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**Article**

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Article

# Determinants of German Direct Investment in CEE Countries

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**Abstract:** This paper studies the determinants of German direct investment in the Central and Eastern European countries during the period 1996–2016 using the augmented Knowledge Capital model to identify the main reasons for foreign direct investment (FDI). The empirical results show increasing multinational enterprise (MNE) activity with growth in country-size and with growing similarities of countries, which supports the horizontal reason for FDI; while the difference in the share of skilled labor force associated with the vertical reason has no effect. Furthermore, the estimation results show unimportance of trade costs to the foreign market and the significance of the distance between source and host countries.

**Keywords:** Central and Eastern Europe (CEE) countries; German MNEs; foreign direct investment; knowledge capital model

## 1. Introduction

Multinational enterprises (MNEs) which are responsible for international foreign direct investment (FDI) flows have become one of the most important features of the globalized world economy. Traditionally, most FDI originates predominantly from developed countries which have also been the major recipients of FDI. However, more recently more and more global FDI flows are directed towards the so-called emerging markets. The liberalization of the countries in Central and Eastern Europe (CEE) at the beginning of the 1990s led to a huge inflow of FDI into these countries. Germany has been one of the most important source countries of foreign capital for the CEE countries (Becker and Cieřlik 2020).

However, the most recent empirical studies dealing with determinants of German FDI focus on distant locations in Africa, Asia and Latin America which is surprising given the geographic and cultural proximity of the CEE countries and their strategic importance for the German economy (Glitsch et al. 2020; Camarero et al. 2020). The existing empirical evidence on the determinants of German FDI in the CEE countries is still rather scarce and mainly limited to firm-level survey evidence. The business survey of German Chambers of Commerce in this region can give a first impression of the factors which are important for German MNEs. In this survey these chambers ask the German MNE affiliates in 15 CEE countries about the current economic situation in each country and ask them to evaluate 21 investments factors. For example, in 2017 a total of 1754 affiliates participated in this survey.

The German Chambers of Commerce Business Survey (2017) gives only a general idea regarding the determinants which effect German MNE activity in the CEE countries. For example, the results show that the Czech Republic, Poland and Slovakia are the most attractive countries for German MNEs in the CEE region. In addition, with a share of 68% satisfied and very satisfied affiliates, EU membership is the most important attractiveness factor for the eleven new EU member states. The survey further reveals that the significance of this factor has increased over the years. However, it is insufficient to

extrapolate these results as valid quantitative determinants of German foreign investment in the region as it contains only very subjective impressions of a limited number of affiliates. Moreover, the number of surveyed firms with subsidiaries in selected countries in the region is usually small and may not be always representative. Equally important, the survey is not directly linked to theories of foreign direct investment.

Therefore, the main aim of this paper is to analyze empirically the determinants of German MNE affiliates' activity in the CEE countries. In particular, in this study we refer to the formal Knowledge-Capital (KK) model of multinational enterprise developed by Markusen (2002, 2013) that provides a direct connection between the theory and the data. The KK model enables us to distinguish between horizontal and vertical motives for FDI. This distinction is important because horizontal FDI has been widely studied while vertical FDI has received much less attention in the literature. The empirically testable research hypotheses are derived directly from the KK model and applied to German MNE affiliates' activity. The model is then augmented with the variables taken from the business survey. The research hypotheses are tested empirically using statistical data for 13 CEE host countries for the period 1996–2016.

The structure of this paper is as follows. The next section provides an overview of the relevant literature on multinational enterprise and foreign direct investment in the context of German FDI in the CEE countries. Afterwards, the main assumptions of the KK model are discussed and the research hypotheses are formulated. Then, definitions, data sources and the empirical methodology are described. In the subsequent section, the empirical results are reported. Finally, the summary of the main findings and directions for the future research are provided in the concluding section.

## 2. Literature Review

The early research on the determinants of MNE activity focused mainly on explaining horizontal FDI between developed countries. The first theoretical models of horizontally-integrated MNEs were developed by Krugman (1983) and Markusen (1984). Their seminal models were later extended by, *inter alia*, Horstmann and Markusen (1987), Markusen and Venables (1998), Helpman et al. (2004), Sinha (2010), Collie (2011), Cieřlik (2013, 2015a, 2015b, 2016, 2018) and Cieřlik and Ryan (2012). At about the same time, theoretical studies also attempted to explain vertical FDI between developed and developing countries. Helpman (1984) and Helpman and Krugman (1985) proposed the first models of vertically-integrated MNEs in which FDI arose as a result of differences in per worker physical capital stocks between source and home countries. These models were later extended by, *inter alia*, Zhang and Markusen (1999) and Markusen and Venables (2000).

For many years, models of horizontally and vertically-integrated MNEs were regarded as two completely disjointed strands in the FDI literature. The milestone in the development of modern MNE theory was the combination of horizontal and vertical approaches into a unified framework in which firms were able to choose between national, horizontal and vertical strategies. This was done by Markusen (2002, 2013) who called his unified framework the KK model. In his model different types of firms arise endogenously within the equilibrium in response to various combinations of home and host country characteristics. According to the KK model national firms exporting to each other's market dominate when countries are similar in economic size and relative factor endowments and trade costs are low. Horizontally integrated MNEs dominate when countries are similar in economic size and relative factor endowments and trade costs are high. Finally, if countries are similar in size but dissimilar in relative factor endowments, vertically integrated MNEs are the dominant type. We describe the microeconomic foundations of this model in the subsequent section.

