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**Determinants of MNE Activity in Poland:**

**The Case of Firms from EU-15**

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| **A B S T R A C T** |
| **Objective**: The main purpose of this paper is to validate the theoretical predictions of competing models of multinational enterprise and identify the main reasons for undertaking FDI in Poland by foreign firms from the EU-15 countries. |
| **Research Design & Methods**: Our analytical framework refers to the knowledge capital model that combines horizontal and vertical reasons for foreign direct investment. The empirical implementation of the theoretical framework is based on the negative binomial model and the bilateral dataset covering the period 1989-2014. |
| **Findings:** Our estimation results indicate that the extent of multinational activity in Poland is positively related to both differences in relative factor endowments and similarity in the relative country size. |
| **Implications & Recommendations:** The empirical evidence confirms the predictions of the knowledge capital modal and points to the horizontal as well as vertical motives for undertaking foreign direct investment in Poland.  |
| **Contribution & Value Added:** The originality of this work lies in the empirical implementation of the hybrid theoretical framework allows distinguishing between horizontal and vertical reasons for FDI.  |
| **Article type:** | research paper |
| **Keywords:** | Count data, multinational enterprises, negative binomial model, Poland.  |
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**INTRODUCTION**

Multinational enterprises (MNEs) with their rapidly increasing shares in world output, investment and trade flows have become the main actors in the ongoing process of globalization in the world economy. While many theories have been proposed to explain the internationalization of production two distinct reasons why a firm should go multinational have been distinguished in the literature: market seeking and efficiency seeking. According to the first one multinational firms are vehicles to overcome distance and lower costs of foreign markets access. Foreign direct investment undertaken to serve local markets is often called horizontal FDI and refers to producing abroad roughly the same goods and services as in the parent country.

According to the second one firms internationalize production and become multinationals to get inputs at lower cost. Foreign direct investment undertaken with the aim of reducing production costs is often called vertical FDI as it involves fragmenting production processes and locating each stage in the country where the factors used intensively in that particular stage are relatively cheap. These two alternative reasons have very different empirical implications.

Most empirical work on FDI determinants has focused on the US firms operating abroad as well as inward FDI in the US and the empirical evidence on multinational activity in the new EU member countries still remains relatively scarce. With over 171 billion euros in foreign direct investment (FDI) at the end of 2014 Poland has emerged as one of the most attractive host countries for the location of MNE activities among the new European Union (EU) member countries in the last several years (National Bank of Poland, 2015). The vast majority of FDI in Poland originates from the old EU-15 countries. Therefore, the purpose of this paper is to validate the predictions of competing theoretical models of the multinational enterprise and identify the main reason for undertaking FDI in Poland using bilateral dataset on EU-15 MNE activity covering the period 1989-2014.

The remainder of this paper is organized as follows. In the next section we survey the relevant literature on the theory of multinational enterprise and describe competing theoretical frameworks. Then, we present definitions and sources of our explanatory variables and describe the empirical methodology. Finally, we discuss our estimation results. Concluding remarks and directions for future research are provided in the last section.

**Literature review**

For many years research on the determinants of the extent of MNE activity was purely theoretical. Early theoretical studies based on the neoclassical assumptions viewed FDI as a part of international capital flows. According to this view these flows were driven by international differences in return on capital. The early theoretical studies on FDI, such as MacDougall (1960) or Kemp (1962), viewed the expansion of multinational firms as the transfer of financial or physical capital. According to these studies capital should flow from capital-abundant to capital-scarce counties and between countries with the same factor endowments capital flows should not be observed. However, the predictions of these studies were not in line with reality as the largest share of multinational activity occurs between developed countries that are similar both in terms of their relative factor endowments and economic size. The traditional neoclassical approach was also criticized because of relying on the set of very unrealistic assumptions, such as constant returns to scale (CRS) and perfect competition, which were not in line with the key industry-level stylized facts on FDI.

For example, Markusen (2002, p. 6) noted that: i) “large differences exist across industries in the degree to which production and sales are accounted for by multinational firms”, ii) “multinationals tend to be important in industries that a) have high levels of R&D relative to sales, b) employ large number of professional and technical workers as a percentage of their total workforces, c) produce new and/or technologically complex products, and d) have high levels of product differentiation and advertising”, iii) “multinationals tend to be firms in which the value of the firms’ intangible assets is large relative to its market value”. Moreover, another problem was that in the neoclassical perfectly competitive constant returns approach firms were infinitely small and it was not possible to study directly the investment decisions that took place within the firm.

