

**THE SPATIAL AND SECTORAL DISTRIBUTION OF
MULTINATIONAL ACTIVITIES IN EASTERN EUROPE**

by

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ABSTRACT

The last three decades have witnessed a spectacular integration of the world economy. On the one hand, the impact of the globalization on the economies is related to the activity of firms operating on a "multi-national" scale. These firms acquire subsidiaries abroad, move part of their production processes to reach new markets or to benefit from the international division of labor. In addition, trade and investment liberalization between Eastern European countries and the European Union leads to a relocation of production activities within the enlarged area. Critics of this integration process argue that firms may shift a part of their production process in transition countries in order to exploit their cheap and skilled labor force. This would increase unemployment of the European economies. Proponents of globalization maintain that multinational activities lead to a better allocation of scarce resources, to transfers of technology and thus enhance economic welfare and growth.

This thesis carries out a thorough empirical analysis of the determinants of multinational activities in Eastern European countries. The analysis of these determinants is important since the stock of the European FDI in the transition countries of Eastern Europe has strongly increased during the nineties. It reaches 83% of the total stock of FDI in Czech Republic, and more than 50% of total stock of FDI in Romania. There are at least three reasons why the progressive integration of Eastern European countries into the European Union leads to a relocation of firm activities within the enlarged area. First, the removal of internal trade barriers allows multinational firms to rationalize and

concentrate production in the low-cost locations of the enlarged area. Second, integration may induce foreign firms that previously exported to the European Union to locate there to take advantage of scale economies and reach internal markets. Third, the removal of internal tariffs barriers should increase competition between firms and lead to a relocation of multinational activities. These factors, which are taken from the new trade theories, are analyzed in this doctoral thesis. The aim is to study the spatial and industrial distribution of FDI in the new European Unions' members.

Chapter 1

Introduction

1.1 Research Focus

The process of integration of Eastern European countries into the European Union is an unique historic event and *one of the most important opportunities for the European Union at the beginning of the 21st century*¹. Central and Eastern European Countries were in virtual autarky until the late eighties and the opening-up of these countries provides an unique opportunity to analyze the effect of trade and investment liberalization on factor flows. Labor has remained rather immobile compared to capital flows. In recent years, long-term capital flows, also called foreign direct investment (FDI), have even risen much faster than international trade flows and world production.

The aim of this dissertation is to analyze the spatial and sectoral distribution of multinational activities especially in the transition countries of Eastern Europe. There are at least three reasons why the progressive integration of Eastern European countries in the European Community leads to a relocation of firm activities within the Union (Neary,

¹ From <http://europa.eu.int/comm/enlargement/index.htm>

2002; Raff, 2001). First, the removal of internal trade barriers allows multinational firms to rationalize and concentrate production in the low-cost locations of the enlarged area. Second, integration may induce foreign firms that previously exported to the European Union to locate there to take advantage of scale economies and reach internal markets. Third, the removal of internal tariffs barriers should increase competition between firms and lead to a relocation of multinational activities.

The proximity to markets, to low-costs locations but also to other firms matter for the distribution of FDI. The rapid growth of multinational activities has spurred a large body of literature examining the determinants of foreign direct investment (FDI). However, there are only few empirical studies on FDI in Eastern European countries and almost none using firm-level data. So far, most of the research has analyzed aggregated FDI flows and identified country-specific FDI determinants. Some pioneering studies on FDI in Eastern Europe include Holland and Pain (1998) and Bevan and Estrin (2000). However, their use of aggregated data masks the activities of individual firms.

The investigation that follows departs from the traditional empirical analysis by adopting rigorous estimation methods and a new and unique database on multinational activities. The lack of detailed data on multinational firms has impeded the growth of rigorous empirical analyzes. So far, internationalization decisions of individual firms have been studied mainly on the basis of US and Swedish data. The US and Sweden are important players on global markets but German firms are the most important foreign

investors in transition countries. The use of the *International Capital Links* database allows a precise analysis of the pattern of German multinational activities.

1.2 Research Design and Results

This investigation takes the following form. Chapter 2, "The Boundary of Multinational Firms", provides a review of the previous theoretical and empirical literature on multinational firms. In particular, it answers the question of the rationale behind multinational activities and their distribution across countries and sectors. Specific attention is paid to foreign direct investment in Eastern European countries.

Chapter 3, "Data and Descriptive Statistics", provides a detailed description of multinational foreign activities in Eastern European countries. It shows that multinational activities remain concentrated in few countries on few sectors and gives some potential reasons for the heterogeneous spatial and sectoral distribution of FDI.

The analysis of the spatial distribution of multinational activities is undertaken in chapter 4: "Foreign Direct Investment in Central and Eastern European Countries: A Dynamic Panel Analysis". This chapter uses aggregated data on outward foreign direct investment flows from several OECD countries. The dynamic panel data approach does not only allow me to use all information available in the cross section and time series dimensions but also to distinguish between the short- and long-term evolution of foreign direct investment in Eastern Europe. This chapter shows that new trade theories, which identify a set of country characteristics (market size, relative endowment differences and

trade costs), cannot fully explain the distribution of foreign direct investment in Eastern Europe. Transition-specific factors play an important role in the investment decision of a multinational company insofar as they reflect the actual state of the transition process, the overall policy stance, or even future prospects.

The Eastern European enlargement should have considerable effects on FDI flows to transition countries. The market potential of the entrants will increase considerably both due to the likely increase in their gross domestic product and to the reduction in the economically relevant distance to the EU, i.e., transportation costs. However, the process of integration should reduce the unit labor cost differences between the Eastern European countries and the present member countries of the EU, which would reduce FDI in Eastern Europe.

In this chapter, multinationals are treated as an homogenous group. They are in fact very heterogeneous entities, which differ remarkably not only between but also within industries. Firms could for instance become multinationals in order to reduce their overall production costs. Hence, firms move different stages of production to foreign countries and produce different products abroad and at home. This so-called vertical FDI arises when countries differ in relative factor endowments. Firms could also move production to foreign countries in order to move closer to customers and to avoid trade costs. In this case, firms produce the same type of product abroad as they produce at home. This form of FDI is called horizontal FDI. As a result, the catching-up process will have a tendency to increase investments of horizontal type and depress investments of vertical

type. However, one major difficulty that arises when testing the new trade theories of multinational activities is that a firm-level database usually does not provide enough information on the product and services sold abroad to distinguish between horizontal and vertical multinationals firms.

This is the issue explored in Chapter 5: "Firm Heterogeneity and the pattern of German Production in Eastern Europe". The fact that firm-level data on multinational activities do not allow to distinguish between vertical and horizontal multinationals is a problem since the same factors may have an opposite impact on multinational activities. The knowledge-capital model predicts that vertical FDI decreases with trade costs and should be negatively influenced by the degree of similarity in relative factor endowments. Horizontal multinationals, however, arise when trade costs are high and when countries are relatively similar in factor endowments.

In order to get around this problem, this paper proposes to test the prediction of the theories by referring to the different values and signs of the exogenous variables' coefficients (Carr *et al.*, 2001; Bloningen *et al.*, 2002, 2003). In particular, the paper shows that German multinational firms are negatively affected by trade costs suggesting vertical motives for multinational activity. German multinationals are attracted to relatively more unskilled-labor abundant Eastern European countries. They have an incentive to split their headquarters and plants by locating their headquarters and plants according to countries' relative factor endowments. In particular, it seems that German multinationals

have on average a tendency to set-up their headquarters in Germany and carry out their production in Eastern European country.

Another particular source of firm heterogeneity results from differences in the complexity of the production process. Firms have backward and forward linkages to a different degree. Production is often not a one-stage process but involves various intermediate inputs. Such complex production processes of the multinational firm are modelled in chapter 6: "The Geography of German Multinational Activities".

This chapter shows that the proximity to different markets, but also to other firms, matters for the location of multinational firms. Multinational firms may benefit from technological and/or pecuniary externalities by locating near their competitors. Technological externalities are knowledge spillovers of various types (R&D spillovers, information bridge or demonstration effect). Pecuniary externalities are transmitted through markets. For example, the entry of (multinational) firms in the downstream activities increases the demand for upstream output, which in turn attracts new entry, improving the supply of new intermediates attracting further downstream entries and so on. On the one side, the combination of these demand and costs linkages creates the potential for the attraction of additional manufacturing firms, also referred to as the agglomeration effect. On the other side, the entry of firms in the downstream industry reduces the demand faced by each firms in the sector and hence reduces profit. This is often referred to as the competition effect.

Because of the lack of data, it is not possible to distinguish empirically between upstream and downstream producers. Taking them together, the chapter demonstrates that a rise in the number of firms in one's own sector has an ambiguous effect on firms' activities: the competition effect tends to reduce profits, while the cost and demand effects tend to raise them. However, an increase in the number of firms in a different sector has a positive effect on profits, since there is no competition effect.

Finally, Chapter 7 reviews the findings of the study and provides a direction for future research.

Chapter 2

The Boundary of Multinational Firms: A Literature Review

2.1 Introduction

This chapter reviews explanations of the rationale behind the existence of multinationals and their spatial distribution. Special attention is paid to MNEs in emerging markets such as those of Eastern Europe. Foreign direct investment is defined as an investment to acquire a substantial controlling interest in a foreign firm or to set up a subsidiary in a foreign country. FDI thus involves ownership and/or control of a foreign firm. The early literature, such as Dunning (1977, 1980), has focused on a bunch of various micro- and macro-economic determinants to explain the willingness of a firm to become multinational. Dunning suggests a framework of *Ownership, Location and Internalization (OLI)* advantages and stresses that various locational elements make a potential country more or less attractive for the location of multinationals' subsidiaries. A more recent literature has examined the particulars of firms and industry characteristics to explain the presence of MNEs.

Both macro- and micro-economic determinants are of importance to explain the presence of MNEs in Eastern Europe. In particular, multinationals' spatial and industrial dispersions in this region are deeply influenced by home- and host-market conditions (market size, endowments and trade costs) and country policies (legal and institutional framework, method of privatization and exchange rate regimes). The accession to the European Union requires abolishing tariff and non-tariff barriers to free trade within Europe, adopting common external tariffs, and guaranteeing full mobility of labor, capital, and services across Europe. Trade and investment liberalization can be expected to have a significant impact on the decision of firms to either locate their production in the accession states through FDI or to service the markets in Eastern Europe through trade.

The following section presents some early works on FDI. Section 2.3 and 2.4 define the concept of vertical and horizontal multinational firms and show how multinationals have been integrated into the Heckscher-Ohlin trade model and into the new trade theories. Section 2.5 presents the knowledge capital model, an attempt to unify the theoretical literature. Section 2.6 shows that industrial linkages may also explain the presence and distribution of FDI. Finally, Section 2.7 summarizes the main development and draws some implication for FDI in Eastern Europe.

2.2 The OLI Framework Revisited

In order to compensate for the costs of operating abroad, a firm must incur significant advantages of going multinational. Dunning (1977, 1980) provides a taxonomy of

micro- and macro-economic determinants which explain a firm's willingness and ability to undertake FDI. Dunning suggests a framework of ownership, location and internalization (OLI) advantages as determining factors for FDI. Studies, including Casson (1986), Ethier (1986), Ethier and Markusen (1996) have focused on and revisited the OLI framework¹. The firm decision to invest abroad and internalize the production process is a rational response to imperfect markets.

The ownership advantages come in several forms, all based on the concept of knowledge-based or firm-specific assets. They are associated with R&D, scientific and technical workers, human capital and product differentiation, but also with patents, blueprints, and other marketing assets like trademarks, reputations and brand name. Those firm-specific assets, tangible or intangible, confer the firm cost advantages and a degree of market power sufficient to cover the costs of producing abroad.

The sources of location advantages differ from the type of multinational involved. Horizontal multinationals produce the same goods and services across countries. They invest abroad to avoid trade costs (in the form of transport costs, tariffs and quotas, etc.) associated with exporting from the home plant to the foreign market. Given the existence of plant-level scale economies, horizontal direct investment is likely to arise when trade costs are high and the host market is large.

These location advantages differ for vertical multinationals which geographically fragment their production process into stages based on factor intensities and locate activities

¹ See Markusen (1995) for an overview of the OLI framework.

according to international differences in factor prices. They invest abroad to reduce the overall cost of production. Vertical direct investment is likely to arise when these stages of production use different factor intensities and when countries have different factor endowments and/or factor-prices. It is also encouraged by low trade barriers. For instance, a vertical multinational may locate R&D and skill-intensive activities in relatively skill abundant countries and carry out unskilled-labour-intensive activities in relatively unskilled-labour abundant countries.

Finally, firms may have an incentive to exploit internally their specific assets abroad when they could vanish through licensing and cooperation agreements. Multinational firms may also prefer to internalize their production process because of the informational asymmetries they face or because of the transaction costs associated with contracting.

2.3 Factor Proportion Approaches and Vertical Multinational Firms

Early papers, including Mundell (1957) and Kemp (1962), start with variants of the factor proportions model of international trade to explain capital flows. This early literature does not make the distinction between FDI and portfolio investments. The idea behind these models is that foreign direct investments or portfolio investments move from the capital-abundant country to where it is scarce. This classic analysis has been developed turning on the idea that different parts of the production process have different input requirements. Since input prices vary across countries, it may be profitable to split production and locate labor intensive activities in labor-abundant countries.

2.3.1 The Factor Proportion Models

The idea that different production stages may be located at different location has been first modelled by Helpman (1984,1985) and Helpman and Krugman (1985). These analyses are based on an extended Heckscher-Ohlin trade model. There are two factors of production and two sectors. The perfectly competitive sector produces a homogenous good under constant return to scale. The other produces differentiated products under increasing returns to scale. Firms in this sector can separate their production process into two distinct activities, headquarters and production activities, and locate them at a lower cost in different countries. There are no trade costs².

The factor proportion between the two activities differs and this is the rationale behind vertical foreign direct investments. Within the factor price equalization (FPE) set, where countries relative endowments are not too different, there is no rational for MNEs to occur. Free trade in goods equalizes international factor prices. However, outside the FPE set, where countries have sufficiently different endowments, trade does not equalize factor prices. Firms have an incentive to geographically fragment their production process to take advantage of factor price differentials across countries.

The type of FDI that can arise from this theory is vertical FDI. However, the bulk of FDI takes place between developed countries (UNCTAD, 2001). Another explanation for a firm to go multinational is to separate parts of the production process to supply different locations.

² Adding trade costs to those models leads to a trade-off between exporting and setting up a branch plant abroad because trade costs increase factor prices differences

2.3.2 Some Empirical Evidences

The traditional approach to FDI has received little attention in the empirical literature. This may be due to the fact that FDI has mainly developed between countries that have relatively similar endowments. In order to test the theory, the empirical literature has concentrated on the real activities of multinational firms taking sales or employment to measure them.

The first attempt to test the explanatory power of the factor proportion model comes from Brainard's (1993) empirical specification. She draws a parallel between the determinants of inter-or intra-industry trade and those of multinationals' affiliates sales in order to specify the model of Helpman and Krugman (1985). Brainard uses US data to test whether multinationals activities increase with differences in relative factor endowment. In this case, the pattern of multinationals sales would be similar to the pattern of inter-industry trade. Brainard finds that the share of the sales of foreign affiliates in total sales to a foreign market (exports plus sales of foreign affiliates) is strongly increasing when countries become similar in relative income share as would be predicted in an intra-industry trade model. It is moreover unaffected by freight costs. This results provides weak evidence for a factor proportions motivation of multinational activities.

There are numerous measures of factor endowments. The way they enter the empirical analysis is an important question. Factor endowments can be proxied by GDP per capita (or per worker), the ratio of capital over the working population or skilled workers in total employment. Di Mauro (2001) uses the absolute difference in GDP per capita and

GDP per worker as a proxy for relative factor endowments. She finds that differences in relative factor endowments have a negative impact on German sectoral outward FDI in Eastern Europe and the OECD countries. This is not either consistent with the factor proportion model.

In a recent paper, Yeaple (2003) explains the country-industry pair variation of US multinational sales by considering an empirical specification in which a country's skilled-labor abundance is interacted with an industry's skilled labor intensity. Yeaple shows that the effect of a country's relative advantage varies across industries in a manner consistent with comparative advantage. US multinationals invest in skilled-labor abundant countries when they invest in skilled-labor intensive industries and favor low skilled-labor abundant countries for their investment in low skilled-labor intensive activities.

2.4 New Trade Theories and Horizontal Multinational Firms

2.4.1 The Theoretical Models

An alternative approach to the factor proportion theory of multinational firms is found in the Markusen (1984) model. In his model, multinationals are defined as firms that produce the same product in multiple plants, serving local markets by local production. The model has two factors of production, two goods and two countries. Both countries are identical with respect to their endowments, technology and preferences³. Firms in the perfectly competitive industry produces a homogenous good, Y , under constant return to scale, while the output of the other good, X , is the product of the output of two

³ This distinguishes the approach from the Heckscher-Ohlin based literature reviewed above.

activities: a corporate headquarter activity C and a plant activity F . C and F may be geographically separated, but the output C is maximized when produced at a single location⁴. However factors of production are immobile across the borders. There are no barriers to trade.

This model makes two crucial assumptions. It assumes the existence of firm-level scale economies and that firm-specific assets C share the property of joint (or public) inputs. This means that the added costs of a second plant is small compared to the cost of establishing a whole firm abroad. This gives the rationale behind multinational activities.

The model is solved with exogenous market structures. It compares the multinational equilibrium to the national firm equilibrium. The technical efficiency of the multinational lies in its ability to avoid duplication of the headquarter activity, C , that would occur with independent national firms. A sufficient condition for the multinational to increase world real income is to increase the output of X . Whereas the home country always gains, host country gains depend on the pricing of the multinational and the ability of the host country's government to retain a share of the MNE profits via a tax. The multinational equilibrium involves unequal factor prices between countries. Each country has higher factor prices for the factor used intensively in its dominant activity. This implies that identical countries can specialize in different activities. Thus, the MNE equilibrium is trade-creating.

⁴ The centralisation of C could be achieved by difference in factor endowments between countries and difference in factor intensities between C and F like in the model of Helpman (1984). This is ruled out by assumption

Extensions of this model are found in Horstmann and Markusen (1987, 1992) and Brainard (1993). In these models, firms in each country can decide about their plant configuration⁵. The market structure is thus endogenous. Brainard explores the extent to which multinational production location decisions can be explained by a trade-off between maximizing proximity to customers and concentrating production to take the advantage of using the economies of scale. The paper develops a two-sector, two-country model. As in Markusen (1984), both countries are identical with respect to their endowments, such that there are no initial factor-price difference. Firms in the differentiated sector choose between exporting and setting up a plant abroad as alternative modes of market penetration. Markets are separated by a transport cost.

The differentiated good sector is characterized by monopolistic competition⁶ and increasing returns at the firm- and plant-level. As in Markusen (1984), firms active in this sector can separate costlessly their production into two activities; Headquarter services or corporate activities, C , and production activities, F . C shares the characteristics of a public good. These activities include R&D, advertising, etc., and can be spread among any plants without diminishing the value of any plant. The production activities are characterized by increasing returns at the plant level due to fixed and variable costs associated with each production plant.

⁵ separating their production activities or not

⁶ Markusen's duopolistic market structure is included as a special case

The model involves a two-stage game in the differentiated sector. First, firms in both markets simultaneously decide whether to enter the industry and choose their plant configurations⁷. In the second stage, firms simultaneously choose prices, yielding a Bertrand equilibrium. Free entry and exit drive profits to zero. In the equilibrium, firms do not have any incentive to change their plant configuration. Consumers cannot improve utility and trade between both countries is balanced.

With the two-stage production process, three equilibrium configurations are possible. There is a pure multinational equilibrium where two-way multinational activities substitute for trade in goods. This equilibrium is more likely the higher are the transport costs relative to plant level scale economies and the greater are scale economies at the firm level relative to those at the plant level. Under the opposite circumstances, a pure national firms equilibrium arises with two-way trade in differentiated products. For some intermediate range of parameters, there is a mixed equilibrium in which both multinationals and national firms coexist in the differentiated sector.

Brainard's results are limited to the situation of symmetric countries. Markusen and Venables (1998, 2000), move away from this restriction and consider how large difference in country size and relative endowments influence equilibrium. Both generalize the Helpman and Krugman (1985) paper⁸. Asymmetry of countries in terms of relative factor endowments and size does not lead to vertical multinationals since they are excluded

⁷ National or multinational

⁸ Markusen and Venables (1998) uses a reciprocal dumping framework while the 2000 paper use a monopolistic competition approach. Markusen and Venables (2000) explicitly model transport costs whereas there are no trade costs in Helpman and Krugman (1985) model

by assumption. Instead, multinationals become more and more important as countries become more similar in size, in relative factor endowments and as world income grows.

The early papers by Helpman and Helpman-Krugman assume the absence of trade costs in order to produce analytical solutions. But under this assumption, there is no role for horizontal multi-plant firms driven by plant-level scale economies. Papers in the Horstmann-Markusen-Venables tradition typically assume that there is only one factor used in the MNE sector, or that different activities (e.g., headquarters and plant) use factors in the same proportion. But under these assumptions, there is little motivation for fragmenting production by stages.

2.4.2 Empirical Studies

An important empirical study is Brainard (1997). Due to the endogeneity between exports and affiliate sales, Brainard uses the parent-country exports divided by the sum of parent-country exports and affiliates sales as endogenous variable. She distinguishes at a sectoral level between the proximity concentration hypothesis and the factor proportions hypothesis. The results provide strong support for the proximity concentration hypothesis.

In particular, she finds that differences in per-capita income (taken as a proxy for relative factor endowments) raise the export share. This means that income similarities are stronger determinants of affiliates sales than of exports. Moreover, Brainard finds some evidence that trade costs increase the share of affiliate sales while investment costs reduce that ratio. Controlling for firm and plant scale economies, she finds that sectors with

high plant economies have high export shares while high firm scale economies increases affiliate sales. Overall, these results are consistent with the horizontal model.

Ekholm (1998) comes to similar conclusions. She uses Swedish affiliates sales and export data mostly for OECD countries and finds trade and foreign direct investment volumes share similar patterns. In particular, foreign direct investment is negatively affected by dissimilarities in income between countries, as well as in relative endowments of human capital. Moreover, her concentration advantages measured in terms of the size of the plants in relation to the size of the firm, affect negatively the probability of foreign production. She finds that once affiliate production has been established, it is positively affected by the geographical distance.

2.5 Integrating Horizontal and Vertical Multinationals

2.5.1 The Knowledge-Capital Model

These differences between the vertical model of multinational firms, which stresses differences in production costs, and the horizontal model, which stresses market access considerations, have made it difficult to analyse the activities of multinationals in a consistent framework and to be able to discriminate between the two approaches empirically. Because both explanations are complementary, merging them into one framework is less of a conceptual problem, but it increases the complexity of the models.

However, Markusen (1997, 2002) proposes a conceptual framework that allows integration of national, horizontal and vertical multinational firms into a single model. This gives firms the options to build single or multiple plants or to geographically separate

headquarters from a single plant. As the former models, Markusen assumes two countries, h and f , and two sectors. Sector X , where firms compete à la Cournot, has increasing returns both at firm and plant level while sector Y , which is perfectly competitive sector, produces with constant return. There are two factors of production, skilled (S) and unskilled labor (L).

The model makes two crucial assumptions: *(i)* it assumes that knowledge is geographically mobile and a joint input to multiple production facilities, *(ii)* knowledge intensive activities are skilled-labor intensive relative to final production⁹. Production may be geographically fragmented into a skilled-labor-intensive headquarters activity and an unskilled-labor-intensive production activity.

In this model, firms can take on six different types depending on the configuration of their headquarters and plants location. National firms have a single-plant with a headquarter and plant in the same location (*type-n* firm). Horizontal multinationals have a headquarter in one country and plants in both countries (*type-m* firm). Vertical multinationals are defined as single-plant firms with headquarter and plant in different locations (*type-v* firm).

The complexity of Markusen's paper (Markusen, 1997, 2002) does not allow for a closed form solution. The type of firm in equilibrium (or equilibrium regimes) depends rather on a set of parameters. The equilibrium regimes are derived using a world Edgeworth box where the world endowment of skilled labor is represented on the vertical axis

⁹ Multinationals export services produced using physical factors rather than those factors themselves

and the world endowment of the unskilled labor on the horizontal axis. The endowment of country h is measured from the southwest (SW) corner and that of country f from the northeast (NE) corner.

Figure 2.1 to 2.3 present three equilibrium configurations. The trade liberalization equilibrium is an equilibrium where trade costs go to zero but foreign direct investment barriers remain (figure 2.2). The investment liberalization equilibrium is one where trade costs are high but no investment barriers exist anymore (figure 2.1). Finally, a combined liberalization of both trade and investment is analyzed (figure 2.3).

— Insert Figure 2.1 about here. —

The removal of trade barriers is shown in figure 2.1. The picture is consistent with the factor proportion approach of multinationals. Type n_h and type n_f firms exist over most of the endowment space. When one country is very small, all firms locate in the larger country.

— Insert Figure 2.2 about here. —

High trade costs and investment liberalization lead to the establishment of *type-m* multinational firms. Type m_h and type m_f firms are invading each others markets leading to two-way foreign direct investment in the central region. Above the SW-NE diagonal, country h is relatively well endowed with skilled labor. This leads to the entry of type m_h firms except when size differences are extreme.

When the countries are similar in relative endowments but very different in size, *type-n* firms located in the larger country dominate. This is especially true if the larger country

is also skilled-labor abundant. For example, there are only type n_h firms in the NE corner of the box when country h is large and skilled-labor abundant. In this area, type n_f firms are operating in a relatively small domestic market, and need to bear transport costs to the large country h market. *Type- m* firms are handicapped insofar as they must make a fixed-cost investment in a country f plant to serve a very small market. Finally, there is no economic motive for *type- v* firms to enter. Country h is both large and skilled-labor abundant, indicating that both a firm's plant and its headquarters should be located in country h .

Now consider the region in the NW corner of Figure 2.2 where country h is very skilled-labor abundant relative to country f but not large relative to country f . In this region, type v_h firms are active. The intuition is that, in the absence of type v_h firms, factor prices would be very unequal in this region. *Type- n* firms are handicapped as they must by definition locate their plant and headquarters together. *Type- m* firms can partially exploit the factor-price difference by locating their headquarters in the country with low wages for skilled labor, but must locate plants in both countries. type v_h firms are in the strongest position to exploit the factor-price differences, locating their headquarters in country h and their single plant in country f .

The results can be summarized as followed. *Type- m* firms are dominant when countries are similar both in size and relative endowments. *Type- n* firms (located in the larger country) are dominant when the countries are very different in size, especially when the

larger country is also skilled-labor abundant. *Type-v* firms (located in the skilled-labor-abundant country) are dominant when the countries are similar in size but very different in relative endowments. Other areas of Figure 2.2 consist of complicated and varying mixed regimes.

— Insert Figure 2.3 about here. —

The last case when trade and investment are liberalized presents a quite different picture (Figure 2.3). Around the SW-NE diagonal, there are no multinationals active. Factor prices are equalized by trade so it is not profitable to have a branch plant. *Type-v* firms enter when countries differ significantly in relative endowments, because they can exploit factor-prices differences. When country h is small, above the SW-NE diagonal, country h 's vertical multinationals dominate.

2.5.2 Estimating the Knowledge-Capital Model

Due to the complexity of the theoretical papers mentioned above, solutions cannot often be given in closed-form. Results have thus to be derived through numerical simulations. Nevertheless, these models are valuable guidelines for empirical work. In fact, one major difficulty that arises when testing theories of multinational firms is that no database provides enough information to distinguish between horizontal and vertical multinationals firms. This is a problem since the same factors may have an opposite impact on multinational sales. In order to get around this problem, Markusen and Maskus (1999), Carr *et al.* (2001) and Blonigen *et al.* (2003), propose to test the prediction of the theories for different value of the exogenous variables.

Carr *et al.* (2001) find support for the knowledge capital model, which encompasses both horizontal and vertical multinationals. However, Markusen and Maskus (1999, 2002) using the same dataset/^{footnote}The dataset provides information on the activities of multinational firms from 37 countries between 1986 and 1994 and a very similar regression model do not find support for vertical FDI models. Given that the knowledge capital model integrates the vertical and the horizontal model of multinational firms, thus support for the knowledge capital model would solely rest on its horizontal model component.

Blonigen *et al.* (2002, 2003), discuss the proper estimation specification to distinguish between the different components of the knowledge capital model building on Markusen and Maskus (1999) and Carr *et al.* (2001). According to Blonigen *et al.* (2002, 2003), the contradiction in the results of Markusen and Maskus (1999) and Carr *et al.* (2001) stems from a misspecification of the non-linear functional form of the skill difference term in Carr *et al.* (2001). Blonigen *et al.* argue that the specification error is amplified by pooling U.S. inward and outward data of affiliate sales. When correcting for this misspecification by using absolute values of differences in factor endowment, Blonigen *et al.* show that affiliate activity between countries decreases as absolute differences in the endowments of skilled labor increase. This, in turn, supports the horizontal model as found in Markusen and Maskus (1999). The vertically integrated firm does not find empirical support.

However, Braconier *et al.* (2002) argue that this lack of support for vertical integration found in the data is due to the use of a skill variable which does not measure human capital appropriately. Both, Carr *et al.*(2001) and Blonigen *et al.* (2002), use the ratio of skilled to unskilled workers provided by the International Labor Organization (ILO) as proxies for human capital endowments. Braconier *et al.*(2002) favor the use of wages for representative jobs (provided by the Union Bank of Switzerland) as a proxy for skill. More precisely, the wage ratio of an electrical engineer to that of an industrial worker is used as a proxy for a so-called skill wage premium. Using this skill wage premium instead of factor endowment differences, they find strong support for vertical FDI: More FDI is conducted in countries where unskilled labor is relatively cheap, i.e. where the wage premium is high. Hence, Braconier *et al.* conclude that the scope for vertical fragmentation of production across borders is much larger than shown by previous studies (see, e.g. Brainard 1997).

