Country Risk and Foreign Direct Investments in Transition Countries

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Chapter 1

Introduction

The process of economic globalization appears in the from of international trade in goods and services, shorter-term capital movements among countries and, more recently, a rapid increase in foreign direct investments (FDI). FDI refer to long term cross-border investments with a substantial influence on the part of the investing multinational enterprise.

Worldwide FDI inflows volumes increased from 13 billion US$ in 1970 up to 58 billion US$ in 1985. Again 15 years later, it received a more than 20 times higher level of about 1,300 billion US$ in 2000.[1] This fact led to a rising interest of economists in the causes and consequences of FDI for the host economies and the countries of origin. In particular, the question raised to what extend FDI could bring new technologies and know-how to local firms in the host economy, and thus contributes to its economic development. On the other hand, people and governments fear that jobs are leaving their country in record numbers if local multinational enterprises invest abroad.

With the fall of the iron curtain during 1989/1990 Central and Eastern European Countries (CEEC) started to transform their planned economies into market economies. CEEC as well as the states of the former Soviet Union

[1]Source: UNCTAD [2004].

removed restrictions towards FDI at the beginning of the Nineties. Hence, Western multinational enterprises received additional investment opportunities. As a consequence, the role of FDI in CEEC and the Commonwealth of Independent States (CIS) has grown dramatically over the course of the 1990s. FDI inflows increased from about 580 million US$ in 1990 to approximately 36,000 million US$ in 2002. After a sharp decline in 2003 by about one third, they recovered in 2004 reaching the former level.[2] Table 3.2 shows the development of FDI inflows by selected host countries in transition compared to worldwide inflows for the period 1990-2003 and the cumulated inflows over this period. During the last decade, all countries in transition attracted a growing amount of FDI. Among these countries, 61% of FDI inflows are observed into the EU-accession countries of 2004. In the early stage of transformation, Hungary had been most successful in attracting FDI receiving 54% of all inflows into transition countries.

[2]Sources: UNCTAD and EBRD estimates.

Table 1.1: FDI Inflows, by Host Region and Economy, 1990-2003
(Millions of US Dollars, Selected Countries)

	1990	1995	1999	2000	2001	2002	2003	1990-2003[a]
World	208,646	335,734	1,086,750	1,387,953	817,574	678,751	559,576	7,454,132
Developed countries	171,109	204,426	828,352	1,107,987	571,483	489,907	366,573	5,205,241
CEEC and CIS	577	16,996	29,029	29,398	29,897	35,735	27,044	260,040
EU Members	569	12,194	18,564	20,329	18,393	22,588	11,459	159,214
Czech Republic	72	2,568	6,310	4,984	5,639	8,483	2,583	40,118
Estonia	0	202	305	387	542	284	891	4,067
Hungary	311	5,103	3,312	2,764	3,936	2,845	2,470	38,471
Latvia	0	180	347	411	163	384	360	3,393
Lithuania	0	73	486	379	446	732	179	3,799
Poland	89	3,659	7,270	9,341	5,713	4,131	4,225	54,758
Slovakia	93	258	428	1,925	1,584	4,123	571	10,923
Slovenia	4	152	106	137	369	1,606	181	3,685
Other CEEC	4	830	4,149	3,870	4,717	4,490	6,943	35,297
Bulgaria	4	90	819	1,002	813	905	1,419	6,446
Croatia	0	114	1,467	1,089	1,561	1,124	1,713	9,295
Romania	0	419	1,041	1,037	1,157	1,144	1,566	10,425
Serbia and Montenegro	0	45	112	25	165	475	1,360	3,319
CIS	4	3,973	6,316	5,199	6,788	8,657	8,641	65,529
Azerbaijan	0	330	510	130	227	1,392	3,285	8,661
Kazakhstan	0	964	1,472	1,283	2,835	2,590	2,068	16,853
Russian Federation	0	2,065	3,309	2,714	2,469	3,461	1,144	27,968
Ukraine	0	267	496	595	792	693	1,424	6,713

[a]Note: Cumulated inflows. Source: UNCTAD [2004]

A multinational enterprise has to make various decisions when undertaking an FDI abroad. First it has to decide whether to invest at all. Second, the question arises whether it should locate the entire production process abroad. Alternatively the production process could be segmented internationally which means to produce intermediate goods and final goods in different countries. These types of investments are called horizontal and vertical FDI respectively.[3] Furthermore, the investor has to decide how to enter the foreign market: Should it built up an entirely new plant which means to undertake a greenfield investment or buy an already existing firm. The latter mode of entry can be realized via mergers and acquisitions (M&A). Table 3.1 gives an overview of the number of cross-border M&A-sales from 1990 to 2003. The worldwide amount of M&A-sales more than trebled during the last decade. About 75% of all transactions during the whole period have been undertaken in developed countries. A remarkably growing number of transactions can be observed during the last decade in countries in transition. Among these group, especially in Poland, Hungary and the Czech Republic the highest amount of cross-border M&A have been realized. Based on a survey of 1050 investment projects, Marin et al. [2002] find that about 44% of FDI flows were accounted for by M&A. The multinational enterprise further has to decide whether to include a partner or not. Hence, the ownership structure and the multinationals' shares on equity has to be taken into account.[4] Finally, the investor has to decide about the timing of foreign market entry.

The economic environment has a substantial influence on all these deci-

[3] It not possible to make a clear cut differentiation between both types of FDI empirically. From a firm survey, Protsenko [2003] estimates that the share of vertical FDI ranges between 50% to 70%, depending on the definition of vertical FDI. Marin et al. [2002] estimate that about 28% of Eastern European affiliates' sales are delivered to their German parents firms.

[4] Marin et al. [2002] report that about 55% of German FDI in CEEC and the CIS are fully-owned affiliates.

sions. Especially in the beginning of the transition process in CEEC and the CIS, multinational enterprises faced a number of potential sources of risks. In case of foreign direct investment decisions these are typically country risks such as an unstable legal environment, the protection of property rights, risks concerning the profit transfer, exchange rate risks and an unstable macroeconomic environment, crime and corruption and so on.

The questions analyzed in this thesis are: does uncertainty or country risk affect

- the investors' decision about the mode of entry (greenfield investment versus acquisition)?
- the decision when to enter a foreign market?
- the profits from horizontal and vertical FDI in different ways? As a consequence, does uncertainty affect the decision between horizontal and vertical production?

The empirical parts of the thesis confirm the theoretical results and suggest that country risks really play an important role in all of these decisions.

Table 1.2: Number of Cross-border M&A Sales
by Host Region and Economy, 1990 - 2003 (Selected Countries)

	1990	1995	1999	2000	2001	2002	2003	1990-2003[a]
World	2,503	4,247	6,994	7,894	6,034	4,493	4,562	63,784
Developed countries	2,299	3,197	5,148	5,834	4,430	3,213	3,124	48,359
CEEC and CIS	14	276	541	646	476	413	391	4,018
EU Members	10	205	378	441	331	246	202	2,705
Czech Republic	-	44	93	114	81	45	42	601
Estonia	1	13	37	37	28	13	19	198
Hungary	7	57	80	89	44	42	39	645
Latvia	-	10	18	16	16	8	17	107
Lithuania	-	2	36	20	19	16	14	131
Poland	2	69	97	131	108	82	49	825
Slovakia	-	6	12	31	25	24	18	146
Slovenia	-	4	5	3	10	16	4	52
Other CEEC	2	21	106	115	87	88	88	664
Bulgaria	2	5	38	30	19	27	18	195
Croatia	-	6	8	17	14	16	11	101
Romania	-	7	50	48	27	20	25	237
Serbia and Montenegro	-	1	-	1	1	15	20	44
CIS	2	50	57	90	58	79	101	649
Azerbaijan	-	-	1	2	-	2	7	17
Kazakhstan	-	3	2	4	4	8	11	71
Russian Federation	2	40	33	51	34	47	48	385
Ukraine	-	6	14	29	15	12	17	114

[a]Note: Total number between 1990 and 2003. Source: UNCTAD [2004]

1.1 Definitions, Brief Literature Survey on FDI and Contribution of the Thesis

The main difference between FDI and other capital flows like portfolio investments is, that FDI refers to an investment made to acquire "lasting interest" in enterprises operating outside of the economy of the investor. Further, the investors purpose is to gain an effective voice in the management of the enterprise. Hence, the IMF suggests a threshold of 10 per cent of equity ownership to qualify an investor as a foreign direct investor. The necessary existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence on the management of the enterprise are the main characteristics of FDI to differentiate them from portfolio investments.[5]

The Ownership, Location and Internalization (OLI) Paradigm (Buckley and Casson [1976], Dunning [1977]) has been an early attempt to create an overall framework to explain why multinational enterprises choose FDI rather than serve foreign markets through alternative modes such as licensing or exporting. The OLI Paradigm states that a firm must first have some competitive advantage in its home market that can be transferred abroad if the firm is to be successful in FDI. Second, the firm must be attracted by specific characteristics in the foreign market that will allow it to exploit its competitive advantage in that market. And finally, the firm will maintain its competitive position by attempting to control the entire value chain in its industry. This leads it to foreign direct investment rather than licensing or outsourcing.[6]

Another strand of research explains the formation of multinational enterprises by differences in factor proportions between countries. Helpman [1984] shows that firms internationally separate the production process from

[5]See IMF [1993].

[6]For an overview and a discussion of the OLI Paradigm, see Markusen [1995].

headquarters activity as they have different factor intensities. The low-skilled intensive production should be located in the low skilled worker abundant country in order to equalize factor prices between countries. Taking up this idea, Helpman [1985] developed a model with multi-product firms and differentiated final goods. As these goods are produced with different factor intensities, factor-price-equalization allocates production of this varieties in different countries. Altogether, these models explain the existence of vertical FDI by differences between countries. Vertical FDI means that the investor separates the production chain internationally.[7] This view that FDI is mainly motivated through differences between countries has been rejected by Brainard [1993]. He shows that multinational activity is more likely the more similar the home and the foreign markets are.[8] One model explaining FDI between similar countries has been developed by Markusen [1984]. He introduces firm-level scale economies as a driving force: Two-plant firms have fixed costs that are less than double those of a single-plant firm, which is the motive for multinational production. Here multinationals are defined as firms that produce the same product in multiple plants, serving local markets by local production. Thus the model gives an explanation for the occurrence of horizontal FDI. These models have been extended by Horstmann and Markusen [1987, 1992] and Brainard [1993].[9] As a result, additionally high transport costs and trade barriers make horizontal FDI more likely. "Knowledge-Capital-Models" of the multinational enterprise combine both horizontal and vertical motives for direct investment. Markusen et al. [1996] and Markusen [1997] demonstrated how both types of firms can arise endogenously due to the simultaneous existence of trade costs and different factor intensities.

[7]Marin et al. [2002] report evidence for vertical FDI for German investors in CEEC.

[8]This explains the fact that the majority of FDI occurs between developed countries. (See Table 3.2.)

[9]See Markusen [2001] for an overview.

Apart from the issue of why FDI occurs, an important debate has risen around its consequences on the host countries. In particular one subject of interest in the literature is, whether FDI inflows affect productivity of host firms and enhances economic growth in the host country. This might due to the chance to adopt managerial and workers' skills or due to technology transfer. Given that firm-specific advantages exist, FDI speeds the international diffusion of new technologies and other efficiency-enhancing intangible assets like organizational skills. Borenzstein et al. [1998], Xu [2000] or for the case of transition countries, Protsenko [2003] find a positive influence from FDI. On the other hand, Djankov and Hoeckman [2000], Konings [2001] and Damijan et al. [2001] find negative spillover effects on the productivity of domestic firms in CEE counties.

The decision about the entry mode of multinational enterprises into a foreign country has been analyzed only in a few theoretical studies. In principle the foreign investor has the option to acquire an existing company (or shares) in the host country or to set up an entirely new plant, which is referred to be a greenfield investment. Buckely and Casson [1998], Görg [2000] and Müller [2002] find that the competition intensity in the foreign market determine the decision between greenfield investment and acquisition. Furthermore, the technological intensity and the technological gap between the investor and the affiliate play an important role. Empirical studies of the entry mode choice focus on factors like the investors degree of diversification, advertising intensity, the relative size of the subsidiary to that of the investor, the growth of demand in the target market and others (e.g. Hennart and Park [1993]). Also the investors technological level is an important determinant on the entry choice. Various studies suggest that high R&D expenditures increase the probability for greenfield investment (e.g. Hennart and Park [1993], Andersson and Svensson [1994], Meyer [1998], Brouthers and Brouthers [2000], Harzing [2002]).

In contrast to the decision about the entry mode, the empirical research on the timing of entry into a foreign market has received relative small attention. Theories suggest different factors being responsible for the timing of FDI. Buckley and Casson [1981] show how the cost structure of alternative market serving strategies, which are exporting or licensing on the one hand and FDI on the other, influence the timing decision. According to Dixit and Pindyck [1994] most investment projects share three important characteristics: Irreversibility of the investment, uncertainty about the cash flows and the possibility for the investor to delay the investment. By developing an option model applied on real investments they find how uncertainty affects the timing decision. Based on OLI advantages, Rivoli and Salorio [1996] find other factors which make the delay of the FDI valuable. However, most empirical literature analyzes the impact of uncertainty on aggregated domestic investment (e.g. Aizenman and Marion [1993b], Brunetti and Weder [1998]) or on investment at the firm level.[10] On the other hand, the timing of FDI decisions at the firm level had also been considered empirically. However, for instance Kogut and Chang [1996], Tan and Vertinsky [1996], Blandon [2001] and Gaba et al. [2002] either do not analyze the impact of uncertainty on the decision when to enter a foreign market or the studies are limited to one host country only.

Most investment decisions, in particular FDI decisions are made in an uncertain environment. Uncertainty in the case of cross-border investments typically occurs in the form of country specific risk.

The aim of this thesis is to analyse the impact of country risk on various FDI decisions. In the next chapter we will define various measures of country risk and develop a measure for exchange rate risk for Central and Eastern European Countries and the former Soviet Union. In Chapter 3 we raise the question whether country risk has an influence on the decision how to enter a

[10] See Leahy and Whited [1996] for a survey.

foreign market, via greenfield investment or via acquisition. A simple model explains the driving forces presumed to be influential for this decision. In the second part, an empirical analysis will be presented to test the implications from the model.

Chapter 4 analyzes the timing decision of a foreign direct investment into Central and Eastern European Countries and the former Soviet Union. From a real options approach it will be derived that country risk decreases the probability of investment at an early stage. A Cox proportional hazard model with firm level data from FDI in transition countries is used in order to test the predictions from the theoretical model.

Chapter 5 explores the impact of uncertainty and country risk on the expected profits from horizontal and vertical investment separately. As a result from the theory, uncertainty negatively affects expected profits of a multinational enterprise engaged in a vertical FDI, whereas it potentially increases profits associated with horizontal FDI. On the one hand, from an ex-post point of view the empirical investigation supports this result. From an ex-ante point of view, uncertainty should have an impact on the decision of the multinational enterprise whether to realize a vertical or a horizontal FDI.

1.2 The Database: Firm Survey of Austrian and German FDI into Countries in Transition

The empirical parts of this thesis mainly base on firm survey data of German and Austrian foreign direct investments in Central and Eastern Europe and in the countries of the former Soviet Union. The survey was conducted by the Chair of International Economics at the University of Munich and was funded by the German Science Foundation (DFG), the Volkswagenstiftung and the Austrian Nationalbank. The data we use contain 2,115 investment projects of 688 German and Austrian firms in transition countries during the period 1990 to 2001.[11]

The firm survey represents about 80% of total German investment projects and includes nearly all Austrian investments in Eastern Europe during the period 1990 to 2001. The survey was carried out during the period from 1998 to 2001 and all investors were queried only once so that no panel data is available.

According to the criteria of the German Bundesbank, German firms had been surveyed if they hold a minimum of 20% of shares in a foreign company and if the investment volume is at least one million DEM.[12] According to the criteria of the Austrian Nationalbank, Austrian firms must hold at least 10% of shares and the investment volume must be at least 1 Mio. ATS.[13]

In a first part, the data contain information about the parent company such as balance sheet, number of employees and sales, organizational patterns and others. The second part provides detailed information about the foreign affiliate. Finally, data about the relationship to the parent firm and partners, market environment and motivations had been conducted.

[11] 1,179 investments are from German multinational enterprises and 936 from Austrian. The number of German and Austrian firms depends on the exactly definition of the investor as some multinational enterprises have legal independent firms which have undertaken the FDI.

[12] 500 thousand DEM in case of service providers.

[13] 500 thousand ATS in case of services.

Chapter 2

Measuring Country Risks

Numerous empirical and theoretical studies have highlighted the importance of uncertainty for investment decisions. A new perspective of this issue had been offered by real option theories. These theories point out that uncertainty has a negative impact on investment decisions if the investment projects are delayable and to some degree irreversible.[1]

Empirical investigations indeed have found a negative relationship between aggregated investment and various measures of uncertainty. Most studies find a negative impact of macroeconomic volatility on private investment. These macroeconomic volatility measures are inflation and exchange rate volatility (e.g. Serven and Solimano [1993], Aizenman and Marion [1995], Darby et al. [1999]). Other studies focus on the impact of political uncertainty on investment. Barro [1991] finds that government instability (the number of revolutions) and political violence (the number of assassinations) are significantly negatively correlated with investments. Similar results yield Keefer and Knack (1995) accounting for uncertainties in property rights enforcement. Lensink et al. [1999] construct various uncertainty measures with respect to interest rates, inflation, taxes and others which negatively affect

[1]See Pindyck [1991], Dixit and Pindyck [1994], and Trigeoris [1996].

growth rates in a cross section of countries.

Less attention had been given to the role of uncertainty on foreign direct investment decisions. Some studies focus on the entry decisions of foreign firms under exchange rate uncertainty (for instance Campa [1993]) whereas other consider composite country risk measures (Gaba et al. [2002], Wezel [2004], Deutsche Bundesbank [2005]).

One important source of uncertainty which makes foreign direct investment different to local investments is the occurrence of country specific risks. Country risks in case of foreign direct investments are the potential volatility of foreign stocks, due to political or economic events in the country.[2]

The literature distinguishes between risk and uncertainty. Risk occurs when the outcome is uncertain, but the probabilities of all outcomes are known or estimable. Uncertainty on the other hand refers to a situation where probabilities are unknown. In this sense, one aim of an investor is to reduce uncertainty by learning about the risk concerning the profits or the value of the firm, coming from the variability of the future state of the economy. Therefore, country risk indices support the investor by reducing uncertainty and detecting the variability potential of the profits and therefore the value of the investment undertaken abroad. As a consequence, the value of a FDI becomes less uncertain but remains risky.[3]

Country risk is separated into several categories such as (1) economic risk, (2) transfer risk, (3) political risk, (4) sovereign risk and (5) exchange rate risk. These categories overlap each other and maybe the one of them might have an influence on another.[4]

Economic risk captures the potential for changes in the country's com-

[2]See Gunter [1992] or Nordal [2002]. Calverly [1990] provides an overview.

[3]For practical purposes, in the following analysis risk and uncertainty are treated as synonyms.

[4]Nordal [2001] distinguishes country risk in a similar way.

parative advantage or in the government's economic policy goals. Measures are institutions like the degree of regulation or property rights, tax policy, government expenditures or inflation. Transfer risk arises from foreign government's restrictions on capital movements and may be a political response to a permanent growing current account deficit. It can be measured as trends in the external financing gap or debt over GDP ratios. Political risk covers cultural and ethnic risk, socio-economic risk or changes in political institutions. Consequently, typical measures are the type of the political structure, the ethnic structure or the incidence of violence. Sovereign risk comes from the government's inability or unwillingness to fulfill its loan obligations. Beside problems of the distinction between the motivations of the government, it does not affect the investment decision of a multinational in a high extent. Exchange rates affect the profits of a foreign affiliate via international trade contracts and of the multinational enterprise when transferring the profits of the FDI. Exchange rates volatility often detects unstable macroeconomic policies since they may arise from varying interest rates, inflation rates or business cycles.

A risk affecting the decisions of a multinational enterprise which invests abroad is different to one that is related to an international portfolio investment or to a lender to a foreign government. The very long time horizon of the direct investment and its specific operational characteristics must be taken into account. For this reason, sovereign risk seems to be less important. Transfer risk remains difficult to quantify and it plays probably not a major role for FDI compared to other types of investment: Beside potential profit transfers, in the short run the aim of the multinational will not be bringing back the complete invested assets. It is also difficult to measure political risk and it remains not clear how profits and therefore the investor's decision are affected.

Within the firm survey of the Chair of International Economics at the

Table 2.1: Rating of Sources of Risk

Profit transfer	3.85
Failure of the banking sector	3.83
Expropriation	4.26
Exchange rate risk	2.95
Change in tax and customs policy	2.97
Insecure property rights	3.68
Unstable macroeconomic environment	3.00
Political turnaround	3.38
Corruption	3.18
Crime and mafia	3.86

Source: Firm Survey, Chair for International Economics, University of Munich (from 1 - most important to 5 - not important at all)

University of Munich, 688 multinational enterprises which had undertaken 2,115 investments in countries in transition were asked to rate different sources of risks in the host country from 1 "most important" to 5 "not important at all". As a result from the survey, Table 2.1 suggests that exchange rate risks seem to be the most important source of risk, followed by economic risks such as a change in tax and customs policy and unstable macroeconomic environment. Expropriation risks which are sometimes also subsumed with sovereign risks are not considered to be relevant.[5]

In the following sections we will discuss some measures of country risk from the literature and from organizations and compare the resulting data for the case of Central and Eastern European Countries and countries from the Commonwealth of Independent States.

