

Regional Distribution of German-Czech Multinationals on the Domestic Market

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This article deals with the domestic location of German multinational firms which have affiliates in the Czech Republic. Due to the common border the Czech Republic represents an attractive target country for both vertical and horizontal direct investments. On the one hand, the still existing wage gap offers the opportunity to offshore activities abroad by reason of cost advantages. On the other hand, the increasing purchasing power of Czech customers provides favorable chances to acquire a new market. On the basis of a register of firms made available by the German-Czech Chamber of Industry and Commerce we present findings on the growing economic integration between the two countries. We use count data models in order to account for the distribution of the dependent variable, i.e. the number of investors in the German domestic regions. Controlling for several economic factors it can be concluded that the distance to the common border plays an important role for the decision to enter the Czech market. In addition, regions that are situated directly at the German-Czech border are involved at an above-average rate in foreign direct investment. Thereby, location patterns differ between manufacturing firms and both trade and service companies.

Keywords: economic integration; multinational firms; foreign direct investment; international trade; offshoring

JEL Codes: F15, F23, R30

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1. Introduction: regions of origin of German investors in the Czech Republic

The Central and Eastern European Countries (CEEC) constitute an attractive target area for German direct investments. The capital stock of German companies is definitely higher in western European countries. The growth rates of foreign direct investment from Germany, however, are considerably higher in the countries which joined the EU in 2004. 60% of German companies with at least 100 employees which shifted production to foreign countries implemented their relocation activities in the new EU member states, compared to a share of 36% of relocation to China and 30% to EU-15 countries (Statistisches Bundesamt/Federal Statistical Office 2008).¹ Among the new EU countries the Czech Republic takes an outstanding position. In the year 2009 the sum of direct and indirect German investments in the Czech Republic added up to 22 bn € (Deutsche Bundesbank/German Central Bank 2011). This amount is far higher than the investments in other CEEC and also in Japan or in one of the BRIC countries Brazil, Russia, India and China. In consideration of the nine German neighbor countries a distinctive wage gap exists with regard to Poland and the Czech Republic. While this is inviting for German investors in order to capitalize cost advantages, the direct German border with the Czech Republic is to a considerable degree longer than the common border with Poland (811 km vs. 442 km).

Due to a firm registry made available by the German-Czech Chamber of Industry and Commerce (DTIHK 2008) it is possible to overview the structure of German companies with affiliates in the Czech Republic. The data set provides information on nearly 1,400 Czech companies and their German investors and is already in use for scientific analyses (Görg, Mühlen, and Nunnenkamp 2010; Mühlen and Nunnenkamp 2011).

In this article we focus on the following research questions: From which German regions arise the foreign direct investments in the Czech Republic? How important is the economic potential of a region in terms of GDP for providing capital to the Czech Republic? Is the sectoral

structure of the domestic region crucial for investments in the Czech Republic? To what extent does distance influence the decision to operate a foreign affiliate in the Czech Republic? Can Poland be seen as an alternative target country for German investors? Are there any differences as a consequence of providing capital to the manufacturing, trade or services sector in the Czech Republic?

An essential factor for the response to these questions is the main motive for a company to invest in the Czech Republic. With respect to horizontal direct investments the main focus is on the development of the market, whereas the utilization of cost advantages is in the fore of vertical direct investments. Correspondingly, there are differences in the relevance of possible determinants for the decision of companies to go abroad, e.g. the distance between the German capital provider and the Czech affiliate.

The article is organized as follows: in Section 2 we describe the used data set. Section 3 contains descriptive evidence with regard to the locations of the headquarters of German-Czech multinationals at different spatial levels. In Section 4 we present count data models and the results. The paper concludes with a summary of results and an outlook to follow-up research in Section 5.

2. The data of the German-Czech Chamber of Industry and Commerce

Regarding the analysis of German direct investments in foreign countries, different data sets are used. On the one hand, there are some commercial suppliers providing data suitable for scientific investigations, e.g. Bureau van Dijk (Amadeus). On the other hand, the Deutsche Bundesbank/German Central Bank (Microdatabase Direct investment – MiDi) and the German Chambers of Industry and Commerce (DIHK 2008) make their surveys available (for analyses see, for instance, Buch et al. 2007). Unfortunately, the mentioned data sources are selective with respect to the characteristics of the enterprises and/or the investment projects

included. The MiDi database, for instance, at present includes only firms which have a foreign subsidiary representing a balance sheet total of at least 3 million €. Moreover, the reported thresholds have been changed several times in recent years. Commercial databases like Amadeus offer only a small part of the population of firms actively operating on both sides of the German-Czech border.

In this paper we use data which stem from a firm registry published in 2008 by the German-Czech Chamber of Industry and Commerce (DTIHK 2008).² The registry contains information on 1,391 Czech companies which are at least partly financed by a German investor. According to the indications of the DTIHK the data set comprises a list of approximately 9,000 Czech firms having a German investor and/or German management. After DTIHK deleted duplicates, letterbox companies and companies which were only founded by a German person in order to be eligible to acquire real estate property circa 3,500 firms remain. These companies were contacted in order to provide information on some essential entrepreneurial parameters, in the case that they are not already available, e.g. due to the membership of a company at the DTIHK. The collected data cover the addresses of the German investor and the Czech affiliate, the number of employees, the economic activities and the founding year of the Czech company. In the case of 1,213 enterprises we have also information about the municipality of the German investor. In addition, in 1,381 cases the data set provides information about the affiliation of the Czech company to the manufacturing, trade or services sector. Thereby, it is possible that the companies categorize themselves as belonging to two or all three sectors.³ We use the information on the locations of German companies providing capital for their Czech affiliates. As a measure of distance from location A to location B we calculate the driving time of a heavy-goods vehicle by means of the route planning software *map & guide calculate* 2009.⁴

3. Regions of origin of German FDI: descriptive evidence

3.1 German federal states (*Deutsche Bundesländer*)

The headquarters of German investors in the Czech Republic are predominantly located in the federal states of Bavaria, Baden-Württemberg, Hesse and North Rhine-Westphalia. 79.69% of German capital providers fall upon these four federal states. In accordance to the data sets of the German Chambers of Industry and Commerce (DIHK) and the Deutsche Bundesbank/German Central Bank these are the most active federal states with regard to foreign direct investments. Bavaria possesses the largest number of investors (361), followed by Baden-Württemberg (258), North Rhine-Westphalia (232) and Hesse (118). Not surprisingly, Bavaria plays a more prominent role than in the data sets of the German Chambers of Industry and Commerce and the German Central Bank, as these comprise not only investors in the Czech Republic, but all around the globe.