Yet, the reason for the different results is not clear. Conceptual differences in the empirical models might be one possible explanation: Braconier *et al.* (2002) introduce a price variable in an equation explaining quantity variables while Carr *et al.* and Blonigen *et al.* do not. In addition, the wage premium used by Braconier *et al.* might express more than just skill differences. Empirical analyzes find skilled labor and physical capital to be complements and unskilled labor and capital to be substitutes. This element might be reflected by wages but not by the skill measures used by Markusen and Maskus (1999), Carr *et al.* (2001), and Blonigen *et al.* (2002, 2003).

2.6 Economic Geography and Multinational Firms

The models reviewed above predict that all locations have some production but only few of them have multinational firms. Thus multinational production appears to be more agglomerated than other forms of production. The theory of multinational production is very much related to the new theory of economic geography. Both theories point out the important role of economies of scale and trade costs. Alternatively clustering of multinational activities may be due to some positive externalities creating incentives to locate close to each other. By clustering, firms may benefit from the proximity to the demand for their output, from a large pool of specialized workers (Krugman, 1991), and/or from lower costs of intermediate inputs (Krugman and Venables, 1995; Puga and Venables, 1996; Venables, 1996). This is the idea behind demand and cost linkages¹⁰. Since multinational firms may locate different activities in different countries, there may be a tendency for activities to agglomerate.

2.6.1 Intermediate Inputs and Agglomeration

According to Gao (1999), firms like to be close to each other because of direct input-output linkages among themselves. To see how these linkages work, Gao considers a two-country (1 and 2) and two-sector world with trade costs between countries. The monopolistically competitive manufacturing sector uses labor and some of its own output as intermediate inputs into production, while the perfectly competitive agriculture sector

¹⁰ For surveys of this literature, see Neary (2001) and Ottaviano and Puga (1998)

uses land. While labor is mobile between sectors, land is sector specific. Both factors are internationally immobile.

As discussed earlier, the production process of the differentiated products is split into two stages. The headquarters services can be separated costlessly from the production plant (horizontal multinationals are ruled out). Both headquarters and plants require labor and intermediate inputs but the plant level production is assumed to be relatively more labor intensive. Vertical multinational locates their activities in different countries.

When trade costs between both countries are very high, manufacturing will be evenly divided between both countries. As integration occurs and if country 1 happens to have a larger share of manufacturing activities, the world economy organizes itself into a core-periphery pattern with country 1 as core. This equilibrium is stable if demand and costs linkages are weak and if wage differentials are not too high. However, without international labor mobility, the manufacturing sector drives up the wage in country 1.

A decrease in trade costs implies that firms takes less advantages of being close to each other. However, wage differentials are not affected by this decrease. At some critical value of trade costs, some firms choose to move their production plants to country 2. Vertical multinational firms appear. Once firms start producing final output in country 2, the share of labor employed in the manufacturing sector of this country increases and wages rise. This prevents further shifting of production to country 2.

The cumulative causation modelled by Gao, relies on the assumption that industry linkages are a channel for agglomeration. Another mechanism that brings about agglomeration is the mobility of workers.

2.6.2 Migration and Agglomeration

Ekholm and Forslid (2001) introduce horizontal and vertical "multi-region" firms in the core-periphery (CP) model developed by Krugman (1991). The question is somewhat different since the goal of this paper is less to understand why firms become multinationals but to foresee the impact of multinational firms on the industrial concentration. They assume two regions (*1* and *2*), and two types of labor (*farmers* and *workers*). Farmers are country- and sector-specific and produce a homogenous good, which is freely tradable. Workers produce differentiated goods and move between regions in response to differences in the real wage. Shipment of differentiated goods is assumed to require a trade cost of the iceberg type¹¹.

The model is solved first with horizontal type of firms and then with vertical multi-region firms. As in Markusen and Venables (1998), horizontal multi-region firms are introduced by assuming multi-plant economies of scale that make it less costly to set up a second plant than to set up a whole new firm. They arise when the additional fixed costs of setting up a branch plant are less than the costs of shipping the differentiated good. When trade costs are high and/or these additional fixed costs are low, there will be only

¹¹ To deliver one unit of the differentiated good to the other region, $\tau > 1$ units have to be shipped.

horizontal multi-region firms in an equilibrium where workers are divided symmetrically between both regions.

In Krugman (1991), this equilibrium is stable if the real wage of the receiving region is lower. There are thus no incentives for workers to move to the receiving region. In Ekholm and Forslid (2001), there are no agglomeration forces as long as single-region firms do not enter. In fact, the symmetric equilibrium is characterized by firms that produce in both regions. The advantages of a lower price index and a larger home market in the larger region disappear. As regions become dissimilar in size¹², the proportion of output that firms sell in the smaller region decreases. Horizontal multi-region firms become less advantageous and there will be entry of single-region firms in the larger region. This introduces agglomeration forces into the model through the demand and cost linkages. Horizontal multi-region firms are weakening the tendency toward the concentration of industrial activities. The larger this effect, the higher is the degree of multi-plant economies of scale.

The case of vertical multi-region firms, which separate the location of their headquarters and production plant¹³, is less straightforward. As in the horizontal multi-region case, either a firm decides to become a single-region firm or a vertical multi-region firm. When it decides to become vertical, it has to choose the location of its headquarters and

¹² The supply of workers is relatively higher in one region.

¹³ The variable costs are assumed to be associated with production while the fixed cost of setting up a firm is associated with headquarters services that are freely tradable within the firm.

its production. Moreover, vertical firms export a part of their output back to their home region¹⁴.

Since headquarters services are freely tradable, they will locate in the region where production costs are the lowest i.e., where nominal wages are the lowest. Under the condition that nominal wages decrease in the region that becomes larger, Ekholm and Forslid show that headquarters have a tendency to agglomerate in the larger region. The symmetric equilibrium¹⁵ becomes unstable when workers are reallocated. However, the introduction of the vertical multi-region firms limits the scope of full agglomeration. Since firms can split their production process, the total costs of compensating workers for the high price level in the smaller region are small when headquarters can be retained in the core region.

2.6.3 The Role of Agglomeration for the Location of FDI

Several authors have detected empirical evidence that agglomeration effects importantly affect the multinational location decision. Wheeler and Mody (1992) and Woodward (1992) were early contributors to this literature. Wheeler and Mody use country characteristics such as the level of inward FDI into the respective market, the quality of infrastructure and the degree of industrialisation to show that US outward FDI is considerably affected by agglomeration. Using a similar approach, Head *et al.* (1995, 1999) find considerable agglomeration on the part of Japanese firms in their location decisions

¹⁴ The region where the headquarters is located.

¹⁵ The symmetric equilibrium is characterized by an equal number of headquarters and plants in each of the two regions.

in the United states. The agglomeration effect is captured through a variable measuring the number of Japanese firms within the same sector already located in the region.

Studying the foreign direct investment location in 25 Eastern European countries, Kinoshita and Campos (2003) show that the previous stock of FDI is an important motive of investment in these countries. The country-level of aggregation does not allow them to differentiate between the type of agglomeration at work. Their estimation however differentiates between the Community of Independent States (CIS) and Central Eastern European and Baltics countries (CEEB). While there is a strong tendency for FDI to agglomerate in the CEEB countries, there is none in the CIS countries.

The firm-level analysis of Mayer and Disdier (2003) confirms this tendency. Following Head *et al.* (1995), Mayer and Disdier study the location choices of French multinational firms between Eastern and Western European countries. Their analysis suggest that the agglomeration effects are less strong in CEECs than in European Union countries. Moreover, French multinationals seem to make a distinction between Eastern and Western European markets, but this tendency decreases as the transition process advances.

As pointed out by Barry *et al.* (2001), the positive effect of previous investment may be due to herding behavior. Because multinationals face a greater uncertainty in foreign countries than their national firms, they may have a tendency to follow previous investment. In this case, the location of multinational firms is a signal of the attractiveness of a country. In other word, what is actually observed is a spurious relation rather than a real agglomeration effect.

There are several papers considering this issue, including Gross *et al.* (2003) and Midelfart-Knarvik *et al.* (2000, 2002). Gross *et al.* study how the presence of Japanese FDI in a given sector affects new Japanese investment in the same sector and other sector. They introduce not only country characteristics but also industry characteristics such as the reliance on intermediates inputs.

2.7 Summary: Implication for FDI in Eastern Europe

This chapter reviewed the literature related to the rationale behind the existence of multinational firms and their spatial and industrial location. Two broad lines of research explaining the existence of multinational firms have emerged. The first one is the proximity-concentration tradeoff, according to which firms invest abroad to improve market access. The second one is the factor-proportion approach, according to which firms become multinationals to reduce production costs. Models focusing on market access explain why there are *horizontally* integrated multinationals that produce similar products in different countries. Production-cost based models explain the existence of *vertically* integrated multinational firms that locate different stages of production in different countries to take advantage of variations in factor prices.

Applying these considerations to the expected structure of FDI in the accession countries, the following picture emerges. The first important factor determining the structure of FDI is the size of the economy. Since the accession countries are small, one might

expect that these markets are relatively unimportant from the point of view of multinational firms. This should lower the explanatory power of market-access-based models. However, multinational firms might not have considered only the market potential of each individual country in making their investment decisions but rather the market potential of servicing other countries in the region or servicing the EU market through FDI in accession countries.

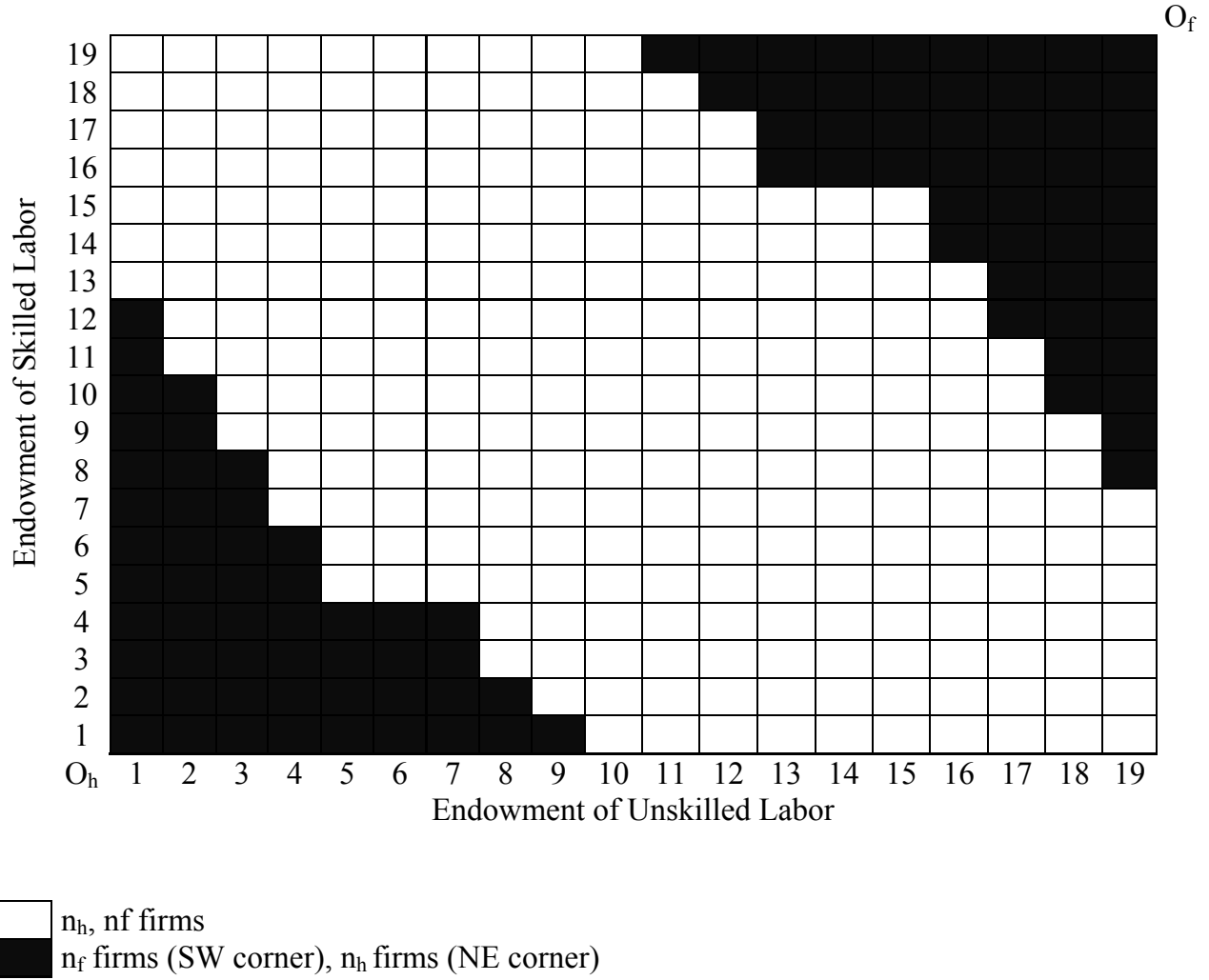
Additionally, relative factor endowments can be expected to influence FDI decisions. If countries differ significantly in terms of their factor endowments, vertical FDI can be expected to prevail. If countries are similar in terms of factor endowments, horizontal FDI becomes the prevalent mode of entry. In this regard, the accession countries share similarities both with other emerging markets as well as with developed industrialized countries. Like other emerging markets, the accession states have been relatively labor abundant, in particular during the early stages of transition when capital stocks had to be rebuilt virtually from scratch. As other industrialized countries, the accession states have, at the same time, a relatively skilled labor force.

Finally, trade costs are an important factor influencing the choice between vertical and horizontal FDI. Generally, the lower trade costs, the less important is horizontal FDI. The reason for this is FDI becomes less profitable relative to exporting goods produced at home. Now, it might be argued that most of the adjustment with respect to trade integration has already taken place during the past decade and that not much change can be expected with regard to falling trade costs during the years to come. This argument

neglects, however, that trade is not only impeded by direct costs in the form of tariffs and quotas but that indirect barriers to trade integration are also important. However, to the extent that trade across borders will be eased if, for instance, border controls are relaxed, we can expect to see falling trade costs. This, in turn, is likely to lower the incentives of firms to engage in FDI relative to exports.

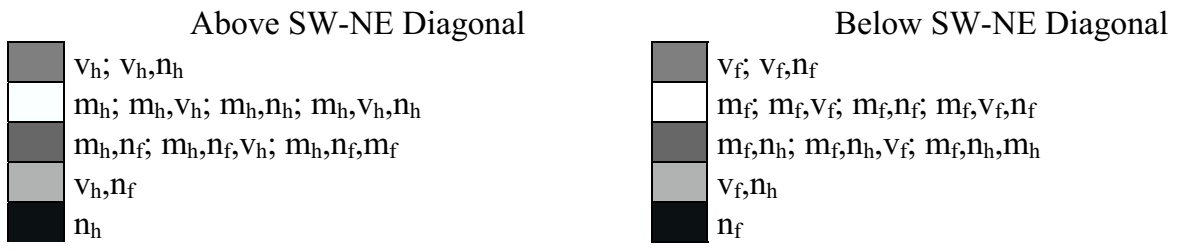
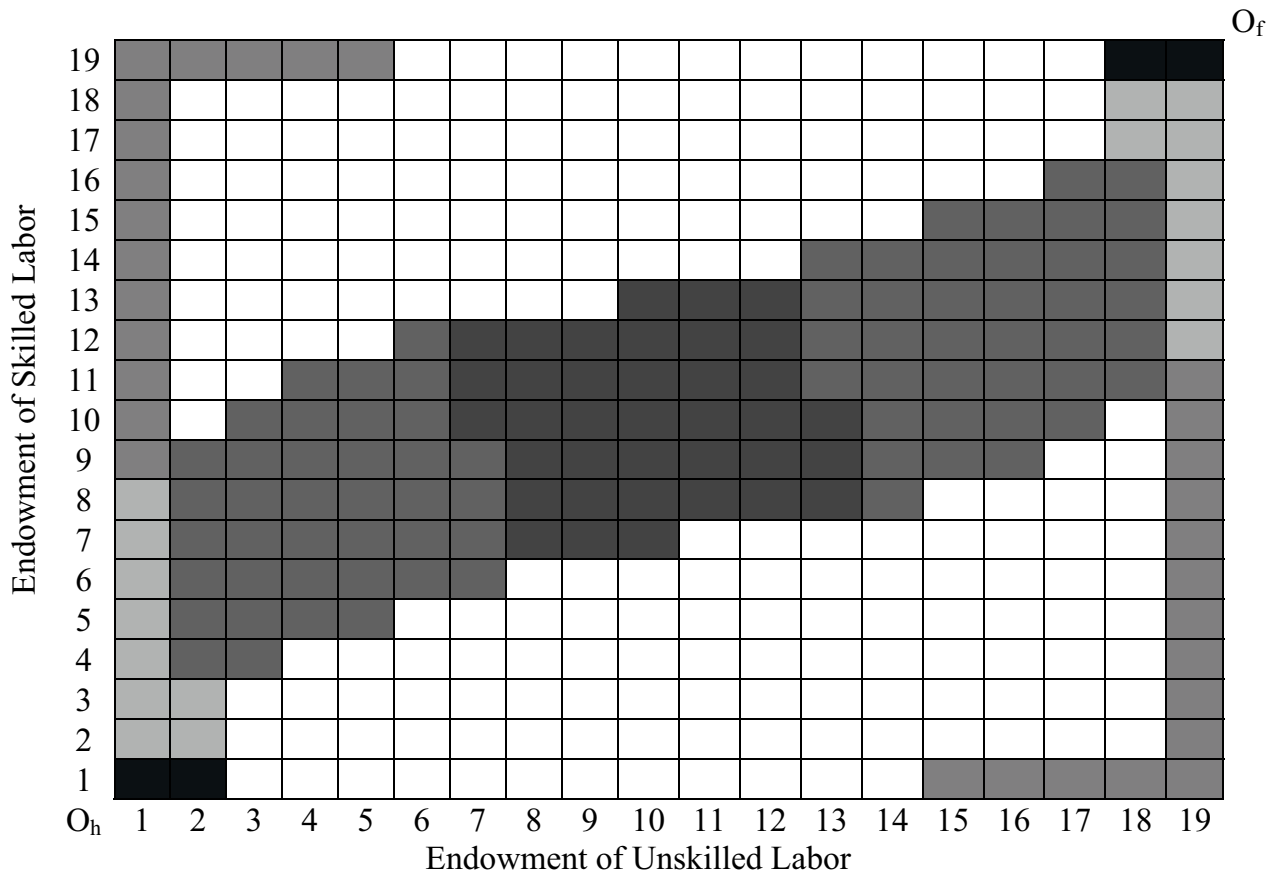
These considerations show that the implications of the New Trade Theory help to explain patterns of FDI in transition economies. Three main conclusions for the empirical analysis emerge from the preceding discussion. First, both horizontal and vertical multinationals are expected to invest in Eastern Europe. The former are not only attracted by local markets but also by the opportunity to service the neighboring countries and the EU market; the latter are attracted by factor endowment differences and low labor costs. Second, the transition path of the individual Eastern European countries matters. A foreign investment decision is certainly affected by the progress of a potential host country toward a market economy. Third, although multinationals are often treated as one homogenous group, they are in fact very heterogeneous entities (Helpman *et al.*, 2004). The use of firm-level data allows us to go beyond the existing literature in another way, namely by testing whether the assumption that all firms are symmetric affects the empirical results. That is, we will test for the effect of firm heterogeneity by assessing how sensitive our results are with regard to firm specific characteristics.

Figure 2.1 Trade Liberalization Regime



Source: Markusen (1997)

Figure 2.2 Investment Liberalization Regime

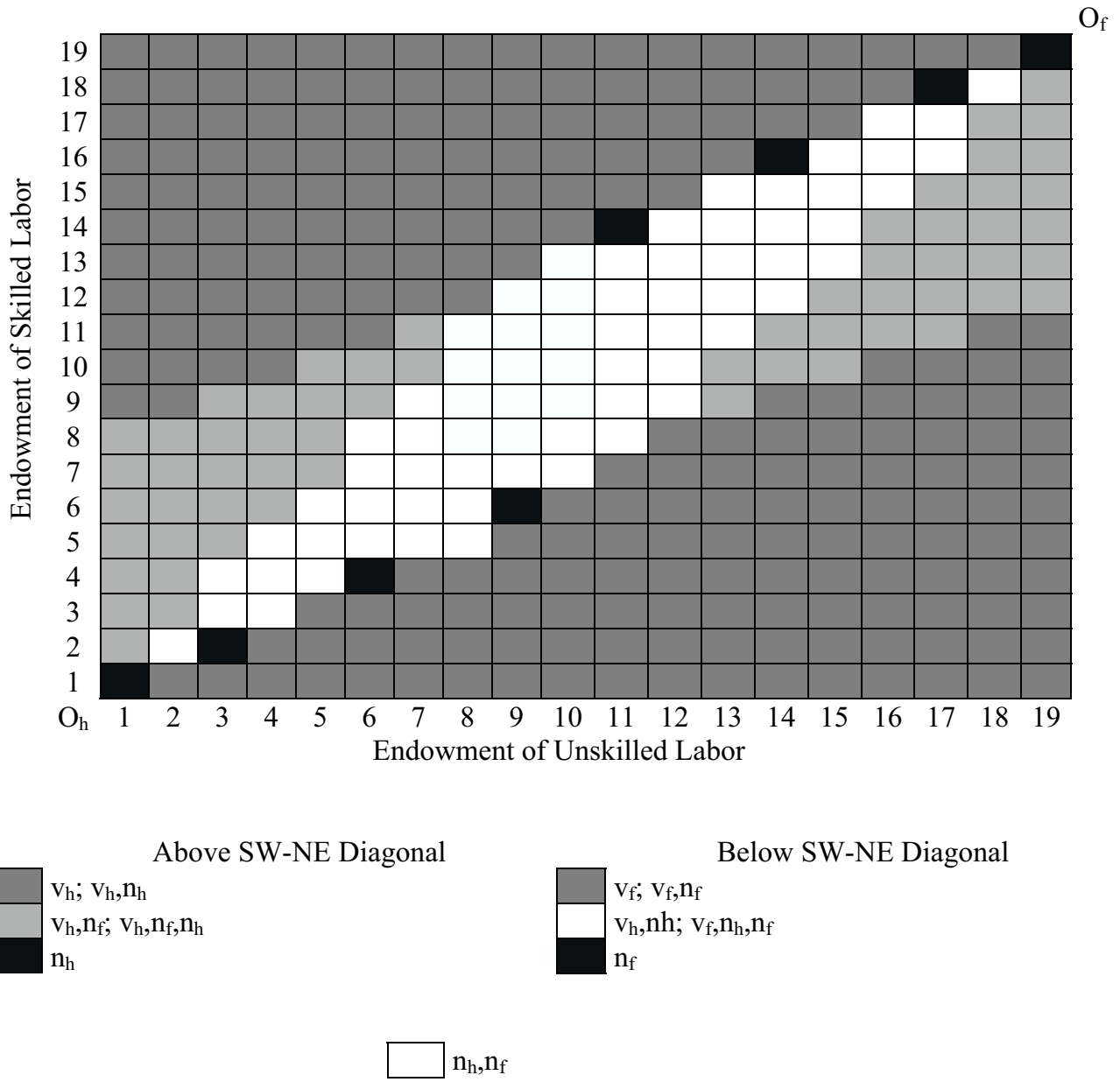


m_h, m_f

In this region (above diagonal), all firms have their headquarter in country h

Source: Markusen (1997)

Figure 2.3 Trade and Investment Liberalization Regime



Source: Markusen (1997)

Chapter 3

Data and Descriptive Statistics

3.1 Introduction

The literature reviewed in the preceding chapter suggests that the spatial and sectoral distribution of multinational activities depends on a set of industry characteristics (such as factor intensities, increasing returns to scale, product differentiation and the agglomeration of firms), country characteristics (such as market size, relative endowment differences and trade costs) and indirect factors (such as public and private infrastructure, the legal framework and institutions).

The purpose of this chapter is to review the evolution of FDI in the ten Central and Eastern European countries (CEECs) that are to enter the European Union¹. The last decade has seen a remarkable growth of European but also U.S. outward direct investments in CEECs. This growth is often thought to be driven by the process of integration of CEECs into the European Union and the associated elimination of the barriers to FDI and by the acceleration of the transition process in those economies. However, the

¹ The group of countries comprises Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic and Slovenia.

CEECs are far from homogeneous and both the level and growth of FDI differ across countries. While the Central European countries, i.e., Czech Republic, Hungary, Poland, Slovak Republic, and Slovenia, have attracted substantial foreign capital, the South Eastern European countries, i.e., Bulgaria and Romania, lag far behind. This chapter shed some light on the uneven spatial and sectoral distribution of foreign direct investment which seems to be correlated with different transition paths.

The analysis uses information of two kinds of databases. The first one are the aggregated datasets from the European Union direct investment yearbook and the OECD international direct investment statistics. These datasets provide useful information on the magnitude and spatial distribution of inward FDI flows in Eastern Europe. The proximity to Western European market has clearly favored Central European countries and encouraged German, Austrian and Italian FDI.

The second kind of data is taken from the firm-level database International Capital Links of the Deutsche Bundesbank. This database provides a detailed breakdown of the foreign assets and liabilities of German multinational firms (Lipponer, 2002a, 2002b). Generally, the dataset makes it possible to use different measures of German companies' foreign activities. Data for FDI include direct and indirect foreign direct investment of German firms abroad. Foreign direct investment is defined as the sum of the equity capital of the foreign affiliate, capital reserves, and retained earnings. In addition, the sales of foreign affiliates and the level of their employment are available. The stock of German FDI is the information we use in this chapter. Generally, the German FDI dataset covers

the period 1990-2000. Although it is not possible to trace a particular company over time because company codes after 1996 differ from earlier codes, the time series for the aggregated data can still be used since these are not affected by the re-classification.

The next section presents the volume of FDI in Eastern European countries. The country level analysis examines the regional distribution of FDI in Eastern Europe. The sectoral aggregation informs about the pattern of German FDI in each Eastern European country and is presented in section 3.3. Section 3.4 presents firm-level data and analyzes the difference between German multinationals that are located in Eastern Europe and those that are not located in accession states. Finally, section 3.5 summarizes the main features found in the data.

3.2 The Volume of FDI in Eastern Europe

Table 3.1 shows the evolution of FDI inflows as a share of GDP into several regions of the world² for the years 1993 to 1999.

— Insert Table 3.1 about here. —

The transition to a market economy in Central and Eastern European countries has been accompanied by a surge of FDI inflows. CEECs attracted more FDI than the low-income countries from 1993 onward and outperformed lower-middle-income countries in 1999, which may be partly attributable to the Asian crisis. According to Brenton and Gros (1997), the commercial integration of some CEECs into the European Union is completed. Hence, FDI flows to these countries may reflect a deeper phase of integration.

² The classification of countries into regions follows the World Development Indicator (2002).

However, the CEEC group is not homogeneous and, as noted by Bevan and Estrin (2000), countries with favorable initial conditions have attracted more FDI than their more risky and poorer performing neighboring countries. The patterns of these investments are heterogenous across recipients (Table 3.2)

— Insert Table 3.2 about here. —

FDI into the Eastern European Countries comes largely from the EU. But the US position is non-negligible particularly in the Visegrad countries³, which absorb about 90% of the US stock of FDI in the region. A first group of European investors, led by Germany, Austria and the Netherlands, invests significantly in Central Eastern European countries, in particular in the Czech Republic, Hungary, Poland and the Slovak Republic. French and Italian multinationals firms are mostly concentrated in Poland, Slovenia and Romania. Theoretical and empirical studies by Altzinger (1998) Buch *et al.* (2003, 2004a), Krugman (1991, 1995), Frankel (1997) attribute these home-host country clusters by the geographical, cultural, and historical proximity.

Since Germany is the most important investor in Eastern Europe, it is worth taking a closer look at the spatial distribution of its FDI. Figure 3.1 presents the dynamics of German FDI stocks in Eastern Europe. It accounts for the different size of the recipient economies by normalizing foreign direct investment stocks by host GDP.

— Insert Figure 3.1 about here —

³ The Visegrad group comprises Poland, the Czech Republic, the Slovak Republic and Hungary.

Figure 3.1 illustrates three characteristics of the German outward position in Eastern Europe. First, the stock of German FDI has increased significantly since the beginning of the transition. This is linked to the progress toward a market economy of the CEECs but also to the process of globalization of the German economy. However, German outward FDI is not homogeneously distributed among the candidate countries. German multinational firms are only concentrated in few Central European Countries. Finally, the rapid growth of the German FDI stock in Bulgaria and Estonia in 1996 and in Latvia in 1997 is certainly due to the change in the privatization methods, which become more open to FDI at that time.

— Insert Table 3.3 about here. —

Table 3.3 shows the magnitude of FDI into transition economies both from a German and an aggregated perspective. Table 3.3 shows, first of all, that German FDI accounts for around 50% of the FDI stocks in Hungary, the Czech Republic, and in the Slovak Republic. In these three countries, German FDI also accounts between 5 and 10% of GDP. For other countries, such as Poland, German FDI is important but not as dominant when measured in relation to GDP. However, measured in terms of the absolute amounts of FDI invested, Poland and Hungary are roughly of equal importance from the German investors' point of view. Another interesting piece of information that can be taken from Table 3.3 when looking at FDI relative to GDP is that the ranking of countries differs for German and total FDI. The Slovak Republic in particular has received more FDI

from Germany than the aggregated figures would suggest, and the country ranks before Poland in relative terms.