 The shortcomings of the formal neoclassical approach led to the rejection of this strand in the literature by some economists and the development of an alternative eclectic strand in the literature. The major representative of this strand is Dunning’s (1977) OLI conceptual framework that later became the frequent point of departure for more formal theoretical modeling. The developments in the so-called new trade theory (NTT) in the late 1970s and the early 1980s provided a set of models that proved extremely useful in studying the emergence of multinational enterprises and foreign direct investment. This led to the development of the new theory of multinational enterprise (NTME) since the mid-1980s.

To explain the phenomenon of FDI between similar countries many models of a horizontally integrated multinational firm have been developed. Typically, these models employed the tools used previously in the New Trade Theory that allowed addressing explicitly the issues of increasing returns and market structure. Initially, these models were based on partial equilibrium frameworks and assumed identical factor endowments across countries and later they were extended to general equilibrium settings. Early examples of this approach are the models developed by Krugman (1983) and Markusen (1984) that assumed the existence of firm-level scale economies as the driving force for FDI. The multinational firm’s headquarter produces a service of a firm-specific asset that can be simultaneously used in multiple plants in a non-rival manner. Therefore, two-plant firms have lower fixed costs than those of two single plants and this motivates multinational production.

These early models were later extended by a number of authors, such as Horstmann and Markusen (1987) and Brainard (1993a), and allowed for endogenous market structure and different forms of competition between firms within the partial equilibrium frameworks. In these frameworks firms had different potential channels of entering a foreign market and each of these channels incurred different costs. A firm faced a choice between concentrating production in the home country and serving foreign markets exporting to achieve scale economies and producing abroad to benefit from proximity to consumers. Theoretical modeling of horizontal FDI typically involved a tradeoff between the saving in variable costs such as transport costs and tariffs, and the additional fixed costs of setting up a new plant in the host country. The theory of the horizontally integrated MNE predicts that this sort of FDI will replace exports in markets where the costs associated with exporting are high or where the costs of setting up a local plant are low. Multinational firms in this framework become horizontally integrated as they produce the same products in their plants in different countries and serve local markets by local production. This theory predicts also that FDI is more likely to replace exports the larger is the host country market. Two main reasons for this are frequently mentioned. The first is related to the plant-level scale economies as the plant specific fixed cost can be spread over a larger number of units in the larger market. The second is related to the intensity of competition in the host country market. Larger markets can support more local firms and this will lead to a lower price. Therefore, if the marginal cost of supply through exporting is relatively high firms may favor local production to exporting.

General-equilibrium extensions of the model of horizontally integrated MNE that allow relating the extent of multinational activity to country characteristics were proposed by Markusen and Venables (1998, 2000). Their models predict that given moderate to high trade costs, multinational firms will prevail in equilibrium when countries are similar in size and in relative factor endowments. If countries were of different sizes but similar in relative factor endowments horizontal multinationals would be at a disadvantage relative to national firms producing in the large country and serving the small country market through exporting as they would have to install costly capacity in the small market. If countries were of similar size but differed in terms of their relative factor endowments multinational firms would be at a disadvantage relative to national firms as they would have to incur a substantial part of their costs in a high-cost location, assuming that human capital was intensively used in both fixed and variable costs in the multinational sector.

With the falling transportation and communication costs between countries an increasing part of multinational activity is explained by the reducing production cost motive. Multinational enterprises started splitting up a vertically integrated production process into separate fragments that can be located in different countries. The theoretical models of the vertically-integrated multinational firms hinge on the idea that different segments of the production process have different input requirements so it may be profitable to locate each segment where the factors used intensively in that stage are relatively cheap. For example, labor-intensive segments, such as assembly activities, will be located in labor abundant countries. In these models multinational firms arise in the absence of trade and investment costs and the driving force is the uneven-distribution of factors of production across countries.

The first models of a vertically-integrated multinational enterprise were developed by Helpman (1984,1985) and Helpman and Krugman (1985). These models can be regarded as extended versions of the Chamberlin-Heckscher-Ohlin new trade theory models in which differences in relative factor endowments between trading partners were so large that trade alone was not sufficient for achieving factor price equalization and reproducing the integrated equilibrium result. For example, if one country had a much higher endowment of capital per worker than the other then it would be profitable for the firm to split up the production process by retaining the capital intensive parts of the process in the capital abundant country and shifting the labor intensive segments to low cost locations. In this framework parent firms from the capital abundant country exported capital intensive products such as headquarter services and intermediate inputs to its subsidiaries located in the labor abundant country while subsidiaries export a high proportion of their output to the home country.