[5]Unfortunately the risk ratings from the firm survey rather reflect subjective evaluations from the investor than being a objective database for the occurence of risk. Nevertheless, the responds offer some insights concerning the relevance of different sources of risks.

2.1 Economic risks

Economic risks are estimated for example by indices provided by the EBRD.[6] These indices cover liberalization, privatization, infrastructure and others.

According to this classification, Table 2.4 gives some indices covering economic risk for CEEC and countries of the CIS. The indices range from from 1: "little progress" up to 4: "typical for advanced industrialized countries". All reported countries performed towards more economic liberalization in respect of each index considered. As expected, the countries joining the European Union since May 2004 made higher efforts to liberalize markets than the other CEEC, which are basically Southern and Eastern European Countries. These in turn achieve slightly higher values indicating more liberalization than the CIS.

The question occurs whether economic liberalization is a substantial source of risk for a multinational enterprise. Country risks which are of particular importance to a multinational enterprise affect the profits or the value of a foreign affiliate. Also the host country's competition policy might be not the best indicator for changes in government's economic policy goals or for changes in the country's comparative advantage. On the other hand, the EBRD's "Rating of legal effectiveness" could adequately measure the protection of property rights as an intangible asset and therefore captures the risk of the value of a foreign affiliate. Unfortunately, there is no data for this index available until 1996.

[6]See European Bank for Reconstruction and Development, Transition Report,several issues.

Table 2.2: Economic Risk Indices

	Index of price liberalization IOPL		Index of enterprise reform IOER		Index of competition policy IOCP		Rating of legal effectiveness ROLEF		Index of infrastructure reform IOIR	
	1989-95	1996-03	1989-95	1996-03	1989-95	1996-03	1989-95	1996-03	1989-95	1996-03
CEEC										
EU Members										
Czech Republic	3.0	3.0	2.6	3.1	2.4	3.0		3.4	2.2	2.7
Estonia	2.6	3.0	2.4	3.0	1.6	2.4		3.8	2.1	2.9
Hungary	3.0	3.3	2.8	3.2	2.4	3.0		3.8	2.7	3.4
Latvia	2.8	3.0	1.8	2.8	1.8	2.3		3.1	1.7	2.6
Lithuania	2.6	3.0	1.6	2.8	1.6	2.4		3.2	1.2	2.3
Poland	3.0	3.2	2.6	3.1	2.6	3.0		3.7	2.2	3.1
Slovak Republic	3.0	3.0	2.6	2.9	2.4	3.0		2.9	1.2	1.9
Slovenia	3.0	3.3	1.9	2.7	1.6	2.3		3.7	1.7	2.6
Other CEEC										
Albania	2.4	3.0	1.4	2.1	1.0	1.6		1.9	1.1	1.5
Bulgaria	2.8	2.8	1.4	2.3	2.0	2.3		3.6	1.3	2.2
Croatia	3.0	3.0	1.4	2.7	1.0	2.3		3.3	1.6	2.1
Macedonia	3.0	3.0	1.4	2.1	1.0	1.3		3.1	1.3	1.8
Romania	2.6	3.1	1.6	2.0	1.0	2.1		3.7	1.0	2.4
CIS										
Armenia	2.5	3.0	1.2	2.0	1.0	1.2		2.4	1.3	2.1
Azerbaijan	2.4	3.0	1.1	1.8	1.2	2.0		1.8	1.0	1.4
Belarus	2.0	2.2	1.1	1.1	1.6	2.0		2.3	1.0	1.2
Georgia	2.5	3.1	1.2	2.0	1.0	2.0		2.4	1.0	1.9
Kazakhstan	2.0	3.0	1.0	2.0	1.4	2.0		3.0	1.2	2.0
Kyrgyzstan	2.4	3.0	1.4	2.0	1.4	2.0		2.5	1.2	1.3
Russia	2.6	2.9	1.3	2.0	2.0	2.3		2.8	1.6	2.0
Ukraine	1.6	3.0	1.2	2.0	1.8	2.3		2.2	1.0	1.5

Source: EBRD, classified from 1: "little progress" up to 4: "typical for advanced industrialized countries"

2.2 Exchange Rate Volatility

Exchange rate volatility is a common measure in order to capture exchange rate risks as a kind of country risk. Different measures have been used in the literature in order to quantify the uncertainty about underlying variables like interest rates, inflation, exchange rates and others. This measures include the normal statistical variance, the variance of the unpredicted part of a stochastic process, the conditional variance estimated from the general autoregressive conditional heteroskedastic (GARCH) model and the variance estimated from an geometric Brownian motion.[7] Authors who calculated the standard deviations of the exchange rate (Kenen and Rodrik [1986]) have been criticized because this procedure does not take into account expectations of future exchange rates. Hence, an appropriate exchange rate risk measure should capture the unexpected deviations of the current spot exchange rate from its expected value - the past forward exchange rate. Therefore, fluctuations in exchange rates should not be considered as a risk as long as they can be anticipated by the market participants. Unfortunately, such an index of exchange rate volatility cannot be constructed in the case of CEEC because forward markets do not exist in each country over the period of interest. Also Goldberg [1993] analyzed the impact of exchange rate volatility on investments in the US. Darby et al. [1999] calculate the deviation from the trend in exchange rates. For instance, Lensink et al. [1999] calculate the standard deviation of the unpredictable part (the residuals) of a stochastic process of interest rates, inflation, exports and others. Taking up this idea, we construct an index of exchange rate uncertainty as follows: First, we estimate the following second order autoregressive equation with a time trend for each country j from monthly data taken from "Datastream"

$$exr_{jt} = a + b \cdot trend_j + c \cdot exr_{jt-1} + d \cdot exr_{jt-2} + \epsilon_{jt} \qquad (2.1)$$

[7] See Lensink et al. [1999] for a discussion.

where exr_{jt-x} is the nominal exchange rate in country j at time (month) $t-x$ ($x = 0, 1, 2$), ϵ_{jt} is the error term of this regression equation and a, b, c, d are coefficients to be estimated.

As a second step, the standard deviation of the monthly residuals is calculated for each year and each country. In order to account for the level of the exchange rate, the standard deviation is normalized by the mean exchange rate. This resulting risk index, the variation of errors one makes with the model in equation (2.1), therefore is comparable between countries.

The data on exchange rates covers 21 Central and Eastern European Countries (CEEC) as well as the Commonwealth of Independent States (CIS).[8] The period is from 1990 up to 2002 if data is available. The residuals for each country from forecasting the exchange rates using equation (2.1), are plotted in Figure 2.1 in the Appendix.[9] As a result, a yearly exchange rate risk index had been constructed for each country. On the one hand it directly measures the variability of exchange rates. On the other hand also uncertain macroeconomic policy is captured: Unanticipated movements in macroeconomic variables would lead to abrupt deviations of the actual exchange rate from its predicted value coming from equation (2.1).

The development of the exchange rate risk index is reported in Table 2.3. Within the group of accession countries in 2004, Lithuania turns out to have the most predictable and thus less risky exchange rate. In contrast, Poland bears the highest exchange rate uncertainty within this group, indicating that exchange rates are less predictable. Within the other CEEC, Croatia and Macedonia do not suffer from highly incalculable exchange rate movements.

[8] Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Macedonia, Poland, Romania, Russia, Slovakia, Slovenia and Ukraine

[9] Note that Figure 2.1 shows the progress of deviations between actual and predicted exchange rates. Consequently one should not consider levels of the deviations but their volatility and extreme amplitudes.

Within the CIS, for Azerbaijan the same is true, achieving levels of country risk comparable with Lithuania. In the beginning Nineties, exchange rates in Poland, Bulgaria and Romania exhibited a large unexpected volatility. In Belarus exchange rate sharply depreciated in 2000 so that the exchange rate uncertainty measure highly increased. The reason is that the National Bank of Belarus accelerated the devaluation of the official exchange rate from BRB 320/US$ at the beginning of the year up to 1,020 in mid-September. The official exchange rate was then unified with the four main non-official exchange markets and a crawling peg exchange rate system was introduced.

Table 2.3: Country Risk Index based on Unpredicted Exchange Rate Volatility
(Standard deviation of residuals divided by the mean of exchange rates)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
CEEC														
EU Members														
Czech Republic					0.017	0.012	0.018	0.014	0.020	0.029	0.027	0.034	0.019	0.021
Estonia				0.035	0.025	0.018	0.028	0.011	0.021	0.021	0.019	0.031	0.021	0.023
Hungary	0.031	0.017	0.033	0.016	0.021	0.023	0.014	0.008	0.015	0.013	0.017	0.031	0.022	0.020
Latvia				0.069	0.033	0.009	0.017	0.007	0.011	0.012	0.009	0.011	0.007	0.019
Lithuania					0.059	0.006	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.008
Poland	0.414	0.117	0.033	0.034	0.016	0.009	0.014	0.008	0.015	0.040	0.025	0.031	0.020	0.060
Slovak Republic					0.033	0.010	0.017	0.011	0.014	0.015	0.023	0.043	0.014	0.020
Slovenia						0.018	0.027	0.015	0.020	0.023	0.020	0.032	0.021	0.022
Other CEEC														
Albania				0.271	0.024	0.029	0.017	0.035	0.064	0.019	0.017	0.022	0.015	0.051
Bulgaria			0.444	0.137	0.099	0.097	0.042	0.291	0.309	0.024	0.019	0.030	0.026	0.138
Croatia					0.159	0.023	0.026	0.015	0.058	0.017	0.022	0.029	0.020	0.041
Macedonia						0.021	0.017	0.015	0.044	0.021	0.020	0.031	0.022	0.024
Romania	0.493	0.457	0.676	0.082	0.037	0.041	0.023	0.022	0.076	0.019	0.025	0.010	0.004	0.151
CIS														
Armenia				0.234	1.053	0.069	0.015	0.018	0.017	0.004	0.015	0.010	0.007	0.144
Azerbaijan							0.006	0.005	0.001	0.002	0.015	0.001	0.002	0.005
Belarus										0.156	0.376	0.147	0.020	0.175
Georgia								0.007	0.004	0.061	0.044	0.024	0.010	0.025
Kazakhstan						0.066	0.041	0.009	0.005	0.005	0.061	0.004	0.002	0.024
Kyrgyz Republic					0.081	0.055	0.012	0.033	0.022	0.053	0.043	0.011	0.011	0.036
Russia				0.179	0.083		0.010	0.006	0.006	0.242	0.021	0.015	0.003	0.063
Ukraine					0.391	0.378	0.054	0.016	0.009	0.084	0.045	0.010	0.002	0.110

Source: Data Stream, Own Calculations

2.3 Composite Country Risk Measures

The aim of composite country risk indices is to offer institutional and private investors aggregated information regarding the level of uncertainty in host economies. The use of sub-indices is a typical way of making a risk index. Usually, these sub-indices measure economic, financial, and political risk. This makes aggregated country risk comparable between different countries. Several banks and private institutions like Standard and Poors, Moodys, The Economist Intelligence Unit (EIU), International Country Risk Guide (ICRG) or magazines like the *Euromoney* regularly publish such indices.

Previous studies using the *Euromoney* country risk index have found an significant impact on the location choice of multinational banks (Yamori [1998], Wezel [2004], *DeutscheBundesbank* [2005]). It is a synthetic indicator of investor perceptions that takes into account several categories of economic and institutional performance. The index has the following composition: 25% political risk, 25% economic performance (GNP per capita etc.) 10% debt indicators, 10% debt in default or rescheduled, 10% credit ratings, 5% access to bank finance, 5% access to short-term finance, 5% access to capital markets, 5% discount on forfeiting.[10] Table 2.4 shows the development of the *Euromoney* country risk index. On the average, the ten new EU-members seem to be more stable than the other CEEC, which again outperform the CIS.

[10] The index is published by *Euromoney* annually in in March and September.

Table 2.4: Composite Country Risk Index from *Euromoney*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
CEEC														
EU Members														
Czech Republic			53.36	54.89	66.20	73.91	74.61	74.54	71.23	61.96	60.19	36.38	34.92	62.73
Estonia			24.20	23.35	33.50	49.40	49.79	53.21	61.77	54.38	54.34	47.26	41.50	45.12
Hungary	60.80	52.00	54.47	54.92	60.70	60.18	67.65	70.06	70.80	65.75	61.83	27.44	25.44	59.12
Latvia			23.00	21.70	33.54	35.59	44.21	55.04	59.06	50.67	52.08	44.61	40.03	41.95
Lithuania			24.05	21.36	32.68	35.42	45.14	52.52	57.43	50.14	50.10	63.78	59.50	43.26
Poland	43.00	40.50	36.47	35.78	41.81	47.89	56.53	56.58	68.05	62.06	61.67	30.47	16.50	47.60
Slovak Republic			44.02	45.32	46.31	57.92	64.88	63.46	61.63	48.33	48.44	40.00	38.54	52.03
Slovenia			34.22	42.19	43.06	61.27	66.30	73.97	75.15	70.06	71.28	53.55	49.10	59.11
Other CEEC														
Albania	27.00	16.70	18.47	17.77	27.77	24.73	40.13	29.58	24.59	17.49	28.18	35.02	37.83	25.62
Bulgaria	34.70	22.60	29.90	24.78	38.05	40.74	40.87	35.07	40.78	37.87	39.75	80.79	66.00	40.07
Croatia			26.54	26.36	26.29	30.84	47.53	57.58	54.47	54.04	47.08	54.71	54.73	42.54
Macedonia				29.65	25.53	26.43	36.81	35.60	31.82	25.33	32.02	4.46	6.30	27.52
Romania	43.30	30.70	35.84	36.94	43.00	48.69	51.95	51.65	52.96	36.28	33.80	25.31	23.87	40.96
CIS														
Armenia			15.05	13.58	17.77	27.93	28.33	27.50	34.03	21.22	28.34	29.85	30.00	24.36
Azerbaijan			15.20	13.66	20.71	11.95	17.27	22.75	29.79	33.39	34.98	67.10	64.74	26.68
Belarus			21.15	18.75	23.75	28.96	32.19	22.70	31.52	27.69	29.14	25.61	26.50	26.15
Georgia			17.62	15.57	22.07	19.06	26.40	14.03	26.56	26.81	26.30	62.53	61.70	25.70
Russia			21.77	18.13	25.96	27.78	40.60	43.97	50.72	20.86	30.00	31.91	31.94	31.17
Ukraine			23.01	19.17	22.73	26.39	31.17	29.31	31.76	29.85	29.96	92.68	74.30	33.60

from 0 (highly risky) to 100 (absolutely safe) Source: Euromoney magazine, several issues

2.4 Comparison of Country Risk Indices

Table 2.5 compares the country risk indices discussed and shows their correlation coefficients. All indices show expected correlations between each other. The volatility of exchange rates *exrunc* is negatively correlated with all other indices as it has low levels for low volatility and vice versa whereas the other show low levels if risk or transition progress appears to be comparable with developed countries.

The correlation between the *Euromoney* index (*euromon*) and the different transition progress indices from the EBRD is relatively high. This is due to the composition of *euromon*. Also within the indices provided by the EBRD there exist high and positive correlations which are nearly all significant at a 5 percent level. All those indices base on subjective ratings and seem to measure similar effects covering the progress in transition.

We will use the country risk index from *Euromoney* and the exchange rate uncertainty index *exrunc* for further analysis in the next chapters of the thesis. The exchange rate uncertainty has the smallest correlation coefficients to all other indices and therefore it seems to capture a different source of risk. Furthermore, in contrast to the EBRD indeces, this index relies on hard facts and not on subjective evaluations. Moreover according to the firm survey, exchange rate risks have been seen to be most important to decision makers in multinational enterprises. We will not use the EBRD indeces because of two reasons. First, the question rises whether the progress in transition towards market economy is a good measure for economic risks. Beside this, as the correlation coefficients of the composite index *euromoney* and the EBRD indeces are in between 50% and 70%, it makes less sence to rely on both types of measures.

In order to make *exrunc* and *euromoney* directly comparable, the latter will be transformed by 100 minus the index which ensures that high scores indicate high levels of country risk.

Table 2.5: Correlations between Risk Indices

		euromoney	exrunc	iopl	ioer	iocp	rolef	ioir
euromon	Composite index	1.0000						
exrunc	Exchange rate uncertainty	-0.2765	1.0000					
iopl	Price liberalization	0.3349	-0.4241	1.0000				
ioer	Enterprise reform	0.7046	-0.5051	0.6106	1.0000			
iocp	Competition policy	0.5961	-0.2794	0.4782	0.7609	1.0000		
rolef	Legal effectiveness	0.4814	-0.0491	0.2091	0.5045	0.4335	1.0000	
ioir	Infrastructure reform	0.6043	-0.2824	0.4474	0.7445	0.6334	0.6362	1.0000

Note: All indeces except *exrunc* show low levels if environment is unstable and high levels otherwise. Hence, the negative signs of the correlation coefficients with *exrunc* indicate that correlation is positive with respect to stability.

2.5 Appendix

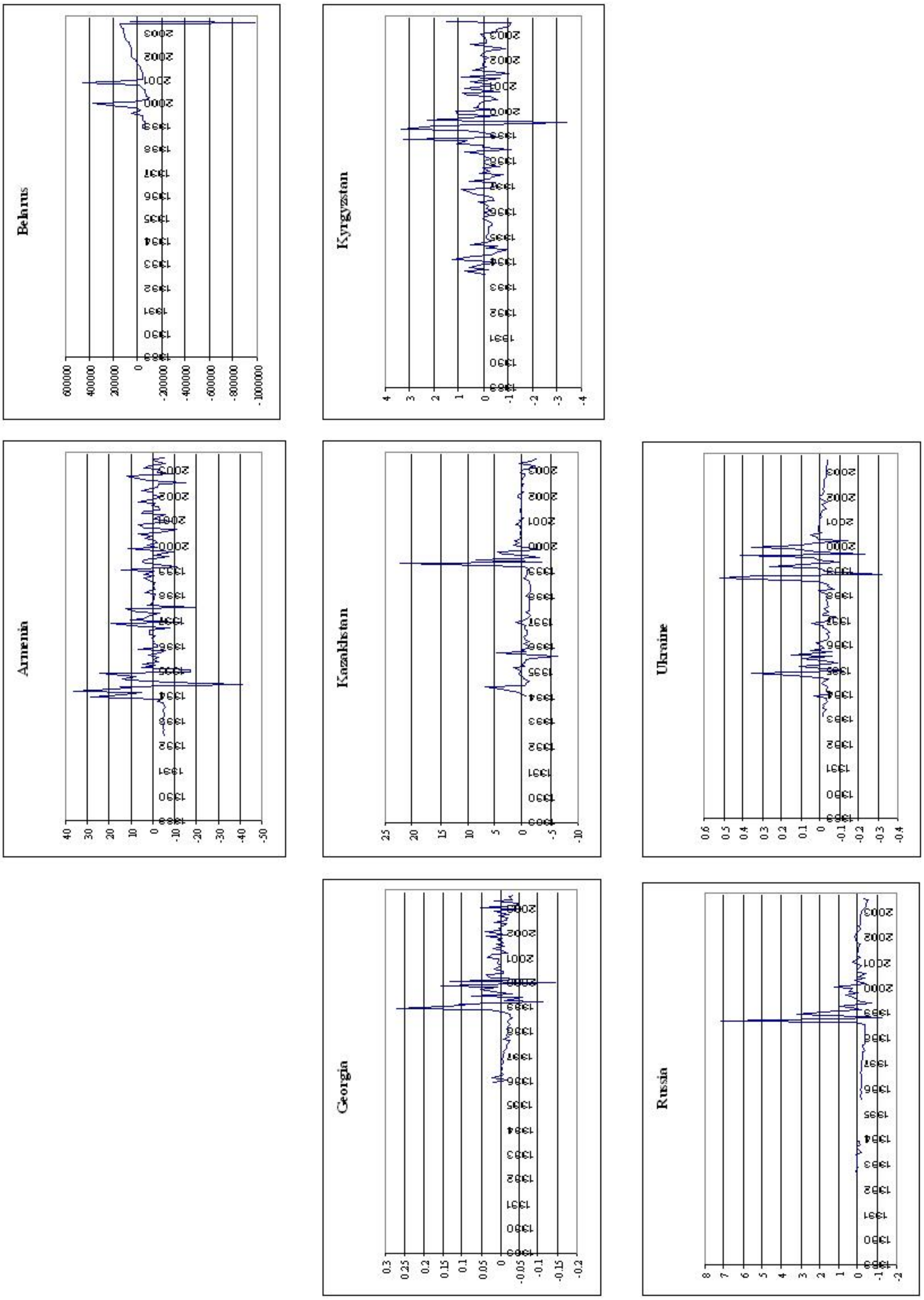

Figure 2.1: Residuals from Exchange Rates Forecasts
Commonwealth of Independent States

