data on either of these questions, we have at our disposal a sample of 350 German daughters in the Czech Republic (T_CZ), of which 264 are greenfield (T_CZ1) and 86 M&A (T_CZ2), 662 firms in the Czech control group (C_CZ), 364 German mother companies in Germany (T_DE), and 1,065 firms in the German control group (C_DE); hence, the total sample consists of 2,441 observations. Table 5-1 provides the mean values of the variables. About half of the total sample and a bit more than half of the mothers and daughters operate in manufacturing. More than two-thirds of the mothers but only about every fourth to fifth daughter engage in R&D. Also in line with expectations the mothers dominate in terms of the technological level of their equipment; they are positioned more upstream in the value chain, and they are much larger than the rest of the sample. However, the greenfield affiliates surprisingly come out with the highest share of the top category of educational attainment; this can be perhaps attributed to the well-known problem that diploma counts do not satisfactorily measure quality. Admittedly, the task complexity variables are more informative in this respect. A more detailed discussion of these differences is presented in the next section.

## Table 5-1: Mean values by location and ownership of the firms

| Location | Czech Republic | | | Germany | | |
|---|---|---|---|---|---|---|
| Ownership | Greenfield daughter (T_CZ1) | M&A daughter (T_CZ2) | Control group (C_CZ) | Mother (T_DE) | Control group (C_DE) | Total |
| General characteristics: | | | | | | |
| Number of employees | 60.5 | 131.6 | 62.7 | 264.8 | 155.5 | 135.5 |
| Age | 12.8 | 17.3 | 16.3 | 45.3 | 46.8 | 33.6 |
| Manufacturing | 56.1 | 70.9 | 47.9 | 56.0 | 40.4 | 47.5 |
| Value chain position: | | | | | | |
| 1: Upstream | 1.1 | 0.0 | 0.8 | 0.8 | 1.7 | 1.2 |
| 2 | 2.3 | 1.2 | 2.4 | 4.4 | 3.5 | 3.1 |
| 3 | 7.2 | 9.3 | 5.0 | 9.6 | 5.7 | 6.4 |
| 4: Middle | 18.2 | 7.0 | 13.6 | 27.2 | 16.3 | 17.1 |
| 5 | 23.1 | 29.1 | 18.9 | 25.3 | 18.9 | 20.6 |
| 6 | 23.1 | 24.4 | 20.2 | 20.1 | 21.6 | 21.3 |
| 7: Downstream | 25.0 | 29.1 | 39.1 | 12.6 | 32.3 | 30.3 |
| Intramural R&D activity: | | | | | | |
| R&D engagement | 18.6 | 26.7 | 23.3 | 67.3 | 28.5 | 31.7 |
| Quality of equipment: | | | | | | |
| -3: Absolutely obsolete | 1.9 | 2.3 | 0.9 | 0.3 | 0.7 | 0.9 |
| -2 | 6.4 | 2.3 | 3.0 | 1.6 | 1.7 | 2.6 |
| -1 | 6.1 | 10.5 | 7.1 | 4.1 | 4.5 | 5.5 |
| 0: Average | 32.6 | 23.3 | 28.4 | 14.6 | 12.2 | 19.5 |
| 1 | 23.5 | 23.3 | 29.5 | 22.3 | 21.5 | 24.0 |
| 2 | 19.3 | 33.7 | 24.6 | 42.3 | 41.6 | 34.4 |
| 3: State-of-the-art | 10.2 | 4.7 | 6.5 | 14.8 | 17.8 | 13.0 |
| Education attainment of employees: | | | | | | |
| Low educated labor | 20.4 | 23.5 | 18.2 | 21.3 | 22.3 | 20.9 |
| Medium educated labor | 46.9 | 57.4 | 58.8 | 60.5 | 67.3 | 61.4 |
| Highly educated labor | 32.7 | 19.1 | 23.0 | 18.2 | 10.4 | 17.7 |
| Task complexity: | | | | | | |
| Routine manual tasks | 31.4 | 39.3 | 25.2 | 25.5 | 29.0 | 28.1 |
| Non-routine manual tasks | 20.0 | 27.9 | 33.9 | 20.5 | 26.5 | 27.0 |
| Routine non-manual tasks | 12.8 | 13.6 | 14.1 | 16.3 | 13.1 | 13.8 |
| Interactive tasks | 19.0 | 10.5 | 14.9 | 20.8 | 18.7 | 17.7 |
| Analytical tasks | 16.9 | 8.7 | 11.9 | 16.9 | 12.7 | 13.4 |
| Number of observations | 264 | 86 | 662 | 364 | 1,065 | 2,441 |

## 5.4 Cluster analysis

To find distinct groups of firms with regards to the factor requirements, we divide them with the help of a cluster analysis according to the type of business activity, technology, education, and skill variables. Hierarchical clustering, more specifically the method of *complete linkage*, is used because the decision on the number of clusters to be retained is not required beforehand, which is preferable for solving the problem at hand. Since the dataset includes binary, ordinal, and continuous variables, we use *Gower's dissimilarity coefficient* in the clustering procedure, which is suitable for a mix of data on different scales and is different from other distance measures (see, for instance, Blien et al. 2010). For more details see Stata (2009a). Calinski and Harabasz (1974) and Duda et al. (2001) developed rules for stopping the hierarchical clustering procedure that can be used to determine the number of clusters. Higher values of the Calinski-Harabasz pseudo-F index and smaller values of the Duda-Hart pseudo-T-squared statistics indicate more distinct clustering. Table 5-2 presents the results. Four or three clusters appear as the most viable solution. Also this partitioning of the data appears to be consistent with the dendrogram. After inspecting the results more closely, we have chosen to retain four clusters because, in our view, this solution more credibly represents the main characteristics of the sample.[39]

**Table 5-2: Cluster analysis stopping rules**

| Number of clusters | Calinski/Harabasz pseudo-F | Duda/Hart Pseudo T-squared |
|---|---|---|
| 2 | 66.33 | 161.60 |
| 3 | 132.87 | 9.00 |
| 4 | 91.12 | 6.30 |
| 5 | 70.56 | 158.32 |
| 6 | 91.70 | 55.05 |
| 7 | 83.53 | 116.98 |
| 8 | 96.45 | 100.29 |
| 9 | 98.72 | 92.15 |
| 10 | 102.73 | 67.42 |

39 Since the categories of education attainment on the one hand and task complexity on the other represent linear combinations of each other, i.e they add together to 100%, we exclude the most frequent categories of “Medium educated labor” and “Routine manual tasks” from the clustering procedure.

**Table 5-3: Mean values by cluster**

| Variable | Cluster 1 High-tech manufacturing | 2 Low-tech manufacturing | 3 High-tech services | 4 Low-tech services | Total |
|---|---|---|---|---|---|
| Manufacturing | 1.00 | 1.00 | 0.00 | 0.00 | 0.48 |
| Value chain position | 4.98 | 5.31 | 5.08 | 5.97 | 5.38 |
| R&D engagement | 1.00 | 0.00 | 0.38 | 0.00 | 0.32 |
| Quality of equipment | 1.32 | 0.87 | 1.57 | 1.06 | 1.19 |
| Low educated labor | 23.9 | 25.8 | 6.8 | 25.3 | 20.9 |
| Medium educated labor | 61.5 | 62.7 | 54.3 | 65.7 | 61.4 |
| Highly educated labor | 14.6 | 11.6 | 38.9 | 9.1 | 17.7 |
| Routine manual tasks | 34.2 | 41.5 | 10.7 | 25.6 | 28.1 |
| Non-routine manual tasks | 26.2 | 30.1 | 18.0 | 31.7 | 27.0 |
| Routine non-manual tasks | 14.5 | 11.3 | 14.9 | 14.5 | 13.8 |
| Interactive tasks | 12.5 | 8.9 | 28.7 | 20.7 | 17.7 |
| Analytical tasks | 12.7 | 8.2 | 27.7 | 7.5 | 13.4 |
| Number of observations | 567 | 593 | 550 | 731 | 2,441 |

Table 5-3 gives mean values on the variables in the four principal clusters. The main dividing line runs on the one hand between principally manufacturing and service firms and on the other hand between firms that score high and low on the technology, educational, and skill variables. From this follows the distinction of high- versus low-tech categories of firms operating in manufacturing and services, respectively:

Cluster (1): High-tech manufacturers

The first cluster identifies manufacturing firms, each of which conducts R&D activity and which maintain more highly educated labor, require a higher share of employees performing interactive and analytical tasks, and furnishe themselves with technologically more advanced equipment compared to firms classified in the inferior manufacturing category. All in all, this earns them the status of the “High-tech manufacturing” category.

Cluster (2): Low-tech manufacturers

The second group marks manufacturing firms on the opposite side of the technological spectrum, which do not engage in R&D, have a less educated workforce, specialize in manual work, especially the most rudimentary routine tasks, and use more technologically outdated equipment than in any of the retained groups; hence, this is the “Low-tech manufacturing” cluster.

Cluster (3): High-tech service providers

The third cluster lumps together advanced service firms, which have by far the most educated labor, the best tasks complexity portfolio and cutting-edge equipment; they even outclass in these characteristics the high-tech manufacturing firms, and by a large margin. Hence, this group comprises the real boon in technology and, hence, clearly deserves to be placed in the “High-tech services” rubric.

Cluster (4): Low-tech service providers

Finally, there is a fourth group, which is the mirror image of the previous category, so that the label of “Low-tech services” fits rather well.

Also the value chain position fits this interpretation. As can be expected, firms classified in manufacturing consider themselves more upstream than in services, if one compares the respective high- and low-tech clusters with each other because many more service firms, by the nature of their business, operate close to the final customer. But there is a difference by the cluster solution within sectors too. Low-tech firms are considerably more downstream, which reflects the fact that value chain segments that are particularly intensive on high-skilled labor, including various professional, engineering and research activities, come early in the value chain, whereas segments that require relatively low-skilled labor, such as assembling, sales or distribution, appear down the route. Another outcome that needs to be clarified is that less than half of firms classified in the high-tech services category reported any engagement in R&D. According to the definition of the OECD (2002), however, there are many jobs which either do not meet the formal criteria of what is considered to be R&D, even though they are closely related to it such as all sorts of educational, measuring and testing services, or oscillate at the borderline of what should (not) be included such as those in the domain of consultancy, software development, and market research. Hence, there can be a downward measurement bias in the R&D question particularly for firms operating in the service sector.

All of the clusters are frequently populated, none of them dominate in terms of the number of observations, and none of them represent a mere residual category, which confirms that each of the groups has a merit in its own right. If we retain several more clusters, mixed groups of firms start appearing in manufacturing and services. But this involves partitioning the sample into too many groups, some of which are sparsely populated, and hence, difficult to work with empirically. So there seem to be pockets of firms that, given the characteristics taken into account, cut across the traditional dichotomy between manufacturing and services. Unfortunately, however, the data in hand do not allow us to say much about them.

Table 5-4 reports the clustering results by ownership and location of the firms, which is at the heart of the interest in this paper. Not surprisingly, the mother companies are by far the most advanced as about half of them belong to the high-tech manufacturing cluster; more than one-fourth of them concentrate in the high-tech services cluster, and only about every fifth of them are classified as low-tech either in manufacturing or services. Of course, the technological superiority of mothers is one, if not the primary, reason why they venture into investing abroad in the first place. More interesting is, therefore, to compare this outcome to the distribution of daughters, and here the distinction between manufacturing and services comes out strong. Daughters in manufacturing seem to be a reverse mirror image of the mothers as by far the most prevalent category is the low-tech manufacturing cluster; with little difference between greenfield and M&A investment projects, the technological superiority of the mothers does not translate into the operations of the daughters. In fact, quite the opposite seems to be the case because the manufacturing daughters are concentrated in the low-tech segment even more than the control group. Hence, the data indicate that in manufacturing there is a clear vertical division of labor between the mothers and daughters, in which the former specialize in technologically intensive activities, while the latter operate at the low end of the spectrum. However, this does not seem to be the case in services, where the proportion of high-tech and low-tech operations comes out to be very similar for the mothers and the greenfield affiliates. M&A daughters lag somehow behind in this respect, but even in this category, the high-tech cluster is more frequent than the low-tech one. This is in a sharp contrast with the control group, for which the low-tech cluster is significantly more populated. From this follows that the cross-border direct investment in the service sector, particularly in greenfield projects, is predominantly horizontal as the daughters tend to engage in a similar portfolio of activities in terms of technology, education, and skill intensity as the mother companies.

Overall, as a result if added together, firms located in Germany appear notably more advanced than those operating in the Czech Republic. This is primarily driven by differences in terms of the cluster classification in manufacturing, in which the Czech firms are clearly technologically inferior to their German counterparts. However, there is not that much difference in the service sector, where the proportion between firms classified as high-tech and low-tech is even slightly higher on the Czech side of the border. According to this data, therefore, the difference between both countries boils down to the low-skilled labor requirements of daughters in the manufacturing stratum of the economy.

**Table 5-4: Percentage distribution of the location and ownership categories by cluster**

| Code | Ownership | Location | Number of observations | Cluster<br>1<br>High-tech manufacturing | <br>2<br>Low-tech manufacturing | <br>3<br>High-tech services | <br>4<br>Low-tech services |
|---|---|---|---|---|---|---|---|
| T_CZ1 | Greenfield daughter | Czech Republic | 264 | 11.7 | 44.3 | 26.5 | 17.4 |
| T_CZ2 | M&A daughter | Czech Republic | 86 | 19.8 | 51.2 | 15.1 | 14.0 |
| C_CZ | Control group | Czech Republic | 662 | 17.1 | 30.8 | 21.6 | 30.5 |
| T_DE | Mother | Germany | 364 | 49.7 | 6.3 | 28.8 | 15.1 |
| C_DE | Control group | Germany | 1,065 | 21.1 | 19.2 | 20.6 | 39.1 |
| CZ | Subtotal | Czech Republic | 1,012 | 15.9 | 36.1 | 22.3 | 25.7 |
| DE | Subtotal | Germany | 1,429 | 28.4 | 16.0 | 22.7 | 33.0 |
| T | Mother & daughter | Subtotal | 714 | 32.1 | 25.8 | 26.3 | 15.8 |
| C | Control group | Subtotal | 1,727 | 19.6 | 23.7 | 21.0 | 35.8 |

## 5.5 Regression analysis

Yet from descriptive tabulations, we can derive only preliminary conclusions because the observed patterns can be driven by a host of factors that are not properly accounted for. More confident statements can be derived from investigating the data in an econometric framework. In the next step, therefore, we estimate a probit model, in which the outcome is the classification of firms obtained from the cluster analysis represented by a dummy variable with the value 1 for the high-tech category and the value 0 for the low-tech cluster, while on the right-hand side is the size of the firms given by the log of employees, the age given by the log of years since the firm was established, a set of location and ownership dummies, for which the mothers represent the base category, and a set of industry dummies.[40] The idea is that firms make a strategic choice to specialize in their respective cluster. Arguably, this is most relevant for the daughters because the mother companies generally decide on their specialization depending on a number of factors, including the global offshoring strategy of the corporation, the main motive for the investment, and the factor endowments of the location. In other words, the mothers are assumed to have a freedom to choose whether the daughter is limited to a low-tech operation primarily exploiting factor cost differences or whether the project develops into a complex, high-tech facility.

Table 5-5 gives the results. Since the cluster solution splits the sample by broad sectors, we estimate the model separately for each of them. In the first column are results for manufacturing, and in the second column are the results for the service sector. For comparing the magnitude of the estimated relationships, we report marginal effects derived at the mean of the other covariates. Specifically for the binary covariates, the marginal effect refers to the discrete change from the base level. For details on the maximum likelihood procedure see Stata (2009b). Even after controlling for the size, age, and industry differences, the results generally confirm the interpretation proposed above. Both the greenfield and M&A daughters are significantly less likely to be high-tech than the mothers in manufacturing, but there does not seem to be a statistically significant difference at the conventional levels in the service sector. The control groups are always significantly inferior to the mothers, but in terms of the estimated marginal effects, this is to a noticeably more extent the case in manufacturing than in services. Moreover, both types of affiliates appear technologically less sophisticated than the control groups in manufacturing, while the reverse tendency is detected in services; note

40 Because of data limitations, the industry dummies have been aggregated to 24 categories broadly following the 2-letter alphabetical structure of NACE, rev. 2 classification. More details on the definition of the categories are available from the authors upon request.

that these differences are statistically significant at the 5% level except for the M&A daughters in the service sector only. According to expectations, there is a positive effect of size in manufacturing because of various scale economies in production. Large firms are in a much better position to finance, for example, their own R&D department, which is the essential identification criterion of the high-tech manufacturing cluster. In contrast, size does not seem to be important in services because the potential for exploiting economies of scale is known to be considerably smaller; hence, it does not make much difference. Age represents factors that are a function of time including various learning effects such as learning by doing and other resources that accumulate gradually over the years. Again, this appears to be much more relevant in manufacturing than in the service sector.

**Table 5-5: Results of a probit model**

| Dependent variable | Cluster<br>1 and 2<br>High-tech manufacturing | <br>3 and 4<br>High-tech services |
|---|---|---|
| Log of employees | 0.094 (0.014)*** | -0.003 (0.010) |
| Log of age | 0.072 (0.023)*** | 0.016 (0.020) |
| Greenfield daughter | -0.642 (0.050)*** | -0.049 (0.064) |
| M&A daughter | -0.616 (0.067)*** | -0.124 (0.108) |
| Czech control group | -0.460 (0.042)*** | -0.208 (0.051)*** |
| German control group | -0.391 (0.039)*** | -0.312 (0.045)*** |
| Industry dummies | Included | Included |
| Wald Chi-Quadrat | 301.74*** | 191.51*** |
| Log pseudolikelihood | -589.80 | -757.63 |
| Pseudo $R^2$ | 0.26 | 0.12 |
| Number of observations | 1,150 | 1,267 |

Note: Marginal effects at the mean of other explanatory variables are reported; robust standard errors in brackets; ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

## 5.6 Conclusions

Using unique micro evidence on technological, educational, and skill intensity of German mother companies and their daughters in the Czech Republic derived from the ReLOC survey, we identified, with the help of a cluster analysis, four main groups of firms that partition the sample in: i) High-tech manufacturers; ii) Low-tech manufacturers; iii) High-tech service providers; and iv) Low-tech service providers. A more detailed examination of the clustering by location and ownership of the firms and in the framework of a probit model revealed that the factor requirements of the daughters do not come out to be significantly different from the mothers in the service sector, from which we conclude that the dominant model of investment is horizontal, whereas there is a profound difference in this respect in manufacturing, which points to predominantly vertical investment in this sector.