The correlation coefficient between the GDP at the federal state level (gross domestic product in 2006 at current market prices; Eurostat Database) and the companies situated there which are actively operating in the Czech Republic is 0.926. Considering the GDP level, North Rhine-Westphalia and Lower Saxony exhibit relatively few enterprises which invest in the Czech Republic. In 2006, the reference year, North Rhine-Westphalia featured the highest GDP among the German federal states by far. Likewise, the eastern German states are under-represented. While the proportion of the New Laender in overall German GDP added up to a share of 14.93%, only 8.00% of the German companies investing in the Czech Republic have their headquarter in one of the newly-formed German states. In contrast, both Bavaria and Baden-Württemberg are represented above average. The share of Bavaria in the companies investing in the Czech Republic (30.00%) is nearly twice as high as the share in overall German GDP (2006: 17.86%).

The correlation coefficient between the number of employees (2007; 15 years or over; Eurostat Database) and the number of companies investing in the Czech Republic is 0.888. On the basis of the number of employees, investors in the Czech Republic from North Rhine-Westphalia are even more underrepresented than taking the GDP as benchmark. This relationship is also valid for eastern German companies.

Figure 1 shows the economic sector affiliation of Czech companies which have German investors from the federal states of Baden-Württemberg, Bavaria, Hesse and North Rhine-Westphalia.

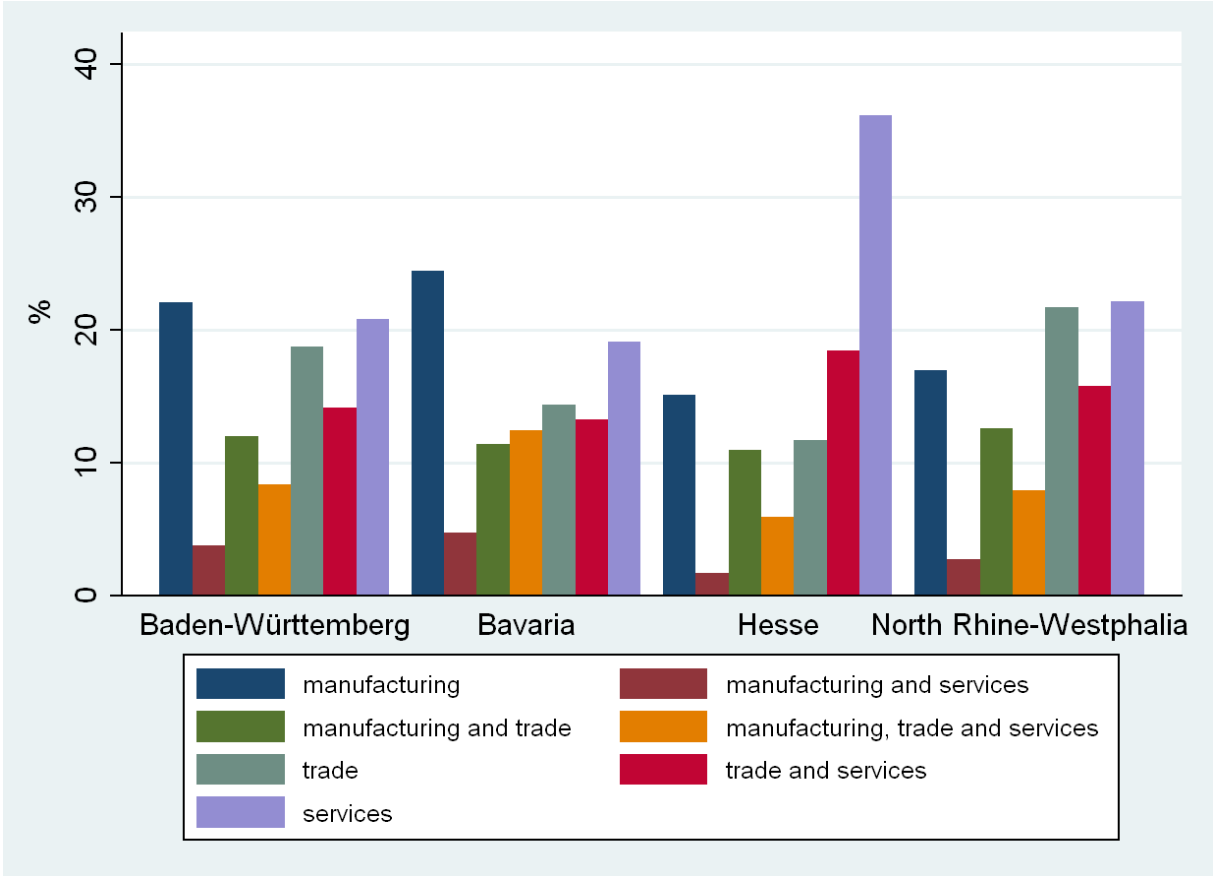


Figure 1. Distribution of economic sectors of Czech companies; Location of headquarters of German investors: Baden-Württemberg, Bavaria, Hesse and North Rhine-Westphalia.

Source. Own calculations; DTIHK (2008).

As mentioned above companies can ascribe themselves to two or three sectors. Companies which have an investor from Bavaria or Baden-Württemberg are more often operating in the

manufacturing sector compared to companies being financed by an investor from Hesse or North Rhine-Westphalia. In the case of Bavaria and Baden-Württemberg manufacturing companies make up the highest share, while companies investing in the Czech services sector dominate in Hesse and North Rhine-Westphalia. Hessian enterprises in particular hold shares in services businesses, whereas companies in North Rhine-Westphalia are to a relatively higher extent involved in the Czech trade sector.

Czech companies with shareholders from Bavaria or Baden-Württemberg have the largest number of workers on average. In contrast, the affiliates of Hessian capital providers have relatively few employees on average. The Eurostat Database for the year 2006 provides evidence that Baden-Württemberg exhibits the highest share both of workers employed in the manufacturing sector and of gross fixed capital formation (GFCF) in the year 2006, followed by Bavaria. Regarding the Czech affiliates, however, a higher share of companies with Bavarian investors is operating in the manufacturing sector, whereas the affiliates of investors from Baden-Württemberg act to a relatively higher extent in the trade sector. Possibly, the manufacturing industry of Baden-Württemberg is more engaged in sales and distribution in the Czech Republic, whereas the Bavarian manufacturing companies are primarily operating production plants. The lower distance to the border could favor the cross-border relocation of manufacturing steps. In turn, the investments of Bavarian companies in Czech trade affiliates are relatively smaller. Not surprisingly, Hesse as an international hub for financial services accounts for a high share of Czech affiliates operating in the services sector.

3.2 Rural districts und autonomous cities (*Landkreise und kreisfreie Städte*)

Figures 2 und 3 (see appendix) illustrate the distribution of German investors and Gross Domestic Product (GDP) at the district level. By trend, economically strong districts exhibit a larger number of investors operating in the Czech Republic. The correlation coefficient be-

tween the GDP at the district level and the number of German-Czech multinationals is 0.8316. Also distance seems to matter. Particularly, a relatively large number of companies from the districts situated close to the Czech Republic are operating beyond the border. Among the 15 districts with the largest number of investors are the metropolises of Munich, Hamburg, Berlin, Stuttgart and Frankfurt, but also the sparsely populated and economically less powerful eastern Bavarian districts of Cham (rank 7) and Wunsiedel im Fichtelgebirge (rank 15) which have a direct border with the Czech Republic. Relatively few investors are located in districts which are especially remote from the Czech border, e.g. in western North Rhine-Westphalia, in the northern parts of Lower Saxony and in Schleswig-Holstein. There is also a lack of German-Czech multinationals in Brandenburg which is close to Poland, where companies can also take advantage of lower labor costs.

