

Appendix A: Development of German FDI stocks in the Czech Republic, Poland and the BRICS

Figure A1 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 from the Deutsche Bundesbank feature an amount of more than €24 billion of German FDI and around 271,000 employees working for 946 German-owned firms in the Czech Republic (DEUTSCHE BUNDESBANK, 2013).

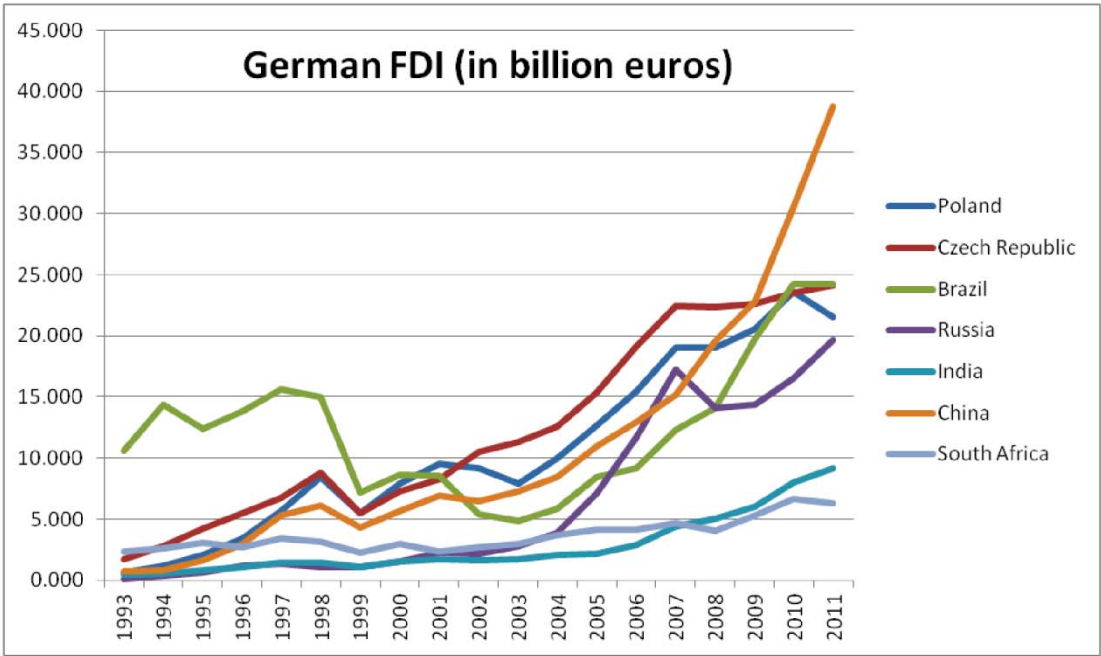


Figure A1: German FDI in the Czech Republic, Poland and BRICS

Source: Deutsche Bundesbank.

However, when interpreting Figure A1, it has to be taken into account that the thresholds reported in the database of the Deutsche Bundesbank have been changed several times in recent years. At present, only foreign subsidiaries of German firms are included which have a balance sheet total of at least €3 million. This might appear not to be very restrictive. However, taking into account that, according to the Czech Commercial Register, the firms registered by the Deutsche Bundesbank represent only about one fourth of the German FDI projects performed in the Czech Republic, it is not clear, what this bias in favour of large firms exactly implies. Therefore, while the numbers in Figure A1 evidentially manifest the rise of German FDI for the illustrated countries, they also reveal one of the greatest impediments concerning research on cross-border FDI relations. It seems plausible to assume that investments of German firms that do not reach the threshold of at least €3 million in terms of balance sheet total are easier to perform and therefore more frequent in the neighbouring Czech Republic than in countries farther away like the BRICS. Thus, the relative impact of the threshold on the recorded total sum of German FDI in the Czech Republic might also have been higher than in these countries. The shortcoming of not including a significant part of small and medium-sized enterprises applies also for commercial suppliers of suitable data for scientific investigations, as the databases are usually based on balance-sheet information (see the assessment by BUDD et al., 2005, for example).

Appendix B: Details on control variables

A first set of control variables included in the analysis can be summarized as *market size and agglomeration features*. To account for the market potential of the home and the target region of investment, the regional *Gross Domestic Product (GDP)* is included. In addition, in both countries the regional *GDP per capita* is intended to account for regional differences in labour productivity. As in other studies (BHAT et al., 2014; HE, 2002), the population density is included to measure urbanisation economies that are external both to firms and to sectors and may generate positive externalities (JACOBS, 1969). Additionally, the spatial concentration of firms belonging to the same sector may also generate positive externalities and attract FDI (BARRIOS et al., 2006; HEAD and MAYER, 2004). To capture these localisation economies that emerge from sharing inputs, knowledge spillovers and labour market pooling (MARSHALL, 1890), the *ratio of employees in the manufacturing sector to employees in the service sector* is applied. To account for weaker economic conditions accompanied with a lower number of headquarters in the eastern federal states compared to the western part of Germany, a dummy variable for *East Germany* is included. Eastern Germany's proximity to Poland as an alternative investment location might additionally lower the likelihood for investments in the Czech Republic. Another dummy variable controls for the special position of *Prague* as this metropolis constitutes the Czech Republic's undisputed centre of economic activities, the most innovative Czech region (BERNARD et al., 2014).