Looking from the German perspective, the results indicate that on the one hand, in terms of the immediate impact on the labor market, cross-border investment is likely to influence the relative wages of skilled and unskilled workers and hence disrupt the market in manufacturing but not in the service sector. However, on the other hand, fears of hollowing out local innovation systems do not seem to be justified in manufacturing as technologically advanced activities remain concentrated near the headquarters, but there is the possibility that high-skilled intensive jobs are being transferred across the border in the service sector. Of course, the impact depends on whether the jobs are relocated from Germany or whether the investment projects generate new jobs not undertaken before in Germany.

From the Czech point of view, however, the results suggest that the cross-border investment in manufacturing generates jobs for low-skilled workers, possibly reducing unemployment in this segment of the labor market, but the investment projects fall short of expectations as far as their contribution to technological upgrading is concerned as they predominantly deepen specialization of the local economy in low-tech jobs, and that somewhat surprisingly cross-border investment in the service sector appears much more promising in terms of stimulating the upgrading process. It is important to realize in this respect that the deepening fragmentation of production makes a lock-in situation in the low-cost edge of global production networks more likely than before. But the ultimate welfare impact on both sides of the border that begs for closer scrutiny clearly goes beyond the scope of this paper.

Admittedly, this points to the main limitations of the paper. First and foremost, it would have been of interest to analyze the impact of these patterns on productivity growth. This requires, however, integrating the ReLOC survey data with information from other sources, most notably with balance sheet data and employment statistics, which exists at least for a subsample of the firms, and hence, this is a feasible next step. It may also be useful to analyze the dynamic aspects of the issues under consideration, something that may be possible if the ReLOC survey is repeated in the coming years.

# 6 German direct investments in the Czech Republic – Employment effects on German multinational enterprises

**Abstract**

Do investments in the Czech Republic lead to employment growth or employment losses in the German firms involved? To address this question, a unique database about German firms with foreign direct investments (FDI) in the Czech Republic and firms without FDI in any country has been established. By developing a new method for linking firm-level data with establishment-level data of the Institute for Employment Research (IAB), this database is now linked with the IAB employment data. As the exact dates of the investments in the Czech Republic are known, the employment development of firms with Czech affiliates and firms without FDI is compared for the same time periods. The analyses show that these groups actually develop differently. One year after the investment, the employment of multinational enterprises (MNEs) in the home country shrinks relative to the employment of the reference group. The negative trend continues for some years. However, not all types of jobs are affected negatively. The negative effects refer to medium and low-skilled workers only, whereby the demand for high-skilled workers even increases after the investment.

**JEL classification:** F15; F23; F66

**Keywords:** Economic integration, multinational firms, foreign direct investment, international trade, labor demand, skill groups, Germany, Czech Republic

## 6.1 Introduction

The fall of the Iron Curtain in 1989, the enlargement of the European Union (EU) in 2004 and the liberalization of trade and factor flows have offered new business opportunities for companies based in the EU. Since the 1990s, Central and Eastern European Countries (CEEC) were one of the favourite destinations for international investments. This is not surprising as these markets are attractive for both primary motives for investing abroad. On the one hand, cost savings drive investors to Eastern Europe, where wages are still considerably lower than in Western Europe, attracting multinational enterprises (MNE) to relocate activities to cheaper sites in the east of the continent. On the other hand, the rising purchasing power in the CEEC makes them an attractive candidate for the opening up of new markets. German firms have a particular advantage because they are located close to these regions. Despite the obvious importance of this development for European countries' economies and societies, little is known about its effects, particularly not on its impact on the old EU countries. Whether public fears concerning the relocation of jobs and the deterioration of the position in competition of manufacturing industries are really justified has so far not been fully assessed. Although previous studies usually find positive or no significant effects of foreign direct investments (FDI) on MNEs' domestic labor demand, even if they differentiate in terms of target regions such as the CEEC. However, they rely on selective FDI databases, which underrepresent small and medium-sized parent companies and/or affiliates (Pflüger et al. 2013).

The contribution of this paper is the utilization of a unique database on German FDI in the Czech Republic - the main target for German investors among the CEEC in recent decades - covering the total population of German affiliates and the corresponding German MNEs. It is based on the full Czech Commercial Register, including the dates of investment, and is therefore not subject to selectivity issues. Because it is linked to the employment data of the German Federal Employment Agency (BA), the merged database has a longitudinal dimension, which facilitates the identification of the effects on the German parent companies. Firms without FDI in any country linked to the BA establishment data in the same manner serve as reference. The effects of FDI will be investigated by comparing these two groups regarding their employment trends. Although the analysis is restricted to a two-country relationship, it is based on the first database for Germany that is not selective in terms of the size of the parent companies or affiliates. Therefore, it allows reliable conclusions on the impact of FDI, at least for the German-Czech case.

A descriptive representation of the development of firm employment, including a differentiation in skills is presented, along with equations for firms' dynamic conditional labor demand in the short run. The key finding is that German MNEs reduce their employment level after the investment. This leads to negative effects when they are compared to firms without FDI. These negative effects are driven by the decreasing demand for low and medium-skilled workers, and they are stronger for FDI in the Czech manufacturing industries. In contrast, MNEs' demand for highly skilled workers increases until shortly after the investment. The findings justify public concerns about offshoring and imply the risk of negative effects of investments to cheap labor countries on jobs for low-skilled and medium-skilled employees. However, it shows that a well-educated workforce can benefit from FDI even in case of great opportunities for cost-reduction investments.

The remainder of this article is structured as follows: Section 2 reviews the recent literature. Section 3 describes the data and shows descriptive statistics. Section 4 presents the econometric model, and Section 5 presents its application and the results.

## 6.2 Related literature

With the strong growth of FDI, a detailed investigation of its labor market effects is particularly important. Do foreign direct investments lead to job losses or to job growth on the domestic side? Which categories of jobs are affected? These are crucial questions for Germany and other advanced economies. By approaching this topic through theory, it is often distinguished between two types of FDI: horizontal and vertical FDI (see Chapter 2 for a more detailed discussion). Vertical FDI is often supposed to affect the domestic workforce negatively. However, reducing firm's production costs by exploiting comparative advantages and shifting part of its domestic jobs to a foreign affiliate can boost productivity and therefore increase demand for all tasks maintained in the home country (Grossman and Rossi-Hansberg 2008; Groizard et al. 2014). Similarly, there is no clear prediction in the case of horizontal FDI. In case of horizontal or market-motivated investments, the investing firm enlarges its market and thus needs more headquarters services, such as research and development, public relations, branding activities, the development of managerial activities or controlling (Markusen 2002). If at least a part of these headquarters services is conducted in the parent company, the demand of the investing company for employees that can conduct these tasks (which are more likely to be skill-intensive) increases. However, if the parent company is establishing manufacturing facilities in a foreign country to save transport costs and to serve the new market with an on-site plant, this market-motivated investment could also reduce the size of its domestic workforce when it replaces former exports in the foreign market (Barba Navaretti et al. 2010). Various activities within the company can thus be affected differently. Here, the division of tasks within the corporate group is crucial. When German parent companies relocate low-skilled, labor-intensive production, such as assembling, from the home base to a country with lower labor costs, workers having executed these jobs formerly become displaced. In contrast, jobs remaining in the home country can benefit from higher productivity and increasing worldwide sales. In this case, less skilled workers are more likely to be negatively affected than highly qualified employees, who in turn might benefit from rising sales.

Although underlying investment motives affect the type of impact on firms' domestic employment, even the classification into horizontal and vertical FDI provides no clear predictions about the employment effects. It is, therefore, particularly important to address this empirically. There are several empirical works based on firm-level, sectoral or regional data analyzing the effects of outward FDI on domestic employment. They find mostly a positive or at least no negative effect on total employment (see Crinò (2009) and Pflüger et al. (2013) for a comprehensive survey). Focusing on studies that compare MNEs with firms without FDI, there are also usually no negative effects, but rather positive effects of FDI on the employment at home: see Barba Navaretti et al. (2010) and Castellani et al. (2008) for Italian MNEs, Barba Navaretti et al. (2010) and Hijzen et al. (2011) for French MNEs, Hijzen et al. (2007) for the case of Japan, and Becker and Muendler (2008), Wagner (2011) and Kleinert and Toubal (2007) for Germany. It should be noted that most of this studies are restricted to MNEs that become multinational for the first time.[41] A study that reports negative effects on the domestic employment of MNEs is from Debaere et al. (2010). They find that Korean firms with their first investment in less advanced countries have smaller employment growth than domestic firms without FDI. For the three-year period following the investment, they estimate a 2% lower annual growth for Korean MNEs. In contrast, investments to more advanced countries do not lower the employment growth of Korean multinationals. Similar results are derived by Jäckle and Wamser (2010). In the three years after having invested abroad for the first time, German MNEs have a 4% lower annual employment growth than firms without FDI. As far as the skill composition is concerned, most studies provide evidence for skill-upgrading in the course of FDI: see for example Head and Ries (2002) for the case of Japan, Hansson (2005) for the case of Sweden, and Becker et al. (2013) and Wagner (2011) for the case of Germany. The study of Becker et al. (2013) includes also the task classification from Autor et al. (2003). They

[41] This applies to Barba Navaretti et al. (2010), Castellani et al. (2008), Hijzen et al. (2011), Kleinert and Toubal (2007), Hijzen et al. (2007), Jäckle and Wamser (2010) and Debaere et al. (2010).

find an educational upgrading as well as an increasing share of non-routine tasks of German multinational firms after expanding their workforce in affiliates abroad. In the case of Italian multinationals, Castellani et al. (2008) identify skill upgrading only when they invest in the CEEC. In this context, the work by Marin (2004, 2011) should be mentioned. She refers to a survey among 660 German and Austrian investors in Eastern Europe. In contrast to other studies, she argues that German and Austrian multinationals are shifting high-skilled jobs and not low-skilled jobs to Eastern Europe, as she detects a great difference between the share of high-skilled employment of the parent companies and their Eastern European affiliates. However, there are basic differences in the education systems between these countries that have to be considered. In particular, the dual education system, which is much less established in Eastern European countries lacking practical education within firms, might play a role here.

However, there is so far no study that uses a comprehensive and unbiased database, as small and medium-sized firms are always underrepresented. The same applies to studies on German FDI. A standard problem of all studies that use the MiDi database from the German Federal Bank is that they cover only investments in foreign affiliates with a balance sheet of more than €3 million and at least a ten percent ownership share of the German investor. In the past, the thresholds were even higher (Pflüger et al. 2013). The Bureau van Dijk databases, such as Amadeus, Markus, Orbis and Dafne, are also confined to rather large companies. Before launching the *Elektronische Bundesanzeiger* in 2007, commercial data providers always had much more information about larger firms because information about their investments is published in business reports more often than is that of medium-sized or small firms. To see the difference, in 2011, the databases of Bureau van Dijk as well as the MiDi database contained approximately 1,000 Czech companies with a German owner. In contrast, the ReLOC database contains approximately 3,900 Czech companies having a German owner and includes many more small and medium-sized firms. The reason for this is the direct utilization of administrative data sources such as the Czech commercial register (Hecht et al. 2013b).

Moreover, there are other sources for possible biases: in their studies, Becker and Muendler (2008) and Becker et al. (2013) identify only the headquarters of each company in the data of the BA. They do not solve the problem that the data from the BA is available at the establishment level and not at the firm level. They might miss establishments because especially bigger companies can consist of several or even many establishments. If the employment of headquarters and their further establishments develop differently, the results become biased. This is all the more relevant in case of large firms and therefore in the context of multinationals.

## 6.3 Data and descriptives

The database used for this analysis is a product of the IAB project ReLOC. It includes about 3,400 German companies with affiliates in the Czech Republic in 2010. To derive a large and comprehensive database on FDI, the Czech Commercial Register was accessed, and any actively operating firm with a German owner was identified. The owners' names and addresses were used for a record linkage procedure that is described in Chapter 3.3 in detail. It must be considered that the BA data includes no firm identifier. Therefore, it was necessary to apply a record linkage method that identifies any establishment belonging to one of the ReLOC firms. On the basis of preprocessed names and addresses of establishments and firms, the record linkage was implemented as follows: first, the names and addresses of the ReLOC companies and the BA establishments were used for the linkage. Second, only firm and establishment names were used to identify any establishment belonging to one of the ReLOC firms. This is possible, as the BA data includes for each establishment the associated firm name. The linkage with the establishment-level data of the BA resulted in 85% of the ReLOC companies in at least one assigned establishment. 30% of these firms consist of more than one establishment. Therefore, the share of multi-site establishments in this sample is relatively high. The same procedure was implemented for a reference group that consists of approximately 9,500 firms without FDI in any country. This database was provided by the survey institute TNS Infratest, which conducted the ReLOC survey (see Hecht et al. 2013b for further details). It is based on all firms listed in the German Commercial Register. The information whether a firm has a foreign affiliate refers to August 2010 and is retrieved from a commercial data provider using the same sources as Creditreform, Bureau van Dijke and Hoppenstedt, for example. It can be expected that for the vast majority the information about the non-existence of a foreign affiliate is valid also in the past. This is confirmed by the ReLOC survey, where 94% of the responding firms from the reference group indicated that they have never had a foreign affiliate (Hecht et al. 2013a). Of course, due to the lack of a comprehensive FDI database the existence of a foreign affiliate can not be ruled out completely. But in general, the share of multinationals in the total economy is still very small. According to the IAB Establishment Panel survey from 2010 (see variable r84a), only about 6% of German plants are involved in FDI.[42] In addition, when drawing the sample of reference firms, small firms were undersampled and medium-sized and large firms oversampled. We thus also benefit from the fact that commercial databases are reliable for large firms (Hecht et al. 2013b).

42 Note that the IAB Establishment Panel covers medium-sized and large plants (and thus also medium-sized and large firms) far above average (see Fischer et al. 2008, for example).

The data linkage results in 81,524 establishment ids – 51,539 assigned to ReLOC firms and 29,985 to the reference group, which are given since the start of the notification process (January 1, 1973). These establishments are merged with the Employment History (BeH) and the Establishment History Panel (BHP) from 1985 to 2010.[43] Both IAB databases are based on worker and plant characteristics that come from the notification process of the social security system. The BeH covers the total population of employees liable to social security contributions and since 1998, also employees in marginal part-time employment. The records include individual characteristics such as education and wages. The wage data are censored at the upper earnings limits of the compulsory social security system (e.g., 66,000 Euro in Western Germany, 2010). To address this, an imputation procedure suggested by Card et al. (2013) to correct the topcoded values is applied. Regarding the skill characteristics, which are sometimes reported mistaken or missing, the imputation algorithm suggested by Fitzenberger et al. (2006) is used (Imputation Procedure 3). Firm-level information on employment and wages is then derived by aggregating individual-level information. The BHP contributes further plant characteristics such as the main industry, the location and the date of foundation. It includes for each year any establishment with at least one employee liable for social security contributions, and since 1998, any establishment with at least one employee in marginal part-time employment as of June 30 (Gruhl et al. 2012). Recently, the BHP has been made available from 1975 until 2010. For firms with more than one establishment, a possible approach to derive company-level information is to choose the region and industry that covers the highest proportion of firm employment.

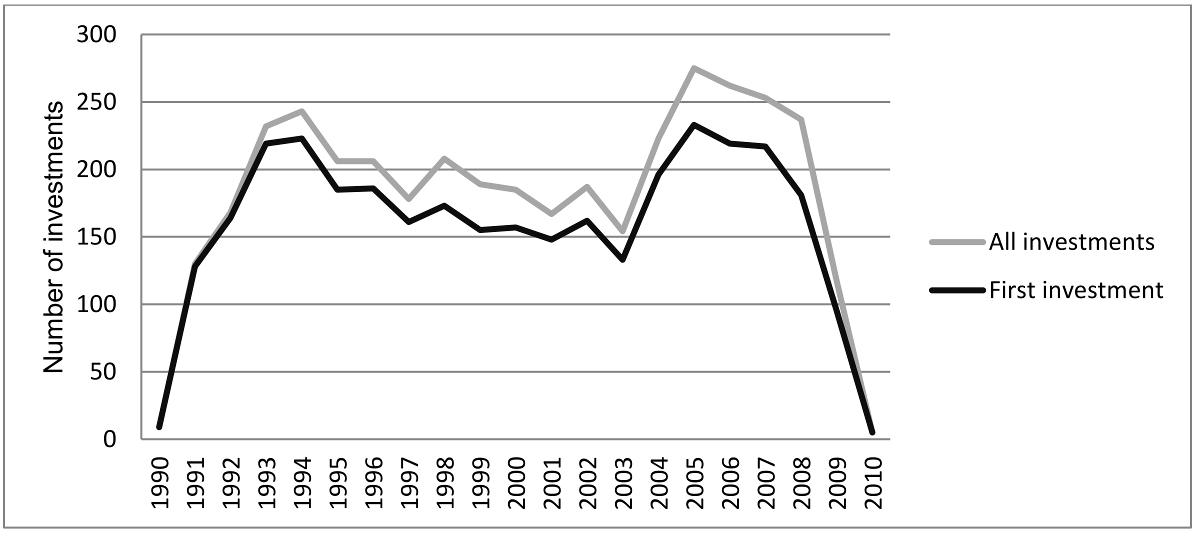
East German establishments are included in the IAB data since 1991. However, due to the time needed for the introduction of the employment notification procedure in eastern Germany, they can not be assumed to be recorded sufficiently complete before 1993 (Gruhl et al. 2012). Due the sell-off of East German firms through the Treuhand and various motives, which played a decisive role for investors particularly coming from West Germany, aggregating establishments across both former separated regions also includes employment shifts that are not driven by an increasing demand for labor but by an access to funds or low-priced real estates, for example. Therefore, for the following analysis, Eastern German plants are excluded as the analysis starts many years before the reliable coverage of East German establishments and due to the very specific circumstances of the former communist economy and its economic units. This means that for each firm only its locations in West Germany are taken into consideration, which affects mainly companies with their headquarters in East Germany, but also some multi-site companies from West Germany that set up East German

[43] The BeH was prepared by Linda Borrs, whom I would like to thank at this point.

locations. Moreover, for the latter, the foundation of East German plants could be even regarded as an investment similar to that in the Czech Republic. In general, the engagement of East German investors in the Czech Republic is very low and compared to West Germany far below average (see Chapter 4). Only about 10% of the German affiliates in the Czech Republic have an owner from East Germany.