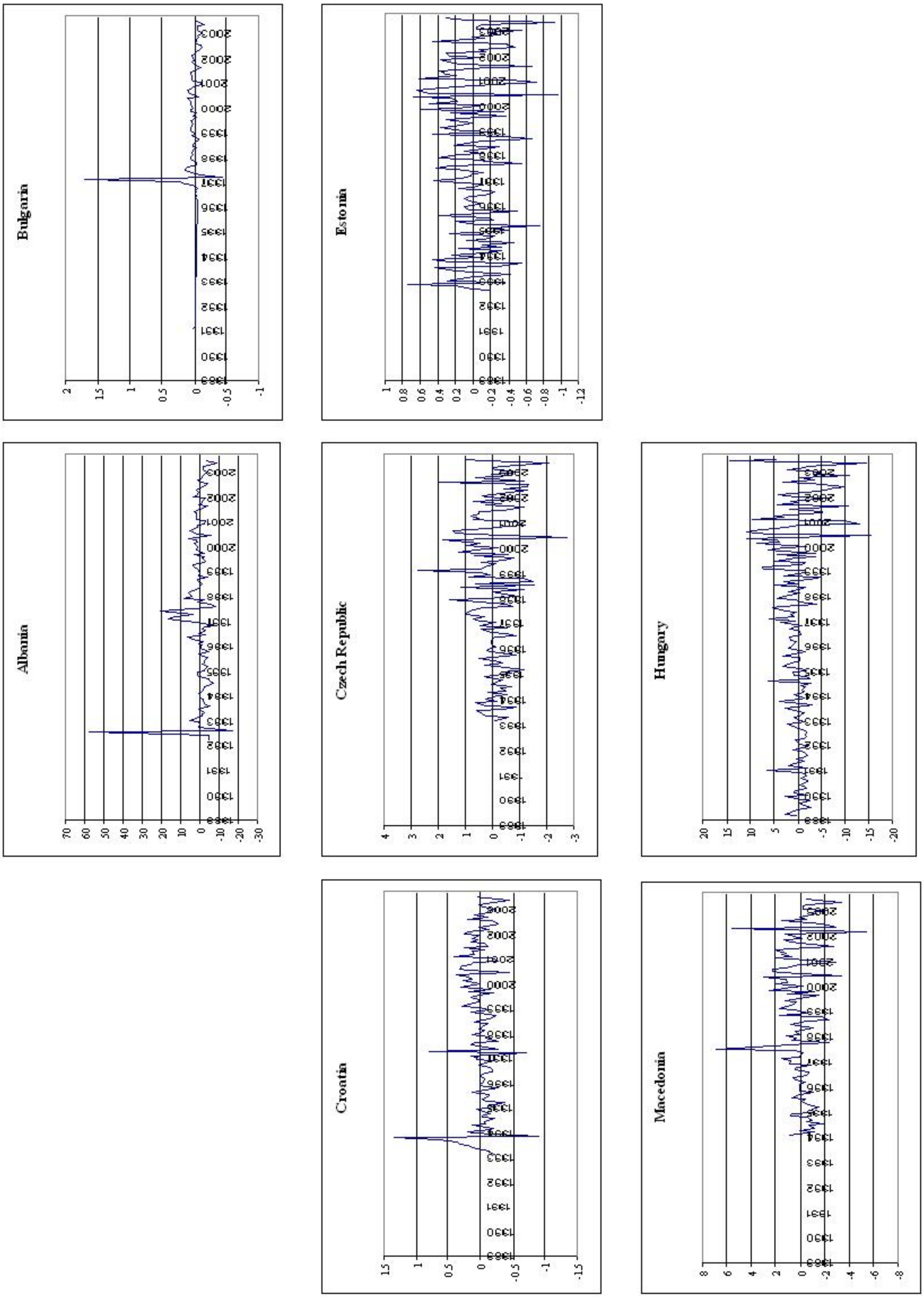

Figure 2.1 (Continued): Residuals from Exchange Rates Forecasts
Central and Eastern European Countries (1)

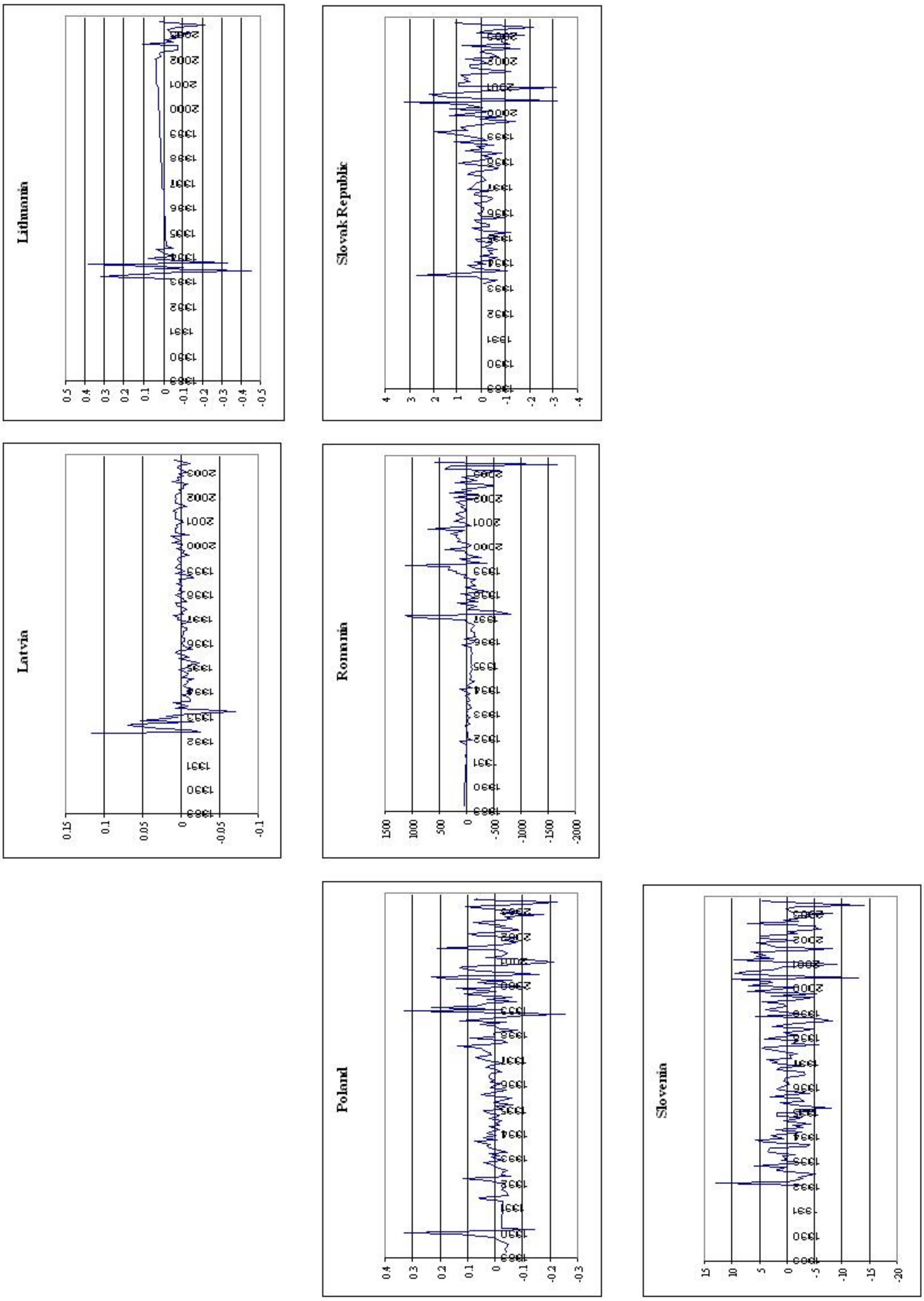

Figure 2.1 (Continued): Residuals from Exchange Rates Forecasts
Central and Eastern European Countries (2)

Chapter 3

Country Risk and the Decision between Greenfield Investment and Acquisition

3.1 Introduction

A multinational enterprise (MNE) has to make a decision between two types of market entry when investing abroad: The MNE can either acquire (or merge with) an already existing firm in the host country or invest greenfield, i.e. set up a new plant in the host country.

Within the literature less attention was attracted to the impact of uncertainty and country risks on the entry mode decision. Caves [1982] points out that takeovers are less risky than greenfield investments, indeed they yield a lower expected rate of return. In contrast, Anderson and Gatignon [1986] analyze the degree of control an entrant will demand in the presence of uncertainty. They state that investors will prefer a higher degree of control within an uncertain environment. On the other hand, the decision about an entry via greenfield investment or acquisition could also be driven by the level of uncertainty in the host economy. This might be plausible if the entry

Table 3.1: Shares of Greenfield Investments across Country Groups

	Share of Greenfield Investments	Observations
New EU Members	62%	1540
Other CEEC	71%	314
CIS	71%	246
Total	64%	2,100

Source: Firm Survey, Chair for International Economics, University of Munich

mode enables the MNE to bear higher risks. If the MNE acquires an already existing firm abroad there is the chance to take over its ability to handle these risks. This would imply that multinational enterprises have a greater propensity to acquire an existing firm when external risks achieve a higher level.

Table 3.1 shows the distribution of greenfield investments and acquisitions into Central and Eastern European Countries (CEEC) and the Commonwealth of Independent States (CIS). The new members of the European Union are showing a slightly lower share of greenfield investments than in all other countries in transition, although. Assuming that the new members exhibit lower uncertainty for investors[1], one would expect a higher share of greenfield investments. The reason for this figure might be due to an enforced privatization process during the early and the mid Nineties within this group, and therefore a large number of acquisitions.

Other empirical studies of the entry mode choice focus on factors like the investor's degree of diversification, advertising intensity, the relative size of the subsidiary to that of the investor, the growth of demand in the target

[1] These countries have to ensure unhindered capital flows and trade to the European union as well as the effective protection of property rights.

market and others (e.g. Hennart and Park [1993]).

In general, only a few authors addressed a theoretical approach concerning the choice of a firm between greenfield investment and acquisition when entering a foreign market. Buckley and Casson [1998] present a fully integrated analysis of the foreign market entry decision, ownership structures and options based on subcontracting and franchising. Comparing the costs of a variety of alternative strategies they are able to determine the optimal mode of entry. One of their results is that a highly specific type of the entrant's technology discourages entry by acquisition and favours greenfield investment. This is because of technological adaptation and restructuring costs which can be prohibitively high in the case of an acquisition, while they will not occur in the case of a greenfield investment.

The importance of adaptation costs is also emphasized by Görg [2000]. He shows within an asymmetric duopoly model, that a new entrant will be better off by acquiring an existing firm as long as these costs are not too high. Müller [2002] determines the acquisition price and the profits under both entry modes endogenously and finds that the optimal entry mode depends on the competition intensity in the market in a non-monotonic way.

Many empirical studies state that the investor's technological level is an important determinant on the entry choice and suggest that high R&D expenditures increase the probability for greenfield investment (e.g. Hennart and Park [1993], Andersson and Svensson [1994], Meyer [1998], Brouthers and Brouthers [2000], Harzing [2002]).

Meyer [1998] refers to multinational enterprises (MNE) with specific technological competences which will probably have large differences in production technologies and production know-how compared to to existing firms in an emerging market. If the MNE enters the market via greenfield investment it has the possibility to select the workers and the location which are

Table 3.2: Shares of Greenfield Investments Into Several Industries

Industry (ISIC Classification)	Share of greenfield Investments	Observations
C - Mining and quarrying	33%	3
D - Manufacturing	53%	982
E - Electricity, gas and water supply	15%	54
F - Construction	64%	110
G - Wholesale and retail trade; repair of goods	79%	300
H - Hotels and restaurants	89%	28
I - Transport, storage and communications	83%	124
J - Financial intermediation	79%	238
K - Real estate, renting and business activities	89%	187
O - Other community, social and personal service activities	50%	6
Total	65%	2,032

Source: Firm Survey, Chair for International Economics, University of Munich

most attractive. This option does not exist if it acquires a new firm and thus problems might occur when skills and technology have to be transmitted (Hennart and Park [1993]).

Table 3.2 shows the distribution of greenfield investments and acquisitions of German and Austrian FDI into several industries. Investors engaged in power supply and mining, which can be assumed to be less advanced in technology, are more likely to enter via acquisition than via greenfield investment: Only 15% of investors coming from the power industry (electricity, gas and water supply) set up an entirely new plant. On the other hand, the manufacturing firms and even more striking, the construction industries, which might use a more advanced technology, favor greenfield investments. A overwhelming majority of firms which are engaged in other service sectors also enter via greenfield investment.

In this chapter we present a model where a MNE faces a decision of foreign market entry via acquisition or greenfield investment. The interaction between uncertainty in the host market and the investor's technological advantage offers an explanation why one entry mode is preferred to the other. There is a trade-off between lower costs of uncertainty in the case of an acquisition, on one hand, and additional costs of restructuring which are increasing in the investor's technological advantage when acquiring a local competitor, on the other hand. As a result, for some combinations of uncertainty and technological advantage no entry will occur, whereas for other combinations the MNE will prefer one strategy to the other.

The chapter is organized as follows. The next section sets up a simple model to explain the decision if under uncertainty the investor should enter the foreign market at all, and if so, which mode of entry should be chosen. Section 3 analyzes the implications of the model empirically. Section 4 concludes.

3.2 Model

In this section, we construct a simple model to derive an econometric specification of the investor's decision whether to enter the foreign market at all, and if so, which mode of entry should be chosen.

The investor is confronted with an uncertain environment. In FDI decisions uncertainty arises from country-specific risk. These can result from economic risk due to the macroeconomic development of the country, commercial risk which is related for example to fulfillment of contracts with other companies or local partners, and political risks such as protection of property rights, behavior of state-owned companies or laws concerning investments (Nordal [2001]). Following the literature on FDI, the resulting uncertainty causes executives to undervalue foreign investments (Root [1986]).

We assume that the value of an investment via acquisition V_a is determined by its non-risk adjusted present value of future operating surpluses V_a^0. The value suffers from the total cost of uncertainty in host country j which is calculated by the level of uncertainty u_j and the marginal cost of uncertainty $c > 0$. Furthermore restructuring costs $\alpha \cdot \tau_i$ decrease the value of an acquisition. We assume that the technological difference and therefore the costs of restructuring are increasing with the technological level τ_i, at which investor i operates. This adaptation costs occur due to a technological gap between the investor and the foreign affiliate: buying an existing firm can result in a technological gap between the investor's R&D ability and that of the foreign firm. To be more precise, this gap might be due to the organizational or technological skills of the employees in the investing firm or due to superior technological assets like machines.

Thus the value of an acquisition can be calculated as

$$V_a = V_a^0 - c \cdot u_j - \alpha \cdot \tau_i \tag{3.1}$$

The costs of restructuring are important especially in the CEEC. Many former state-owned firms have an technological disadvantage against their foreign competitors: Inefficient structures as well as low productivity are often still the case. Therefore it is necessary for the investor to enhance the ability of the foreign affiliate in order to extract benefits from the investment. The costs of restructuring are substantial if the investor has to provide firm-specific know how about products or about the production process. Therefore firms with high R&D potential are more likely to enter a foreign market via greenfield investment, where adaptation costs do not occur.

The value of a foreign affiliate which is established via greenfield investment is

$$V_g = V_g^0 - (c + d) \cdot u_j \tag{3.2}$$

where $(c + d) > 0$ are the marginal costs of uncertainty to a greenfield investment. The difference between the marginal costs of uncertainty to a greenfield investment and an acquisition is $d > 0$. Thus the marginal cost of uncertainty to an acquisition is assumed to be lower than those to a greenfield investment. Uncertainty is less harmful to an acquisition because these already existing firms demonstrated that they were able to stand their ground in the past despite of an uncertain environment. As a consequence the employees know more about the nature of the uncertainty in the country than the foreign investor and they know better how to handle the specific uncertainty.

From here we can derive three fundamental conditions. First, building up a new firm via greenfield investment will be observed only if its value is greater than zero, $V_g > 0$. The necessary condition from equation (3.2) for setting up a greenfield investment is

$$u_j < \frac{V_g^0}{(c+d)}. \tag{3.3}$$

Thus an investor will only undertake a greenfield investment if the costs of uncertainty $(c+d)$ is not too high. This upper level of uncertainty depends on the non-risk adjusted present value of future surpluses and the marginal cost of uncertainty to the new plant.

Second and similar, the condition for entry via acquisition is that the value of the existing firm is positive: The foreign investor would decide to buy an existing firm only if $V_a > 0$ which is the case if in equation (3.1)

$$u_j < \frac{V_a^0 - \alpha \cdot \tau_i}{c}. \tag{3.4}$$

The upper level of uncertainty indeed negatively depends on level of the marginal costs of uncertainty, but additionally on the level of the investor's technology and thus the cost of restructuring.

As a first result, there exists an upper level of uncertainty for each mode of entry which must not be exceed. Otherwise the respective mode of entry will not be chosen.

Third, comparing both modes of entry, a greenfield investment will be preferred to an acquisition if the value of the greenfield investment is greater than that of an acquisition, so if and only if $V_g > V_a$ or

$$V_g^0 - (c+d) \cdot u_j > V_a^0 - c \cdot u_j - \alpha \cdot \tau_i \tag{3.5}$$

Solving for u_j yields

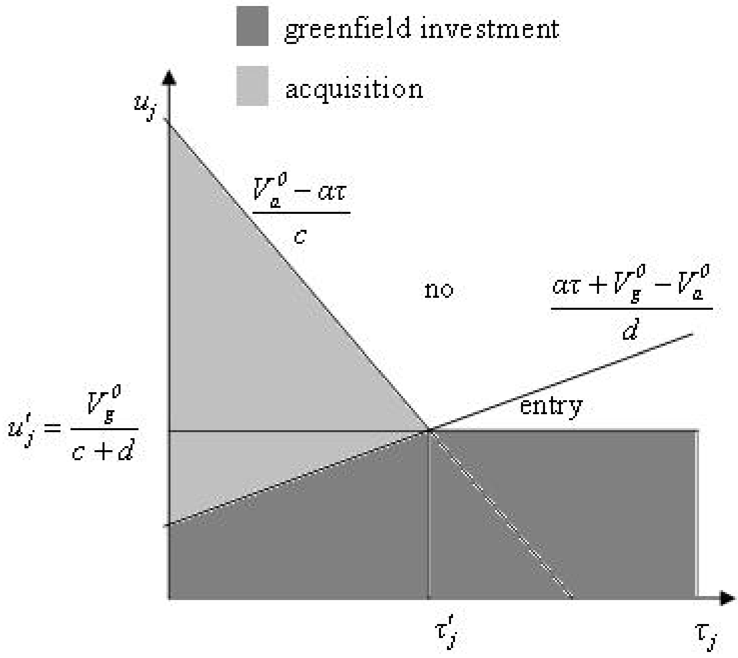

Figure 3.1: Optimal Modes of Entry

$$u_j < \frac{\alpha \cdot \tau_i + V_g^0 - V_a^0}{d} \tag{3.6}$$

From equation (3.6) it is obvious that the greenfield investor will accept a certain level of uncertainty only if the non-risk-adjusted value of a greenfield investment V_g^0 is sufficiently high and the difference of the marginal costs of uncertainty relative to an acquisition is low. Additionally, a more superior technology τ_i will give him an incentive for an entry via greenfield investment since an acquisition would become more expensive due to higher restructuring costs.

The three conditions from equations (3.3), (3.4) and (3.6) are presented in Figure 3.1. Here we assume that $V_g^0 > V_a^0$. This might be acceptable because the efficiency and profitability of a recently created firm may be higher than that of a former state-owned firm.[2]

In Figure 3.1 we plot combinations of levels of uncertainty in the host country (u_j) and levels of the technological advantage of the investor i (τ_i) where either no investment will take place, greenfield investment or entry via acquisition will be preferred.

As equation (3.3) shows, the upper level of uncertainty for a greenfield investment taking place does not depend on the level of the investor's technology. Therefore it spans a horizontal line in a diagram for combinations of uncertainty and technology. Above this line no greenfield investment will be observed.

The upper level of uncertainty in case of an acquisition depends negatively on technology and leads to the decreasing line in the figure. From equation (3.4) we can derive: If τ_i increases, adaptation costs increase and entry via acquisition is only possible if u_j decreases. Again, above this line no acquisition is achievable.

From the last condition in equation (3.6) we know, that there exists an upper level of uncertainty for each level of technology where the investor is indifferent between both modes of entry. Below this line entry via greenfield investment is preferred. In other words, given the technology of an investor, levels of uncertainty below the curve characterize states where greenfield investments will yield lower total costs and therefore a higher value of the foreign affiliate.[3]

As a result from the three equations (3.3), (3.4) and (3.6), in the white area no entry will occur. In the dark gray area greenfield investment will

[2]Relaxing this assumption would not yield to different general results.

[3]The three curves do have to cross in one single point: While the horizontal line indicates the level of uncertainty where the value of a greenfield investment is zero, the decreasing line gives a value of zero for an acquisition. These curves cross at a point where the investor is indifferent between both modes of entry. This is the case along the increasing curve.

maximize the firm's value. Whereas in the bright gray area entry via acquisition is favorable.

The results of the model can now be summarized. First, certain combinations of uncertainty in the host country (u_j) and technological advantage of the investor i (τ_i) yield no entry. This will be the case if $\tau_i > \tau_i'$ and $u_j > u_j'$ in Figure 3.1. Under these circumstances the technological level and thus the cost of restructuring the acquisition is too large, so that the advantage of an acquisition with regard to uncertainty is exhausted. At the same time, for $u_j > u_j'$ we exceed the upper level of uncertainty so that no greenfield investment will be established. Second, for $u_j > u_j'$ the investor will only enter the market if $\tau_i < \tau_i'$. In this case only acquisition is achievable. Finally, for low levels of uncertainty $u_i < u_i'$ an greenfield investment becomes more attractive as the technological advantage rises: For higher technological levels acquisitions become too expensive because of the costs of restructuring the existing foreign firm and greenfield investments are more preferable even if uncertainty rises (up to u_j').

3.3 Empirical Evidence

In this section we empirically examine the impact of technology and, more important, country risk on the foreign market entry decision between greenfield investment and acquisition.

3.3.1 Methodology

The greenfield vs. acquisition - decision could be estimated by an ordinary binary choice model. But as our theory already suggests, we have to take into account that there is also the possibility not to enter the market at all. As a simple probit or logit estimation would therefore lead to a sample selection bias, we have to test the entry mode decision under the condition that an investment has been undertaken.