3.3 Spatial planning regions (*Raumordnungsregionen*)

Before we switch over to the econometric analysis of German-Czech cross-border investments in Section 4 we aggregate the rural districts and autonomous cities to spatial planning regions. The reason for this is the more functional classification of the domestic regions compared to the formation at district level. Moreover, it is then possible to use additional data of the Federal Institute for Research on Building, Urban Affairs and Spatial Development (*Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR)*). As the 429 NUTS3 units at district level are aggregated to 97 spatial planning regions, we have then, of course, a smaller number of observations. At the time of completion of this study, the NUTS3 regions are classified according to the borders of July 1, 2007. Transforming the NUTS3 data to the state of the spatial planning regions from the year 1996 onwards until the year 2006 is only possible in the case of 95 spatial units, since the administrative reform in Saxony-Anhalt in July 2007 can only partly be taken into account.

Regarding the following analysis, we calculate a measure which indicates the distance of a spatial planning region to the Czech market. Thereby, we first identify for every rural district and autonomous city the route between the office of the respective district administration and the administrative centers of the cities of Ústí nad Labem, Karlovy Vary, Pilsen and České Budějovice, the capitals of the correspondent four border regions at NUTS3 level. For every route to the NUTS3 regional capitals we calculate then the driving time for the section between the German district capital and the next German-Czech border crossing. Afterwards, we generate the mean value between the route with the least driving time and the driving time to the administrative center of the capital city of Prague. This measure for the distance between a German district and the Czech Republic captures both the distance of a district to the most attractive location (Prague) plus the regions behind it and the distance to the investment opportunities nearby. The farther apart from the border and the more spatially proximate the districts are located, the less relevant is the consideration of the four capitals in the Czech border regions. For districts which are located close to the border, but a long way away from each other, the relative distance with respect to an investment in the nearest Czech region are indicated somewhat biased due to the inclusion of the driving time to Prague. The correlation coefficient between the distance measure and the driving time to Prague amounts to 0.9999. A slightly perceptible difference of the relative distances exists only for geographically dispersed districts which are situated closely to the border. The driving time to the Czech Republic for Dresden (in Saxony) is 2.3% lower than for Deggendorf (in eastern Bavaria).

Concerning the spatial planning regions, we calculate the distance measure of one unit by generating the mean value for the associated districts weighted by the average GDP of a district in the period from 1995 to 2006. In a similar way, we compute the driving time of a spatial planning region to the Polish border regions. Thereby, we calculate the routes of every district to the capitals of the Polish administrative districts which have a common border with

Germany.⁵ Regarding spatial planning regions, as above the mean value of the corresponding districts is computed. As the proximity to the Polish market offers substitutive incentives, for instance, with regard to investments in the Czech manufacturing sector, we choose the route with the least driving time as a distance measure.

Figures 4 to 6 (see appendix) show the number of German investors in the spatial planning regions subject to the economic activity of the Czech affiliates. The spatial planning regions Regensburg, Stuttgart, Munich, Upper Palatinate-North (*Oberpfalz-Nord*) and Upper Franconia-East (*Oberfranken-Ost*) exhibit the largest numbers of Czech affiliates operating in the manufacturing sector. The regions Regensburg and the two last-mentioned are situated directly at the Czech border. The spatial planning regions Düsseldorf, Hamburg and Berlin play a more prominent role as far as investments in Czech trade companies are concerned. Regarding services the relative strength of the Rhine-Main area attracts attention. Also Berlin and the Saxon spatial planning region Upper Elbe Valley/Eastern Ore Mountains have a relatively large number of investors in this sector. The region Upper Elbe Valley/Eastern Ore Mountains includes Dresden and borders on the Czech Republic. The regional distribution of German capital providers is more asymmetric for the services sector. In the case of a relatively large number of regions there is no single company investing in Czech services businesses, while some few regions feature a strikingly high level of activity in this field. The regional pattern of companies investing in the Czech manufacturing sector correlates to a higher extent with the figures for companies operating actively in the Czech trade sector. Regions with a large number of investors operating in the Czech manufacturing sector tend to possess also a higher number of German-Czech trade companies.

4. Econometric analysis for regions of origin of German FDI

4.1 Count data models

In order to investigate our research topics econometrically we use count data models (for a detailed discussion see Cameron and Trivedi 1998). Our dependent variable, the number of companies located in a German spatial planning region, which invest in an affiliate in the Czech Republic, is a variable taking the value zero or positive, integer values. Regarding count data there are alternative methods which are superior compared to using standard OLS regression. In general, count data indicate the number of occasions of a certain event. There is no upper limit of the positive, integer values of the variable, e.g. the number of births per woman, the number of visits to a doctor per person). The law of rare events says that if a Bernoulli experiment with the probability of success p is performed n times, the numbers of successes ($n \cdot p$) are Poisson distributed assumed that n tends to infinity and p tends to 0. Hence, an approximative 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.

Y follows a Poisson distribution with the parameter μ :

$$\Pr[Y = y] = \frac{e^{-\mu} \mu^y}{y!} \quad (1)$$

μ represents both the expected value and the variance of Y .

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

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

and $\mu_i = \exp(x_i' \beta)$.

The expected value of y_i is a function of explanatory variables. The model implies heteroscedasticity as both the expected value and the variance of y_i is a function of the explanatory

variables. The log-linear form warrants that μ_i is larger than 0. The coefficient vector β can be estimated consistently by the Maximum Likelihood Method. The t-statistics follow a normal distribution and can be interpreted in the usual way. Different models can be compared by means of selection criteria and the likelihood.

If the equality assumption of expected value and variance

$$\mu_i = E[y_i|x_i] = \text{Var}[y_i|x_i] \text{ (equidispersion)} \quad (3)$$

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

Assumed that the variance of y is a multiple of the expected value

$$(\text{Var}[y_i|x_i] = (1+\alpha) \cdot E[y_i|x_i]), \quad (4)$$

the standard errors can be corrected subsequently. In this case the variance can be weighted correspondingly by a Generalized Linear Model (GLM) (NB1 variance). The necessary weighting factor can be estimated consistently.