While these early models have been regarded as an elegant way of introducing multinational firms into the general equilibrium framework of new trade theories their applicability to real life has been criticized because of their unrealistic assumptions of zero trade and investment costs. Adding these costs brings two new forces into the model. If trade costs are introduced factor price equalization does not take place, unless relative factor endowments are the same in both countries, and the resulting factor price differentials increase incentives to fragment production. However, if there are also additional costs of fragmenting production internalization of production becomes less attractive. In this case the decision to go multinational will depend on the interaction between these two forces. The vertical FDI models generate clear testable implications that differ significantly from the predictions of horizontal models. In vertical models multinational activity takes place only between countries that are very different in terms of their relative factor endowments. In particular, these models predict that the larger the difference in relative factor endowments between the home and host countries the larger the involvement of multinational firms from the home country in production activities in the host country, given the relative economic size of trade and investment partners. If there are no differences in relative factor endowments there is also no incentive for internationalization of production and multinational production. This prediction is the consequence of the zero trade cost assumption.

Throughout the 1980s and 1990s horizontal and vertical models of multinational enterprise were treated as two separate strands in the literature. The next step in the development of the theory of multinational enterprise aimed at combining the horizontal and vertical approaches into a hybrid framework in which firms can choose between national, horizontal and vertical strategies. This has been done by Markusen (2002) who called this integrated framework the knowledge capital model. His model was based on three main assumptions that allow different types of firms to arise endogenously. First, he assumed that, like in the pure vertical model, creation and services of knowledge-based assets, such as R&D, could be geographically separated from production and supplied to foreign subsidiaries by the headquarter at a fairly low cost. Second, he assumed that headquarter services were more human-capital intensive than production. Third, he assumed that these knowledge-based services had a joint-input characteristic. In other words, they could be simultaneously used by multiple production facilities, giving rise to firm-level scale economies, like in the pure horizontal model. The first two assumptions provided incentives for the international fragmentation of production and locating various segments of production process where the factors used intensively in each segment were relatively cheap. The third assumption motivated horizontal investment that replicated the production of the same goods or services in different countries.

The theoretical knowledge capital model that combines both horizontal and vertical motives for internationalization of production cannot be, however, solved analytically. These analytical difficulties imply that most results had to be derived from numerical simulations. These simulations generated predictions on the relationship between foreign direct investment and country characteristics. For example, national firms exporting to each other’s market would be the dominant type when countries were similar in economic size and relative factor endowments and trade costs were low. Horizontal multinationals would dominate when countries were similar in economic size and relative factor endowments and trade costs were high.

However, if countries were dissimilar in either size or in relative factor endowments one country would be favored as a location of both headquarters and production activities or one of these two activities. In particular, if countries were dissimilar in size but similar in relative factor endowments then national firms located in the large country would be favored as they could avoid installing costly capacity in the smaller market. On the other hand, if countries were similar in size but dissimilar in relative factor endowments vertical multinationals would be the dominant type as there was an incentive to split the production process and concentrate headquarters in the human-capital abundant country and production in the labor-abundant country, unless trade costs were high. The extent of multinational activity in the knowledge capital model would be the largest when the parent country was moderately small and highly abundant in human capital.

In the later years the knowledge capital model has been extended in many directions. These extensions include, *inter alia*, the theoretical studies by Markusen and Strand (2009), Markusen and Stähler (2011), and Chen *et al.* (2012). However, one of the most important recent extensions of this framework is the incorporation of physical capital in addition to the human capital that allows the direct comparison of the knowledge capital model with the horizontal and vertical models of the multinational enterprise in which differences in relative factor endowments were determined by the capital to labor ratios. Therefore, in contrast to the previous empirical studies, in addition to studying the differences in relative human capital endowments in the current research we will also study the role of differences in physical capital to labor ratios.

Empirical studies that attempted to validate the predictions of the new theories of multinational enterprise have not started until the early 1990s. Initially they were focused almost entirely on American multinationals while firms from other counties received much less attention. These studies were initiated by Brainard (1993, 1997) who tested two alternative hypotheses: „the proximity-concentration tradeoff” for horizontally integrated MNEs and relative factor endowments for vertically integrated MNEs. She found that the majoirty of American MNEs were integrated horizontally, and not vertically. However, Carr, Markusen and Maskus (2001) estimated specifications directly derived from the knowledge capital model and found that American MNEs were integrated not only horizontally but also vertically. Since then the determinants of foreign direct investment flows have been widely investigated also in other countries. In particular, the opening of the economies of Central and East European countries (CEECs) to FDI in the early 1990s stimulated interest in studying determinants of FDI into those countries. Initially, empirical studies for those countries were conducted treating all the countries in the whole region jointly. Examples of such studies include Lansbury *et al.* (1996), Brenton *et al.* (1999), Benacek *et al.* (2000), Resmini (2000), Garibaldi *et al.* (2001), Bevan and Estrin (2004), Carstensen and Toubal (2004), Cieślik and Ryan (2004), Baniak *et al.* (2005), Gorbunova *et al.* (2012), and most recently also Wach and Wojciechowski (2016). Subsequently, studies for individual CEECs started to appear. In particular, determinants of FDI in Poland were studied by Cieślik (1996), Witkowska (1996), Przybylska (1998, 2001), Liberska (1999), Polak (2002), Cieślik (2006), [Markowicz](http://bazekon.icm.edu.pl/bazekon/contributor/dbd29baf43a3296df8dfb7405c62ae48) and [Miłaszewicz](http://bazekon.icm.edu.pl/bazekon/contributor/30d0ad780bf343abbf0c850abdc23d53) (2007), Ancyparowicz (2009), and more recently [Lizińska](http://yadda.icm.edu.pl/yadda/contributor/c6ad98c947bbf2d67f0ea21a45d59459) (2012).

