

A Knowledge-Capital Model Approach of FDI in Transition Countries

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ABSTRACT. This paper aims at assessing the nature of foreign direct investment (FDI) in transition countries. We provide an empirical application of the knowledge-capital model of multinationals (MNEs) to an original panel of affiliates of MNEs in seven transition countries. We succeed in proving that the strategies of MNEs are heterogeneous by looking at FDI flows by sectors of activity and by source countries. We find evidence for both horizontal and vertical FDI in the region, while current studies detect only the vertical ones. Therefore, we argue that transition countries start being attractive for foreign investors not only because of their low labor costs, but also because of their market potential.

JEL classification: F21, F23

Keywords: Foreign direct investment, Multinationals, Knowledge-capital model, Panel data.

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1. INTRODUCTION

Theory on multinational enterprises (MNEs) usually distinguishes between horizontal and vertical firms. "Horizontal" firms produce the same product in different locations and seek to improve access to host country markets. "Vertical" firms geographically fragment their production process into stages and seek to benefit from international factor price differences.¹ In order to create, acquire or expand a foreign affiliate, MNEs undertake foreign direct investment (FDI). As a consequence, it is also possible to make the distinction between vertical FDI and horizontal FDI.

The knowledge-capital model presented in Markusen et al. (1996) and Markusen (1997, 2002) is a technical device that embeds both vertical and horizontal FDI. Hence, it is a powerful tool to disentangle the type of FDI (vertical versus horizontal) when looking at general FDI flows. Such an approach allows the researcher to identify very clearly what the objective of the strategic actions undertaken by MNEs is: exploiting larger markets (horizontal FDI) or reducing production costs (vertical FDI).

By referring to this theoretical framework, Carr, Markusen and Maskus (2001) are able to transpose the theoretical formulation of the model to an empirical definition. Results of numerical simulations of the knowledge-capital model allow them to identify the fundamental variables to be introduced into a general econometric specification to achieve the distinction between vertical and horizontal FDI flows. Their method proves to be successful for data about foreign affiliates of MNEs from US, Sweden and Germany.

In this paper we apply the knowledge-capital model to a sample of MNEs from countries from the European Union (EU)² that carry out FDI in transition countries.³ Investment decisions in transition countries represent a very complex and challenging phenomenon that has been recently widely studied empirically. Unfortunately, a unique theoretical framework referring to the determinants of FDI does not exist.

The present paper proposes a new approach for studying the determinants of FDI in transition countries by estimating the empirical specification of the knowledge-capital model.

We choose an ad hoc sample of affiliates of MNEs from the EU in transition coun-

¹See Section 2 for more details about these two different types of FDI.

²We consider as European Union all the countries belonging to the European Union before 2004.

³The transition countries belonging to our sample are: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania.

tries because of several reasons. First, the EU is the main investor in the transition countries from Central and Eastern European region - its share in the volume of FDI inward stock in transition countries is more than 60%.⁴ Therefore, we consider it would be interesting to identify the strategies and the reasons why MNEs from the EU are so active in transition countries. Second, transition countries represent a very challenging experiment for the study of FDI, since FDI was practically absent in this region before 1990s and it increased substantially after 1990s. Finally, as we point out in the next section, there is a need to provide more empirical evidence for the knowledge-capital model for the case of developed countries investing in developing or less-developed countries.

The current literature about FDI in transition countries mainly focuses on the importance of relatively low labor (or factor) costs in this region for attracting MNEs (Resmini, 2000; Carstensen and Toubal, 2004). Undoubtedly, this is evidence towards vertical FDI, since factor cost differences create an incentive to locate different activities in these countries. We are able to refine this statement, by using a more recent and very comprehensive dataset at firm-level for affiliates of MNEs from the EU active in transition countries and by applying the empirical specification of the knowledge-capital model. There are not exclusively vertical FDIs. A mixture of vertical and horizontal FDI strategies coexist depending on the objectives of the investors.

The novelty of our approach consists in looking at FDI flows at a more disaggregated level, by using bilateral data that allow to identify the home and the host countries of MNEs and the sectors of activity of the foreign affiliates. Therefore, we are able to analyze to what extent investment strategies vary with respect to the sector of activity of the foreign affiliate or the home country of the investor. We succeed in proving that the horizontal component of the knowledge-capital model dominates when we consider separately different sectors of activity, both in manufacturing and services. Moreover, when we isolate different home countries, we find evidence for both vertical and horizontal FDI.

To our knowledge, this is the first paper in the literature that applies the knowledge-capital framework to the case of FDI in transition countries. Our results confirm the assumption that such a framework is a modern approach to investigate the complex nature of FDI, above all in this region. It allows to distinguish between vertical and horizontal FDI. Besides, our analysis at firm level makes it possible to take into

⁴See Appendix 5.

account the heterogeneity of different types of FDI and of their origins.

The remaining of the paper is organized as follows: Section 2 reviews the theoretical and empirical literature on MNEs, with emphasis on the knowledge-capital model. Section 3 describes in more detail the knowledge-capital model, its predictions and the empirical specification. Section 4 presents the data and the empirical results. Finally, Section 5 concludes.

2. THE KNOWLEDGE-CAPITAL MODEL: LITERATURE REVIEW

From a theoretical point of view, the literature on FDI distinguishes between two main patterns of internationalization: vertical and horizontal. Markusen (1997, 2002) has unified these two approaches into a single model, called the knowledge-capital model. Because of the complexity of these models, we will limit the discussion in this section to a very intuitive presentation of their main predictions.⁵

The vertical pattern is explained by the factor proportion approach, developed by Helpman (1984) and Helpman and Krugman (1985). In a perfect competition framework, they study the strategies of single-plant firms that fragment their production process into different stages. The location of the different stages of production is based on differences in factor endowments and factor prices across countries. The authors assume that trade costs between countries are negligible. In this framework, firms become MNEs in order to reduce their total costs. Firms split their activity in two components: headquarters services (for example R&D and advertising), which are intensive in skilled labor, and production, which is intensive in unskilled labor. The vertical model predicts that firms will locate headquarters in countries that are relatively endowed with skilled labor, because skilled labor is relatively cheap. Production will be settled in countries relatively rich in unskilled labor, because unskilled labor is relatively cheap. Consequently, vertical FDI is expected to take place mainly between countries with different factor endowments and at different stages of economic development.

Conversely, the horizontal pattern is developed by Markusen (1984, 2002) and Markusen and Venables (1998). In an imperfect competition framework, they consider multi-plant firms that produce the same good in various countries, for local sale. The model allows for positive trade costs between countries. In this framework, horizontal FDI arises when trade costs are high. In such a case, it will be expensive for the firm to export, therefore it will be more efficient to locate production abroad.

⁵See Markusen (2002) for a detailed description of all these models.

Hence, firms choosing horizontal FDI seek to achieve better access to foreign markets, be closer to the customers and avoid trade costs. Consequently, horizontal FDI is expected to take place between countries at similar stages of economic development.

However, both the vertical and the horizontal model have drawbacks. On the one hand, the model of vertical FDI assumes that there are no trade costs. But then, there is no reason for horizontal FDI. On the other hand, the model of horizontal FDI assumes that different activities (headquarters and production) use factors of production in the same proportion or only one factor of production. But in such a case, there is no factor price reason for vertical FDI.