Empirical studies that tried to validate the predictions of modern MNE theories did not start, however, until the early 1990s. Most empirical work on MNE activity has focused on US firms operating abroad as well as inward FDI in the US while MNEs from other countries received relatively less attention. The empirical studies on determinants of MNE activity were initiated by Brainard (1993, 1997). She tested theoretical predictions derived from the models of both horizontally and vertically integrated

MNEs. According to her findings the majority of US MNEs were integrated horizontally and not vertically. Subsequently, her results were called into question by Carr et al. (2001) who estimated specifications directly derived from the more general model and found that US MNEs were integrated not only horizontally but also vertically. The importance of vertical FDI was confirmed later in the follow up studies by Braconier et al. (2005) and Davies (2008).<sup>1</sup>

The analysis of German MNE activity in general and especially in the CEE countries is still rather an under researched topic. In one of the first empirical studies on German MNEs Buch et al. (2005) investigated determinants of German outward FDI using data on German MNEs which were active in more than 100 countries during the 1990s. Their empirical results showed that the foreign direct investment of German firms was mainly motivated by market access (horizontal FDI) and not by lower production costs (vertical FDI). Moreover, their results showed that German FDI was negatively affected by distance and restrictive policies.<sup>2</sup> These results were generally in line with the results for the pre-WWII period reported in the study by Kling et al. (2011). Their dataset included information on 948 investments which were undertaken by 377 German joint stock companies between 1873 and 1927. They showed that the horizontal motive was the dominant reason for FDI. Nevertheless, their results also showed evidence of vertical motivated investments but the share of this kind of FDI accounted for only about 10% of investments.

Most recently, Camarero et al. (2019) provided new empirical evidence on the determinants of German FDI for the period 1996–2012 using the Bayesian model averaging (BMA) approach. They found that determinants associated with horizontal FDI appeared to be dominant for explaining German FDI in developed countries while for the group of developing countries vertical FDI motives played a larger role. In the case of the European Union countries they found evidence pointing to the benefits associated with the proximity to large euro area markets for the EU core countries, while for the peripheral countries vertical motivation seemed to prevail.

In contrast to the cross-country evidence that on average showed the bigger share of horizontal investments among German outward FDI, the existing survey evidence for the CEE countries yielded rather mixed results. The early empirical evidence on German FDI in the CEE countries seems to favor the vertical explanation. For example, in one of the earliest studies that focus on the CEE region Marin et al. (2003) show strong evidence for a high share of vertically motivated investments of German companies in this part of Europe. Their work was based on a survey among 1050 investment projects which have been done by 420 German firms in Central Eastern Europe during the period 1989–2001. They found strong evidence of vertical FDI suggesting that German MNEs are outsourcing a substantial share of their production to the CEE affiliates to exploit lower labor costs in the East. In addition, their results showed that German FDI in the CEE countries was very beneficial for these countries as the German MNEs transferred substantial amounts of financial capital, even if they did not bring the most advanced technologies to their foreign affiliates in the region.

More recently, Moritz et al. (2019) also used a survey to categorize the FDI motivation of German companies when they invested in the Czech republic. Their survey results suggested that the share of horizontal motivated FDI (57%) was slightly higher than that of vertical motivated FDI (42%) in the case of German companies. Furthermore, their work showed that the productivity was not only important for whether German companies want to invest, but also how many employees they wanted to hire for their affiliates in the Czech Republic.

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<sup>1</sup> In the context of the European Union important examples of empirical studies of FDI determinants include Baltagi et al. (2008) and Martínez-San Román et al. (2016).

<sup>2</sup> In a follow up paper Buch and Lipponer (2007) studied the determinants of FDI in the OECD countries for German banks using data for the years 1997–2001 which included foreign investment activity of banks as well as the supply of cross-border financial services. They used an extended gravity model which connects the scope of economic activity between Germany and the partner country with the distance between these countries and the size of the economies. They showed that if German banks undertake FDI they also supply cross-border financial services. Hence, their results suggested that German banks' FDI and cross-border services are, rather, complements instead of substitutes.

Despite the importance of Germany as a significant source of FDI, empirical studies analyzing its determinants in the CEE countries are still far from being conclusive. Therefore, given the controversies surrounding the determinants of German FDI in the CEE countries our study attempts to contribute to a better understanding of reasons for FDI in these countries. In particular, we study the determinants of German FDI in the CEE countries using the KK model of multinational enterprise that enables us to distinguish between horizontal and vertical motives for FDI. This distinction is important because horizontal FDI has been widely studied while vertical FDI have received much less attention in the literature.

### 3. Theoretical Framework and Hypotheses Development

In this section we provide an overview of the original KK model and discuss the research hypotheses that can be derived from this model and tested empirically using the data on German MNE activity in the CEE region in the subsequent section. The original KK model developed by Markusen (2002, 2013) is based on some main assumptions which are in line with previous works in the area of foreign direct investment. Firstly, as assumed in vertical models, a company's production can be separated from knowledge-based assets (fragmentation). The costs of supplying these assets to a single plant in the foreign country are relatively small compared to the costs of a single domestic plant. The costs of fragmentation could be calculated by the ratio of vertical company's fixed costs to the domestic company's fixed costs. Markusen (2002) restricts this ratio to between one and two, whereby a ratio of one means no costs for fragmentation and a ratio of two reflects a situation with very high costs for fragmentation.

Secondly, as assumed in the vertical approach, the knowledge-based activity of companies is relatively more skilled-labor intensive than final production. Thirdly, as assumed in the horizontal approach, knowledge-based assets have the characteristics of a joint input factor. This implies that the added costs of an additional plant are small compared to opening a company with local production ("jointness"). This factor could be calculated by the ratio of horizontal active MNE's fixed costs to domestic company's fixed costs. Likewise, for this fragmentation ratio Markusen (2002) also assumed a value between one and two, in which case one would mean perfect "jointness" and two would reflect the situation with no "jointness".

Besides these three main assumptions, Markusen (2002) further assumed that the fixed costs of a horizontal investing MNE is less than double of fixed costs of a domestic company. Further, he assumed that the fixed costs of a vertical investing MNE is less than for a horizontal investing MNE, but higher than for a domestic company.