Hence, we use the Van de Ven and Van Praag (1981) probit application of the Heckman (1979) selection bias correction procedure. We estimate an investment decision equation where a multinational enterprise i decides to invest in country j

$$invest_{ij} = \begin{cases} 1 & \text{if } invest_{ij}^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad \text{where } invest_{ij}^* = X_{ij}\gamma + \alpha_1 u_j + \alpha_2 \tau_i + \epsilon_{ij}^1. \tag{3.7}$$

Here $invest_{ij}$ is a dummy variable equal to 1 if firm i invests in country j which is the case if the latent variable $invest_{ij}^* > 0$. The latent variable $invest_{ij}^*$ depends on uncertainty u_j and technology τ_i as our model predicts, but also on additional variables X_{ij} which earlier studies found to have an impact on the investment decision. These will be discussed in the next section.

Simultaneously, under the condition that an investment took place, we estimate an entry mode decision

$$green_{ij} = \begin{cases} 1 & \text{if } green^*_{ij} > 0 \\ 0 & \text{otherwise} \end{cases} \quad \text{where } green^*_{ij} = Z_{ij}\delta + \beta_1 u_j + \beta_2 \tau_i + \epsilon^2_{ij} \tag{3.8}$$

where $green_{ij}$ is the dependent variable which is 1 if firm i enters country j via greenfield investment. Again, this is the case if the underlying latent variable $green^*_{ij} > 0$, which also depends on u_j and τ_i and a set of other influences Z_{ij} detected in previous studies.

We observe that $green_{ij}$ is equal to one only if $invest_{ij}$ is equal to 1. In these equations, α_1, α_2, β_1, β_2 are coefficients and γ, δ coefficient vectors to be estimated. Within this simultaneous Maximum-Likelihood estimation procedure, we can assume that the residuals from both equations, ϵ^1_{ij} and ϵ^2_{ij}, are correlated.

$$\epsilon^1_{ij} \sim N(0,1), \quad \epsilon^2_{ij} \sim N(0,1) \quad \text{and} \quad cov(\epsilon^1_{ij}, \epsilon^2_{ij}) = \rho$$

If $\rho = 0$, the model could be estimated using independent probit equations.

3.3.2 Hypotheses

The predictions we derived from our model can be summarized within the following hypotheses. The model explains under which circumstances a multinational enterprise will enter a foreign market and, given this decision which entry mode it will choose. We will refer to the entry mode decision equation first.

We assumed that the value of an entirely new plant suffers more from an uncertain environment than the value of an acquired affiliate. Local firms may be more familiar with uncertainty in the host market. By undertaking an acquisition the investor adopts the local management of the existing firm which possesses information and knowledge about the local economy. These skills might me more valuable the higher uncertainty in the host country and therefore, buying an existing firm becomes more and entering via greenfield investment becomes less likely.

HYPOTHESIS 1: The probability to enter a foreign market via greenfield investment depends negatively on the level of uncertainty in the foreign market.

Furthermore, the value of an acquisition depends negatively on the technological advantage of the multinational enterprise. As analyzed in the previous section, an investor operating with a superior technology will be confronted with high adaptation costs. The reason is that the MNE has to restructure the foreign affiliate in order to assimilate the technological processes and the skills of the employees. Markusen [1995], Hennart and Park [1993] as well as Andersson and Svensson [1994] refer to this aspect.[4]

HYPOTHESIS 2: The probability to enter a foreign market via greenfield investment rises as the technological advantage of the multinational enterprise increases.

A number of empirical studies uncover a positive and significant impact of the technological intensity on the likelihood of entering a foreign market via

[4] Beside this argument, Brouthers and Brouthers [2000] mention the reduced chances of dissemination of firm specific advantages to other local competitors in the case of a greenfield investment.

greenfield investment (e.g. Andersson and Svensson [1994], Harzing [2002]).[5] Kogut and Singh [1988] and Chang and Rosenzweig [2001] find this impact to be more fragile when choosing subsamples of their datasets.

The empirical literature on the entry mode decision detects other influential variables which are not considered in our model: The greater the new plant compared to the investor the less likely a greenfield occurs. Relatively small investors may be constrained in recruiting and training managers for the foreign market. Therefore in this case management skills of the foreign firm can be exploited by buying an existing firm.[6]

HYPOTHESIS 3: The greater the foreign firm compared to the investor, the lower the likelihood for a greenfield investment.

Other characteristics have been found to be statistically influential on the investors decision whether to enter a foreign market via greenfield investment or via acquisition. The probability for setting up a new firm is higher in case of a fully owned affiliate (Hennart and Park [1993]) and lower for the manufacturing sector (Kogut and Singh [1988]).

The non-risk adjusted value of future operating surpluses of the foreign affiliate coming from our model should be also taken into account. Although it directly affects the value of the project, its impact on the entry mode decision remains unclear.

For the investment decision equation, the model suggests that the value of the foreign affiliate becomes smaller if the technological level of the investor, i.e. the costs of restructuring, and the level of uncertainty in the host country are very high. In this case no foreign direct investment is achievable and the multinational enterprise will serve the foreign market via exporting,

[5] Although this result comes along with most of the empirical literature, Kogut and Singh [1988] draw up the thesis that R&D-intensive investors might be more likely enter via acquisition if they are investing for technology sourcing.

[6] See e.g. Hennart and Park [1993].

licensing or franchising.

HYPOTHESIS 4: The higher the technological level of the multinational enterprise and uncertainty in the host country the less the probability that any foreign direct investment will occur.

The Ownership-Location-Internalization-Advantages Paradigm (Dunning [1993]) detects three channels influencing the attractiveness of a FDI project and therefore provides additional explanations for the decision to investment abroad.

First, ownership advantages relate on the investors firm specific characteristics i.e. specific competency of the firm to accomplish competition in foreign markets. Such advantages may be intangible assets or may come from the firm's size. Since e.g. R&D expenditures increase intangible assets, they therefore favor the decision to invest. This finding contradicts the *Hypothesis 4*; the impact of R&D remains ambiguous. On the other hand, greater firms also should exhibit higher ownership advantages in the form of financial and managerial resources.[7] Hence,

HYPOTHESIS 5: The larger the size of the multinational enterprise the higher the probability that it will undertake a FDI.

Secondly, location advantages focus on the question where to invest. These cover conditions in the host country the investor is faced with e.g. the cultural distance or the market potential. Lipsey [1999] finds that market potential measured by GDP and GDP growth has a positive effect on the investment decision.

HYPOTHESIS 6: The larger the market potential, the higher the probability for a FDI.

[7]See e.g. Blomström and Lipsey [1986]. For example, Choe [2000] shows that the parent's firm size has a positive effect on the size of of foreign affiliate.

Li and Guisinger [1991] found that cultural distance has a significant impact on the failure rate of foreign subsidiaries. Thus, we would expect that cultural distance between the home and the host country has a negative impact on FDI.

HYPOTHESIS 7: The larger the cultural distance, the lower the probability for a FDI.

Finally, internalization advantages refer to the ability of the multinational enterprise to exploit the product or process internally by setting up a foreign affiliate rather than licensing another firm. Dunning [1993] and Chandprapalert [2000] treat country risk as a measure for internalization advantages since it can affect the investor's ability to benefit from entering the market via FDI instead of exporting or licensing.

3.3.3 Data

The data describing the multinational enterprises and the foreign affiliates comes from the firm survey "German and Austrian FDI in CEEC" - and of course the CIS. 2,115 investments into 27 countries in transition coming from 688 investors which had been collected.[8] The entry mode decision of a multinational enterprise is analyzed in two simultaneous steps: The investor's decision whether to invest at all and the entry mode decision itself.

For the investment decision we observe 688 investors who either invested in one or more of the 27 countries or decided not to invest there. From this point of view we observe 18,576 decisions from 688 investors times 27 countries, each with certain characteristics. Taking into account that some investors decided to invest in a single country more often at different dates, we reach 19,015 observations.

[8] See Section 1.2.

On the other hand, without considering any missing values theoretically 2,115 observations for the entry mode equation are available.

According to equations (3.7) and (3.8), the following two binary model equations will be estimated simultaneously by Maximum Likelihood:

$$\begin{aligned} invest_{ij} = \gamma_0 + \alpha_1 uncert_j + \alpha_2 tecint_i + \gamma_1 sizew_i + \gamma_2 lgdp_j \\ + \gamma_3 gdpgr_j + \gamma_4 ldistanc_j + \epsilon^1_{ij} \end{aligned} \tag{3.9}$$

$$\begin{aligned} green_{ij} = \delta_0 + \beta_1 uncert_j + \beta_2 tecint_i + \delta_1 surplus_i + \delta_2 relsize_i \\ + \delta_3 daughter_i + \epsilon^2_{ij} \end{aligned} \tag{3.10}$$

As mentioned earlier, the dependent variables are $invest_{ij}$ and $green_{ij}$ which are equal to 1 if the multinational enterprise undertakes a FDI in country j and sets up an entirely new plant respectively.

Uncertainty in the host country $uncert_j$ is measured by the exchange rate uncertainty index $exrunc_j$ - the coefficient of variations of the residuals - and the country risk index from the *Euromoney* magazine, *euromon*.[9] It should be noted that exchange rate uncertainty has two opposite effects on the investment decision: On the one hand, firms might be prevented from exporting through volatile exchange rates and avoid these uncertainty by serving the market via FDI. Exchange rate uncertainty therefore should favor FDI. On the other hand, what we will presume here is that exchange rate volatility is an indicator for an uncertain economic environment which captures overall economic uncertainty. In this context, exchange rate volatility should prevent investments abroad.

[9]See Chapter 2.

The variable $tecint_i$ denotes the technological intensity of the investing firm measured by its R&D expenditures relative to sales.

The size of the investor $sizew_i$ is the logarithm of its worldwide sales. All variables are from the firm survey except country risk variables.

Additionally, country specific variables occur in the investment decision equation. We capture location advantages for market searching FDI, by the logarithm of GDP $lgdp_j$ (from Penn World Tables Version 6.1) and growth of GDP $gdpgr_j$ (from EBRD).[10] The cultural distance ($ldistanc_j$) is the logarithm of the geographical distance between the capitals of the country of origin and the host country (from route planner software "Route 66").[11]

The entry mode decision equation requires some other variables from the firm survey. We approximate the non-risk adjusted value of the affiliate by the variable $surplus_i$ which is sales minus labor costs over employees. The relative size between the investor and the foreign affiliate $relsize_i$ is the number of employees in the affiliate relative to the multinational enterprise. The dummy variable $daughter_i$ indicates that the investor holds at least 95 percent of shares. Additionally we control for industry specific effects.

[10] Both variables are from the year the investment has been undertaken. In the case where no investment occurs, the average over the period from 1990 up to 2001 has been taken.

[11] The impact of the log of the geographical distance from the investor's location to the foreign firm is ambiguous: If the distance is a measure for transport costs, exporting to far markets would be expensive and therefore investment would be more likely. But if distance is a measure for cultural distance, the tastes are unknown, the legal system different and investment should be less favored.

Table 3.3: Variables and Data Sources

Variable Name	Description	Source
$green_{ij}$	Dummy variable; "entry via greenfield investment" = 1	Firm Survey
$invest_{ij}$	Dummy variable; "investment of firm i in country j took place"= 1	Firm Survey
$exrunc_j$	Exchange rates - uncertainty	Datastream
$euromon_j$	Index of country risks (0 "low risk level" - 100 "high risk level")	*Euromoney*
$tecint_i$	R&D expenditures over sales of the investor	Firm Survey
$sizew_i$	Logarithm of investor's sales worldwide	Firm Survey
$lgdp_j$	Logarithm of GDP in host country	Penn World Tables
$gdpgr_j$	Growth of GDP in host country	EBRD
$ldistanc_{ij}$	Logarithm of geographical distance between investor and foreign affiliate	Router Software
$surplus_i$	Sales minus labor cost over employees of the FDI	Firm Survey
$relsize_i$	Number of employees of foreign affiliate relative to investor	Firm Survey
$daughter_i$	Dummy variable; "investor owns at least 95% of shares" = 1	Firm Survey

Note: The subscripts i denote the investment and j the country.

Table 3.4: Expected Signs of Coefficients

Variable	Expected sign for $invest_{ij}$	Expected sign for $green_{ij}$
$exrunc_j$	-	-
$euromon_j$	+	+
$tecint_i$	$-^a +^b$	+
$sizew_i$	+	
$lgdp_j$	+	
$gdpgr_j$	+	
$ldistanc_j$	-	
$surplus_i$		?
$relsize_i$		-
$daughter_i$		+

Note: The subscripts i denote the investment and j the country.
In case (a) the cost of restructuring, and in case (b) ownership advantages matter.

Table 3.3 summarizes the descriptions and data sources of the variables. Table 3.4 reports the predicted signs of the coefficients of the dependent variables.[12] As it can be seen in Table 3.4, the impact of the technological advantage of the investor $tecint_i$ on his decision to invest in country j is ambiguous: We derived from the model that the coefficient should be negative for high levels of uncertainty. In this case it is more likely to enter the market by buying an existing firm. The higher the technological advantage, the higher the costs of restructuring the foreign plant. As a consequence, the advantage of an acquisition vanishes and no investment will be undertaken. On the other hand, we conclude from the OLI paradigm that ownership advantages should be higher for technological intensive firms and therefore entering the foreign market is more likely.

[12]Descriptive statistics and the correlation coefficients of the independent variables are given in Table 3.6 and Table 3.7 in the Appendix.

3.3.4 Empirical Results

The empirical results from the sample selection model are reported in Table 3.5. In the upper part it shows the bivariate probit estimates for the entry mode decision. Here the dependent variable is *green*. In the lower part the sample selection equation with the dependent variable *invest* is given. It takes into account whether the multinational enterprise invested in the particular country. Table 3.5 includes *euromon* and *exrunc* as alternative measures for country risk. After omitting the relevant missing values, the sample size is 8,563 for the first investment decision estimation. From these, 743 investments actually have been undertaken, which is the number of observations for the entry mode estimation. The entry mode equation includes dummy variables for industries.

In the last line of the table, a likelihood ratio test clearly rejects the hypothesis that the correlation between the residuals in the entry mode and the investment equation is 0. Therefore, the empirical methodological approach to implement the bivariate probit model with sample selection is validated.

In the first specification in column (1) in Table 3.5 country risks are captured by the index from the magazine *Euromoney*. Regarding to the investment decision in the lower part of the first column, it turns out that higher levels of uncertainty in the host economy decrease the probability that multinational enterprises invest abroad. The estimated coefficient is significant at high conventional levels.

The ratio of R&D over sales of the multinational enterprise *tecint* shows no impact on the likelihood to undertake a FDI. This finding does not support the result from the model that high technology and skill intensive production processes increase the cost of reconstructing of the foreign affiliate and investment becomes less likely. On the other hand, firms with high R&D ratios might exhibit strong ownership advantages which enable them to invest abroad more easily. Maybe in the special case of Austrian and German FDI into Central and Eastern Europe and the CIS the underlying story is more complicated. As Marin [2004] shows, skilled labor is relatively scarce in Germany and Austria, whereas Central and Eastern European countries are relatively well endowed. The author shows, with data from the same firm survey which is employed in this analysis, that German affiliates in CEEC and the CIS on the average have about three times higher shares of well educated workers than their German parents. This outsourcing of skill intensive activities indicate that Germany is poorly endowed with skills relative to Eastern countries.[13] Beside the pressure to reduce production costs, German and Austrian multinational investors are forced to locate also R&D intensive processes into these countries in order to elude this factor endowment scarcity at home. Hence, R&D intensive multinationals could invest in order to hire skilled employees. As the null hypothesis for the coefficient of *tecint* can not be rejected in the selection equation, both opposite forces, high adaptation costs on the one hand and skill endowment on the other hand, could play an important role for the investment decision.

The positive and significant coefficient of *sizew* indicates that larger investors are more likely to invest abroad than smaller ones. Moreover, as expected, the size of the host market has a positive impact on the probability that a FDI occurs. Also the growth of the host economy shows a significant positive impact on the investment decision. Both variables support the hypothesis that large and fast-growing economies attract market searching FDI.

On the other hand, the larger the distance between the multinational enterprise and the foreign market, measured by *ldistanc*, the lower the likelihood that it will invest. This result indicates that the geographical distance

[13] A similar picture is true for Austrian affiliates.

Table 3.5: Bivariate Probit Estimates with Sample Selection
(Industry dummies included)

	(1)		(2)		(3)		(4)	
green								
euromon	-0.025	***	-0.025	***				
	(-3.79)		(-3.82)					
exrunc					-2.164		-1.986	
					(-1.34)		(-1.25)	
tecint	-1.652	**	-0.776		-2.232	***	-1.239	
	(-2.31)		(-1.12)		(-2.70)		(-1.55)	
surplus	6.08E-07	***	5.04E-07	***	6.58E-07	***	5.35E-07	***
	(2.95)		(2.87)		(2.69)		(2.64)	
relsize	-5.71E-03	*			-6.57E-03	*		
	(-1.76)				(-1.76)			
daughter	0.700	***			0.819	***		
	(6.77)				(7.89)			
Constant	-0.082		0.280		-0.844	***	-0.445	***
	(-0.33)		(1.23)		(-6.28)		(-3.52)	
invest								
euromon	-0.033	***	-0.032	***				
	(-12.48)		(-12.42)					
exrunc					-4.483	***	-4.349	***
					(-7.28)		(-7.16)	
tecint	0.118		0.092		0.084		0.048	
	(0.33)		(0.26)		(0.24)		(0.14)	
sizew	0.095	***	0.095	***	0.086	***	0.086	***
	(8.78)		(8.83)		(7.79)		(7.84)	
lgdp	0.062	***	0.064	***	0.121	***	0.121	***
	(7.33)		(7.59)		(11.23)		(11.34)	
gdpgr	0.027	***	0.024	***	0.038	***	0.034	***
	(4.48)		(4.00)		(5.88)		(5.31)	
ldistanc	-0.429	***	-0.453	***	-0.742	***	-0.762	***
	(-9.01)		(-9.57)		(-20.36)		(-21.05)	
Constant	-0.039		0.070		-0.936	**	-0.784	*
	(-0.10)		(0.18)		(-2.14)		(-1.80)	
Obs. invest equ.	8,563		8,596		9,017		9,050	
Obs. green equ.	743		776		738		771	
Log likelih.	-2,232.08		-2,340.05		-2,266.15		-2,373.57	
LR test (ρ=0)[a]	22.46	***	19.18	***	21.95	***	17.09	***

Note: t-statistics in parentheses. Significant at *** 1%, ** 5%, * 10% level.
Industry Dummies included but not reported. [a] $\chi^2(1)$

is rather a measure for cultural distance than for transport costs.

Given that an investment took place, the upper part of Table 3.5 shows the impact of the variables presumed to be influential on the entry mode decision.

As the model predicts, high levels of country risks *euromon* significantly lower the probability to enter the foreign market by setting up an entirely new plant. In other words, economic uncertainty increases the affinity to invest abroad via acquisition as the multinational enterprise gets the affiliates knowledge and experience to handle specific uncertainty or local authorities.

The technological intensity *tecint* enters the entry mode equation negatively which is a contradiction to the prediction derived from the model.[14] One would expect that a multinational enterprise with R&D and skill intensive production processes would avoid the resulting adaptation costs in the case of an acquisition. Therefore, the probability for greenfield investment should be higher and the sign of the coefficient should be positive. However, earlier empirical studies find a robust and positive impact of the investor's R&D intensity on the probability to enter a foreign market via greenfield investment (Hennart and Park [1993], Andersson and Svensson [1994], Meyer [1998], Brouthers and Brouthers [2000], Harzing [2002]). Again, the reason for this result could be explained by the finding of Marin [2004]. If German and Austrian multinationals are searching for well skilled workers in Eastern Europe, taking over an existing firm abroad may be an easier channel to get at skilled labor than setting up an entirely new plant and hiring new staff.

The coefficients of *relsize* and *daughter* exhibit a negative sign and a positive sign respectively. Their impacts are significant and confirm earlier results from the empirical literature. The control variable *surplus* enters

[14]Table 3.8 in the Appendix shows that this result does not change when excluding the industry dummy variables. Measuring the technological intensity by the share of workers employed in R&D shows no impact.

positively and significantly.

The second estimation does not contain the variables *relsize* and *daughter* as they where not derived from the model discussed before. Only the coefficient of *tecint* looses its explanatory power in the entry mode equation. All other coefficients remain robust.

The third column in Table 3.5 contains the volatility of the exchange rates *exrunc* as a measure for country risks. As expected, the level of country risk turns out to have a negative and significant impact on the investor's decision to invest in the particular country. Thus the data does not confirm the argument that exchange rate volatility favours FDI in order to avoid these uncertainty. For the entry mode decision, *exrunc* also affects the probability to enter a foreign market via greenfield investment negatively. However, the result is not significant at conventional levels. In the grand scheme of things, all other coefficients do not change in general. Again, the results remain robust when excluding *relsize* and *daughter* from the entry mode decision (column (4)). Table 3.8 in the Appendix confirms these findings when excluding the industry dummy variables and including a dummy variable *manufac* for the manufacturing sector instead.

The empirical investigation partly confirms the results from the model. As predicted, high country risks prevent multinational enterprises from investing abroad and, given that an investment had been undertaken, entry via greenfield investment becomes less likely. Surprisingly, the impact of the R&D intensity of the investor on the probability of entry by setting up a new firm is negative. All results remain robust for different specifications.

3.4 Conclusions

This chapter offers a model which explains the decision of a multinational enterprise if and how to enter a foreign market in the presence of country risks. The multinational investor has the choice between setting up an entirely new plant or buying an existing one. Earlier studies on the entry mode decision of foreign investors completely ignored the issue of uncertainty regarding the host economy.