In the final sample, with an observation period from 1985 until 2010, there are about 6,800 firms from the reference group and 2,500 MNEs that appear at least once. Figure 6-1 shows the investment dates of the German multinationals. For the black line, each MNE counts only once. For firms that own at least two affiliates, the earliest investment is selected. Regarding the gray line, all investments are counted. It reveals that there are two peaks that are close to important cornerstones in the history of the Czech Republic. In January 1993, Czechoslovakia was split up into the sovereign states the Czech Republic and Slovakia. In this initial period, yearly entrances of German MNEs were still increasing. Since 1995, German investments have been declining, but they rose again in the period of the accession to the European Union, which occurred in May 2004. After that, they again decreased, whereas the number of investments since 2009 is underestimated due to some time lag in reporting.

**Figure 6-1: Year of investment**




Source: ReLOC database; author's own calculations.

Table 6-1 reports summary statistics for the sample of firms with FDI in the Czech Republic and the reference group. For the MNE sample, the values are calculated for the first observation when they become multinational. For instance, when the date of investment is May 20, 2001, firm characteristics are based on June 30, 2001. Because the actual investment date is not recorded or not unambiguously identifiable in the Czech commercial register in some cases, the number of observations is below 2,500.[44] For firms from the reference group, any observation from 1990 to 2010 is included.

On average, firms without FDI are clearly smaller than firms from the MNE sample. Moreover, MNEs pay slightly higher wages and employ a higher share of employees with tertiary education and a lower share of medium-skilled and low-skilled workers. Low-skilled employees are those without vocational training or a high school degree. Medium-skilled employees have a vocational qualification or high school degree. Employees with a degree from a university or a technical college are classified as high-skilled. Regarding the industry affiliation, the groups do not differ remarkably.

**Table 6-1: Basic firm characteristics**

| | **Reference (n=6,800)** | | **MNE (n=2,145)** | |
|---|---|---|---|---|
| **Variable** | **Mean** | **Std. dev.** | **Mean** | **Std. dev.** |
| number of total employed | 186.616 | 417.471 | 672.356 | 5803.530 |
| number of full-time equivalents | 172.244 | 365.764 | 646.255 | 5592.920 |
| number of full-time employed | 156.320 | 317.669 | 613.021 | 5340.564 |
| average daily gross wage | 83.378 | 36.822 | 96.382 | 43.466 |
| average wage high-skilled | 149.768 | 71.540 | 160.452 | 63.744 |
| average wage medium-skilled | 81.840 | 29.834 | 91.270 | 36.013 |
| average wage low-skilled | 55.055 | 23.689 | 61.707 | 29.921 |
| share of high-skilled | 0.087 | 0.153 | 0.135 | 0.189 |
| share of medium-skilled | 0.758 | 0.199 | 0.727 | 0.207 |
| share of low-skilled | 0.141 | 0.160 | 0.124 | 0.148 |
| share of manufacturing firms | 0.430 | 0.495 | 0.459 | 0.498 |
| share of service firms | 0.459 | 0.498 | 0.434 | 0.496 |

Source: ReLOC database; author's own calculations. Note: Wages and skill-specific shares are calculated on the basis of full time employees.

Although the mean number of employees in MNEs is relatively high, compared to the MiDi database, it is small. To see the difference, for the sample of multinationals of Becker and Muendler (2008), average employment is approximately 2,600. As already mentioned, the MiDi database includes larger FDI projects only. This is of special relevance here because of being close, in distance, to the Czech Republic. For that reason, the transaction and information

44 There are some cases where the MNE doesn't occur in the IAB data before or in the year of the investment. The reason is that the ReLOC sample refers to investors in 2010 only. This gives rise to specific cases that can't be treated properly and, therefore, should be excluded: Before the firm in the MNE sample appeared as owner in the Czech Commercial register, another investor that is affiliated with the recent one was already registered in the Czech Commercial Register, whereas the recent owner didn't exist when the predeccessing investor conducted the investment. Especially in this case, the proper observation unit would be the whole corporate group, which is not available. Therefore, the MNE sample is restricted to those firms that had already occured in the IAB data before or in the year of the investment.

costs are lower, and thus smaller firms can also afford to set up foreign affiliates. This assessment is supported by Buch et al. (2005), who find that foreign affiliates of German companies are remarkably small in the CEEC. They interpret this finding as evidence that small and medium-sized German firms take particular advantage of these nearby investment locations.

The great difference in firm size is considerably smaller when firms with more than 1,701 full-time employees -the 99% percentile of the reference group - are dropped (see Table 6-2). This is because of the exclusion of some exceedingly large multinationals. Other firm characteristics barely change. The fact that there is not too much difference left comes also from a previous sample adjustment of the reference group. To ensure that there are enough firms that are basically comparable to MNEs, small firms were undersampled and medium-sized and large firms oversampled (Hecht et al. 2013b).[45]

**Table 6-2: Basic firm characteristics without exceedingly large firms**

| | Reference (n=6,732) | | MNE (n=2,035) | |
|---|---|---|---|---|
| **Variable** | **Mean** | **Std.** | **Mean** | **Std.** |
| number of total employed | 162.467 | 231.717 | 176.652 | 287.790 |
| number of full-time equivalents | 149.890 | 202.784 | 169.247 | 271.488 |
| number of full-time employed | 136.259 | 184.744 | 160.596 | 258.945 |
| average daily gross wage | 83.110 | 36.635 | 95.435 | 43.757 |
| average wage high-skilled | 149.160 | 71.438 | 157.981 | 63.806 |
| average wage medium-skilled | 81.647 | 29.750 | 90.553 | 36.500 |
| average wage low-skilled | 54.818 | 23.565 | 60.793 | 30.547 |
| share of high-skilled | 0.087 | 0.154 | 0.135 | 0.192 |
| share of medium-skilled | 0.759 | 0.200 | 0.728 | 0.210 |
| share of low-skilled | 0.141 | 0.160 | 0.122 | 0.150 |
| share of manufacturing firms | 0.429 | 0.495 | 0.445 | 0.497 |
| share of service firms | 0.460 | 0.498 | 0.447 | 0.497 |

Source: ReLOC database; author's own calculations. Note: Wages and skill-specific shares are calculated on the basis of full time employees.

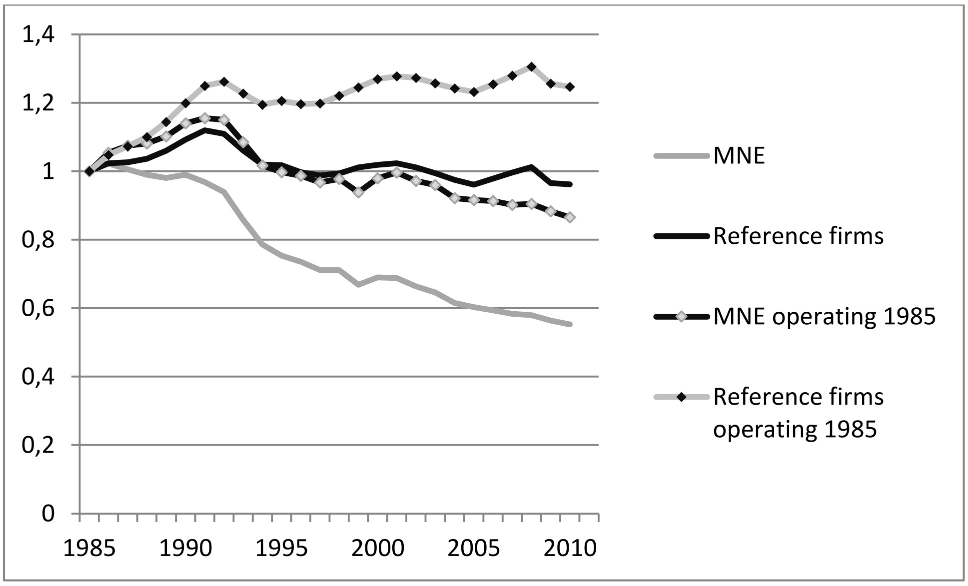
Figure 6-2 displays the development of average firm size since 1985 for both groups. Until the early 1990s, multinational firms' employment remained quite stable, but subsequently, it fell. Regarding the reference group, firm employment grew until the peak of the economic boom in 1992. After that, it decreased slightly, reaching again its initial level of 1985. However, these numbers must be interpreted carefully, as not all firms already operated in 1985 and new

45 To be certain that this did not induce a selection bias, in a robustness check, all firms that belong to the class that was oversampled (>199 employees in 2010), in particular, were excluded from the empirical analysis. The results presented later change only slightly.

established firms lower the average firm size. It can also be supposed that in the first few years after the fall of the Iron Curtain, particularly productive firms invested in the states of the former Eastern Bloc area. Afterwards, due to decreasing information costs and continuously improving investment conditions, less productive firms could also take the plunge into these emerging markets. This finds support in the ReLOC data, where firm size at the date of investment is larger as the investment is dated back longer. Another explanation for this initial difference might be a positive selection bias. The ReLOC database includes only German firms that were operating in 2010 in the Czech Republic. The longer the investment period, the stronger the selection bias and therefore the initial size of those firms that still maintain their foreign direct investment.

When including only firms that already operated in 1985, the conclusions are basically the same. After the employment followed a similar development for some years, that of the reference group increased slightly, reaching in 2010 its level of 1991, while that of the MNE group declined. Accordingly, since the 1990s, there appears a clear difference in the employment trend of firms with investments in the Czech Republic and firms without FDI.

**Figure 6-2: Average firm size of MNEs and non-MNEs**

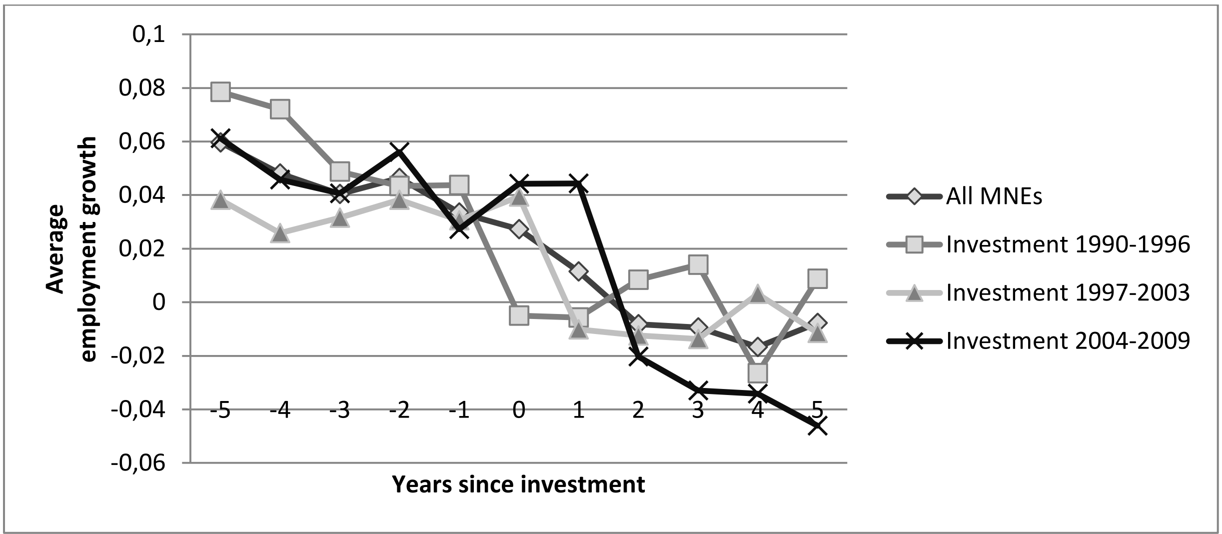



Source: ReLOC database; author's own calculations.

The employment trend of German firms without FDI reflects the general business cycle with minor differences, as labor demand responds with some time lag to GDP. It illustrates the boom in the early 1990s, the recession in 1993, and the subsequent period with a relatively stable growth ending in a peak in 2000. The next cycle had his climax shortly before the current economic crises, which started in 2008.

Turning toward the MNEs and their evolution close to the investment, we can state that they increased their employment prior to the investment (see Figure 6-3).[46]

**Figure 6-3: Employment growth of MNEs**



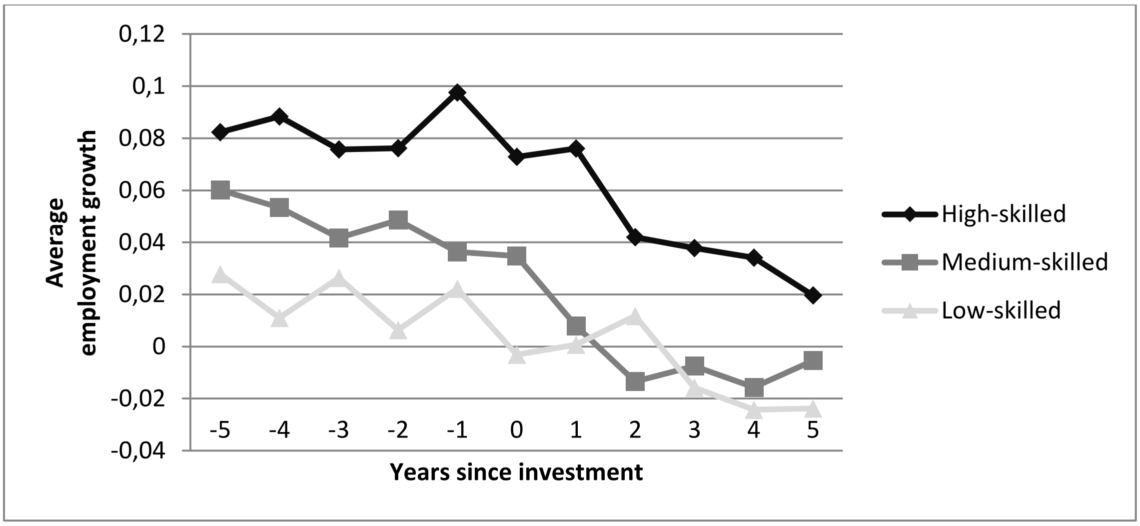

Source: ReLOC database; author's own calculations.

It is striking that the employment growth changes fundamentally shortly after the investment. On average (each firm gets the same weight whether large or small), it even becomes negative two years after the investment. This pattern holds for any cohort with minor differences. For example, firms that invested between 1990 and 1996 experience this slump in the year of investment and thus one year earlier than the subsequent cohort and two years earlier than the latest cohort. Differences regarding the magnitude of growth rates might be explained by business cycles. The German economy grew relatively strongly in the late 1980s and in the early 1990s, while later on, until 2003, growth rates were modest by contrast. Part of the employment losses of the last cohort are caused by the economic crisis. The average growth rate for all observations since the investment – this includes also the one from the year of investment - is nearly zero (0.06%). Starting one year after the investment yields mean growth below zero (-0.5%). However, this pattern does not apply for each skill group in the same manner (see Figure 6-4). There are remarkable differences in the employment trends. For all skill groups, the number of employees increased before the investment. However, afterwards, jobs for medium-skilled and low-skilled workers decreased, while the growth rate for high-skilled employment remained clearly positive. The average over all observations since the

46 The growth rates are calculated on the basis of full-time employees, but there are no notable differences when part-time and minor employment is considered. To ease the interpretation by constructing positive and negative growth equally, the average of the values in t and t-1 are in the denominator. The range of values lies between -2 and 2, instead of -1 and +∞, and creates symmetry around zero (Davis et al. 1996: 190).

investment reveals employment losses for low-skilled workers (-0.8%), but not for medium-skilled workers (0.1%) as their stock still increased in the year of investment. By starting one year after the investment, mean growth of medium-skilled employment was also negative (-0.6%).

**Figure 6-4: Employment growth of MNEs - Skills**




Source: ReLOC database; author's own calculations.

To summarize, with the beginning of German-Czech investment relations, those firms being involved exhibited a worse employment development compared to a group of firms without FDI. The reduction after the investment occurred for low-skilled and medium-skilled employment. At this point it should be noted again that the ReLOC sample represents a positive selection of German firms with investments in the Czech Republic because it is based on investors that had an affiliate in 2010. MNEs that had invested in the past but had been liquidated or closed down their Czech affiliate in the meanwhile are not part of this sample. Therefore, it is necessary to use a comparison group consisting of firms operating in 2010 as well. Whether the conclusions also apply in a multivariate setting that allows one to control for other firm characteristics will be the subject of the next chapter.