Markusen (1997, 2002) integrated these two models into a single general-equilibrium model, known as the knowledge-capital model.⁶ The model allows for trade costs between countries and different factor intensities across activities, therefore both horizontal and vertical FDI are likely to appear. In this setting, firms have the options of building multiple plants or of geographically separating headquarters from a single plant. Hence, firms decide whether it is convenient to become a horizontally integrated MNE, a vertically integrated MNE, or to stay a domestic producer which serves the foreign market through exports.

Several empirical papers that aim at providing evidence to these different theoretical issues of MNEs and FDI have emerged. In particular, the main concern of these empirical studies is to detect the existence of vertical FDI versus horizontal FDI. Brainard (1997) finds evidence for horizontal FDI, using data for affiliates sales of US MNEs. Ekholm (1998) also finds strong support for the existence of horizontal FDI, by using data for Swedish MNEs. A recent empirical paper by Buch et al. (2005) detects horizontal FDI for the case of German MNEs. Hanson et al. (2001) investigate three types of foreign activities of US MNEs: global outsourcing, the use of export platforms and wholesale trading. They find strong evidence for vertical FDI.

The knowledge-capital model which incorporates both vertical FDI and horizontal FDI has also been tested empirically. Carr, Markusen and Maskus (2001) propose an empirical specification drawn from the theoretical predictions of the model.⁷ They give strong support to the knowledge-capital model, using a panel dataset (1986-1994) on US affiliates sales abroad (outward affiliate sales) and of foreign affiliates in

⁶It is called like this because intangible assets like human capital or skilled labor are sometimes referred to as knowledge-capital.

⁷See Section 3 for more details regarding the empirical specification from Carr et al. (2001).

the US (inward affiliate sales).

Markusen and Maskus (2001) extend the empirical work from Carr et al. (2001) and estimate the empirical model only for US outward affiliate sales. Surprisingly, for this subsample they reject the knowledge-capital model.

In another paper, Markusen and Maskus (2002), again using the same dataset as in Carr et al. (2001), propose another empirical model. Their methodology distinguishes between the vertical model, the horizontal model and the knowledge-capital model. They find support for both the knowledge-capital model and the horizontal model, but no support for the vertical model. Their conclusion is that the knowledge-capital model and the horizontal model describe better the reality than the vertical model: direct investment is important between countries that are similar both in size and in relative endowments.

These three papers use the same dataset and are all derived from the predictions of the knowledge-capital model. However, they present mixed evidence. This led Blonigen, Davies and Head (2003) to argue that the empirical specification of the knowledge-capital model in Carr et al. (2001) might be misspecified. In particular, they claim that the model misspecifies the proxy for relative skilled labor endowments. They propose a different specification that uses absolute values of skilled labor endowments differences. The authors estimate this specification for the same dataset from Carr et al. (2001). They find no evidence for the vertical model or the knowledge-capital model and strongly support the horizontal model.

In the same line of Blonigen et al. (2003), other recent papers proposed different empirical approaches for the knowledge-capital model (Braconier et al., 2002, 2005; Davies, 2004; Geishecker and Görg, 2005). For our purposes, the paper by Geishecker and Görg (2005) is particularly relevant. They argue that different types of FDI may be driven by different incentives. Hence, the authors suggest to look separately at FDI in manufacturing and FDI in services. They estimate the empirical specification of the knowledge-capital model proposed in Carr et al. (2001) for a bilateral dataset on FDI for European and major non-European countries for the period 1994-2001. They find that FDI in services is dominated by horizontal FDI while FDI in manufacturing is dominated by vertical FDI. This suggests that the controversy with respect to the empirical relevance of horizontal FDI, vertical FDI or both can be solved by looking at FDI at a more disaggregated level.

Our approach joins the research path started by Geishecker and Görg (2005). We

look at FDI at a disaggregated level for a sample of affiliates of MNEs from the EU active in transition countries. In particular, our dataset allows to distinguish not only between manufacturing and services, but also between different sectors of activity in both manufacturing and services and between various home countries of the MNEs. We estimate the empirical specification of the knowledge-capital model formulated by Carr et al. (2001) for the full sample of companies and then, separately for different sectors of activity and for different home countries. This allows us to refine the main findings in the literature on FDI in transition countries: we show that recently there is a combination of vertical and horizontal FDI in the region, with horizontal FDI prevailing.

3. THE THEORETICAL AND EMPIRICAL SPECIFICATION OF THE KNOWLEDGE-CAPITAL MODEL

Before discussing the econometric approach, we provide a brief description of the theory behind the empirical specification of the knowledge-capital model.

The knowledge-capital model builds on the general-equilibrium horizontal model developed by Markusen (1984, 2002) and Markusen and Venables (1998). The horizontal model assumes two goods (X and Y), two countries (i and j) and two factors of production (unskilled-labor, L and skilled-labor, S). The factors of production are mobile between sectors, but internationally immobile. Good Y is unskilled-labour intensive and produced under constant returns to scale in a competitive industry. Good X is skilled-labour intensive and exhibits increasing returns to scale. Firms in the X sector operate under the free entry condition. Firms may choose to supply the foreign markets with exports or to build an affiliate plant in the foreign country. Markusen (2002) presents two approaches of this model: a Cournot oligopoly model with homogeneous goods and a monopolistic-competition model with differentiated goods. Results are similar in both versions of the model. Since our data on activities of affiliates is at firm level, the monopolistic-competition version of the theoretical model (Markusen, 2002) would be more appropriate.

In addition to these assumptions of the horizontal model, the knowledge-capital model is characterized by three main properties:

1. Fragmentation: the services of knowledge-based assets (knowledge-capital), such as R&D, may be fragmented from production and are easily supplied to production facilities at low cost.

2. Skilled-labor intensity: knowledge-capital is skilled-labor intensive relative to final production.
3. Jointness: the services of knowledge-based assets are (at least partially) joint (“public”) inputs into multiple production facilities.

The first two properties characterize activities of vertical MNEs that locate production in countries where unskilled-labor is more abundant and headquarters in countries where skilled-labor is more abundant. The third property characterizes activities of horizontal MNEs that have plants producing the same final good in multiple countries.

Hence, in the framework of the knowledge-capital model, headquarters services and plant facilities may be geographically separated within a firm and a firm may have plants in one or both countries. This setting allows the existence of six firm types, and each firm may move from one type to another type. The taxonomy of the firms is the following:

- Horizontal MNEs (H_i), that maintain plants in both countries (i and j) with headquarters located in country i ;
- Horizontal MNEs (H_j), that maintain plants in both countries (i and j) with headquarters located in country j ;
- National firms (N_i) that maintain a single plant and headquarters in country i . They may or may not export to country j ;
- National firms (N_j) that maintain a single plant and headquarters in country j . They may or may not export to country i ;
- Vertical MNEs (V_i) that maintain a single plant in country j and headquarters in country i . They may or may not export to country i ;
- Vertical MNEs (V_j) that maintain a single plant in country i and headquarters in country j . They may or may not export to country j .

The equilibrium in the X sector is determined by pricing equations (marginal revenue equals marginal cost) and free-entry conditions (profits are nonpositive). The production regime refers to the combination of firm types that are active in equilibrium. The equations and inequalities that characterize equilibrium in the model are

developed in Markusen et al. (1996) and Markusen (1997, 2002). They show that the firm types active in equilibrium will be a function of country characteristics like market size, differences in market size, differences in relative labor endowments and transport costs between the home and the host country.