In the model it has been argued that there is a trade-off between higher costs of uncertainty when undertaking a FDI via greenfield investment and the costs of restructuring an existing firm abroad. As a result, high levels of uncertainty and a large technological gap between the investor and the affiliate should discourage the multinational enterprise from investment. Once the investor decided to undertake a FDI, high uncertainty should decrease and high technological advantages should increase the probability to enter the foreign market via greenfield investment.

The empirical analysis partly supports the predicted effects from the model. Using data from Austrian and German FDI projects into the CEEC and the CIS, a probit application of the Heckman selection model is applied. This is necessary because we have to take into account that the model also offers the possibility not to invest at all.

Empirically, the main results support the finding that uncertainty prevents investors from market entry via greenfield investment and makes acquisitions more likely. Surprisingly, the impact of the R&D intensity on the likelihood for greenfield investment is negative. This result contradicts earlier empirical findings and the prediction from the model we discussed. The reason for this might be that Austrian and German multinationals with high R&D intensive processes also invest in Central and Eastern European Countries and the Commonwealth of Independent States to overcome the shortfall of skilled labor in Austria and Germany. If this is the case, acquiring an existing firm could be more favorable than setting up a new plant and hiring new employees. This question has to be left for further research.

3.5 Appendix

Table 3.6: Descriptive Statistics

Variable	Observ.	Mean	Std. Dev.	Min	Max.
invest	13,057	0.11	0.31	0	1
green	1,401	0.64	0.48	0.00	1
euromon	10,692	61.22	12.84	37	79.01
exrunc	10,213	0.05	0.05	4.55E-3	0.17
tecint	13,057	0.03	0.06	0	0.58
surplus	918	208,250	482,054	-17,007	7,038,839
relsize	1,301	1.62	12.25	4.16E-5	290.9091
daughter	1,333	0.56	0.50	0	1
manufac	13,030	0.59	0.49	0	1
sizew	12,785	18.73	2.00	13.84	25.60
lgdp	11,559	26.90	2.75	21.72	33.21
gdpgr1	11,567	-2.69	3.45	-34.90	13.30
ldistanc	13,057	7.30	0.89	2.83	8.70

Table 3.7: Pairwise Correlation Matrix of Independent Variables

	euromon	exrunc	tecint	surplus	relsize	daughter	manufac	sizew	lgdp	gdpgr	ldistanc
euromon	1										
exrunc	0.437	1									
tecint	0.007	0.005	1								
surplus	-0.058	-0.070	-0.082	1							
relsize	-0.006	0.021	-0.026	-0.037	1						
daughter	-0.030	0.048	0.132	0.097	-0.035	1					
manufac	0.006	0.001	0.238	-0.172	-0.038	-0.066	1				
sizew	-0.023	-0.010	0.095	0.187	-0.075	0.022	0.083	1			
lgdp	-0.117	0.474	0.001	0.010	0.031	0.092	-0.003	0.005	1		
gdpgr	-0.494	-0.127	-0.003	0.012	0.006	0.005	0.001	0.030	0.309	1	
ldistanc	0.625	0.148	0.008	-0.052	-0.002	-0.086	0.026	0.000	-0.113	-0.407	1

Table 3.8: Bivariate Probit Estimates with Sample Selection
(No industry dummies included)

	(1)		(2)		(3)		(4)	
green								
euromon	-0.028	***	-0.021	***				
	(-4.83)		(-3.16)					
exrunc					-2.096		0.062	
					(-1.32)		(0.04)	
tecint	-0.494		-0.112		-0.844		-0.498	
	(-0.78)		(-0.18)		(-1.09)		(-0.71)	
surplus	6.41E-07	***	8.76E-07	***	7.26E-07	***	9.44E-07	***
	(3.63)		(5.02)		(3.29)		(4.80)	
relsize	-7.24E-03	**			-8.60E-03	**		
	(-2.15)				(-2.14)			
daughter	0.660	***			0.812	***		
	(6.94)				(8.20)			
manufac	-0.553	***			-0.677	***		
	(-6.17)				(-6.72)			
Constant	0.520	**	0.384	*	-0.252	*	-0.170	
	(2.39)		(1.77)		(-1.71)		(-1.39)	
invest								
euromon	-0.033	***	-0.033	***				
	(-12.62)		(-12.44)					
exrunc					-4.517	***	-4.417	***
					(-7.35)		(-7.28)	
tecint	0.111		0.070		0.080		0.044	
	(0.31)		(0.20)		(0.22)		(0.12)	
sizew	0.098	***	0.099	***	0.088	***	0.087	***
	(9.24)		(9.05)		(7.96)		(7.86)	
lgdp	0.062	***	0.064	***	0.122	***	0.123	***
	(7.39)		(7.55)		(11.32)		(11.50)	
gdpgr	0.026	***	0.026	***	0.038	***	0.035	***
	(4.41)		(4.35)		(5.90)		(5.40)	
ldistanc	-0.419	***	-0.428	***	-0.740	***	-0.756	***
	(-8.84)		(-8.77)		(-20.31)		(-20.77)	
Constant	-0.129		-0.113		-1.003	**	-0.884	**
	(-0.34)		(-0.29)		(-2.30)		(-2.02)	
Obs. invest equ.	8,563		8,596		9,017		9,050	
Obs. green equ.	743		776		738		771	
Log likelih.	-2,242.79		-2,393.52		-2,278.71		-2,425.48	
LR test (ρ=0)^a	29.14	***	17.9	***	24.55	***	13.29	***

Note: t-statistics in parentheses. Significant at *** 1%, ** 5%, * 10% level.
Industry Dummies included but not reported. ^{a} $\chi^2(1)$

Chapter 4

Country Risk and the Timing of First Entry into Foreign Markets

4.1 Introduction and Related Literature

The political and economic change in Central and Eastern European Countries (CEEC) as well as in the former Soviet Union during the beginning of the Nineties opened opportunities for multinational enterprises to serve additional markets. Although governments in CEEC and the Commonwealth of Independent States (CIS) opened their economies for foreign investors about the same time, Western multinational enterprises have chosen different dates to invest in these emerging economies. The question discussed in this chapter is the decision of a multinational enterprise when to invest abroad in an uncertain environment or, in other words, the question of the timing of FDI in consideration of uncertainty.

FDI inflows potentially play an important role for the process of industrial modernization of transition economies and increasing competitiveness due to organizational restructuring of host firms, workers training or technology transfer. The impact of FDI on the economic growth of the host countries has been analyzed by a number of previous studies. As many of them find a positive influence, early FDI inflows could speed up the transition process.[1]

A number of earlier studies already discussed the factors which might influence the timing of investments abroad. Buckley and Casson [1981] presented a transaction costs based model pointing out the decision of firms how to enter foreign markets. They argue that the optimal "timing" of FDI depends on the differences of the cost structure of alternative market serving strategies, which are exporting and licensing on the one hand and market development via direct investment on the other hand.

Rivoli and Salorio [1996] also analyze the optimal timing of FDI and find Ownership-Location-Internalization (OLI) advantages (Dunning [1993]) to be determinants of the timing of market entry under uncertainty. When uncertainty exists, the possibility of postponing the investment and waiting for further information becomes highly valuable. They are treating ownership advantages as source for a quasi-monopoly e.g. in the presence of existing patents, which make investments more delayable. Therefore market entry should be observed to occur later. Market entry could be done at once if the investment is completely reversible. In this case the entire investment expenditure can be regained by reselling the project. But this requires effective markets and a lot of alternative uses of the firm's assets. In the case of high internalization advantages such as tacit knowledge which is difficult to codify and to transmit, high transaction costs are likely to occur. So higher internalization advantages decrease the reversibility of the investment project and therefore the value of waiting will be higher.

[1] See for example Borenzstein et al. [1998], Xu [2000] or Protsenko [2003]. On the other hand, Djankov and Hoeckman [2000], Konings [2001] and Damijan et al. [2001] find negative spillover effects on the productivity of domestic firms in CEE counties. This result might due to the fact that this studies cover periods of a few years only.

Another approach based on Myers [1977] regards the investment decision as an American call option. The decision maker has the right though not the obligation to undertake the investment at an exercise price which is the sunken cost of investment. Standard textbook models state that one should undertake an investment if the present value of future cash flows are equal to the investment cost. The problem is that this rule ignores the possibility of getting additional information about market conditions and future cash flows. Therefore, the pure opportunity to invest can be seen as an American call option which is valuable as long as this investment opportunity has not been exercised. Undertaking the investment means exercising this option. A huge amount of literature highlights the value of this opportunity and shows that it is positively associated with uncertainty about future profits. Consequently, a multinational enterprise which has to decide whether and when to invest abroad within an uncertain environment would make a suboptimal entry timing choice by applying the ordinary net present value rule.

McDonald and Siegel [1986] develop such a theoretical real option model and show that the ordinary net present value rule no longer holds because of uncertainty about the value of the investment and because of two crucial underlying assumptions: First the expenditure is at least partially irreversible. The second assumption is that the investment decision can be delayed, i.e. the investor has the opportunity to wait for better information about the profitability of the investment project. The alternative to this assumption would be a now-or-never-decision which would be less realistic. They find out that at a given point in time, for an investment to be made, its net present value must be sufficiently larger than zero to cover the value to the decision maker of delaying the decision and keeping the investment option alive. This leads to a focus on the importance of the timing of investment decisions, the role of uncertainty in influencing that timing, and hence on the level of investment activity at a given point of time for a particular level of uncertainty prevailing among investors.

The option pricing approach has been applied by some empirical studies of firms investment decisions such as Hurn and Wright [1994] who focus on oil field operations in the North sea. They use a Cox proportional hazard model to analyze the factors which affect the time that elapses between the discovery of an oil field and its development. As a result they find that the level of the oil price but not the standard deviation as an uncertainty measure is important for the timing of the development.

The question about the timing of a FDI has also been analyzed in some studies. Contrary to the present analysis, they either do not account for the impact of uncertainty on the decision when to enter a market abroad or they are limited to one or two host countries only.

Kogut and Chang [1996] examine the entry of Japanese electronic firms into the US during the time interval from 1976 to 1989. They consider those firms from the Tokyo Stock Exchange which had no affiliates until the beginning of this period. As a result, they find out that an undervalued dollar, the size of multinational enterprise and high R&D intensity makes entry into the US earlier.

Very similar, Tan and Vertinsky [1996] analyze market entry of Japanese electronics firms in the U.S. and Canada for both periods between 1966 and 1974 as well as 1975 and 1990 separately. Their findings concerning R&D confirm those from Kogut and Chang [1996] only for the second period, but they also do not consider any covariate which captures uncertainty.

Blandon [2001] looks at foreign bank entry into Spain from 1978 until 1992. He also does not include any uncertainty proximity and concludes that banks with strongest OLI advantages were the first to enter Spain.

Gaba et al. [2002] analyze the timing of entry of U.S. firms in China between 1979 and 1996. Among other things, they find that high market uncertainty is associated with late entry. Also firms with greater level of internalization advantages will enter the Chinese market earlier.

The topic of this chapter is to detect the determinants of foreign direct investment delays from Austrian and German multinational enterprises in Central and Eastern European Countries and the Commonwealth of Independent States. The contribution to the existing literature is twofold: The first difference of the following analysis to most of the earlier empirical studies about the decision of the timing of foreign direct investments is that we are not looking at only one (Gaba et al. [2002], Kogut and Chang [1996], Blandon [2001]) or two (Tan and Vertinsky [1996]) host countries, but the large region of Central and Eastern European Countries and the former Soviet Union. This enables us to take into account differences in country-specific characteristics. Secondly, the empirical studies on the timing of foreign direct investments do either not account for uncertainty or for the degree of irreversibility. Thus, this analysis extends these studies and catches up the predictions of the real option models applied to foreign direct investment decisions more exactly.

The remaining chapter is organized as follows: The next section discusses the real option approach and derives the factors which affect the timing of a FDI . Section 3 summarizes the hypotheses which will be tested and describes the data and the estimation procedure. Thereafter the results are presented. Finally section 4 concludes.

4.2 Theoretical Background: The Real Option Approach

In this section we will develop a real options model in order to find the factors which influence the timing of a multinational firm's entry into a foreign market. Following McDonald and Siegel [1986] or Dixit and Pindyck [1994] it will be shown how uncertainty - among other factors - affects the decision of a multinational enterprise about the timing of undertaking an investment abroad.

It is assumed that the FDI project has two important characteristics: First, the expenditure is at least partially irreversible. This can be stated to be typical for plants, specific investments in machines and R&D or when markets of these assets are imperfect. In this case investment costs cannot be fully recovered. The second assumption is that the investment decision can be delayed, i.e. the investor has the opportunity of waiting for better information concerning the value of the investment project. Alternatively, one could assume that the investor is faced with a now-or-never-decision. In this case there would exist no decision about the timing of starting the investment project.

These assumptions make the investment decision of a multinational enterprise very similar to the decision of exercising a financial option: In our case the firm has the right, though not the obligation to invest abroad at a predetermined price which is the cost of the investment I. If the firm decides to invest in return it receives an asset or more specifically a foreign affiliate with value $V(t)$ which stochastically fluctuates over time. Additionally, the affiliate generates some net operating income which is lost if the multinational enterprise does not invest and which therefore can be seen as the opportunity cost of delaying the investment.

Thus, in the terminology of option theory, the foreign direct investment opportunity can be treated as an American call option.

4.2.1 The Model

Let $V(t)$ be the present value of an affiliate located in a foreign country. Due to country specific risk, assume that the value of this foreign direct investment project $V(t)$ follows a stochastic process which is assumed to be a geometric Brownian motion with

$$dV = \alpha V dt + \sigma V dz. \tag{4.1}$$

dz is an increment of a Wiener process such that:

$$dz = \epsilon_t \sqrt{dt} \tag{4.2}$$

where $\epsilon_t \sim N(0,1),\ E(\epsilon_i, \epsilon_j) = 0\ \forall\ i \neq j$.

With this specification, the current value of the project is observable, whereas the future values are lognormally distributed with a variance that grows linearly in time. Here α is a drift parameter or the expected growth rate of the value and σ is the standard deviation of dV (and of the growth rate of V) and measures the uncertainty about the value of the project. Although the investor observes V changing over time as information arrives, future values are always uncertain.[2]

Let I denote the sunk costs of investment into a foreign market. An investor wants to set up a foreign affiliate at a point in time at which he will maximize the expected present value of the investment. The value of the option to invest is

$$F(V) = max\ E[(V_T - I)e^{-\rho T}]. \tag{4.3}$$

[2]See Pindyck [1991].

V_T is the present value of the foreign affiliate at the unknown future time T the investment is undertaken and ρ is the discount rate. An important assumption is that the discount rate ρ exceeds the drift parameter α in equation (4.1). Otherwise delaying entry into a foreign market via FDI would always outmatch the decision to invest. As a consequence no optimal point in time for the investment would exist. The difference between the discount rate ρ and the drift parameter α is $\delta = \rho - \alpha$. Hence, the total expected return of an investment is $\rho = \alpha + \delta$, that is the expected rate of the investment project stock appreciation α plus the dividend rate on this stock from net operating income δ. The latter is realized only if the investment has been undertaken. Thus δ can also be interpreted as the opportunity cost of delaying the investment project and waiting for further information.

Keeping the option to invest abroad yields no dividends, but the value of the option may appreciate over time.

In order to maximize the present value of the option to invest abroad, the multinational enterprise is to equate, in the continuation region (that is, at the margin between holding and exercising the option), the value that he would obtain by exercising the option given the discount rate ρ, to the expected present value of the future capital gains obtained by holding the option.[3] This fundamental condition for optimality is expressed by the Bellman equation:

$$\rho F = \frac{E(dF)}{dt} \tag{4.4}$$

As F is a function of the stochastic variable V, the total differential of the continuous time stochastic process dF can be calculated via Itos Lemma:

[3] In other words, holding this option and thus delaying the FDI is the optimal strategy as long as the amount of return from exercising the option, which an investor would require given the discount rate ρ, is less than the expected rate of return from holding the option.

$$dF = F'(V)dV + \frac{1}{2}F''(V)(dV)^2 \tag{4.5}$$

Substituting dV from (4.1) into (4.5) and taking expectations yields

$$E(dF) = \alpha V F'(V)dt + \frac{1}{2}\sigma^2 V^2 F''(V)dt.^4 \tag{4.6}$$

The modified Bellman equation where dV is a continuous stochastic process can be obtained by substituting equation (4.6) into equation (4.4)

$$\rho F = \alpha V F'(V) + \frac{1}{2}\sigma^2 V^2 F''(V) \tag{4.7}$$

This second order differential equation shows that the value of the option F will respond to changes in the present value of the FDI, V, and in changes of the volatility of its value, σ. Let V^* be the level of the net present value where an investor is indifferent between investing and waiting. Thus for each point in time t there will be a critical value $V^*(t)$, with waiting to invest is the optimal strategy if V_t lies on the one side of $V^*(t)$, and undertaking the FDI if on the other side. In order to determine the optimal point of time to enter the foreign market the investor has to calculate the trigger value $V^*(t)$. In the case of investment the payoff then is the expected present value of revenue minus investment cost.

To obtain V^* equation (4.7) has to be solved given the following boundary conditions:

$$\begin{aligned} F(0) &= 0 \\ F(V^*) &= V^* - I \\ F'(V^*) &= 1 \end{aligned} \tag{4.8}$$

[4]As the expectation of dz is zero, some terms disappear.

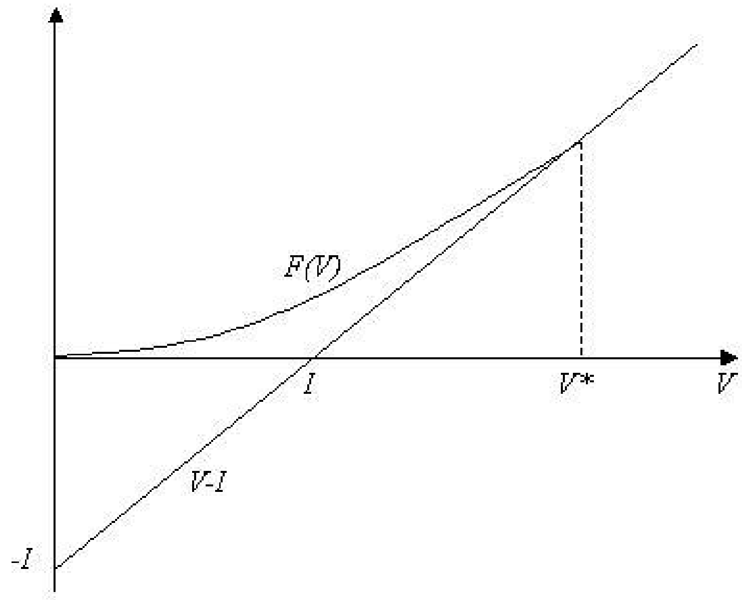

Figure 4.1: Net Present Value and the Value of the Option to Invest

The first condition in (4.8) states that if the present value of the FDI becomes zero than the value of the option to invest is zero. The second one characterises the optimal value V^*, where the value of the option to undertake a FDI and thus the cost of giving up the option is equal to the net present value and thus the gain of the investment. In other words, it is optimal to invest if the present value of the project at least equals the investment expenditure I plus the indirect opportunity costs of giving up the option $F(V)$. The third condition is the "smooth pasting" condition (Dixit, 1993) which ensures that $F(V)$ is continuous around the optimal investment timing point.

Figure 4.1 shows the development of the net present value $V - I$ and the value of the option to invest $F(V)$ which satisfies the conditions (4.8). The investor will postpone the investment as long as the value of the option is bigger than the net present value. This is the case for $V < V^*$. Thus the optimal trigger value V^* will be where the curve of $F(V)$ becomes tangential to and then follows the straight line $V - I$ in Figure 4.1.

Obviously, V^* is greater than in the case of the net present value rule where $V = I$, which is the crossing point of the $V - I$ line with the horizontal axis. The reason for this is that uncertainty about the future present value of the project makes information valuable which arrives in course of time. Thus although the net present value is zero the investor will wait for additional information and will keep the option to invest alive, i.e. he postpones the investment abroad.

In order to determine V^*, the option value $F(V)$ must be calculated. The solution for $F(V)$ that satisfies the boundary conditions (4.8) takes the form

$$F(V) = AV^{\beta} \tag{4.9}$$

where A and β are constant parameters.

The unknown values of V^*, A and β given I, σ and $\alpha = \rho - \delta$ can now be derived.[5] First, from equation (4.9) and from the second and the third boundary condition in (4.8) the critical value V^* at which it is optimal to invest can be calculated:

$$V^* = \frac{\beta}{\beta - 1} I \tag{4.10}$$

The constant A in equation (4.9) is

$$A = \frac{V^* - I}{(V^*)^{\beta}} = \frac{(\beta - 1)^{\beta - 1}}{\beta^{\beta} I^{\beta - 1}} \tag{4.11}$$

In order to examine the impact of uncertainty on the critical present value V^* it is necessary to calculate β. By substituting equation (4.9) and

[5] See appendix, for more detailed derivations.

its derivatives into equation (4.7) we derive the following quadratic equation

$$\frac{1}{2}\sigma^2\beta(\beta-1)+\alpha\beta-\rho=0. \tag{4.12}$$

The solution for β is

$$\beta=\frac{1}{2}-\frac{(\rho-\delta)}{\sigma^2}+[(\frac{(\rho-\delta)}{\sigma^2}-\frac{1}{2})^2+\frac{2\rho}{\sigma^2}]^{1/2}. \tag{4.13}$$

Dixit and Pindyck [1994] (pp. pp. 142-143) show that $\beta > 1$.[6] Hence, $\beta/(\beta-1) > 1$ in equation (4.10) and $V^* > I$: There is a wedge between the optimal investment rule received with this analysis and the net present value rule. McDonald and Siegel [1986] interpret the wedge $F(V)$ as the "value of waiting to invest". This wedge and hence the critical value V^* hinges on several factors which will be discussed in the following section.