The model contains two countries ( $i$  and  $j$ ) which are producing two homogenous goods (X and Y). Unskilled labor (L) and skilled labor (S) are the two production factors. The labor in the model is mobile between industries but not between the two countries. Markusen (2002) uses Y as a numeraire good which has a constant elasticity of substitution function in both countries:

$$Y_{i,j} = (aL_{iy}^{\alpha} + (1-a)S_{iy}^{\alpha})^{1/\alpha} \quad (1)$$

The market of the second good X is characterized by imperfect-competition with Cournot-competing companies and increasing returns to scale production. Further, the production market for X contains firm-level and plant-level scale economies. In addition, Markusen (2002) assumed free entry and free exit of companies. As a result, six different kinds of company can appear on the market: two horizontal MNEs with plants in both countries which only differ in the location of the headquarter (type  $h_i$  & type  $h_j$ ); two vertical MNEs whose plant is in the other country than the location of the production plant (type  $v_i$  with headquarter in country  $i$  and production in country  $j$  & type  $v_j$  with vice versa location of production and headquarters). Vertical companies could choose whether they export to the headquarter country or not. Lastly, there are two domestic companies with production and headquarter located within the same country (type  $d_i$  & type  $d_j$ ). Domestic companies could decide whether they export to the foreign market or not.

Furthermore, Markusen (2002) made three assumptions which are relevant for empirical estimation. Firstly, he assumed that the production plant is less skilled-labor intensive than the headquarter services. Because of this assumption and the fact that for a domestic company the production plant and the headquarter services are at the same location, the type-d companies are more skilled-labor intensive than the production plants of type-v and type-h companies. Further, he assumed that the whole sector of the numeraire good Y is less skilled-labor intensive than a single production plant (without headquarter services). Markusen (2002) prepared the following causality to understand the previous assumptions more easily.

Skilled-labor intensity assumptions:

$$[\text{Sector Y}] < [\text{production plant}] < [\text{type-d company}] < [\text{just headquarter services}]$$

In addition, there are further assumptions about the skilled-labor intensity of the different companies which have been made. Due to managing activities which also have to be done in the foreign as well as in the home affiliate of the type-h companies, Markusen assumed that type-h companies need more skilled-labor than type-v or type-d companies. This assumption is especially important for the analysis of investment and trade liberalization. Further, Markusen (2002) assumed that fixed and transportation costs for the market of good X are fixed-coefficient technologies for both countries, as follows:

$$c_i(w_i, z_i) = w_i c_{iw} + z_i c_{iz} \tag{2}$$

$$t_i(w_i, z_i) = w_i \tau c_{iw} + z_i \tau c_{iz} = \tau c_i(w_i, z_i) \tag{3}$$

whereby,  $c_i$  are the marginal production costs of good X in country  $i$  and for firms in both countries. Further,  $t_i$  represents transportation costs for good X (using the factors in the same proportion as  $c$ ). The wage of workers in country  $i$  is expressed by  $w_i$  for unskilled workers and  $z_i$  for skilled workers. In addition,  $c_{iw}$  and  $c_{iz}$  are factor-price derivatives of  $c$  which give the sector X a unit input requirement for unskilled labor (L) and skilled labor (S) in country  $i$ . Finally,  $\tau$  is proportionality constant between costs of trade and marginal production costs.

Furthermore, it is assumed that plants need the same number of unskilled workers whether the plant is located in the home or foreign country. The fixed costs of unskilled workers are expressed in  $G$ . The fixed costs for skilled workers, instead, are distinguished from the location of the firm. Fixed costs for skilled labor in the home country are expressed by  $F_i$ . If the company also has an affiliate in the foreign economy (for type-v and type-h companies), the fixed costs of skilled workers for these plants are expressed by  $F_j$ . Thus, the fixed costs for the different company types located in country  $i$  are as follows:

$$f c_i^d(w_i, z_i) = z_i F_i^d + w_i G \tag{4}$$

$$f c_i^h(w_i, z_i, w_j, z_j) = z_i F_i^h + w_i G + z_j F_j^h + w_j G \tag{5}$$

$$f c_i^v(z_i, w_j, z_j) = z_i F_i^v + z_j F_j^v + w_j G \tag{6}$$

In addition, Markusen (2002) made assumptions about companies' costs and skilled labor requirements. As a result of these assumptions, fixed costs of a horizontal investing MNE are less than double of the fixed costs of a domestic company. Because of the assumptions described earlier in this section, skilled labor requirements of type-h companies are greater but less than double of type-d companies' skilled labor requirements. Further, he assumed that these additional skilled-labor requirements of type-h companies compared to type-d occur partly in the home and partly in the foreign plant. Moreover, Markusen assumed that the domestic plant of a type-h company requires extra skilled-labor for managing and coordination tasks. Markusen (2002) sums up the previous assumptions about skilled-labor requirements by the following inequation:

$$2F_i^d > F_i^h + F_j^h > F_i^d < F_i^h \tag{7}$$

Furthermore, he assumed that the fragmentation of type-v firms is not perfect and therefore skilled-labor requirements for these companies are higher than type-d but less than type-h companies' requirements. The following inequation can be used to show the skilled-labor requirements of all three company types (Markusen 2002):

$$F_i^h + F_j^h > F_i^v + F_j^v > F_i^d \tag{8}$$

Moreover, because of the zero-profit condition for the X sector in the equilibrium, income of country *i* is equal to the sum of wages of skilled and unskilled workers. Markusen (2002) labeled the income of the countries as *M<sub>i</sub>*. Further, the utility function of the representative consumer is a Cobb-Douglas function in which *X<sub>ic</sub>* and *Y<sub>ic</sub>* represent the consumption of good Y and X in country *i*. In addition, the donation *X<sub>ij</sub>* tells us that the headquarters of the company is located in country *i* and the product is sold (but not necessarily produced) in country *j*. The superscript letters *d*, *v* and *h* express the type of company which sold this product. Moreover, the price of good X in country *i* (*p<sub>i</sub>*) is expressed in terms of Y, whereby, the price of the product depends on the markups of the companies. Markusen (2002) derived the following optimal markup formula for the firms:

$$m_{ij}^k = \frac{X_{ij}^k}{X_{jc}} = \frac{p_j X_{ij}^k}{\beta M_j} \quad k = \text{type-d, h, v company } i, j = 1, 2 \tag{9}$$