Under the assumption that

$$\text{Var}[y_i|x_i] = (1+\alpha) \cdot (E[y_i|x_i])^2 + E[y_i|x_i], \quad (5)$$

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 option 1 or option 2 (in both models the same number of parameters is estimated). In contrast to the Generalized Linear Model (option 1), 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. Within the scope of a NEGBIN1 model and NEGBIN2 model (option 2) also the assumption of equidispersion is tested. The parameter *alpha* indicates the absolute

value of the dispersion parameter, $\ln\alpha$ denotes the logarithmic value. If α is significantly different from 0, the equidispersion assumption is violated. Alternatively, we can estimate a Poisson regression with robust standard errors (option 3). In all of the three described options the coefficients are estimated consistently and the t-statistics can be interpreted in the usual way.

4.2 A specification for all activities

We regress the number of headquarters of German companies which are located in German spatial planning regions and actively operate in the Czech Republic on a set of control variables. A detailed description of the variables including the indication of source is provided in Table 1 (see appendix).

The regression model has the form:

$$\begin{aligned} \text{investors}_i = & \exp(\beta_0 + \beta_1 \cdot \ln_DrivT_CZ_i + \beta_2 \cdot \ln_DrivT_PL_i + \beta_3 \cdot \text{border}_i + \beta_4 \\ & \cdot \text{EastGermany}_i + \beta_5 \cdot \ln_GDP_i + \beta_6 \cdot \text{SecondSector}_i + \beta_7 \\ & \cdot \text{PopDens}_i + u_i), \\ i = & 1, \dots, 95 \end{aligned} \tag{6}$$

The dependent variable *investors* denotes the number of headquarters of German-Czech multinationals in one of the 95 German spatial planning regions. *ln_DrivT_CZ* expresses the logarithm of the driving time to the Czech Republic and *ln_DrivT_PL* the logarithm of the driving time to Poland (in each case in minutes). Two dummy variables control for regions which are directly located at the German-Czech border (*border*) and regions in eastern Germany (*East-Germany*). The variable *ln_GDP* denotes the logarithm of the regional GDP and is incorporated in the regression as a measure of dimension and economic prosperity of a region. For each region we calculate the mean GDP value (in millions of euros, Eurostat Database) of the years 1995-2006. *SecondSector* stands for the share of employees working in the regional

secondary sector, i.e. the industries of energy and water supply, mining, manufacturing, construction. The employment share of the secondary sector is available for the years 1998-2000 and 2004-2005 (INKAR Database of the Federal Institute for Research on Building, Urban Affairs and Spatial Development). We calculate the mean value of the mentioned five years. As a measure for the level of agglomeration the variable *PopDens* represents the regional population density. These data are also taken from the INKAR Database of the Federal Institute for Research on Building, Urban Affairs and Spatial Development. Due to theoretical considerations and our descriptive results we expect the following outcome of the estimations:

- *ln_DrivT_CZ*: Depending on the investment motives the driving time to the Czech Republic has a different impact on the attractiveness of investments in the neighboring country. Regarding investments which are executed mainly due to the reduction of costs, distance as a proxy for trade costs can have a negative effect on investments. Concerning market development the direction of impact is less clear. On the one hand, due to lower information and communication costs the incorporation of subsidiaries, for instance in the trade sector, should also be more attractive in nearby regions (Buch, Klei- nert, and Toubal 2003). On the other hand, German companies could be interested to gain access to consumer markets that are remote from the German-Czech border. In order to better exploit the customer potential and better serve its customers in the areas east of Prague, a company will establish subsidiaries on-site. Therefore, with respect to market motives both a negative and positive relationship to distance can possibly appear.
- *ln_DrivT_PL*: An investment in Poland can constitute a substitute for cost reducing activities in the Czech Republic. As a result regions having a relatively short distance to Poland should have a fewer number of investors. Regarding market motives the substitutive correlation should be less pronounced. Companies might have an incentive to both

enter the Czech and the Polish market. All in all, a positive impact of a low distance to Poland on the number of German-Czech multinationals is less probable but not impossible.

- *border*: In regions which directly border on the Czech Republic transaction costs in terms of cross-cultural communication should be especially low. This could lead to enlarged foreign direct investments, apart from the advantageous lower transportation costs that are captured by the driving time.
- *EastGermany*: As the economic system in the New Laender 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. Consequently, the number of investors with headquarters in eastern Germany should be lower.
- *ln_GDP*: The descriptive figures show that the GDP of a region is clearly positively correlated with the number of investors. In empirical studies the relation of GDP and FDI is usually positive.⁶
- *SecondSector*: A large number of multinational companies in a region should depend on the structure of economic sectors in a region. Possibly, a higher share of employees in the secondary sector positively correlates with the number of large firms in a region which are more likely to become multinationals (Barba Navaretti and Venables 2006). Thereby, the effect of the share of employees in the secondary sector could differ between the three economic sectors. Regions with a relatively high share of employees in the secondary sector should especially register a higher number of investors operating in the Czech manufacturing sector.
- *PopDens*: The population density (measured as inhabitants/km²) represents a measure of the agglomeration level of a region. Larger, often more productive companies are to a

higher extent located in agglomerative areas. It can be assumed that more productive enterprises more likely operate abroad (Melitz 2003). For that reason the regional population density supposedly affects the number of cross-border investors in a positive way.

The equidispersion assumption of an identical value for expected value and variance of the dependent variable is rejected at the 10% level in the NEGBIN1 estimation, but not in the NEGBIN2 estimation. The results of the Poisson regression with robust standard errors, which are depicted in Table 2, and the GLM regression with corrected standard errors (according to the NB1 variance) (see Table 3 in the appendix) are, however, very similar.

Table 2. Poisson regression with robust standard errors.

Poisson regression	Number of obs	=	95
	wald chi2(7)	=	1312.45
	Prob > chi2	=	0.0000
Log pseudolikelihood = -240.65099	Pseudo R2	=	0.7135

investors	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
ln_DrivT_CZ	-.9567028	.1154001	-8.29	0.000	-1.182883	-.7305228
ln_DrivT_PL	.1778761	.052225	3.41	0.001	.075517	.2802352
border	.6490985	.1092567	5.94	0.000	.4349594	.8632377
EastGermany	-.8987135	.1255691	-7.16	0.000	-1.144824	-.6526026
ln_GDP	1.20785	.0582093	20.75	0.000	1.093762	1.321938
SecondSector	.0242698	.0044985	5.40	0.000	.0154529	.0330868
PopDens	.0001244	.0000526	2.36	0.018	.0000213	.0002274
_cons	-5.97561	1.002286	-5.96	0.000	-7.940054	-4.011166

In the Poisson regression with robust standard errors all regressors exhibit significant coefficients. The largest impact emanates from regional GDP and the driving time to the Czech Republic. An increase in the GDP by 1% raises the number of investors ceteris paribus by 1.21%. The value of the lower confidence bound is 1.09, i.e. there is an above-average partial relation between economic potential and capital providers. A rise of the driving time to the Czech Republic by 10% reduces the number of investors by 9.57%. In contrast, an increase in

the driving time to Poland by 10% minutes leads to an expansion of German-Czech multinationals by 1.78%. The number of investors in regions with a direct border to the Czech Republic is higher by 91.38% (corresponding to $e^{\beta(border)} - 1 = e^{\beta(0.6490985)} - 1 = 0.9138$), whereas the number of capital providing companies in eastern Germany is lower by 59.29% (corresponding to $e^{\beta(EastGermany)} - 1 = e^{\beta(-0.8987135)} - 1 = -0.5929$). A higher share of employees working in the secondary sector positively affects the presence of cross-border investors in a spatial planning region. A rise of the sectoral share by one percentage point increases the number of German-Czech companies by 2.46%.⁷ The variable *PopDens* exhibits a positive coefficient which is significant in the statistical sense (not so in the GLM estimation with NB1 variance). The practical relevance, however, is of limited importance as a rise of the population density by one person per km² increases the number of capital providers by 0.01%.