4.2.2 Comparative Statics

Now we can carry out some comparative static analysis and explore how the critical value V^* changes if exogenous parameters change like the uncertainty of the value of the FDI project, σ, the dividend rate from net operating income, δ, and the cost of investment, I.

- $(\partial V^*)/(\partial\sigma) > 0$

  Dixit and Pindyck [1994] (pp. 143-144) show analytically that $(\partial\beta)/(\partial\sigma) < 0$ and hence $(\partial V^*)/(\partial\sigma) > 0$. The reason is that an increasing uncertainty increases the value of the option and shifts the curve $F(V)$ in Figure 4.1 upwards. This implies a higher critical value V^*, that is, the

[6] Thus, only positive values for V^* in equation (4.10) are possible.

multinational firm requires a higher return before she decides to invest abroad.

- $(\partial V^*)/(\partial \delta) < 0$

  An increase of the dividend rate from net operating income δ is equivalent to an increase of the opportunity costs of delaying the investment. As a result as the value of waiting to invest $F(V)$ diminishes which leads to a lower critical value V^*. The investment will occur earlier.

- $(\partial V^*)/(\partial I) > 0$

  It follows directly from equation (4.10) that the higher the investment cost I, the higher the critical value of the investment project abroad V^*.[7] As V follows the trend α, more time has to pass to reach the higher level and the multinational enterprise will invest abroad later.

4.3 Empirical Analysis of the Decision about the Timing of FDI

In order to examine, among other factors, the impact of uncertainty on the decision about the timing of a FDI, we model the time which elapses until an investor undertakes a FDI into a particular country in transition. In terms of the real option approach in the previous section, we are searching for the factors which influence the option value and thus the survival time of keeping the option alive. Following the related empirical literature (for example, Hurn and Wright [1994], Blandon [2001]), we utilize a Cox proportional hazard model for the empirical analysis concerning this question.[8]

[7] The net present value rule would also require a higher V.
[8] See Cox [1972].

The Cox proportional hazard model specifies the hazard function $h(t)$ to be

$$h(t) = h_0 e^{X\beta} \tag{4.14}$$

where $h(t)$ is the rate at which a multinational enterprise invests at time t into a particular country given that it has not invested in t-1. Similarly, $h(t)$ can be interpreted as the rate at which the investor exercises the option to invest. Further on, h_0 is the baseline hazard function when all of the covariates are set to zero and X is a set of country and firm characteristics postulated to impact a multinationals decision when to invest.

The Cox model seems to be a proper model for a number of reasons. First, it does not require any restrictions about the baseline hazard, such as the Weibull or lognormal specification. This is reasonable for the aims of the present analysis, as the main interest is not in the estimation of the underlying baseline hazard but in the impact of country risk or uncertainty and other factors on the foreign direct investment timing decision. As the literature on survival analysis points out, it is favorable to refer to the semi-parametric modelling approach of the Cox proportional hazard model if the parametric form of the baseline hazard function h_0 is not known for sure. Secondly, Tan and Vertinsky [1996] refer to the fact that on the one hand probit or logit models could also be alternative estimation strategies. These consider the difference of influential forces between firms that have or have not undertaken investments abroad *at a given point in time*. On the other hand, the advantage of the Cox model is that it relates a firms decision to the *time span* in which the FDI has or has not occurred.

In the following sections the results from the theoretical model will be summarized in hypotheses, afterwards the data will be descripted and finally, the findings from the empirical analysis will be presented.

4.3.1 Hypotheses

The model and the comparative statics in the previous section show which factors might influence a multinationals decision when to invest abroad. These results will be extended by outcomes from the existing literature on timing of FDI.

As a result from the real options approach, uncertainty or - in the case of foreign direct investment projects - country risk makes the option to invest more valuable. Therefore we can state the following hypothesis:

HYPOTHESIS 1: High country specific risk potential rises the critical value for an investment V^* and entry into that country occurs later.

The second prediction from the model is that the dividend rate as the opportunity costs of delaying the investment decreases the option value and thus the required critical value V^*.

HYPOTHESIS 2: The higher the expected profits from a foreign affiliate, the earlier the multinational enterprise will undertake the investment abroad.

The expected dividend rate from a foreign direct investment might be estimated by the profits which were actually realized. This would imply that the multinational enterprise is able to forecast them well. Alternatively the investor could estimate the profitability by the available macroeconomic data such as the growth or the size of the economy.

Similar to the net present value approach the investment costs directly influences the necessary level of V^*.

HYPOTHESIS 3: The multinational will enter the foreign market later if the sunken costs of investment are high.

Other influential variables have been explored empirically in the literature or can be derived indirectly from the previous model. The distance to a foreign location is usually considered in the OLI literature as an important locational specific advantage.[9] Typically monitoring costs are considered to grow with distance which indeed become less important with new communication technologies. However, cultural differences may increase with distance and therefore, the multinationals ability to fit with its potential customer needs.

HYPOTHESIS 4: Geographically closer markets are expected to be entered earlier.

The reversibility of a multinationals investment abroad should have a strong impact on the timing of foreign direct investment. If the investment would be completely reversible, there would be no reason to postpone an investment with a positive net present value because the sunken costs of investment could be fully recovered in case that the project fails. This argument might be true for tangible assets as these may be easier to resell than intangible assets such as the firms knowledge stock in R&D or its brand label.[10]

HYPOTHESIS 5: A high degree in intangible assets implies less reversibility of the investment and entry should be expected to occur later.

Additional factors which might influence the FDI decision come from gravity models (Brenton et al., 1999). These state that FDI flows depend positively on the size of the economy.

HYPOTHESIS 6: The larger the market of the host country the more likely is that the FDI occurs at an early stage.

[9] See Blandon [2001].
[10] See Rivoli and Solario [1996].

4.3.2 Data

Generally it is difficult to collect data on investment delay, which is the time that elapses from the point in time when the investment opportunity occurs until the realization of the project. However, the fall of the iron curtain during 1989/1990 indicates a unique starting date for a sudden removal of restrictions towards FDI into Central and Eastern European Countries in transition and the former Soviet Union.[11] This pattern is confirmed by macroeconomic data: FDI inflows in the Central and Eastern European Countries increased from an average of 59 million US$ in the period 1985-1989, up to 300 US$ in 1990 and 2,448 US$ in 1991.[12]

Furthermore, the point in time from which on investments abroad are possible, not only depends on the economic environment but also on specific characteristics of the investor. Therefore, only those firms are considered within the following analysis which at least have undertaken one investment abroad.

The firm survey "German and Austrian FDI in CEEC" of the Chair of International Economics at the University of Munich produced 2,115 investments into 27 countries in transition from 688 investors. The survey was carried out during the period from 1998 to 2001 and all investors were queried only once so that no panel data is available.

In general, each of these 688 investors could invest in each of the 27 countries such that 18,576 (688 times 27) investment opportunities exist. Each of these observations have country specific and investor specific characteristics. As we are interested in the first entry of a multinational enterprise in a particular country further investments into the same country are not considered.

[11] Hungary was the only country where to some extent FDI inflows already existed before.

[12] See UNCTAD, World Investment Report, various years.

In the case that an investor actually invested in a particular country, the survival time of the option to invest abroad is the year of investment minus 1990, the starting date of foreign direct investment opportunities into countries in transition. These observations are treated to be uncensored. For those cases where an investor did not exercised his option to invest into a specific country until the year he had been surveyed, the survival time of the option is set by the period from 1990 until the year he had been surveyed. These cases are treated to be censored. Thus, a dummy variable has been included which equals 1 for uncensored observations and zero for censored observations.

Uncertainty or, in the case of foreign direct investments, country risk is captured by two alternative measurements. The first one is *exrunc* which is the yearly standard deviation of unpredicted exchange rate movements in a country, divided through the mean of the exchange rate level in that year.[13] Hence, a high value of *exrunc* indicates an uncertain macroeconomic environment.

Alternatively, we refer on a composite risk variable, the *Euromoney* country risk index *euromon* which has been transformed such that values between zero and 100 indicate an absolutely save environment and mostly uncertain one respectively. The multinational should postpone the investment if risks are high.

Expected profits from a foreign affiliate are assumed to be higher, the higher the economic performance in the relevant country measured by the growth of GDP *gdpgr* (taken from EBRD *Transition Report*). A good market performance should favor an early investment. *ldistanc* is the logarithm of the geographical distance in kilometers between the multinational enterprise and the foreign affiliate (source: Route planner software *Route*66). Invest-

[13]The exchange rate is forecasted by $exr_{jt} = a + btrend_j + cexr_{jt-1} + dexr_{jt-2} + \epsilon_{jt}$. See Chapter 2 for more details about both risk measures.

ments to a place with greater distance should have been postponed.

In addition to uncertainty, a further assumption of real option models is that the investment abroad is at least partially irreversible. Otherwise the multinational enterprise could recover the complete sunken costs of investment if the foreign direct investment failed. The reversibility of an investment is presumed to be lower when the investment project has a huge amount of intangible assets such as tacit knowledge. We assume that the R&D intensity of the multinational enterprise reflects these assets adequately. The variable *tecint* are the investor's R&D-expenses over sales, which is computed from the firm survey and which we would expect to affect an early foreign market entry negatively as high R&D reflects high irreversibility.

The size of the economy is captured by the logarithm of GDP *lgdp* (source: Penn World Tables). To take into account the privatization progress in countries in transition, we also control for the cumulated privatization revenues as a percentage of GDP pr_j which is taken from several issues of EBRD *Transition Report*.

Additionally, one could rely on investment specific variables which might capture the influences on investment timing such as investment costs or the future profits of the FDI project. To do this, it has to be assumed that the investor knows these flows in advance. Those projects which had not been realized actually could not be considered as we have no data on this hypothetical investment opportunities. Our third hypothesis suggests late investment if investment costs are high. Expected profits $profit$ are approximated by the logarithm of sales minus labor costs of the foreign affiliate. This strategy will lead to a much smaller number of observations which all represent a foreign direct investment project.

As some German and Austrian investors have more than one affiliate in the same country, we only consider the first entry into a country.[14] Table 4.1 summarizes the definitions and sources of the variables and Table 4.2 shows their expected impact on the investment timing.

The predictions from the real option based model and equation (4.14) give the following estimation equation for the hazard of investing within a certain period using data from host country (j) and the investor (m)

$$\begin{aligned} h(t) &= h_0 e^X \\ X &= \beta_1 RISK_j + \beta_2 gdpgr_j + \beta_3 tecint_m + \beta_4 lgdp_j \\ &\quad + \beta_5 pr_j + \beta_6 ldistanc_{im} + \epsilon \end{aligned} \tag{4.15}$$

Here $RISK$ are the alternative country risk indices $exrunc$ and $euromon$. The technological intensity $tecint$, the size of the country $lgdp$, the progress of the privatization process in terms of revenues pr and the geographical distance $ldistanc$ are variables which could not be directly derived from the model but which were found to play an potential role in the investment timing decision.

As mentioned before, it is also possible to include investment specific variables like the sunken costs of the investment $lfdi$ and a more direct approximation of the economic performance of the foreign affiliate $profit$ instead of the market growth $gdpgr$. We then estimate the following specification

$$\begin{aligned} h(t) &= h_0 e^Z \\ Z &= \beta_1 RISK_j + \beta_2 profit_i + \beta_3 lfdi_i + \beta_4 tecint_m \\ &\quad + \beta_5 lgdp_j + \beta_6 pr_j + \beta_7 ldistanc_{im} + \epsilon \end{aligned} \tag{4.16}$$

As in this case data is only available for investments that have been undertaken, only these actual investments can be taken into account.

[14] The reason is that additional FDI projects could be treated as incremental investments which are analyzed by Dixit and Pindyck [1994]. They analyze a firm choosing the time path of its capital stock when investing into additional projects under uncertainty.

Table 4.1: Variables and Data Sources

Variable Name	Description	Source
dependent variable	number of years until multinational enterprise i invests in country j	Firm Survey
$exrunc_j$	Exchange rate - uncertainty	Datastream
$euromon_j$	Country risk index (transformed to 0 "low risks" - 100 "high risks")	*Euromoney* Magazine
$tecint_m$	R&D expenditures over sales of the investor	Firm Survey
$lgdp_j$	Logarithm of GDP in host country	Penn World Tables
$gdpgr_j$	Growth of GDP in host country	EBRD *Transition Report*
$ldistanc_{im}$	Logarithm of geographical distance between investor and foreign affiliate	Router Software *Route*66
pr_j	Cumulated privatization revenues in per cent of GDP in host country	EBRD *Transition Report*
$profit_i$	Sales minus labor cost of the FDI	Firm Survey
$lfdi_i$	Logarithm of investment expenditures	Firm Survey

Note: The subscripts i denote the investment, m the multinational enterprise and j the country.

Table 4.2: Expected Signs of Coefficients

Variable	Expected sign
$exrunc_j$	-
$euromon_j$	-
$tecint_m$	-
$lgdp_j$	+
$gdpgr_j$	+
$ldistanc_{im}$	-
pr_j	?
$profit_i$	+
$lfdi_i$	-

Note: The subscripts i denote the investment, m the multinational enterprise, j the country and t the respective year.

4.3.3 Empirical Results

Before analyzing the decision of multinational enterprises when to enter the countries in transition by applying the Cox proportional hazard model, we will look at the Kaplan-Meier estimator that the investor's option will survive beyond a given point in time distinguishing between the new EU-Members in 2004 and other Countries in transition.

The Kaplan-Meier estimator of surviving beyond time t is the product of survival probabilities in t and the preceding periods $S(t) = \Pi_{j=t_0}^{t}(n_j - d_j)/n_j$. Here n_j represents the number of noncensored investment opportunities or options that are still alive, and are not censored at the beginning of time period t. "Noncensored" means that only those FDI options are considered which actually were realized until the end of the survey in 2001. d_j is the number of failures or - in this case - investments that occur to these observations during time period t. The plot of $S(t)$ against t is the Kaplan-Meier survival curve in Figure 4.2.

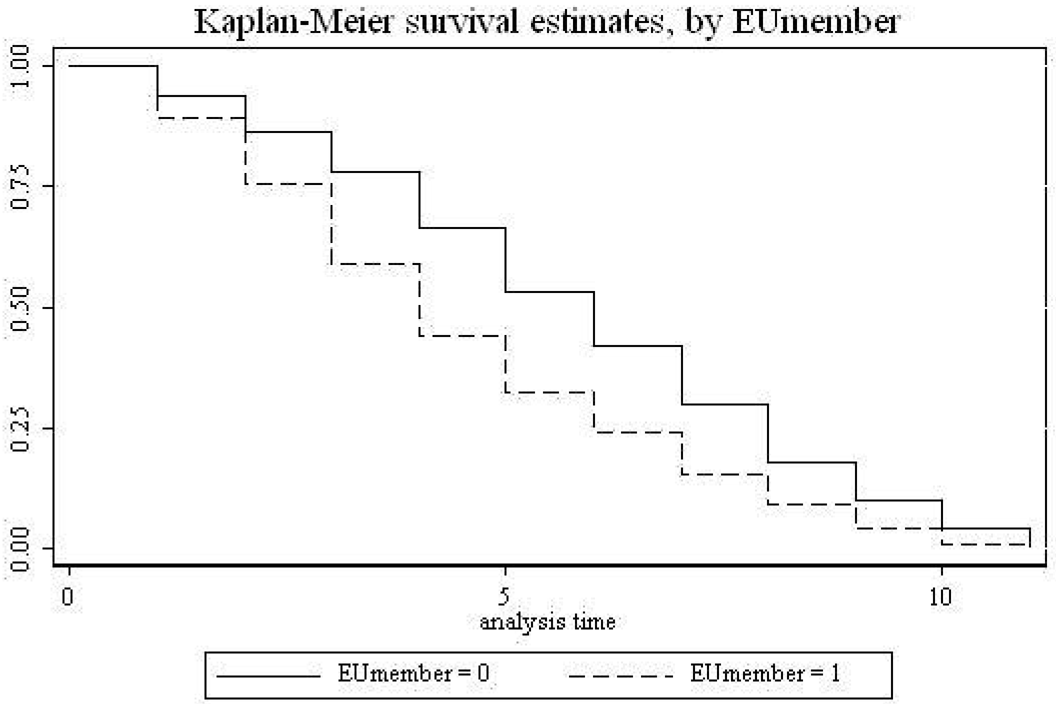

Figure 4.2: Kaplan-Meier Survival Curves for New EU-Members
and other Countries in Transition

As we can see, the probability of survival for the option is lower in the case of multinationals which invest in the Central- and Eastern European new members of the EU (which is the *EUmember* group among the dashed line) than for investors into all other countries. In other words, at each point in time foreign direct investments into the new EU members are more likely than into non members. A log-rank test clearly rejects the hypothesis that the survivor functions are the same for both groups with a significance level of less than 0.01% ($\chi^2(1)$=41.48).

Tables 4.3 and 4.4 report the results from the Cox proportional hazard model and give the estimated hazard rates for the independent variables discussed before. A hazard rate smaller than one indicates that the underlying independent variable has a negative impact on the probability that a multinational enterprise undertakes an investment abroad given that it did not invest into the country until that time. In more technical terms, in this case the variable has a positive influence on the survival rate of the option to invest and it is more likely that the investor will postpone the investment. A hazard rate greater than one means that high values of the variable in question favor early investment.

Taking into account that each multinational enterprise from the firm survey could have invested in each CEEC and in each country of the CIS, we obtain Table 4.3. Due to missing values, from 18,576 possible investment opportunities only between 8,167 and 9,323 observations remain for the analysis. Many of these possible investments had not been undertaken until the multinational enterprise had been surveyed.

The first column reports the results for exchange rate uncertainty *exrunc* as a measure of country risk and the forecast of the profitability of the project which is approximated by the market growth *gdpgr*. Both variables exhibit the expected impact on the timing of a foreign direct investment at significant levels: A highly uncertain environment makes late investment more likely, whereas a good economic performance favors early investment. These results remain robust for different specifications (columns (2) and (3)) and therefore clearly support the first and the second hypothesis. The effect that a high country risk lets multinational enterprises postpone investments abroad is confirmed by Gaba et al. [2002]. In contrast to this study, they do not find an impact of market growth.

The second specification contains additional variables which were not directly derived from the underlying model. Surprisingly, *tecint* as a measure for irreversibility of the investment has a positive impact on the probability for early investment. The hazard rate is not statistical at conventional significance levels. This result does not change if industry dummy variables are included (column (3)).

The geographical distance *ldistanc* substantially decreases the propensity for early investment: Austrian and German multinational enterprises wait longer until they decide to invest in countries of the former Soviet Union compared to investments in countries with a common border. This effect might be driven by the lack of knowledge of the costumers tastes. Blandon [2001] also obtains strong evidence that a large cultural distance makes early investment into the Spanish banking sector less likely. Finally, the hazard rate for *lgdp* points out that multinational enterprises invest earlier into bigger host markets, whereas the share of cumulated privatization revenues to GDP *pr* as a proxy variable for the privatization progress shows a negative and significant influence on the FDI timing decision.

Specification (3) shows that including dummy variables for industries of the investor does not change the results and therefore confirms the robustness of the analysis.

In columns (4) to (6) in Table 4.3 country risk is measured by the index from the magazine *Euromoney*. It has been transformed such that low levels indicate low risks and vice versa. The Cox proportional hazard models report very similar results as in the first three specifications. Again, high levels of country risk make early investment less likely. This result is again highly significant. The hazard rate of the growth of GDP indeed becomes more significant when further explanatory variables are included. As all other results remain nearly unchanged, they seem to be stable and robust against different specifications.

Table 4.3: Estimated Hazard Rates from the Cox Proportional Hazard Model (Realized and Non-Realized Investments)

	(1)		(2)		(3)		(4)		(5)		(6)	
exrunc	0.023	***	0.049	**	0.037	***						
	(-4.53)		(-2.47)		(-2.71)							
euromon							0.923	***	0.971	***	0.968	***
							(-21.36)		(-7.20)		(-7.59)	
gdpgr	1.252	***	1.353	***	1.337	***	1.059	***	1.350	***	1.333	***
	(21.51)		(22.12)		(20.95)		(3.85)		(21.88)		(20.89)	
tecint			1.728		2.328				1.688		2.466	*
			(1.00)		(1.61)				(0.94)		(1.73)	
ldistanc			0.578	***	0.577	***			0.813	***	0.833	**
			(-8.48)		(-8.50)				(-2.52)		(-2.21)	
lgdp			1.137	***	1.138	***			1.088	***	1.085	***
			(5.83)		(5.90)				(4.95)		(4.83)	
pr			0.971	***	0.973	***			0.969	***	0.971	***
			(-4.34)		(-4.06)				(-4.83)		(-4.53)	
industry dummies	No		No		Yes		No		No		Yes	
No. of subjects	9,323		8,657		8,657		8,852		8,187		8,187	
Loglikelihood	-7,683.97		-5,575.18		-5,541.43		-7,329.38		-5,515.73		-5,479.86	
LR χ^2(No. of obs.)	486.21	***	1,065.45		1,132.95		1,047.29		1,070.57		1,142.32	

Note: t-statistics in parentheses. Significant at *** 1%, ** 5%, * 10% level.

Another possibility to explore the driving forces for the foreign direct investment timing of multinational enterprises is to consider data from the foreign affiliates. Since these data can only be observed after the investment has been undertaken, we have to assume that the investor had appropriate expectations concerning the unknown profits of the investment.