Finally, he substitutes the markup formula into the MR = MC inequalities of the different companies to get the total output of good X produced in country *i*:

$$X \geq \beta M_i \frac{p_i - c_i(w_i, z_i)}{p_i^2}, \quad \text{for } X_{ii}^d, X_{ii}^h, X_{ji}^h, X_{ji}^v \tag{10}$$

$$X \geq \beta M_j \frac{p_j - c_j(w_j, z_j)(1 + \tau)}{p_j^2}, \quad \text{for } X_{ij}^d, X_{jj}^v \tag{11}$$

From the substitution of these inequalities into the zero-profit condition of the companies, Markusen (2002) notes five findings: firstly, because domestic companies and vertically integrated MNEs have to pay transportation costs, their markup revenue will be less than those of horizontal investing companies. Indeed, the fixed costs of the latter will be higher than the fixed costs of a type-d or a type-v company from at least one country. Therefore, type-h companies will dominate the market if country *i* and *j* are relatively similar in factor prices and income when world income is high and when trade costs are relatively high. If, on the other hand, trade barriers and world income are low or country *i* and *j* are not symmetrical in factor prices or country size, then vertically integrated and domestic companies will dominate the market.

Finally, Markusen (2002) points out the advantage of vertical companies compared to domestic ones. Type-v companies have an advantage over type-d companies if the factor prices are not equal. In this case, the type-v companies can locate their headquarter in the country with relatively cheaper skilled labor, and locate the plant in the country with advantage in unskilled labor wages and a large market. Domestic companies instead will face an advantage compared to the vertically integrated companies if factor prices are equal or almost equal because of the assumption that technology transfers are not for free. At this point, Markusen (2002) clarifies that a case with a high share of *v<sub>i</sub>* and *v<sub>j</sub>* companies will never be observed. For one of these two, it always would be cheaper to replace the company by a domestic one. Therefore, vertical activity in the KK-model will be observed only in one direction. Vertical companies will occur additionally to domestic companies in the market, if factor prices between the countries are different. However, the situation in which type-v companies have the highest share relatively to type-d companies will occur if one country is small but rich in terms of skilled-labor. Hence, there are four possible market structures: (1) only horizontally-integrated MNEs operate in the market, (2) the mixed structure of type-d and type-h companies, (3) vertically-integrated MNEs are in the market (but also others), and (4) only national firms are in the market.

The analytical difficulties imply that most results in the KK model have to be derived from numerical simulations. These simulations generate predictions on the relationship between the extent of MNE activity and country characteristics. National firms exporting to each other's markets are the dominant type when countries are similar in economic size and relative factor endowments and trade costs are low. Horizontally-integrated MNEs dominate when countries are similar in economic size and relative factor endowments and trade costs are high. However, if countries are dissimilar in either size or in relative factor endowments, one country is favored as a location of both headquarters and production activities, or for one of these two activities.

In particular, if countries are dissimilar in size but similar in relative factor endowments then national firms located in the large country are favored as they can avoid installing costly capacity in the smaller market. On the other hand, if countries are similar in size but dissimilar in relative factor endowments, vertically-integrated multinational firms are the dominant type as there is an incentive to split the production process and locate headquarters in the skilled-labor abundant country and production in the labor-abundant country, unless trade costs are high. The extent of MNE activity in the KK model is largest when the parent country is moderately small and highly abundant in skilled-labor.

The KK model can also be used to study how trade costs affect the sales volume of foreign affiliates. The model predicts that there is no affiliate production if the two countries are similar in size and endowment of skilled-labor. Further, if trade costs are low there are no horizontally-integrated MNEs because firms are not willing to pay the costs of the second plant if they can export their products to the foreign market at low cost. In line with the previous results of the model, the production of affiliates reaches its highest volume if one country is small but skilled-labor abundant.

For high trade costs only horizontally-integrated MNEs are in the market if two countries are similar in size and in relative endowments. If the difference in one of these two factors increases, a mixed structure of domestic and horizontal companies is observed. Further, if one of the countries is small but abundant in terms of skilled-labor, then vertically-integrated MNEs emerge in the market. It is interesting to note that with increasing endowment of skilled-labor in the case of a small country, or with increasing size of a country with poor endowment of skilled-labor, more type-v companies operate in the market.

The KK model predicts a decrease in affiliate production with a fall in trade costs if partner countries are similar in size and skilled-labor endowment. This decrease is explained by the replacement of horizontally-integrated MNEs by domestic firms. As explained earlier, companies avoid the costs of foreign production and instead prefer to export to the foreign economy at low costs. In this case affiliate foreign production and trade act as substitutes.

However, the model indicates that there are combinations of country profiles for which a reduction of trade costs may increase the production of affiliates. This happens if one of the two countries is skilled-labor abundant and small, but differences with the second country are not big. In this case, before reducing trade costs, affiliate production is done by type- $h_i$  companies. Country  $i$  is served by plants of type- $h_i$  in the domestic country. With the reduction of trade costs there are only vertically integrated companies with their headquarter in country  $i$  and plant in country  $j$  on the market. In this case the home market is served by imports from the affiliate production abroad.

Even though most findings of the KK model are derived from numerical simulations, the model generates a number of testable predictions, relating the extent of MNE activity to country characteristics. The predictions of the KK model can be tested using statistical data on FDI from Germany to the CEE countries. However, it should be noted that [Markusen \(2002, 2013\)](#) analyzed bilateral multinational activity, while in our study we take into account only unilateral multinational activity, i.e., our dataset includes only one-way FDI, from Germany to the CEE countries. This, in turn, will lead to only three types of firms' activity as shown in Table 1.



**Table 1.** Types of foreign direct investment (FDI) from Germany to Central and Eastern Europe (CEE) and countries' characteristics.