4.3 Specifications separately for different economic sectors

The sample is now split in three subsamples. Corresponding to the information from the German-Czech Chamber of Industry and Commerce we divide the German investors up into three groups. The first (second, third) subsample includes only companies which provide capital for a Czech manufacturing (trade, services) affiliate. Companies which ascribe themselves to more than one activity are excluded from the samples. We are interested in whether the influence of the explanatory variables on the number of investors varies depending on the affiliation to an economic sector.

Table 4 provides the complete estimation outcome for the single economic sectors. The dependent variable *investors_M* (*investors_T*, *investors_S*) denotes the number of enterprises in a German spatial planning region which are actively operating in the Czech manufacturing (trade, services) sector. In all cases the equidispersion assumption is not rejected. Thus, we estimate Poisson regressions, nevertheless using robust standard errors.⁸

For all sectors, the estimations yield a highly significant impact of the gross domestic product. The influence of the regional economic performance in the domestic region is clearly above-average for the services sector. In contrast, the coefficient of the population density is insignificant in all cases. The driving time both to the Czech Republic and to Poland exhibits significant values for the manufacturing and the services sector, but not so for the trade sector. The unequal importance of distance on investments in the manufacturing and in the trade sector could depend on different motives for foreign direct investments. Regarding the negative effect on investments in services businesses, the cultural distance could also play a crucial role. The service activities of Czech affiliates are for the most part very demanding. Concerning complex activities, e.g. in the field of financial and legal advice or consultancy, cultural distance possibly is all but of vital importance. Another influencing factor could be the relocation of service activities by German companies.

By comparing the results for the trade and the services sector it is noticeable that in the case of the services sector the dummies for the border region and eastern Germany are insignificant. On the one hand, this means for investments in the Czech trade sector that locations directly at the German-Czech border play a prominent role, whereas the driving times to the Czech Republic and to Poland are of minor importance. On the other hand, headquarters of companies providing capital for the Czech services sector are to a relatively higher degree situated in eastern German and non-border areas with good transport connections to the Czech Republic, but rather off the main road to Poland. The share of employees in the secondary sector is significantly positive only for the manufacturing and trade sector. Confirming the descriptive figures this outcome suggests the closer relationship between the regional investments in the Czech manufacturing and the trade sector.

Table 4. Regressions separately for economic sectors – manufacturing, trade, services.

Poisson regression Number of obs = 95
wald chi2(7) = 254.21
Prob > chi2 = 0.0000
Log pseudolikelihood = -137.82565 Pseudo R2 = 0.4253

investors_M	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
ln_DrivT_CZ	-.959483	.2159308	-4.44	0.000	-1.3827	-.5362665
ln_DrivT_PL	.3149553	.0816395	3.86	0.000	.1549447	.4749658
border	1.08257	.1568918	6.90	0.000	.7750682	1.390073
EastGermany	-1.394871	.2871563	-4.86	0.000	-1.957687	-.8320546
ln_GDP	1.033143	.1105531	9.35	0.000	.8164625	1.249823
SecondSector	.0378757	.0087522	4.33	0.000	.0207217	.0550296
PopDens	-.0003332	.0002272	-1.47	0.143	-.0007786	.0001121
_cons	-7.00507	1.860316	-3.77	0.000	-10.65122	-3.358918

Poisson regression Number of obs = 95
wald chi2(7) = 230.08
Prob > chi2 = 0.0000
Log pseudolikelihood = -134.90114 Pseudo R2 = 0.4581

investors_T	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
ln_DrivT_CZ	-.2797933	.3136692	-0.89	0.372	-.8945736	.334987
ln_DrivT_PL	.1083237	.1625277	0.67	0.505	-.2102247	.4268721
border	.9520908	.3104591	3.07	0.002	.3436021	1.56058
EastGermany	-.9136186	.349854	-2.61	0.009	-1.59932	-.2279174
ln_GDP	1.312941	.12237	10.73	0.000	1.0731	1.552782
SecondSector	.037518	.0117594	3.19	0.001	.0144701	.060566
PopDens	.0002046	.0001261	1.62	0.105	-.0000426	.0004518
_cons	-13.01026	2.287908	-5.69	0.000	-17.49448	-8.526043

Poisson regression Number of obs = 95
wald chi2(7) = 473.39
Prob > chi2 = 0.0000
Log pseudolikelihood = -140.87978 Pseudo R2 = 0.6308

investors_S	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
ln_DrivT_CZ	-1.373461	.2788648	-4.93	0.000	-1.920026	-.8268963
ln_DrivT_PL	.4245558	.1657009	2.56	0.010	.099788	.7493236
border	.4773496	.3205687	1.49	0.136	-.1509536	1.105653
EastGermany	-.3620635	.2882333	-1.26	0.209	-.9269904	.2028634
ln_GDP	1.602827	.100616	15.93	0.000	1.405623	1.800031
SecondSector	.0044364	.0082328	0.54	0.590	-.0116995	.0205723
PopDens	.0001138	.0001	1.14	0.255	-.0000822	.0003097
_cons	-9.843967	1.80547	-5.45	0.000	-13.38262	-6.305312

5. Conclusion

The Czech Republic represents a highly appealing target country for German direct investments. On the one hand, the still existing wage gap offers an opportunity for companies to take advantage of lower costs by offshoring activities across the border. On the other hand, the rising purchasing power of Czech consumers is attractive for the opening up of new markets. With regard to theoretical considerations for both vertical and horizontal direct investments the low distance to Germany should matter. A firm registry made available by the German-Czech Chamber of Industry and Commerce has the advantage that it covers a far larger number of German-Czech multinationals than other databases dealing with German foreign direct investments. The analysis of the data yields results with regard to the relevance and impact of different factors on economic activities of German companies in the Czech Republic. Descriptive figures show that almost 80% of the headquarters of German investors are located in the four federal states Bavaria, Baden-Württemberg, Hesse and North Rhine-Westphalia. The eastern German New Laender are far less engaged in investments in the neighboring country. Both at the level of federal states and at the district level economic strength strongly correlates with the number of companies investing in the Czech Republic. Likewise, the distance to the Czech market seems to have an impact on the investment activity. Particularly striking is the relatively strong position of the rather densely populated regions bordering on the Czech Republic. In the econometric analysis we use count data models in order to investigate the determinants of the number of German-Czech multinationals in the domestic regions. Estimating a model that includes all activities in Czech Republic the geographical distance has a negative effect on the number of investors in a spatial planning region. By splitting up the data into three subsamples it comes out that this impact can be attributed especially to the investments in the Czech manufacturing and services sectors. The find-

ings illustrate the relevance and different impact of regional aspects for foreign direct investments dependent on the target sector in the country of destination.