# 6.4 Econometric analysis

To compare the labor demand of MNEs with that of firms without FDI firm's dynamic conditional labor demand is estimated. The labor demand is derived from the decision-making process of a firm, which depends on firm's expectations. The dynamic model follows Kölling (1998) whose presentation is based on that of Sargent (1978) and Nickell (1986). Starting with the production function of a firm,

$$F(N_t) = a_1 N_t - 0.5 a_2 N_t^2 \tag{1}$$

with $N_t$ as firm employment. $a_1$ and $a_2$ are constant and positive parameters. $N_t$ is the only factor of production which can be changed. Other factors, such as the capital stock, are assumed to be quasi-fixed. If a firm is in a situation where the employment input deviates from the optimal level, due to production or wage shocks, for example, it needs time and material expenses to approach in the long-run the profit-maximizing level. Firm's costs of adjustment are described by the convex function (Sargent 1978):

$$C_t = \frac{c}{2}(N_t - N_{t-1})^2 \tag{2}$$

The parameter c is constant. The adjustment costs increase more than proportionally with the difference between $N_t$ and $N_{t-1}$. Under these assumptions firms maximize the following profit (Nickel 1986; Sargent 1978):

$$\Pi = \sum_{t=0}^{\infty} b^t \left\{ a_1 N_t - 0.5 a_2 N_t^2 - w_t N_t - \frac{c}{2}(N_t - N_{t-1})^2 \right\}, \tag{3}$$
$$0<b<1.$$

$\Pi$ represents the profit of a firm with $b$ as the discount factor for future values and $w_t N_t$ as the total costs of labor. Following the standard model with rational expectations (Sargent 1978), the equation to be estimated is

$$N_t = \mu_1 N_{t-1} + (1-\mu_1)\frac{(1-b\mu_1)}{(1-\rho_w b\mu_1)} N_t^* + (1-b\mu_1)\theta_t \tag{4}$$

with $\theta_t$ as error from the expectation formation, $\mu_1$ as solution of the characteristic polynomial of the Euler equation, $\rho_w$ as parameter of the autoregressive process of the expectation formation ($0< \mu_1<1, 0<\rho_w <1$) and $N_t^*$ as the optimal level of employment. This results in the equation

$$N_t = \alpha_1 N_{t-1} + \alpha_2 N_t^* + v_t, \tag{5}$$
$$0 < \alpha_1 < 1, 0 < \alpha_2 < 1 \text{ und } \alpha_1 + \alpha_2 < 1.$$

To bring the equation into a form that can be estimated, assumptions on the long-run (optimal) level of employment $N^*$ are required. Assuming a Cobb-Douglas production function in the long-run:

$$\frac{\partial F(N,K)}{\partial N} = \alpha \frac{F}{N} \tag{6}$$

$$\Rightarrow \; N^* = \alpha \frac{pF}{w}$$

with $F(.)$ as production function, $K$ as capital stock, $w$ as nominal wage, $p$ as the price level and $\alpha$ as partial elasticity of production.

Formulating (5) in logarithm and replacing $N^*$ results in:

$$\ln(N_t) = \alpha_1 \ln(N_{t-1}) + \beta_0 + \beta_1 \ln(sales_t) + \beta_2 \ln(w_t) + v_t, \tag{7}$$

which is the basis for subsequent regressions with the restriction that the ReLOC data does not provide information on firm sales. Accordingly, the employment of firm i in year t is regressed on its lagged value (t-1) and the average wage (in t and t-1), both transformed in natural logs.

$$\ln(N_{it}) = \beta_0 + \beta_1 * \ln(N_{it-1}) + \beta_2 * \ln(w_{it}) + \beta_3 \ln(w_{it-1}) + \sum_{j=0}^{n} \eta_j * X_{it-j} + \sum_{j=1}^{11} \gamma_j * inv\_j + v_{it} \tag{8}$$

X represents further firm controls. For a better comparability of firms, the share of high-skilled employees and routine intensive occupations in t-1 and firm age is included. Likewise in Dauth et al. (2014), routine intensive occupations are represented by basic activities in the taxonomy of Blossfeld (1987). This includes unskilled manual occupations, unskilled services and unskilled commercial and administrative occupations. Firm age is calculated as number of days since first occurrence in the BHP. This characteristic is left-censored as the BHP starts on June 30, 1975. For firms with at least one establishment that has existed since the beginning, a dummy named *BHP_1975* obtains the value 1, while the age variable is set to zero. Furthermore, dummies for year, region, industry and legal form are incorporated. The regional dummies refer on spatial planning regions, a functional aggregation of districts to 96 regions based on commuting linkages. On the basis of the company names, six dummies are created that control for the legal form. They correspond to the classification that is used for the IAB Establishment Panel (Städele and Müller 2006). The six categories are: 1. sole proprietorship; 2. partnership (*KG, OHG, GbR*); 3. private limited liability company (*GmbH*) or private limited liability company & Co. limited partnership (*GmbH & Co. KG*); 4. stock corporation (*AG, KGaA*); 5. statutory corporation, foundation; 6. others, such as incorporated cooperative (*eG*) and registered association (*e.V.*). Statutory corporations and foundations are not represented in the ReLOC data, so that four dummies are required. Industry dummies are based on the 31 subsections of the WZ 93 classification (see Statistisches Bundesamt 2002). To derive a uniform industry classification during the observation period, the extrapolation of industry codes provided by Eberle et al. (2011) is used.

Each variable is calculated at the firm level. In case of two or more establishments per firm, the number of employees is totaled. For firm wage, averages are calculated. For firms with more than one establishment, the region and industry that covers the highest proportion of firm employment is chosen.

The main interest is on dummies indicating the years since or until the investment (*inv_j*). These investment dummies are designed to cover an observation period of eleven years, starting five years before and ending five years after the investment. In case of investors with more than one Czech affiliate and different investment dates, this refers to the first investment, which applies to 235 cases. The observation period is chosen in this way because part of the effects might not arise directly after the investment, but some years later. Of course, there might always be an incentive to relocate jobs, even when the investment occurred a long time ago. However, the longer the observation period after the investment, the stronger the representation of firms that have invested in the early transition years. For example, a dummy indicating that a firm had invested ten years ago starts up only for firms with investments before 2001. Furthermore, the initial effect of the investment vanishes over time, while the risk for picking up developments that are not influenced by the investment itself increases. Therefore, the length of the observation period is restricted. This applies to the period before the investment too. Mapping the preceding trend is useful for understanding that afterwards and for obtaining a complete picture. Planning to invest abroad could induce adjustments in advance. In addition to this period of eleven years, no observation of the MNE group is considered in the following estimations. Consequently, for observations of the MNE group, there is always one investment dummy that obtains the value 1. In contrast, only firms without any kind of FDI (in 2010) serve as reference. For them, the investment dummies are always set to zero. Thus, the coefficient of each investment dummy indicates c. p. the percentage difference regarding the employment level between the MNE and the reference group in the respective period.

Information about capital stock or firm output is not available. Both characteristics are part of firms' labor demand, but in the short run, they can be assumed constant. If there is further unobservable firm heterogeneity that influences the employment level in t, at least part of it will be caught by its lagged value. In addition, due to the approach of comparing MNEs with firms from a suitable reference group, the results are only biased when unobserved determinants of firm-specific labor demand, such as capital or total factor productivity, change diversely across both groups within one year given the other control variates. To utilize the unique database and to evaluate the effects of the investment based on the total population of German affiliates as clear as possible, different estimation methods are applied: pooled OLS, fixed effects with and without lagged dependent variable and the system GMM estimator (see Blundell and Bond 1998). Some comparable studies use propensity score matching or combine propensity score matching with diff-in-diff estimations (see Barba Navaretti et al. 2010 and Debaere et al. 2010). According to Angrist and Pischke (2009), the differences between matching and regression are unlikely to be of major empirical relevance when the treatment is binary. Regression can be seen as a type of propensity-score weighting, so the difference is mostly in the implementation. Both methods are control strategies where the conditions for causality are based on the same assumptions. What distinguishes this approach is confounding on the pre-year characteristics. In the case of matching and diff-in-diff regressions, the construction of the control group is based on pre-treatment characteristics. Therefore, it must be assumed that unobservable characteristics are time constant for the respective estimation period. The ReLOC database, however, does not include firms' capital stock, for example, which is an important explanatory variable. Assuming it to be constant for many years might be too strong. Moreover, firms need to respond at any time on changing conditions. Therefore, it seems to be most appropriate to build estimations on changes from one year to another. To assure that there is no problem with the common support assumption, in robustness checks, exceedingly large firms are dropped.

Table 6-3 reports the estimation results of pooled OLS. Apart from the investment dummies, all explanatory variables have the expected signs and are in the expected range. The coefficient of lagged employment is close to 1, indicating a highly persistent employment level of German firms. Therefore, moving the lagged dependent variable to the left side of the equation would yield almost identical results for all other explanatory variables. As a consequence, the coefficients of the investment dummies can be also interpreted as differences in employment growth. The wage in t representing the costs of employment affects firms' labor demand negatively. By including recent employment costs, the wage in t-1 becomes a measure for productivity and impacts future labor demand positively. Turning toward the eleven investment dummies (see column 2), in comparison to the reference group, MNEs' employment rises before the investment, but falls afterwards.[47] The positive development prior to the investment points to self-selection of the most productive firms into investment. This is in line with theoretical considerations by Helpman et al. (2004), who show that only the most productive firms conduct FDI. Assuming a monotonic relationship between productivity and firm size (as, for example, conducted by Antràs and Helpman 2004), there is a positive correlation between firm size and the decision to invest abroad. Hence, MNEs are not only basically larger at the date of investment but still increase their employment five years before their foreign engagement. Despite these plausible arguments for a selection effect, there is also an alternative explanation. Maybe multinational firms back up their domestic workforce because they need more headquarters services already in advance for planning and building up their foreign subsidiary. The further rise two years before the investment might indicate that, however, it is rather small and the coefficients are not significant. In this case of German FDI, the preceding growth is not lasting. Instead, the investment marks a turning point. One year after the investment, the labor demand of German multinationals is below that of the reference group. During the five years after the investment, the estimated differences between MNEs and non-MNEs range from -1.5% to -3.1%. In an alternative specification, the dummies indicating the period before the investment and those indicating the period after are replaced by one dummy to calculate the average difference (Table 6-3, column 1). A difference of 2.3% per year indicates a total loss of 11.5%. Accordingly, there is clear evidence for a negative trend after the investment. What is striking is the similarity with the results in the study from Debaere et al. (2010) about Korean MNEs. They find, for a period of three years since the investment, a 2% lower annual growth for multinationals compared to firms without FDI, when they set up affiliates in less developed countries, which is a similar situation like in the case of German investments in the Czech Republic.

When adding investment dummies for further years, such as *inv_since_6* and *inv_since_7*, the coefficients' signs are still negative, but they are not significant. Being aware that the ReLOC database includes no information about investments in other countries, we can at least suppose that negative effects occur up to five years after the investment. After that, there are no further job losses. It is often argued that efficiency-seeking investments might lead to positive effects in the long run, as it takes some time until gains in efficiency and competiveness are realized (Barba Navaretti et al. 2010). In line with this, some studies find evidence for a positive impact in case of FDI in low-income countries that arises after some time lag (Barba Navaretti et al. 2010; Hijzen et al. 2011). In this case of German direct

[47] The dummy *investment in this year* takes on the value 1, if the investment is less than one year ago. For instance, when the date of investment is March 1, 2001, firm characteristics are based on June 30, 2001. In the subsequent year (June 30, 2002), the dummy *investment 1 year ago* takes on the value 1, and so on.

investments in the Czech Republic, there is no evidence for a positive impact on total firm employment in the long run. Even the extension of the observation period until ten years reveals no positive significant coefficient of the investment dummies.

So far, the estimation method is pooled OLS with lagged dependent variable. In the following, fixed effects estimations are applied. When the lagged dependent variable is excluded from the fixed effects estimations, both models are not nested and they use alternative identifying assumptions (Angrist and Pischke 2009). In the case of the lagged dependent variable model, one assumes that an omitted variable bias does not come from a time-invariant unit-level factor, but from time-varying pre-treatment trends. On the other hand, conditioning on fixed effects controls for all unit-specific factors that are constant over time, whether observable or unobservable. In subsequent fixed-effect estimations without a lagged dependent variable, the last observation before the investment will serve as reference to estimate the differences in changes over time across both groups. For this purpose, the observation period for MNEs is now restricted to six years and only those MNEs are included that occur already one year before the investment in the IAB data with at least one full-time employee. Consequently, the reference firms are included from 1989 to 2010 because the first investment occurred in 1990. The coefficients of the investment dummies are different from those in Table 6-3. In specifications without the lagged dependent variable, they picture the deviation from the last observation before the investment relative to the reference group. The estimations indicate a relative loss of 5.2% five years after the investment (in case the MNE still has at least one full-time employee) (see Table 6-4, column 1). However, as the previous analysis revealed the turning into a negative trend indicating a substantial change in firm behavior one year after the investment, it could be argued that MNEs react with some time lag. In this case, the samples need to be adjusted accordingly. For MNEs, the within estimations starts with the investment year as reference, while the reference sample starts 1990. As expected, the coefficients of the investment dummies become larger in absolute terms, indicating a loss of 6.4% after five years (see Table 6-5, column 1).

However, past values of firm employment determine its recent level and are time-varying confounders that cannot be subsumed in a time-constant fixed effect. Hence, the estimation is conducted combining fixed effects and the lagged dependent variable model. Again, the results are similar to those in Table 6-3, whereas the negative coefficients of the investment dummies tend to be larger in magnitude (see Table 6-4, column 2, Table 6-5, column 2 and Table 6-6)[48].

[48] As fixed effects are calculated on the basis of the observations included in the estimations, they vary according to the chosen observation period, which also affects the estimated coefficients of the covariates. Therefore, results for different observation periods are shown.

At the same time, the positive coefficients of the investment dummies are smaller. Accordingly, the estimations in Table 6-6 that also take into account the period before the investment do not support the former findings of an overall positive trend before the investment.[49] Asymptotically, in the case of pooled OLS, the coefficient of the lagged dependent variable is biased upwards, and in the case of fixed effects estimation, it is biased downwards (Nickell 1981). The same applies to the investment dummies when their coefficient is below zero. When the coefficient is above zero, this ranking is inverted (Harris et al. 2008). This means that the coefficients of the investment dummies from pooled OLS and fixed effects estimations (with a lagged dependent variable) indicate an upper and lower bound for reliable results. Another estimation method for dynamic equations, such as for labor demand, is the Generalized Method of Moments (GMM). It adresses the problem that explanatory variables, such as the lagged dependent variable, are correlated with the error term, if there is a fixed effect. The basic idea is to instrument them with some of their earlier lags (t-2 or deeper). In case the dependent variable is close to a random walk, the application of the system GMM estimator (Blundell and Bond 1998) is suggested. It combines moment conditions for the model in first differences with moment conditions for the model in levels. In the first specification (see Table 6-7, column 1), the coefficient of the lagged employment is within the range of OLS and the within estimator. The same applies to the coefficients of the investment dummies. The slightly positive trend for multinationals prior to the investment disappears. To address the rejection of the null hypothesis of second order correlation of the errors at the 5% significance level (p-value: 0.015), another specification is estimated including also the second lag of firm employment as explanatory variable (see Table 6-7, column 2). Here, the null hypothesis is not rejected (p-value: 0.219), but the coefficients of the investment dummies and lagged employment are now outside the expected range. The result of the Hansen test points to a reasonable explanation, as it indicates that the instruments, as a group, don't appear exogenous (p-value: 0.001). If there is a firm-specific fixed effect, such as managerial skills or the level of innovation, it is likely to be correlated with the decision to invest, and, as a consequence, with the investment dummies.

Therefore, in the following, the basic estimation method is pooled OLS. Unlike the within estimator without a lagged dependent variable, OLS reveals short-term dynamics and, compared to within estimations with lagged dependent variable, tends to indicate a lower bound for negative effects. Instrumental variable estimation methods such as the dynamic system GMM estimator require exogeneous instruments. As we have seen, in this case, this

[49] Compared to the pooled OLS regressions that do not calculate fixed effects, the observation period starts one year earlier to identify the coefficients for each of the eleven investment dummies.

is a strong assumption which is violated when the decision to invest is endogenous. Yet, each estimation method leads to the same conclusions, as there is always a clear negative trend after the investment.

**Robustness checks**

Continuing with robustness checks regarding the specification of the sample and the dependent variable, first, firm variables are calculated on the basis of all establishments, whether from East Germany or West Germany (see Table 6-8).

Second, instead of full-time employment, the number of full-time equivalents is used as dependent variable (see Table 6-9). The IAB data includes information on individual working time status, but not on the number of working hours. The different options are full-time, minor part-time (less than 18 hours) and major part-time (between 18 and 39 hours). Following Dauth (2014), full-time equivalents are calculated by weighting minor part-time with 16/39 and major part-time with 24/39.

Third, exceedingly large firms are dropped (see Table 6-10). In doing so, the 99% percentile of the maximum size of the reference firms during the observation period, which is 1,701 full-time employees, is the threshold. Each firm from the reference and MNE group exceeding this value at least once during the observation period is excluded. This applies to 110 MNEs and 68 reference firms. The great difference in firm size becomes considerably smaller (see Table 6-2).

Fourth, in addition to exceedingly large firms also small firms are removed from the samples (see Table 6-11). For the MNE group, each firm with less than 50 full-time employees with regard to the year before the investment is dropped. Correspondingly, for the reference group, each firm whose number of employees falls below 50 at least once between 1989 and 2010 is excluded. The MNE samples are reduced by 1,002, the reference group by 2,216 firms. On the one hand, firm growth is likely to vary with firm size. For small companies, little absolute changes of firm size can yield high amplitudes of firm growth. On the other hand, a few related studies are lacking parent companies with less than 20 employees (Castellani et al. 2008) or 50 employees (Hijzen et al. 2007), for example. Therefore, an exclusion of small firms allows to evaluate whether differences to these studies with regard to the results are caused by such sample restrictions. Unfortunately, it is not possible to restrict the MNE sample with regard to the size of the affiliate to make it comparable to studies which have to deal with that, such as from Becker and Muendler (2008) and Barba Navaretti et al. (2010). To address this, the entire histories of the size of the Czech affiliates are needed.