The above literature review clearly shows that quite a lot of research was done on the determinants of foreign direct investment location decisions of multinational corporations in Central and Eastern Europe. In particular, considerable attention has been paid especially to the factors influencing the volume of inward FDI in transition economies that recently became member countries of the European Union. In each of the papers the focus of analysis was on the country specific determinants of foreign direct investment location decisions. What seems to be even more important, all the described studies aimed at comparing the sets of explanatory variables identified as significant for the amount of FDI flows received by various countries due to a willingness to explain the differences in foreign capital distribution among the CEECs. However, with the exceptions of the early studies by Cieślik (1996,2006) who approximated differences in relative factor endowments with GDP per capita differences, none of the aforementioned studies tried to test empirically the predictions derived directly from the formal models of the new theory of multinational enterprise and distinguish between horizontal and vertical FDI.

In many cases previous studies presented simple analogies based on the research results for other countries or were limited to case studies and survey evidence for a relatively small number of firms which did not allow making generalizations based on a large number of cases. In addition, only in a very limited number of studies more formal econometric evidence on FDI determinants was presented. However, the majority of these studies were based on *ad hoc* regressions without firm references to the theory which made the interpretation of estimation results very difficult. Also, very little attention was given to the impact of Poland’s accession to the EU on FDI. Comprehensive studies concerning the issue of the factors affecting FDI flows in the time period between 2008 and 2014 are still lacking, especially with regard to different sources of origin.

 Thus, further research on the problem of foreign direct investment determinants in in Poland in the most recent years would definitely be of interest. It seems clear that the process of integration into the EU should have a significant impact on the amount of foreign direct investment located in Poland. This is mostly due to the fact that through a GDP growth and reduction in trade costs such as transportation costs and tariffs it led to a substantial expansion of market size. However, at the same time the accession to the EU reduced the differences between Poland and the old EU member countries in terms of unit labor costs. This in turn is expected to decrease the inflows of vertical FDI and increase inward horizontal FDI from the founding European Union members to the countries that joined the community in the year 2004 and afterwards.

**MATERIAL AND METHODS**

The theoretical models discussed in the previous section predict how multinational activity on a bilateral basis can be related to combined market sizes, differences in economic country size, relative factor endowments and trade costs. Both horizontal and vertical models of multinational enterprise can be nested into and regarded as two special cases of the knowledge capital model and estimated using a panel of cross-country observations for Poland over the period 1989-2014. Country characteristics determining the extent of multinational activity between countries in pure horizontal and vertical models appear also in the hybrid model although their expected impact differs across models. Therefore, checking whether the market access motive or the production cost motive better explains the cross-country pattern of FDI in Poland can be done by evaluating the signs and significance of the estimated coefficients on various country-pair characteristics.

 The two key variables that allow distinguishing between competing theoretical are the measures of similarity in relative factor endowments and economic size between the home and the host countries. In particular, the purely horizontal model of the multinational enterprise predicts that the involvement of multinational firms in the host country would decrease with increasing differences in relative factor endowments while the purely vertical model predicts an opposite relationship. Therefore, if the estimated coefficient on the measure of differences in relative factor endowments between the home and the host countries turns negative then the market access motive should be more important, while if it turns positive then the production cost motive should be more important.

In the hybrid model, there is some non-monotonicity in the relationship between the measure of involvement of MNEs in the host country and differences in relative factor endowments. The rise in human capital per worker in the human capital-scarce country, that reduces differences in relative factor endowments between countries, leads to a fall in the foreign involvement in the host country for a relatively similar countries but increases FDI when the host country is very human capital-scarce. The theory cannot exactly predict where the turning point is (Carr et al., 2004).

Despite ongoing convergence between Poland and the EU-15 the differences in relative factor endowments between these countries are still substantial, hence we should expect a positive sign of the coefficient on differences in relative factor endowments if the production cost motive were to dominate. In this study we use two ways of measuring differences in the relative factor endowments between countries. First, we to assure comparability with the previous studies we proxy for differences in relative factor endowments between Poland and its investment partners with the per capita difference in GDP (GDPPCDIFF) calculated using output-side real GDP at chained PPPs and expressed in constant 2011 US dollars.