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Notes

1. The percentage values do not add up to 100%, since 38% of the relocating companies named more than one target country.
2. Note the difference between the data sets of the German Chambers of Industry and Commerce (DIHK) and the German-Czech Chamber of Industry and Commerce (DTIHK).
3. For more detailed descriptive statistics with regard to direct investments of German companies in the Czech Republic see Moritz and Schäffler (2009).
4. Scheduled driving time of a heavy-goods vehicle: motorway: 75 km/h, federal highway: 45 km/h, country road: 40 km/h, urban road: 30 km/h.
5. Three of 16 Polish administrative districts (*województwa*) border on Germany.
6. We are aware of the endogeneity problem that arises by using GDP as an explanatory variable. A higher number of German-Czech multinationals in a given region, of course, contributes to a higher GDP level. Nevertheless, due to the resounding correlation between this economic factor and the variable to be explained and the lack of adequate instrumental variables, it should be included in the estimation. We also included GDP per employee as explaining variable in the regression which exhibited in all estimation variants an insignificant coefficient value.
7. Possibly, the share of high-skilled employees also plays a role for the positive coefficient value. The share of high-skilled employees negatively correlates with the share of workers employed in the secondary sector (correlation coefficient: -0.4911). Regions with a higher share of high-skilled employees are potentially less affected by cross-border relo-

cations for reasons of cost reduction. By adding the share of high-skilled employees to the set of right-hand side variables, however, the coefficient value is insignificant.

8. The results only slightly change by estimating Poisson regressions without robust variances.

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Appendix

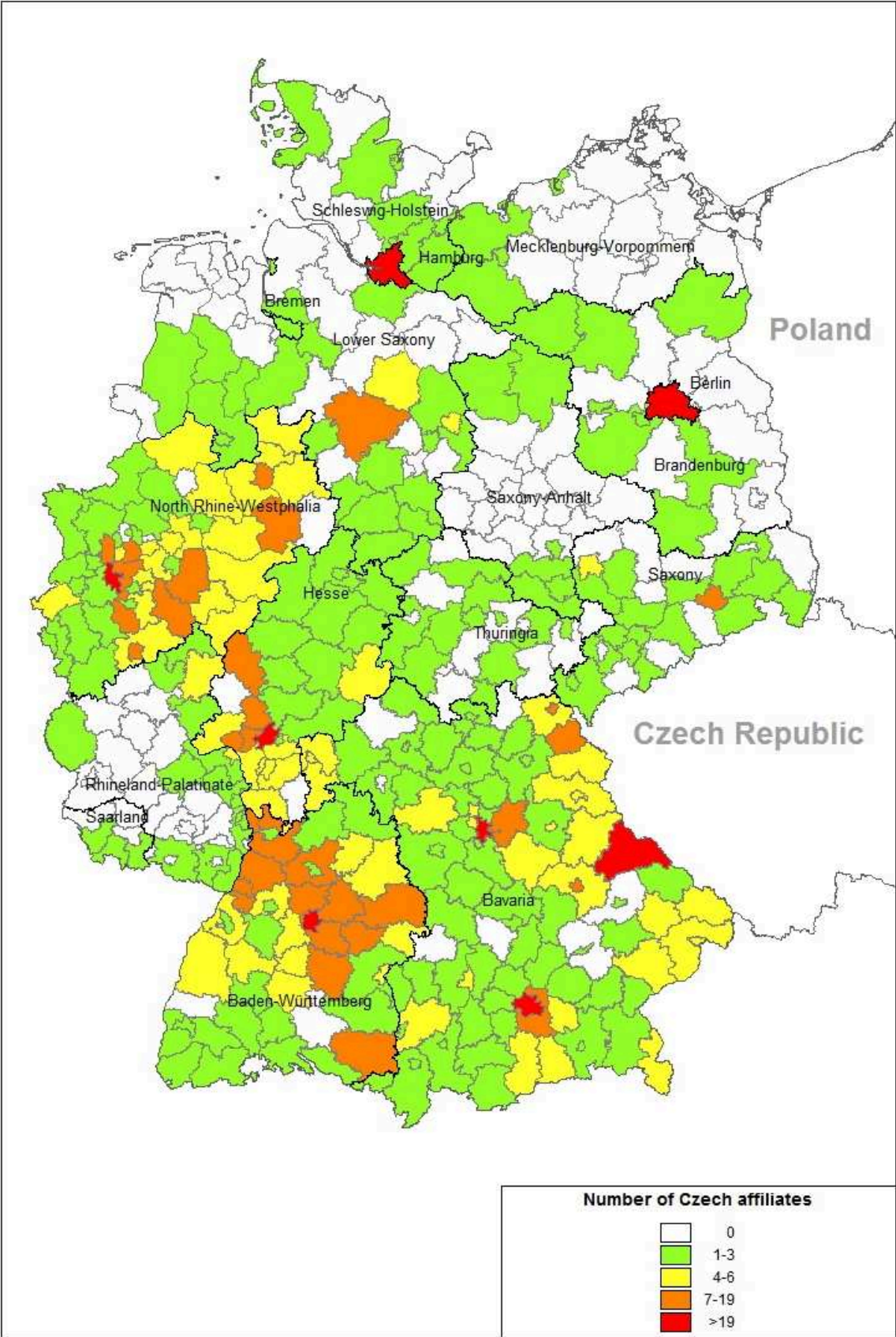


Figure 2. Spatial distribution of German investors at the district level. Source. Own calculations; DTIHK (2008).