Dominant type of FDI from Germany to CEE Countries		Different in Size and Relative Endowments		Similar in Size, Relative Endowments and Factor Prices	Trade Cost	Total Income	Note
		Germany (i)	CEE Countries (j)				
Horizontal FDI	Type-hi		Not high foreign investment barriers	Yes	High	High	Trade costs here are costs between Germany and CEE countries
Vertical FDI	Type-vi	Small Skilled-labor abundant	Not high foreign investment barriers		Not excessive	Low	Trade costs here are costs from the CEE countries back to Germany
No FDI (German firms prefer producing domestically)	Type-di	Large Skilled-labor abundant		Yes	Low		Trade costs here are costs between Germany and CEE countries
			High foreign investment barriers				Domestic firms from Germany may export to CEE countries if trade cost is not excessive

Source: Own summary.

We assume that MNEs are headquartered in the parent country, Germany, which means that Germany is the  $i$ -country and the CEE countries are the  $j$ -country in the theoretical model. As shown in Table 1, country characteristics have different influence on FDI, depending on the type of FDI. In the case of German FDI in the CEE countries a higher share of horizontally motivated investment should be observed, with an increasing similarity in terms of size of the partner country. The endowments of skilled labor are, for this scenario, neglectable as long as none of the two countries has almost all or all the endowment of skilled labor. But with increasing similarity not only in terms of size but also in the endowment of skilled labor, the share of horizontally motivated investments should increase, type-h companies should dominate the market and fewer national companies should be active. Therefore, the sales of foreign companies should increase.

Only domestic companies operate in the market if Germany (country  $i$ ) has high endowments of skilled-labor and the partner countries are at least similar in size, respectively, and Germany is relatively larger. In this case, German type-d companies serve the market of country  $j$  via exports. If Germany, for example, has relatively high endowments of skilled-labor compared to two partner countries, which differ only in country size but not in endowments of skilled-labor, German vertically-integrated MNEs should have a higher share in the smaller country than in the bigger one. In the case in which country  $j$  has not at least a similar size to Germany, there will be no production of German affiliates. However, if country  $j$  is bigger than Germany, the production level increases with increasing relative size of country  $j$ . In the case of FDI by German MNEs in the CEE countries an increase of the size of the partner countries increases the production volume of German affiliates in that country.

Furthermore, a reduction in trade costs, achieved for example by regional trade agreements or joining the European Union (EU), may have an important effect on the pattern of German MNE activity in the CEE region. If the partner country joins the EU, this reduces the trade costs between Germany and this country. Thus, an increase of vertical investments should be observed after joining the EU if the partner country is relatively small and labor abundant, but the differences with respect to Germany are not too big. On the other hand, horizontal activity should decrease if Germany and the partner country become more similar in size and skilled labor endowment.

Our empirically testable research hypotheses on the extent of German MNE activity in the CEE countries derived from the KK model can be formulated as follows:

**Hypothesis 1.** *The bigger the combined absolute market size and the more similarity in market size between Germany and CEE host countries, the larger the extent of German MNE activity, as there is more horizontal FDI.*

**Hypothesis 2.** *The bigger differences in relative factor endowments between Germany and CEE host countries, the larger the extent of German MNE activity, as there is more vertical FDI.*

**Hypothesis 3.** *The lower the investment costs between Germany and CEE host countries, the larger the extent of German MNE activity, as there is more both horizontal and vertical FDI.*

In addition, we also include some other typical factors usually shown as having effects on FDI in the business survey of the German Chambers of Commerce on investment attractiveness of CEE countries.

#### 4. Empirical Model Specification

The empirical model specification which is used in this study is based on the original KK model described in the previous section augmented with some additional variables used in the business survey of the German Chambers of Commerce on investment attractiveness of the CEE countries. This survey showed that availability of employees and whether the host country is a member of the European Union are important factors for German companies. Further, the survey also showed a decrease in the number of German affiliates which supported the introduction of the euro in the CEE countries. Therefore, three additional variables regarding the EU membership, Euro adoption and

unemployment rate are added to the original specification of the KK model. Thus, our estimating equation used in this study looks as follows:

$$\begin{aligned} Sales\_Revenue_{jt} = & \beta_0 + \beta_1 SUMGDP_{ijt} + \beta_2 GDPDIFSQ_{ijt} + \beta_3 SKDIFF_{ijt} + \\ & \beta_4 INVF_{jt} + \beta_5 TF_{jt} + \beta_6 TF_{jt} * SKDIFSQ_{ijt} + \beta_7 TF_{it} + \\ & \beta_8 DISTWCES_{ij} + \beta_9 EU_{jt} + \beta_{10} EURO_{jt} + \beta_{11} URATE_{jt} + u_{ijt} \end{aligned}$$

where country *i* represents Germany and country *j* a host country in Central and Eastern Europe and:

*Sales\_Revenue<sub>j</sub>* = Revenue of German MNE affiliates in country *j*

*SUMGDP<sub>ij</sub>* = (GDP<sub>Germany</sub> + GDP<sub>*j*</sub>)

*GDPDIFF<sub>ij</sub>* = (GDP<sub>Germany</sub> - GDP<sub>*j*</sub>)

*GDPDIFSQ<sub>ij</sub>* = (GDP<sub>Germany</sub> - GDP<sub>*j*</sub>)<sup>2</sup>

*SKDIFF<sub>ij</sub>* = (SK<sub>Germany</sub> - SK<sub>*j*</sub>)

*SKDIFSQ<sub>ij</sub>* = (SK<sub>Germany</sub> - SK<sub>*j*</sub>)<sup>2</sup>

*INVF<sub>j</sub>* = Investment freedom to invest in country *j*

*TF<sub>j</sub>* = Index for freedom to export from Germany to country *j*

*TF<sub>i</sub>* = Index for freedom to export from country *j* to Germany

*DISTWCES<sub>ij</sub>* = Weighted distance between Germany and country *j*

*EU<sub>j</sub>* = Is country *j* member of the EU? Yes = 1, No = 0

*EURO<sub>j</sub>* = Is the euro official currency of country *j*? Yes = 1, No = 0

*URATE<sub>j</sub>* = Unemployment rate in country *j*

where: *SK<sub>i</sub>* = Share of skilled labor in country *j*.