There is no clear pattern of correlation between FDI and the market size of the host country or the host wages. In terms of overall market size, measured by GDP, one might expect that Poland has received most FDI. This pattern is indeed reflected in the volume of German FDI in absolute terms but it does not show up in the importance of aggregated FDI relative to GDP. Also, one might expect that low-wage countries would receive most FDI if firms use the accession states as locations for production. This, again, is not confirmed by the data. Countries like Bulgaria and Romania, which have comparatively low wages, have received the least FDI and Slovenia, which has relatively high wages, has received more FDI relative to GDP than these countries.

One variable, which relatively closely tracks the ranking of countries in terms of FDI relative to GDP, is the transition indicator published by the EBRD. This indicator is a summary measure of the core dimension of reform to well-functioning market economy. This variable declines continuously as one moves from countries with high FDI over GDP towards countries with low FDI stocks. Country risk is another indicator that tracks the ordering of countries quite closely, the exception being Slovenia, which has the lowest country risk in the region but only comes in with an average ratio of FDI over GDP. Interestingly, the share of the private sector relative to GDP gives only a relatively weak indication of how important FDI is for a given country. The chosen method of privatization may matter as much as the privatization level (Holland and Pain, 1998).

A number of countries, notably Hungary and Estonia, have pursued a policy of sales to strategic owners, with few restrictions on the involvement of foreign companies. Other countries have largely adopted voucher-based mass privatization schemes, at least in the initial wave of privatization, with companies being sold to domestic residents. Such schemes offer fewer direct opportunities for foreign investment (Czech and Lithuania). A third method of privatization, largely used in the Balkan countries, has consisted of management-employee buy-outs. Again this approach offers few opportunities for the direct purchase of assets by foreign firms in the initial stages of privatization.

3.3 The Sectoral Breakdown

The German FDI database allows me to take a closer look at the sectoral pattern of German outward FDI. The four tables presented below report the average FDI for the period 1990-2000⁴. Table 3.4 and 3.5 present the cross country and sectoral distribution of German FDI stocks for 23 NACE-rev1 sectors by industry of affiliates. Table 3.6 and 3.7 report the same statistics using the average number of German multinationals.

— Insert Table 3.4 about here —

Table 3.4 provides information about the distribution of German FDI stocks by sector and country. The data are given as share of the average German FDI stocks in Eastern European countries for the period 1990 to 2000.

⁴ Because of the confidentiality of the data-set, information on the evolution of FDI will not be presented

They show that at a sectoral level, German FDI is concentrated in few countries. The Czech Republic, Hungary, Poland, the Slovak Republic and Slovenia are the main recipients of German FDI. In the manufacturing industry, they account for more than 72 % of the German stock of FDI, while their share in services is about 78 % of the stock of FDI in the region. Within the manufacturing sector, the sectoral breakdown reveals a strong concentration of German FDI on particular sectors in each country. For instance, German investment in the food processing industry is located mostly in Slovenia, while more than 60 % of German FDI invested in Eastern European countries in the transport equipment sector is in Czech Republic and in Hungary. Those countries have benefited from their highly trained and cheap labor force. They are also geographically close to Germany, which is relevant in a sector where transportation costs are important. Poland does not attract much manufacturing FDI. However, Poland is the main location of FDI in services especially in the financial intermediation sector and in real estate and business services, where it accounts for respectively 27.90 % and 37.88 % of the total FDI stocks in the region. South Eastern European countries, Bulgaria and Romania, have mainly attracted FDI in more traditional sectors, like the wood and wood product industry (26 % of the stock of German FDI in this industry in the CEECs is located in Romania), the basic metal industry (44.69 % in Romania), or the more capital intensive chemical industry (44.56 % in Bulgaria). Both countries offer low labor costs and ready access to raw materials. The Baltic countries, particularly Estonia, lag far behind. Those countries are small and strongly integrated with the Scandinavian countries in particular Sweden.

They account for less than 10 % of the German FDI stock in both the manufacturing industry and the service sector. FDI in Latvia concentrates in the coke and refined petroleum products industry, while Lithuania is the second most important destination of German FDI after Romania in the wood and wood product industry.

— Insert Table 3.5 about here —

Table 3.5 presents the sectoral distribution of German FDI within each country. The data are given as share of the average German FDI stock in each country for the period 1990 to 2000. Except for Romania, German firms do not diversify between sectors. They have a relatively strong position in the manufacturing industry. Except for Estonia, Hungary and Lithuania, where the electricity gas and water industry is predominant, the manufacturing sectors accounts for 60 to about 95 % of the German FDI stock. For example, 53.94 % of the German stock of FDI invested in Bulgaria is going to the chemical industry while the coke and refined petroleum industry is the main manufacturing sector in Latvia. Almost all countries share the same feature concerning the services sector. Financial intermediation is the bigger recipient of German FDI, especially in Poland. In Hungary and the Slovak Republic, the deregulation of the telecommunication industry explains why this sector succeeded in attracting a relatively large amount of German FDI.

— Insert Table 3.6 about here —

Table 3.6 presents some information about the sectoral distribution of German multinationals across the CEECs. The table shows patterns similar to those presented in

Table 3.4. German multinationals are concentrated in the Central European countries. In manufacturing, about 82 % of the total number of German multinationals investing in Eastern Europe are located in the Czech Republic, Hungary, Poland. Even if the stock of German FDI is relatively low in Poland compared to the Czech Republic and Hungary, it has attracted the greatest number of multinationals. The same concentration of German multinationals is observable in services. In South-Eastern Europe and in the Baltic countries, few multinationals are accounting for large amount of FDI (cf Table 3.5).

Table 3.7 presents the sectoral distribution of the number of German multinationals within each countries.

— Insert Table 3.7 about here —

Comparing table 3.5 and table 3.7 provides a quite interesting picture. In fact, compared to the volume of FDI, the number of German multinational firms is much higher in services than in manufacturing. On average, fewer firms in manufacturing account for the large amount of FDI in some sectors. In the Czech Republic and Hungary, about 4% of German multinational firms are responsible for 23 and 14% of German FDI, respectively. In Slovenia, only 1.77% of German multinationals accounts for more than two-third of the total German FDI stock in the food, beverage and tobacco industries.

The services sector is a mirror image of the manufacturing industry. About 40% of German multinational engaged in Slovenia account for only 0.62% of the stock of German FDI invested in wholesale and retail trade. This pattern is similar in all Eastern European countries.

3.4 The Firm-Level Analysis

A comparison of the investing firms in accession countries and non-accession countries shows quite significant differences.

— Insert Figure 3.2

In terms of the total number of affiliates, the accession countries have shown the most significant increase during the past ten years. Whereas the number of affiliates increased from around only 100 in 1990 to more than 3500 in 2000 in the accession countries, the number of affiliates in non-accession countries increased from 17,000 to a little over 23,000. Hence, affiliates in Central and Eastern Europe account for an increasing fraction of German firms' foreign affiliates.

The International Capital Links micro-database does not provide sufficient information to describe the German parent company. However, it reports the balance sheet of the affiliate company and provides information on its size.

— Insert Table 3.8 about here —

As shown in table 3.8, one third of total FDI is driven by small German affiliates. In the Slovak Republic and Slovenia, about 45 % of German affiliates have fewer than 20 employees. The Baltic countries are a notable exception. In Estonia and Lithuania the vast majority of German FDI consists of larger affiliates with more than 500 employees.

3.5 Summary

Substantial amounts of FDI have streamed into the accession countries over the past decade. FDI into the accession countries accounts for an increasing share of German outward direct investment. However, the location of German multinationals in the accession countries has also followed a relatively uneven pattern. While for some countries like Hungary, the Czech and the Slovak Republic, and Poland, German FDI is quite important, German investors do not take such a dominant role in other countries.

The uneven allocation of German FDI across countries found in the aggregated figures is also confirmed when looking at sectoral data. Some sectors cluster almost exclusively in certain countries. This shows that factor endowments, the legal environment and the geographic distance to important markets have motivated German investors to invest in countries formerly secluded from the rest of the world by the "iron curtain". Different transition paths and the economic integration to the European Union may play an important role too.

Table 3.1 FDI inflows into CEECs (as share of GDP, 1993-1999)

Regions	1993	1994	1995	1996	1997	1998	1999
CEEC*	1.87	1.68	3.23	2.24	3.17	3.78	4.37
Low Income Countries	1.32	1.23	2.05	2.48	3.06	3.39	2.98
Lower Middle Income Countries	3.02	3.32	4.65	6.05	3.13	3.81	3.50
Upper Middle Income Countries	2.29	3.28	3.70	3.90	4.94	5.22	6.10
High Income OECD Countries	1.47	1.62	1.88	1.75	2.16	3.98	5.63

Source: World Development Indicators (2002). Own computations.

* Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovak Republic, Slovenia.

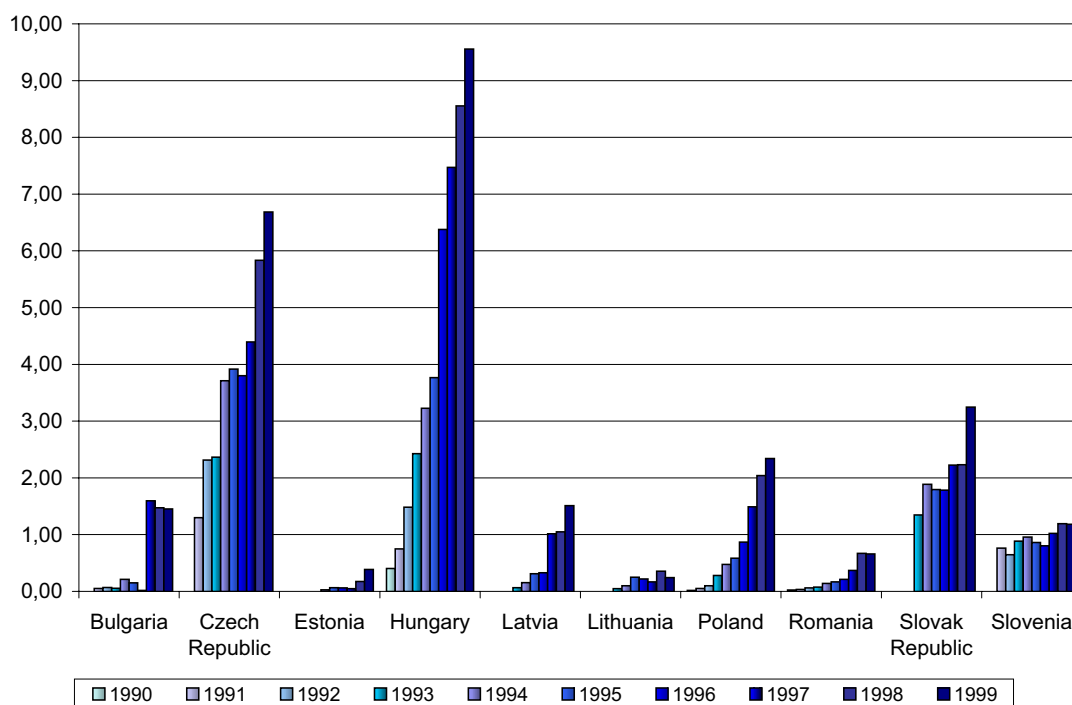
Table 3.2 FDI stock by country (as of December 1999, share in percent)

From%to	CZ	HU	PL	SK	SLO	BG	RO
<i>EU</i>	<i>82.7</i>	<i>76.9</i>	<i>63.8</i>	<i>74.5</i>	<i>81.2</i>	<i>60.2</i>	<i>56.8</i>
Austria	11.5	11.7	2.3	16.9	37.5	4.5	5.1
France	4.7	6.1	11.0	4.2	12.8	3.0	7.1
Germany	29.6	28.0	17.3	22.0	12.3	15.3	10.2
Italy	0.9	3.2	9.1	1.6	6.6	1.2	7.6
Netherlands	27.1	15.5	9.2	15.0	3.8	6.0	11.6
UK	4.7	6.4	5.9	9.1	4.8	5.7	5.1
Others	4.2	6.0	9	5.7	3.4	24.5	10.1
<i>USA</i>	<i>8.2</i>	<i>12.2</i>	<i>14.7</i>	<i>13.0</i>	<i>4.4</i>	<i>7.1</i>	<i>7.7</i>
<i>Other</i>	<i>9.1</i>	<i>7.9</i>	<i>21.5</i>	<i>12.5</i>	<i>14.4</i>	<i>32.7</i>	<i>64.5</i>

Source: UNCTAD (2001). BG: Bulgaria. CZ: Czech Republic. HU: Hungary.

PL: Poland. RO: Romania. SK: Slovak Republic. SLO: Slovenia

Figure 3.1 German Outward FDI Stocks in Transition Countries (1993-1999, as % of GDP)



Source: German Bundesbank. Own computations.

Table 3.3 A macroeconomic overview (1999)

Countries	German FDI Stocks	German FDI Stocks	Total FDI Stock	Gross Domestic Product	Monthly Gross Wage	Private Market Share	Method of Privatization	Country Risk*	<i>TRI</i> **
	Millions US\$	Percent of GDP	Percent of GDP	Billion US\$	US\$	Percent of GDP	Primary Privatization Method		
Estonia	-	-	-	5.12	285.31	70	Direct Sales	54.38	3.52
Latvia	-	-	-	6.66	227.46	65	Direct Sales	50.67	3.12
Lithuania	-	-	-	10.66	246.75	70	Voucher	50.14	3.09
Baltics	165.33	-	-						
Czech Republic	4583.65	8.40	15.77	133.80	297.78	80	Voucher	61.96	3.49
Hungary	4985.02	10.38	17.26	115.08	320.90	80	Direct Sales	65.75	3.69
Poland	4391.13	2.83	11.17	326.63	418.67	65	Direct Sales	62.06	3.48
Slovak Republic	799.47	4.06	8.56	57.15	264.48	75	Direct Sales	48.33	3.33
Slovenia	280.63	1.40	9.14	31.72	792.82	55	Insider	37.87	3.20
Bulgaria	64.18	0.52	8.17	41.62	111.69	70	Direct Sales	36.28	2.86
Romania	331.75	0.94	4.75	135.68	111.70	60	Insider	70.06	2.80
Portugal	3736.70	2.41	20.68	113.72	718.00	94		82.84	-

* The higher is the index the less risky is the country

***TRI*: Transition Index. This index is taken as a simple average of the progress in transition indicators proposed by the EBRD.

Source: German Stock of FDI from the European Union Direct Investment Yearbook (2000). total FDI stock as percent of GDP from UNCTAD (2001). Gross Domestic Product from World Development Indicator (2001). Monthly Gross Wage from Countries in Transition (2001) and ILO (2001). Share of Private Businesses as percent of GDP from EBRD (2001). Method of privatization from the EBRD (2001). Country Risk index from Euromoney (1999). Transition Index from EBRD (2001).

Table 3.4 Sectoral FDI stocks by country (average FDI stocks 1990-2000, share in percent)

NACE Sector	BG	CZ	EST	H	LT	LV	PL	RO	SK	SLO	Total
Agriculture, hunting fishing and forestry	0.00	8.64	0.00	39.30	0.00	22.03	0.47	0.00	29.56	0.00	100
Mining and quarrying	0.00	48.84	0.00	15.30	0.00	0.00	27.40	0.00	8.46	0.00	100
<i>Manufacturing</i>	<i>11.95</i>	<i>17.48</i>	<i>0.68</i>	<i>14.26</i>	<i>4.30</i>	<i>2.31</i>	<i>10.11</i>	<i>8.53</i>	<i>13.55</i>	<i>16.82</i>	<i>100</i>
Food products, beverages and tobacco	4.91	9.49	0.00	7.53	0.77	1.08	8.60	8.14	17.92	41.56	100
Textiles and textile products	0.94	29.47	0.00	11.68	21.63	0.00	8.24	11.44	4.78	11.82	100
Wood and wood products	0.00	1.78	0.23	17.02	0.00	22.68	16.64	26.91	9.53	5.21	100
Pulp. paper and paper products; publishing and printing	0.47	49.48	1.00	8.44	0.00	0.00	12.63	0.96	15.69	11.33	100
Coke. refined petroleum products and nuclear fuel	0.00	0.00	0.00	0.00	98.67	0.00	1.33	0.00	0.00	0.00	100
Chemicals, chemical products and man-made fibres	44.56	16.31	1.33	9.93	0.13	0.16	6.18	2.55	8.71	10.14	100
Rubber and plastic products	0.00	26.05	0.00	24.77	0.00	0.00	6.91	0.00	5.80	36.47	100
Other non-metallic mineral products	9.17	15.68	0.46	14.06	2.86	6.00	12.92	9.44	12.01	17.40	100
Basic metals and fabricated metal products	0.00	11.69	0.59	9.63	2.15	6.74	12.34	44.69	6.54	5.62	100
Machinery and equipment n.e.c.	21.09	7.16	0.00	4.83	0.00	3.43	4.33	12.39	25.65	21.13	100
Electrical and optical equipment	4.35	15.09	1.74	9.34	9.05	4.30	18.39	8.79	9.49	19.47	100
Transport equipment	0.33	28.03	0.00	31.48	1.27	0.00	10.68	6.39	16.49	5.34	100
Furniture and manufacturing n.e.c.	0.00	17.43	6.92	9.87	0.00	1.63	18.02	0.71	25.82	19.58	100
Electricity, gas and water supply	0.00	7.32	6.11	68.42	0.00	17.13	1.02	0.00	0.00	0.00	100
<i>Services</i>	<i>8.48</i>	<i>10.65</i>	<i>2.21</i>	<i>29.67</i>	<i>3.12</i>	<i>4.67</i>	<i>17.45</i>	<i>3.70</i>	<i>17.52</i>	<i>2.53</i>	<i>100</i>
Construction	5.24	23.36	5.40	13.83	6.91	4.67	24.89	13.86	1.85	0.00	100
Wholesale and retail trade	25.66	10.70	1.28	16.08	3.23	12.20	13.49	7.71	5.41	4.23	100
Hotels and restaurants	0.00	32.44	0.00	21.05	0.00	14.49	32.02	0.00	0.00	0.00	100
Transport. storage and communication	6.18	4.66	0.46	48.48	0.64	1.30	2.78	1.93	32.25	1.32	100
Financial intermediation	8.71	14.46	4.08	18.01	6.38	7.53	27.90	4.12	7.79	1.02	100
Real estate, renting and business activities. consulting	7.03	13.21	0.00	13.87	0.06	1.55	37.88	6.18	10.53	9.69	100
Community social and personal services	2.48	21.42	7.72	12.53	0.00	0.00	30.09	0.09	6.97	18.70	100

Source: German Bundesbank. Own computations.

BG: Bulgaria. CZ: Czech Republic. EST: Estonia. HU: Hungary. LV: Latvia. LT: Lithuania. PL: Poland. RO: Romania. SK: Slovak Republic. SLO: Slovenia

Table 3.5 Country FDI stocks by sector (average FDI stocks 1990-2000. share in percent)

NACE Sector	BG	CZ	EST	H	LT	LV	PL	RO	SK	SLO
Agriculture, hunting fishing and forestry	0.00	0.23	0.00	0.59	0.00	1.65	0.02	0.00	0.96	0.00
Mining and quarrying	0.00	3.07	0.00	0.53	0.00	0.00	2.44	0.00	0.64	0.00
<i>Manufacturing</i>	<i>80.00</i>	<i>72.86</i>	<i>21.91</i>	<i>32.73</i>	<i>79.63</i>	<i>26.53</i>	<i>59.64</i>	<i>86.74</i>	<i>67.59</i>	<i>94.97</i>
Food products, beverages and tobacco	5.17	6.23	0.00	2.72	2.23	1.96	7.99	13.03	14.07	36.93
Textiles and textile products	0.17	3.29	0.00	0.72	10.73	0.00	1.30	3.12	0.64	1.79
Wood and wood products	0.00	0.11	0.10	0.55	0.00	3.69	1.39	3.87	0.67	0.42
Pulp, paper and paper products; publishing and printing	0.08	5.40	0.84	0.51	0.00	0.00	1.95	0.26	2.05	1.68
Coke, refined petroleum products and nuclear fuel	0.00	0.00	0.00	0.00	40.18	0.00	0.17	0.00	0.00	0.00
Chemicals, chemical products and man-made fibres	53.94	12.30	7.75	4.12	0.42	0.33	6.59	4.69	7.86	10.36
Rubber and plastic products	0.00	1.67	0.00	0.87	0.00	0.00	0.63	0.00	0.44	3.16
Other non-metallic mineral products	9.68	10.32	2.35	5.10	8.34	10.91	12.03	15.15	9.46	15.51
Basic metals and fabricated metal products	0.00	2.12	0.83	0.96	1.73	3.38	3.17	19.77	1.42	1.38
Machinery and equipment n.e.c.	8.55	1.81	0.00	0.67	0.00	2.39	1.55	7.63	7.75	7.22
Electrical and optical equipment	1.96	4.25	3.78	1.45	11.30	3.34	7.32	6.04	3.19	7.42
Transport equipment	0.44	23.34	0.00	14.43	4.68	0.00	12.58	12.98	16.43	6.02
Furniture and manufacturing n.e.c.	0.00	2.03	6.25	0.63	0.00	0.53	2.97	0.20	3.60	3.09
Electricity, gas and water supply	0.00	8.18	52.97	42.14	0.00	52.89	1.62	0.00	0.00	0.00
<i>Services</i>	<i>20.00</i>	<i>15.66</i>	<i>25.12</i>	<i>24.01</i>	<i>20.37</i>	<i>18.94</i>	<i>36.29</i>	<i>13.26</i>	<i>30.81</i>	<i>5.03</i>
Construction	0.26	0.71	1.28	0.23	0.94	0.39	1.08	1.03	0.07	0.00
Wholesale and retail trade	4.44	1.15	1.07	0.95	1.54	3.63	2.06	2.03	0.70	0.62
Hotels and restaurants	0.00	0.36	0.00	0.13	0.00	0.44	0.50	0.00	0.00	0.00
Transport, storage and communication	5.91	2.77	2.10	15.89	1.68	2.13	2.34	2.80	22.97	1.06
Financial intermediation	7.98	8.26	18.04	5.66	16.18	11.88	22.54	5.74	5.32	0.79
Real estate, renting and business activities. consulting	1.24	1.46	0.00	0.84	0.03	0.47	5.90	1.66	1.39	1.45
Community social and personal services	0.18	0.95	2.64	0.30	0.00	0.00	1.88	0.01	0.37	1.12
Total	100	100	100	100	100	100	100	100	100	100

Source: German Bundesbank. Own computations.

BG: Bulgaria. CZ: Czech Republic. EST: Estonia. HU: Hungary. LV: Latvia. LT: Lithuania. PL: Poland. RO: Romania. SK: Slovak Republic. SLO: Slovenia

Table 3.6 Number of German multinational by sector(average number of German multinationals 1990-2000, share in percent)

NACE Sector	BG	CZ	EST	HU	LV	LT	PL	RO	SK	SLO	Total
Agriculture. hunting fishing and forestry	0.00	5.44	0.00	42.58	0.00	5.44	38.93	0.00	7.61	0.00	100
Mining and quarrying	0.00	34.55	0.00	19.92	0.00	0.00	42.13	0.00	3.40	0.00	100
<i>Manufacturing</i>	<i>1.28</i>	<i>28.40</i>	<i>1.11</i>	<i>23.98</i>	<i>1.06</i>	<i>1.25</i>	<i>29.11</i>	<i>4.86</i>	<i>6.42</i>	<i>2.53</i>	<i>100</i>
Food products, beverages and tobacco	1.74	15.36	0.00	28.00	0.87	0.87	41.31	5.53	5.17	1.16	100
Textiles and textile products	1.48	24.53	0.00	26.12	3.41	0.00	22.82	12.20	8.26	1.18	100
Wood and wood products	0.00	19.14	2.54	25.53	0.00	5.92	31.39	5.07	7.89	2.54	100
Pulp, paper and paper products, publishing and printing	1.46	25.09	1.46	18.95	0.00	0.00	39.53	8.11	3.94	1.46	100
Coke, refined petroleum products and nuclear fuel	0.00	0.00	0.00	0.00	50.00	0.00	50.00	0.00	0.00	0.00	100
Chemicals. chemical products and man-made fibres	3.63	18.09	5.57	18.54	2.75	2.46	27.18	6.87	7.76	7.14	100
Rubber and plastic products	0.00	32.37	0.00	24.84	0.00	0.00	30.22	0.00	5.24	7.33	100
Other non-metallic mineral products	2.79	27.90	2.02	15.89	0.89	3.32	32.03	5.89	6.95	2.31	100
Basic metals and fabricated metal products	0.00	39.89	0.68	25.39	0.63	0.51	23.31	1.98	5.72	1.88	100
Machinery and equipment n.e.c.	1.24	30.98	0.00	29.46	0.00	0.93	24.22	2.02	8.01	3.15	100
Electrical and optical equipment	2.33	30.15	0.75	30.46	1.82	0.75	17.43	4.47	6.55	5.29	100
Transport equipment	1.34	33.72	1.11	24.29	1.11	0.00	17.68	4.04	10.77	5.94	100
Furniture and manufacturing n.e.c.	0.00	21.64	1.81	22.88	0.00	1.81	46.42	1.81	1.81	1.81	100
Electricity. gas and water supply	0.00	39.82	6.57	31.06	0.00	8.77	13.78	0.00	0.00	0.00	100
<i>Services</i>	<i>1.57</i>	<i>29.99</i>	<i>0.90</i>	<i>20.23</i>	<i>1.65</i>	<i>1.70</i>	<i>31.32</i>	<i>2.93</i>	<i>6.92</i>	<i>2.80</i>	<i>100</i>
Construction	1.21	32.83	1.21	22.27	1.21	1.69	34.11	2.01	3.48	0.00	100
Wholesale and retail trade	1.57	28.89	0.81	16.69	1.90	1.38	34.47	3.50	7.37	3.42	100
Hotels and restaurants	0.00	22.90	0.00	36.09	0.00	15.27	25.74	0.00	0.00	0.00	100
Transport, storage and communication	2.35	33.07	2.17	19.56	2.93	2.75	24.82	3.57	6.72	2.05	100
Financial intermediation	1.73	27.63	0.71	23.76	1.16	3.04	27.15	2.26	9.12	3.43	100
Real estate, renting and business activities. consulting	1.10	35.32	0.51	29.58	1.02	1.02	23.61	1.31	5.44	1.09	100
Community social and personal services	3.20	27.07	3.20	28.37	0.00	0.00	28.55	3.20	3.20	3.20	100

Source: German Bundesbank. Own computations.