Fifth, the MNE sample is split into three cohorts of equal length and with a similar number of MNEs: investments between 1990 and 1996 (641 MNEs), investments between 1997 and 2003 (657 MNEs) and finally, investments since 2004 (803 MNEs) (see Table 6-12 to 6-14). It could be supposed that first movers and latecomers had been affected differently because they faced other challenges when they established their affiliates in the Czech Republic. In addition, an over time shrinking wage and purchasing power gap is likely to come along with a higher importance of market-seeking and a lower importance of efficiency-seeking motives. The fragmentation into different cohorts considers also the specific development during the financial crisis, in which the number of those employed in Germany declined after 2008. Estimations for the first two cohorts are not affected by this shock because their observation periods end between June 30, 2001 and June 30, 2008.

For each specification, the results for the coefficients of the investment dummies are very similar to those of the baseline model. Concerning the estimations for different cohorts, the significances are generally lower, yet this can be explained by less observations and therefore less statistical power. For the last cohort, for instance, dummies indicating the investment five or four years ago cover only MNEs with investments in 2004 or 2005. However, for each sample, there is at least one coefficient for the period after the investment that is significantly negative. Likewise in the descriptives (see Figure 6-3), for the first cohort, the negative development started earlier as the coefficient for the investment year is significantly negative. For the second cohort, this trend starts one year later, and it starts two years later for the most recent investors. This might reflect higher risks for frontrunners that entered the Czech Republic in the early stage of the economic transformation, some of them even before the dissolution of the former Czechoslovakia in 1993, when uncertainty was particularly high. Investment risks diminished substantially during the second subperiod, which is also reflected by a remarkably improving rating by the International Country Risk Guide. Since the accession to the European Union in 2004, investment conditions have improved further (Mühlen and Nunnenkamp 2011). The exclusion of small firms (see Table 6-11) induces a positive selection bias that affects the observations before the investment as the exclusion of MNEs is based on the last observation before the investment. In contrast, the negative trend after the investment remains and is quite similar to the results for the full sample. Accordingly, the employment reduction in the multinational firms is not restricted to small firms.

**Skill levels**

According to theory and empirical evidence, not any type of job might be affected in the same manner. On the one hand, it is easier to offshore routine tasks and therefore more medium-skilled and low-skilled jobs. On the other hand, particularly in the early years of the transformation, the technological and educational level lagged behind that of Western economies. Therefore, it is unlikely that German firms preferred to relocate working steps that require many highly skilled workers. Moreover, firms that realize efficiency gains by reducing costs of production are able to cut prices, which increases their sales (in case all other determinants remain constant). Due to the expansion, they need more crucial services, such as management, marketing, and R&D services. If at least part of these headquarters services are conducted in the parent company, the demand of the investing company for employees that can conduct these tasks, which are more likely to be skill-intensive, increases. In this case, multinational enterprises are exporters of knowledge-based services (Markusen 2002). If it is planned that the affiliate obtains other inputs and complementary products from the parent company for its production, the demand for the respective workers at home increases further (Barba Navaretti et al. 2010). In this German-Czech case, German inputs are supposed to be more high-skilled intensive.

Following the basic model, there are several options to identify skill-specific effects. One is to focus on relative measures, such as the share of wage costs of the respective skill group in the total wage bill (e.g., Head and Ries 2002, Hansson 2005) or the share of workers related to a skill group in total employment (Hijzen et al. 2005; Ekholm and Hakkala 2006). Another opportunity is to estimate the labor demand for different skill levels separately (e.g., Elia et al. 2009, Driffield et al. 2009, Bajo-Rubio and Diaz-Mora 2015).[50] The advantage of the latter is that it allows to identify the impact on skill-specific labor demand in absolute terms and not only in relation to other skill groups. Moreover, it is more comparable to the estimations for total employment, so we can draw conclusions on what drives the results for total employment. Thus, the number of employees for each skill group serves as dependent variable, setting up on the estimation equation for total employment. As firms' labor demand for a factor of production is affected by the costs of each input, wages for other skill groups are included as explanatory variables too. To consider that some firms do not employ workers of all skill types, dummies are created taking the value 1 when there is no employee in the respective skill

50 What affects any types of measures is that SUR regressions are not practical because many (44% and 37%, for MNEs and non-MNEs, respectively) observations are lost unless the skill-specific wage is not excluded from the regressions. That is because each observation where a firm does not have for any skill group at least one full-time employee is dropped, as skill-specific wages are not fully defined in a proper way. This always applies to the wages of the skill that is represented by the dependent variable in the respective equation. In contrast, wages of other skill groups can be treated like censored predictor variables.

group. The natural log of the skill-specific wage is then set to 0. Interactions between these dummies proved to be insignificant for the results and are therefore not included.

Tables 6-15 to 6-17 present the results. The skill-specific trends are clearly different. In comparison to the reference group, the demand for low-skilled and high-skilled employment increases some years before the investment, whereas this applies to high-skilled employment in particular.[51] The negative trend after the investment appears for low-skilled and medium-skilled employment only, whereas it seems to be more significant for the latter. The demand for highly skilled labor still increases in the year of the investment as well as one year after. This shows a skill-upgrading process before and, in particular, after the investment. This is supported by regressions with the share of high-skilled labor as dependent variable (Table 6-18). Prior to the investment, in the multinationals, high-skilled employment is the factor that increases the most and therefore in relative terms. Afterwards, the number of highly skilled workers still increases or remains constant while low and medium-skilled employment decreases in absolut terms.

The results do not support the findings from Marin (2004, 2011), who argues that German firms are relocating high-skilled jobs to the CEEC, but are in line with most other studies that find evidence for skill upgrading, particularly in the case of investments in low-income countries. The fact that medium-skilled employment seems to be most affected by the negative trend suggests additional explanatory power by the task-based approach, which was initially used to explain the polarization in the US and UK labor markets, where high-income and low-income jobs had higher growth rates than those in the middle of the income distribution (Acemoglu and Autor 2011; Autor et al. 2006; Goos and Manning 2007). Whether jobs can be performed by computers or can be relocated to foreign locations depends on their routine content. The basic idea is that there is no perfect correlation between job substitutability and skills. There are low-skilled jobs that cannot be replaced because they include personal interactions and physical presence, for example. Therefore, there are many jobs in the low-income segment of the labor market that are not at risk of being relocated to foreign countries, such as cleaning, catering, hairdressing and security services. Instead, many jobs for medium-skilled workers, such as administrative clerks or even highly trained specialists are easily offshorable (Blinder 2009). The proportion of computer users is particularly high among those with secondary education (see Spitz-Oener 2008), which makes their jobs attractive for being relocated abroad if no physical presence is needed.

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51 In fixed effects estimations such as those in Table 6-6, for low-skilled employment, the positive significant coefficient prior to the investment becomes insignificant. The positive trend for high-skilled employment remains significant, albeit to a lesser extent.

To check the results for robustness, seemingly unrelated regressions (SUR) that refer to the entire sample are applied. Therefore, wages are excluded, and the dependent variable is now the natural log of the number of employees in the respective skill group plus one. The results are presented in Tables 6-19, 6-20 and 6-21. They are very similar to the former ones. The only difference is that the coefficients of the investment dummies are in some cases more significant. This applies to low-skilled and high-skilled employment in particular. The reason is that also those observations where a firm has no employee in the respective skill group in t or t-1 are considered. Moreover, by assessing the entire sample, statistical power increases. This least affects estimations for medium-skilled, because most firms (99%) employ at least one medium-skilled worker during the observation period, while 14% exhibit no low-skilled and 19% no high-skilled employee. Accordingly, in contrast to the previous estimations (Tables 6-15 to 6-17), a stronger affection of medium-skilled employment by the negative trend after the investment is not found here.

**Manufacturing and service FDI**

Based on the ReLOC survey, the results in Chapter 5 indicate that in the manufacturing sector, technologically advanced activities remain concentrated at the German MNEs. Instead, the German affiliates provide – even in comparison to domestic Czech firms – many manual routine jobs. In the case of investments in the Czech service sector, German affiliates and parent companies are not different regarding their factor requirements. Thus, we conclude that for service FDI, the horizontal model dominates, while for the manufacturing sector, it is clearly the vertical model. Therefore, the question arises, whether the sectoral affiliation leads to different effects on the domestic workforce. In the case of parent companies from advanced countries, vertical FDI is expected to cause a relocation of low-skilled, labor-intensive production to foreign locations with lower costs of labor. In contrast, horizontal FDI is conducted to serve a foreign market on site where MNEs engage in the same activities in different locations, creating the same type of jobs abroad. These assumptions correspond to our findings from Chapter 5. Furthermore, studies on service offshoring show that so far, it is a less significant phenomenon. The share of foreign intermediate service inputs is relatively small, and it appears that there are only minor effects on the domestic workforce (Amiti and Wei 2005; Geishecker and Görg 2013; Amiti and Wei 2009; Liu and Trefler 2008). Accordingly, the part of cost-reduction investments is clearly smaller in the case of service FDI. In the ReLOC survey, among participants with investments in the Czech manufacturing sector, 75% named the reduction of costs as their principal investment motive, whereas among those with affiliates in the Czech service sector, only 21% indicated that. A separation regarding the sector (manufacturing or service) of the parent company reveals no further differences.

Interestingly, the simple assignment to manufacturing and service FDI is much more highly correlated with the survey-based classification into cost-reduction and market-oriented investments than measures that rely on the assumption that the investment is horizontal if the affiliate operates in the same industry as the parent company and vertical otherwise (see, for example, Buch et al. 2005). Such measures are not even significantly correlated with managers' statements on their principal intention to invest in the ReLOC survey. A general problem of this type of measure is that it relies on the level of aggregation of industry codes. When they are highly aggregated, intra-industrial sourcing of foreign labor is classified as horizontal FDI. When they are highly disaggregated, a slightly different industrial affiliation of the domestic and foreign location leads to a classification of vertical FDI. Moreover, such sensitive measures need exact reporting and detailed information on the principal activity of the parent company and the affiliate.

To test whether there are differences between manufacturing and service FDI and to clarify whether the negative development after the investment is driven by parent-affiliate relationships with mainly vertical feature, two types of investment dummies are created. The first type indicates whether the Czech affiliate is operating primarily in the manufacturing sector (718 MNEs), and the second type indicates that the Czech affiliate is operating mainly in the service sector (1,299 MNEs). Affiliates from the construction (25 MNEs) and the primary sector (58 MNEs) or with missing information (1 MNE) are excluded. The NACE codes come from the Czech Business Register retrieved in December 2009. Therefore, it is assumed that the principal activity of the Czech affiliate remains constant during the investment of the German firm.[52]

The estimations for total employment are similar to the basic model, which does not differentiate between manufacturing and service FDI (see Table 6-22). In both cases, the coefficients after the investment are negative, whereby, in average, they are larger in magnitude and more significant for manufacturing FDI. This is in line with the results for different skill groups. The negative trend of low-skilled and medium-skilled employment in the multinational companies seems to be stronger in the case of manufacturing FDI (see Table 6-24 and 6-25). The higher demand for high-skilled employment in the period after the investment is driven by investments in the Czech service sector (see Table 6-23). In the estimations for

[52] To be sure that there is no significant occurrence of changes in the affiliation over time, the commercial register excerpt for 20 randomly drawn affiliates was checked. This includes the full history of the scope of business. None of these cases indicated that there was a fundamental switch from manufacturing to services or the other way round during the ownership of the German multinational.

total employment, the positive coefficients prior to the investment are only significant for service FDI.[53] Altogether, manufacturing FDI does not lead to an increase of jobs for high-skilled employment in the business at home. While high-skilled employment increases one year after the investment, there is to the same extent a reduction in the following year. This could indicate a deployment to the Czech affiliate of newly recruited employees who had been prepared for their job at the home base. If so, the reduction of high-skilled employment in the second year can not be considered as detrimental for labor demand and workers at home. To clarify this, a much closer look on the occupation structure and individual transition histories is needed, which is beyond the scope of this paper.

## 6.5 Conclusions

The Czech Republic provides great opportunities for cost-reduction investments as well as for extending firms' global market share. German firms exploit these benefits most frequently. So far, the effects on the domestic employment of German multinationals investing in the CEEC are not clear-cut. By using data based on the total population of German affiliates in the Czech Republic, existing studies are complemented, and the evaluation of the labor market effects of FDI is fostered. The central result is that after the investment, the total labor demand of German multinational firms decreases compared to firms without FDI. The negative development continues for some years. Five years after the investment, MNEs' domestic employment has fallen by 11.5%. Whether the domestic workforce is affected negatively depends on the skill level. The multinational firms even increase their number of high-skilled employees shortly after the investment. In contrast, medium and low-skilled jobs are reduced. In both cases – the Czech affiliate operates primarily in the manufacturing sector, and the Czech affiliate operates primarily in the service sector – low and medium-skilled employment is declining. Accordingly, it is not only a matter of vertical FDI. However, as the negative coefficients of the investment dummies are, in average, more significant and greater in their magnitude for manufacturing FDI, we can conclude that this negative impact increases with a higher importance of vertical FDI.

What might be the next steps? Due to the rich database and its linkage to the employment data of the IAB, there are several opportunities for further research. One is to take a closer

53 In fixed effects estimations for total employment such as those in Table 6-6, the positive coefficients prior to the investment become again insignificant. Only the regressions for high-skilled employment support the finding of a positive trend before the investment in case the afiliate is operating in the service sector .

look at different locations of parent and daughter companies. A basic question in this regard is whether distance matters and employment effects vary with the distance to the Czech market or affiliate. While taking advantage of factor price differentials is less profitable when transport costs are high, market-motivated investments are more likely at larger distances. This could lead to different effects on MNEs, particularly in border regions, where incentives for vertical FDI are particularly high. Another subject is the identification of the wage effects of FDI on workers employed by German MNEs. In contrast to the previous analysis, this issue must be conducted at the individual level to control for workers' heterogeneity. Finally, as previously mentioned, another approach is to include the refinements from the literature on tasks, such as in Becker et al. (2013). Whether this distinction provides further insights will also be a valuable issue.

# Appendix to Chapter 6

**Table 6-3: Regression results - Baseline**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.007 | 0.077 | | |
| investment in 5 years | | | 0.018 | 0.054 |
| investment in 4 years | | | 0.006 | 0.422 |
| investment in 3 years | | | -0.005 | 0.527 |
| investment in 2 years | | | 0.007 | 0.378 |
| investment in 1 year | | | 0.009 | 0.261 |
| investment in this year | 0.008 | 0.366 | 0.008 | 0.367 |
| investment 1 year ago | | | -0.015 | 0.028 |
| investment 2 years ago | | | -0.031 | 0.000 |
| investment 3 years ago | | | -0.024 | 0.000 |
| investment 4 years ago | | | -0.028 | 0.001 |
| investment 5 years ago | | | -0.016 | 0.016 |
| after investment | -0.023 | 0.000 | | |
| ln(employment (t-1)) | 0.973 | 0.000 | 0.973 | 0.000 |
| ln(wage (t)) | -0.273 | 0.000 | -0.273 | 0.000 |
| ln(wage (t-1)) | 0.288 | 0.000 | 0.288 | 0.000 |
| share of highskilled (t-1) | 0.061 | 0.000 | 0.061 | 0.000 |
| share of routine occ. (t-1) | 0.013 | 0.004 | 0.013 | 0.004 |
| ln(age (t)) | -0.093 | 0.000 | -0.093 | 0.000 |
| BHP_1975 | -0.804 | 0.000 | -0.804 | 0.000 |
| ln(plants (t-1)) | 0.018 | 0.000 | 0.018 | 0.000 |
| constant | 0.861 | 0.000 | 0.861 | 0.000 |
| Observations | 152,741 | | 152,741 | |
| Number of firms | 8,796 | | 8,796 | |
| R-squared | 0.9704 | | 0.9704 | |
| Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-4: Regression results - Fixed effects I**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| investment in this year | 0.008 | 0.334 | 0.002 | 0.827 |
| investment 1 year ago | -0.001 | 0.918 | -0.019 | 0.035 |
| investment 2 years ago | -0.017 | 0.170 | -0.029 | 0.003 |
| investment 3 years ago | -0.023 | 0.078 | -0.025 | 0.010 |
| investment 4 years ago | -0.040 | 0.008 | -0.032 | 0.004 |
| investment 5 years ago | -0.052 | 0.002 | -0.030 | 0.004 |
| ln(employment (t-1)) | | | 0.761 | 0.000 |
| ln(wage (t)) | -0.253 | 0.000 | -0.310 | 0.000 |
| ln(wage (t-1)) | 0.089 | 0.000 | 0.205 | 0.000 |
| share of highskilled (t-1) | 0.019 | 0.787 | 0.115 | 0.002 |
| share of routine occ. (t-1) | 0.594 | 0.000 | 0.005 | 0.812 |
| ln(age (t)) | 0.385 | 0.000 | -0.031 | 0.000 |
| ln(plants (t-1)) | 0.380 | 0.000 | 0.045 | 0.000 |
| constant | 3.723 | 0.000 | 1.886 | 0.000 |
| Observations | 129,298 | | 129,298 | |
| Number of firms | 8,675 | | 8,675 | |
| R-squared within | 0.1824 | | 0.6785 | |
| R-squared between | 0.1176 | | 0.9724 | |
| R-squared overall | 0.0854 | | 0.9478 | |
| Notes: Within estimator, standard errors are clustered on firm-level; including dummies for industry, region and year. | | | | |