Analytically, the general-equilibrium of the model is very difficult to solve because of two reasons. First, it requires numerical methods to solve a system of almost sixty equalities and inequalities. Second, most of the relationships derived from the model are nonlinear and non-monotonic. Therefore, the general-equilibrium is solved using numerical simulations. The authors calibrate firm fixed costs for different firm types and experiment with different levels of trade and investment costs.

According to the results of the numerical simulations, different country characteristics favour different firm types. Horizontal MNEs dominate when countries are similar in size, similar in relative labor endowments, total demand is high and trade costs are moderate to high. Vertical MNEs dominate when countries have very different relative labor endowments and, in particular, the incentive for vertical FDI is strongest when the skilled-labor abundant country is also small.

The results of the simulations can be tested empirically, because they link the volume of production of affiliates of MNEs to country characteristics like market size, differences in size, differences in endowments and trade and investment costs. Therefore, Carr et al. (2001) proposed an empirical model to test the above predictions of the knowledge-capital model. This empirical specification is perhaps the best specification for the determinants of multinational activity, because it is the first one that is driven from a formal theory of MNEs such as the knowledge-capital model:

$$\begin{aligned}
Y_{ijt} = & \beta_0 + \beta_1(GDP_i + GDP_j) + \beta_2(GDP_i - GDP_j)^2 + \beta_3(SK_i - SK_j) + \\
& + \beta_4(SK_i - SK_j)(GDP_i - GDP_j) + \beta_5 \text{Investment costs}_j + \\
& + \beta_6 \text{Trade costs}_j + \beta_7(\text{Trade costs}_j(SK_i - SK_j)^2) + \\
& + \beta_8 \text{Trade costs}_i + \varepsilon
\end{aligned}$$

In this specification, the subindex i refers to the home (source) country of a MNE. The home country is defined as the country where the headquarters of the MNE is located. The subindex j refers to the host country of a MNE. The host country is defined as the country where the foreign affiliates of the MNE are located.

The squared terms and the interaction terms are included to capture some of the non-linearity present in the model.

The dependent variable Y_{ijt} is a proxy for the activity of affiliates of MNEs (see Carr et al., 2001). In this paper we will use two different measures: sales of affiliates and the volume of FDI stock of affiliates of MNEs from country i located in country j at time t . This will allow us to check the robustness of the results with respect to different proxies.

The major difficulty that emerges when one tries to test empirically the theoretical models of FDI consists in identifying in the data the horizontal FDI from the vertical FDI. The same factors may have different impacts on these two types of FDI. For instance, high trade costs in the host country will have a positive effect in the case of horizontal FDI, but a negative one in the case of vertical FDI. Papers that have tried to give empirical support to these theories solve this problem by looking at the signs of the coefficients of the explanatory variables (Carr et al., 2001; Markusen and Maskus, 2002).

The first two independent variables are joint market size (the sum of real GDPs from parent and host country) and the square of the GDP difference. The former is expected to have a positive sign, since it is a measure of the size of the market or of the total demand. The latter variable captures the square of the difference in GDP between countries and is expected to have a negative sign because affiliate sales volume has an inverted U-shaped relationship to differences in country size (Carr et al., 2001)⁸. None of these variables are expected to be significant in the case of vertical FDI, since, according to the theory, this type of FDI is independent of the total demand or the difference in size between countries. Therefore, significant coefficients for these two variables can be interpreted as evidence for the horizontal model against the vertical one (Markusen and Maskus, 2002).

The third variable is the difference in skilled-labor abundance between the home country (SK_i) and the host country (SK_j). According to the predictions of the knowledge-capital model, it is expected to have a positive sign, meaning that firms tend to settle their headquarters in the skilled-labor abundant country. The positive sign represents evidence for the vertical component of the knowledge-capital

⁸Figure 1 from the paper by Carr et al. (2001) shows the general pattern of regimes of firm types. This figure has a saddle pattern, with an inverted U-shaped curve along the SW-NE diagonal where countries differ in size but not in relative endowments. Affiliate sales are at a minimum when the two countries are similar in relative endowments but different in size. This result leads the authors to predict a negative sign for the squared difference in size between home country and host country.

model: a significant difference in skilled-labor abundance between the home and the host country is the motivation for vertical FDI. By contrast, a negative sign is interpreted as evidence for the horizontal component of the knowledge-capital model, since horizontal FDI is driven by similarity in relative skilled-labor endowments between countries.

The fourth explanatory variable is an interaction term: the product of the difference in skilled-labor endowments and the difference in economic size. The knowledge-capital model establishes a very precise prediction regarding this term: affiliate sales are highest when the home country is small and skilled-labor abundant. Therefore a negative sign is expected. This is interpreted as evidence for vertical FDI.

The remaining variables capture the investment costs in the host country and costs of exporting to the home and to the host country. Investment costs in the host country affect negatively the volume of affiliate sales or the volume of FDI stock. Costs of exporting to the host country are expected to have a positive sign for horizontal FDI, since this type of FDI is preferred by MNEs when trade with the host country proves to be very expensive. However, a negative sign is regarded as a signal of vertical FDI, because the existence of high trade costs between the home and the host country would make trade more costly. Costs of exporting to the home country are expected to have a negative sign in both types of FDI. High trade costs in the home country diminish the incentives to locate plants abroad and to export back to the parent country.

Finally, the empirical model contains an interaction term between the trade costs of the host country and the square of the difference in skilled-labor abundance. This term should capture the horizontal component of the knowledge-capital model: high trade costs of the host country encourage horizontal investment, but not vertical investment and horizontal investment is more important when countries are similar in relative skilled-labor endowments. Carr et al. (2001) are agnostic about the sign of this variable and, eventually, suggest a negative sign.

4. DATA SOURCES AND EMPIRICAL RESULTS

One of the main contributions of this study is the selection of a specific database. We use an ad hoc dataset for affiliates of MNEs from the EU in transition countries than spans the period 1997-2003. The data are taken from the commercial database Amadeus, collected by the consultancy Bureau van Dijk. The major advantage of this database is the fact that it provides information on the home and the host country

of each company and by industry at 4 digits level NACE Rev.1.1. The database is organized by country with records for firms within each country. We retrieve all companies for which unconsolidated information was available. The available ownership information refers to the year 2003 and we assume that this applies to all the years. The choice of firm level data for the dependent variable is due to the fact that we deal with an unbalanced panel dataset, and hence, aggregating the data at country level would not be a reliable choice.

We have enough information for affiliates of MNEs from the 15 member states of the EU before 2004, in 7 transition countries (the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland and Romania).

We use two different measures for the activities of affiliates of MNEs. The first one is the real volume of production of foreign affiliates measured by sales of affiliates in each host country (Carr et al., 2001, Markusen and Maskus, 2002). We express the volume of affiliate sales in millions of US dollars. Note that affiliate sales include both sales for the local markets and sales for foreign markets. The former represent horizontal FDI and the latter vertical FDI. The signs of the explanatory variables will allow to distinguish between these two forms of FDI.