Then, in order to calculate cross-country differences in relative factor endowments we also use the actual factor data on human as well as physical capital. The differences in human capital endowments (HLDIFF) are calculated using the human capital index, based on years of schooling and returns to education. The differences in physical capital endowments (KLDIFF) are calculated using the capital stock expressed in PPPs in constant 2011 US dollars and the number of people employed. The data necessary to calculate differences in relative factor endowments come from the PennWorld Table (PWT) 9.0 available on www.ggdc.net/pwt.

The second key explanatory variable is similarity in economic size between the home and the host countries. Both the pure horizontal and the hybrid knowledge capital model predict a negative relationship between differences in the country size and the extent of involvement of multinational firms in the host country, while in the pure vertical model similarity in country size does not play any role. Therefore, we can expect a positive sign of the estimated coefficient on this variable if the market access motive is important and no relationship for the production cost motive. To measure similarity in relative country size we use the size dispersion index proposed by Helpman (1987). The value of this index is positively related to similarity in size of investment partners and is maximized when both the home and the host countries are of equal size. In order to calculate the size similarity index (SIMILARITY) data on output-side real GDP at chained PPPs and expressed in constant 2011 US dollars for Poland and particular EU-15 countries is used. This data also comes from the PennWorld Table (PWT) 9.0 available on www.ggdc.net/pwt.

In addition to the measures of differences in relative factor endowments and similarity in economic size that are used for model identification we also include a number of additional variables in our estimating equation in order to control for other effects. To control for the absolute economic size of investment partners we include the sum of Poland’s and the home country’s GDP (GDPSUM). In all the theoretical models that were surveyed in the previous section the absolute economic size of investment partners is positively related to the extent of foreign involvement in the host country. Therefore, a positive sign on the GDPSUM variable should be expected. To calculate the sum of investment partners’ GDP we use the same data on GDP that was used previously to calculate the GDP similarity index which comes from the PennWorld Table (PWT) 9.0 available on www.ggdc.net/pwt.

In order to control for the effects of transport and other distance related costs such as communication and monitoring we include geographic distance (DISTANCE) between the home country and Poland. The economic theory, however, does not yield clear predictions about the exact impact of distance on the extent of foreign involvement in the host country. On the basis of previous empirical studies we can expect a negative sign of the estimated coefficient on the DISTANCE variable. We choose to measure distance in the simplest possible way by calculating a “as the crow flies” distance between European capitals and the capital city of Poland - Warsaw and express it in kilometers. This data is available on line from <http://www.indo.com/distance>.

Finally, to control for business cycle and policy changes effects such, as joining the EU in 2004, we include individual time effects and to control for country heterogeneity we include country-pair fixed effects. The definitions of explanatory variables and their signs predicted by competing models of multinational enterprise are summarized in Table 1.[[1]](#footnote-1)

**Table 1. Definitions and summary statistics of dependent and explanatory variables and their expected signs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Explanatory variable | Definition | mean | Std. dev. | min | Max | Expected signs |
| Horizontal model | Vertical model | Hybrid model |
| MNE | Number of firms with foreign capital | 764.9103 | 1242.628 | 0 | 6303 | na | na | na |
| GDPPCDIFF | Per capita GDP difference between parent country and Poland | 17870.64 | 7452.429 | 235.2053 | 46666.89 | - | + | +/- |
| HLDIFF | Human capital per worker difference | 0.2635798 | 0.2137941 | 0.0008984 | 0.8997912 | - | + | +/- |
| KLDIFF | Capital per worker difference | 183962.9 | 72660.18 | 50610.21 | 421443.3 | - | + | +/- |
| SIMILARITY | Helpman GDP dispersion index | 0.3731373 | 0.1032258 | 0.0624395 | 0.4999996 | + | 0 | + |
| GDPSUM | Sum of parent country and Poland’s GDPs | 1368554 | 933535.6 | 309587.3 | 4694847 | + | + | + |
| DISTANCE | Geographic distance of each parent country’s capital city from Warsaw | 1292.267 | 609.746 | 515 | 2756 | +/- | +/- | +/- |

Our measure of the extent of foreign involvement in Poland’s economy is the number of operational entities with foreign capital participation obtained from the Polish Central Statistical Office (CSO).[[2]](#footnote-2) According to the most recent CSO (2015) data in 2014 there were 26464 operational firms with foreign equity and 18517 of this total (70%) reported equity that belonged to investors located in the EU-15 countries. The top three source countries were, respectively, Germany with 6041 firms (22.8%), the Netherlands with 2575 firms (9.7%), and the UK with 1384 firms (5.2%). The majority of multinational enterprises as well as the foreign equity were concentrated in service and manufacturing activities and foreign involvement in the primary sector was negligible.