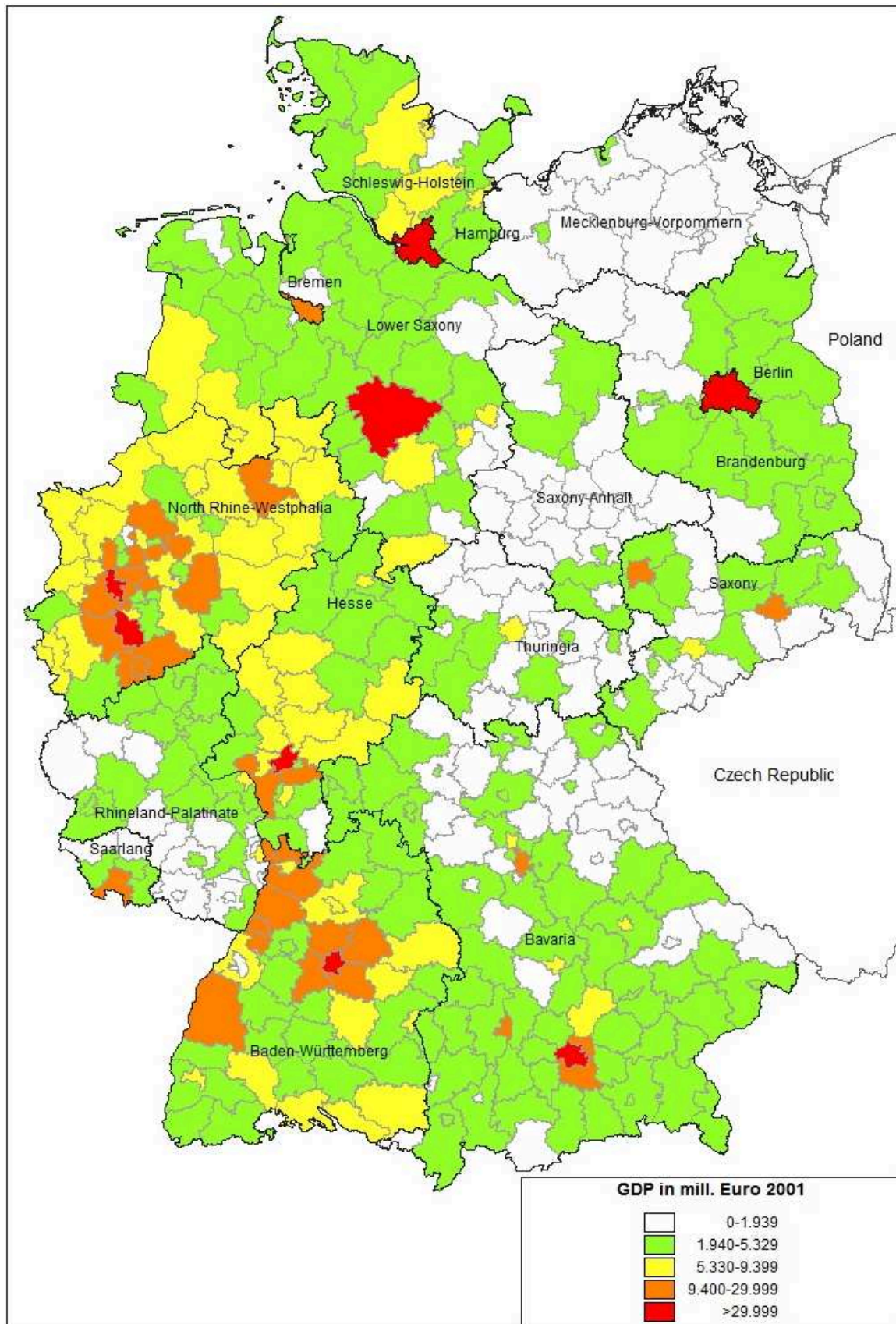


Figure 3. Gross Domestic Product (GDP) at the district level.

Source. Own calculations; Software District 8.0 (GDP data).

Note. The number of cases for the size ranges corresponds to the distribution in Figure 2.

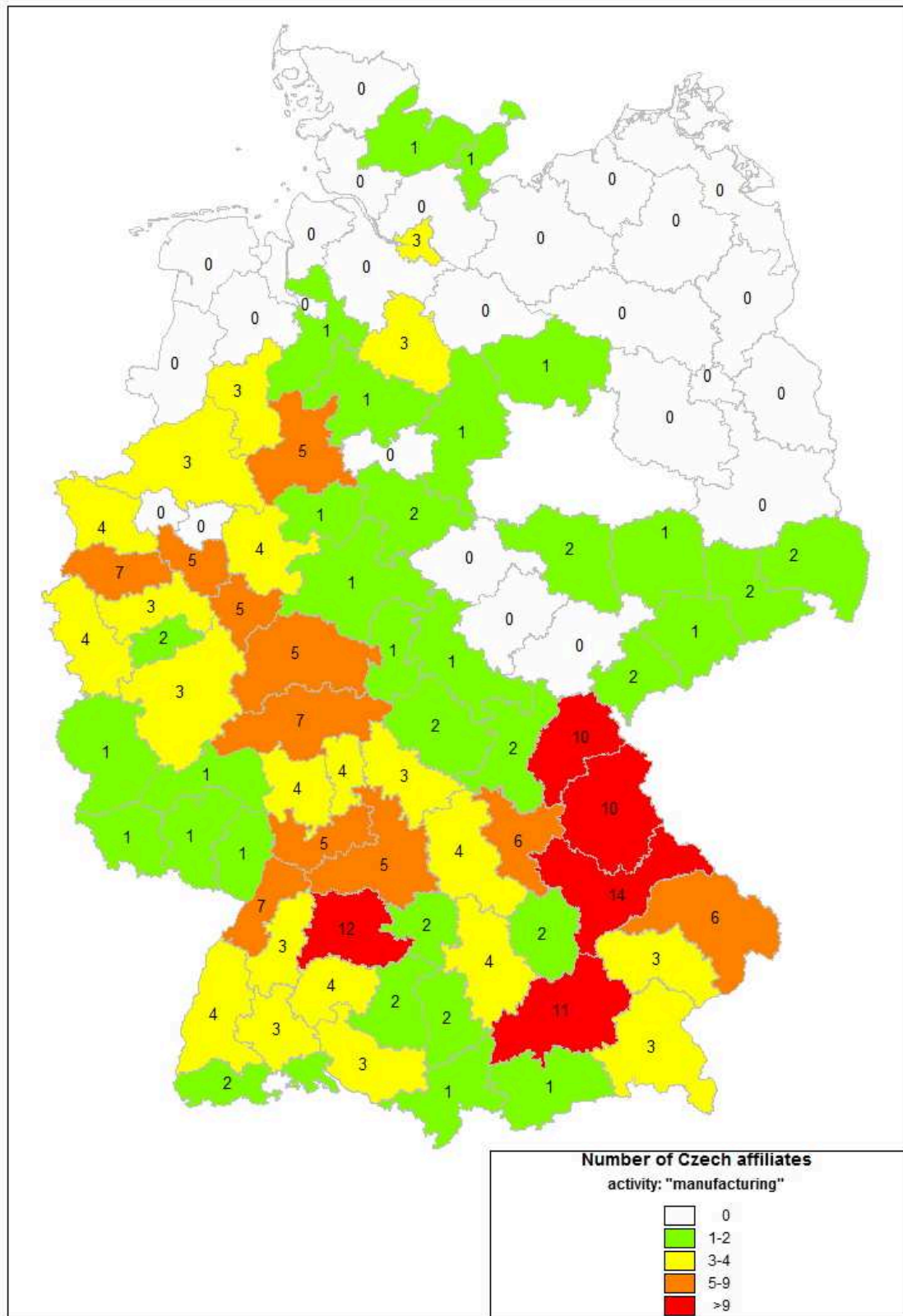


Figure 4. Spatial distribution of German investors in the manufacturing sector. Source. Own calculations; DTIHK (2008).