The second measure for the dependent variable is the volume of FDI stock. Since our database does not provide such a measure, we calculate it. Smarzynska and Spatareanu (2004) and Aitken and Harrison (1999) proposed the percentage of subscribed capital (equity) owned by the foreign company in the domestic company as a measure of the FDI stock. Likewise, OECD defines FDI stock as the contribution of the MNE to the total assets of their foreign affiliates or as financing provided by the MNE to its affiliates in the form of either equity or debt (OECD, 2003). Amadeus database provides information on the total assets⁹ of a company. If the company is a subsidiary of another company (foreign or domestic), the database provides information on the percentage of ownership that the parent company (ies) owns. Thus, we can calculate the volume of FDI stock from a year by multiplying the percentage of ownership of the foreign company by the total assets of its subsidiary located in a certain country (in millions of US dollars). Unfortunately, there was no information available on ownership for different years, so we were forced to assume the same percentage of ownership for each of the years from our panel.¹⁰ This second measure

⁹Total assets include: fixed assets (tangible fixed assets, intangible fixed assets and other fixed assets) and current assets (stocks, debtors and other current assets).

¹⁰According to the current literature this is not a strong assumption. The percentage of ownership

of international production reflects actually the capital stock abroad of the foreign company.

Both these proxies are computed in real values by deflating them by the producer price index with base year 2000, taken from the International Monetary Fund database.¹¹

When the dependent variable is sales of affiliates, the total number of firms is 9239 and when the dependent variable is the volume of FDI stock, the total number of firms is 9594.

The data for the explanatory variables are taken from various sources (see Appendix 1 for details).

Real GDPs of parent and host country are taken from World Development Indicators and are measured in billions of 2000 US dollars.

Skilled-labor abundance is calculated following Carr et al. (2001): the ratio of the sum of occupational categories 1 (legislators, senior officials and managers), 2 (professionals) and 3 (technicians and associate professionals) to total employment. It is the ratio of skilled workers to total employment. These data are taken from the International Labor Organization database.¹²

Investment costs in the host country is a subindex of the Index of Economic Freedom constructed by the Heritage Foundation. It has values between 1 and 5. Costs of exporting to the host and to the home country (trade costs) are defined differently from Carr et al. (2001), due to unavailable data. We follow Geishecker and Görg (2005) and we calculate them as the ratio of imports at values CIF (cost, insurance and freight) and exports at values FOB (free on board).¹³

Since our dataset is a panel of firms and our dependent variable is at firm level, we estimate the benchmark specification by fixed effects, controlling for firm heterogeneity. As it was emphasized by Carr et al. (2001), "...the theoretical results apply equally well to time-series and cross-section processes". Country heterogeneity will be captured by the country level variables. To control for heteroskedasticity we report always robust t-statistics.

is usually established when the foreign company takes the decision to invest in a country and there are extremely few cases when this changes over the years. Damijan et al. (2003) made the same assumption.

¹¹Producer Price Index relates to output prices and it is an indicator of the prices received by producers. It is often used to deflate in order to remove the effect of price changes.

¹²The data uses ISCO-88 classification for occupational categories, as compared to the data used by Carr et al. (2001) that uses ISCO-1968. However, we made the equivalence of the two classifications.

¹³See Appendix 1 for more details.

First, we estimate the knowledge-capital model for the full sample, using our two different measures of affiliate activities. Table 1 reports the results of the estimation.

The main variables used to identify the two different investment motives (horizontal and vertical) are: the aggregate size, the difference in size and the difference in relative skilled-labor endowments between the home and the host country.

Column (1) shows the results of the estimation when the dependent variable is the volume of affiliate sales. The sum of GDP and the squared difference of GDP are significant and have the expected signs (positive and negative, respectively). According to the knowledge-capital model, such effects of economic size and size differences are regarded as evidence for horizontal FDI. The positive coefficient for the sum of GDP implies that an increase in combined real income of the two countries boosts affiliate sales. In addition, the negative effect of the square of the difference between the home and host countries GDPs suggests that the more similar the home and the host countries real incomes are, the higher the volume of multinational activity is.

The difference in skilled-labor abundance and the interaction term between endowment and size differences are not significant, implying that the vertical component of FDI is absent.

The last four variables are the measures of investment and trade costs. Only the index of investment costs of the host country has the expected negative sign and it is significant. The trade costs index of the host country has negative sign and it is significant. This indicates the presence of the vertical aspect in the incentives for FDI. The second interaction term, between the trade costs of the host country and the squared difference of skilled-labor abundance has a positive sign, opposite to what we would expect. This is not such a surprising result since the theoretical predictions for this interaction term are not very precise. Carr et al. (2001) also found a positive but not significant coefficient for this term.

Table 1
Fixed effects estimation of the knowledge capital model
Full sample

	Sales of affiliates	FDI stock of affiliates	Predicted sign
$\sum GDP$	16.050*** (4.09)	18.233*** (2.85)	+
$(\Delta GDP)^2$	-0.004*** (3.93)	-0.005** (2.49)	-
ΔSK	-2,095.825 (1.52)	-933.087 (0.37)	+
$\Delta SK * \Delta GDP$	-3.956 (1.24)	-1.444 (0.71)	-
FDI index of host country	-224.986*** (3.19)	-253.748*** (2.83)	-
Trade costs of host country	-1,320.215*** (1.92)	-214.742 (0.27)	+
Trade costs of host country * $(\Delta SK)^2$	16,070.587 (1.55)	5,048.018 (0.65)	-
Trade costs of home country	-9.639 (0.08)	-394.037 (1.11)	-
Constant	-9,196.030*** (3.88)	-10,332.420** (2.80)	
R ²	0.0072	0.0024	
Observations	26324	30180	
Number of firms	9238	9593	

Notes: Robust t statistics are reported in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Column (2) contains the results of the estimation when the dependent variable is the volume of FDI stock. Notice that the results are very similar, except that the trade costs index of host country is not significant anymore. The volume of FDI stock in transition countries increases in the bilateral aggregate economic activity and in the similarity in size between the home and the host countries. This provides

empirical evidence for the horizontal component of the knowledge-capital model. The investment cost index has the expected negative sign.

These first two estimations imply interesting conclusions. Using data for affiliates sales and the volume of FDI stock, we find that activities of affiliates of MNEs are strongly sensitive to the sum of GDPs of the home and host countries, to the squared difference in GDP and to the investment costs. Therefore, estimation of the full sample of firms shows that the horizontal component of the knowledge-capital model dominates in the pattern of FDI in transition countries over the period 1997-2003. Our results bring further evidence for the empirical literature on the knowledge-capital model: this is the first paper that analyses FDI in transition countries within the empirical framework of the knowledge-capital model and we find support for the horizontal model.

One might worry about the very low value of the R-squared in both estimations. In these estimations we pool together all companies from different home countries and different sectors of activity, therefore we expect a low goodness of fit. This result motivates technically our approach in the next two subsections. In subsection 4.1 we allow the coefficients to differ across various sectors of activity. In subsection 4.2 we allow the coefficients to differ across various home countries of MNEs. In this way, we can check how this empirical specification behaves when we disaggregate the data. This exercise will indicate whether strategies of MNEs differ according to their sector of activity or to their home country.

4.1. Estimation of the knowledge-capital model for different sectors of activity. The distribution by sectors of activity of the companies from our sample can be found in Appendix 4. 35.81% of the foreign affiliates are active in manufacturing activities, while 64.19% are active in services. This is consistent with the actual pattern seen at world level: in 2001, the share of manufacturing in the world FDI inward stock was 41.6%, while that of services was 50.3% (UNCTAD, 2001). One can notice that FDI in services has increased substantially in recent years as compared to FDI in manufacturing.