Our dependent variable assumes non-negative integer values and the distribution of firms is skewed towards a few EU-15 source countries. The preponderance of zeros and small values in the sample, as well as the clearly discrete nature of the dependent variable, suggest that we can improve on traditional estimation techniques, such as OLS for example, with a specification that accounts for these features. Therefore, the use of count models in this study seems to be the most suitable choice. The Poisson and negative binomial (NB) models are two most popular count models. In the Poisson model the probability of observing a count of foreign firms from country *i* *yi* that operate in Poland is:

 *y*i = 0, 1, 2,…, N. (1)



where *λ*i is the expectation of the number of multinational firms from country *i* operating in Poland, assumed to be log-linearly dependent on the vector of country characteristics *xi*:

ln*λi = β’xi*  (2)

and *β* is a parameter vector that needs to be estimated.

The crucial assumption of the Poisson model is the equality of conditional variance and conditional mean. However, count data very often exhibits overdispersion. This problem can be easily avoided by using the NB model which is a generalized version of the simple Poisson model that introduces an individual unobserved effect into the conditional mean:

ln*λi = β’xi + εi*  (3)

where *εi* reflects either a specification error or some cross-sectional heterogeneity with exp*(εi)* having a gamma distribution with a unit mean and variance α.

The expected value *yi* in the negative binomial model is exactly the same as in the Poisson model but the variance is bigger than the mean and equals:

var[yi|xi] = E[yi|xi]{1 + αE[yi|xi]} (4)

The negative binomial model approaches the Poisson model as overdispersion approaches zero. When the estimated parameter α is not statistically different from zero, the conditional mean becomes equal the conditional variance and the negative binomial model simplified to the Poisson model. Hence, the Poisson model is nested in the negative binomial model. In order to make the comparison between these two models the standard likelihood ratio test can be used. In this study we estimated both the Poisson and NB models. However, it turned out that in all cases the estimated parameter α was statistically different from zero and the likelihood ratio test always favored the NB model versus the Poisson model. Therefore, in the next section we report only the negative binomial model estimates.

**RESULTS AND DISCUSSION**

In this section we report two sets of our estimation results. First, in order to achieve comparability with the earlier studies, in Table 3 we report estimation results obtained for the specification in which we use GDP per capita as a measure of relative factor endowments. Then, in Table 4 we report estimation results obtained from the specification in which we use actual human and physical capital data.

 **Table 3. Estimates of the NB model for the period 1989-2014: GDP per capita data**

(z-stats)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Explanatory variable | (1) | (2) | (3) | (4) |
| GDPPCDIFF | 0.000087\*\*\*(12.33) | 0.000078\*\*\*(7.84) | 0.000069\*\*\*(10.65) | 0.000043\*\*\*(5.20) |
| SIMILARITY | 3.759283\*\*\*(9.34) | -6.201976\*\*\*(4.92) | 3.575377\*\*\*(10.55) | 2.853520\*\*\*(2.92) |
| GDPSUM | 1.10e-06\*\*\*(23.34) | 1.77e-06\*\*\*(19.83) | 1.01e-06\*\*\*(14.65) | -6.99e-07\*\*\*(4.34) |
| DISTANCE | -0.000663\*\*\*(13.65) | 0.000599\*\*\*(3.86) | -0.000935\*\*\*(14.65) | -0.002912\*\*\*(11.92) |
| Constant | 2.261137\*\*\*(6.81) | 2.527454\*\*\*(6.11) | 0.483792(1.58) | 6.975686\*\*\*(13.80) |
| Time-specific effects | NO | NO | YES | YES |
| Country-specific effects | NO | YES | NO | YES |
| Loglikelihood | -2648.633 | -2551.608 | -2539.198 | -2372.102 |
| Pseudo R2 | 0.096 | 0.129 | 0.133 | 0.190 |
| Alpha α(z-stat) | 0.532090(14.36) | 0.329316(13.58) | 0.320132(13.89) | 0.129663(12.61) |
| LR test(p-val) | 7.7e+04(0.000) | 4.7e+04(0.000) | 6.2e+04(0.000) | 1.1e+04(0.000) |
| Chi2 test for country effects(p-val) |  | 251.82(0.000) |  | 548.78(0.000) |
| Chi2 test for time effects(p-val) |  |  | 361.02(0.000) | 629.30(0.000) |

Notes: Dependent variable: the number of multinational enterprises; N = 390 in all specifications; \*\* significant at the 5% level of significance, \*\*\* significant at the 1% level of significance.