BG: Bulgaria. CZ: Czech Republic. EST: Estonia. HU: Hungary. LV: Latvia. LT: Lithuania. PL: Poland. RO: Romania. SK: Slovak Republic. SLO: Slovenia

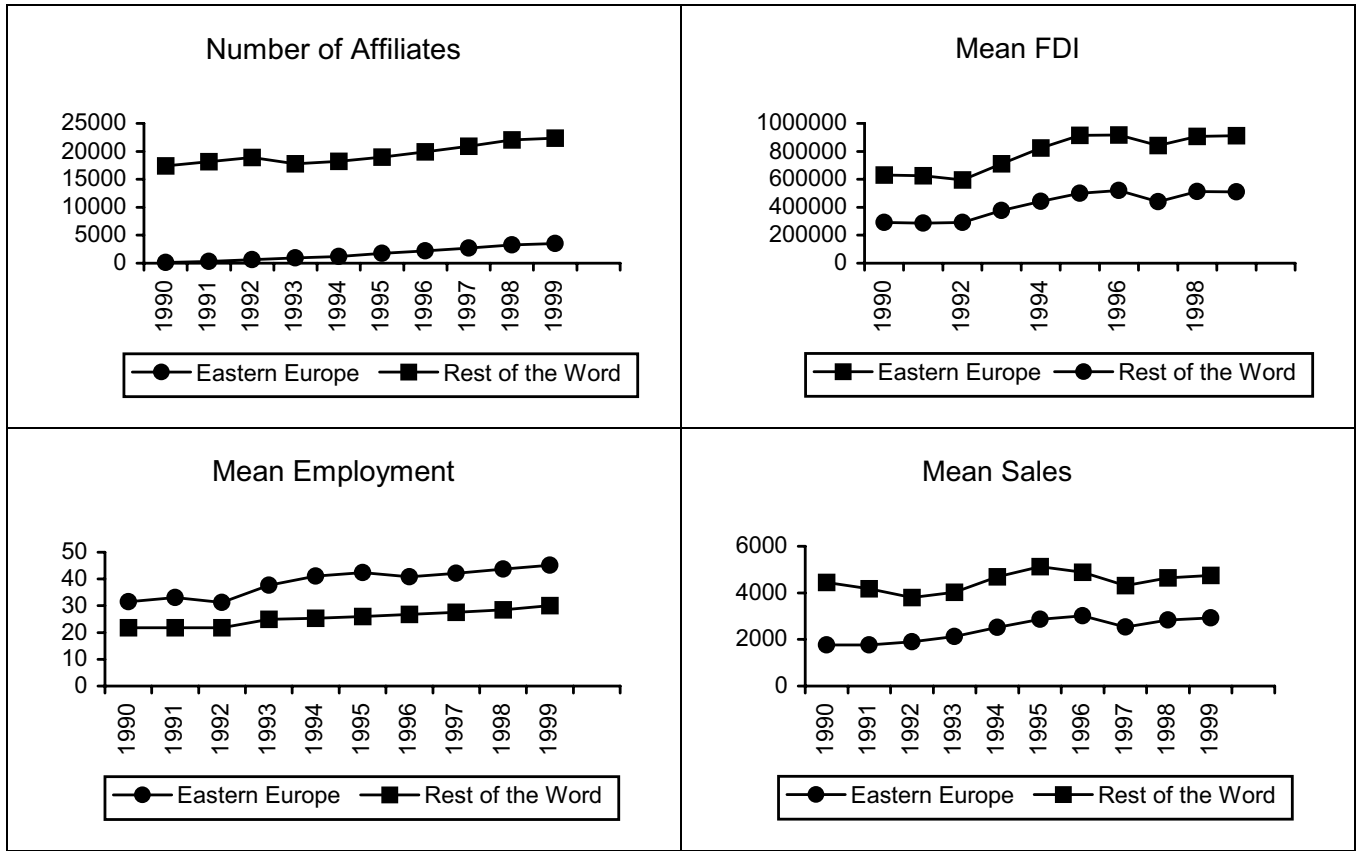
Table 3.7 Number of German multinational by country (average number of German multinationals 1990-2000, share in percent)

NACE Sector	BG	CZ	EST	H	LT	LV	PL	RO	SK	SLO
Agriculture, hunting fishing and forestry	0.00	0.13	0.00	1.32	0.00	2.49	0.91	0.00	0.79	0.00
Mining and quarrying	0.00	1.31	0.00	0.99	0.00	0.00	1.57	0.00	0.57	0.00
<i>Manufacturing</i>	<i>40.97</i>	<i>42.58</i>	<i>47.10</i>	<i>48.04</i>	<i>35.23</i>	<i>32.38</i>	<i>40.58</i>	<i>56.07</i>	<i>42.87</i>	<i>47.16</i>
Food products, beverages and tobacco	5.29	2.27	0.00	5.43	2.77	2.49	6.04	6.71	3.38	1.77
Textiles and textile products	3.30	2.67	0.00	3.73	8.00	0.00	2.45	10.90	3.97	1.33
Wood and wood products	0.00	0.97	3.71	1.70	0.00	5.82	1.57	2.11	1.76	1.33
Pulp, paper and paper products; publishing and printing	2.64	2.21	3.71	2.19	0.00	0.00	3.44	5.86	1.53	1.33
Coke, refined petroleum products and nuclear fuel	0.00	0.00	0.00	0.00	2.77	0.00	0.13	0.00	0.00	0.00
Chemicals. chemical products and man-made fibres	6.49	1.57	13.97	2.11	5.14	4.16	2.33	4.90	2.98	6.41
Rubber and plastic products	0.00	1.32	0.00	1.33	0.00	0.00	1.22	0.00	0.94	3.10
Other non-metallic mineral products	8.31	4.03	8.42	3.01	2.77	9.32	4.57	6.99	4.43	3.45
Basic metals and fabricated metal products	0.00	12.61	6.18	10.52	4.28	3.12	7.28	5.14	7.98	6.14
Machinery and equipment n.e.c.	3.52	4.30	0.00	5.36	0.00	2.49	3.32	2.29	4.90	4.51
Electrical and optical equipment	8.24	5.18	3.71	6.86	6.73	2.49	2.96	6.30	4.96	9.39
Transport equipment	3.17	3.89	3.71	3.67	2.77	0.00	2.01	3.82	5.48	7.08
Furniture and manufacturing n.e.c.	0.00	1.54	3.71	2.13	0.00	2.49	3.25	1.05	0.57	1.33
Electricity, gas and water supply	0.00	1.17	5.56	1.19	0.00	4.99	0.40	0.00	0.00	0.00
<i>Services</i>	<i>59.03</i>	<i>54.82</i>	<i>47.35</i>	<i>48.46</i>	<i>64.77</i>	<i>60.14</i>	<i>56.53</i>	<i>43.93</i>	<i>55.77</i>	<i>52.84</i>
Construction	2.64	3.50	3.71	3.11	2.77	3.49	3.59	1.76	1.64	0.00
Wholesale and retail trade	35.07	31.40	25.29	23.77	44.44	28.98	36.99	31.22	35.29	38.41
Hotels and restaurants	0.00	0.29	0.00	0.60	0.00	3.74	0.32	0.00	0.00	0.00
Transport, storage and communication	4.76	3.26	6.18	2.53	6.23	5.26	2.42	2.89	2.92	2.09
Financial intermediation	8.26	6.40	4.76	7.21	5.79	13.68	6.21	4.29	9.31	8.20
Real estate, renting and business activities. consulting	5.66	8.88	3.71	9.75	5.54	4.99	5.86	2.71	6.03	2.82
Community, social and personal services	2.64	1.09	3.71	1.49	0.00	0.00	1.13	1.05	0.57	1.33
Total	100	100	100	100	100	100	100	100	100	100

Source: German Bundesbank. Own computations.

BG: Bulgaria. CZ: Czech Republic. EST: Estonia. HU: Hungary. LV: Latvia. LT: Lithuania. PL: Poland. RO: Romania. SK: Slovak Republic. SLO: Slovenia

Figure 3.2 Characteristics of Firms in Eastern Countries



Source: German Bundesbank. Own computations.

Table 3.8 Structure of German Affiliates in Eastern Europe (1999, share in percent)

Affiliate's number of employees	BG	CZ	EST	H	LT	LV	PL	RO	SK	SLO
1 to 19	38.60	36.54	22.95	34.29	22.35	21.33	39.06	30.65	44.34	43.01
20 to 49	10.53	18.18	9.84	21.82	9.41	9.33	22.64	24.19	17.65	12.90
50 to 99	12.28	14.31	4.92	14.27	3.53	13.33	14.13	6.45	14.48	17.20
100 to 499	24.56	24.75	6.56	25.06	4.71	10.67	22.72	30.65	23.08	26.88
500 to 999	7.02	3.51	1.64	4.44	56.47	9.33	0.77	2.42	0.00	0.00
1000+	7.02	2.70	54.10	0.12	3.53	36.00	0.68	5.65	0.45	0.00
Total	100	100	100	100	100	100	100	100	100	100

Source: German Bundesbank. Own computations.

BG: Bulgaria. CZ: Czech Republic. EST: Estonia. HU: Hungary. LV: Latvia. LT: Lithuania.

PL: Poland. RO: Romania. SK: Slovak Republic. SLO: Slovenia

Chapter 4

Foreign Direct Investment in Central and Eastern European Countries: A Dynamic Panel Analysis

‡This chapter is based on Kai Carstensen and Farid Toubal (2004). Foreign Direct Investment in Central and Eastern European Countries: A Dynamic Panel Analysis. *Journal of Comparative Economics*, 32, 3-22.

4.1 Introduction

This chapter examines the determinants of foreign direct investment (FDI) into Central and Eastern European countries (CEECs) during their transition towards a market economy. The last decade has seen a remarkable growth of European but also U.S. outward direct investments in the CEECs. This growth is often thought to be driven by the process of integration of the CEECs into the European Union and the associated elimination of the barriers to FDI and by the acceleration of the transition process in those economies. However, the CEECs are far from homogeneous and both the level and growth of FDI differ across countries. While the Central European countries, *i.e.*, Czech Republic, Hungary, Poland, Slovak Republic, and Slovenia, have attracted substantial foreign capital, the South Eastern European countries, *i.e.*, Bulgaria and Romania, lag

far behind. We argue that this discrepancy cannot be explained fully by traditional FDI determinants because transition-specific factors play an important role in the investment decision of a multinational company in so far as they reflect the actual state of the transition process, the overall policy stance, or even future prospects.

The traditional determinants of FDI are found in the knowledge-capital model examined in Chapter 2. This model combines different elements of the two most successful microeconomic models of the multinational firm: (i) the proximity-concentration tradeoff that explains why there are horizontally integrated multinationals that produce similar products in different countries; and (ii) the factor-proportion approach that explains the existence of vertically integrated multinational firms that locate different stages of production in different countries to take advantage of variations in factor prices. Both horizontal and vertical MNEs are expected to invest in the CEECs. The former are not only attracted by local markets but also by the opportunity to service the neighboring countries and the EU market through FDI in accession countries; the latter are attracted by factor endowment differences and low labor costs.

To focus on the transition process, we supplement these traditional determinants, e.g., market size, endowments and trade costs, derived from the new trade theories presented in Chapter 2 with transition-specific factors, e.g., the level and method of privatization. By using both traditional and transition-specific variables, we extend the work of Lansbury et al.(1996) and Holland and Pain (1998); these authors focus on the business environment and the privatization process as primary determinants of FDI in CEECs.

The impacts of these variables are estimated within a dynamic panel data framework using an appropriate generalized method of moments (GMM) estimation technique¹. By employing a dynamic panel data approach, we incorporate all available information in the cross section and time series dimensions and also distinguish the short-run and long-term evolution of FDI in CEECs. Only a few studies of FDI have used panel data at all, and these estimated static models only (Bevan and Estrin, 2000). By stressing the dynamic nature of FDI we render a more realistic analysis of FDI in Eastern Europe.

The structure of this chapter is as follows. The econometric specification is presented in section 4.2. The estimation strategy is laid out in sections 4.3. Section 4.4 reports and discusses the empirical results while section 4.5 concludes with a policy discussion and some suggestions for extensions.

4.2 Empirical Specification

Based on the theoretical literature, we identify a set of traditional determinants of FDI, namely market size, trade costs, plant and firm specific costs, and relative factor endowments. A second set of explanatory variables introduces transition-specific determinants, namely, the share of private businesses, the method of privatization, and the risk associated with each host country, which may influence the decision to invest in CEECs. The motivation for our choice of variables follows; the details of the computations and the data sources are given in the Appendix.

¹ Buch, Kokta, and Piazzolo. (2004) estimate a dynamic cointegration model to investigate the long-run determinants of FDI for a larger set of European countries. However, this approach requires a large time dimension that precludes the use of transition-specific variables. Since their estimation results are rather unstable, we decide not to apply panel cointegration techniques.

The impact of market size on FDI inflows in the CEECs must be treated carefully. Initially, FDI inflows coincided with a period of recession up to 1995, which has been associated with the transition to a market economy (Kornai, 1995 and 1996, Lavigne, 1999, Roland, 2000). Hence, a spurious relationship between FDI and market size would result from using the actual output of the host country. Practical suggestions to overcome this statistical problem include proxying market size by population size (Meyer, 1996), starting the analysis at the point of recovery (Barrell and Holland, 2000), and taking FDI inflows relative to GDP (Holland and Pain, 1998). All these approaches find FDI to be significantly and positively influenced by market size *ceteris paribus*. As an alternative approach, we propose taking the market potential associated with a specific location because this is the information that a MNE considers when making a locational decision. The decision of whether to serve remote customers by export or by FDI is not related simply to the size of the domestic market but it also depends on the market size of all neighboring countries (Head and Mayer, 2002). Even within a country, the domestic market is limited by transportation costs between the subsidiary and the various regional markets. Therefore, we measure the market potential of a country as the average of the output of all countries in the sample weighted by an inverse distance measure derived from transportation costs on a region-to-region basis.

In the empirical literature, distance is often used to model trade costs. However, since this variable is constant over time, it cannot be distinguished from any other time-invariant variables in our panel. In her analysis of U.S. FDI at a sectoral level, Brainard

(1997) uses freight cost and tariffs as proxies for trade costs. Unfortunately, freight costs are not available for Eastern European countries. Consequently, we take the host country's tariff revenue as a percentage of imports to be the sole proxy for trade costs. Since the impact of tariffs on FDI depends on the size of the host country, we multiply it by the average GDP of the host country². This variable conveys more information than a simple distance measure because it changes over time. Due to the aggregate nature of our data, we cannot differentiate between horizontal and vertical FDI; thus, we expect tariffs to have an ambiguous impact on FDI.

Given the relatively low labor costs in CEECs, firms should have a strong incentive to locate their labor-intensive activities in the area. Holland and Pain (1998) find that wage differences between CEECs have a significant impact on FDI inflows from the EU. However, they do not control for the bilateral wage relation between host and home countries. Moreover, low wages do not necessarily reflect low production costs because labor productivity may be low. Taking this into account, the location decision of a multinational depends on the relative productivity-adjusted labor cost in the host country. Thus, we expect that high unit labor costs of the host country relative to the reporting country will depress FDI.

The potential access to skilled labor in the host country is also important. While actual unit labor costs measure the relevant costs for a given production technology,

² We do not use yearly GDP data because we want to control for relative size effects between individual host countries and not for business cycles or other fluctuations.

investment by western MNEs leads to innovations in the host country's production technology even though this technology remains less advanced than in home countries. Bartel and Lichtenberg (1987) suggest that the transition from the old to the new technology generates job tasks and operating procedures that are not only different but less defined in the short run. Nelson and Phelps (1966) argue that education increases the capability to process and understand information; they confirm empirically that educated people are better able to cope with the implementation of a new technology. Consequently, a MNE's demand for educated labor should be high at least for a transition period until the production technology is fully implemented in the CEECs³. Therefore, we expect a skilled labor force to have a positive impact on FDI inflows. In this paper, we measure skill as the fraction of medium and higher-educated workers in the relevant labor force.

The absolute difference in GDP per capita is often taken as a proxy for the difference in relative factor endowments, although the relative capital-labor ratio would be a better measure. Unfortunately, capital stock data are not available for CEECs. Moreover, constructing capital stock data from investment data by means of the perpetual inventory method as outlined by the OECD (2001b) is not easily adaptable to CEECs for several reasons. First, the average service lives or depreciation rates for different types of productive assets are uncertain. Second, long consistent series of investment data are missing⁴. Finally, an unknown fraction of the capital stock, that was used in the

³ This hypothesis is not inconsistent with Egger and Stehrer (2003), who find that the wage bill of manual workers increased in comparison to non-manual workers, because we measure education directly and assume that education is advantageous even for manual workers when a new technology is introduced.

centrally planned economies, turned out to be inappropriate for the market system introduced after the abolishment of communism. Consequently, we use the investment-labor ratio, with investment measured as gross fixed capital formation and labor measured as the working population, as a rough proxy for the unobservable capital-labor ratio⁵. Although we have no unambiguous prior expectation of the sign of this variable, the sign of the estimated coefficient provides some information about whether FDI in CEECs is horizontal or vertical.

The 1996 UNCTAD report on FDI incentives concludes that, even if the traditional determinants are still important in the location decision, firms also look for places to invest that offer specific financial and fiscal advantages, e.g., the existence of favorable investment and tax regimes. In particular, Breuss *et al.* (2001) argue that structural subsidies play an important role in the location decision. However, the lack of information on incentives given to MNEs does not allow us to control for discriminatory policies towards FDI by CEEC governments. However, non-discriminatory practices, e.g., low corporate tax rates, should encourage FDI as Bénassy-Quéré *et al.* (2000) assert. We consider the impact of nominal corporate tax rates, corrected for the fiscal regime, and expect this variable to have a negative impact on FDI inflows into CEECs.

Other variables may have important impacts on FDI in transition economies. Intangible assets, such as the business culture, may affect the location decision of MNEs.

⁴ Data before 1990 are calculated according to the material product system (MPS), which is different from the system of national accounts (SNA) used thereafter. Constructing capital stock data from investment data since 1990 only is clearly inadequate because no initial capital stock is available.

⁵ In the steady-state, a close correspondence between investment and capital is predicted by standard growth theories. However, in transition periods, this correspondence may be weaker.

The method and the level of privatization may reflect this effect because they are closely related to the effectiveness of corporate governance. Holland and Pain (1998) and Bevan and Estrin (2000) suggest taking the private sector share of GDP as a proxy for the level of privatization. We use this variable and expect it to influence FDI positively. However, we go beyond the methodology of Holland and Pain, who measure the method of privatization by a general index taking values from 1 to 5 to indicate the different methods ordered from most impeding to most attractive for FDI. The most impeding method involves using vouchers or management and employees buy-outs (MEBO) while the most attractive policy uses sales to outside owners (SOO) only. The other methods use a combination of these techniques as primary and secondary tools with the order indicating proximity to one of the extremes. Since this index is an ordinal variable, we use five dummy variables to capture the impact of each method of privatization on FDI. Moreover, since the quality of the business environment and the overall political climate is likely to influence FDI, we introduce a country risk variable. For this index, higher values indicate less risk associated with a specific country. Therefore, we expect the country-risk variable to have a positive impact on FDI inflows.

Our explanatory variables fall into two categories, namely traditional and transitional. Contained in the first group are the market potential of the host country j at time t , denoted MK_{jt} , tariffs as a proxy for trade costs, denoted $TARIFF_{jt}$, relative unit labor costs between the host country j and the home country i , denoted $RULC_{ijt}$, the fraction of skilled labor to total labor, denoted $SKILL_{jt}$, the relative labor-capital endowment

between host and home country, denoted RLK_{ijt} , and the corporate tax rate, denoted TAX_{ijt} , which also controls for the different fiscal regimes in the home country. The second group consists of the private market share of host country j , denoted $PRIV_{jt}$, a political risk index, denoted $RISK_{jt}$, and a measure of the method of privatization. For the last variable, we use the index proposed by Holland and Pain (1998), denoted $METH_{jt}$, but split it into five dummy variables, denoted M_{jt}^1 to M_{jt}^5 .⁶ The panel comprises ten OECD reporting countries, namely, Austria, Belgium (including Luxembourg), Denmark, France, Italy, Germany, Portugal, Spain, U.K. and U.S., and seven CEEC destination countries, namely, Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovak Republic and Slovenia. We consider the period from 1993 to 1999 because yearly data are available. The predicted signs of the independent variables are given in Table 4.1

— Insert Table 4.1 about here. —

4.3 Econometric Methodology

The data give rise to a specific panel model with two cross-section dimensions (reporting countries i , $i = 1, \dots, N_i$, and host countries j , $j = 1, \dots, N_j$) and one time

⁶ Since the influence of the dummy variables should be increasing from M_{jt}^1 to M_{jt}^5 , their signs depend on the dummy that we drop to avoid perfect collinearity. For example, if M_{jt}^3 is dropped, M_{jt}^1 and M_{jt}^2 should be negative and M_{jt}^4 and M_{jt}^5 should be positive.

dimension t , $t = 1, \dots, T$:

$$y_{ijt} = x'_{ijt}\beta + \varepsilon_{ijt}, \quad (4.1)$$

$$\varepsilon_{ijt} = \mu_{ij} + \nu_{ijt}, \quad (4.2)$$

where y_{ijt} is the net annual outward bilateral FDI of the reporting country i into host country j at time t and x_{ijt} denotes a $1 \times k$ vector of exogenous variables which vary in the cross-section (either with the reporting country i , the partner country j , or with both) and in the time dimension t . Depending on the model we estimate, x_{ijt} can comprise the following variables described in the preceding section: MK_{ijt} , $TARIFF_{jt}$, $RULC_{ijt}$, $SKILL_{jt}$, RLK_{ijt} , TAX_{ijt} , $PRIV_{jt}$, $RISK_{jt}$, $METH_{jt}$ and M_{jt}^k , $k = 1, \dots, 5$.

The semi-log model takes into account the fact that FDI can take negative values meaning a disinvestment. This model is chosen and only the exogenous variables are given in logs except for $TARIFF_{jt}$, $RULC_{ijt}$, $PRIV_{jt}$, TAX_{ijt} , which are expressed in percent, the privatization index $METH_{jt}$ and the dummy variables M_{jt}^k .

The typical error component structure is given in (4.2) where μ_{ij} models the time-invariant country-pair-specific effects⁷ and ν_{ijt} is a stochastic error term which is assumed to be uncorrelated over all i , j and t . Due to the heterogeneity of the country pair specific effects, the F -test rejects the ordinary least squares estimation (test statistic 89.82, p -value 0.000). Turning to the choice between fixed and random effects μ_{ij} , the fixed

⁷ It is also possible to decompose μ_{ij} into a home country specific effect μ_i and a host country specific effect μ_j with $\mu_{ij} = \mu_i + \mu_j$. By putting more structure on the model, this decomposition considerably reduces the number of (fixed-effects) parameters from $N_i N_j = 70$ to $N_i + N_j = 17$. However, this cannot of course solve the autocorrelation problem reported below. In a dynamic setting the country pair specific effects are simply wiped out by first differentiating the model, regardless of the specific (time-invariant) structure. We therefore stick with the traditional one-way error component structure (4.2).

effects model is preferred because it controls for structural determinants other than the ones associated with the explanatory variables. In addition, the Hausman χ^2 -statistic rejects the random effects model (test statistic 14.36, p -value 0.045).

The residuals of the static FDI model exhibit a considerable degree of autocorrelation indicating the presence of a sluggish adjustment process. The LM test for autocorrelation described by Baltagi (2001, p. 95) clearly rejects the null of no autocorrelation (test statistic 23.67, p -value 0.000). We therefore proceed by specifying a dynamic FDI model. For this purpose, we use one lagged endogenous variable as an additional regressor in the economic model:

$$y_{ijt} = y_{ijt-1}\alpha + x'_{ijt}\beta + \mu_{ij} + \nu_{ijt}, \quad |\alpha| < 1. \quad (4.3)$$

The parameter α reflects the persistence in the process of adjustment towards an equilibrium. Note that β now measures the short-run effect of x_{ijt} on y_{ijt} given $y_{ij,t-1}$. The long-run effect is then given as $\beta/(1 - \alpha)$.

It is well-known from the work of Nickell (1981) that the least squares dummy variables (LSDV) estimator of the dynamic panel data model (4.3) is inconsistent because the within transformation of the data which is used to get rid of the individual effects μ_{ij} leads to a correlation between the lagged endogenous variable and the disturbance term. The resulting "Nickell bias" may be severe, in particular for small time dimension T . Therefore, Arellano and Bond (1991) propose to apply a general method of moments (GMM) estimator to (4.3) in first differences,

$$\Delta y_{ijt} = \alpha \Delta y_{ijt-1} + \Delta x'_{ijt}\beta + \Delta \nu_{ijt}, \quad (4.4)$$

so that the individual specific effects are wiped out. They employ all possible lags of the variables y_{ijt-1} and x_{ijt} to generate orthogonality restrictions and use a nonparametric estimator of the covariance matrix as proposed by Hansen (1982). For predetermined variables x_{ijt} , this results in the moment conditions $E[x_{ijt-1}\Delta\nu_{ijs}] = 0$ for $t \leq s$ and $E[y_{ijt-2}\Delta\nu_{ijs}] = 0$ for $t \leq s$.

While this estimator has been widely used in the literature, various authors have proposed additional moment conditions to further improve its efficiency (Arellano and Bover, 1995; Ahn and Schmidt, 1995). In particular, Blundell and Bond (1998) show both asymptotically and in Monte Carlo simulations that using lagged differenced variables as instruments for the equation (4.3) in levels offers dramatic efficiency gains, in particular for small T . We implement their system GMM estimator by exploiting the additional conditions $E[\Delta y_{ijt-1}\varepsilon_{ijt}] = 0$ and $E[\Delta x_{ijt-1}\varepsilon_{ijt}] = 0$.

With respect to the explanatory variables x_{ijt} , there are more moment restrictions available than country pairs $N = N_i N_j$. Since estimation in panel data models normally means averaging only over the cross section dimension, this implies linear dependencies within the moment restrictions and, thus, non-invertibility of the associated moment matrices. Arellano and Bond (1991,p. 290) suggest to average the moment conditions of the explanatory variables over N and T . Given a time dimension of $T = 7$, the

instrument matrix is given as:

$$W_{ij}^d = \begin{bmatrix} y_{ij1} & 0 & 0 & \cdots & 0 & \cdots & 0 & x'_{ij2} \\ 0 & y_{ij1} & y_{ij2} & \cdots & 0 & \cdots & 0 & x'_{ij3} \\ \vdots & \vdots & \vdots & \cdots & \vdots & \cdots & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & y_{ij1} & \cdots & y_{ij5} & x'_{ij6} \end{bmatrix} \quad (4.5)$$

for the equation in differences and the instrument matrix

$$W_{ij}^l = \begin{bmatrix} \Delta y_{ij2} & 0 & \cdots & 0 & \Delta x'_{ij2} \\ 0 & \Delta y_{ij3} & \cdots & 0 & \Delta x'_{ij3} \\ \vdots & \vdots & \cdots & \vdots & \vdots \\ 0 & 0 & \cdots & \Delta y_{ij6} & \Delta x'_{ij6} \end{bmatrix} \quad (4.6)$$

for the equation in levels. Stacking the equations yields the system instrument matrix

$$W_{ij}^s = \begin{bmatrix} W_{ij}^d & 0 \\ 0 & W_{ij}^l \end{bmatrix}. \quad (4.7)$$

The calculation of the two-step GMM estimator proceeds as outlined in Blundell and Bond (1998).

4.4 Estimation Results

To examine the impact of adding more explanatory variables and also to assess the robustness of our model, we use five empirical specifications in Table 4.2 to estimate short-term effects and in Table 4.2 to estimate long-term effects. The baseline specifications, namely (S1) and (S2), are designed to include the effects of the traditional determinants

for FDI inflows but exclude the determinants specific to the CEE host countries. The only difference between (S1) and (S2) is that we use the skill ratio as the endowment variable in the first specification and replace it with the investment-labor ratio in the second.

Specifications (S3) and (S4) introduce transition-specific determinants. These specifications control for the private market share and the privatization method. While specification (S3) uses the privatization index $METH_{jt}$ which takes values between 1 and 5, specification (S4) uses the four dummy variables M_{jt}^1 (vouchers), M_{jt}^2 (MEBO), M_{jt}^4 (SOO and MEBO) and M_{jt}^5 (SOO)⁸. The country risk variable is added in the last specification (S5). This specific risk is obviously also closely related to the transition path each country pursues.

As a first step to assess the validity of the five specifications we compute for each of them the Sargan test for overidentifying restrictions and the Arellano and Bond (1991) m_2 test for autocorrelation.⁹ Except for specification (S4), the overidentifying restrictions cannot be rejected at the 5% level. However, since Arellano and Bond (1991) notice a strong tendency of the Sargan test to overrejection, the p -value of 0.043 in model (S4) is not very troublesome. The m_2 test for absence of second order autocorrelation of the differenced disturbances is particularly important because the consistency of the GMM estimator hinges on this property. For each of the five specifications the null of

⁸ Note that we leave out M_{jt}^3 (MBEO and SOO) to avoid perfect collinearity.

⁹ In fact, we employ a variant of the m_2 test adjusted for the extended number of moment conditions we use.

no autocorrelation at any conventional significance level cannot be rejected. The GMM method is therefore appropriate for the model and the data at hand.

— Insert Table 4.2 about here. —

— Insert Table 4.3 about here. —

In all specifications, the significant and positive short-term impact of the lagged FDI indicates that the adjustment process plays a significant, but small role. The maximum estimate of $\hat{\alpha} = 0.348$ in specification (S2) can be interpreted as follows: a permanent change in an exogenous variable has $(1 - \alpha) \times 100\% = 65.2\%$ of its long-run impact in the first period, $(1 + \alpha)(1 - \alpha) \times 100\% = 87.9\%$ after two periods, $(1 + \alpha + \alpha^2)(1 - \alpha) \times 100\% = 95.8\%$ after three periods and so on. As a single measure of persistence the mean lag measure as in Hendry (1995), takes the value $\hat{\alpha}/(1 - \hat{\alpha}) = 0.534$ years. The low coefficient of the lagged FDI variable reflects a fast adjustment towards a new equilibrium.

With respect to the exogenous variables the first thing to note is that the signs of their estimated parameters are all in accordance with our theoretical expectations presented in Table 4.1. Remember that only the exogenous variables are in logs so that the parameters have to be interpreted as semi-elasticities. Market potential has a substantial positive effect on FDI. If it increases by 1%, the average FDI flows from one home to one host country rise by about 1.66 million dollars in the first year and 2.46 million dollars in the long run.

The reduction of tariffs by one percentage point has also a positive impact on FDI. The size of this impact depends on the size of the host country and ranges between 20

million dollars for Poland and 17 million dollars for Slovenia in the first year and 30 million dollars for Poland and 25 million dollars for Slovenia in the long run. The fact that FDI inflows rise with decreasing tariffs indicates a complementarity relationship between trade and FDI but is also a feature of vertical multinational activities.

According to the new trade theory, vertical multinationals reduce the overall costs of production by locating their labor-intensive activities in countries with relatively low unit labor costs. This is also the case in our sample, where a decrease of the relative unit labor costs of host country to reporting country by 1% increases the flows of FDI into this country by roughly 25 million dollars in the first year and 37 million dollars in the long run. The education of the labor force in the host country as measured by our skill ratio has a strong positive impact on FDI inflows. Obviously, a skilled labor force plays a crucial role for the adaptation to the western business culture but also for innovations and for the size and composition of demand as noted by Egger (2001). Not surprisingly, multinationals investing in CEECs are not only motivated by relatively cheap labor but also discriminate between more or less skilled labor in host countries.

Relatively high corporate tax rates exert pressure on profits and have an adverse effect on FDI flows to Central and Eastern Europe. However, the estimated parameter value is small and not significant at the 5% level. A decrease of the nominal corporate tax rate in the host countries by 1 percentage point increases bilateral FDI flows by less than 2 million dollars in the first year. This small impact may be due to the fact that we do not take into account the special tax regimes designed to attract FDI.

The second specification (S2) replaces the skill variable with a relative endowment variable. This has a particularly strong effect on the coefficients of market potential and relative unit labor costs, both of which remain highly significant. The construction of these variables may have led to some weak collinearity between them. However, it does not affect the main results which confirm Markusen and Venables (1996). Our empirical evidence shows that FDI increases as countries become more and more different in their relative endowments. This also means that the FDI flows are rising with the specialization. As mentioned above, the sign of the relative endowment variable is not so clear-cut and obviously depends on its definition. The positive impact indicates activities of vertical multinationals but this result cannot be clearly confirmed due to the aggregated nature of the data. Moreover, the use of the investment-labor ratio as a proxy for the capital-labor ratio is clearly not optimal and may induce a significant error. We therefore refrain from using the investment-labor ratio in the following specifications.