Table 2
Fixed effects estimation of the knowledge capital model
Manufacturing versus services

	MANUFACTURING		SERVICES	
	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates
$\sum GDP$	27.841*** (3.22)	35.949** (2.26)	7.454*** (3.38)	6.515*** (3.53)
$(\Delta GDP)^2$	-0.007*** (2.96)	-0.011** (1.99)	-0.002*** (3.17)	-0.002*** (3.15)
ΔSK	-5,556.997 (1.38)	-4,014.239 (0.56)	-799.774 (1.13)	-154.909 (0.20)
$\Delta SK * \Delta GDP$	-4.912 (0.62)	0.354 (0.06)	-3.327* (1.78)	-1.303 (1.17)
FDI index of host country	-428.939*** (2.58)	-542.695** (2.27)	-93.474** (2.33)	-81.240*** (3.34)
Trade costs of host country	-2,363.307 (1.30)	221.457 (0.10)	-764.372** (2.19)	-400.125 (1.45)
Trade costs of host country * $(\Delta SK)^2$	31,820.416 (1.09)	12,799.189 (0.64)	8,469.636 (1.28)	2,339.384 (0.48)
Trade costs of home country	-150.103 (0.32)	-1,662.272 (1.27)	51.615** (2.02)	77.780** (2.36)
Constant	-16,333.701*** (3.07)	-20,310.739** (2.24)	-4,097.591*** (3.31)	-3,654.340*** (3.62)
R ²	0.0107	0.0053	0.0060	0.0014
Observations	9907	11274	16417	18906
Number of firms	3340	3450	5898	6143

Notes: Robust t statistics are reported in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Table 2 reports the results of the estimation for firms from manufacturing and firms from services, separately.

The first two explanatory variables are significant and have the expected signs in all four columns. This is evidence for the horizontal component of the knowledge-capital model. The third important explanatory variable, the difference in skill en-

dowments, always has a negative sign, but it is not significant in any of the cases. Therefore, we can conclude that horizontal FDI dominates in both manufacturing and services.

Next, we proceed to the estimation of the knowledge-capital model for each one of the main industries that are identified in Appendix 4. Table 3 contains the results of the estimation for various manufacturing industries, while Table 4 contains the results of the estimation for various services sectors.

For the following manufacturing industries: food, beverages and tobacco, wood and wood products, rubber and plastic products, metal and metal products, electronic and electronic equipment, we can draw some very interesting results.¹⁴ The first two explanatory variables are significant and have the expected signs in almost all the cases (except of metal and metal products, and electronic and electronic equipment when the dependent variable is sales of affiliates, and other manufacturing when the dependent variable is the volume of FDI stock), implying that FDI in these sectors is horizontal.

The difference in skilled-labor endowments is significant in some sectors of activity, but it always has a negative effect on the volume of affiliate sales or on the volume of FDI stock. This strengthens even more the previous result: similarity in skilled-labor abundance between countries encourages FDI and this is evidence for horizontal FDI.

Therefore, we can conclude that horizontal FDI dominates when we look separately at different manufacturing activities. This confirms our finding for aggregate manufacturing activities.

Regarding the remaining explanatory variables, the index for investment costs is significant and it has the expected negative sign. Trade costs of host country have negative sign, in spite of what we are expecting. However, in most of the cases it is only marginally significant (at 10% significance level) - for food, beverages and tobacco, rubber and plastic products, metal and metal products, electronic and electronic equipment. This negative sign pinpoints the possible existence of vertical FDI too.

¹⁴For the remaining manufacturing industries: textiles, clothing and leather; publishing, printing and reproductions of recorded media; chemicals and chemical products; non-metallic mineral products; precision instruments; motor vehicles and other transport equipment; machinery and equipment we were not able to draw any conclusions, since we obtained either insignificant coefficients or wrong-signed coefficients. For space reasons, we do not include these results in the paper. They are available upon request.

Table 3
Fixed effects estimation of the knowledge capital model
Manufacturing industries

<i>Industry</i>	Food, beverages and tobacco		Wood and wood products		Rubber and plastic products		Metal and metal products	
	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates
$\sum GDP$	91.116* (1.79)	59.086*** (2.97)	8.389*** (2.67)	5.811*** (3.13)	14.500* (1.94)	8.919*** (2.36)	41.783 (1.30)	36.854*** (2.29)
$(\Delta GDP)^2$	-0.017*** (2.64)	-0.009*** (3.02)	-0.003*** (2.75)	-0.002*** (3.40)	-0.005* (1.89)	-0.003** (2.34)	-0.012 (1.30)	-0.008* (1.89)
ΔSK	-22.286.712 (0.73)	-33.731.831** (2.47)	-1,911.405** (2.25)	-176.491 (0.20)	-3,890.697 (1.43)	-2,452.952 (1.11)	-8,531.140 (0.97)	-7,036.398* (1.67)
$\Delta SK * \Delta GDP$	-26.455 (0.29)	-69.941* (1.78)	1.297** (2.13)	-0.047 (0.05)	0.719 (0.32)	-0.834 (0.64)	-7.407 (0.73)	-14.632 (1.48)
FDI index of host country	-1,776.511* (1.61)	-1,052.788** (2.52)	-26.246 (1.20)	-67.448** (2.13)	-47.562 (0.86)	-89.018* (1.81)	-611.896 (1.37)	-619.099** (2.32)
Trade costs of host country	-11,557.310 (0.80)	-13,512.849** (2.50)	-617.574* (1.74)	-294.820 (1.27)	-1,334.448* (1.72)	-736.954* (1.90)	-1,771.992 (0.56)	-3,578.920* (1.81)
Trade costs of host country * $(\Delta SK)^2$	186,516.151 (0.85)	218,772.951*** (2.36)	8,388.969* (1.66)	3,114.874 (0.59)	24,319.132 (1.57)	10,411.184 (1.26)	14,680.695 (0.39)	29,040.158 (1.37)
Trade costs of home country	-251.821 (1.05)	163.930 (0.86)	2.073 (0.11)	-6.539 (0.58)	229.197 (0.48)	223.566 (0.68)	-691.861 (0.91)	206.055 (0.48)
Constant	-50,686.219* (1.76)	-23,886.477** (2.52)	-4,271.081*** (2.74)	-3,293.864*** (2.73)	-7,799.404** (1.99)	-4,763.317** (2.05)	-22,801.497 (1.34)	-21,717.626** (2.31)
R ²	0.0395	0.0818	0.1480	0.0356	0.1012	0.0494	0.0827	0.1150
Observations	1050	1197	977	1152	574	629	892	1075
Number of firms	350	372	328	342	192	194	322	340

Notes: Robust t statistics are reported in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Table 3 continued
Fixed effects estimation of the knowledge capital model
Manufacturing industries