In line with [Markusen's \(2002\)](#) original approach, this study uses the sales volume of German affiliates located in host country *j* as the dependent variable (*Sales\_Revenue*). Furthermore, variable *SUMGDP* contains information about the sum of GDP of home and host economies. As Germany is the only source country in this estimation, a higher value of this variable reveals a bigger host market for German companies. As discussed in the theoretical section, an increasing size of the host country market increases revenues of German affiliates (Hypothesis 1). Therefore, in line with the KK model, a positive sign of the estimated coefficient on this variable is expected.

Hypothesis 1 also provides information about the expected sign of variable *GDPDIFSQ*. This variable is the squared difference between a host country's GDP and Germany's GDP. For analysis of this variable it is important to know that for all host countries Germany's GDP is bigger in each year. Therefore, with an increase of country *j*'s GDP, *GDPDIFSQ* will decrease and vice versa. Hence, an increase in *GDPDIFSQ* represents a decrease in the foreign market size. In this case, according to the KK model, a decrease in affiliate revenues should be observed, so the estimated coefficient on the *GDPDIFSQ* variable should display a negative sign.

The *SKDIFF* variable includes information about differences in the share of skilled labor between Germany and the CEE host countries. According to the KK model firms prefer to set up their headquarters in the skilled-labor abundant country, while their production activities are located in the unskilled-labor abundant country. An increase in the *SKDIFF* variable means an increased difference of skilled-labor endowment between Germany and the host country. This increased difference should increase production activity of German affiliates because of the higher wage advantage of the host economy. For this reason, *SKDIFF* should have a positive effect on the German affiliates' revenues (Hypothesis 2).

Furthermore, index variable *INVF<sub>j</sub>* contains information about investment freedom in country *j*. Higher investment freedom increases profitability of foreign direct investment and therefore increases MNE activity in this country (Hypothesis 3). The value of 100 would represent the highest possible

investment freedom, and a country with a value of 0 would have no investment freedom. Therefore, the estimated parameter on this variable should have a positive sign.

Moreover,  $TF_i$  and  $TF_j$  are also index variables which provide information about the freedoms of exporting to countries  $i$  and  $j$ , respectively. On the one hand, a high freedom to export to country  $j$  (a potential host country) decreases the motivation of firms to invest horizontally in the foreign market instead of exporting products produced in the home country. Therefore, a negative effect of  $TF_j$  is predicted. On the other hand, the high freedom to export to the parent country increases profits as well as the MNE activity of firms investing vertically. For this reason,  $TF_i$  should have a positive sign.

Further, following [Markusen \(2002\)](#) an interaction term ( $TF_j * SKDIFSQ$ ) of export freedom to the host country and the squared differences in terms of skilled labor between home and partner countries is included in the estimating equation. The idea behind the inclusion of this term is the aforementioned observation that trade freedom has a negative effect on horizontal but a positive effect on vertical investments. In addition, increasing similarity in terms of relative factor endowments between two countries increases horizontal investments. An increase in  $TF_j * SKDIFSQ$  represents either increasing differences of skilled labor force between two countries or increasing freedom to export to a foreign country. Moreover, a combination of both reasons is also possible. In each case, horizontal foreign direct investment decreases. Therefore, the estimated coefficient on this interaction variable should have a negative sign.

In addition, variable *DISTWCES* reflects the population weighted distance between the home and host countries that serves as an additional proxy for trade and investment costs. However, according to [Markusen \(2002\)](#) the sign of this variable is not clear because distance affects both investment and monitoring costs, as well as the costs of exporting to and from the host country.

Moreover, according to the business survey of the German Chambers of Commerce, the accession to the EU by a host country increases its attractiveness for German direct investments. Besides cost factors, investment certainty and the inflow of cohesion payments from the European Union are also explanations. For these reasons, a positive effect of EU membership on production volume of affiliates is predicted.

Furthermore, investing in a foreign country is always associated with exchange rate uncertainty. Variations in the foreign currency rates might turn into costs for MNEs. For example, because of a wrong currency prediction when a company calculates a products' price, its profits may be adversely affected. However, if a host country is using the same official currency (e.g., euro) the uncertainty of MNE operations decreases and therefore FDI should increase in this country due to the decreased cost of investment. Moreover, even if the business survey shows a decrease in the share of companies which support the introduction of the euro, the majority of them are still in favor of euro adoption. Therefore, the dummy variable *EURO*, equals 1 if the host country uses Euro as official currency and 0 if the host country has another official currency. This dummy variable is expected to have a positive sign.

Finally, the business survey shows that the availability of employees is an important consideration when companies undertake FDI. Without available employees, companies are not able to run their production. A higher unemployment rate in a foreign country may be expected to increase the chances of a company finding employees. However, on the other hand the higher rate of unemployment might indicate adverse economic conditions and low purchasing power of the population. Therefore, the sign of the *URATE* variable must be determined empirically.

In the first set of estimations, the basic [Markusen \(2002\)](#) KK model will be used. Thus, the variables, *EU*, *EURO* and *URATE* which were added on the basis of the German-Polish Chamber's business survey will not be included in these estimations. Afterwards, a second estimation, which includes all variables, is run and results are compared with the results from the previous estimation. Additionally, to compare results of both estimations we also verify the empirical findings in terms of the hypotheses from the theoretical section.