In the specifications (S3) to (S5), we introduce two transition specific variables: the market share of private businesses and the method of privatization. As argued above, not only the level but also the method of privatization are expected to affect the flows of FDI. The estimation results confirm this view. In specification (S3) both the market share of private businesses and the privatization index are highly significant and positive. Moreover, the introduction of these variables does not change the sign of the baseline variables but considerably lowers their (absolute) impacts in comparison to specification (S1) with the skill ratio being the only notable exception. We interpret this as indication

for the importance of the transition specific variables. The relevance of other determinants notwithstanding, the decision to invest in CEECs relies heavily on the level and method of privatization. This is in accordance with the stylized fact that, despite their large markets and their low relative costs, Bulgaria and Romania were always performing badly in terms of FDI before 1996. It is only recently with the introduction of new privatization laws, which enable sales to outside owners, that they succeed in attracting FDI.

The estimated coefficient on $PRIV_{jt}$ means that a rise of the market share of private businesses by one percentage point leads on average to additional 240 million dollars bilateral FDI into this country in the short run (296 million in the long run). At the same time, the method of privatization as defined by Holland and Pain (1998) is also particularly important. The estimated coefficient of roughly 71 can only be interpreted with caution because the privatization index used in specification (S3) is constructed as a metric variable although it is really only an ordinal measure. It implies that changing the privatization scheme from, say, vouchers ($METH_{jt} = 1$) to managers and employees buys-out (MEBO, $METH_{jt} = 2$) has the same short-run impact of an additional 71 million dollars bilateral FDI inflows as a change from the combination of sales to outside owners (SOO) and MEBO ($METH_{jt} = 4$) to SOO only ($METH_{jt} = 5$). This equidistance assumption may be very unrealistic.

In specification (S4), the method of privatization variable is replaced by five dummies, M_{jt}^1 to M_{jt}^5 . To avoid perfect collinearity, we arbitrarily omit M_{jt}^3 . As a consequence,

the impacts of the other dummy variables have to be interpreted as departures from privatization method 3 (MEBO and SOO). For instance, using method 1 (vouchers) leads to roughly 76 million dollars less bilateral FDI inflows than using method 3. Using the four estimated coefficients, we can thus derive that a change from vouchers to MEBO has a short-run effect of additional $-32 + 76 = 44$ million dollars bilateral FDI inflows while a change from SOO and MEBO to SOO leads to an FDI increase of $375 - 109 = 266$ million dollars in the first year. This result shows that the equidistance assumption is clearly untenable and recommend using the dummy variables instead of the privatization index $METH_{jt}$.

However, this has an adverse effect on the relevance of the private market share as an explanatory variable. The estimated coefficient is much smaller than in specification (S3) and insignificant. On the one hand, this can be explained by the fact that the method and level of privatization are correlated which leads to collinearity between the dummy variables and the private market share. On the other hand, the Sargan test is significant at the 5% level which might indicate a misspecification although, as argued above, this test tends to overreject the null hypothesis.

The variable $RISK_{jt}$, which controls for the overall risk of host countries is introduced in specification (S5). This variable, which takes values between 10 (no risk of non-payment of foreign debt) and 0 (no chance of payment), should be highly relevant for firms making investment decisions. Moreover, it should be expected that this variable is somewhat correlated with the level of privatization because the countries with the

fastest privatization are also the less risky ones in our panel. In order to separate both effects, it may be necessary to include both variables at the same time. The estimation results confirm this view. The coefficient of private market share is virtually the same as in specification (S3) and significant at the 5% level. The parameters of the dummy variables have the same overall magnitude as in specification (S4). The fact that they shrink somewhat towards zero indicates that the impact of the method of privatization is slightly overestimated in specification (S4).

As expected, the coefficient of the $RISK_{jt}$ variable is highly significant and positive. The higher the country risk index, i.e. the less risky the investment, the more attractive is a country for FDI. Note however, that the introduction of the country risk variable lowers considerably the coefficient and the significance level of the trade cost variable. Since country risk is defined as the risk of non-payment or non-servicing payments for goods or services, loans, trade-related finance and dividends and the non-repatriation of capital, it is also a type of trade cost, which shares some common information with the $TARIFF_{jt}$ variable. Finally, the large coefficient of the skill ratio again indicates the importance of a highly educated workforce in addition to relative unit labor costs.

4.5 Summary

In a dynamic panel model, we identified the factors that encourage and impede FDI flows from OECD countries to seven transition countries in Central and Eastern Europe.

Both traditional variables suggested by theory and transition-specific variables have significant and plausible effects on FDI. Among the traditional variables, we find a robust and positive impact of market potential on FDI. However, market access explains only partly foreign direct investment in CEECs. Comparative advantages, e.g., low relative unit labor costs, corporate tax rates and relative endowments, also exert a significant influence. Moreover, a skilled labor force helps attracting foreign investors, presumably because it is crucial to the implementation of innovative production technologies and to the adaptation to a Western business culture. From the negative impact of trade costs on FDI, we conclude that FDI and trade are complementary. However, traditional variables are not sufficient to explain FDI in the CEECs. We find that both the level of privatization, measured by private market share, and the actual method of privatization, as a proxy for the quality of corporate governance, have considerable positive impacts on the decision to invest in CEECs. Moreover, we find a significant effect for country risk indicating that uncertainty linked to the legal, political, and economic environment is an important deterrent to FDI.

These empirical results suggest that transition economies can be divided into two broad groups. The Central European economies have been the most successful in attracting FDI because of their relatively high market potential and their sound legal and economic environment, even though they have relatively high unit labor costs. The two Southern and Eastern European countries certainly benefit from low unit labor costs; however, their slow transition process combined with a risky economic environment was

a major obstacle for foreign investors. These countries were unsuccessful in attracting FDI during the first half of the nineties. They began to attract investors only after they changed to foreign-oriented privatization policies in the late nineties.

Three interesting extensions come to mind. First, our finding of a complementary relationship between FDI and trade should be explored further. In our framework, no trade variable is included in the estimated equation. A multiple equation model that takes both trade and FDI into account simultaneously would provide a more complete treatment of this issue and determine the robustness of our result.

Second, EU enlargement should have considerable effects on FDI flows to CEECs, because the market potential of the entrants will increase considerably due both to the likely increase in their GDP and to the reduction in the economically relevant distance to the EU, i.e., transportation costs. Decreasing trade costs should also be reflected in a reduction of CEECs tariffs. However, the process of integration should reduce the unit labor cost differences between the CEECs and the present member countries of the EU, which would reduce FDI in the CEECs. As a result, the catching-up process will have a tendency to increase investments of the horizontal type and depress investments of the vertical type. However, firm-level database on multinational activities does not allow us to distinguish between vertical and horizontal multinationals. Specifying an empirical model that uses multinational firm-level data could shed some light on the nature of multinational firms' activities in Eastern Europe. This is one of the issue explored in the next chapter.

Table 4.1 Expected signs of explanatory variables

Variables Name	Expected Sign	Transformation
Market potential	+	Logarithm
Trade costs	-/+	Percentage: [0, 100]
Relative unit labor costs	-	Index ranges: [0, 1]
Skill ratio	+	Index ranges: [0, 1]
Relative labor-capital endowment	+/-	Logarithm
Corporate tax rate	-	Percentage: [0,100]
Private market share	+	Percentage: [0, 100]
Method of privatization	+	Dummy Variable
Country risk index	+	Index range: [0, 10]

Table 4.2 The results of the dynamic panel model: short-term parameters

Independent variables	(S1)	(S2)	(S3)	(S4)	(S5)
Lagged FDI	0.326*** (0.000)	0.348*** (0.000)	0.189*** (0.000)	0.237*** (0.001)	0.198*** (0.009)
Market Potential	166.192*** (0.000)	92.186*** (0.000)	60.568** (0.024)	185.106*** (0.000)	101.830** (0.022)
Trade Costs	-1.767*** (0.000)	-2.019*** (0.000)	-0.310** (0.049)	-0.818** (0.015)	-0.487* (0.087)
Relative Unit Labor Costs	-24.815*** (0.000)	-14.568*** (0.000)	-18.620*** (0.001)	-25.295*** (0.000)	-21.672** (0.012)
Skill Ratio	121.741** (0.010)		205.636*** (0.001)	249.759*** (0.001)	347.293*** (0.000)
Corporate Tax Rate	-1.667* (0.079)	-5.332*** (0.003)	-1.870** (0.032)	-3.845* (0.055)	-5.821*** (0.009)
Relative Endowments		19.290* (0.055)			
Private Market Share			240.089*** (0.002)	69.838 (0.313)	252.824** (0.038)
Methods of Privatization			71.329*** (0.000)		
Vouchers				-76.394** (0.045)	-66.732* (0.081)
MEBO				-32.428*** (0.007)	-56.212*** (0.000)
SOO and MEBO				109.301*** (0.000)	82.86*** (0.000)
SOO				375.255*** (0.000)	354.310*** (0.001)
Country Risk					13.070*** (0.000)
Number of Observations	420	420	420	420	420
Sargan Test	23.761 (-0.475)	20.962 (-0.641)	30.893 (-0.232)	43.233** (-0.043)	42.232* (-0.068)
Second Order Autocorrelation	0.261 (-0.797)	0.222 (-0.824)	0.309 (-0.758)	-0.275 (-0.784)	-0.349 (-0.727)
Long Run Multiplier	1.483	1.534	1.234	1.311	1.241
p-values in parentheses, * significant at 10%, ** significant at 5%, *** significant at 1%					

Table 4.3 The results of the dynamic panel model: long-term parameters

Independent variables	(S1)	(S2)	(S3)	(S4)	(S5)
Market Potential	246.537*** (0.000)	141.373*** (0.000)	74.719** (0.017)	242.590*** (0.000)	126.980** (0.011)
Trade Costs	-2.621*** (0.000)	-3.097*** (0.000)	-0.382** (0.049)	-1.073** (0.014)	-0.608* (0.091)
Relative Unit Labor Costs	-36.812*** (0.000)	-22.341*** (0.000)	-22.971*** (0.002)	-33.150*** (0.000)	-27.024** (0.017)
Skill Ratio	180.596*** (0.005)		253.679*** (0.000)	327.322*** (0.000)	433.065*** (0.000)
Corporate Tax Rate	-2.473* (0.091)	-8.177*** (0.005)	-2.307** (0.036)	-5.039* (0.057)	-7.259*** (0.009)
Relative Endowments		29.583* (0.055)			
Private Market Share			296.181*** (0.004)	91.527 (0.316)	315.265** (0.045)
Methods of Privatization			87.994*** (0.000)		
Vouchers				-100.119** (0.044)	-83.214* (0.084)
MEBO				-42.499*** (0.006)	-70.095*** (0.000)
SOO and MEBO				143.245*** (0.000)	103.324*** (0.000)
SOO				491.791*** (0.001)	441.816*** (0.002)
Country Risk					16.298*** (0.000)
p-values in parentheses, * significant at 10%, ** significant at 5%, *** significant at 1%					

Chapter 5

Firm Heterogeneity and the Pattern of German Production in Eastern European Countries

‡An early version of this chapter using a different level of aggregation and a different econometric methodology has been published as: Farid Toubal (2004). La localisation des firmes multinationales allemandes dans les pays de l'Est. *Économie et Prévision*, forthcoming.

5.1 Introduction

This chapter uses the International Capital Links database to analyse, at the firm level, the nature of German multinational firms in Eastern Europe. The dataset provides detailed information on foreign affiliates' sales. This is one of the striking differences with the preceding chapter since the firm-level evidence allows studying the foreign sales of an individual multinational firm in a given host country, rather than aggregated FDI. Since the literature presented in Chapter 2 gives predictions on real activity by multinational firms rather than financial flows or stock, this links the empirical specification more closely with the theory.

One major difficulty that arises when testing theories of FDI is that the database does not provide enough information to distinguish between horizontal and vertical multinational firms. This is a problem since the same factors may have an opposite impact on FDI. For instance, the theory predicts that vertical FDI decreases with trade costs and should be negatively influenced by the degree of similarity in relative factor endowments. Horizontal multinationals, however, arise when trade costs are high and when countries are relatively similar in factor endowments. In order to get around this problem, Carr *et al.* (2001), Bloningen *et al.* (2003), propose to test the prediction of the theories by referring to the different values and signs of the exogenous variables' coefficient. This is also the strategy adopted in this chapter. Moreover, I follow Helpman *et al.* (2004) and take into account multinationals' heterogeneity. In order to do so, I include a full set of firm-specific fixed effects as well as control variables at the firm level. This also makes the empirical specification more realistic.

The stylized facts presented in Chapter 3 show that the opening up of Central and Eastern Europe has created new investment opportunities for German firms. Even if, the German FDI position in the region has risen dramatically during the last decade, it remains concentrated in a few countries. The preceding chapter shows that transition specific variables influence considerably the location of OECD foreign direct investment flows to Eastern European countries. In this chapter, I analyze the influence of these transition specific factors on the spatial distribution of German multinationals in Eastern Europe.

The following section presents the empirical specification pointing out the difference between the variable used in this chapter and in the preceding chapter. Section 5.3 lays out the estimation strategy while section 5.4 presents the empirical results. Section 5.5 summarizes the main findings of this chapter.

5.2 Specification of the Reduced Form

In order to compute the dependent variable, I add up the real sales¹ of all foreign affiliates that a German multinational firm maintains in a certain sector of each country. Depending on the specification, the set of explanatory variables comprises variables that capture, the market size and potential of the host country, the relative factor endowments, trade costs, and some macroeconomic determinants that are linked to the stability and transition process of Eastern European countries.

Increased market size increases total multinational foreign sales and market size is more important for local production than for production for export. However, according to Eckholm (1998), even if the decision to set up an affiliate is positively related to the market size, once affiliate's production has been established, local sales or exports are determined by geographical distances or more generally trade and/or transport costs. The market potential of the host country should influence positively multinational sales. As in the last chapter, the market potential is defined as the distance weighted economic activity².

¹ The real foreign sales of a German company are the foreign sales deflated by the consumer price index

From a theoretical point of view, trade costs have an ambiguous impact on multinational activities. When trade costs are high, horizontal multinational firms arise because the costs of exporting are too high. Trade costs impede vertical multinational firms. Trade costs are difficult to find at sectoral level. Since 1995, the Heritage foundation has been publishing an index of economic freedom which can be broken into several sub-indices. One of these sub-indices captures the degree of *foreign entry restriction*. Contrary to chapter 4, I use this sub-index in the following, to be as close as possible to Carr *et al.* (2001) specification of the knowledge capital model. In fact, this index is not only based on a country's average tariff rate³ but entails also information on non-tariffs barriers and corruption in the customs service. The index runs from 1 to 5 and the higher the tariff rate, worse (or higher) the index. Hence, I expect trade costs to have a positive or negative impact on the volume of German affiliate sales abroad.

A number of empirical studies based on general equilibrium models of multinational have included a measure of relative factor endowments as determinant of multinational activities (Brainard, 1993; Carr et al. 2001; Egger and Pfaffermayr, 2002). The variable used in the following is different from the education level used in chapter 4. Here, endowments are proxied by the percentage of workforce with tertiary education. In this chapter, the relative endowment variable is the ratio of Germany's workforce with tertiary education over the host country's workforce with tertiary education. The variable is given

² As in the preceding chapter, the market potential has been computed using a database kindly provided by Johannes Bröcker. It is the output of all countries in the world divided by a distance measure which is derived on a region-to-region basis using internal transportation costs

³ Weighted by import from the country's trading partners.

in percentage. In the empirical literature, the impact of *relative* factor endowments on multinational activities is mixed. Brainard (1993) finds that the total volume of US affiliate sales is explained by similarities rather than differences in relative factor endowments. Carr et al. (2001) find that the larger US affiliates are, the larger are the relative endowment differences.

Helpman *et al.* (2003) have explicitly considered the fact that firms are typically quite heterogeneous along important dimensions, in particular as regards their productivity. Essentially, MNEs in the model by Helpman *et al.* (2003) are horizontally integrated firms, but the decision of firms to become multinationals depends on their productivity. To control firm heterogeneity, I include a full set of firm-specific fixed effects as well as control variables at the firm level. At the level of the German reporting firm, I compute a measure for the degree of internationalization, i.e. I calculate the number of countries worldwide in which the firm is active. I expect larger (more international) parents to have larger foreign sales on average and thus a positive coefficient.

The last set of variables controls for several macroeconomic policy and transition specific determinants. On the macroeconomic side, it has long been argued that the exchange rate regime may influence multinationals' location choices. The impact of the exchange rate regime on FDI is ambiguous. Numerous studies provide evidence that exchange rate uncertainty may function as a trade barrier, implying that it should increase FDI (Goldberg and Kolstad, 1995; Cushman, 1985, 1988; Zhang, 2001). According to Sung and Lapan (2000) exchange rate volatility increases the option value of FDI, and change

the magnitude of investment in each production plant abroad. Under this "production flexibility" approach, the exchange rate volatility increases the value of having a plant in both countries. It enables multinational firms to decide at any time whether to export from home or to produce in their foreign plant. On the other hand, exchange rate variations should deter FDI by introducing uncertainty into both the production costs and future revenues of foreign plants (Chakrabati and Scholnick, 2002). Apart from "ideal type" exchange rate regimes (fixed rate and free float) there is a wide range of intermediate regimes, e.g. crawling peg and horizontal bands are among them. Therefore, the analysis includes three types of regimes: free-float, fixed and intermediate exchange rate regimes.

The level of privatization acts as a signal of the commitment to private ownership. The privatization programs were thus an important factor in stimulating inward FDI (Holland and Pain, 1998; Lansbury *et al.*, 1996). A means to capture the speed of privatization is through the private sector share of GDP, which is given as percentage of GDP. At the firm level, the impact of the private share of GDP is ambiguous because at the end of the nineties, a large number of efficient firms were already sold. The private share of GDP alone may not be a good signal on the openness of a host country to FDI, because firms may have been sold to local resident through managers or employees buys-out (MEBO) and/or through mass-privatization. These approaches offer few opportunities for the purchase of assets by foreign firms. The methodology of Holland and Pain uses

a general index taking values from 1 to 5 to indicate the different methods of privatization ordered from the most impeding to the most attractive to FDI. The most impeding method involves using vouchers or management and employees' buy-outs (MEBO) while the most attractive policy uses sales to outside owners (SOO) only. The other methods use a combination of these techniques as primary and secondary tools with the order indicating proximity to one of the extremes. After 1996, no country has used the vouchers or management and employees buy-outs (MEBO), as sole method of privatization. The index takes thus only four values. Since it is an ordinal variable, it may be more appropriate to split it into 4 dummy variables, which capture the impact on FDI of each method of privatization. However, since Estonia and Hungary are the only country to report sales to outside owners as sole primary method, we decided to group the method of privatization into three groups, *Direct*, which is most open to multinational firms, *Voucher* or mass privatization, and *Insider*, which is less open to multinational firms. The methodology is presented in detail in Appendix C.

The overall political climate is also likely to influence foreign production. This effect is captured through a country risk variable. This index is defined as the risk of non-payment or non-servicing payments for goods or services, loans, trade-related finance and dividends and the non-repatriation of capital. This variable takes values between 10 (no risk of non-payment of foreign debt) and 0 (no chance of payment). It takes higher values when the risk associated with a specific country is low and is, therefore, expected to have a positive impact on multinational activity. The political climate alone does not

account for the quality of the business environment. Multinational foreign production activities are likely to be positively influenced by a stable, transparent, predictable and non-discriminatory business climate. I use two sets of measurement in order to test the influence of the business environment quality on German multinational location. I control first for the commercial legal framework, which has been often omitted in the literature (Smarzynska, 2004). This variable is taken from the EBRD and assesses the extent to which legal rules affecting FDI are clear and accessible as well as implemented and enforced. Since the legal variable is an ordinal variable, I introduce a set of four dummy variables ordered from the legal framework, which is the most limited in scope, *LEGAL1_{jt}*, to the legal framework that is the most developed, *LEGAL4_{jt}*. These data are only available after 1997. Bulgaria, Romania and the Slovak Republic have the lowest score in 1997 while Hungary, Poland and Slovenia have the most developed framework in 1999.

The second set of variables is a measure of political freedom that capture the effect of corruption on multinational activity (Smarzynska and Wei, 2000). Since this index is also an ordinal variable, I use four dummy variables which rank from an environment that is most conducive to political freedom, *FREE1_{jt}*, to an environment that is less conducive to political freedom, *FREE4_{jt}*. Bulgaria and Romania are the only Eastern European countries that never reach the highest score while with respect the political environment Hungary and the Czech Republic are the best performing countries.

To summarize, the empirical model uses the following variables with potential influence on multinational foreign sales in Eastern European countries: market size is measured by the market potential, MK_{jt} , of the host country j at time t ; $TARIFF_{jt}$, as a proxy for trade costs; $RSKILL_{jt}$ as proxy for differences in skilled labour between Germany and Eastern European countries. The variables $FIXED_{jt}$, $INTER_{jt}$ and $FLOAT_{jt}$ are the proxies for the different exchange rate regimes. The private market share, $PRIV_{jt}$, and the method of privatization, *Direct*, *Voucher* and *Insider* control for the corporate governance and openness to FDI. The country risk index, $RISK_{jt}$, the commercial legal framework, $LEGAL1_{jt}^1$ to $LEGAL4_{jt}$, and the political freedom dummy variables, $FREE1_{jt}$ to $FREE4_{jt}$ are proxy for the country risk and the quality of the business environment.

The panel comprises 2406 German companies investing in 23 NACE rev1 sectors, of ten CEECs destination countries, namely, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia. I consider the period from 1996 to 1999 because it is not possible to trace a particular firm over time before 1996. The firm codes after 1996 differ from earlier periods. The predicted signs of the independent variables are given in Table 5.1.

— Insert Table 5.1 about here. —

More details on the construction of the variables and the data sources are given in Appendices C and D.

5.3 Econometric Methodology

I estimate the model using panel data estimation techniques to make use of all information in cross-sections and time-series. The panel has three cross-section dimensions, a parent company i , $i = 1, \dots, 2406$, a sectoral dimension s , $s = 1, \dots, 23$ and a country dimension j , $j = 1, \dots, 10$, and one time dimension t , $t = 1, \dots, 4$. The model is specified as in 5.1 and 5.2:

$$y_{isjt} = x'_{ijt}\beta + \varepsilon_{isjt}, \quad (5.1)$$

$$\varepsilon_{isjt} = \mu_i + \gamma_s + \nu_{isjt}, \quad (5.2)$$

where y_{isjt} describes the multinational's i 's activity in the sector s of the host country j at time t . x_{ijt} denotes the $1 \times K$ vector of exogenous variables. The explanatory variables vary in the cross-section with the partner country and the parent firm and in the time dimension. Since an individual firm may invest in several sectors, I introduce μ_i and γ_s that capture respectively the parent-company and the sectoral specific effects. The literature on FDI in Eastern Europe has ignored so far the firm-specific effects μ_i . ν_{isjt} is a stochastic error term which is assumed to be uncorrelated over all i , j , s and t . Contrary to the preceding chapter, I do not introduce country fixed-effects in the empirical specification. The country heterogeneity is captured by the explanatory variables in order to disentangle the factors that explain the concentration of German production in some Eastern European countries.

Due to the heterogeneity of the idiosyncratic effects, the F -test rejects the ordinary least squares estimation (test statistic 7.49 , p -value 0.000)⁴. Attrition or the fact that a firm can leave the panel may seriously bias the random effect estimator. In particular, when the reason why a firm leaves the panel is correlated with the unobserved idiosyncratic error, this leads to inconsistent estimators. The fixed effect methodology avoid this bias (Wooldridge, 2002). This is confirmed by the Hausman χ^2 -statistic which rejects the random effects model (test statistic 144.38 , p -value 0.000).

While heteroscedasticity in ν_{isjt} is always a potential problem, serial correlation is likely to be more important, because it affects the standard error in fixed-effects models. The residuals of the static FDI model exhibit autocorrelation. This indicates the presence of a sluggish adjustment process. The Baltagi (2001) LM5 test for autocorrelation rejects the null of no autocorrelation (test statistic 15.28, p -value 0.000). The effect is larger the longer the time horizon. Since I have short time-series and a large cross-section, it is appropriate to use cluster-sample methods (Wooldridge, 2003). Essentially, this is a generalization of White's robust covariance matrices (Arellano, 1987; White, 1980; Wooldridge, 2002, equation (10.59) p. 275). The only difference is that instead of dealing with individual observations, we now treat each cluster or group as if it were a "single observation". This robust variance matrix estimator is valid in the presence of heteroscedasticity and serial correlation provided as in our case that T is small compared

⁴ All tests are done with the last specification (S4) of table 5.2

to the number of groups (Wooldridge, 2002, 2003). The robust standard errors are obtained as the square roots of the diagonal elements of the covariance matrix.

Before presenting the estimation results there are two specification issues that should be noticed. First, I drop the observation where zero sales are reported, in order to take the logarithm of the $Sales_{isjt}$ variable. Since less than 3% of the observation are zero sales, taking their logarithms might introduce a small bias in the estimation. The bias is larger, the larger is the number of firm that report zero sales.

Second, a large part the results rely on the interpretation of the coefficient of indexes and dummy variables. The issue is with change in the exogenous variable being infinitesimal or discrete. In the case of dummy variable, the percentage change in Y , from Y_0 to Y_1 , say, for a discrete change in the dummy variable from 0 to 1, should be calculated using the following transformation:

$$\hat{p} = 100 \times (\exp\{\hat{\beta}\} - 1), \quad (5.3)$$

where \hat{p} is the estimated percentage effect on Y of a discrete change in the dummy variable and $\hat{\beta}$ is the dummy variable coefficient, which is estimated and assumed to be positive.

According to Kennedy (1981), the use of the transformation (5.3) results in a biased estimator for p , due to the nonlinearity of the transformation (5.3). Kennedy (1981) suggests:

$$\hat{p} = 100 \times (\exp\{\hat{\beta} - 0.5\hat{V}(\hat{\beta})\} - 1), \quad (5.4)$$

for estimating \hat{p} , where $\hat{V}(\hat{\beta})$ is the estimate of the variance of $\hat{\beta}$. In the following, I use the Kennedy estimates to interpret the coefficient of the indexes and dummy variables.

5.4 Estimation Results

The estimated coefficients of the model (5.1) are presented in Table 5.2.

The endogenous variable, *Sales*, the market size and the internationalization variables, respectively MK_{jt} and $SIZE_{jt}$, are the only variables in logs. $TARIFF_{jt}$ is an index that runs from 1 to 5 and $RISK_{jt}$ ranges from 0 to 10. $Priv_{jt}$ and $RSKILL_{jt}$ are given in percentages.

The table reports four different, increasingly complex specifications (S1) to (S4). Proceeding as such allow to study the effects of taking up more and more explanatory variables and to assess the robustness of the model.

The baseline specification (S1), is designed to capture the effect of market size, trade costs, the relative endowments, and the degree of internationalization of an individual German multinational firm, on its foreign production.

The specification (S2) introduces the macroeconomic policy variables, $FIXED_{jt}$, $INTER_{jt}$ and $FLOAT_{jt}$. $FIXED_{jt}$ is left out to avoid perfect collinearity. The coefficients of $FLOAT_{jt}$ and $INTER_{jt}$ have thus to be interpreted relative to the fixed exchange rate regime.

The specification (S3) introduces the private share of GDP and the method of privatization dummy variables. The coefficient of the method of privatization variables has

to be interpreted relative to the *Insider* variable. The specification (S4) introduces the country risk and the institutional variables. It uses first four dummy variables to specify the commercial legal framework. To avoid perfect collinearity, the less attractive legal framework, *LEGAL1_{jt}*, is taken as the reference variable⁵. I also introduce the political freedom dummy variables. The less attractive political environment, *FREE4_{jt}* is taken as reference variable.

— Insert Table 5.2 about here —

With respect to the exogenous variables, the signs of their estimated parameters are all in accordance with the theoretical predictions. Generally, the explanatory variables, also the fixed-effects, explain over 75% percent of the variation of German foreign sales in Eastern European countries.

The market size has a positive and significant impact on multinational foreign real sales. The elasticity of foreign production with respect to market potential ranges from 0.37 in specification (S1) to 0.78 in specification (S4).

The trade cost variable ranges from 1, the less restrictive foreign entry, to 5, the most restrictive framework. Estonia is the sole country that reach the lowest trade cost in 1996, while Slovenia has the most impeding framework in the Eastern European country considered. A reduction of the host country trade costs by one index point increases on average multinational foreign real sales by about 23% in specification (S4) to 31% in specification (S1)⁶. The effect is large and highly significant. While no trade variable

⁵ The introduction of the legal framework dummy variables reduces by 136 the number of groups, because the data were not available for 1996.

enters the different specifications, this result suggests that trade and investment share a complementary relationship. This is also consistent with the vertical foreign direct investment model. As trade costs fall, vertical multinational firms split their production process to take advantage of the differences in factor prices. Specifically, if there is an Eastern European assembly plant that exports back to Germany, this activity generates both multinational foreign production and exports.