<i>Industry</i>	Electronic and electronic equipment		Other manufacturing	
	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates
$\sum GDP$	1.695 (0.54)	19.552** (2.11)	0.213*** (3.27)	0.051 (0.73)
$(\Delta GDP)^2$	-0.001 (0.67)	-0.006** (2.06)	-0.0006*** (2.72)	-0.000 (0.06)
ΔSK	-1,117.339 (1.57)	-4,430.729 (0.61)	45.963** (2.41)	11.748 (0.32)
$\Delta SK * \Delta GDP$	1.035 (1.52)	0.554 (0.21)	0.122** (2.44)	-0.058 (0.46)
FDI index of host country	-8.897 (0.23)	-249.462** (1.97)	-1.743* (1.91)	0.203 (0.18)
Trade costs of host country	-803.083* (1.71)	-3,675.101 (1.53)	-1.425 (0.16)	-21.590 (0.96)
Trade costs of host country * $(\Delta SK)^2$	5,523.890 (1.41)	-23,075.230 (0.45)	-653.112** (2.20)	-167.737 (0.45)
Trade costs of home country	-334.024 (1.35)	-925.967 (1.33)	-0.399 (0.30)	1.473 (0.59)
Constant	328.118 (0.20)	-5,574.663 (1.30)	-133.081*** (3.84)	-17.273 (0.41)
R^2	0.0277	0.0750	0.1640	0.0403
Observations	614	681	725	831
Number of firms	209	212	261	268

Notes: Robust t statistics are reported in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Therefore, we can argue that FDI in manufacturing industries is mostly horizontal. However, the negative sign for the trade costs of the host countries indicates that the vertical aspect is present as well, at least for some industries.

In the case of services, Table 4 shows similar results as for manufacturing.¹⁵ The

¹⁵For finance, construction and the rest of services not included in the table, we could not draw any conclusion. For space reasons, we do not include these results in the paper. They are available upon request.

Table 4
Fixed effects estimation of the knowledge capital model
Services

<i>Industry</i>	Wholesale and retail trade		Transport, storage and communications		Business activities		Electricity, gas, water	
	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates
$\sum GDP$	8.271*** (2.76)	6.760*** (4.20)	14.843* (1.69)	11.978** (2.38)	7.008 (1.30)	2.279** (2.13)	0.719** (2.42)	1.113*** (3.48)
$(\Delta GDP)^2$	-0.002*** (2.62)	-0.002*** (4.42)	-0.002* (1.69)	-0.002** (2.47)	-0.001 (1.43)	-0.001** (2.07)	-0.0002** (2.11)	-0.0002*** (2.81)
ΔSK	-334.811 (0.48)	-639.807 (0.84)	-4,048.305 (1.09)	-1,379.214 (0.98)	-2,308.642 (1.02)	-246.853 (0.45)	73.167 (0.90)	46.351 (0.30)
$\Delta SK * \Delta GDP$	-1.988 (1.09)	-2.100 (1.36)	-18.858 (1.36)	-8.266 (1.26)	-6.125 (1.03)	-0.576 (0.68)	0.021 (0.12)	-0.452 (0.87)
FDI index of host country	-100.208** (2.04)	-92.263*** (3.19)	-207.276 (1.11)	-200.186** (2.06)	-89.706 (0.81)	-11.980 (0.60)	-0.351 (0.04)	-5.078 (0.48)
Trade costs of host country	-495.574 (1.40)	-463.091* (1.65)	-3,541.559* (1.61)	-1,613.391* (1.67)	-1,497.900 (1.27)	-378.284 (1.59)	-5.804 (0.15)	-100.602** (2.21)
Trade costs of host country * $(\Delta SK)^2$	3,994.067 (0.66)	4,634.603 (1.03)	61,796.373 (1.09)	27,436.370 (1.51)	18,043.935 (0.93)	2,642.607 (0.53)	19,879 (0.05)	534,940 (0.83)
Trade costs of home country	25.939 (0.88)	111.734** (2.23)	-24,352 (0.26)	-14,238 (0.33)	67,711 (1.33)	11,211 (0.75)	-9,764 (1.14)	26,043 (1.51)
Constant	-4,363.623*** (2.74)	-3,691.936*** (3.86)	-6,389.252 (1.50)	-6,056.320** (2.28)	-3,962.920 (1.19)	-1,029.490 (1.80)	-396.700** (2.23)	-627.634*** (3.10)
R ²	0.0037	0.0094	0.0632	0.0634	0.0245	0.0042	0.2867	0.3290
Observations	8826	9872	1422	1622	3722	4489	92	106
Number of firms	2989	3076	527	538	1448	1563	32	34

Notes: Robust t statistics are reported in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

first two explanatory variables which illustrate the existence of the horizontal motives are significant and have the expected signs.

The index of investment costs has the expected negative sign and is significant in some cases, confirming that higher investment costs in the host country will decrease the volume of sales or the volume of FDI stock. The trade costs index of the host country is negative and marginally significant in some cases, indicating weakly the presence of vertical FDI.

Hence, we can conclude that for services, as well as for manufacturing, the results of the estimation of the knowledge-capital model illustrate that horizontal FDI dominates. This result is in line with Geishecker and Görg (2005): they also find that the horizontal component of the knowledge-capital model describes better FDI in services.

The R-squared of most of the estimations improves considerably, though it remains relatively low. This indicates that allowing the coefficients to differ across industries is a more appropriate approach, from an econometric point of view as well.

We find strong evidence for horizontal FDI in both manufacturing and services sectors of activity. Yet, there exists weak empirical evidence for vertical FDI because of the negative sign of the trade costs of the host country.

4.2. Estimation of the knowledge-capital model for different home countries. In this section, we exploit the bilateral nature of our dataset. This nice feature of the dataset allows to identify the home and the host country of the MNE. In particular, we will concentrate on the differences that could arise when distinguishing MNEs with respect to their home country. We argue that MNEs from different home countries adopt different strategies when dealing with FDI decisions in transition countries.

Appendix 5 contains the distribution, at country level, of FDI inward stock in four of the transition countries from our sample¹⁶, by country of origin, for the year 2002. Two relevant facts for our paper emerge from this table: the EU is the biggest investor in transition countries - its share is more than 60% in all the cases; and the most active investor countries in the region are Austria, Germany, Italy, Netherlands, United Kingdom. Appendix 6 contains the distribution of the firms from our sample by countries of origin of MNEs. Most of the foreign affiliates of our sample belong to MNEs located in Italy (27.18%), Germany (23.03%), Netherlands (9.95%) and

¹⁶The Czech Republic, Hungary, Poland and Romania.

Austria (7.23%). Using the empirical framework of the knowledge-capital model, we can draw some conclusions regarding the type of investment that they undertake.

Table 5 contains the estimation of the knowledge-capital model separately for some of the home countries of the MNEs from our dataset.¹⁷

In the case of Austria, the explanatory variables are significant and have the expected signs, when the dependent variable is the volume of FDI stock. The total size of the market and the squared difference of GDPs are significant and have the expected signs. The negative influence of the difference in skilled-labor abundance and the positive influence of the trade costs of the host country strengthen even more this result. Therefore, we can conclude that horizontal FDI is the dominant strategy for investors from Austria in transition countries.

The results of the estimations for Germany evidence very clearly vertical FDI. The first two explanatory variables -the sum of GDP and the squared difference in GDP-, are not significant. The difference in skilled-labor abundance is significant and has a positive sign for both proxies for MNEs activity. This confirms that MNEs from Germany invest in transition countries mostly to take advantage of low factor costs. However, the trade costs of the host country have a positive sign, which suggests that there is a horizontal component as well, but maybe not so powerful as the vertical one. The positive sign of the index of investment costs in transition countries in explaining the volume of FDI stock is a bit puzzling, but it is only marginally significant (10% significance level). Surprisingly, trade costs of the home country have an unexpected positive sign.