**Table 6-5: Regression results - Fixed effects II**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| investment 1 year ago | -0.006 | 0.373 | -0.020 | 0.033 |
| investment 2 years ago | -0.024 | 0.014 | -0.034 | 0.000 |
| investment 3 years ago | -0.032 | 0.005 | -0.030 | 0.002 |
| investment 4 years ago | -0.055 | 0.000 | -0.041 | 0.000 |
| investment 5 years ago | -0.064 | 0.000 | -0.033 | 0.001 |
| ln(employment (t-1)) | | | 0.754 | 0.000 |
| ln(wage (t)) | -0.246 | 0.000 | -0.306 | 0.000 |
| ln(wage (t-1)) | 0.075 | 0.002 | 0.201 | 0.000 |
| share of highskilled (t-1) | 0.007 | 0.919 | 0.120 | 0.002 |
| share of routine occ. (t-1) | 0.586 | 0.000 | 0.018 | 0.375 |
| ln(age (t)) | 0.379 | 0.000 | -0.032 | 0.000 |
| ln(plants (t-1)) | 0.375 | 0.000 | 0.045 | 0.000 |
| constant | 3.650 | 0.000 | 1.865 | 0.000 |
| Observations | 123,413 | | 123,413 | |
| Number of firms | 8,731 | | 8,731 | |
| R-squared within | 0.1732 | | 0.6664 | |
| R-squared between | 0.1159 | | 0.9710 | |
| R-squared overall | 0.086 | | 0.9467 | |
| Notes: Within estimator, standard errors are clustered on firm-level; including dummies for industry, region and year. | | | | |

**Table 6-6: Regression results - Fixed effects III**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | -0.005 | 0.555 | | |
| investment in 5 years | | | 0.002 | 0.846 |
| investment in 4 years | | | -0.005 | 0.639 |
| investment in 3 years | | | -0.016 | 0.105 |
| investment in 2 years | | | -0.006 | 0.590 |
| investment in 1 year | | | 0.000 | 0.970 |
| investment in this year | 0.001 | 0.959 | 0.001 | 0.956 |
| investment 1 year ago | | | -0.016 | 0.112 |
| investment 2 years ago | | | -0.032 | 0.002 |
| investment 3 years ago | | | -0.029 | 0.005 |
| investment 4 years ago | | | -0.036 | 0.002 |
| investment 5 years ago | | | -0.029 | 0.007 |
| after investment | -0.028 | 0.002 | | |
| ln(employment (t-1)) | 0.785 | 0.000 | 0.785 | 0.000 |
| ln(wage (t)) | -0.320 | 0.000 | -0.320 | 0.000 |
| ln(wage (t-1)) | 0.221 | 0.000 | 0.221 | 0.000 |
| share of highskilled (t-1) | 0.114 | 0.000 | 0.114 | 0.000 |
| share of routine occ. (t-1) | 0.005 | 0.726 | 0.005 | 0.730 |
| ln(age (t)) | -0.032 | 0.000 | -0.032 | 0.000 |
| ln(plants (t-1)) | 0.037 | 0.000 | 0.037 | 0.000 |
| constant | 1.700 | 0.000 | 1.700 | 0.000 |
| Observations | 158,176 | | 158,176 | |
| Number of firms | 8,796 | | 8,796 | |
| R-squared within | 0.7281 | | 0.7281 | |
| R-squared between | 0.9767 | | 0.9767 | |
| R-squared overall | 0.9528 | | 0.9528 | |
| Notes: Within estimations, standard errors are clustered on firm-level; including dummies for industry, region and year. | | | | |

**Table 6-7: Regression results - System GMM**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| investment in 5 years | 0.011 | 0.246 | 0.009 | 0.277 |
| investment in 4 years | 0.004 | 0.596 | 0.004 | 0.606 |
| investment in 3 years | -0.005 | 0.537 | -0.003 | 0.680 |
| investment in 2 years | 0.006 | 0.421 | 0.007 | 0.318 |
| investment in 1 year | 0.007 | 0.346 | 0.007 | 0.265 |
| investment in this year | 0.005 | 0.537 | 0.011 | 0.143 |
| investment 1 year ago | -0.020 | 0.004 | -0.007 | 0.263 |
| investment 2 years ago | -0.032 | 0.000 | -0.019 | 0.006 |
| investment 3 years ago | -0.026 | 0.000 | -0.015 | 0.023 |
| investment 4 years ago | -0.031 | 0.000 | -0.024 | 0.004 |
| investment 5 years ago | -0.019 | 0.007 | -0.014 | 0.036 |
| ln(employment (t-1)) | 0.951 | 0.000 | 1.022 | 0.000 |
| ln(employment (t-2)) | | | 0.018 | 0.011 |
| ln(wage (t)) | -0.290 | 0.000 | -0.379 | 0.000 |
| ln(wage (t-1)) | 0.319 | 0.000 | 0.314 | 0.000 |
| share of highskilled (t-1) | 0.058 | 0.007 | 0.054 | 0.002 |
| share of routine occ. (t-1) | 0.000 | 0.990 | -0.084 | 0.000 |
| ln(age (t)) | -0.095 | 0.000 | -0.072 | 0.000 |
| BHP_1975 | -0.803 | 0.000 | -0.675 | 0.000 |
| ln(plants (t-1)) | 0.024 | 0.008 | -0.037 | 0.000 |
| constant | 0.734 | 0.000 | 0.956 | 0.000 |
| Observations | 152,741 | | 149,031 | |
| Number of firms | 8,796 | | 8,672 | |
| AB test AR(1) p-value | 0.000 | | 0.000 | |
| AB test AR(2) p-value | 0.015 | | 0.219 | |
| Hansen test p-value | 0.217 | | 0.001 | |
| Number of instruments | 155 | | 155 | |

Notes: System GMM, standard errors are robust applying the finite-sample correction by Windmeijer (2005). Each equation assumes the lagged employment as endogenous variable using its second, third, fourth and fifth lag as instruments. The estimations include dummies for industry, region, legal form and year.

**Table 6-8: Regression results - Robustness check: Including Eastern Germany**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.006 | 0.148 | | |
| investment in 5 years | | | 0.027 | 0.003 |
| investment in 4 years | | | 0.005 | 0.534 |
| investment in 3 years | | | -0.006 | 0.477 |
| investment in 2 years | | | 0.004 | 0.582 |
| investment in 1 year | | | 0.000 | 0.969 |
| investment in this year | 0.004 | 0.627 | 0.004 | 0.633 |
| investment 1 year ago | | | -0.020 | 0.004 |
| investment 2 years ago | | | -0.028 | 0.000 |
| investment 3 years ago | | | -0.022 | 0.001 |
| investment 4 years ago | | | -0.030 | 0.000 |
| investment 5 years ago | | | -0.018 | 0.008 |
| after investment | -0.024 | 0.000 | | |
| ln(employment (t-1)) | 0.966 | 0.000 | 0.966 | 0.000 |
| ln(wage (t)) | -0.244 | 0.000 | -0.244 | 0.000 |
| ln(wage (t-1)) | 0.260 | 0.000 | 0.260 | 0.000 |
| share of highskilled (t-1) | 0.060 | 0.000 | 0.060 | 0.000 |
| share of routine occ. (t-1) | 0.015 | 0.001 | 0.015 | 0.000 |
| ln(age (t)) | -0.106 | 0.000 | -0.106 | 0.000 |
| BHP_1975 | -0.908 | 0.000 | -0.908 | 0.000 |
| ln(plants (t-1)) | 0.028 | 0.000 | 0.028 | 0.000 |
| constant | 0.950 | 0.000 | 0.950 | 0.000 |
| Observations | 172,868 | | 172,868 | |
| Number of firms | 10,219 | | 10,219 | |
| R-squared | 0.9656 | | 0.9656 | |

Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year.

**Table 6-9: Regression results - Robustness check: Full-time equivalents**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.005 | 0.199 | | |
| investment in 5 years | | | 0.018 | 0.051 |
| investment in 4 years | | | 0.004 | 0.598 |
| investment in 3 years | | | -0.005 | 0.520 |
| investment in 2 years | | | 0.001 | 0.929 |
| investment in 1 year | | | 0.008 | 0.330 |
| investment in this year | 0.006 | 0.494 | 0.006 | 0.495 |
| investment 1 year ago | | | -0.020 | 0.003 |
| investment 2 years ago | | | -0.031 | 0.000 |
| investment 3 years ago | | | -0.027 | 0.000 |
| investment 4 years ago | | | -0.034 | 0.000 |
| investment 5 years ago | | | -0.024 | 0.000 |
| after investment | -0.027 | 0.000 | | |
| ln(employment (t-1)) | 0.972 | 0.000 | 0.972 | 0.000 |
| ln(wage (t)) | -0.215 | 0.000 | -0.215 | 0.000 |
| ln(wage (t-1)) | 0.226 | 0.000 | 0.226 | 0.000 |
| share of highskilled (t-1) | 0.052 | 0.000 | 0.052 | 0.000 |
| share of routine occ. (t-1) | 0.025 | 0.000 | 0.025 | 0.000 |
| ln(age (t)) | -0.092 | 0.000 | -0.092 | 0.000 |
| BHP_1975 | -0.795 | 0.000 | -0.795 | 0.000 |
| ln(plants(t-1)) | 0.020 | 0.000 | 0.020 | 0.000 |
| constant | 0.855 | 0.000 | 0.855 | 0.000 |
| Observations | 152,741 | | 152,741 | |
| Number of firms | 8,796 | | 8,796 | |
| R-squared | 0.9706 | | 0.9706 | |

Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year.

**Table 6-10: Regression results - Robustness check: Excluding large firms**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.006 | 0.164 | | |
| investment in 5 years | | | 0.017 | 0.094 |
| investment in 4 years | | | 0.007 | 0.360 |
| investment in 3 years | | | -0.008 | 0.343 |
| investment in 2 years | | | 0.004 | 0.666 |
| investment in 1 year | | | 0.009 | 0.283 |
| investment in this year | 0.000 | 0.991 | 0.000 | 0.989 |
| investment 1 year ago | | | -0.018 | 0.015 |
| investment 2 years ago | | | -0.033 | 0.000 |
| investment 3 years ago | | | -0.026 | 0.000 |
| investment 4 years ago | | | -0.032 | 0.000 |
| investment 5 years ago | | | -0.020 | 0.006 |
| after investment | -0.026 | 0.000 | | |
| ln(employment (t-1)) | 0.973 | 0.000 | 0.973 | 0.000 |
| ln(wage (t)) | -0.274 | 0.000 | -0.274 | 0.000 |
| ln(wage (t-1)) | 0.290 | 0.000 | 0.290 | 0.000 |
| share of highskilled (t-1) | 0.061 | 0.000 | 0.061 | 0.000 |
| share of routine occ. (t-1) | 0.011 | 0.011 | 0.011 | 0.011 |
| ln(age (t)) | -0.092 | 0.000 | -0.092 | 0.000 |
| BHP_1975 | -0.796 | 0.000 | -0.795 | 0.000 |
| ln(plants(t-1)) | 0.016 | 0.000 | 0.016 | 0.000 |
| constant | 0.849 | 0.000 | 0.849 | 0.000 |
| Observations | 149,956 | | 149,956 | |
| Number of firms | 8,618 | | 8,618 | |
| R-squared | 0.9685 | | 0.9685 | |

Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year.

**Table 6-11: Regression results - Robustness Check: Without small (<50 employees) firms**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.023 | 0.000 | | |
| investment in 5 years | | | 0.034 | 0.005 |
| investment in 4 years | | | 0.023 | 0.004 |
| investment in 3 years | | | 0.009 | 0.215 |
| investment in 2 years | | | 0.014 | 0.058 |
| investment in 1 year | | | 0.033 | 0.002 |
| investment in this year | -0.010 | 0.109 | -0.010 | 0.109 |
| investment 1 year ago | | | -0.014 | 0.044 |
| investment 2 years ago | | | -0.017 | 0.022 |
| investment 3 years ago | | | -0.015 | 0.033 |
| investment 4 years ago | | | -0.032 | 0.003 |
| investment 5 years ago | | | -0.014 | 0.084 |
| after investment | -0.018 | 0.000 | | |
| ln(employment (t-1)) | 0.970 | 0.000 | 0.970 | 0.000 |
| ln(wage (t)) | -0.366 | 0.000 | -0.366 | 0.000 |
| ln(wage (t-1)) | 0.359 | 0.000 | 0.359 | 0.000 |
| share of highskilled (t-1) | 0.097 | 0.000 | 0.097 | 0.000 |
| share of routine occ. (t-1) | 0.000 | 0.974 | 0.000 | 0.979 |
| ln(age (t)) | -0.058 | 0.000 | -0.057 | 0.000 |
| BHP_1975 | -0.504 | 0.000 | -0.504 | 0.000 |
| ln(plants(t-1)) | 0.010 | 0.000 | 0.010 | 0.000 |
| constant | 0.686 | 0.000 | 0.686 | 0.000 |
| Observations | 77,153 | | 77,153 | |
| Number of firms | 5,578 | | 5,578 | |
| R-squared | 0.9739 | | 0.9739 | |

Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year.

**Table 6-12: Regression results - Robustness check: Investment 1990-1996**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.010 | 0.106 | | |
| investment in 5 years | | | 0.028 | 0.062 |
| investment in 4 years | | | 0.009 | 0.379 |
| investment in 3 years | | | 0.003 | 0.750 |
| investment in 2 years | | | -0.007 | 0.490 |
| investment in 1 year | | | 0.015 | 0.272 |
| investment in this year | -0.020 | 0.044 | -0.020 | 0.045 |
| investment 1 year ago | | | -0.011 | 0.363 |
| investment 2 years ago | | | -0.019 | 0.068 |
| investment 3 years ago | | | -0.025 | 0.024 |
| investment 4 years ago | | | -0.043 | 0.000 |
| investment 5 years ago | | | -0.017 | 0.076 |
| after investment | -0.023 | 0.000 | | |
| ln(employment (t-1)) | 0.973 | 0.000 | 0.973 | 0.000 |
| ln(wage (t)) | -0.285 | 0.000 | -0.285 | 0.000 |
| ln(wage (t-1)) | 0.301 | 0.000 | 0.301 | 0.000 |
| share of highskilled (t-1) | 0.065 | 0.000 | 0.065 | 0.000 |
| share of routine occ. (t-1) | 0.016 | 0.001 | 0.016 | 0.001 |
| ln(age (t)) | -0.095 | 0.000 | -0.095 | 0.000 |
| BHP_1975 | -0.820 | 0.000 | -0.820 | 0.000 |
| ln(plants (t-1)) | 0.017 | 0.000 | 0.017 | 0.000 |
| constant | 0.879 | 0.000 | 0.878 | 0.000 |
| Observations | 139,890 | | 139,890 | |
| Number of firms | 7,336 | | 7,336 | |
| R-squared | 0.9709 | | 0.9709 | |
| Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-13: Regression results - Robustness check: Investment 1997-2003**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | -0.007 | 0.329 | | |
| investment in 5 years | | | 0.004 | 0.811 |
| investment in 4 years | | | -0.011 | 0.506 |
| investment in 3 years | | | -0.021 | 0.069 |
| investment in 2 years | | | -0.008 | 0.619 |
| investment in 1 year | | | 0.000 | 0.990 |
| investment in this year | 0.009 | 0.647 | 0.009 | 0.653 |
| investment 1 year ago | | | -0.044 | 0.001 |
| investment 2 years ago | | | -0.035 | 0.002 |
| investment 3 years ago | | | -0.025 | 0.024 |
| investment 4 years ago | | | -0.023 | 0.102 |
| investment 5 years ago | | | -0.020 | 0.080 |
| after investment | -0.029 | 0.000 | | |
| ln(employment (t-1)) | 0.973 | 0.000 | 0.973 | 0.000 |
| ln(wage (t)) | -0.281 | 0.000 | -0.281 | 0.000 |
| ln(wage (t-1)) | 0.297 | 0.000 | 0.297 | 0.000 |
| share of highskilled (t-1) | 0.063 | 0.000 | 0.063 | 0.000 |
| share of routine occ. (t-1) | 0.015 | 0.001 | 0.015 | 0.001 |
| ln(age (t)) | -0.094 | 0.000 | -0.094 | 0.000 |
| BHP_1975 | -0.818 | 0.000 | -0.818 | 0.000 |
| ln(plants (t-1)) | 0.018 | 0.000 | 0.018 | 0.000 |
| constant | 0.877 | 0.000 | 0.878 | 0.000 |
| Observations | 139,783 | | 139,783 | |
| Number of firms | 7,352 | | 7,352 | |
| R-squared | 0.9696 | | 0.9696 | |

Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year.

**Table 6-14: Regression results - Robustness check: Investment 2004-2010**

| Dependent variable: ln(employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.017 | 0.015 | | |
| investment in 5 years | | | 0.021 | 0.230 |
| investment in 4 years | | | 0.019 | 0.138 |
| investment in 3 years | | | 0.003 | 0.857 |
| investment in 2 years | | | 0.032 | 0.019 |
| investment in 1 year | | | 0.012 | 0.343 |
| investment in this year | 0.031 | 0.046 | 0.031 | 0.046 |
| investment 1 year ago | | | 0.005 | 0.627 |
| investment 2 years ago | | | -0.039 | 0.005 |
| investment 3 years ago | | | -0.020 | 0.113 |
| investment 4 years ago | | | -0.009 | 0.611 |
| investment 5 years ago | | | -0.006 | 0.744 |
| after investment | -0.015 | 0.030 | | |
| ln(employment (t-1)) | 0.973 | 0.000 | 0.973 | 0.000 |
| ln(wage (t)) | -0.278 | 0.000 | -0.279 | 0.000 |
| ln(wage (t-1)) | 0.294 | 0.000 | 0.294 | 0.000 |
| share of highskilled (t-1) | 0.063 | 0.000 | 0.063 | 0.000 |
| share of routine occ. (t-1) | 0.016 | 0.000 | 0.016 | 0.000 |
| ln(age (t)) | -0.092 | 0.000 | -0.092 | 0.000 |
| BHP_1975 | -0.800 | 0.000 | -0.800 | 0.000 |
| ln(plants (t-1)) | 0.017 | 0.000 | 0.017 | 0.000 |
| constant | 0.857 | 0.000 | 0.857 | 0.000 |
| Observations | 139,602 | | 139,602 | |
| Number of firms | 7,498 | | 7,498 | |
| R-squared | 0.9695 | | 0.9695 | |

Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year.