The baseline estimates obtained via the traditional NB approach on the pooled dataset that does not allow controlling for individual time and country-pair effects are presented in column (1) of Table 3. It turns out that all estimated coefficients are statistically significant already at the 1% level and display expected signs that favor the knowledge capital model in which both market access and cost reducing motives determine FDI over the pure models of vertically- and horizontally-integrated multinational firms. In particular, both the positive sign of the estimated parameter on the measure of differences in relative factor endowments and on the measure of similarity in terms of market size suggest that multinational activity in Poland increases with GDP per capita differences and the similarity in GDPs.

In column (2) we control for individual country-specific effects by including dummy variables for particular countries in our sample. The estimated coefficients on country-specific effects are jointly statistically significant, as indicated by the value of chi2 test, and their inclusion improves the accuracy of our baseline estimates, reported in column (1), which is reflected in the higher value of the loglikelihood. The inclusion of country-specific effects does not change the previous statistical significance of the estimated parameters on our explanatory variables. However, it changes the sign of the estimated parameter on the measure of similarity in terms of the market size. Nevertheless, our previous conclusions concerning the impact of differences in relative factor endowments on the extent of foreign involvement in Poland remain unchanged.

In column (3) we control for individual time specific effects by including dummy variables for particular years of our sample. The estimated coefficients on time effects are jointly statistically significant, as indicated by the value of chi2 test, and their inclusion improves the accuracy of our baseline estimates, reported in column (1), which is reflected in the higher value of the loglikelihood. In qualitative terms the inclusion of time effects, however, does not change much our previous conclusions, obtained on the basis of our baseline estimates reported in column (1), concerning impact of particular country-pair characteristics on the extent of foreign involvement in Poland and the preferred theoretical model.

In column (4) we check the robustness of our estimates by including both country-specific effects and time-specific effects. These estimation results do not differ much from the baseline results reported in column (1) as the estimated coefficients on the measures of differences in relative factor endowments and the similarity in market size display the expected positive signs and are statistically significant already at the 1% level. However, the sign of the estimated parameter on the absolute market size now becomes negative.

In Table 4 we study the robustness of the estimation results reported in Table 3 using actual human and physical capital data on differences in relative factor endowments. The particular columns in Table 4 are the direct counterparts of columns in Table 3.

**Table 4. Estimates of the NB model for the period 1989-2014: Factor endowment data**

(z-stats)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Explanatory variable | (1) | (2) | (3) | (4) |
| HLDIFF | -0.227927(0.98) | 1.237651\*(1.88) | 0.0828342(0.44) | 2.005267\*\*\*(5.05) |
| KLDIFF | 4.89e-06\*\*\*(7.57) | 4.50e-06\*\*\*(5.75) | -5.30e-07(0.54) | 2.76e-06\*\*\*(3.08) |
| SIMILARITY | 1.691817\*\*\*(9.34) | -2.976678\*\*(2.02) | 1.341179\*\*\*(4.64) | 2.216457\*\*(2.37) |
| GDPSUM | 9.25e-07\*\*\*(17.06) | 1.24e-06\*\*\*(8.35) | 8.14e-07\*\*\*(18.08) | -7.00e-07\*\*\*(4.78) |
| DISTANCE | -0.001261\*\*\*(15.03) | -0.000803\*\*\*(3.89) | -0.001412\*\*\*(21.05) | -0.003441\*\*\*(11.92) |
| Constant | 4.825054\*\*\*(21.67) | 4.143003\*\*\*(6.81) | 3.032148\*\*\*(11.13) | 6.636638\*\*\*(14.10) |
| Time-specific effects | NO | NO | YES | YES |
| Country-specific effects | NO | YES | NO | YES |
| Loglikelihood | -2684.373 | -2557.287 | -2590.246 | -2351.004 |
| Pseudo R2 | 0.084 | 0.128 | 0.116 | 0.198 |
| Alpha α(z-stat) | 0.632036(14.73) | 0.339680(13.66) | 0.412512(14.26) | 0.115140(12.46) |
| LR test(p-val) | 9.5e+04(0.000) | 4.0e+04(0.000) | 7.3e+04(0.000) | 9649.28(0.000) |
| Chi2 test for country effects(p-val) |  | 378.69(0.000) |  | 1015.71(0.000) |
| Chi2 test for time effects(p-val) |  |  | 329.75(0.000) | 803.92(0.000) |

Notes: Dependent variable: the number of multinational enterprises; N = 390 in all specifications; \*\* significant at the 5% level of significance, \*\*\* significant at the 1% level of significance.