Italy is also one of the major investing countries in the region. The results of the estimation of the knowledge-capital model for affiliates of MNEs from Italy display evidence for vertical FDI. The difference in skilled-labor abundance has a positive sign and is significant. Again, the index of investment costs is positive, but it is significant only at 10% level and only for the volume of FDI stock. Trade costs of the home country have the expected negative sign.

Netherlands is the only country from the sample that displays strong and clear evidence for horizontal FDI: the first two explanatory variables are significant and have the expected signs, independent of the proxy for the activities of foreign affiliates

¹⁷Unfortunately, for 5 countries (France, Greece, Ireland, Luxemburg and Portugal) we were not able to run separate regressions, because of not enough observations. For Belgium, Denmark, Spain and Finland, even if we could run the regressions, we could not draw any relevant conclusion since very few variables were significant and/or had the wrong sign. For space reasons, we do not include these results in the paper. They are available upon request.

Table 5
Fixed effects estimation of the knowledge capital model
Home countries

Home country	AUSTRIA		GERMANY		ITALY		NETHERLANDS		UNITED KINGDOM	
	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates	Sales of affiliates	FDI stock of affiliates
$\sum GDP$	81.210 (1.54)	38.993*** (3.04)	0.254 (0.90)	-0.016 (0.06)	-37.047* (1.64)	-13.245** (2.43)	424.202* (1.78)	636.816** (2.06)	-42.186** (2.00)	-22.507** (2.17)
$(\Delta GDP)^2$	1.094 (1.54)	0.492** (2.36)	-1.07e-06 (0.01)	0.00004 (0.54)	0.039* (1.74)	0.015*** (2.73)	-1.961* (1.78)	-3.083** (2.09)	0.033** (2.08)	0.018** (2.50)
ΔSK	-113.579.104 (1.55)	-59.735.234*** (2.68)	2.340.120* (1.66)	1.827.859** (2.36)	414.573.325* (1.76)	160.194.378*** (3.09)	-1149292.642* (1.76)	-1696842.399** (2.03)	71,929.258* (1.94)	41,410.644*** (2.83)
$\Delta SK * \Delta GDP$	-62.423 (0.26)	-38.994 (0.30)	-0.920 (1.28)	-0.673** (1.99)	-454.074* (1.75)	-175.709*** (2.88)	3,218.094* (1.78)	4,989.793** (2.08)	-138.840 (1.51)	-89.614** (2.42)
FDI index of host country	-450.766 (1.53)	-208.343*** (3.00)	3.803* (1.69)	3.398* (1.84)	787.997 (1.53)	320.854** (2.23)	-3,311.767* (1.74)	-4,377.667* (1.85)	-1,580.904** (2.24)	-753.562*** (2.82)
Trade costs of host country	22.308.082 (1.54)	9,582.842*** (3.01)	150.301* (1.86)	108.905 (1.49)	-3,425.824 (1.06)	-1,779.640 (1.30)	740.532 (0.77)	4,475.445 (1.16)	-12,223.194 (1.48)	-7,676.178** (2.57)
Trade costs of host country * $(\Delta SK)^2$	1408996.938 (1.54)	691.735.029** (2.44)	-3,590.054*** (3.33)	-2,402.152*** (2.69)	278.896.837 (1.31)	102,301.175 (1.52)	194,214.035* (1.63)	182,987.477 (1.11)	309,459,644* (1.65)	187,296,445** (2.63)
Trade costs of home country	7,200.775 (1.56)	3,275.448*** (2.59)	51,230*** (2.63)	24,879*** (2.73)	-11,643.386* (1.64)	-4,355.181*** (2.60)	-580.433* (1.62)	-591,253 (1.20)	-569,630 (0.65)	-183,759 (0.72)
Constant	-68,160.158 (1.56)	-30,285.518*** (3.02)	-685.689*** (4.50)	-280.606* (1.85)	15,947.780 (1.29)	5,852.195 (1.59)	14,826.556* (1.70)	24,962.116* (1.69)	27,811.713 (1.43)	17,231,396** (2.01)
R ²	0.1415	0.1148	0.0324	0.0141	0.1007	0.1183	0.0336	0.0259	0.0428	0.0999
Observations	2086	2458	6940	7644	7187	8883	2125	2423	1258	1492
Number of firms	709	721	2292	2286	2577	2711	874	958	412	447

Notes: Robust t statistics are reported in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

that we use. Moreover, the difference in skilled-labor abundance affects negatively both the volume of affiliate sales and the volume of FDI stock, confirming that horizontal FDI prevails.

In the case of the United Kingdom, as for Italy, the first two explanatory variables are significant but do not have the signs predicted by the knowledge-capital model. The significance and the positive coefficient of the difference in skilled-labor abundance represents evidence for vertical FDI. The negative and significant influence of the trade costs of the host country reinforces this fact.

Like in the previous subsection, the R-squared improves substantially relative to the R-squared from the pooled sample. This indicates again that the goodness of fit of the knowledge-capital model is better when we allow for different coefficients across different home countries.

The application of the knowledge-capital model separately for affiliates of MNEs from different home countries provides some stimulating insights about FDI types. Even if we cannot derive conclusions for all the home countries of MNEs from our sample due to data limitations, still we can draw some very interesting results. They show that some of the countries from the EU are attracted to transition countries because of the low factor costs, while others because of their market potential. In particular, the estimation of the knowledge-capital model separately for each of the home countries of the MNEs from our sample shows that the vertical component dominates in the strategies of investment of MNEs located in Germany, Italy and United Kingdom. MNEs from these countries locate their activities in transition countries mainly to benefit from relative cheap unskilled-labor. However, we find evidence for horizontal FDI for MNEs from Austria and Netherlands: they mainly invest in transition countries to guarantee a better access to the local host markets.

5. SUMMARY AND CONCLUSIONS

In this paper we propose the empirical specification of the knowledge-capital framework as described in Carr et al. (2001) for the case of foreign affiliates of MNEs from the EU active in transition countries. We argue that this is a suitable and modern approach to distinguish the type of FDI (vertical or horizontal) in this region. We use a particular panel of foreign affiliates for the period 1997-2003 that allows to identify their sector of activity, the home and the host country of the foreign investors. We estimate the model for the full sample and then, separately, by sectors of activity and by home countries. In this way, we succeed in proving that the strategies of MNEs

are heterogeneous with respect to the sector of activity or to their country of origin. In addition, our results are in general robust to two different measures of activities: the volume of affiliate sales and the volume of FDI stock.

We find evidence for the horizontal component of the knowledge-capital model for the full sample of data, when the explained variable is either the volume of affiliate sales or the volume of FDI stock. This confirms that firms invest recently in transition countries in order to access directly to their local markets. This result is consistent with previous results in the literature (Brainard, 1997; Ekholm, 1998), that argue that the horizontal FDI is prevailing versus the vertical one.

When we differentiate among the sectors of activity, we find that most of FDI is horizontal. We identify the existence of the vertical component of FDI only in a few sectors: food, beverages and tobacco, rubber and plastic products, metal and metal products, electronic and electronic equipment.

Additionally, our dataset at firm level is bilateral. This feature enables us to investigate to what extent the strategies of foreign investors are heterogeneous with respect to their country of origin. We find that MNEs from Germany, Italy and United Kingdom display strong preferences towards vertical FDI, while those from Austria and Netherlands mostly undertake horizontal FDI.