**Table 6-15: Regression results - High-skilled employment**

| Dependent variable: ln(high-skilled employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.025 | 0.000 | | |
| investment in 5 years | | | 0.034 | 0.001 |
| investment in 4 years | | | 0.030 | 0.002 |
| investment in 3 years | | | 0.011 | 0.228 |
| investment in 2 years | | | 0.034 | 0.000 |
| investment in 1 year | | | 0.019 | 0.032 |
| investment in this year | 0.017 | 0.042 | 0.017 | 0.041 |
| investment 1 year ago | | | 0.034 | 0.000 |
| investment 2 years ago | | | -0.003 | 0.759 |
| investment 3 years ago | | | 0.005 | 0.569 |
| investment 4 years ago | | | 0.009 | 0.238 |
| investment 5 years ago | | | -0.006 | 0.463 |
| after investment | 0.009 | 0.028 | | |
| ln(high-skilled emplyoment (t-1)) | 0.959 | 0.000 | 0.959 | 0.000 |
| ln(wage high-skilled (t)) | -0.090 | 0.000 | -0.090 | 0.000 |
| ln(wage high-skilled (t-1)) | 0.085 | 0.000 | 0.085 | 0.000 |
| ln(wage medium-skilled (t)) | 0.068 | 0.000 | 0.068 | 0.000 |
| ln(wage medium-skilled (t-1)) | -0.002 | 0.910 | -0.002 | 0.901 |
| ln(wage low-skilled (t)) | 0.052 | 0.000 | 0.052 | 0.000 |
| ln(wage low-skilled (t-1)) | -0.031 | 0.000 | -0.031 | 0.000 |
| no medium-skilled (t) | -0.047 | 0.527 | -0.046 | 0.537 |
| no medium-skilled (t-1) | 0.263 | 0.001 | 0.262 | 0.001 |
| no low-skilled (t) | 0.084 | 0.000 | 0.084 | 0.000 |
| no low-skilled (t-1) | -0.033 | 0.133 | -0.033 | 0.131 |
| ln(age (t)) | -0.039 | 0.000 | -0.039 | 0.000 |
| BHP_1975 | -0.350 | 0.000 | -0.349 | 0.000 |
| ln(plants (t-1)) | 0.018 | 0.000 | 0.018 | 0.000 |
| constant | 0.114 | 0.004 | 0.112 | 0.005 |
| Observations | 101,202 | | 101,202 | |
| Number of firms | 7,150 | | 7,150 | |
| R-squared | 0.9533 | | 0.9533 | |
| Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-16: Regression results - Medium-skilled employment**

| Dependent variable: ln(medium-skilled employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.006 | 0.095 | | |
| investment in 5 years | | | 0.010 | 0.226 |
| investment in 4 years | | | 0.005 | 0.465 |
| investment in 3 years | | | -0.003 | 0.703 |
| investment in 2 years | | | 0.010 | 0.190 |
| investment in 1 year | | | 0.008 | 0.314 |
| investment in this year | 0.012 | 0.166 | 0.012 | 0.166 |
| investment 1 year ago | | | -0.016 | 0.019 |
| investment 2 years ago | | | -0.027 | 0.000 |
| investment 3 years ago | | | -0.019 | 0.006 |
| investment 4 years ago | | | -0.024 | 0.002 |
| investment 5 years ago | | | -0.009 | 0.174 |
| after investment | -0.019 | 0.000 | | |
| ln(medium-skilled emplyoment (t-1)) | 0.957 | 0.000 | 0.957 | 0.000 |
| ln(wage high-skilled (t)) | 0.044 | 0.000 | 0.044 | 0.000 |
| ln(wage high-skilled (t-1)) | -0.034 | 0.000 | -0.034 | 0.000 |
| ln(wage medium-skilled (t)) | -0.262 | 0.000 | -0.262 | 0.000 |
| ln(wage medium-skilled (t-1)) | 0.260 | 0.000 | 0.260 | 0.000 |
| ln(wage low-skilled (t)) | 0.092 | 0.000 | 0.092 | 0.000 |
| ln(wage low-skilled (t-1)) | -0.084 | 0.000 | -0.084 | 0.000 |
| no high-skilled (t) | 0.038 | 0.060 | 0.037 | 0.061 |
| no high-skilled (t-1) | -0.053 | 0.007 | -0.053 | 0.007 |
| no low-skilled (t) | 0.144 | 0.000 | 0.144 | 0.000 |
| no low-skilled (t-1) | -0.179 | 0.000 | -0.179 | 0.000 |
| ln(age (t)) | -0.076 | 0.000 | -0.076 | 0.000 |
| BHP_1975 | -0.664 | 0.000 | -0.665 | 0.000 |
| ln(plants (t-1)) | 0.022 | 0.000 | 0.022 | 0.000 |
| constant | 0.777 | 0.000 | 0.777 | 0.000 |
| Observations | 146,945 | | 146,945 | |
| Number of firms | 8,706 | | 8,706 | |
| R-squared | 0.9718 | | 0.9718 | |
| Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-17: Regression results - Low-skilled employment**

| Dependent variable: ln(low-skilled employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.004 | 0.408 | | |
| investment in 5 years | | | 0.001 | 0.907 |
| investment in 4 years | | | 0.008 | 0.472 |
| investment in 3 years | | | 0.019 | 0.045 |
| investment in 2 years | | | -0.001 | 0.927 |
| investment in 1 year | | | -0.008 | 0.440 |
| investment in this year | -0.013 | 0.238 | -0.013 | 0.237 |
| investment 1 year ago | | | -0.009 | 0.368 |
| investment 2 years ago | | | -0.009 | 0.376 |
| investment 3 years ago | | | -0.016 | 0.134 |
| investment 4 years ago | | | -0.018 | 0.087 |
| investment 5 years ago | | | -0.023 | 0.036 |
| after investment | -0.014 | 0.001 | | |
| ln(low-skilled emplyoment (t-1)) | 0.950 | 0.000 | 0.950 | 0.000 |
| ln(wage high-skilled (t)) | 0.008 | 0.156 | 0.008 | 0.155 |
| ln(wage high-skilled (t-1)) | -0.001 | 0.921 | -0.001 | 0.923 |
| ln(wage medium-skilled (t)) | -0.217 | 0.000 | -0.217 | 0.000 |
| ln(wage medium-skilled (t-1)) | 0.147 | 0.000 | 0.147 | 0.000 |
| ln(wage low-skilled (t)) | -0.284 | 0.000 | -0.284 | 0.000 |
| ln(wage low-skilled (t-1)) | 0.288 | 0.000 | 0.288 | 0.000 |
| no high-skilled (t) | -0.047 | 0.047 | -0.047 | 0.048 |
| no high-skilled (t-1) | 0.025 | 0.284 | 0.026 | 0.282 |
| no medium-skilled (t) | -0.979 | 0.000 | -0.979 | 0.000 |
| no medium-skilled (t-1) | 0.642 | 0.000 | 0.642 | 0.000 |
| ln(age (t)) | -0.032 | 0.000 | -0.032 | 0.000 |
| BHP_1975 | -0.291 | 0.000 | -0.291 | 0.000 |
| ln(plants (t-1)) | 0.025 | 0.000 | 0.025 | 0.000 |
| constant | 0.640 | 0.000 | 0.640 | 0.000 |
| Observations | 115,374 | | 115,374 | |
| Number of firms | 7,539 | | 7,539 | |
| R-squared | 0.9446 | | 0.9446 | |
| Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-18: Regression results - High-skilled share**

| Dependent variable: share of high-skilled (t) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.0029 | 0.000 | | |
| investment in 5 years | | | 0.0028 | 0.026 |
| investment in 4 years | | | 0.0033 | 0.009 |
| investment in 3 years | | | 0.0030 | 0.019 |
| investment in 2 years | | | 0.0026 | 0.047 |
| investment in 1 year | | | 0.0027 | 0.044 |
| investment in this year | 0.0031 | 0.014 | 0.0031 | 0.014 |
| investment 1 year ago | | | 0.0059 | 0.000 |
| investment 2 years ago | | | 0.0035 | 0.013 |
| investment 3 years ago | | | 0.0022 | 0.067 |
| investment 4 years ago | | | 0.0042 | 0.000 |
| investment 5 years ago | | | 0.0029 | 0.003 |
| after investment | 0.0038 | 0.000 | | |
| share of high-skilled (t-1) | 0.9101 | 0.000 | 0.9102 | 0.000 |
| ln(employment(t-1)) | -0.0005 | 0.001 | -0.0005 | 0.001 |
| ln(wage high-skilled (t)) | -0.0035 | 0.001 | -0.0035 | 0.001 |
| ln(wage high-skilled (t-1)) | 0.0070 | 0.000 | 0.0070 | 0.000 |
| ln(wage medium-skilled (t)) | 0.0075 | 0.020 | 0.0075 | 0.020 |
| ln(wage medium-skilled (t-1)) | 0.0032 | 0.326 | 0.0032 | 0.326 |
| ln(wage low-skilled (t)) | -0.0056 | 0.000 | -0.0056 | 0.000 |
| ln(wage low-skilled (t-1)) | 0.0035 | 0.000 | 0.0035 | 0.000 |
| no medium-skilled (t) | -0.0999 | 0.000 | -0.0999 | 0.000 |
| no medium-skilled (t-1) | 0.1031 | 0.000 | 0.1031 | 0.000 |
| no low-skilled (t) | 0.2904 | 0.000 | 0.2904 | 0.000 |
| no low-skilled (t-1) | -0.2078 | 0.000 | -0.2078 | 0.000 |
| ln(age (t)) | -0.0001 | 0.861 | -0.0001 | 0.892 |
| BHP_1975 | -0.0019 | 0.564 | -0.0017 | 0.591 |
| ln(plants (t-1)) | -0.0008 | 0.000 | -0.0008 | 0.000 |
| constant | -0.0389 | 0.000 | -0.0391 | 0.000 |
| Observations | 148,843 | | 148,843 | |
| Number of firms | 8,796 | | 8,796 | |
| R-squared | 0.913 | | 0.913 | |
| Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-19: SUR results - High-skilled employment**

| Dependent variable: ln(high-skilled employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.024 | 0.000 | | |
| investment in 5 years | | | 0.026 | 0.000 |
| investment in 4 years | | | 0.029 | 0.000 |
| investment in 3 years | | | 0.016 | 0.020 |
| investment in 2 years | | | 0.021 | 0.001 |
| investment in 1 year | | | 0.030 | 0.000 |
| investment in this year | 0.026 | 0.000 | 0.026 | 0.000 |
| investment 1 year ago | | | 0.025 | 0.000 |
| investment 2 years ago | | | 0.001 | 0.855 |
| investment 3 years ago | | | 0.006 | 0.400 |
| investment 4 years ago | | | 0.001 | 0.926 |
| investment 5 years ago | | | -0.006 | 0.448 |
| after investment | 0.006 | 0.045 | | |
| ln(high-skilled emplyoment (t-1)) | 0.977 | 0.000 | 0.977 | 0.000 |
| ln(age (t)) | -0.028 | 0.000 | -0.027 | 0.000 |
| BHP_1975 | -0.234 | 0.000 | -0.233 | 0.000 |
| ln(plants (t-1)) | 0.017 | 0.000 | 0.017 | 0.000 |
| constant | 0.246 | 0.000 | 0.245 | 0.000 |
| Observations | 148,843 | | 148,843 | |
| Number of firms | 8,796 | | 8,796 | |
| R-squared | 0.964 | | 0.964 | |
| Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-20: SUR results - Medium-skilled employment**

| Dependent variable: ln(medium-skilled employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | 0.007 | 0.028 | | |
| investment in 5 years | | | 0.015 | 0.022 |
| investment in 4 years | | | 0.006 | 0.347 |
| investment in 3 years | | | -0.005 | 0.429 |
| investment in 2 years | | | 0.007 | 0.241 |
| investment in 1 year | | | 0.009 | 0.123 |
| investment in this year | 0.009 | 0.137 | 0.009 | 0.138 |
| investment 1 year ago | | | -0.019 | 0.002 |
| investment 2 years ago | | | -0.028 | 0.000 |
| investment 3 years ago | | | -0.017 | 0.009 |
| investment 4 years ago | | | -0.026 | 0.000 |
| investment 5 years ago | | | -0.012 | 0.098 |
| after investment | -0.021 | 0.000 | | |
| ln(medium-skilled emplyoment (t-1)) | 0.967 | 0.000 | 0.967 | 0.000 |
| ln(age (t)) | -0.068 | 0.000 | -0.068 | 0.000 |
| BHP_1975 | -0.586 | 0.000 | -0.586 | 0.000 |
| ln(plants (t-1)) | 0.023 | 0.000 | 0.023 | 0.000 |
| constant | 0.676 | 0.000 | 0.677 | 0.000 |
| Observations | 148,843 | | 148,843 | |
| Number of firms | 8,796 | | 8,796 | |
| R-squared | 0.973 | | 0.973 | |
| Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-21: SUR results - Low-skilled employment**

| Dependent variable: ln(low-skilled employment (t)) | | | | |
|---|---|---|---|---|
| | 1 | | 2 | |
| | coefficient | p-value | coefficient | p-value |
| before investment | -0.005 | 0.203 | | |
| investment in 5 years | | | 0.000 | 0.980 |
| investment in 4 years | | | -0.011 | 0.180 |
| investment in 3 years | | | 0.003 | 0.684 |
| investment in 2 years | | | -0.011 | 0.197 |
| investment in 1 year | | | -0.006 | 0.477 |
| investment in this year | -0.020 | 0.015 | -0.020 | 0.015 |
| investment 1 year ago | | | -0.025 | 0.002 |
| investment 2 years ago | | | -0.015 | 0.060 |
| investment 3 years ago | | | -0.030 | 0.000 |
| investment 4 years ago | | | -0.031 | 0.000 |
| investment 5 years ago | | | -0.028 | 0.002 |
| after investment | -0.026 | 0.000 | | |
| ln(low-skilled emplyoment (t-1)) | 0.955 | 0.000 | 0.955 | 0.000 |
| ln(age (t)) | -0.029 | 0.000 | -0.029 | 0.000 |
| BHP_1975 | -0.251 | 0.000 | -0.251 | 0.000 |
| ln(plants (t-1)) | 0.030 | 0.000 | 0.030 | 0.000 |
| constant | 0.300 | 0.000 | 0.300 | 0.000 |
| Observations | 148,843 | | 148,843 | |
| Number of firms | 8,796 | | 8,796 | |
| R-squared | 0.955 | | 0.955 | |
| Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-22: Regression results - Target industry: Total employment**

| | | Dependent variable: ln(employment (t)) | | | |
|---|---|---|---|---|---|
| | | 1 | | 2 | |
| | | coefficient | p-value | coefficient | p-value |
| Manufacturing FDI | before investment | -0.004 | 0.555 | | |
| | investment in 5 years | | | 0.001 | 0.957 |
| | investment in 4 years | | | -0.003 | 0.833 |
| | investment in 3 years | | | -0.005 | 0.629 |
| | investment in 2 years | | | -0.013 | 0.190 |
| | investment in 1 year | | | 0.000 | 0.984 |
| | investment in this year | 0.000 | 0.983 | -0.001 | 0.964 |
| | investment 1 year ago | | | -0.020 | 0.040 |
| | investment 2 years ago | | | -0.026 | 0.015 |
| | investment 3 years ago | | | -0.027 | 0.001 |
| | investment 4 years ago | | | -0.042 | 0.008 |
| | investment 5 years ago | | | -0.022 | 0.037 |
| | after investment | -0.027 | 0.000 | | |
| Service FDI | before investment | 0.013 | 0.011 | | |
| | investment in 5 years | | | 0.026 | 0.049 |
| | investment in 4 years | | | 0.009 | 0.359 |
| | investment in 3 years | | | -0.004 | 0.700 |
| | investment in 2 years | | | 0.019 | 0.081 |
| | investment in 1 year | | | 0.015 | 0.095 |
| | investment in this year | 0.009 | 0.446 | 0.009 | 0.458 |
| | investment 1 year ago | | | -0.013 | 0.190 |
| | investment 2 years ago | | | -0.034 | 0.000 |
| | investment 3 years ago | | | -0.020 | 0.041 |
| | investment 4 years ago | | | -0.019 | 0.038 |
| | investment 5 years ago | | | -0.009 | 0.282 |
| | after investment | -0.019 | 0.000 | | |
| | ln(emplyoment (t-1)) | 0.973 | 0.000 | 0.974 | 0.000 |
| | ln(wage (t)) | -0.272 | 0.000 | -0.272 | 0.000 |
| | ln(wage (t-1)) | 0.287 | 0.000 | 0.287 | 0.000 |
| | share of high-skilled (t-1) | 0.061 | 0.000 | 0.061 | 0.000 |
| | share of routine occ. (t-1) | 0.013 | 0.004 | 0.010 | 0.016 |
| | ln(age (t)) | -0.093 | 0.000 | -0.093 | 0.000 |
| | BHP_1975 | -0.806 | 0.000 | -0.808 | 0.000 |
| | ln(plants (t-1)) | 0.018 | 0.000 | 0.018 | 0.000 |
| | constant | 0.862 | 0.000 | 0.865 | 0.000 |
| | Observations | 151,962 | | 151,962 | |
| | Number of firms | 8,712 | | 8,712 | |
| | R-squared | 0.9703 | | 0.9703 | |

Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year.