Therefore, only actual foreign direct investments can be taken into account which reduces the number of observations after considering missing values to a total number of 461 to 666. Table 4.4 shows the results from the Cox proportional hazard model for this strategy. Instead of approximating the profitability of the foreign affiliate by the host market growth, we now rely on a more direct measure $profit$, which is computed by data from the investment projects. In contrast to the previous strategy, also the amount of sunken investment costs $lfdi$ can now be considered.

The first column of Table 4.4 displays the hazard rates for the influential variables which have been derived from the real option approach, restricted to the cases of actual investments during the regarded period from 1990 to 2001. Again, the significant hazard rate smaller than one shows that under high country risk (measured by exchange rate uncertainty) it is less likely that a multinational enterprise will give up its option to invest at a given point in time. Therefore it will undertake the investment later. Also the other two variables from the theoretic model have an influence on the investment timing: Investments which are presumed being highly profitable (high values of $profit$) will be realized more likely at an early stage of transition (with a significance level of less than 1%). High investment costs $lfdi$ show a negative and significant impact.

Table 4.4: Estimated Hazard Rates from the Cox Proportional Hazard Model (Realized Investments Only)

	(1)		(2)		(3)		(4)		(5)		(6)	
exrunc	0.092	**	1.171E-03	***	4.976E-04	***						
	(-2.07)		(-3.56)		(-3.91)							
euromon							0.986	***	0.978	***	0.974	***
							(-3.82)		(-3.58)		(-3.98)	
profit	1.079	***	1.061	*	1.058	*	1.081	***	1.067	**	1.063	*
	(2.79)		(1.80)		(1.65)		(2.90)		(1.97)		(1.77)	
lfdi	0.940	**	0.968		0.977		0.934	***	0.966		0.976	
	(-2.37)		(-0.98)		(-0.66)		(-2.62)		(-1.06)		(-0.69)	
tecint			0.352	*	0.418				0.396		0.473	
			(-1.65)		(-1.30)				(-1.49)		(-1.12)	
ldistanc			1.107		1.156	**			1.195	**	1.273	***
			(1.49)		(2.03)				(2.07)		(2.64)	
lgdp			1.102	***	1.109	***			1.027		1.024	
			(3.23)		(3.42)				(1.24)		(1.08)	
pr1			0.930	***	0.930	***			0.931	***	0.931	***
			(-7.14)		(-7.09)				(-6.89)		(-6.82)	
industry dummies	No		No		Yes		No		No		Yes	
No. of subjects	660		461		461		666		462		462	
Loglikelihood	-3,729.27		-2,420.94		-2,416.60		-3,763.63		-2,427.16		-2,422.49	
LR χ^2(No. of obs.)	14.06	***	75.25	***	83.93	***	25.45	***	75.57	***	84.91	***

Note: t-statistics in parentheses. Significant at *** 1%, ** 5%, * 10% level.

Column (2) shows the results when additional variables are included. Here it is confirmed that low uncertainty and higher profits favor an early investment abroad. The explanatory power of $lfdi$ vanishes. Also $profit$ becomes less significant. In contrast to the previous results in Table 4.3 now those investors which possess a fair amount of intangible assets invest abroad later. Assuming that the technological intensity *tecint* adequately captures these assets, and assuming further on that investments undertaken from these multinational enterprises are less reversible, the fifth hypothesis is supported: Highly irreversible investments will occur later.

Country specific variables like GDP and privatization revenues *pr* still explain the timing decision at significant levels. Indeed the distance between investor and affiliate is no more significant. The reason for this might be due to the fact that in contrast to the analysis before, here only actual investments are considered. Thus with this reduced sample a selection bias occurs. On the other hand, by reducing the data to actual investments only, we found *tecint* to have a negative and partly significant impact on the investment timing decision, now given that an investment has been undertaken at some point in time. The main results are confirmed if industry dummy variables are included (specification (3)).

An overall similar picture appears if instead of *exrunc* the alternative country risk index *euromon* is included in specification (4). Again, multinational enterprises seem to invest later in countries with a highly uncertain environment. FDI projects which are expected to be more profitable (indicated by higher levels of $profit$) are realized earlier. Sunken costs of investment $lfdi$ turn out to have a negative and significant impact on early investment abroad. This again supports the third hypothesis. Somewhat puzzling is the positive impact of the distance between the investor and the foreign plant. Given that a multinational enterprise had decided to invest in a country, the hazard rate bigger than one indicates that the investment abroad will be sooner the larger the distance.[15] This contradicts the finding from Figure 4.2. Most of the new EU members have a common border with Germany or Austria. These countries have been entered earlier than all other transition countries.

The technological intensity *tecint* has a negative, but less significant impact on the timing of a foreign direct investment. Less reversible investments indicated by high levels of technological intensity are less likely to occur at an early stage. Given that an investment has been undertaken, the size of a country has no influence on the timing decision.

Overall, the empirical analysis strongly supports the main results derived from the real option model in the case of foreign direct investments in the CEEC and the CIS. The timing of entry via FDI in countries in transition depends on host country risk and the expected profitability of the foreign affiliate. Furthermore, the sunken costs of investment and the degree of the project's irreversibility through tacit knowledge influence the multinational's decision when to invest abroad.

[15]One possible explanation for this result is that distance is also a measure for transport costs in the case of exporting. The higher these costs the earlier entry will occur in order to serve the market.

4.4 Conclusion

The question about the timing of investments under uncertainty has been analyzed theoretically and empirically by a number of earlier studies. Only few of them focus on FDI as it is difficult to define a point in time from which on investments into a certain economy or region is possible. With the fall of the iron curtain 1989/1990 and the collapse of the communist command economies additional investment opportunities for multinational enterprises into a huge region emerged. This historical event offers the possibility to apply theoretical considerations about the dates of undertaking investments abroad empirically.

First of all, a theoretic model has been described which regards investment opportunities as a real option. As a result, a multinational enterprise should postpone an investment abroad if the concerning country exhibits high economic risks. The reason is that in this case the option to invest becomes highly valuable and the investor desires a higher present value from the FDI project. Also other factors like the profitability of the investment or the degree of irreversibility of the investment should affect the date of starting the project. The costs of delaying a FDI are high if the presumed profits from the foreign investment are high. Hence in this case early market entry should be observed. The FDI project should be postponed if high efforts due to tacit knowledge cannot be fully recovered, that is if the FDI project is partially irreversible.

These findings have been confirmed by the empirical analysis. First, all possible investment opportunities of Austrian and German enterprises into CEEC and the CIS from the underlying firm survey have been taken into account. As a result, high country specific uncertainty decreases and a solid economic performance increases the likelihood for early investment.

Additionally, other covariates which could not be directly derived from the theory have also a significant impact on the timing decision.

As a second step, only the realized investments abroad have been considered. This strategy allowed to include more direct measures like approximated profits or the sunken cost of the FDI project. Again, low uncertainty and high expected profits explain an early foreign market entry. Additionally, a high R&D-intensity as an approximation for the irreversibility of the investment makes it more likely that the investment will be postponed.

As a political implication to promote early FDI inflows, a stable economic environment and a policy that enhances economic growth has found to be most important. Unfortunately, in contrast to other empirical studies, this analysis is constraint to the last decade and it might be give new insights if it could be applied to a longer period.

4.5 Appendix

Deriving V^* and A in equations (4.10) and (4.11)

In general the solution for $F(V)$ from equation (4.7) given the boundary conditions in equation (4.8) has the functional form

$$F(V) = AV^{\beta} \tag{4.17}$$

The first and the second derivatives are

$$F'(V) = \beta AV^{\beta-1} \qquad F''(V) = \beta(\beta-1)AV^{\beta-2} \tag{4.18}$$

From the third boundary condition of the equations (4.8) it follows that

$$F'(V^*) = \beta AV^{\beta-1} = 1 \tag{4.19}$$

Inserting the second boundary condition this is equivalent with

$$\beta \frac{V^* - I}{V^*} = 1 \tag{4.20}$$

The solution for V^* is (4.10).

The second the boundary condition in equation (4.8) is

$$F(V^*) = V^* - I = AV^{*\beta} \tag{4.21}$$

Solved for A and substituting V^* yields equation (4.11).

Deriving equation (4.12)

Substituting the derivatives of equation (4.9) into equation (4.7) yields

$$F = \frac{\alpha}{\rho} V \beta AV^{\beta-1} + \frac{1}{2}\frac{\sigma^2 V^2}{\rho}\beta(\beta-1)AV^{\beta-2} = AV^{\beta-1} \tag{4.22}$$

which is equivalent with

$$F = \frac{\alpha}{\rho}\beta A V^{\beta-1} + \frac{1}{2}\frac{\sigma^2}{\rho}\beta(\beta-1)AV^{\beta-1} = AV^{\beta-1} \tag{4.23}$$

By dividing through with AV^{β} and subtracting ρ yields

$$\alpha\beta + \frac{1}{2}\sigma^2\beta(\beta-1) - \rho = 0 \tag{4.24}$$

Deriving the solution for β

Substituting $\alpha = \rho - \delta$ and rewriting equation (4.12) gives

$$\frac{1}{2}\sigma^2\beta^2 - \beta[\frac{1}{2}\sigma^2 - (\rho - \delta)] - \rho = 0 \tag{4.25}$$

which has the following solutions

$$\beta_1 = \frac{1}{2} - \frac{(\rho-\delta)}{\sigma^2} + [(\frac{(\rho-\delta)}{\sigma^2} - \frac{1}{2})^2 + \frac{2\rho}{\sigma^2}]^{1/2} > 1 \tag{4.26}$$

and

$$\beta_2 = \frac{1}{2} - \frac{(\rho-\delta)}{\sigma^2} - [(\frac{(\rho-\delta)}{\sigma^2} - \frac{1}{2})^2 + \frac{2\rho}{\sigma^2}]^{1/2} < 0 \tag{4.27}$$

Therefore the general solution of equation (4.9) is

$$F(V) = A_1V^{\beta_1} + A_2V^{\beta_2} \tag{4.28}$$

From the first boundary condition in (4.8) it follows that $A_2 = 0$ and thus β_1 is the only solution.

Chapter 5

The Impact of Country Risk on Vertical and Horizontal FDI

In the previous chapters we focused on FDI decisions of multinational enterprises in the presence of country risks. Contrary to this, the aim of this chapter is to analyze the impact of uncertainty and country risks on the expected profits of the foreign affiliate. More specifically, we will thereby distinguish between horizontal and vertical foreign direct investments. Horizontal FDI means that the entire production process is located abroad, whereas in the case of a vertical FDI the different stages of the production process are internationally segmented. In this context we will investigate the question whether demand and supply uncertainty in the host economy affects the profits of both types of FDI in different ways. As this is actually the case, we therefore expect that uncertainty has also an influence on the decision between both production modes.

5.1 Introduction and Related Literature

The literature distinguishes between two types of foreign direct investments: Vertical and horizontal FDI. A vertical FDI occurs if a multinational enterprise geographically separates stages of the production process. Vertical FDI are driven by differences in factor endowments and consequently by relative factor prices between countries (Helpman [1984], Helpman and Krugman [1985], Markusen [1995], Hanson et al. [2003]). As a consequence, the foreign affiliate on the one hand either receives a large proportion of the required input factors from the multinational enterprise abroad. On the other hand, the multinational enterprise receives a high share of the production from the affiliate. It then uses these production as intermediate inputs for a final good. This process induces a large amount of intra-firm trade.

Contrary to this, a horizontal FDI takes place if the multinational enterprise produces the same goods or services in multiple countries in order to serve the local market. One driving force for this strategy was elaborated by Markusen [1984] who points out the possibility that a multi-plant firm might exhibit lower total fixed costs than a single-plant firm. Furthermore, Brainard [1993] offers a model with firm-level economies of scale and transportation costs: Low fixed costs or large economies of scale make horizontal FDI projects more attractive in the presence of high trade costs. Additionally, the host market size is expected to have a positive impact on horizontal FDI because a larger market size offers greater opportunities to realize economies of scale (Zhang [2000]).

Previous studies showed the importance of vertical FDI for instance on the relative wages effects (Feenstra and Hanson [1997]) or on the productivity of local firms (Protsenko [2003]). Only one study analyzes the impact of uncertainty on different types of FDI. Aizenman and Marion [2004] show within a theoretical model that higher volatility of supply shocks increases the expected profits associated with horizontal FDI and reduces the expected profits from vertical FDI. The main reason for this result is the assumption that in the case of horizontal FDI, production is characterized by a higher degree of substitutability between the parent firm and the foreign affiliate as both plants produce the same goods. In the case of vertical FDI, the parent firm requires some certain amount of intermediate goods which are solely produced by the foreign affiliate. A supply shock abroad therefore increases the costs of production which now cannot be shifted between plants, and profits decrease. They also show that sovereign risks should be more harmful in the case of vertical FDI as the negotiation power between the multinational and the foreign government is higher in case of a horizontal FDI. This result is also driven by the possibility of substitution between the investor and its affiliate in case of horizontal FDI. Additionally, both types of FDI suffer from demand uncertainty.

The conclusion from this results could bear important policy implications. In the case of a high uncertain environment, profits would tend to be lower for vertical FDI projects. This would deter multinational enterprises from undertaking vertical FDI. As Protsenko [2003] shows, vertical FDI tend to exhibit positive productivity spillover effects on domestic firms. In addition to other negative effects from uncertainty, these positive spillover potentials would be lost.

The aim of this chapter is to analyze the impact of uncertainty on vertical and horizontal FDI separately. First, we will discuss a theoretical model which bases on that from Aizenman and Marion [2004]. It suggests that supply uncertainty is harmful for the profits of a multinational engaged in a vertical FDI but potentially beneficial on the profits from horizontal FDI. Demand uncertainty affects the expected profits always negatively. Using German FDI data on the firm level, we will test these implications empirically. Furthermore we use a bivariate probit model to explore empirically whether one type is preferred to the other in the presence of different sources of uncertainty.

One contribution of this analysis is the use of disaggregated firm-level data which enables us to find appropriate measures for the factors derived from the model. Secondly, not only the effect on the profits can be explored, but also the resulting implications for the decision of the multinational enterprise between vertical and horizontal FDI can be analyzed.

5.2 The Theoretical Framework

We consider two countries home and foreign, where * denotes foreign variables. The households in both countries consume two final goods Y and Z and obtain the utility according the identical utility function

$$U = Z + \frac{A}{\delta} Y^{\delta}, \quad 0 < \delta < 1. \tag{5.1}$$

The price of good Y is P_Y and the price of Z is normalized to one. Labor supply is exogenously given by $L^S = \overline{L}$ and $L^{S*} = \overline{L^*}$. Good Z is produced in the home country according the production function $Z = L_Z$ and in the foreign country according $Z^* = a^* L^*_Z$. As a^* is the labor productivity in the foreign country, the equilibrium wage in the foreign country is $w^* = a^*$ and in the home country $w = 1$.

Two alternative production modes are possible for the Y-sector. A risk neutral multinational monopolist has to decide whether the production process should be fragmented geographically or whether the entire process should be located in the home as well as in the foreign country. In order to focus on the effect of uncertainty in the foreign country, we assume no transportation costs.

In the first case of vertical production, final production in the home country uses an intermediate input M which is produced in the foreign country corresponding to the technology

$$M = (1 + \epsilon^*) b^* \sqrt{L^*_M}, \tag{5.2}$$

where L_M^* is labor employed in the intermediate sector in the foreign country, b^* is the labor productivity in this sector and ϵ^* is a productivity shock in the foreign country with $E(\epsilon^*) = 0$ and which ranges in between $]-1; 1[$. As a second stage, final production of Y^v in the home country requires a certain proportion of M and L_Y given the Leontief technology

$$Y^v = min[M; b\sqrt{L_Y}].^1 \tag{5.3}$$

The total set-up costs of both plants are C_v.

Alternatively, horizontal production of Y in the home and in the foreign country would also require two plants with total set-up costs C_h. The production functions are

$$Y = a\sqrt{L_Y}; \quad Y^* = (1+\epsilon^*)a^*\sqrt{L_Y^*}. \tag{5.4}$$

Here a and a^* are labor productivity in case of horizontal FDI in the home and the foreign country respectively.

The production process in case of a vertical FDI according to equation (5.2) and (5.3) implies a certain ratio of the input factors L_Y and M in the final production of good Y. Hence, the ratio of labor employed in both plants is

$$\frac{L_Y}{L_M^*} = \frac{[b^*(1+\epsilon^*)]^2}{b^2}. \tag{5.5}$$

Horizontal production allows perfect substitutability between the plants in the home and in the foreign country. The multinational enterprise will minimize total labor costs for a given output by equalizing the marginal production costs in both plants. The relative labor demand in this case therefore is

$$\frac{L_Y}{L_Y^*} = \frac{a^2}{[a^*(1+\epsilon^*)/w^*]^2}.^2 \tag{5.6}$$

[1]Contrary to Aizenman and Marion [2004] we do not assume any shocks in the home country as the main interest is the focus on foreign market conditions.

[2]See Appendix for a more detailed derivation.

The comparison of equations (5.5) and (5.6) reveals that the impact of a foreign productivity shock on relative employment is opposite for vertical and horizontal FDI. From equation (5.1) the demand function for Y in the home and in the foreign country is

$$Y^d = [\frac{A}{P_Y}]^\eta; \ \eta = \frac{1}{1-\delta} > 1.^3 \tag{5.7}$$

Here, η is the demand elasticity. Total demand in both countries is $2Y^d$. In the case of a vertical FDI, final goods Y are produced only in the home country and then they are partly exported in order to serve the foreign market. The expected profits are calculated by substituting L_Y and L_M^* from equations (5.2) and (5.3) into the monopolist profit function. This yields the optimal output, and thus expected profits.

The expected profits in the case of vertical FDI are

$$E[\Pi_v] = k_v E[\theta_v + \theta_v^*(1+\epsilon^*)^{-2}]^{-\frac{\eta-1}{\eta+1}} - C_v, \tag{5.8}$$

$$k_v = (1-0.5\delta)A^{\frac{2\eta}{\eta+1}} 2^{\frac{2}{\eta+1}} \left[\frac{\delta}{b^{-2}+w^*b^{*-2}}\right]^{\frac{\eta-1}{\eta+1}},$$

$$\theta_v = \frac{b^{-2}}{b^{-2}+w^*b^{*-2}}, \ \theta_v^* = \frac{w^*b^{*-2}}{b^{-2}+w^*b^{*-2}}.$$

If the multinational monopolist undertakes a horizontal FDI, Y is produced in both plants such that marginal costs are equal. Consequently, also in this case exports can occur as each plant does not produce exclusively for its own market and no prohibitive transportation costs are assumed. Minimizing total costs for a given output by locating domestic labor and labor employed abroad gives the optimal labor ratio in both plants. Hence, profit-maximizing domestic labor can be calculated and a monopolists expected

[3] See Appendix.

profits for horizontal production. This yields

$$E[\Pi_h] = k_h E[\theta_h + \theta_h^*(1+\epsilon^*)^2]^{\frac{\eta-1}{\eta+1}} - C_h, \tag{5.9}$$

$$k_h = (1-0.5\delta)A^{\frac{2\eta}{\eta+1}}2^{\frac{2}{\eta+1}}\left[\delta\left(a^2+\frac{a^{*2}}{w^*}\right)\right]^{\frac{\eta-1}{\eta+1}},$$

$$\theta_h = \frac{a^2 w^*}{a^2 w^* + a^{*2}},\ \theta_h^* = \frac{a^{*2}}{a^2 w^* + a^{*2}}.$$

where $\theta_{(.)}$ and $\theta_{(.)}^*$ are constants determined by productivity and wages with $\theta_{(.)} + \theta_{(.)}^* = 1$ and $k_{(.)}$ are gross profits in the absence of uncertainty.[4]

Inspecting equations (5.8) and (5.9) reveals that expected profits are increasing in productivity shocks[5]:

$$\frac{\partial E(\Pi_v)}{\partial \epsilon^*} > 0$$

and

$$\frac{\partial E(\Pi_h)}{\partial \epsilon^*} > 0.$$

Figure 5.1 illustrates the profits from equations (5.8) and (5.9) with respect to the levels of the supply shock ϵ^* for both production modes. In case of vertical FDI, a negative supply shock is more harmful to the profits than the benefits from a positive shock. On the other hand, a negative supply shock is less harmful to the profits in the horizontal case than the benefits from a positive shock. The reason for this is that the profits of a vertical production might be concave with respect to ϵ^* whereas the profits from horizontal FDI potentially are convex. Aizenman and Marion [2004] try to proof that

$$\frac{\partial^2 E(\Pi_v)}{\partial \epsilon^{*2}} < 0$$

and

$$\frac{\partial^2 E(\Pi_h)}{\partial \epsilon^{*2}} > 0.$$

[4]See Appendix for a detailed derivation of the expected profits for both types.

[5]See Appendix.