## 5. Statistical Data and Estimation Method

The dataset used in this study contains information on the following CEE countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Serbia, Slovakia and Slovenia.<sup>3</sup> The unbalanced dataset covers the period 1996–2016. The sample is determined by data availability. Information about revenues of German affiliates comes from the German Central Bank (Deutsche Bundesbank) and is expressed in euro.<sup>4</sup>

GDP data for Germany and partner countries are expressed in constant 2010 US\$ and come from the World Bank database. Information about the share of skilled labor force in Germany and particular host countries comes from the International Labour Organization (ILO). This work used the Employment by education dataset which contains information about the highest education level attained by employees. The sum of shares of employees with an intermediate and advanced education level is used as indicator for the share of skilled labor force in Germany and host countries.<sup>5</sup>

Moreover, data about trade and investment freedoms are obtained from the Index of Economic Freedom provided by Heritage Foundation, who included different restrictions or barriers to trade and investment into this data. For both indexes 100 would be the highest possible score which represents a country with no investment or export costs, and therefore 0 would be the opposite case. Further, the annual unemployment rate was taken from the ILO. Finally, data about the distance between the home and host countries comes from the CEPII Institution. The weighted distance is used which considers population and distance between different cities, not only between capitals.<sup>6</sup>

In his original work, [Markusen \(2002\)](#) used Weighted Least Squares (WLS) and Tobit estimation methods to estimate the KK model. Both methods delivered similar p-values and signs of the estimated coefficients on explanatory variables. The results of estimations differed only in the values of some coefficients. In order to determine the appropriate estimation method for this study, the Breusch-Pagan test is conducted due to a high chance of heteroskedasticity in FDI data. The Breusch-Pagan test shows the existence of heteroskedasticity in a dataset. Hence, the WLS method used by [Markusen \(2002\)](#) can be employed in the presence of non-constant variances but only if weights are known exactly. A further problem is the sensitivity of WLS estimation with respect to the impact of outliers in this affiliates revenue dataset. Therefore, the WLS estimation is not used in this study.

Instead, we use the Pseudo Poisson Maximum Likelihood (PPML) estimation promoted by [Santos Silva and Tenreyro \(2006\)](#) who showed that this method is robust with respect to different kinds of heteroskedasticity. They argued that, especially if patterns of heteroskedasticity are not known, PPML is the best estimation method.<sup>7</sup> Moreover, an advantage of PPML compared to the Gamma Pseudo Maximum Likelihood (GPML) method is the equal weights given to all observations ([Gómez-Herrera 2013](#)). Therefore, PPML is used as the main estimation method to study the determinants of the German MNE affiliates' revenue in the CEE countries.

## 6. Empirical Results

The estimation results for the original specification of the KK model obtained using PPML estimation method are reported in Table 2. The estimates of the baseline KK model are shown in column (1) while the estimates of the extended model are shown in column (2). In both cases the

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<sup>3</sup> Due to missing data on the revenue of German affiliates, Kosovo and Montenegro are not included in the sample.

<sup>4</sup> For the years before Germany introduced the euro as official deposit currency in 1999, the German Central Bank offers data about MNE revenues on the hypothetical euro basis, which is used for the period 1996–1998.

<sup>5</sup> The ILO dataset contains no information about employees' education in Germany in 1998. However, because the shares of skilled labor force in general and especially in Germany are relatively stable, the value for 1998 was extrapolated as the arithmetical average of 1997 and 1999 values.

<sup>6</sup> The summary statistics for our variables are reported in Appendix A.

<sup>7</sup> These results are supported by other studies (e.g., [Shepard 2012](#); [WTO and UNCTAD 2012](#); [Arvis and Shepherd 2013](#)).

estimated coefficients on both GDP sum and GDP difference variables display the predicted signs and both are significant already at the 1% level. These results support the horizontal motive for FDI, so Hypothesis 1 cannot be rejected. At the same time, the estimated coefficients on the share of skilled labor force are not statistically significant in the baseline and the extended models. This means that the vertical motive for FDI does not find support in the data so Hypothesis 2 can be rejected. Moreover, both *INVF* and *TF<sub>j</sub>\*SKDIFSQ* variables are significant in both sets of our estimations. This means that Hypothesis 3 cannot be rejected. Finally, trade freedom to export from the host country to the home country is not statistically significant in the case of the baseline model and it is only weakly significant in the case of the extended model.

**Table 2.** Pseudo Poisson Maximum Likelihood (PPML) Estimation Results for the baseline and extended Knowledge-Capital (KK) model.

Variable:	Column (1)	Column (2)	Sign as Predicted
<i>SUMGDP</i>	0.731 *** (7.64)	0.662 *** (7.11)	Yes
<i>GDPDIFSQ</i>	-0.233 *** (5.40)	-0.193 *** (4.59)	Yes
<i>SKDIFF</i>	-0.0000432 (0.07)	0.000135 (0.20)	No/Yes
<i>INVF<sub>j</sub></i>	0.000779 * (1.90)	0.000756 * (1.91)	Yes
<i>TF<sub>j</sub></i>	-0.000735 (1.27)	-0.00107 * (1.88)	Yes
<i>TF<sub>j</sub>*SKDIFSQ</i>	-0.00000108 *** (3.66)	-0.00000977 *** (3.43)	Yes
<i>TF<sub>i</sub></i>	-0.000276 (0.13)	-0.000283 (0.13)	No
<i>DISTWCES</i>	-0.0000771 *** (5.97)	-0.0000792 *** (5.79)	?
<i>EU</i>		0.0179 (1.61)	Yes
<i>EURO</i>		-0.0253 *** (2.65)	No
<i>URATE</i>		-0.00221 *** (3.77)	?
Constant	-4.505 (1.05)	-4.754 (1.16)	
N	230	230	
R-squared	0.6547	0.6905	

Notes: \*  $p < 0.1$ , \*\*\*  $p < 0.01$ , z-statistics in parentheses.

Column (2) of Table 2 contains the estimation results obtained for the extended specification with the additional variables from the business survey which include EU membership, the common currency and the unemployment rate. In particular, the EU membership of the host country is not statistically significant while the unemployment rate in the host country and the *EURO* variable are significant and display negative signs. A possible explanation for the negative sign of the estimated coefficient on the unemployment rate can be related to the connection between the unemployment rate and available income of consumers which was not taken into account in the theoretical model. In our

view, households with lower incomes have lower purchasing power and therefore horizontal foreign investment may seem less attractive to German firms.