The difference in factor endowment is robust and highly significant in the five specifications. The variable is defined as the ratio of German workforce with tertiary education relative to the workforce with tertiary education of the host country. It is continuous and expressed as percentage. An increase of one percentage point in the variable Germany's skilled workforce relative to the host country increases on average German multinational foreign real sales by 19% in specification (S2) and (S3) to 43% in (S4)⁷. This result is consistent with the vertical multinational model. German firms have an incentive to split their headquarters and plant by locating their headquarters and plants according

⁶ This is computed using the Kennedy estimates as in equation 5.4:

$$\hat{p}_{tariff} = 100 \times (\exp\{\hat{\beta} - 0.5\hat{V}(\hat{\beta})\} - 1) = 100 \times (1 - \exp\{-0.258 - 0.5(0.009)\})$$

in specification (S4) and

$$\hat{p}_{tariff} = 100 \times (\exp\{\hat{\beta} - 0.5\hat{V}(\hat{\beta})\} - 1) = 100 \times (1 - \exp\{-0.362 - 0.5(0.006)\})$$

in specification (S1)

⁷ The Kennedy estimates are given as in equation 5.4:

$$\hat{p}_{rskill} = 100 \times (\exp\{\hat{\beta}\} - 1) = 100 \times (\exp\{0.172\} - 1)$$

in specification (S2) and

$$\hat{p}_{rskill} = 100 \times (\exp\{\hat{\beta}\} - 1) = 100 \times (\exp\{0.356\} - 1)$$

in specification (S3)

to countries' relative factor endowments. German multinationals, which set-up their headquarters in Germany, carry out their production in Eastern Europe.

German multinational firms that are active in more host countries, have also higher sales. This is reflected by a positive and significant effect of the $SIZE_{jt}$ variable. This finding also confirms earlier evidence in Buch *et al.* (2003) who use the same data for a cross-section analysis for the year 2001 but exclude firm fixed effects. The reason for the positive effect is that the degree of internationalization is largely determined by the size of the firm (Horst 1972, Morck and Yeung 1991). Larger firms, in turn, tend to be more profitable and productive, and higher productivity increases the probability to set up a foreign affiliate (Helpman *et al.* 2004).

The introduction of the macroeconomic and transition variables does not influence the qualitative results of the main variables of the baseline specification. The policy variables are introduced in specification (S2). The flexible and intermediate exchange rate regimes have a positive impact on the sales of an individual firm in Eastern Europe relative to the fixed exchange rate regimes. According to Von Hagen and Zhou (2002), Hungary and Poland are the only country still maintaining a conventional crawling band. In contrast, Bulgaria and the Baltic States operate hard pegs: currency boards in Bulgaria, Estonia and Lithuania, and a conventional peg with a zero fluctuation band in Latvia. The impact of the flexible and intermediate exchange rate on German real sales can be ranked since the coefficient of $INTER_{jt}$ and $FLOAT_{jt}$ are statistically different⁸.

⁸ F-test=22.185, p-value=0.000

Introducing a floating exchange rate regime leads 228% more sales than choosing a fixed exchange rate regime. The impact is even higher when introducing the intermediate regime⁹. Switching from the floating exchange rate regime to the intermediate exchange rate regime has a positive effect on the production of a German multinational plant. This results is consistent with the concentration of German multinationals in the most advanced country of Central Europe, which turned to have an intermediate exchange rate regimes in the late eighties.

The privatization variables are introduced in specification (S3). Contrary to the analysis of the preceding chapter that uses aggregated data on FDI flows, the private share of GDP does not influence the sales of an individual German firms in Eastern Europe. Toubal (2004) shows, using the equity capital invested in a particular affiliate as endogenous variable, that the private market share of GDP does not influence the current level of FDI but is a strong signal for future investment. In particular, the second lag of the private market share has a positive and significant impact on an individual firm stock of FDI¹⁰. However the method of privatization matters. The more open Eastern European

⁹ This is computed using the Kennedy estimates as in equation 5.4:

$$\hat{p}_{float} = 100 \times (\exp\{\hat{\beta} - 0.5\hat{V}(\hat{\beta})\} - 1) = 100 \times (\exp\{1.215 - 0.5(0.233)\} - 1)$$

and

$$\hat{p}_{inter} = 100 \times (\exp\{\hat{\beta} - 0.5\hat{V}(\hat{\beta})\} - 1) = 100 \times (\exp\{1.439 - 0.5(0.233)\} - 1)$$

¹⁰ I owe this point to Johannes Bröcker

countries are to foreign direct investment, the higher the foreign sales of German multinationals. Using direct sales as method of privatization leads an individual German firm to sale 9% more than to implement the insider method of privatization¹¹.

As expected, the coefficient of the country risk variable is highly significant and positive. The higher the country risk index, i.e. the less risky the investment, the more attractive is a country for FDI. The index ranges from 0 to 10. Bulgaria and Romania, with an index of about 3 in 1996 and 1999 are the riskiest country over the period. The Czech Republic, Slovenia, Hungary are the less risky country with an index that ranges from 5 to more than 6 over the period. A reduction of the country risk by one index point increases on average multinational foreign real sales by about 215%¹². However the introduction of the country risk and the institutional variables has an adverse effect on the relevance of the direct sales method of privatization as an explanatory variable. The estimated coefficient becomes negative in specification (S4) and insignificant. This can be explained by the fact that the method of privatization, the country risk and the institutional variables are correlated which leads to collinearity between them. The less risky and most advanced Eastern European countries are also those that are the most open to FDI.

¹¹ This is computed using the Kennedy estimates as in equation 5.4:

$$\hat{p}_{direct} = 100 \times (\exp\{\hat{\beta} - 0.5\hat{V}(\hat{\beta})\} - 1) = 100 \times (\exp\{0.087 - 0.5(0.001)\} - 1)$$

¹² This is computed using the Kennedy estimates as in equation 5.4:

$$\hat{p}_{risk} = 100 \times (\exp\{\hat{\beta} - 0.5\hat{V}(\hat{\beta})\} - 1) = 100 \times (\exp\{1.180 - 0.5(0.252)\} - 1)$$

The progress in legal reform has also a positive and significant impact on the real sales of an individual firm in Eastern Europe. The impact of the legal variables have to be interpreted as departures from the legal framework which is the most limited in scope: $LEGAL1_{jt}$. For example, implementing the most extensive and effective legal framework, $LEGAL4_{jt}$, leads an individual German firm to sale 6% more than implementing the least developed legal institutions¹³. The political freedom variables are also significant and of the expected signs. As for the legal dummy variables, the impact of the political freedom dummy variables has to be interpreted relative to the environment that is the least conducive to political freedom: $FREE4_{jt}$. The environment that is most conducive to political freedom, $FREE1_{jt}$, leads an individual German firm to sale 404% more than the environment that is the least conducive to political freedom¹⁴.

5.5 Summary

This chapter investigated the determinants of the production of a German multinational in Eastern European countries. The analysis takes into account observed and unobserved firms heterogeneity by using data at firm level and a fixed-effects panel estimation technique.

¹³ This is computed using the Kennedy estimates as:

$$\hat{p}_{legal4} = 100 \times (\exp\{\hat{\beta} - 0.5\hat{V}(\hat{\beta})\} - 1) = 100 \times (\exp\{0.063 - 0.5(0.001)\} - 1)$$

¹⁴ This is computed using the Kennedy estimates as:

$$\hat{p}_{free4} = 100 \times (\exp\{\hat{\beta} - 0.5\hat{V}(\hat{\beta})\} - 1) = 100 \times (\exp\{1.738 - 0.5(0.239)\} - 1)$$

The empirical specifications show that the central variables of the model have the correct expected signs and are statistically significant and robust to different specifications. In particular, the market size, proxied by the market potential has a positive impact on German foreign production in Eastern Europe. The trade costs effect is large, highly significant and negative. This suggests vertical motives for foreign direct investment. This is somehow confirmed by the relative factor endowment variables that affect the sales of an individual firm positively. German foreign production is relatively attracted to more unskilled-labor abundant Eastern European countries. The data also indicates that German production is higher in countries that have chosen an intermediate exchange rate regime (Horizontal Bands or adjusted peg with central parity).

However, the central variables of the model are not sufficient to explain German production in Eastern European countries. The progress in transition toward a market economy has a clear and significant impact on German production in those countries. Contrary to the preceding chapter, the private sector share or GDP has no impact on the individual firm. This can be explained by the large share of GDP that has been already privatized before 1996 or by the fact that the privatization level affect firms entry in the country but not their level of sales. The method of privatization, which give also information on the level of investment barrier, is however relevant for German multinationals foreign sales. In particular, the direct sales method of privatization has a positive impact on an individual German multinational sales in Eastern Europe.

German multinational sales are higher in countries that have implemented a sound and stable business, political and legal environment. The impact is large and highly significant, especially, the effect of the political institution. This is certainly due to the heterogeneity of the country in a panel where I do not control for country-specific effects.

This transition specific factors are expected to improve with the adhesion to the European Union. As in Chapter 4, the impact of the Enlargement on multinational activities in Eastern Europe is ambiguous. This impact should not be emphasized too much since we do not have more than 4 years of data. The effects depends on how strong each determinant will be affected. The market potential is expected to rise considerably, trade costs to decrease significantly. Both have a positive impact on German multinational sales. However, the catching-up process should improve the skill of the labor force. This, in turn reduces German multinational activities.

Table 5.1 The Expected Signs

Variables Name	Label	Expected Sign	Transformation
Market Size	MK_{jt}	+	Logarithm
Trade Costs	$TARIFF_{jt}$	+/-	Index range: [0, 5]
Relative Factor Endowment	$RSKILL_{jt}$	+/-	Percentage: [0, 100]
Internationalization	$SIZE_{it}$	+	Logarithm
Exchange Rate Regimes	$FLOAT_{jt}$	+/-	Dummy Variable
Reference variable: $FIXED_{jt}$	$INTER_{jt}$	+/-	Dummy Variable
Privatization	$PRIV_{jt}$	+	Percentage: [0, 100]
Method of Privatization	$Voucher$	+	Dummy Variable
Reference variable: $Insider$	$Direct$	+	Dummy Variable
Country Risk	$RISK_{jt}$	+	Index range: [0, 10]
Legal Framework	$LEGAL2_{jt}$	+	Dummy Variable
Reference variable: $LEGAL1_{jt}$	$LEGAL3_{jt}$	+	Dummy Variable
	$LEGAL4_{jt}$	+	Dummy Variable
Political Freedom	$FREE1_{jt}$	+	Dummy Variable
Reference variable: $FREE4_{jt}$	$FREE2_{jt}$	+	Dummy Variable
	$FREE3_{jt}$	+	Dummy Variable

Table 5.2 The Determinants of German Multinational Production in Eastern Europe

Variable Name	Label	(S1)	(S2)	(S3)	(S4)
Market Size	MK_{jt}	0.372*** (0.005)	0.687*** (0.000)	0.701*** (0.000)	0.781*** (0.000)
Trade Costs	$TARIFF_{jt}$	-0.362*** (0.000)	-0.286*** (0.000)	-0.291*** (0.000)	-0.258*** (0.005)
Relative Factor Endowment	$RSKILL_{jt}$	0.227*** (0.000)	0.172*** (0.000)	0.175*** (0.000)	0.356*** (0.000)
Internationalization	$SIZE_{it}$	0.226*** (0.001)	0.310*** (0.000)	0.307*** (0.000)	0.307*** (0.000)
Exchange Rate regimes Reference Variable:	$FLOAT_{jt}$		1.215*** (0.000)	1.237*** (0.000)	0.971*** (0.003)
	$FIXED_{jt}$		1.439*** (0.000)	1.468*** (0.000)	1.359*** (0.000)
Privatization	$Priv_{jt}$			-0.315 (0.333)	-0.022 (0.955)
Method of Privatization Reference Variable:	$Voucher$			0.081 (0.108)	-0.010 (0.909)
	$Insider$			0.087** (0.013)	-0.155 (0.110)
Country Risk	$RISK_{jt}$				1.181*** (0.000)
Commercial Legal Framework Reference Variable:	$LEGAL2_{jt}$				0.094 (0.544)
	$LEGAL1_{jt}$				0.186* (0.080)
	$LEGAL4_{jt}$				0.063* (0.079)
Political Freedom Reference Variable:	$FREE1_{jt}$				1.738*** (0.000)
	$FREE4_{jt}$				0.613*** (0.000)
	$FREE2_{jt}$				0.555*** (0.000)
	$FREE3_{jt}$				
Number of groups		2406	2406	2406	2270
Observations		8815	8815	8815	7137
R-squared		0.757	0.771	0.772	0.803
p-values in parentheses, * significant at 10%, ** significant at 5%, *** significant at 1%. Standard errors have been adjusted for clustering around the firm's identity					

Chapter 6

The Geography of German Multinational Activities

6.1 Introduction

The location decision of multinational firms may depend not only on the proximity to a given market and its ease of access but also on the proximity to other firms. Other firms' previous decisions to invest in a particular location create, therefore, additional incentives or disincentives to become active in this location. The aim of this chapter is to analyze this issue using German firm level data from the International Capital Links database.

As seen in chapter 2, multinational firms may benefit from technological and/or pecuniary externalities by locating near their competitors. Technological externalities are knowledge spillovers of various types (R&D spillovers, information bridge or demonstration effects). Pecuniary externalities are transmitted through markets. For example, the entry of (multinational) firms in a downstream activity increases the demand for intermediate inputs. This in turn leads to entry in intermediate-good production. The improved supply attracts further downstream entry and so on (Neary, 2001; Head and

Mayer, 2002; Gross *et al.*, 2003). On the one hand, the combination of these demand and costs linkages creates the potential for the attraction of additional manufacturing firms, also referred to as an agglomeration effect. On the other hand, the entry of firms in the downstream industry reduces the demand faced by each firm in the sector and hence reduces profit. This is often referred to as the competition effect.

As noticed by Gross *et al.*, it is not possible to distinguish empirically between upstream and downstream producers. Taking them together, *"a rise in the number of firms in one's own sector then has an ambiguous effect on profits: the competition effect tends to reduce profits, while the cost and demand effects tend to raise them. However, an increase in the number of firms in a different sector should have a positive effect on profits, since there is no competition effect."*, Gross *et al.* (2003) p. 6. The present chapter sheds some lights on how those effects are at work for German multinational firms. The International Capital Links database provides detailed information on German multinationals' foreign employment. The industry classification of the affiliates is at the two digit NACE level. I use this information to study further the differences between manufacturing and services FDI. These differences have recently been examined by Buch *et al.* (2004a) and Gross *et al.* (2003).

The preceding two chapters use the Harris (1954) measure of market potential and show that the market potential of Eastern European countries is of importance not only at the aggregated level for the OECD countries FDI outward flows but also at a firm level for German multinationals' sales in Eastern Europe. In other words, multinational firms

have a tendency to concentrate where the demand for their final or intermediate products is high. In a recent paper, Redding and Venables (2000, 2004) develop a theoretical trade and geography model that provides microeconomic foundations for the traditional measures of market potential. This is the market potential we use in this chapter, because it provides more information on trade barriers that potentially segment markets.

The next section presents the empirical specification that is derived from the theoretical discussion in the literature review of chapter 2. Section 3 presents the estimation strategy and issues. In particular, it shows that a Tobit estimation is appropriate for analyzing the foreign location decision and the affiliate size of German multinational firms. Section 4 presents the empirical results while section 5 summarizes the main findings.

6.2 The Empirical Specification

The following study uses the information available at the firm level to analyze the spatial and sectoral distribution of German multinationals' foreign activities in OECD and accession countries. In order to compute the dependent variable, I add up the employment of all foreign affiliates that a German multinational firm maintains in a certain sector of each country¹. For the sake of simplicity the aggregated foreign employment of a German company is called German multinational activities or German affiliate size. Depending on the specifications, the set of explanatory variables comprises proxies for the market potential of the host country, the number of competitors faced by German

¹ The same exercise has been done for the real equity capital that an individual firm maintains in each country. The estimation led to qualitatively similar results that are, however, not reported and available upon request.

multinationals, the relative factor endowments, and some macroeconomic determinants that control for the attractiveness of the host country.

The size of the market is of particular importance for the location of multinational activities. As seen in the previous chapter, the location of multinational firms does not only depend on the size of demand in alternative locations, but also on the access to the various sources of demand. As noted by Davies and Weinstein (2003), trade barriers segment markets and give rise to differences in local prices affecting the pattern of local production. Recent models of international location choice under imperfect competition incorporate these trade barriers in the measurement of their market potential (Altomonte, 2002; Redding and Venables, 2000, 2004; Head and Mayer, 2002). The market potential² is the appropriately distance weighted sum of the market capacities of all partner countries. The methodology follows Redding and Venables (2000, 2004) and is presented in detail in Appendix F. I take the logarithm of this variable. An increase in market potential of the host country should have a positive impact on German multinational presence.

Multinational firms' location choices depend on the proximity to other firms. The idea that proximity to other firm may also play an important role for the spatial distribution of multinational activities is now well-known (Devereux and Griffith, 1998; Gross *et al.*, 2003; Head *et al.*, 1995, 1999; Mayer and Disdier, 2003). Multinational firms can benefit from technological and/or pecuniary externalities but also be hurt by local competition.

² Although called market access by Redding and Venables (2000, 2004).

The number of multinational firms already located in the host country is often taken as a proxy for industrial clustering. Since multinational firms take their own investment into account in the anticipated level of agglomeration, the agglomeration variable is the logarithm of one plus the number of German firms in the host country (Head *et al.*, 1995)³. This proxy alone gives only slight information on the agglomeration effect, since firms may follow previous investors simply because earlier FDI projects lead to demonstration effects (Barry *et al.*, 2001). In other word, the number of multinational firms already present in the market might simply measure the attractiveness of the host country for FDI. Thus, I interpret the coefficient on the total number of firms as a proxy for the demonstration or attractiveness effect. These are effects that are related to the country under study, rather than the sector in which firms are active. I expect the impact of the number of German multinationals on the presence of German multinationals to be positive.

In order to distinguish the attractiveness and the "pure" agglomeration or competition effects, I add three additional explanatory variables, which are the percentage of German firms active in the industry under consideration, $N_{same_{jt}}$, the percentage of firms active in the manufacturing sector, $N_{man_{jt}}$, and the percentage of firms active in the services sector, $N_{ser_{jt}}$. The number of German multinational in a host country informs on how attractive is the country, while the percentages inform on the agglomeration or competition effects. To avoid the industry under consideration to be counted twice, I

³ Certainly, the only use of the number of German multinational firms restricts my results to the "German" agglomeration or competition effects.

subtract the number of firms in this industry from the number of firms in the respective sector. For example, for a firm that is active in the chemical industry I include, first, the percentage of German firms in the chemical industry; second, the percentage of German firms in the manufacturing sector excluding firms in the chemical industry; and, third, the percentage of firms active in services sectors. Since the three variables add up to 100, they are perfectly collinear which implies that the three effects cannot be measured independently. Instead, I arbitrarily choose one variable, $Nsame_{jt}$, to be dropped from the regressor list. The interpretation of the effects of the remaining two variables is as follows: the variables $Nman_{jt}$ and $Nser_{jt}$ have a positive effect on a German multinational foreign employment if agglomeration forces are stronger between sectors than within the industry under consideration or if the competition effect in this industry dominates.

A number of studies have included measures of labor cost as a determinant of multinational activities (see for instance: Disdier and Mayer, 2004). However, those studies do not control for the labor productivity and the index is often taken at a country level of aggregation. In this chapter, I include a measure of productivity-adjusted labor cost or unit labor cost at sectoral level and take its logarithm. This index is likely to be strongly correlated with sectoral production costs. Higher unit labor costs make FDI more costly and reduce multinational activities in host countries. I expect the sectoral unit labor cost to have a negative impact on the employment of an individual German multinational firm.

The availability of a large pool of specialized workers also influence the location of firm activities (Ottaviano and Puga, 1998). The relative endowment variable is taken as 100 times the ratio of the percentage of Germany's workforce with tertiary education over the percentage of the host country's workforce with tertiary education. The impact of the relative endowment on multinational activities is ambiguous. For instance, German multinational firms may locate their unskilled labor-intensive activities in unskilled labor-abundant countries and their skilled-labor intensive activities in skilled-labor abundant countries.

The spatial distribution of multinational activities depends also on the heterogeneity of multinational firms. According to Buch *et al.* (2003), German multinationals that maintain more foreign affiliates have on average higher foreign employment. Thus, I include the number of affiliates worldwide that an individual German multinational has as a regressor and take its logarithm. The variable, which indirectly accounts for the size of the parent company or its degree of internationalization, is thus expected to have a positive impact on German multinational activities.

From a macroeconomic point of view, the quality of the business environment is also likely to influence the spatial location of multinational firms. As in the preceding chapters, I introduce a country risk index, which is also another control for the attractiveness of the host country. This index is defined as the risk of non-payment or non-servicing payments for goods or services, loans, trade-related finance and dividends and the non-repatriation of capital. This variable takes values between 10 (no risk of non-payment of foreign

debt) and 0 (no chance of payment). It takes higher values when the risk associated with a specific country is low and is, therefore, expected to have a positive impact on multinational activity.

Finally, the estimation includes a set of time and regional dummy variables. The time dummies are included to pick up omitted variables that vary over time such as exchange rate movements and the host country business cycle fluctuations. The first regional dummy variable takes the value of one for the (old) EU member countries for which data are available (Austria, Belgium, Denmark, Finland, France, Italy, Netherlands, Portugal, Sweden, United Kingdom). The second regional dummy variable is set to one for the Eastern European countries that have recently entered the EU (Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania and the Slovak Republic) or candidate to join the EU at a later time (Bulgaria and Romania). Finally, a third regional dummy variable takes the value of one for other OECD members (Canada, Japan, Mexico, South Korea and United States of America). To avoid perfect collinearity the first regional dummy, *EU* is omitted. Grouping countries into regions provides useful information on the relative activities of German multinational firms. For example, using the affiliate employment as dependent variable allows to point out the differences in labor intensities of German multinational activities in the accession countries relative to the EU countries.

To summarize the preceding discussion, the empirical model uses the following variables with potential influence on the spatial distribution of German multinational foreign employment at a sectoral level: market size, measured by the logarithm of the market

potential, MK_{jt} , of the host country j at time t ; the logarithm of one plus the number of German multinationals present in the host country, denoted by N_{jt} ; in addition, I introduce, the variables $N_{same_{jt}}$, $N_{ser_{jt}}$ and $N_{man_{jt}}$, which are the percentages of German multinational firms that are investing in the same sector, in the services sectors and in the manufacturing industries of the host country, respectively. $N_{same_{jt}}$ is left out the regression to avoid perfect collinearity. The sectoral unit labor cost ULC_{jt} is the logarithm of the productivity-adjusted labor cost that proxies the foreign sectoral production costs. $RSKILL_{jt}$ is the percentage of the ratio of German skilled-labor endowment over the host country skilled labor endowment. $SIZE_{it}$ is the logarithm of the worldwide number of affiliates of the multinational i . $Risk$ is a political risk index associated with each host country. $Accession$ and $OECD$ are the regional dummies. The dummy variable EU is skipped to avoid perfect collinearity.

The expected signs of the explanatory variables on German affiliate size are given in table 6.1.

— Insert Table 6.1 about here. —

6.3 Estimation Strategy

Data on foreign employment of a German multinational firm are taken from the *Deutsche Bundesbank's* International Capital Links firm-level database. The database provides a detailed description of the activities of German firms abroad in particular about their spatial and sectoral distribution.

The database provides a sector code for each affiliate, which can be aggregated using the 2-digit NACE classification. Each sector is analyzed separately. From the firm-level database, I add up, for each sector, s , the employment of all foreign affiliates that a German multinational firm, i , maintains in each country, j , at time t . Since the company codes have been changed each year before 1996, it is not possible to trace a particular German multinational back to 1990. Thus, the study uses four years of data, from 1996 to 1999.

Since some German firms are not present in all sectors and all countries, the dependent variable takes a value of zero for a significant fraction of the observations. The conventional regression methods, in particular the Ordinary Least Squares, fail to account for the qualitative difference between zero observations and non-zero observations, in contrast to the Tobit estimation (Wooldridge, 2002).

For simplicity, we use \mathbf{X}_{ijt} to denote the $K \times 1$ vector of exogenous variables although they are all not varying in the firm, country and time dimension at the same time.

Formally, we consider the latent random variable y_{ijt}^* that linearly depends on x_{ijt} as in (6.1).

$$\begin{aligned} y_{ijt}^* &= \mathbf{X}_{ijt}'\beta + \varepsilon_{ijt}, \\ \varepsilon_{ijt} &\sim N(0, \sigma^2) \end{aligned} \tag{6.1}$$

β is a $K \times 1$ vector of parameter and the error term ε_{ijt} is independently and normally distributed with mean 0 and variance σ^2 . The distribution of y_{ijt}^* given \mathbf{X}_{ijt} is therefore also normal: $y_{ijt}^* | \mathbf{X}_{ijt} \sim N(\mathbf{X}_{ijt}'\beta, \sigma^2)$. The expected value of the latent variable is

$E(y_{ijt}^* | \mathbf{X}_{ijt}) = \mathbf{X}'_{ijt}\beta$. Since the observation is only observed if $y_{ijt}^* > 0$, equation (6.1)

implies that the observed variables y_{ijt} are related to y_{ijt}^* by:

$$y_{ijt} = \begin{cases} y_{ijt}^* & : y_{ijt}^* > 0 \\ 0 & : \text{Otherwise} \end{cases} \quad (6.2)$$

The observed value y_{ijt} is censored below 0.

The observed variable is a mixture random variable with a probability mass $P(y_{ijt} = 0 | \mathbf{X}_{ijt}) = P(y_{ijt}^* < 0 | \mathbf{X}_{ijt}) = \Phi(-\mathbf{X}'_{ijt}\beta/\sigma)$ on 0 and a continuum of value above 0.

The expected value of the observed variable is given as in (6.3).

$$\begin{aligned} E(y_{ijt} | \mathbf{X}_{ijt}) &= P(y_{ijt}^* < 0 | \mathbf{X}_{ijt}) \cdot 0 + P(y_{ijt}^* > 0 | \mathbf{X}_{ijt}) \cdot E(P(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)), \\ &= \Phi(\mathbf{X}'_{ijt}\beta/\sigma) \cdot \left(\mathbf{X}'_{ijt}\beta + \sigma \frac{\phi(-\mathbf{X}'_{ijt}\beta/\sigma)}{1 - \Phi(-\mathbf{X}'_{ijt}\beta/\sigma)} \right), \\ &= \Phi(\mathbf{X}'_{ijt}\beta/\sigma)(\mathbf{X}'_{ijt}\beta + \sigma\lambda) \end{aligned} \quad (6.3)$$

where λ is the inverse Mills ratio, $\lambda = \phi(\mathbf{X}'_{ijt}\beta/\sigma)/\Phi(\mathbf{X}'_{ijt}\beta/\sigma)$, with ϕ and Φ denoting the standard normal density and the standard normal distribution function, respectively (Greene, 2003, p.762-763). By derivation of equation (6.3), the marginal effect is given as in equation (6.4) :

$$\frac{\partial E(y_{ijt} | \mathbf{X}_{ijt})}{\partial x_{ijt}^k} = \beta_k \Phi \left(\frac{\mathbf{X}'_{ijt}\beta}{\sigma} \right) \quad (6.4)$$

where superscript k denotes a specific explanatory variable. The economic interpretation of (6.4) is not straightforward, as it gives the marginal effect of the explanatory variable on the expected number of employees allowing for corner solutions but without explicitly separating corner cases from interior cases (Wooldridge, 2002). An interesting

decomposition of equation (6.4) is given by McDonald and Moffitt (1980) who give a decomposition of the marginal effects, which shows that a change in \mathbf{X}_{ijt} in fact has two effects: (i) it affects the conditional mean of y_{ijt}^* in the uncensored part of the distribution (6.5) and (ii) it affects the probability that the observation fall in the uncensored part of the distribution (6.6).

$$\frac{\partial E(y_{ijt} | \mathbf{X}_{ijt})}{\partial x_{ijt}^k} = \frac{\partial E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)}{\partial x_{ijt}^k} P(y_{ijt}^* > 0), \quad (6.5)$$

$$+ \frac{\partial P(y_{ijt}^* > 0)}{\partial x_{ijt}^k} E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0) \quad (6.6)$$

Since the model is non-linear, the marginal effects are not constant and need to be interpreted at some sample point. I choose to use the means of the independent variables to do this evaluation. If x_{ijt}^k is a dummy variable, the marginal effects are computed for a discrete change from 0 to 1.

Notice however, that the expected marginal effects can change considerably if they were not computed at sample means but at other sample points. This is why Tables 6.2 to 6.7 present three expected marginal effects: β , κ and π .

β are the estimated marginal effects of the explanatory variable on the latent variable: $E(y_{ijt}^* | \mathbf{X}_{ijt})$. They have the advantage to be constant and independent of \mathbf{X}_{ijt} . However, since the data are censored, the coefficients β are difficult to interpret. In fact they can be interpreted as the limiting marginal effects on y_{ijt} when $(\mathbf{X}_{ijt}'\beta/\sigma)$ tend to infinity, that is to say when the probability of a censoring tend to zero. κ are the estimated marginal

effects computed at the means of the independent variables on $E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)$:

$$\kappa = \frac{\partial E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)}{\partial x_{ijt}^k} \quad (6.7)$$

κ give the expected conditional marginal effects of an increase of one unit of x_{ijt}^k ⁴ on the number of foreign employees, conditional on *employment* being positive. π are the marginal effects computed at the means of the independent variables on $P(y_{ijt}^* > 0)$:

$$\pi = \frac{\partial P(y_{ijt}^* > 0)}{\partial x_{ijt}^k} \quad (6.8)$$

π are associated with the marginal effect on the probability of an existing activity in the foreign country⁵.

Before interpreting the results, the specified model raises several econometric issues. The market potential is derived using the estimated coefficient of the trade equation (see Appendix E). Sampling errors carried over from the first-stage regressions could lead to a slight over-estimation of the standard error of the estimated coefficient in the second-stage regression.