**Table 6-23: Regression results - Target industry: High-skilled employment**

| Dependent variable: ln(high-skilled employment (t)) | | | | | |
|---|---|---|---|---|---|
| | | 1 | | 2 | |
| | | coefficient | p-value | coefficient | p-value |
| Manufacturing FDI | before investment | 0.008 | 0.220 | | |
| | investment in 5 years | | | 0.030 | 0.073 |
| | investment in 4 years | | | 0.006 | 0.664 |
| | investment in 3 years | | | 0.001 | 0.918 |
| | investment in 2 years | | | 0.006 | 0.649 |
| | investment in 1 year | | | -0.004 | 0.789 |
| | investment in this year | -0.001 | 0.960 | -0.001 | 0.960 |
| | investment 1 year ago | | | 0.030 | 0.026 |
| | investment 2 years ago | | | -0.024 | 0.070 |
| | investment 3 years ago | | | 0.013 | 0.323 |
| | investment 4 years ago | | | 0.007 | 0.609 |
| | investment 5 years ago | | | -0.018 | 0.209 |
| | after investment | 0.002 | 0.703 | | |
| Service FDI | before investment | 0.033 | 0.000 | | |
| | investment in 5 years | | | 0.034 | 0.012 |
| | investment in 4 years | | | 0.036 | 0.004 |
| | investment in 3 years | | | 0.017 | 0.168 |
| | investment in 2 years | | | 0.050 | 0.000 |
| | investment in 1 year | | | 0.029 | 0.011 |
| | investment in this year | 0.026 | 0.019 | 0.026 | 0.019 |
| | investment 1 year ago | | | 0.035 | 0.000 |
| | investment 2 years ago | | | 0.017 | 0.096 |
| | investment 3 years ago | | | 0.001 | 0.959 |
| | investment 4 years ago | | | 0.013 | 0.181 |
| | investment 5 years ago | | | 0.004 | 0.691 |
| | after investment | 0.015 | 0.002 | | |
| | ln(high-skilled emplyoment (t-1)) | 0.959 | 0.000 | 0.959 | 0.000 |
| | ln(wage high-skilled (t)) | -0.091 | 0.000 | -0.091 | 0.000 |
| | ln(wage high-skilled (t-1)) | 0.086 | 0.000 | 0.086 | 0.000 |
| | ln(wage medium-skilled (t)) | 0.069 | 0.000 | 0.069 | 0.000 |
| | ln(wage medium-skilled (t-1)) | -0.005 | 0.799 | -0.005 | 0.796 |
| | ln(wage low-skilled (t)) | 0.051 | 0.000 | 0.051 | 0.000 |
| | ln(wage low-skilled (t-1)) | -0.030 | 0.000 | -0.030 | 0.000 |
| | no medium-skilled (t) | -0.043 | 0.570 | -0.043 | 0.573 |
| | no medium-skilled (t-1) | 0.255 | 0.001 | 0.255 | 0.001 |
| | no low-skilled (t) | 0.081 | 0.000 | 0.081 | 0.000 |
| | no low-skilled (t-1) | -0.030 | 0.175 | -0.030 | 0.168 |
| | ln(age (t)) | -0.039 | 0.000 | -0.039 | 0.000 |
| | BHP_1975 | -0.349 | 0.000 | -0.348 | 0.000 |
| | ln(plants (t-1)) | 0.018 | 0.000 | 0.018 | 0.000 |
| | constant | 0.118 | 0.003 | 0.116 | 0.004 |
| | Observations | 100,646 | | 100,646 | |
| | Number of firms | 7,087 | | 7,087 | |
| | R-squared | 0.9532 | | 0.9532 | |
| | Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

**Table 6-24: Regression results - Target industry: Medium-skilled employment**

| Dependent variable: ln(medium-skilled employment (t)) | | 1 | | 2 | |
|---|---|---|---|---|---|
| | | coefficient | p-value | coefficient | p-value |
| Manufacturing FDI | before investment | -0.001 | 0.807 | | |
| | investment in 5 years | | | 0.001 | 0.941 |
| | investment in 4 years | | | 0.001 | 0.918 |
| | investment in 3 years | | | -0.004 | 0.692 |
| | investment in 2 years | | | -0.005 | 0.620 |
| | investment in 1 year | | | 0.000 | 0.975 |
| | investment in this year | 0.001 | 0.929 | 0.001 | 0.929 |
| | investment 1 year ago | | | -0.023 | 0.020 |
| | investment 2 years ago | | | -0.021 | 0.040 |
| | investment 3 years ago | | | -0.032 | 0.000 |
| | investment 4 years ago | | | -0.033 | 0.030 |
| | investment 5 years ago | | | -0.020 | 0.062 |
| | after investment | -0.026 | 0.000 | | |
| Service FDI | before investment | 0.010 | 0.043 | | |
| | investment in 5 years | | | 0.012 | 0.309 |
| | investment in 4 years | | | 0.006 | 0.529 |
| | investment in 3 years | | | -0.003 | 0.785 |
| | investment in 2 years | | | 0.020 | 0.053 |
| | investment in 1 year | | | 0.013 | 0.172 |
| | investment in this year | 0.015 | 0.198 | 0.015 | 0.198 |
| | investment 1 year ago | | | -0.014 | 0.126 |
| | investment 2 years ago | | | -0.027 | 0.003 |
| | investment 3 years ago | | | -0.010 | 0.318 |
| | investment 4 years ago | | | -0.021 | 0.020 |
| | investment 5 years ago | | | 0.002 | 0.818 |
| | after investment | -0.015 | 0.001 | | |
| | ln(medium-skilled emplyoment (t-1)) | 0.957 | 0.000 | 0.957 | 0.000 |
| | ln(wage high-skilled (t)) | 0.043 | 0.000 | 0.043 | 0.000 |
| | ln(wage high-skilled (t-1)) | -0.033 | 0.000 | -0.033 | 0.000 |
| | ln(wage medium-skilled (t)) | -0.261 | 0.000 | -0.261 | 0.000 |
| | ln(wage medium-skilled (t-1)) | 0.258 | 0.000 | 0.258 | 0.000 |
| | ln(wage low-skilled (t)) | 0.091 | 0.000 | 0.091 | 0.000 |
| | ln(wage low-skilled (t-1)) | -0.083 | 0.000 | -0.083 | 0.000 |
| | no high-skilled (t) | 0.036 | 0.069 | 0.036 | 0.072 |
| | no high-skilled (t-1) | -0.051 | 0.009 | -0.051 | 0.010 |
| | no low-skilled (t) | 0.141 | 0.000 | 0.141 | 0.000 |
| | no low-skilled (t-1) | -0.175 | 0.000 | -0.175 | 0.000 |
| | ln(age (t)) | -0.076 | 0.000 | -0.076 | 0.000 |
| | BHP_1975 | -0.665 | 0.000 | -0.666 | 0.000 |
| | ln(plants (t-1)) | 0.021 | 0.000 | 0.021 | 0.000 |
| | constant | 0.776 | 0.000 | 0.777 | 0.000 |
| | Observations | 146,204 | | 146,204 | |
| | Number of firms | 8,624 | | 8,624 | |
| | R-squared | 0.9719 | | 0.9719 | |

Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year.

**Table 6-25: Regression results - Target industry: Low-skilled employment**

| Dependent variable: ln(low-skilled employment (t)) | | | | | |
|---|---|---|---|---|---|
| | | 1 | | 2 | |
| | | coefficient | p-value | coefficient | p-value |
| Manufacturing FDI | before investment | 0.000 | 0.972 | | |
| | investment in 5 years | | | -0.012 | 0.532 |
| | investment in 4 years | | | 0.018 | 0.231 |
| | investment in 3 years | | | 0.030 | 0.049 |
| | investment in 2 years | | | -0.016 | 0.184 |
| | investment in 1 year | | | -0.018 | 0.216 |
| | investment in this year | 0.005 | 0.773 | 0.005 | 0.774 |
| | investment 1 year ago | | | -0.021 | 0.180 |
| | investment 2 years ago | | | -0.023 | 0.108 |
| | investment 3 years ago | | | -0.016 | 0.225 |
| | investment 4 years ago | | | -0.039 | 0.043 |
| | investment 5 years ago | | | -0.016 | 0.326 |
| | after investment | -0.023 | 0.001 | | |
| Service FDI | before investment | 0.008 | 0.205 | | |
| | investment in 5 years | | | 0.010 | 0.483 |
| | investment in 4 years | | | 0.001 | 0.935 |
| | investment in 3 years | | | 0.015 | 0.244 |
| | investment in 2 years | | | 0.011 | 0.409 |
| | investment in 1 year | | | 0.003 | 0.810 |
| | investment in this year | -0.028 | 0.073 | -0.028 | 0.072 |
| | investment 1 year ago | | | -0.001 | 0.915 |
| | investment 2 years ago | | | 0.000 | 0.978 |
| | investment 3 years ago | | | -0.017 | 0.266 |
| | investment 4 years ago | | | -0.005 | 0.701 |
| | investment 5 years ago | | | -0.025 | 0.078 |
| | after investment | -0.009 | 0.118 | | |
| | ln(low-skilled emplyoment (t-1)) | 0.950 | 0.000 | 0.950 | 0.000 |
| | ln(wage high-skilled (t)) | 0.007 | 0.172 | 0.007 | 0.170 |
| | ln(wage high-skilled (t-1)) | 0.000 | 0.991 | 0.000 | 0.992 |
| | ln(wage medium-skilled (t)) | -0.214 | 0.000 | -0.215 | 0.000 |
| | ln(wage medium-skilled (t-1)) | 0.145 | 0.000 | 0.145 | 0.000 |
| | ln(wage low-skilled (t)) | -0.286 | 0.000 | -0.286 | 0.000 |
| | ln(wage low-skilled (t-1)) | 0.289 | 0.000 | 0.289 | 0.000 |
| | no medium-skilled (t) | -0.981 | 0.000 | -0.982 | 0.000 |
| | no medium-skilled (t-1) | 0.645 | 0.000 | 0.646 | 0.000 |
| | no high-skilled (t) | -0.047 | 0.045 | -0.047 | 0.046 |
| | no high-skilled (t-1) | 0.027 | 0.251 | 0.027 | 0.251 |
| | ln(age (t)) | -0.032 | 0.000 | -0.032 | 0.000 |
| | BHP_1975 | -0.289 | 0.000 | -0.289 | 0.000 |
| | ln(plants(t-1)) | 0.025 | 0.000 | 0.025 | 0.000 |
| | constant | 0.634 | 0.000 | 0.633 | 0.000 |
| | Observations | 114,811 | | 114,811 | |
| | Number of firms | 7,475 | | 7,475 | |
| | R-squared | 0.9446 | | 0.9446 | |
| | Notes: Pooled OLS, standard errors are clustered on firm-level; including dummies for industry, region, legal form and year. | | | | |

# 7 Summary and conclusions

This dissertation reveals new insights about the regional distribution, nature and effects of German-Czech investment relations, which exemplify a historical part of the economic intra-European integration. Yet, the findings do not only foster the understanding and evaluation of investments by German companies in this specific CEE country. They also broaden the current state of knowledge about foreign direct investments in general covering various topics. The locations of the German parent companies and their affiliates are the basis for a unique result in the empirical literature about location decisions of multinational enterprises. The basic result from Chapter 4 was that particularily investors from the German borderlands are locating directly at the border on the Czech side and not in regions farther away. This indicates the importance of regional interconnectedness beyond the relevance of transport costs and confirms that in the context of international investment flows economic forces are able to foster the regional integration of border regions.

But what kind of investments are we talking about? In Chapter 5, we utilize the extensive ReLOC survey to identify differences between the German parent companies and their Czech affiliates in terms of innovation, factor demand and technology level. We find clear differences between the parent companies and their Czech locations when they are operating mainly in the manufacturing sector. In this segment there is a strong tendency for vertical integration. The German sites produce with a relatively high proportion of manual routine tasks even compared to Czech firms without a foreign owner. Also the establishment of R&D facilities is not more likely when there is an existing relationship to a German investor. From the Czech perspective, this suggests that German investments in manufacturing industries create jobs for low-skilled workers. On the one hand, this might reduce unemployment in this specific segment of the labor market. On the other hand, these investments don’t contribute to technological upgrading. Rather, they deepen the specialization of the Czech economy in low-tech jobs. In contrast, German investments in the Czech service sector appear much more promising in terms of stimulating the upgrading process. Hence, knowledge and technology transfer, both often related to FDI, are only supposed for investments in the Czech service sector.

This finding explains some of the negative employment trends in the parent companies after their investment, the central result of Chapter 6. Unlike the majority of other studies on global as well as German FDI, German firms with investments in the Czech Republic reduce their employment level after the investment. This negative trend is also evident when it is compared to that of firms without FDI which serve as control group. During the first five years after the investment, the labor demand of the multinational enterprises is reduced in average 2,3% per year, which results in an overall employment loss of 11.5%. In subsequent years, the differences between the labor demand of MNEs and firms without FDI become insignifcant.

These results differ from other empirical studies on German multinational enterprises, even from those which explicitly distinguish between countries of destination treating the CEEC as an own group. One reason for this might be the previously mentioned selectivity issues of FDI databases which underrepresent small and medium-sized firms. However, not any kind of jobs are affected negatively. Multinational firms reduce their number of low and medium-skilled workers, but on the other hand they increase their stock of high-skilled employees. This is in line with the theory of the multinational firm as well as other concepts about the international organization of firm activity. Both vertical and horizontal FDI can lead to negative effects on home employment, but this does not affect any kind of jobs in the same manner. The international organization of a firm and the extension of its activity increase the need for advanced tasks. Yet, likewise in several other empirical studies, in case of manufacturing FDI, the impact on the German workforce is more negative. Associating results of Chapter 5 and Chapter 6 provides a clear explanation here. The reduction of lower skill groups is larger in firms engaging in the Czech manufacturing sector, where the vertical model is dominating and the Czech affiliates provide to a higher extent manual routine jobs. The above mentioned increase of high-skilled employment doesn’t take place when the investment flows into the Czech manufacturing industry. While the number of high-skilled employees increases one year after the investment, there is to the same extent a reduction in the following year.

The example of Germany and the Czech Republic shows that investments from industrialized countries that flowed into the CEEC since the Fall of the Iron Curtain can be accompanied by negative effects on the domestic workforce. The fears of public and policy can therefore not being considered as unjustified. Especially less-qualified workers are in risk to experience job losses. The good news is that even in case of such great opportunities to relocate jobs to foreign markets German firms didn’t cut any type of job. There are also winners of these multinational activities as the demand for high-skilled employees raised in absolute as well as in relative terms. What implications do the results provide for policy, employees and other decision makers? Looking on strongly linked economies, prospering trade and a German labor market in a favourable condition, requesting restrictions on international investment flows is not a reasonable option. Foreign economic engagements such as FDI are natural parts of integrated economies, as they increase the possibility to get new customers and to boost firm productivity. Especially in peripheral regions, which are often in risk to be left behind, businesses expand their markets across borders. This enhances their possibilities and compensates part of their locational disadvantage. This strong occurrence of investment relations within the borderlands supports a regional policy in peripheral regions which is aimed at promoting cross-border projects. It seems to be a promising option to boost the internationalization of firms even in rather sparsely populated areas and, moreover, to attract other German firms to set up plants not only on the Czech but also in the border areas on the German side. The fact that the large number of ties within the common border region appear not only for manufacturing FDI, which are more related to efficiency seeking investments, but also for service FDI, makes it even more attractive for local policy and population. Otherwise, the investment activity of local firms could be unpopular. Furthermore, these regions can incorporate this particular type of neighbourhood in their regional image. In times of demographic changes leading to a competition between regions for the settlement of companies and the attraction of new recruits, these regions stand out with their closeness and economic ties to foreign countries. It is also possible to reduce negative drawbacks, as high-qualified personel of multinational firms are not affected negatively. Accordingly, a well trained German workforce should be one objective. It makes it less attractive to lay off German employees and to substitute them by foreign workers. Advantages, such as increasing competitiveness and new customers are exploited, and at the same time negative effects can be diminished. In this regard, the German dual education system is an important issue. It is much less established in Eastern European countries where the vocational training is lacking a practical education integrated in local firms. The fact that German companies try to establish it more in the Czech Republic, for example, reveals its importance for the German labor market and the basic need for well-educated personnel in locations abroad. Though this dissertation reveals negative effects for medium-skilled employees and therefore those with vocational training also, the German workforce has still an advantage regarding the quality of the education system even apart tertiary education. But the interest and appealings of German firms and related interest parties such as the foreign sites of Chambers of Commerce show that this might change someday. The greater the improvements in the field of education in foreign countries with strong economic engagements of German firms, the greater the competition for German workers. Some German multinationals already initiated cooperations with local Czech vocational schools to offer an apprentice which is corresponding to the German model or even operate vocational schools in the Czech Republic on their own. Policy and decision makers should therefore make sure to provide a high quality in education and apprenticeship and to support those who are in risk to enter the labor market without completing schooling. From the Czech perspective, a stronger implementation of the German educational system is a great chance for the Czech labor market. It might also reduce the educational and technological gaps between German parent companies and their affiliates in the manufacturing sector and improve knowledge and technological spill-overs.

The various articles provide a comprehensive overview, yet due to the rich data there are still numerous other interesting issues not being addressed within the scope of this dissertation. Here I would like to point to past and future work of my colleagues Veronika Hecht, Michael Moritz and Linda Borrs, who are also involved in the ReLOC project. Especially the research of Linda Borrs on the wage effects of the German investments in the Czech Republic complements my analysis. While I focused on firm-level characteristics, such as MNEs' labor demand, wage effects need to be examined on individual level to take into account worker heterogeneity. Individual-level analyses enable also to track workers after their job at the multinational enterprises. At this, it might be promising to take a closer look on occupations and tasks which can provide further insights into organizational changes in multinational firms and associated impacts on domestic jobs. Another subject where it is necessary to change the unit of observation is the regional differentiation of employment effects. Effects on domestic establishments might differ with their distance to the Czech market or affiliate. Taking advantage of factor price differentials is less profitable if transport costs are high. In contrast, market motivated investments are more profitable, when the distance to the foreign market is large. Accordingly, incentives for investments motivated by cost reductions are particular high in German-Czech border regions, especially when the affiliate is located close to the border. At this point, one needs to take into account the assignment to multi-site companies and single-site companies. While an establishment of a single-site company represents the whole firm, an establishment of a multi-level company represents only a part of it.

Apart from the ReLOC project, what is promising is the increasing quality of databases of commercial data providers due to the implementation of the *Elektronische Bundesanzeiger* in 2007. Since this, the selectivity issues in commercial databases are getting fundamentally lower. Any firm which doesn't fulfil its publication duties is penalized. This makes also small and medium-sized firms publishing their annual reports. Though this doesn't improve the evaluation of trends before 2007, it offers new options for research on recent developments.
In any case, there is no lack of future research issues, neither within nor outside the ReLOC project.

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