We believe that our study sheds some light on a very interesting issue in the literature on FDI in transition countries: investigating the nature of FDI in this region. Previous studies mainly found evidence for vertical FDI in transition countries. This result is partially associated with the quality of data and the empirical framework which is used. We argue that a high degree of aggregation is not suitable for distinguishing between horizontal and vertical FDI. Instead, by using data disaggregated at firm-level and estimating the empirical specification of the knowledge-capital model, our results indicate that there is a combination of these two types of FDI, with horizontal FDI prevailing. Consequently, we can conclude that transition countries start being attractive for foreign investors not only because of their low unit labor costs, but also because of their market potential.

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A. APPENDIX 1

Data sources and construction of the variables

<i>Variable</i>	<i>Description and source</i>
Sales	Millions of US dollars, deflated by the Producer Price Index. <i>Source: Amadeus database.</i>
FDI stock	Percentage of ownership x Total assets. Millions of US dollars, deflated by the Producer Price Index. <i>Source: Amadeus database, own calculations.</i>
GDP in constant 2000 US dollars	GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in billions of constant 2000 U.S. dollars. <i>Source: World Development Indicators</i>
Skilled-labor abundance (SK)	The ratio of the sum of occupational categories 1 (legislators, senior officials and managers), 2 (professionals) and 3 (technicians and associate professionals) to total employment. Total employment by occupation presents absolute figures on the distribution of employed by occupation, according to either ISCO-68 or ISCO-88, or to both versions side by side, in cases where the latest revision of this international classification has been adopted during the 10-year time series covered in the Yearbook. It is in thousands of employees. <i>Source: International Labor Organization database, own calculations.</i>
Investment costs	It is a subindex of the Index of Economic Freedom, constructed by Heritage Foundation. The <i>Index of Economic Freedom</i> measures 161 countries against a list of 50 independent variables divided into 10 broad factors of economic freedom. The scores run from 1 to 5. Low scores are more desirable. The higher the score on a factor, the greater the level of government interference in the economy and the less economic freedom a country enjoys <i>Source: Heritage Foundation (www.heritage.org.)</i>
Imports and exports	The statistical value of the trade data is the value calculated at national frontiers. It is an FOB value (free on board) for exports and dispatches, or CIF (cost, insurance, freight) for imports and arrivals. <i>Source: Eurostat (Comext database): http://fd.comext.eurostat.cec.eu.int/xtweb</i>
Trade costs host	$\frac{IMP_{jt}^{CIF}}{EXP_{jt}^{FOB}}$ <i>i – home country; j – host country</i>
Trade costs home	$\frac{IMP_{jt}^{CIF}}{EXP_{jt}^{FOB}}$ <i>i – home country; j – host country</i>
Producer Price Index	Producer Price Index relates to output prices and it is an indicator of the prices received by producers. It is often used to deflate in order to remove the effect of price changes. <i>Source: International Monetary Fund</i>

B. APPENDIX 2
Descriptive statistics full sample (10 080 companies)

<i>Variable</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>Minimum</i>	<i>Maximum</i>
Sales	405.589	7674.634	0.0003	640302.7
FDI stock	345.505	5950.081	0.00002	543600
$\sum GDP$	1017.434	644.590	20.415	2064.577
$(\Delta GDP)^2$	1211682	1191601	0.301	3546558
ΔSK	0.129	0.069	-0.172	0.316
$(\Delta SK)^2$	0.021	0.019	2.75e-08	0.100
FDI index of host country	2.230	0.568	1	3
Trade costs of host country	0.937	0.146	0.576	5.259
Trade costs of home country	1.052	0.227	0.205	4.432

C. APPENDIX 3
Construction of the database

The data regarding the activities of affiliates of MNEs from the EU in transition countries is taken from Amadeus database. Amadeus concentrates on private companies and it does not cover financial institutions and insurance companies.¹⁸ The data is collected by the Information Providers (IPs) of Amadeus at each national official public body in charge of collecting the annual accounts in its country. In some East-European countries where the data is difficult to get from a central source, IPs might collect it directly from the companies.

We constructed our sample by performing the following quality checks. For each country, we excluded those companies for which there was no information available on

¹⁸These are covered by another product database of Amadeus, that is called BankScope.

sales and the percentage of ownership of the shareholders. Companies that invested in the primary sector were also excluded, because they represent a very small part of the investments done in these countries and they would need a special treatment as well.

For the companies that had more shareholders, we considered the one with the highest participation of shares. In case the information on ownership was on the form: wholly-owned or majority-owned, we assumed 100% percentage of ownership for wholly-owned and 50% percentage of ownership for majority-owned (following the definitions from Amadeus database: wholly-owned $\geq 98\%$, majority-owned $\geq 50,01\%$).

The final sample of transition countries is: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland and Romania.

D. APPENDIX 4

Affiliates of MNEs from the EU in transition countries by industry

<i>Industry</i>	Share in total number of companies (%)
<i>Total</i>	100
<i>Manufacturing</i>	35.81
Food, beverages and tobacco	3.97
Textiles, clothing and leather	8.86
Wood and wood products	3.45
Publishing, printing and reproduction of recorded media	1.96
Coke, petroleum products and nuclear fuel	0.03
Chemicals and chemical products	1.12
Rubber and plastic products	2.03
Non-metallic mineral products	2.03
Metal and metal products	3.58
Machinery and equipment	1.88
Electronic and electronic equipment	2.24
Precision instruments	0.56
Motor vehicles and other transport equipment	1.32
Other manufacturing	2.77
<i>Services</i>	64.19
Wholesale and retail trade	31.95
Transport, storage and communications	5.9
Finance	0.74
Business activities	16.52
Electricity, gas, water	0.35
Construction	4.23
Other services	4.76

Source: Amadeus database, own calculations

A sample of 10 080 affiliates of MNEs from the EU in seven transition countries

E. APPENDIX 5

Foreign direct investment inward stock, by country of origin
 (as of December 2002, shares in %)

	Czech Republic	Hungary	Poland	Romania
Austria	10.0	11.1	3.6	6.2
Denmark	0.5	0.4	2.9	0.1
Germany	24.2	34.0	18.1	9.9
Italy	0.6	2.0	4.2	6.1
Netherlands	29.2	15.2	24.8	17.6
Sweden	0.8	1.3	3.6	1.2
United Kingdom	6.1	1.3	3.2	3.0
USA	6.4	9.0	10.1	7.9
EU-15	84.5	76.1	82.5	60.3

*Source: The Vienna Institute for International Economic Studies (WIIW),
 Handbook of Statistics*

F. APPENDIX 6

**Affiliates of MNEs from the EU in
transition countries by home and host country**

<i>Country</i>	Share in total number of companies (%)
<i>Home countries</i>	100
Austria	7.23
Belgium	2.62
Denmark	2.11
Finland	4.60
France	7.60
Germany	23.03
Greece	3.33
Ireland	0.12
Italy	27.18
Luxemburg	1.24
Netherlands	9.95
Portugal	1.19
Spain	0.50
Sweden	4.85
United Kingdom	4.44
<i>Host countries</i>	100
Czech Republic	4.40
Estonia	7.31
Hungary	3.30
Latvia	1.70
Lithuania	0.56
Poland	17.93
Romania	64.80

*Source: Amadeus database
A sample of 10 080 affiliates of MNEs from the EU
in seven transition countries*