The baseline estimates obtained via the traditional NB approach on the pooled dataset that does not allow controlling for individual time and country-pair effects are presented in column (1) of Table 4. It turns out that almost all estimated coefficients are statistically significant already at the 1% level and display expected signs with the exception of differences in human capital endowments. In particular, both the positive sign of the estimated parameter on the measure of differences in capital-labor ratios and on the measure of similarity in terms of market size suggest that both vertical and horizontal reasons are important for multinational activity in Poland. These findings are in line with the findings reported in column (1) of Table 3. However, they do not fully support the knowledge capital model where differences in human capital abundance play a key role in determination of the extent of multinational activity.

In column (2) we control for individual country-specific effects by including dummy variables for particular countries in our sample. Similar to the estimates reported in column (2) of Table 3, the estimated coefficients on country-specific effects are jointly statistically significant, as indicated by the value of chi2 test. Their inclusion improves the accuracy of our baseline estimates, reported in column (1), which is reflected in the higher value of the loglikelihood. The inclusion of country-specific effects does not change much statistical significance of the estimated parameters on our explanatory variables with the exception of the human capital differences variable which becomes statistically significant at the 10 per cent level. In addition, the inclusion of country-specific effects changes the sign of the estimated parameter on the measure of similarity in terms of the market size which becomes negative. Nevertheless, our previous conclusions concerning the impact of differences in capital to labor ratios on the extent of foreign involvement in Poland remain unchanged.

In column (3) we control for individual time specific effects by including dummy variables for particular years of our sample. The estimated coefficients on time effects are jointly statistically significant, as indicated by the high value of chi2 test. Their inclusion improves the accuracy of our baseline estimates, reported in column (1), which is reflected in the higher value of the loglikelihood. However, the inclusion of individual time effects makes the capital-labor ratio statistically not significant. This would suggest that only horizontal reasons for multinational activity in Poland are important.

Finally, in column (4) we include both country-specific effects and time-specific effects. These estimation results differ from the baseline results reported in column (1) as now both measures of differences in relative factor endowments are statistically significant already at the 1% level and display expected positive signs. The estimated coefficients on similarity in market size also displays the expected positive signs and is statistically significant already at the 1% level. However, the sign of the estimated parameter on the absolute market size now becomes negative and statistically significant. These results suggest that both differences in relative factor endowments as well as the market access are important for multinational firms based in the EU-15 countries that undertake FDI in Poland. These empirical are generally in line with the knowledge capital model of multinational enterprise.

**CONCLUSIONS**

The advances of industrial organization of the early 1980s allowed to incorporate formally multinational enterprises into the microeconomic general equilibrium theory of international trade giving rise to new theories of multinational enterprise. According to these new theories multinational enterprises arise endogenously in response to country characteristics such as differences in relative factor endowments, relative economic size, as well as various trade and investment costs. Initially, these theories were assigned to two main groups. The first group concentrated on horizontally-integrated multinational firms that followed the market seeking strategy and produced the same goods and services in multiple locations to avoid trade costs. The second group focused on vertically-integrated multinational firms that followed the efficiency seeking strategy and fragmented geographically their production processes by stages differing in terms of their factor intensity and placed labor-intensive stages of production in locations with relatively abundant labor. Later, an integrated approach that combined these two early approaches called the knowledge-capital model emerged. This hybrid model allows both horizontally and vertically integrated firms to coexist in equilibrium. All these approaches have very different empirical implications. The purpose of this paper was to validate the theoretical predictions of the competing models of multinational enterprise using bilateral panel data on EU-15 MNE activity in Poland during the last 26 years. The assembled empirical evidence points to the horizontal as well as vertical motives for undertaking foreign direct investment in Poland. In addition, both differences in relative human capital endowments and physical capital to labor ratios are important for determining the extent of MNE activity in Poland.

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**Appendix**

**Table A1. Correlations between variables**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  variable | MNEs | GDPPCDIFF | HLDIFF | KLDIFF | SIMILARITY | GDPSUM | DISTANCE |
| MNEs | 1.000 |  |  |  |  |  |  |
| GDPPCDIFF | 0.1931 | 1.000 |  |  |  |  |  |
| HLDIFF | 0.1426 | -0.0932 | 1.000 |  |  |  |  |
| KLDIFF | 0.1079 | 0.1124 | -0.1152 | 1.000 |  |  |  |
| SIMILARITY | -0.1391 | -0.4985 | -0.0347 | -0.5118 | 1.000 |  |  |
| GDPSUM | 0.7085 | 0.5097 | 0.2443 | 0.0332 | -0.4680 | 1.000 |  |
| DISTANCE | -0.3974 | -0.0903 | 0.2223 | -0.1235 | 0.1553 | -0.2267 | 1.000 |

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1. The calculated values of the correlations between the variables used in the empirical study are reported in Table A1 in the Appendix. [↑](#footnote-ref-1)
2. CSO, 2015, The economic activity of firms with foreign capital participation, Zakład Wydawnictw Statystycznych, Warszawa. [↑](#footnote-ref-2)