A second group of control variables can be summarized as *labour market features*. One essential variable in this field is the wage level. In the home country, a higher wage level refers to a higher productivity in the region which could be correlated to a larger number of multinationals. Moreover, as the reduction of labour costs ranges

among the most important relocation motives (ALAJÄÄSKÖ, 2009; YEAPLE, 2003), high labour costs in the home region could be an incentive for companies to invest abroad. In the target country, higher wages reflect a higher consumer purchasing power as well as higher labour costs. Another labour market attribute is the regional unemployment rate. In the domestic regions a low unemployment rate stands for a favourable economic situation and potentially for the scarcity of labour. Regarding the destination country, high unemployment rates signal, on the one hand, the availability of workers and, on the other hand, weak economic structures. As in the Czech Republic, specific grants and investment incentives 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), this variable also captures institutional regional differences. The last variable of this group is the share of high-skilled employees in a region and serves as a proxy for the relative endowment with human capital. The availability of a highly qualified workforce can be a locational advantage for regions in the target country competing for FDI, if foreign investors search for a creative and innovative business environment. An above-average share of high-skilled employees could, however, also be opposed to the demands of multinational companies. This would be the case, if less skill-intensive production steps are offshored which require a relatively large supply of low-skilled workers. With regard to the activities of German multinationals in eastern European countries, MARIN (2004) finds evidence that investments are not only motivated by the search for lower costs but also by seeking qualified labour. Concerning the Czech Republic, SPILKOVÁ (2007) confirms that Czech regions with a higher educational level and with higher wage levels are preferred location sites for foreign direct investment.

Appendix C: Details on the estimation method

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). Discrete choice models are widely applied to estimate the probability to be chosen as investment location (BASILE et al., 2009; DISDIER and MAYER, 2004; GUIMARÃES et al., 2000; HEAD et al., 1995, 1999; ZVIRGZDE et al., 2013). Since this paper considers information from home and host regions of FDI, the scope is closer to a second strand, 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 countries, 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).

In a basic version of the gravity equation, it is assumed that the GDP of both investing and receiving unit (country, region) i and j with respect to a specific observation, denoted by GDP_i and GDP_j , have a positive impact on the volume of foreign direct investment FDI_{ij} between the units. A negative impact of distance $Dist_{ij}$ is assumed due to rising costs as distance increases. Thus, the basic equation can be written as

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

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

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

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

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

This course of action, however, gives cause for criticism. Firstly, due to Jensen's inequality $E(\ln y) \neq \ln E(y)$, the estimation of equation (3) produces inconsistent results in the presence of heteroscedastic error terms. Secondly, in cases where there are no FDI flows between two units of observation, the zeros in the dependent variable pose a problem for the estimation of the log-linear specification. Alternative approaches like dropping the zero observations, taking $FDI_{ij} + 1$ as the dependent variable or using a Tobit model lead to inconsistent parameter estimates.

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

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

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

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

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

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

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

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

Under the assumption that

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

a Negative Binomial (NegBin) model with corresponding variance function has to be estimated, again applying the Maximum Likelihood Method. This model is referred to as NegBin II model. Within the scope of a NegBin II model the assumption of equidispersion is tested: *alpha* indicates the absolute value of the dispersion parameter. If *alpha* is significantly different from zero, the equidispersion assumption is violated and the estimation of the NegBin II model is preferred. Alternatively, if *alpha* is not statistically different from zero, the estimation of a Poisson regression with robust standard errors is favoured. In both cases, the coefficients are estimated

consistently and the t-statistics follow a normal distribution and can be interpreted in the usual way.

**Appendix D: Estimation result of Negative Binomial regressions for
manufacturing FDI and services FDI projects – all specifications**

Table D1 and Table D2 show the estimation result of all specifications for manufacturing FDI projects and services FDI projects.

Table D1: Estimation result of Negative Binomial regressions for manufacturing FDI projects – all specifications

Manufacturing FDI projects		1		2		3		4		5	
		Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
market size and agglomeration	ln_GDP_GER	0.9681***	0.0597	0.8759***	0.0531	1.0834***	0.0903	1.1514***	0.1061	1.1465***	0.1106
	ln_GDP_CZ	0.1022	0.0711	0.4814***	0.0899	0.3342***	0.1103	0.3638*	0.2072	0.3832*	0.2086
	ln_GDPpc_GER							-0.3727	0.4413	-0.3099	0.4608
	ln_GDPpc_CZ							-1.0937	1.3300	-1.1952	1.3316
	ln_PopDens_GER							0.2924***	0.0958	0.2671***	0.1012
	ln_PopDens_CZ							-0.1638	0.2455	-0.1691	0.2455
	ln_Manu/Serv_GER							0.8773***	0.1244	0.9944***	0.1302
	ln_Manu/Serv_CZ							-0.1187	0.2605	-0.1059	0.2607
	East_Germany			-1.4340***	0.1333	-1.2401***	0.2447	-1.4484***	0.2511	-1.5105***	0.2618
	Prague			-1.0137***	0.2032	-1.3230***	0.2979	-0.5183	1.3502		
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	Constant	-0.8567	0.9723	-1.9631	1.2516	0.2539	2.8657	17.7621	12.7915	19.1712	12.8824
	N	1344		1344		1344		1344		1248	
	Pseudo-R ²	0.1153		0.1694		0.1747		0.1943		0.1977	
	Loglikelihood	-1557.3166		-1462.1765		-1452.6849		-1418.2341		-1312.7070	
	Alpha	0.9090***		0.4812***		0.4256***		0.3345***		0.3306***	

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

Table D2: Estimation result of Negative Binomial regressions for services FDI projects – all specifications

Services 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	Constant	-8.1143***	0.8560	-7.4943***	1.2196	1.5755	2.6605	12.5711	13.0940	17.1690	13.3297
	N	1344		1344		1344		1344		1248	
	Pseudo-R ²	0.1972		0.2365		0.2457		0.2638		0.22	
	Loglikelihood	-1738.7974		-1653.7495		-1633.8167		-1594.5861		-1336.5701	
	Alpha	0.8262***		0.4747***		0.4053***		0.3226***		0.3278***	

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

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