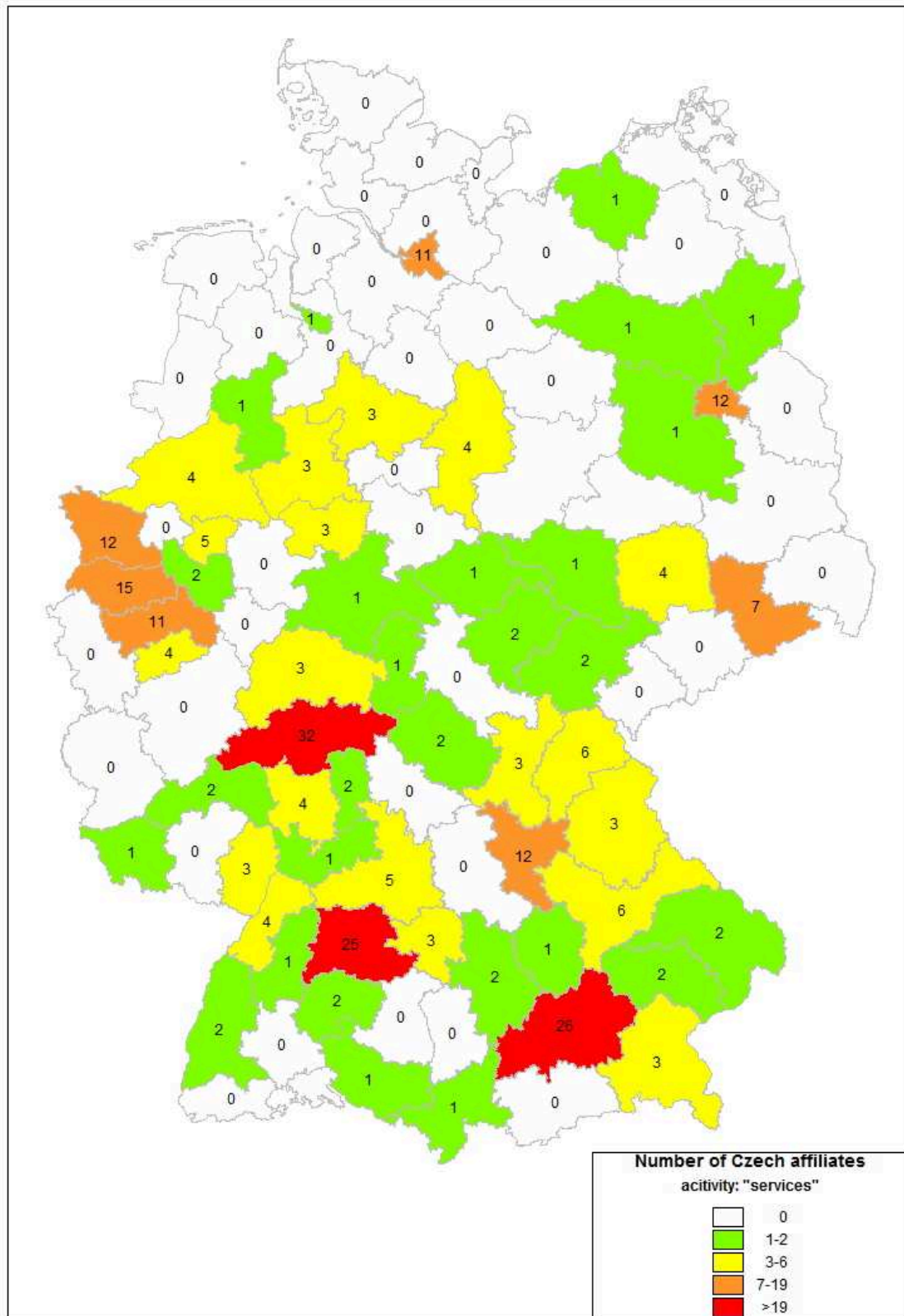


Figure 6. Spatial distribution of German investors in the services sector.
Source. Own calculations; DTIHK (2008).

Table 1. List of variables.

Variable	Source
<i>investors</i> : number of German companies in a spatial planning region which actively operate in the Czech Republic	German-Czech Chamber of Industry and Commerce (<i>Deutsch-Tschechische Industrie- und Handelskammer DTIHK</i>)
<i>driving time</i> : Driving time of a heavy-goods vehicle: motorway: 75 km/h, federal highway: 45 km/h, country road: 40 km/h, urban road: 30 km/h.	route planning software <i>map & guide calculate 2009</i>
population density (<i>PopDens</i>) at the level of spatial planning regions	The Federal Institute for Research on Building, Urban Affairs and Spatial Development (<i>Bundesinstitut für Bau-, Stadt- und Raumforschung BBSR</i>)
gross domestic product (<i>GDP</i>), number of employees, gross fixed capital formation at the level of German federal states	Eurostat Database
<p>share of employees working in the secondary sector (<i>SecondSector</i>):</p> $= \frac{\text{employees in the secondary sector subject to social insurance contribution}}{\text{all employees subject to social insurance contribution}}$ <p>Definition of secondary sector: energy and water supply, mining, manufacturing, construction</p> <p>Years: 1998, 1999, 2000, 2004, 2005</p>	The Federal Institute for Research on Building, Urban Affairs and Spatial Development (<i>Bundesinstitut für Bau-, Stadt- und Raumforschung BBSR</i>), CD-ROM “INKAR”, editions 1999, 2000, 2002, 2006, 2007

Table 3. Regression model for all activities with NB1 variance.

Generalized linear models		No. of obs	=	95
Optimization	: ML	Residual df	=	87
		Scale parameter	=	1
Deviance	= 129.4488846	(1/df) Deviance	=	1.487918
Pearson	= 122.4847083	(1/df) Pearson	=	1.40787
Variance function:	$v(u) = u$	[Poisson]		
Link function	: $g(u) = \ln(u)$	[Log]		
		<u>AIC</u>	=	5.234758
Log likelihood	= -240.6509894	<u>BIC</u>	=	-266.7384

investors	Coef.	OIM Std. Err.	z	P> z	[95% Conf. Interval]	
ln_DrivT_CZ	-.9567028	.165006	-5.80	0.000	-1.280109	-.6332969
ln_DrivT_PL	.1778761	.0838596	2.12	0.034	.0135143	.3422379
border	.6490985	.152184	4.27	0.000	.3508234	.9473736
EastGermany	-.8987135	.1651681	-5.44	0.000	-1.222437	-.57499
ln_GDP	1.20785	.0640113	18.87	0.000	1.08239	1.33331
SecondSector	.0242698	.0056565	4.29	0.000	.0131833	.0353563
PopDens	.0001244	.0000761	1.63	0.102	-.0000249	.0002736
_cons	-5.97561	1.227596	-4.87	0.000	-8.381653	-3.569567