Finally, the model relies crucially on the assumption of homoskedasticity in the underlying latent variable model. I use the Huber-White method to correct for heteroscedasticity. Since the data are pooled over four years, I also correct for serially correlated responses from firm (Wooldridge, 2002).

⁴ x_{ijt}^k being continuous

⁵ The Tobit model implies that the decision to invest in a country is not different from the decision on how large the size of the affiliate should be (Cragg, 1971).

6.4 Estimation Results

The estimated marginal effects β , κ and π from the Tobit model are presented in tables 6.2 to 6.7.

— Insert Table 6.2 to Table 6.7 about here. —

All specifications include time dummy variables, which are not reported.

6.4.1 Interpreting κ : the estimated marginal effects on employment, conditional on employment being positive

Market potential has a statistically significant and positive impact on the expected conditional foreign employment of an individual German multinational firm. The sectoral analysis shows that the effect of the market potential on the conditional expected affiliate size varies largely across sectors. A one percent increase of the market potential raises the conditional expected employment by 0.0009 in the basic and fabricated metal industry to 0.061 in the financial activity sector. However, the market potential variable does not include any adjustments to take into account where the competitors are. Hence, the demand impact on the size of the typical affiliate may be slightly overestimated.

As can be seen in the second column of tables 6.2 to 6.7, the number of German firms located in the country has a strongly significant and positive impact on the average affiliate size of a German multinational in all industries. The estimated conditional marginal effect ranges from about 0.19 in wood and wood products industry to about 2.17 in the financial activities sector. As mentioned before, this variable controls for the attractiveness of the host country and it is not possible from the number of firm

variable alone to distinguish between agglomeration and demonstration effects (Barry *et al.*, 2001). Typically, German multinationals face greater uncertainties than domestic firms in the host country and may hence have an incentive to follow previous investors.

The sectoral breakdown of the number of German multinationals into the two variables $N_{man_{jt}}$ and $N_{ser_{jt}}$ reveals cross-sector effects on the foreign employment of a German multinational firm. First, a one percentage point increase in the fraction of German firms located in the manufacturing sector, raises the estimated conditional foreign employment by 0.31 in the food products, beverage and tobacco industry to about 6.86 employees in the transport equipment industry. The effect on the conditional expected foreign employment is negative in the transport, storage and communication sector.

Second, an one percentage point increase in the fraction of German firms in the service sector has also a positive and significant impact on the estimated conditional average size of German affiliates⁶. The expected conditional marginal effect of the number of firms in services ranges from -0.75 in the construction sector to 1.89 in the wholesales and retail sector. Notice, that a percentage point increase in the number of German multinationals in services is very different from a one percentage point increase in the number of German multinationals in manufacturing, because there are many more German multinational firms in services than in manufacturing.

The unit labor costs, that account for productivity changes, have a negative impact on the expected conditional foreign employment of a German multinational firm. A one

⁶ except for the transport, storage and communication sector.

percent increase in the unit labor cost reduces the expected conditional employment of an individual German affiliate by 0.02 in the machinery and equipment sector to 0.80 in the transport equipment industry.

This significant effect of the unit labor cost variable contrasts with the performance of the relative factor endowments variable. For most of the NACE sectors, the parameter is small and not significant. The fact that the parameter is close to 0 does not mean that it is not significant if the variance of the estimated parameter is small. This is the case in the pulp and paper industry, in the basic metal industry and in the machinery and equipment sector⁷. This indicates that the relative factor endowment has no impact on the foreign employment of a German multinational firm in those sectors

The impact of the relative factor endowments is not homogeneous across the sectors for which it is significant. The expected conditional marginal effect is negative and significant in the chemical industry, the wholesales and retail trade sector, the real estate sector and the community services sector. In these sectors, the conditional expected foreign employment of an individual German multinational firm is larger, the larger the relative supply of skilled labor in the host country relative to Germany.

However, the conditional expected marginal effect of the relative factor endowments on foreign employment is positive in the food and beverage and tobacco sector, the rubber and plastic products industry and the other non-metallic products industry. In this case,

⁷ The variance is equal to $(\hat{V}ar(\hat{\beta}) = 0.028)$ in the pulp and paper industry, to $(\hat{V}ar(\hat{\beta}) = 0.048)$ in the basic metal industry and to $(\hat{V}ar(\hat{\beta}) = 0.002)$ machinery and equipment industry.

the foreign affiliates of German firms are larger, the bigger is the supply of skilled labor in Germany relative to that in the host country⁸.

Country risk is defined as the risk of non-payment for goods or services, loans, trade-related finance and dividends and the non-repatriation of capital. As in the previous chapters, the index ranges from 0 to 10. The higher the country risk index, i.e. the less risky the investment, the more attractive is a country for the location of multinationals. The impact of the country risk on the estimated conditional expected marginal effects affiliate is mostly not significant except for the food products, beverage and tobacco industry, the wood industry and the real estate sector, for which it has the expected positive and significant effect.

The model accounts for the degree of internationalization of the reporting company by including the number of its worldwide foreign affiliates as an explanatory variable. This variable $SIZE_{it}$ is always positive and significant, which implies that German multinationals that maintain more foreign affiliates have also higher foreign employment. A one percent increase in the worldwide number of foreign affiliates raises the expected conditional marginal effect by about 0.09 employees in the food, beverage and tobacco industry to 1.36 employees in the financial activity sector. This indicates that German firms that have a larger degree of internationalization have larger foreign employment.

Relative to the European Union, the foreign employment of a German multinational firm is higher in the ten accession countries. This is the case in all industries. Compared

⁸ The relative labor endowment is defined as Germany's skilled-labor force relative to the host country.

to the EU members, an accession country affiliate has up to about 67.2 employees more in the transport storage and communication sector, while an OECD country has up to 30 employees less in the electrical and optical equipment sector. This indicates that German multinational firms employ more labor in Eastern Europe relative to the EU countries, controlling for host countries characteristics. The impact of the accession country dummy variable is the largest and confirms the predominant role of the Eastern European countries for the location of German multinational firm.

6.4.2 Interpreting π : the estimated marginal effects on the probability of employment being positive

Tables 6.2 to 6.7 give information on the estimated marginal effects on the probability of employment being positive. Thus, it captures the probability of FDI occurrence. As for κ , the marginal effects on the probability of FDI occurrence depends on the sample points at which it is estimated (the sample means). Notice, that a small probability $P(y_{ijt}^* < 0)$ at sample means, should lead to a small marginal effects on the probability of FDI occurrence.

The results indicate that the number of multinational firms already located in the host country, the degree of internalization of the parent company and the accession dummy variable, have the highest marginal effect on the probability of FDI to occur. Their impacts are discussed below.

A one percent increase of the number of German firms located in the country raises the probability of employment being positive by 0.0141 percentage point in the real estate

sector to 0.0438 percentage point in the other non-metallic mineral industry. German firms follow previous investors, because they give information on the attractiveness of the location. In contrast, the share of firms in the manufacturing and services industry, which inform on the agglomeration or competition effects, has a less important impact on the probability of FDI to occur. This results suggest that the demonstration effect has a strong impact on the German decision to invest abroad.

German multinationals that maintain more foreign affiliates have a higher probability of commitment to FDI. A one percent increase in the worldwide number of affiliate raises the probability of employment being positive from 0.010 percentage point in the real estate sector to about 0.023 percentage point in the in the chemical industry.

Finally, the marginal effects of the *Accession* variable on the probability of investment abroad is large, positive and significant. It confirms the relative importance of these countries for the decision of German firms to invest abroad. Compared to the EU members, an accession country increases the probability of FDI occurrence up to 9.9 percentage point in the machinery and equipment industry, while an OECD country reduces at most the probability of employment being positive by about 1.42 percentage point in the electrical and optical equipment.

6.5 Summary

This chapter shows that the location of German multinational firms depends on the proximity to markets and their ease of access but also on the proximity to other German firms.

The empirical results suggest that firms are more likely to invest in an accession country and to have larger affiliate there compared to OECD or (old) EU member countries. That is accession countries are associated with a higher expected probability of FDI occurrence and a larger expected conditional size of German affiliates.

The empirical specifications show that the key variables of the model have the correct expected sign and that they are statistically significant. In particular, the market potential has a positive impact on the conditional marginal effect of employment being positive. The estimated marginal effect on the probability of FDI to occur is however low in all sectors. The market potential has a positive and big effect on the affiliate size of an individual multinational firm, but seems to have a lower impact on the commitment to invest in a particular country.

The empirical analysis shows that the presence of other German firms in a given foreign market has significant positive effects on the marginal effect of foreign employment of an individual German firm. On the one hand, German multinational firms are likely to follow previous investors because the latter's presence sends a positive signal concerning the attractiveness of the host market. This is the effect, I control using the number of German multinationals in the host market. On the other hand, they may

benefit from demand and cost linkages from different sectors. In order to show this, I use three explanatory variables, which are the percentage of firm active in one sector and the percentage of firm active in other manufacturing and services sectors. The increase in the number of German firms located in the manufacturing sector raises the foreign employment of an individual German multinational. It indicates that German multinational firms benefit from a larger demand for upstream and/or downstream industries. Moreover, they are not affected by competition since the entry of multinational firms happens in other sectors.

The analysis of the marginal effects of these two sets of variables on the probability of FDI occurrence shows that the number of German firms that are already present in the market, increase the probability to engage in foreign production. The estimated marginal effect is large and positive. In contrast, the estimated marginal effects of the agglomeration variables on the probability of foreign employment being positive are positive but remain in contrast small relative to the demonstration effect.

Table 6.1 The Geography of German Multinational Activities: Variable Expected Signs

Variables Name	Label	Expected Sign	Transformation
Market Size	MK_{jt}	+	Logarithm
Number of German Multinationals (MNEs)	N_{jt}	+	Logarithm
Share of the number of German MNEs	$Nser_{jt}$	+/-	Percentage: [0, 100]
Reference variable: $Nsame_{jt}$	$Nman_{jt}$	+/-	Percentage: [0, 100]
Sectoral Unit Labor Costs	ULC_{jt}	-	Logarithm
Relative Factor Endowment	$RSKILL_{jt}$	+/-	Percentage: [0, 100]
Number of Affiliates Worldwide	$SIZE$	+/-	Logarithm
Country Risk	$RISK_{jt}$	+	Index range: [0, 10]
Regional Dummy Variables	$OECD$	+/-	Dummy Variable
Reference variable: EU	$Accession$	+/-	Dummy Variable

Table 6.2 Estimation Results in Manufacturing Industries (Individual Multinationals' Foreign Employment)

Sector NACE: Manufacturing I	‡	MK_{jt}	N_{jt}	$Nser_{jt}$	$Nman_{jt}$	ULC_{jt}	$RSKILL_{jt}$	$SIZE_{it}$	$RISK_{jt}$	Accession	OECD	Obs.
Food products, beverages and tobacco	β	2.0911	170.9514	3.1927	2.5378	-62.6740	0.2276	78.8355	5.1488	104.8712	-98.1852	11298
	κ	0.2612	21.3550	0.3988	0.3170	-7.8292	0.0284	9.8480	0.6432	17.8974	-11.4811	
	π	0.0005 (0.007)***	0.0388 (0.000)***	0.0007 (0.042)**	0.0006 (0.066)*	-0.0142 (0.000)***	0.0001 (0.000)***	0.0179 (0.000)***	0.0012 (0.000)***	0.0521 (0.000)***	-0.0177 (0.017)*	
Textile and textile products	β	12.1927	174.7156	12.4356	12.4413	-26.0992	-0.1356	114.588	2.5608	57.9849	39.9299	10703
	κ	1.5101	21.6392	1.5402	1.5409	-3.2325	-0.0168	14.1921	0.3172	8.3222	5.0401	
	π	0.0022 (0.007)***	0.0315 (0.000)***	0.0022 (0.000)***	0.0022 (0.000)***	-0.0047 (0.002)***	-0.0000 (0.122)	0.0206 (0.000)***	0.0005 (0.090)*	0.0171 (0.000)***	0.0077 (0.279)	
Wood and wood products	β	1.3958	145.1934	9.4843	10.5408	-57.8964	-0.0834	20.4982	2.0283	91.9195	58.2113	3100
	κ	0.1791	18.6313	1.2170	1.3526	-7.4293	-0.0107	2.6303	0.2603	13.7967	7.7830	
	π	0.0004 (0.061)*	0.0417 (0.000)***	0.0027 (0.002)***	0.0030 (0.001)***	-0.0166 (0.003)***	-0.0000 (0.487)	0.0059 (0.352)	0.0006 (0.070)*	0.0436 (0.001)***	0.0191 (0.172)	

p-values of the β coefficients in parentheses. Significant at 10%; significant at 5%; significant at 1%.

Estimation with robust standard errors (clustering around the parent company). Year specific intercepts are not reported.

‡: β are the estimated marginal effects of the independent variables on the latent variable

‡: κ are the estimated marginal effects computed at the means of the independent variables on $E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)$

‡: π are the marginal effects computed at the means of the independent variables on $P(y_{ijt}^* > 0)$

Table 6.3 Estimation Results in Manufacturing Industries (Individual Multinationals' Foreign Employment)

Sector NACE:	‡	MK_{jt}	N_{jt}	$Nser_{jt}$	$Nman_{jt}$	ULC_{jt}	$RSKILL_{jt}$	$SIZE_{it}$	$RISK_{jt}$	Accession	OECD	Obs.
Manufacturing I	β	8.9857	281.0858	6.0327	4.9432	-111.5263	-0.0766	120.1973	1.2885	175.3212	-37.7638	8825
	κ	1.0371	32.4425	0.6963	0.5705	-12.8722	-0.0088	13.8730	0.1487	45.9544	-4.2972	
	π	0.0012 (0.097)*	0.0371 (0.000)***	0.0008 (0.045)**	0.0007 (0.052)*	-0.0147 (0.000)***	-0.0000 (0.532)	0.0159 (0.000)***	0.0002 (0.301)	0.0867 (0.000)***	-0.0047 (0.451)	
Chemicals and man-made fibres	β	19.5088	715.8036	2.1671	-4.4645	-189.3038	-0.9938	395.0848	1.8378	195.8096	7.3654	14943
	κ	2.4926	91.4555	0.2769	-0.5704	-24.1866	-0.1270	50.4785	0.2348	49.2993	0.9417	
	π	0.0011 (0.047)**	0.0419 (0.000)***	0.0001 (0.681)	-0.0003 (0.307)	-0.0111 (0.000)***	-0.0001 (0.005)***	0.0231 (0.000)***	0.0001 (0.509)	0.0623 (0.000)***	0.0004 (0.910)	
Rubber and plastic products	β	2.5736	267.1297	3.4182	2.7618	-65.0210	0.1071	124.9057	2.3026	108.3220	29.2187	15858
	κ	0.3070	31.8633	0.4077	0.3294	-7.7557	0.0128	14.8988	0.2747	19.3714	3.5209	
	π	0.0004 (0.024)**	0.0378 (0.000)***	0.0005 (0.079)*	0.0004 (0.100)*	-0.0092 (0.000)***	0.0000 (0.148)	0.0177 (0.000)***	0.0003 (0.095)*	0.0440 (0.000)***	0.0043 (0.382)	

p-values of the β coefficients in parentheses. Significant at 10%; significant at 5%; significant at 1%.

Estimation with robust standard errors (clustering around the parent company). Year specific intercepts are not reported.

‡: β are the estimated marginal effects of the independent variables on the latent variable

‡: κ are the estimated marginal effects computed at the means of the independent variables on $E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)$

‡: π are the marginal effects computed at the means of the independent variables on $P(y_{ijt}^* > 0)$

Table 6.4 Estimation Results in Manufacturing Industries (Individual Multinationals' Foreign Employment)

Sector NACE:	‡	MK_{jt}	N_{jt}	$Nser_{jt}$	$Nman_{jt}$	ULC_{jt}	$RSKILL_{jt}$	$SIZE_{it}$	$RISK_{jt}$	Accession	OECD	Obs.
Manufacturing II	β	1.9649	231.4789	4.0427	7.1978	-40.1557	0.1672	121.0531	0.1328	64.8649	54.4785	9706
	κ	0.2644	31.1487	0.5440	0.9686	-5.4035	0.0225	16.2894	0.0179	9.4982	7.4920	
	π	0.0004 (0.673)	0.0438 (0.000)***	0.0008 (0.171)	0.0014 (0.013)**	-0.0076 (0.001)***	0.0000 (0.083)*	0.0229 (0.000)***	0.0000 (0.933)	0.0161 (0.000)***	0.0110 (0.226)	
Basic metals and fabricated metal	β	0.8087	243.0384	3.0986	2.9550	-63.4947	-0.0807	97.0724	1.3782	107.4669	35.1402	24515
	κ	0.0936	28.1322	0.3587	0.3420	-7.3496	-0.0093	11.2363	0.1595	21.0058	4.1326	
	π	0.0001 (0.004)***	0.0372 (0.000)***	0.0005 (0.048)**	0.0005 (0.031)**	-0.0097 (0.000)***	-0.0000 (0.188)	0.0149 (0.000)***	0.0002 (0.084)*	0.0573 (0.000)***	0.0057 (0.138)	
Machinery and equipment	β	5.3236	209.5421	-0.2853	-0.8663	-14.6408	0.0050	127.0099	0.0068	36.5745	-108.225	28342
	κ	0.6049	23.8085	-0.0324	-0.0984	-1.6635	0.0006	14.4311	0.0008	5.0498	-12.0403	
	π	0.0007 (0.014)**	0.0286 (0.000)***	-0.0000 (0.853)	-0.0001 (0.532)	-0.0020 (0.062)**	0.0000 (0.958)	0.0173 (0.000)***	0.0000 (0.992)	0.0994 (0.006)***	-0.0137 (0.000)***	

p-values of the β coefficients in parentheses. Significant at 10%; significant at 5%; significant at 1%.

Estimation with robust standard errors (clustering around the parent company). Year specific intercepts are not reported.

‡: β are the estimated marginal effects of the independent variables on the latent variable

‡: κ are the estimated marginal effects computed at the means of the independent variables on $E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)$

‡: π are the marginal effects computed at the means of the independent variables on $P(y_{ijt}^* > 0)$

Table 6.5 Estimation Results in Manufacturing Industries (Individual Multinationals' Foreign Employment)

Sector NACE:	‡	MK_{jt}	N_{jt}	$Nser_{jt}$	$Nman_{jt}$	ULC_{jt}	$RSKILL_{jt}$	$SIZE_{it}$	$RISK_{jt}$	Accession	OECD	Obs.
Electrical and optical equipment	β	29.3849	433.2952	7.9547	3.9662	-104.8242	0.2454	354.2330	3.0934	193.9111	-253.753	19720
	κ	3.5437	52.2532	0.9593	0.4783	-12.6413	0.0296	42.7187	0.3731	32.5326	-29.7640	
	π	0.0018 (0.015)**	0.0268 (0.000)***	0.0005 (0.079)*	0.0002 (0.293)	-0.0065 (0.000)***	0.0000 (0.179)	0.0219 (0.000)***	0.0002 (0.212)	0.0305 (0.000)***	-0.0142 (0.001)***	
Transport equipment	β	26.7697	1791.9578	53.4547	53.7851	-632.3912	-2.2882	923.8889	20.7239	340.4453	7.9469	12858
	κ	3.4167	228.7114	6.8225	6.8647	-80.7134	-0.2920	117.9179	2.6450	51.5444	1.0146	
	π	0.0005 (0.448)	0.0362 (0.029)**	0.0011 (0.102)	0.0011 (0.069)*	-0.0128 (0.038)**	-0.0000 (0.108)	0.0187 (0.029)**	0.0004 (0.155)	0.0568 (0.036)**	0.0002 (0.973)	
Furniture; recycling	β	5.3272	432.5842	4.8936	6.4527	-130.9759	0.1159	161.3092	10.3813	212.3090	231.2400	5893
	κ	0.6764	54.9257	0.6213	0.8193	-16.6302	0.0147	20.4816	1.3181	36.8250	31.4319	
	π	0.0005 (0.673)	0.0436 (0.003)***	0.0005 (0.380)	0.0006 (0.248)	-0.0132 (0.010)**	0.0000 (0.615)	0.0162 (0.003)***	0.0010 (0.024)*	0.0464 (0.007)***	0.0291 (0.234)	

p-values of the β coefficients in parentheses. Significant at 10%; significant at 5%; significant at 1%.

Estimation with robust standard errors (clustering around the parent company). Year specific intercepts are not reported.

‡: β are the estimated marginal effects of the independent variables on the latent variable

‡: κ are the estimated marginal effects computed at the means of the independent variables on $E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)$

‡: π are the marginal effects computed at the means of the independent variables on $P(y_{ijt}^* > 0)$

Table 6.6 Estimation Results in Services Sectors (Individual Multinationals' Foreign Employment)

Sector NACE:	‡	MK_{jt}	N_{jt}	$Nser_{jt}$	$Nman_{jt}$	ULC_{jt}	$RSKILL_{jt}$	$SIZE_{it}$	$RISK_{jt}$	Accession	OECD	Obs.
Construction	β	1.7036	358.656	-5.8336	8.0161	-69.3181	0.1784	242.252	1.5289	117.3380	-82.1475	7180
	κ	0.2180	45.9030	-0.7466	1.0260	-8.8718	0.0228	31.0050	0.1957	17.0014	-10.2637	
	π	0.0002 (0.067)*	0.0404 (0.017)**	-0.0007 (0.075)*	0.0009 (0.228)	-0.0078 (0.005)***	0.0000 (0.295)	0.0273 (0.019)**	0.0002 (0.509)	0.0200 (0.005)***	-0.0085 (0.393)	
Wholesales and retail trade	β	1.6847	605.827	15.8573	5.7955	-75.3753	-0.3466	396.3441	-0.1244	141.4790	-5.6986	181585
	κ	0.2013	72.3813	1.8945	0.6924	-9.0055	-0.0414	47.3532	-0.0149	24.0944	-0.6802	
	π	0.0001 (0.075)*	0.0401 (0.001)***	0.0010 (0.003)***	0.0004 (0.028)**	-0.0050 (0.002)***	-0.0000 (0.016)**	0.0262 (0.001)***	-0.0000 (0.853)	0.0256 (0.002)***	-0.0004 (0.743)	
Transport, storage and communication	β	1.3395	473.255	-4.4584	-16.4072	-158.729	0.0623	259.392	1.1565	266.2745	-144.165	12540
	κ	0.1723	60.8718	-0.5735	-2.1104	-20.4163	0.0080	33.3640	0.1488	67.1540	-17.9872	
	π	0.0001 (0.043)**	0.0406 (0.000)***	-0.0004 (0.105)	-0.0014 (0.001)***	-0.0136 (0.001)***	0.0000 (0.770)	0.0222 (0.000)***	0.0001 (0.642)	0.0706 (0.001)***	-0.0112 (0.062)*	

p-values of the β coefficients in parentheses. Significant at 10%; significant at 5%; significant at 1%.

Estimation with robust standard errors (clustering around the parent company). Year specific intercepts are not reported.

‡: β are the estimated marginal effects of the independent variables on the latent variable

‡: κ are the estimated marginal effects computed at the means of the independent variables on $E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)$

‡: π are the marginal effects computed at the means of the independent variables on $P(y_{ijt}^* > 0)$

Table 6.7 Estimation Results in Manufacturing Industries (Individual Multinationals' Foreign Employment)

Sector NACE:	‡	MK_{jt}	N_{jt}	$Nser_{jt}$	$Nman_{jt}$	ULC_{jt}	$RSKILL_{jt}$	$SIZE_{it}$	$RISK_{jt}$	Accession	OECD	Obs.
Financial Activity	β	52.0444	1842.4207	2.5663	-6.3271	-125.3283	-0.9037	1153.8384	11.4183	228.0314	-159.3611	13442
	κ	6.1468	217.6011	0.3031	-0.7473	-14.8020	-0.1067	136.2753	1.3486	30.2989	-18.6943	
	π	0.0008 (0.192)	0.0275 (0.029)**	0.0000 (0.782)	-0.0001 (0.645)	-0.0019 (0.339)	-0.0000 (0.333)	0.0172 (0.026)**	0.0002 (0.285)	0.0515 (0.304)	-0.0023 (0.586)	
Real estate	β	19.1526	546.3653	5.8054	2.8894	-214.9714	-0.4845	400.4067	4.2849	98.4395	-321.0136	58522
	κ	1.8141	51.7503	0.5499	0.2737	-20.3615	-0.0459	37.9255	0.4059	9.7491	-30.1161	
	π	0.0005 (0.000)***	0.0141 (0.000)***	0.0001 (0.000)***	0.0001 (0.236)	-0.0056 (0.000)***	-0.0000 (0.003)***	0.0103 (0.000)***	0.0001 (0.006)***	0.0832 (0.000)***	-0.0080 (0.000)***	
Community services	β	13.9680	991.1882	6.5489	34.2729	-90.0851	-2.0419	598.3354	22.5656	178.2587	-115.1501	4030
	κ	1.6607	117.8428	0.7786	4.0747	-10.7103	-0.2428	71.1364	2.6828	25.6347	-13.5907	
	π	0.0004 (0.617)	0.0298 (0.000)***	0.0002 (0.531)	0.0010 (0.033)**	-0.0027 (0.302)	-0.0001 (0.026)**	0.0180 (0.000)***	0.0007 (0.029)**	0.0101 (0.258)	-0.0034 (0.582)	

p-values of the β coefficients in parentheses. Significant at 10%; significant at 5%; significant at 1%.

Estimation with robust standard errors (clustering around the parent company). Year specific intercepts are not reported.

‡: β are the estimated marginal effects of the independent variables on the latent variable

‡: κ are the estimated marginal effects computed at the means of the independent variables on $E(y_{ijt}^* | \mathbf{X}_{ijt}, y_{ijt}^* > 0)$

‡: π are the marginal effects computed at the means of the independent variables on $P(y_{ijt}^* > 0)$

Chapter 7

Conclusion

7.1 Summary of the results

This dissertation examines the location of multinational activities especially in the transition countries of Eastern Europe. After a review of the relevant literature and a description of the available data, Chapter 4 to 6 analyze the spatial and sectoral distribution of multinational activities in Eastern European countries after trade and investment liberalization.

Chapter 4 shows that the different transition trajectories explain why foreign direct investment remains concentrated in few countries, especially those of Central Europe. It applies a dynamic panel data approach to bilateral FDI flows in Eastern Europe. This estimation technique is rather new and allows for the first time to distinguish the short-run and long-term evolution of FDI in accession states. Further integration into the European Union reduces trade barriers and should increase FDI flows to transition economies. However, increasingly smaller cost differentials between Central and Eastern European countries and the EU should decrease foreign direct investment flows.

Chapter 5 examines if the results hold on using the information at the firm level. The analysis takes into account firm heterogeneity by using fixed effect panel data estimation techniques that are adapted to the short period of analysis (1996-1999). The qualitative results are in line with the results found in chapter 4. However, the use of firm-level data provides a closer look at the pattern of production of German multinationals in Eastern Europe. German multinational firms locate their skilled-labor intensive stages of production in locations where skilled-labor is cheaper. This empirical finding is in line with the theoretical model of Markusen (1997, 2002) which distinguishes between horizontal multinationals that produce the same good and services across location and vertical multinationals that split their production process into stages to benefit from factor price differences. Foreign direct investment in Eastern Europe seems to be more vertical in nature.

Chapter 4 and 5 shows that multinational firms shift production abroad to take advantage of the proximity to markets and cost differentials. In Chapter 6, I extend the analysis to the OECD and Eastern European countries. I develop a new methodology to show at a sectoral level that the proximity to other firms has a direct impact on the distribution of multinational activities. The number of firms already present in a country is often considered as a proxy for an agglomeration effect. However, the number of firms only reflects the attractiveness of the location. More generally, it cannot be considered as a pure agglomeration effect.

The methodology consists of including three more explanatory variables, which are the percentage of firms active in the industry under consideration, the percentage of firms active in manufacturing and the percentage of firm active in services. Including these three variables allow to better disentangle from agglomeration and competition effects. In particular, I show in this last chapter that German multinational firms may benefit from demand and cost linkages from different sectors.

7.2 Future Research

The two last chapters have taken into account the facts that multinational firms might be heterogenous but does not further analyze these issues. The degree of firm heterogeneity within an industry affects strategic decisions of firms with regard to the internationalization of their activities. Few studies have been regarding this issues since the theoretical models of multinational firms are based on the assumption that firms are symmetric (Helpman *et al.* 2004). This symmetry assumption allows to analyze a representative firm in each country in order to derive implications for aggregate or sectoral FDI. The effect of firm heterogeneity on the internationalization of activities is a promising avenue for future research that I would like to explore. A first paper that goes in that direction is entitled "Heterogeneity and FDI: Evidence from Firm-level Data" [with Claudia M. Buch and Joern Kleinert].

This paper draws inference with regard to differences in the determinants of German foreign investment for the size of foreign affiliates and the number of firms investing

in a given host country. It compares the results of using different level of aggregation for German foreign direct investment. One result of this paper is that proximity has a differential effect on the size of the foreign affiliate and the number of firms being present in a given host country. More specifically, many small affiliates tend to be set up in nearby markets whereas few but on average larger affiliates tend to be set up in distant markets. For aggregate FDI, the effect of proximity on the number of firms dominates. Hence, we find that there is more FDI in geographically close countries, and especially in those with which Germany shares a common border.

Different effects of distance on the number and size of foreign affiliates are a mirror image of the differential effect of aggregated bilateral trade on these two measures of German multinational activities. Whereas there is a positive link between aggregated FDI (and the number of German affiliates in a given market) and trade, the link is negative for the size of the affiliate. One interpretation of this result is that affiliates, which are production units and therefore substitute trade, are larger in size. An affiliate set up for distribution might be smaller (with regard to the equity investment it requires) than a production unit.