A potential explanation for the negative sign on the *EURO* variable might be related to the decreased trade cost that accompanies the adoption of the same currency by the host country. A decrease in trade costs decreases horizontal FDI and instead may increase exports from Germany to the host country. Furthermore, increasing wage costs in the new Eurozone member countries might also motivate German MNEs to move their production to third countries with lower wage costs. These issues require closer attention in future studies.

The estimation results for the extended model show that the PPML estimations generate very similar conclusions regarding the signs and statistical significance of most explanatory variables to those reported in column (1). In particular, the estimated coefficient on the *GDPDIFSQ* variable displays the expected negative sign and is statistically significant at the 1% level. A decrease in *GDPDIFSQ* specifies an increase in similarities between Germany and the partner country which increases the affiliates' revenues. This result clearly supports the horizontal reason for FDI. For interpretation of this variable it is important to remember that Germany's GDP is always higher than the one from the CEE partner countries. This means that an increase of *GDPDIFSQ* reflects a situation in which the GDP of the partner country decreases. A negative sign of the estimated coefficient on this variable indicates that a decreasing foreign market decreases the revenue of German affiliates and, vice versa, an increase in a foreign market increases revenue. Hence, with increasing similarities in country size between Germany and the partner country, sales of MNE affiliates increase.

Moreover, our estimation results show that the estimated coefficient on the sum of Germany's and the CEE partner countries' GDP displays a positive sign and is statistically significant at the 1% level. This result is in line with the KK model predictions and provides additional support for the market seeking motive. Hence, our estimation results for both *SUMGDP* and *GDPDIFSQ* confirm Hypothesis 1 discussed in the theoretical section predicting an increase in sales volumes with the increase in foreign market size. Moreover, the estimation results do not support Hypothesis 2 regarding differences in skilled-labor endowments as the estimated coefficient on the *SKDIFF* variable is not statistically significant. This result indicates that the differences in relative factor endowments do not affect the revenues of German affiliates in the CEE countries.

The only difference between the two sets of estimation results reported in columns (1) and (2) is the significance of the freedom of exporting to the host country ( $TF_j$ ). While this variable was not significant in the estimation of the original specification without the additional variables, it becomes significant at the 10% level in the extended model and displays an expected negative sign. This means that with increased trade freedom the activity of German MNEs decreases, which additionally supports the horizontal reason for FDI.

Finally, another important difference between the two models concerns the levels of  $R^2$ . The calculated  $R^2$  value is higher for the extended specification of the KK model. This indicates that the extended model better explains the German MNE activity in the CEE countries compared to the original KK model.

## 7. Conclusions

The aim of this study was to analyze the determinants of German direct investment in the CEE countries. By estimating the KK-model for the years 1996 to 2016 different reasons which affect German MNE activities in the CEE countries could be revealed. The estimation results of this study show the statistical significance of the sum of partner countries' GDP and the squared differences of the GDP. This confirms the importance of the horizontal reason for FDI for German multinational firms that invested in the CEE region. These results are in line with the results of previous studies on the determinants of German FDI that underline the role of horizontal FDI. Furthermore, the lack of statistical significance of the estimated coefficient on the skilled labor differences suggests that the

vertical reason is on average not important. Therefore, it can be concluded that the primary motive for the German multinational firms investing in the CEE countries is improved market access.

Our findings have important policy implications for labor markets in Germany and CEE countries receiving German FDI. In particular, in the case of vertical FDI the transfer of labor-intensive stages of production processes from Germany to the CEE economies could reduce demand for labor in the home country resulting in lower wages while the opposite could take place in the host countries. As a consequence, vertical FDI would simulate wage convergence between home and host countries, while in the case of horizontal FDI such effects should not be observed.

Moreover, by augmenting the KK-model with variables from the business survey of German Chambers of Commerce this study was able to increase the explanatory power of the empirical model. In particular, the indicator variable which includes information about whether the partner country has adopted the Euro as the official currency was significant and displayed a negative sign. We hypothesize that a potential explanation for the negative effect of the *EURO* variable might be related to the decreased trade cost that accompanies the adoption of the same currency by the host country. A decrease in trade costs may stimulate exports from Germany to the host country and at the same time decrease horizontal FDI. However, whether the adoption of common currency leads to expansion of German exports to those CEE countries that adopted the euro needs to be verified in future studies.

In addition, the negative and significant influence of the host country’s unemployment rate on FDI should be further analyzed. Hence, especially, the neoclassical assumption of the theoretical model about full employment in the economy should be relaxed in future theoretical and empirical studies.

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## Appendix A

**Table A1.** Summary Statistics.

Variable	N	Mean	Min	Max	SD	Median
<i>Sales_Revenue</i>	230	$1.45 \times 10^{10}$	$1.7 \times 10^6$	$7.78 \times 10^{10}$	$2.02 \times 10^{10}$	$3.99 \times 10^9$
<i>SUMGDP</i>	230	$3.17 \times 10^{12}$	$1.96 \times 10^{12}$	$4.44 \times 10^{12}$	$6.83 \times 10^{11}$	$3.46 \times 10^{12}$
<i>GDPDIFSQ</i>	230	$9.4 \times 10^{24}$	$3.1 \times 10^{24}$	$1.5 \times 10^{25}$	$3.61 \times 10^{24}$	$1.06 \times 10^{25}$
<i>SKDIFF</i>	230	0.470869	-11.5	39	10.32269	-2
<i>DISTWCES</i>	230	951.6164	406.4409	1480.316	324.5453	986.2493
<i>INVE<sub>j</sub></i>	230	66.19565	30	85	10.36373	70
<i>TF<sub>j</sub></i>	230	81.09174	49.6	88	8.522853	85.8
<i>TF<sub>i</sub></i>	230	82.56739	75	88	4.137234	81.4
<i>EU</i>	230	0.5	0	1	0.5010905	0.5
<i>EURO</i>	230	0.126087	0	1	0.3326713	0
<i>URATE</i>	230	11.3703	3.95	32.02	5.557859	10.025

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