Another particular source of firm heterogeneity results from differences in the complexity of the production process. Firms have backward and forward linkages to a different degree. Production is scarcely a one-stage process but involves various intermediate inputs. The agglomeration of multinational firms have been introduced in chapter 6 of this dissertation but need a much more structural approach.

These are several promising avenues for future research that I want to explore.

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Appendix A: The Dynamic Panel: Construction of Variables

The following list describes the construction of the variables used in the empirical analysis. The subscript i refers to the home country while j refers to the host country, t is the period. All the data have been converted in US dollars. The data sources are reported in Table B.1.

1. Endogenous Variable

Foreign Direct Investment (FDI) are taken from the OECD International Direct Investment Statistic Yearbook and European Union Foreign Direct Investment Yearbook. The data are in million US dollars.

According to the OECD, "A direct investment enterprise is an incorporated enterprise in which a foreign investor owns 10 percent or more of the ordinary shares or voting power for an incorporated enterprise or an unincorporated enterprise in which a foreign investor has equivalent ownership. Ownership of 10 percent of the ordinary shares or voting stock is the guideline for determining the existence of a direct investment relationship."

(OECD, <http://www.OECD.org/dataoecd/56/1/2487495.pdf>).

2. Market Potential

MK_{jt} denotes the market potential of the host country. This market potential is not only related to the domestic market but also to the market of all the neighbouring countries. We measure MK_{jt} by taking into account the host internal transportation costs proxied by the distance in minutes and the transportation costs between the host and home country.

- In a first step, we compute the weighted arithmetic distance d_{ijt} over all region-to-region distances $\delta_{kk'}$ between country j and i . R_i is defined as the set of all regions in country i and \widetilde{GDP}_{kt} the GDP of region k at time t .

$$d_{ijt} = \sum_{k \in R_j} \sum_{k' \in R_i} \frac{\widetilde{GDP}_{kt}}{GDP_{jt}} \frac{\widetilde{GDP}_{k't}}{GDP_{it}} \delta_{kk'}$$

- In a second step, we introduce the transportation costs in the calculation of market potentials for each year:

$$MK_{jt} = \sum_i \frac{GDP_{it}}{d_{ijt}}$$

This variable is transformed in logarithm.

3. Trade Costs

$TARIFF_{jt}$ is the trade cost proxy for country j . We consider the tariff revenues as percentage of imports. To account for the possibility that the effect on FDI depends on the size of the host country, we multiply this measure with the log average of GDP of the host country.

4. Relative Unit Labor Costs

$RULC_{ijt}$ is the relative unit labor cost between the host county j and the home country i :

$$RULC_{ijt} = 100 \times \frac{ULC_{jt}}{ULC_{it}},$$

where ULC_{jt} , the unit labor cost of Eastern European Countries, are computed as $ULC_{jt} = \frac{W_{jt} * E_{jt}}{GDP_{jt}}$ with W_{jt} the average monthly gross wage, E_{jt} the total employment and GDP_{jt} the gross domestic product in millions US\$. The unit labor costs of the reporting countries ULC_{it} are calculated as $ULC_{it} = \frac{C_{it}E_{it}}{GDP_{it}e_{it}}$ with C_{it} the compensation of employees, E_{it} the total employment, e_{it} the wage and salary earners and GDP_{it} the gross domestic product in millions US\$.

5. Relative Investment-Labor Ratio

RKL_{ijt} measures the relative investment-labor ratio between country j and country i :

$$RKL_{ijt} = \ln \frac{K_i}{L_i} - \ln \frac{K_j}{L_j},$$

where K is gross fixed capital formation and L is employment.

6. Relative Factor Endowments

$SKILL_{jt}$ measures the relation of skilled to total labor in CEECs:

$$SKILL_{jt} = \frac{EDU_{jt}^3 + EDU_{jt}^2}{EDU_{jt}^3 + EDU_{jt}^2 + EDU_{jt}^1},$$

with EDU_{jt}^h being the gross education enrollment, $h = 1, 2, 3$, where $h = 3$ denotes tertiary education, $h = 2$ secondary education and $h = 1$ primary education.

7. Corporate Tax Rate

TAX_{ijt} is the corporate tax rate which also controls for the different fiscal regimes

$$TAX_{ijt} = TAX_{jt} - TAX_{it}.$$

- If the investing country has adopted an exemption scheme, the above calculation applies.
- If the investing country has adopted a (partial) credit scheme and $TAX_{it} > TAX_{jt}$, then $TAX_{ijt} = 0$.
- If the investing country has adopted a (partial) credit scheme and $TAX_{it} < TAX_{jt}$, then the above calculation applies.

8. Private Market Share

$PRIV_{jt}$ is the market share of private businesses in country j as percent of GDP.

9. Method of Privatization

$METH_{jt}$ indicates the method of privatization that has been used in Eastern Europe. We follow Holland and Pain (1998) and construct the $METH_{jt}$ variable as follows:

Ranking	Primary Method	Secondary Method
5	SOO	-
4	SOO	Voucher or MEBO
3	Voucher or MEBO	SOO
2	Voucher or MEBO	MEBO or Voucher
1	Voucher or MEBO	-

We use the abbreviations SOO and MEBO for Sales to Outside Owners and Managers and Employees Buy-Outs, respectively. Additionally, we split the variable into 5 dummies: M_{jt}^1 to M_{jt}^5 each corresponding to the method used at time t .

10. Country Risk

$RISK_{jt}$ is the political risk index taken from various issues of Euromoney. It is defined as the risk of non-payment or non-servicing payments for goods or services,

loans, trade-related finance and dividends and the non-repatriation of capital. This variable takes values from 10 (nil risk of non-payment) to 0 (no chance of payments). Countries are scored in comparison both with each other and with the previous year.

Appendix B: The Dynamic Panel: Data Sources

Table B.1 The Dynamic Panel data Sources

Variable Name	Label	Sources
Foreign Direct Investments	FDI	OECD International Direct Investment Statistic Yearbook, European Union Foreign Direct Investment Yearbook. several editions.
Market Potential	MK_{jt}	The GDP data were taken from the World Development Indicators (2001) . Regional GDPs and distances were kindly provided by Prof. Johannes Bröcker (see Bröcker and Richter, 1999).
Trade Costs	$TARIFF_{jt}$	EBRD (2001)
Relative Unit Labor Costs	$RULC_{ijt}$	European Economy (2002); the Vienna Institute of International Economic Studies (2001); International Labor Office, several editions.
Skill Ratio	$SKILL_{jt}$	UNICEF (2001) The World Development Indicator, several editions.
Relative Factor Endowments	RKL_{ijt}	The gross fixed capital formation was taken from the Transition Report (2001). The employment variable comes from the World Development Indicators (2001).
Corporate Tax Rate	TAX_{ijt}	PriceWaterhouseCoopers, several editions.
Private Market Share	$PRIV_{jt}$	EBRD (2001).
Methods of Privatization	$METH_{jt}$	EBRD, several editions; Holland and Pain (1998); Böhm A. Simoneti M., (1993-1995).
Country Risk	$RISK_{jt}$	Euromoney, several editions.

Appendix C: German Production in Eastern Europe: Construction of Variables

The following list describes the construction of the variables used in the empirical analysis. The subscript i refers to the German multinational firm while j refers to the host country. The subscript s refers to the sector of activity of a multinational firm in country j and t is the period. All the data have been converted in US dollars.

1. Endogenous Variable

The foreign activity of **an individual German multinational** i of a country j is the sum of its foreign affiliates' sales invested in a particular country j . Sales are originally in German Mark (until 1998) and Euro (from 1999 on) and are converted to millions of 1995 U.S. dollars using exchange rate information and the consumer price index from International Financial Statistics and the World Development Indicators, respectively.

From the firm-level database, I add up, for each sector, the sales of all foreign affiliates that a German multinational firm maintains in each sector of a country at time t . After having aggregated the data, I transform them by taking their logarithm. Taking the log of sales may introduce a small bias since about 3% of the observation were zero and thus dropped.

2. Market Potential

MK_{jt} denotes the market potential of the host country. This market potential is not only related to the domestic market but also to the market of all the neighbouring countries. We measure MK_{jt} by taking into account the host internal transportation costs proxied by the distance in minutes and the transportation costs between the host and home country.

- In a first step, we compute the weighted arithmetic distance d_{ijt} over all region-to-region distances $\delta_{kk'}$ between country j and i . R_i is defined as the set of all regions in country i and \widetilde{GDP}_{kt} the GDP of region k at time t .

$$d_{ijt} = \sum_{k \in R_j} \sum_{k' \in R_i} \frac{\widetilde{GDP}_{kt}}{\widetilde{GDP}_{jt}} \frac{\widetilde{GDP}_{k't}}{\widetilde{GDP}_{it}} \delta_{kk'}$$

- In a second step, we introduce the transportation costs in the calculation of market potentials for each year:

$$MK_{jt} = \sum_i \frac{GDP_{it}}{d_{ijt}}$$

This variable is transformed in logarithm.

3. Trade Costs

$Tariff_{jt}$, the trade cost proxy for country j , is taken from the Heritage Foundation. The sub-index of foreign entry restriction is based on a country's weighted average tariff rate weighted by imports from the country's trading partners. The index runs from 1 to 5 and the higher the tariff rate, worse (or higher) the index. Tariffs, however, are not the only barriers to trade. Many countries impose import quotas, licensing requirements, and other mandates known collectively as non-tariff barriers (NTBs) to restrict imports. The circumstances are analyzed and documented whenever possible. This sub-index also considers corruption within the customs services.

4. Relative Factor Endowments

$RSKILL_{jt}$ is the ratio of the percentage skilled labor in Germany to the percentage skilled labor of the host country.

$$RSKILL_{jt} = 100 \times \frac{X_{Germany_t}}{X_{jt}}$$

where X is the percentage of workforce with tertiary education. This is measured as professional, technical and associated professionals, other professionals and managerial workers. Skill information is from the International Labor Organizations (ILO) Yearbook of Labor Statistics and the ILO web site.

5. Degree of Internationalization of a German Firm

$SIZE_{jt}$ is a measure for the degree of internationalization of a German multinational firm. It is a count variable that informs on the number of countries in which the firm is active. This variable is transformed in logarithm.

6. Exchange Rate Regimes

The exchange rate regimes variables are taken from the IMF and grouped following the Von Hagen and Zhou (2002) methodology. Since the mid-1990s, there has been

a tendency to move towards exchange rate regimes that are either relatively flexible or very rigid.

The Czech Republic, Poland and the Slovak Republic abandoned their crawling pegs in favor of more or less managed floats. Romania and Slovenia have retained floating regimes since the early years of transition although in practice Slovenia severely limits exchange rate movements. Hungary is the only country still maintaining a conventional crawling band. In contrast, Bulgaria and the Baltic States operate hard pegs: currency boards in Bulgaria, Estonia and Lithuania, and a conventional peg with a zero fluctuation band in Latvia. While Bulgarias and Estonias currency boards are tied to the euro, Lithuanias currency board is tied to the dollar and Latvias peg is to the SDR¹.

The methodology is given in Table C1:

¹ Special Drawing Right. An artificial currency unit based upon several national currencies. The Special Drawing Right serves as the official monetary unit of several international organizations including the International Monetary Fund, and acts as a supplementary reserve for national banking systems.

Table C1: The Exchange Rate Regimes

Exchange Rate Regime	Descriptions	Groups
1. Dollarization, euroization 2. Currency Board 3. Conventional Fixed Pegs	No separate legal tender Currency fully backed by foreign exchange reserves Peg to another currency or currency basket within a band of at most +/- 1%	$FIXED_{jt}$
4. Horizontal Bands 5. Crawling Pegs 6. Crawling Bands	Pegs with bands larger than +/- 1% Pegs with central parity periodically adjusted in fixed amounts at a pre-announced rate or in response to changes in selected quantitative indicators Crawling pegs combined with bands larger than +/- 1%	$INTER_{jt}$
7. Managed float 8. Independent Float	Active intervention without precommitment to a preannounced target or path for the exchange rate Market-determined exchange rate with monetary policy independent of exchange rate policy	$FLOAT_{jt}$

7. Private Market Share

$PRIV_{jt}$ is the market share of private businesses in country j as percent of GDP.

8. Method of Privatization

$METH_{jt}$ is an index for the method of privatization used in Eastern Europe from Holland and Pain (1998). The variable takes the following values:

$METH_{jt} = 5$ if SOO is the primary method,

$METH_{jt} = 4$ if SOO is the primary and voucher or MEBO is a secondary method,

$METH_{jt} = 3$ if voucher or MEBO is the primary and SOO is a secondary method, $METH_{jt} = 2$ if voucher or MEBO is the primary and voucher or MEBO is a secondary method, and

$METH_{jt} = 1$ if voucher or MEBO is the only method.

The abbreviations SOO and MEBO refer to sales to outside owners and managerial and employee buy-outs, respectively. After 1996, $METH_{jt} = 1$ is not implemented anymore. Since Estonia and Hungary are the only country to report sales to outside owners as sole primary method, we decided to group the method of privatization into three groups. *Direct*, which is the more open to multinational firms, regroups $METH_{jt} = 4$ and $METH_{jt} = 5$. *Voucher* or mass privatization corresponds to $METH_{jt} = 3$. *Insider* is the sale of domestic firms through MEBO or voucher ($METH_{jt} = 2$).

9. Country Risk

$RISK_{jt}$ is a political risk index taken from various issues of Euromoney. It is defined as the risk of non-payment or non-servicing payments for goods or services, loans, trade-related finance and dividends and the non-repatriation of capital. This variable takes values from 10 (nil risk of non-payment) to 0 (no chance of payments). Countries have been scored in comparison both with each other and with the previous year.

10. Commercial Framework

$LEGAL_{jt}$ is a commercial legal indicator taken from the EBRD. It is based on two criteria: the extensiveness and effectiveness of legal reform. For commercial law, extensiveness is measured based on the impact of a jurisdiction pledge, bankruptcy and company law on commercial transactions. For financial markets, extensiveness is assessed on the basis of whether banking and capital markets' legal rules approach minimum international standards.

Effectiveness of legal reform measures the extent to which commercial and financial legal rules are clear, accessible and adequately implemented, both administratively and judicially. Extensiveness score must be read in conjunction with effectiveness scores.

The overall legal score is the average of the scores given for the two indicators rounded down (EBRD,2000, p.25). This score is an ordinal variable and is split into four dummy variables for Central and Eastern European countries.

11. **Political Framework**

$FREE_{jt}$ is a freedom index taken from the Freedom House (<http://www.freedomhouse.org>). It is an index running from 1 through 7, whereby a value of 1 indicates the highest degree of political freedom and liberty. This index is an ordinal variable and is split into four dummy variables for Central and Eastern European countries.

Appendix D: German Production in Eastern Europe: Data Sources

Table D1: The Data Sources

Variables Name	Label	Sources
German Multinational Sales	$SALES_{jt}$	Deutsche Bundesbank.
Market Size	MK_{jt}	Regional GDPs and distances were kindly provided by Prof. Bröcker <i>et al.</i> (2001).
Trade costs	$TARIFF_{jt}$	Heritage Foundation, several editions
Relative Factor Endowments	$RSKILL_{jt}$	Key Indicators of the Labour Market (2001-2002).International labour Organization.
Internalization	$SIZE_{it}$	Deutsche Bundesbank.
Exchange Rate Regimes	$FIXED_{jt}$ $INTER_{jt}$ $FLOAT_{jt}$	Von Hagen, J., Zhou, J. (2002)
Private Market Share	$PRIV_{jt}$	EBRD, several editions
Methods of Privatization	<i>Direct</i> <i>Voucher</i> <i>Insider</i>	Holland and Pain (1998); EBRD, several editions
Country Risk	$Risk_{jt}$	Euromoney. Several Editions
Legal Framework	$LEGAL_{jt}$	EBRD, several editions
Political Freedom	$FREE_{jt}$	www.freedomhouse.org

Appendix E: The Geography of German multinational activities: Construction of Variables

The following list describes the construction of the variables used in the empirical analysis. The subscript i refers to the German multinational firm while j refers to the host country. The subscript s refers to the sector of activity of a multinational firm in country j and t is the period. All the data have been converted in US dollars.

1. Endogenous Variable

The foreign employment of **an individual German multinational** i in a sector s of a country j is the sum of its foreign affiliates' employment in sector s of a country j .

From the firm-level database, I add up, for each sector, the employment of all foreign affiliates that a German multinational firm maintains in each country at time t . Since the companies have been changed each year before 1996, it is not possible to trace a particular German multinational back to 1990.

2. The Market Potential

The potential demand for good and services produced in any one location depends upon the distance weighted GDP of all location. In this chapter, the market potential is derived from Redding S., Venables A.J., (2000). *Economic Geography and International Inequality. CEPR Discussion Paper No. 2568* and published as Redding S., Venables A.J., (2004). *Economic Geography and International Inequality. Journal of International Economics*, Vol. 62, p. 53-82. They extend traditional market potential measures to improve their treatment of domestic market and exploit information on the distance coefficient from a gravity model. The use of trade data allows revealing both observed and unobserved determinants of market potential.

(a) The Theoretical foundation

The theoretical framework is based on a Dixit-Stiglitz model of monopolistic competition and trade, extended to have transport frictions in trade and

intermediate goods in production¹. Let E_j denotes total expenditures on manufacture by country j . Given this expenditure, country j 's demand for each product is

$$x_{kj} = p_{kj}^{-\sigma} E_j G_j^{\sigma-1} \quad (\text{E.1})$$

where p_{kj} is the delivered price faced by a consumer in j for varieties from k . It is the product of the mill price p_k and the iceberg trade cost, T_{kj} , paid by consumers². The own price elasticity of demand is σ and the term $E_j G_j^{\sigma-1}$, gives the position of the demand curve facing each firm in market j . It is the market capacity of country j ; it depends on the total expenditure in j and the number of competing firms and the price they charge, this is summarized in the price index, G_j .

The equation above gives the volume of sales per firm to each location, and expressing it in aggregate value gives exports from k to j of

$$n_k p_k x_{kj} = n_k p_k^{1-\sigma} (T_{kj}^{1-\sigma}) E_j G_j^{\sigma-1} \quad (\text{E.2})$$

The right-hand side of this trade equation contains both demand and supply variables. The term $E_j G_j^{\sigma-1}$ is country j market capacity, as defined above. On the supply side, the term $n_k p_k^{1-\sigma}$ measures the supply capacity of the exporting country; it is the product of the number of firms and their price competitiveness. In addition, the term $T_{kj}^{1-\sigma}$ measures bilateral transport costs between countries.

Redding and Venables (2000, 2004) estimate the trade equation in order to obtain empirical estimates of bilateral transport costs between countries and of each country's market and supply capacities. Labelling these m_k and s_k , respectively, they are defined as

¹ This model follows Fujita *et al.* (1999) but only focuses on the manufacturing sector.

² if $T_{kj} = 1$ then trade is costless, while $T_{kj} - 1$ measures the proportion of output lost in shipping from k to j .

$$\begin{aligned} m_j &\equiv E_j G_j^{\sigma-1}, \\ s_k &\equiv n_k p_k^{1-\sigma} \end{aligned} \tag{E.3}$$

This allows the trade equation to be rewritten as (E.4):

$$n_k p_k x_{kj} = s_k (T_{kj}^{1-\sigma}) m_j \tag{E.4}$$

Redding and Venables (2000, 2004) estimate this equation on bilateral trade flow data and obtain prediction for $(T_{kj}^{1-\sigma}) m_j$ and $s_k (T_{kj}^{1-\sigma})$ for each exporting country k and importing partner j . For our purpose, only the market capacity are of interests.

The market potential of each exporting country k , MK_k is defined as:

$$MK_k = \sum_j (T_{kj}^{1-\sigma}) m_j \tag{E.5}$$

Using predicted values of $(T_{kj}^{1-\sigma}) m_j$, from the trade equation, the empirical prediction for the market potential is constructed

(b) Trade Equation Estimation

Data on bilateral trade flows for each cross-section of 70 countries are obtained from the World Bank's Trade and Production database on the internet (1996-1999)³. The trade data are combined with information on economic and geographical country characteristics.

The value of bilateral trade flows in the trade equation depends upon country and partner GDP data (Y_k and Y_j , respectively), and transportation costs. The bilateral component of the transportation costs is modelled using data on the distance between capital cities ($dist_{kj}$) and a dummy for whether an exporting country and importing partner share a common border ($bord_{kj}$).

³ The cross-section used in this chapter is smaller than the cross-section used in Redding and Venables (2000, 2004). However the Trade and Production database comprises the main partner of the country used in this chapter

Trade barriers and transport costs are also captured by dummy variables for whether exporting countries and importing partners are land-locked ($llock_k$ and $llock_j$, respectively), islands (isl_k and isl_j , respectively). The trade equation (E.4) becomes:

$$\begin{aligned} \ln(X_{kj}) = & \theta + \mu \ln(Y_k) + \lambda \ln(Y_j) + \delta_1 \ln(dist_{kj}) + \delta_2 (bord_{kj}) \\ & + \delta_3 (isl_k) + \delta_4 (isl_j) + \delta_5 (llock_k) + \delta_6 (llock_j) + v_{kj} \end{aligned} \quad (\text{E.6})$$

where $\ln(X_{kj})$ denotes the log of the value of exports from country k to partner j , and v_{kj} is a stochastic error. There are a certain number of zero bilateral trade flows. I follow Redding and Venables (2004) and add 1 to all trade flows before taking logarithms⁴.

The model is estimated using the Tobit estimator that takes into account the censored nature of the data. The results are presented in Table E1 for the year 1994 in order to compare the estimates with the results of Redding and Venables (2000, 2004).

⁴ Obviously, this makes the endogenous variable dependent of the scale retained. The aim is to be close as possible as Redding and Venables (2004).

Table E1: Results from the Trade Equation Estimation

Independent Variables	Redding and Venables	Own results
$\ln(dist_{kj})$	-1,46***	-1,51***
$\ln(Y_j)$	1,13***	1,31***
$\ln(Y_k)$	1,34***	1,50***
$llock_j$	-0,99***	-0,62***
$llock_k$	-0,86***	-1,75***
isl_j	0,31***	0,32***
isl_k	0,33***	1,05***
$Open_j$	1,36***	
$Open_k$	0,85***	
$bord_{kj}$	1,57**	0,92**
Pseudo R^2	0,197	0,135
<i>Obs.</i>	9506	7361

Tobit estimation for 1994. The Sachs and Warner (1995) measure of international openness *Open* is not available for the time series considered

All variables are correctly signed according to economic priors and statistically at 5 % level. The distance and land-locked have negative effects on trade, while the common border, island have positive effects. The international measure of openness was not available for the time series that we consider in this chapter and so was not included in the gravity equation above. Overall, the results are consistent with those of Redding and Venables.

(c) Market Potential Construction

The coefficients of the country and partner variables in the trade equation (E.6) provide estimates of the market capacities of each country. The distance, border, land-locked and island coefficient provide estimates of the bilateral transport costs measure. These give the weights that combine market capacities in the construction of market potential. For each year of analysis, the estimated market potential is defined as:

$$\hat{M}\hat{K}_k = D\hat{M}A_k + F\hat{M}A_k = (Y_k^\lambda)(T_{kk}^{1-\sigma}) + \sum_{j \neq k} (Y_j^\lambda) \cdot dist_{kj}^{\hat{\delta}_1} \cdot bord_{kj}^{\hat{\delta}_2} \cdot \Delta$$

$$\Delta = [exp(isl_k)]^{\hat{\delta}_3} [exp(isl_j)]^{\hat{\delta}_4} [exp(llock_k)]^{\hat{\delta}_5} [exp(llock_j)]^{\hat{\delta}_6}$$

The market potential is split into a domestic and foreign component (DMA and FMA respectively). The reason is that the gravity equation (E.6) does not provide with estimates of intra-country transport cost measures ($T_{kk}^{1-\sigma}$). The intra-industry transport costs are approximated using the formula $dist_{kk} = 0.66(area/\pi)^{1/2}$, to give the average distance between two points in a circular country. DMA is thus constructed using $T_{kk}^{1-\sigma} = dist_{kk}^{\hat{\delta}_1}$.

The market potential is computed for each year 1996 to 1999. I take the logarithm of this variable.

3. The Number of German Firms.

The computation of the N_{jt} variable follows Head *et al.* (1995). It consists of a count of German multinational firms in a host country j plus one. This method assumes that an individual multinational firm taking the decision to invest in a host country, takes its own investment into account in the anticipated level of agglomeration or competition. I take the logarithm of this variable.

$Nser_{jt}$ is the ratio of the cumulated number of German firms active in other services sectors than the own sector of activities over the cumulated number of German firms in services and manufacturing. Defining $s = 1, \dots, S_2$ as being the number of sectors, where $1, \dots, S_1$ are the services sectors and $S_1 + 1, \dots, S_2$ are the manufacturing sectors, and $F(s)$, a German firm in sector s , then

$$Nser_{s jt} = 100 \times \sum_{\substack{i=1 \\ i \neq s}}^{S_1} F(i) / \sum_{i=1}^{S_2} F(i)$$

Similarly, $Nman_{jt}$ is the ratio of the cumulated number of German firms active in other manufacturing sectors than the own sector of activities over the cumulated number of German firms in services and manufacturing. It is defined as:

$$Nman_{sjt} = 100 \times \sum_{\substack{i=S_1+1 \\ i \neq s}}^{S_2} F(i) / \sum_{i=1}^{S_2} F(i)$$

4. Sectoral Unit Labor Costs.

ULC_{sjt} is logarithm of the sectoral unit labor cost of the host countries. ULC_{jt} is calculated as:

$$ULC_{sjt} = \frac{W_{sjt} * E_{sjt}}{output_{sjt}}$$

with W_{sjt} the average earning per worker in sector s in US\$, E_{sjt} the total employment in sector s , $output_{sjt}$ is the sectoral output in millions US\$.

5. Relative factor endowments.

$RSKILL_{jt}$ is the difference between the ratio of skilled labor to total labor force in Germany and the host country.

$$RSKILL_{jt} = 100 \times \frac{X_{Germanyt}}{X_{jt}}$$

skilled workers are defined as professional with technical and managerial skills *i.e* the labor force with tertiary education. Information on skills are from the International Labor Organization's (ILO) Yearbook of Labor Statistics and the ILO web site.

6. Parent Company Size.

$SIZE_{it}$ is the logarithm of the worldwide number of affiliates of an individual German multinational.

7. Country Risk.

$RISK_{jt}$ is the political risk index taken from various issues of Euromoney. It is defined as the risk of non-payment or non-servicing payments for goods or services, loans, trade-related finance and dividends and the non-repatriation of capital. This variable takes values from 10 (nil risk of non-payment) to 0 (no chance of payments). Countries were both scored in comparison with each other and with the previous year.

8. Regional Dummy Variables.

EU takes the value of one for the member states of the European countries for which data are available (Austria, Belgium, Denmark, Finland, France, Italy, Netherlands, Portugal, Sweden, United Kingdom).

Accession is set to one for the Eastern European countries that are to enter the EU or that candidate to enter into the EU (Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovak Republic, Slovenia).

Finally, *OECD* takes the value of one for other OECD members (Canada, Japan, Mexico, South Korea and United States of America).

To avoid perfect collinearity the first regional dummy, *EU* is omitted.

Appendix F: The Geography of German multinational activities: Data Source

Table F1: The Geography of German multinational activities, the Data Sources

Variables Name	Label	Sources
German Multinational Foreign Activities	Y_{isjt}	Deutsche Bundesbank.
Market Size	MK_{jt}	Trade data are from the Worldbank Trade and Production database on the internet(http://www.worldbank.org/). GDPs are from the World Development Indicators CD-rom. Border, Island, Land-locked and area comes from the CIA World Factbook on the internet (http://www.cia.gov/cia/publications). The Bilateral distances come from the CEPII distance database on the internet (http://www.cepii.fr).
Number of German Multinational	N_{jt}	Deutsche Bundesbank.
Share of the number of German Multinationals	$Nser_{jt}, Nman_{jt}$	Deutsche Bundesbank.
Sectoral Unit Labor Costs	ULC_{jt}	Wage and Employment from the Vienna Institute of International Economic Studies and the International Labor Office on internet (http://laborsta.ilo.org/) Output from the OECD STAN database and the Vienna Institute of International Economic Studies
Relative Factor Endowments	$RSKILL_{jt}$	Key Indicators of the Labour Market (2001-2002). International labour Organization.
Country Risk	$RISK_{jt}$	Euromoney

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Eidesstattliche Versicherung

Ich versichere hiermit an Eides Statt, dass ich die Dissertation, "The Spatial and Sectoral Distribution of Multinational Activities in Eastern Europe", selbständig angefertigt habe, alle von anderen Autoren wörtlich übernommenen Stellen und sich an die Gedankengänge anderer Autoren eng anlehnenden Ausführungen besonders gekennzeichnet und keine anderen als die in der Dissertationsschrift angegebenen Hilfsmittel benutzt habe.

Ich versichere an Eides Statt, dass ich mich an keiner anderen Fakultät einer Doktorprüfung oder Staatsprüfung unterzogen habe. Meine Prüfung zum Master in International Economics habe ich an der Univerisität Lille abgeschlossen.

Tübingen, 08.09.2004

(Farid Toubal)

Hilfsmittel

Die Berechnungen in Kapitel 4 sind mit Hilfe der Mathematik-Software Matlab durchgeführt worden. Die Berechnungen in Kapitel 5 und 6 sind mit Hilfe der Ökonometrie-Programmpakets Stata 7 SE und Stata 8 SE.

Die Schaubilder in Kapitel 2 und 3 wurden mit WinWord und Excel erstellt.

Tübingen, 08.09.2004

(Farid Toubal)