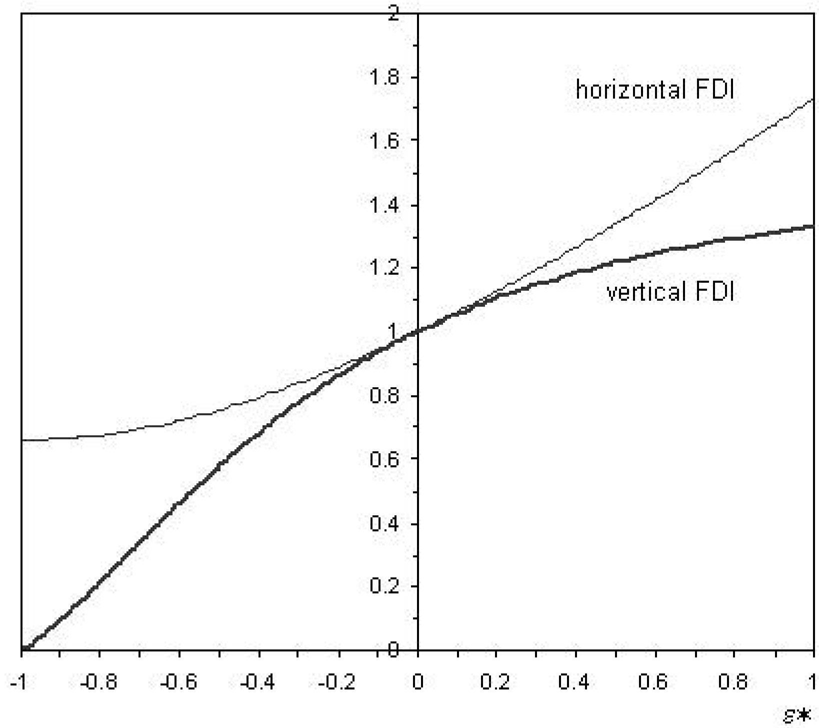

Figure 5.1: Impact of Productivity Shocks on Profits

Note: Simulation results for $\theta = \theta^* = 0.5$ and $\eta = 4$. Profits are normalized to one for both cases in the absence of a shock.

However, their proof contains some mistakes. For plausible, not too extreme values of θ_v^* and η we find that under vertical production $E(\Pi_v)$ actually is concave with respect to ϵ^*. Thus, as stated before, it is likely that high uncertainty lowers profits from vertical fragmentation. In case that production is organized horizontal, there exists a wide range of values for θ_h^* and η where $E(\Pi_h)$ will never or not necessarily be convex.[6] Hence, uncertainty could have a positive impact or even a negative one, which is less likely but still possible.

[6]See Appendix for a derivation and a discussion.

Intuitively, the reason for these results is the following: Under vertical production the multinational monopolist has to ensure a certain proportion between the labor employed in the parent firm and the amount of intermediate goods from the foreign affiliate. A positive supply shock induces that less labor will be employed in the foreign plant, which becomes more productive. On the other hand, a negative shock would increase the amount of labor in order to hold the intermediate production constant. As labor has decreasing marginal productivity, the necessary increase in foreign labor due to a negative shock is larger than the decrease of labor induced by a positive shock. Hence, supply uncertainty increases costs and reduces the expected profits from vertical FDI. In the case of horizontal FDI, substitutability between both plants ensures that total marginal costs of production are equal. A positive supply shock shifts employment towards the foreign affiliate. A negative shock can be partly compensated by shifting employment towards the parent firm. Both effects might compensate each other or even a positive effect might remain.

Consequently, it is likely that more volatile production shocks reduce the profits of a multinational enterprise engaged in a vertical FDI. On the contrary, profits which are related to horizontal FDI might increase if uncertainty is high.

The first derivatives of the profit functions with respect to productivities and wages reveal that

$$\frac{\partial \Pi_v}{\partial b} > 0,\ \frac{\partial \Pi_v}{\partial b^*} > 0,\ \frac{\partial \Pi_v}{\partial w^*} < 0,\ \frac{\partial \Pi_h}{\partial a} > 0,\ \frac{\partial \Pi_h}{\partial a^*} > 0,\ \frac{\partial \Pi_h}{\partial w^*} < 0.$$ [7]

Thus, as intuitively expected, higher productivity in the parent firm as well as in the foreign affiliate increases profits for horizontal and vertical production, whereas higher wages in the foreign affiliate reduce profits.

[7] See Appendix for a detailed analysis. The shocks do not affect the sign of the derivatives.

It is less difficult to derive the impact of demand shocks on expected profits of a multinational enterprise in the case of vertical and horizontal production.[8] In the absence of a supply shock and for the case of a demand shock, we modify the demand function equation (5.7) to be

$$Y^d = [\frac{A}{P_Y}]^\eta;\ \eta = \frac{1}{1-\delta} > 1$$

with

$$A = \begin{cases} A_0 & \text{for the home country} \\ (1+\nu^*)^{1/\eta} A_0 & \text{for the foreign country} \end{cases}$$

ν^* is a mean zero demand shock. It can be shown that a higher volatility of this shock reduces the expected profits for both vertical and horizontal FDI as profits are concave with respect to demand shocks

$$\frac{\partial^2 E(\Pi_v)}{\partial \nu^{*2}} < 0 \text{ and } \frac{\partial^2 E(\Pi_h)}{\partial \nu^{*2}} < 0.^9$$

To summarize the results, demand uncertainty has a negative influence on expected profits for both modes, whereas supply uncertainty most likely has a negative impact on vertical but potentially positive impact on profits from horizontal FDI.

In the next section, we will empirically test the predictions from the model.

[8] Aizenman and Marion [2004] also analyze sovereign risks. In this case, profits are less effected in the case of an horizontal FDI as the bargaining power of a multinational enterprise against the foreign government is higher due to the higher substitutability of production between home and foreign. We will not consider sovereign risks here. As shown in Chapter 2, they do not play an important role for Austrian and German investors.

[9] See Appendix.

5.3 Empirical Analysis

Aizenman and Marion [2004] empirically test the impact of uncertainty on profits of horizontal and vertical FDI. They use data on the sales of majority owned foreign affiliates of U.S. multinationals which is provided by the U.S. Bureau of Economic Analysis. The authors measure profits from vertical FDI as total exports of all U.S. affiliates from the host country, assuming that these exports represent intermediate goods used for further production in the U.S. or any third country. Profits from horizontal FDI are measured by the sum of all affiliate sales in the host market considered. The assumption here is that these local sales are final goods. The cross-country data they use cover 42 countries for the years 1989 and 1994. Dependent variables are aggregated exports and local sales of U.S. affiliates located in a particular country. The explanatory variables are risk measures and other control variables like real GDP of the host country, distance from the USA, the tax rate and a dummy variable for an English speaking country. They find out that supply-side uncertainty which is measured by the volatility of GDP per worker negatively affects the export volume of U.S. multinational affiliates in a particular country but the effect on local sales is smaller and not significant. This indicates that supply risks are harmful for the profits of vertical FDI but not for horizontal FDI. The volatility in terms of trade as a measure of demand-side uncertainty and the sovereign risk index show a negative and significant impact on the exports as well as on local sales.

Although the data confirm the theoretic findings, they also show some essential shortcomings. First, the theory suggests that uncertainty has an impact on the profits of the *multinational enterprise*. However, the aggregated exports or local sales of U.S. affiliates within one country might rather be an approximation to the profits of the *foreign affiliates*. Secondly, the theory suggests that firm-level characteristics like the productivity and the wages of the plants play an crucial role for explaining the profits of multinational enterprises.

The purpose of the following analysis is to test the empirical implications of the model discussed with firm-level data from German foreign direct investments into CEEC and the CIS. The advantage of the use of disaggregated data is that we are able to test the implications of uncertainty on the profits of horizontal and vertical organized multinational enterprises and not only those of the foreign affiliates. Moreover, in contrast to the empirical analysis of Aizenman and Marion, we are able to find appropriate measures of the variables derived from the theory. Furthermore, we can explore the role of uncertainty on the decision of a multinational enterprise whether to undertake a horizontal or a vertical FDI project. The next section describes the estimation function for the profits and the data for the empirical analysis.

5.3.1 The Data and Estimation Equation

It is not possible to make a clear-cut differentiation between vertical and horizontal FDI. The reason is that some FDI projects might be motivated by cost-reducing and market searching strategies simultaneously. The empirical literature separates vertical from horizontal FDI in different ways.

One strand claims that vertical FDI have strong input-output-relationships between the multinational enterprise and the foreign affiliate, for instance Braconier and Ekholm [2001], Braconier et al. [2002] for firm-level Data and Aizenman and Marion [2004] for cross-country data. According to Lankes and Venables [1997] horizontal FDI are assumed to be market searching. Consequently, a second distinction between both types of FDI can be made by observing horizontal FDI if the complete production of the foreign affiliate is sold at the host market. Finally, Protsenko [2003] combines both approaches and defines a vertical FDI being in place if the foreign affiliate exports more than 50 percent of its output. Otherwise a horizontal FDI had been established.

The last definition seems to be adequate for our purposes: The theory defines horizontal FDI if the entire production is located in each of both countries. As no transportation costs are assumed, the foreign affiliate might export (a part of) its production to other markets. Hence, the second definition seem to be too narrow, whereas the last one is flexible enough to account for this possibility.

The firm data is drawn from the firm survey "German and Austrian FDI in CEEC" by the University of Munich.[10] We only consider German FDI and do not include Austrian FDI projects. The reason is that only 13.7% of Austrian projects are vertical FDI according to the definition we made, whereas this is the case for about 27% of German projects. The data are devided in two subsamples for horizontal and vertical FDI projects. Similar to the analysis of Aizenman and Marion, demand-side uncertainty is captured by *exrunc* which is a measure for exchange rate risks. Contrary to them, we choose *euromon* as a measure for supply-side risks. Their risk measure for supply risk (volatility of GDP per worker) could also be a measure for demand risks to some extent. On the other hand, the composite country risk index from the magazine *Euromoney* captures a wider range of risks which are important for institutional investors like political risks, debt indicators or access to capitial markets. Both risk indices already had been used in the previous chapters.[11]

From equations (5.8) and (5.9) we separately estimate the following equation for the profits of a multinational in case of a horizontal FDI and a

[10]See Section 1.2.
[11]See Chapter 2 for more detailed information.

vertical FDI

$$msales = \beta_0 + \beta_1\ euromon + \beta_2\ exrunc + \beta_3\ pproduct + \beta_4\ aproduct + \beta_5\ awage + \beta_6\ memploy + \mu \tag{5.10}$$

where *msales* is the logarithm of worldwide sales of the multinational enterprise, uncertainty is captured by *euromon* or *exrunc*. *pproduct* and *aproduct* are the productivity of the parent firms and the foreign affiliates respectively. The productivity of the investor and the affiliate is measured as sales per worker. *awage* is the wage in the foreign affiliate. In order to account for level effects we additionally include the logarithm of worldwide employment of the multinational *memploy*.

5.3.2 Estimation Results

The results from OLS estimations are presented in Table 5.1. The estimation results of the profits of multinational enterprises engaged in vertical FDI are shown in the first three columns and for the cases of horizontal FDI in the last three columns.

As expected, the worldwide sales of the multinational enterprise as a measure for its profits is mostly explained by worldwide employees. We included the logarithm of employees in order to control for level effects. The wage of the foreign affiliate *awage* has no impact on profits from vertical FDI and a negative impact on the profits associated with horizontal FDI, although not significant at conventional levels. As predicted, the productivity of the foreign affiliate *aproduct* has a positive impact on worldwide sales, whereas for the parent firms productivity this is only the case for multinationals which are organized horizontally.

Table 5.1: OLS Estimation of Sales of the Multinational Enterprise

	Vertical FDI			Horizontal FDI		
	(1)	(2)	(3)	(4)	(5)	(6)
euromon	-0.0121 **		0.0006	-0.0011		0.0071
	(-2.42)		(0.08)	(-0.33)		(1.42)
exrunc		-3.9959 ***	-4.1038 **		-2.0781 *	-3.6912 **
		(-3.05)	(-2.11)		(-1.88)	(-2.31)
pproduct	-1.49E-07	-1.65E-07	-1.66E-07	6.37E-07 ***	6.38E-07 ***	6.44E-07 ***
	(-0.83)	(-0.93)	(-0.93)	(13.51)	(13.58)	(13.61)
aproduct	1.05E-06 ***	1.03E-06 ***	1.03E-06 ***	4.53E-07 ***	4.46E-07 ***	4.39E-07 ***
	(4.07)	(4.09)	(4.06)	(4.09)	(4.03)	(3.95)
awage	-3.07E-07	-6.24E-07	-5.80E-07	-1.30E-06	-1.35E-06	-1.34E-06
	(-0.06)	(-0.12)	(-0.11)	(-1.23)	(-1.29)	(-1.27)
memploy	1.0511 ***	1.0570 ***	1.0572 ***	1.0144 ***	1.0116 ***	1.0129 ***
	(37.03)	(37.69)	(37.27)	(56.18)	(56.61)	(55.43)
Constant	11.7219 ***	11.2944 ***	11.2707 ***	11.7420 ***	11.7936 ***	11.4948 ***
	(34.64)	(49.82)	(28.98)	(54.40)	(79.21)	(46.35)
Number of obs.	135	134	134	350	349	345
R-squared	0.9174	0.9202	0.9202	0.9064	0.908	0.9062
Adj. R-squared	0.9142	0.917	0.9164	0.905	0.9067	0.9045

Note: t-statistics in parentheses. Significant at *** 1%, ** 5%, * 10% level. Vertical FDI > 49% of output exported.

Now we turn on the effect of uncertainty. As the theoretical findings predict, the coefficients of the measures for productivity uncertainty (*euromon*) and demand uncertainty (*exrunc*) both are negative and significant in the case of vertical FDI in columns (1) and (2). *euromon* looses its explanatory power if both risk measures are included, but *exrunc* still remains significant (column (3)). For horizontal FDI, the model predicts that the coefficient of demand uncertainty *exrunc* should be always negative, whereas the coefficient of productivity uncertainty should rather be positive or show no impact than being negative. The empirical results support this hypotheses: Higher demand risk *exrunc* lowers the profits of a multinational enterprise. The coefficient in column (5) is negative and significant, also if *euromon* is included in column (6). Higher supply risks measured by *euromon* do not effect the profits in column (4) and its coefficient is positive but not significant at conventional levels if both risks measures are considered (column (6)). This supports the predictions derived from the theory.

To summarize the empirical results, the data from German FDI into CEEC and the CIS confirm the model which predicts that demand risks decrease expected profits of a multinational enterprise in both types vertical and horizontal FDI. In the other hand, supply risks significantly decrease profits from vertical FDI, but they have no or even a positive impact in the case of horizontal FDI.

These findings should have a notable influence on the decision of an investor whether he should enter the foreign market by fragmenting the production process vertically or whether he should prefer horizontal FDI. We will empirically address this question in the next section.

5.3.3 Empirical Investigation of the Decision between both Production Modes

As an implication from the model, from an ex-ante point of view a multinational enterprise should avoid vertical FDI if supply risks are high. The reason is that these have a negative impact on expected profits from vertical FDI, whereas there is no impact of supply risks on profits from horizontal FDI, or even a positive one. Hence, high supply risks should make vertical FDI less likely. On the other hand, demand risks should not influence the decision of an investor. It has been shown that demand risks affect profits from *both* types of FDI negatively. Therefore, they might prevent the investor from investing at all, but they should not have any impact on the choice between both types.

From the literature we find further variables which have an influence on the decision of a multinational enterprise between vertical and horizontal FDI. As vertical FDI are driven by relative factor prices between countries (Helpman [1984], Helpman and Krugman [1985], Markusen [1995], Hanson et al. [2003]), higher wages should make vertical FDI less likely. Thus, high wages in the foreign affiliate *awage* as a measure for the wage level in the host economy should prevent the multinational from vertical FDI.

A larger distance between the home country of the parent firm and the host country increases transportation costs. In order to avoid these costs, the investor will set up the whole production process abroad (Brainard [1993]). This increases the probability to undertake a horizontal FDI and hence makes vertical FDI less likely. The logarithm of the distance between the parent firm and the foreign affiliate *ldistanc* is taken as a measure for transportation costs. Additionally, a larger market size offers greater opportunities to realize economies of scale which makes horizontal FDI more likely and lowers the probability for vertical FDI. The market size is measured by the logarithm of the total population *lpop*.

The results from bivariate probit estimations are presented in Table 5.2. The dependent variable is *vertical* which is one if the multinational enterprise has undertaken a vertical FDI and zero in case of a horizontal FDI. As before, we define a vertical FDI if the foreign affiliate exports at least 50% of its production.

The first specification only includes those variables which have been found to be influential in the earlier literature. All coefficients have the expected negative signs and are significant at high levels: Multinationals do enter larger markets (*lpop*) less likely via vertical FDI and more likely by undertaking a horizontal investment. Higher wages also decrease the probability for vertical FDI which underlines the argument that cost reducing is the typical motivation for vertical FDI. The distance between the foreign affiliate and the parent firm has a negative influence on the probability for vertical FDI. Intermediate goods from vertical production in the foreign country are exported to the parent firm. Larger distances and higher transportation costs therefore lower the probability of vertical FDI.

Table 5.2: Probit Estimation: Vertical versus Horizontal FDI

	(1)		(2)		(3)		(4)	
euromon			-0.019	**			-0.029	***
			(-2.35)				(-2.70)	
exrunc					1.043		4.376	*
					(0.59)		(1.93)	
lpop	-0.115	*	-0.062		-0.140	**	-0.056	
	(-1.94)		(-0.94)		(-2.27)		(-0.78)	
awage	-1.38E-05	***	-1.53E-05	***	-1.40E-05	***	-1.45E-05	***
	(-3.39)		(-3.65)		(-3.38)		(-3.48)	
ldistanc	-0.255	***	-0.017		-0.257	**	-0.022	
	(-2.84)		(-0.13)		(-2.47)		(-0.17)	
Constant	3.254	***	1.700		3.650	***	1.923	
	(3.27)		(1.42)		(3.38)		(1.53)	
Number of obs.	599		588		585		580	
Pseudo R2	0.050		0.057		0.052		0.061	
Log likelih.	-338.60		-331.91		-331.55		-326.81	

Note: t-statistics in parentheses. Significant at *** 1%, ** 5%, * 10% level.
Dependent variable is *vertical*=1 if > 49% of output exported, zero otherwise.

The empirical analysis confirms the typical forces for vertical and horizontal FDI which have been discussed in the literature. We now observe an additional force which has not been discussed so far. Column (2) shows that higher supply risks (*euromon*) significantly decrease the probability for vertical FDI. This is because the impact of supply risks on the profits from vertical and horizontal FDI are completely opposite: Negative for the profits from vertical and potentially positive for those from horizontal FDI. This makes vertical FDI less likely in presence of supply risks. However, including *euromon* reduces the significance of *lpop* and *ldistanc*. We also expect that demand uncertainty *exrunc* has no impact on the probability of vertical FDI as it negatively affects profits from both types. Column (3) supports this point of view.

Finally, if we control for both uncertainty measures, larger supply side risks (*euromon*) still reduce the probability of vertical FDI. The coefficient shows a high significance. Surprisingly, higher demand uncertainty now increases the probability of vertical FDI. As we have seen in the previous section, *exrunc* negatively affects the expected profits from both production modes. Hence, the positive sign of the coefficient in the decision estimation could indicate that the investor expects that demand uncertainty is more harmful on the profits with horizontal FDI than on those from vertical FDI.

All in all, the behaviour of the multinational investors corresponds with the predictions of the theoretical model. As different sources of uncertainty affect the profits from vertical and horizontal production in a different way, they also have an impact on the investors decision between both production modes.

5.4 Conclusions

In this chapter we explored the impact of demand and supply uncertainty on vertical and horizontal FDI. The theoretical framework suggests that higher supply risks should decrease the profits of a multinational enterprise when production is fragmented vertically in different countries. In case of horizontal FDI supply uncertainty has no or the opposite effect. Additionally, greater demand risks adversely affects expected income under both production modes.

The empirical analysis contributes to the literature in two ways. First, firm level data enable us to find appropriate measures for the factors derived from the model. Using data from German direct investments into Eastern Europe supports the result that higher demand and supply risks significantly reduce the incomes from vertical FDI. Only higher demand risks significantly reduce profits from horizontal FDI, whereas higher supply risks show no impact or even have a positive impact. The second contribution is that the decision of a multinational enterprise between both production modes also has been examined. We have shown that well known forces like the foreign market size, the distance between the parent firm and the foreign affiliate, and the factor prices explain the decision between horizontal and vertical FDI. Additionally, higher supply risks turn out to have a significant negative impact on the probability to set up a vertical FDI. This effect has not been considered in the literature so far.

5.5 Appendix

1. Derivation of equation (5.6)

Minimizing total labor costs in case of horizontal FDI for a given total output yields the Langrangian function

$$\Psi = L_Y + w^* L_Y^* - \lambda[a\sqrt{L_Y} + (1+\epsilon^*)a^*\sqrt{L_Y^*} - \overline{Y}] \tag{5.11}$$

which leads to the following first order conditions

$$\frac{\partial \Psi}{\partial L_Y} = 1 - \lambda 0.5 a L_Y^{-0.5} = 0 \tag{5.12}$$

$$\frac{\partial \Psi}{\partial L_Y^*} = w^* - \lambda(1+\epsilon^*)a^* 0.5 a L_Y^{*-0.5} = 0 \tag{5.13}$$

$$\frac{\partial \Psi}{\partial \lambda} = a\sqrt{L_Y} + (1+\epsilon^*)a^*\sqrt{L_Y^*} - \overline{Y} = 0 \tag{5.14}$$

Equation (5.6) follows from equations (5.12) and (5.13).

2. Derivation demand for Y (equation (5.7))

Maximizing the utility (5.1) given total income $I = YP_Y + Z$ gives the Langrangian function

$$\Psi = Z + \frac{A}{\delta} Y^{\delta} - \lambda[YP_Y + Z - \overline{I}] \tag{5.15}$$

and the following first order conditions

$$\frac{\partial \Psi}{\partial Y} = AY^{\delta-1} - \lambda P_Y = 0 \tag{5.16}$$

$$\frac{\partial \Psi}{\partial Z} = 1 - \lambda = 0 \tag{5.17}$$

$$\frac{\partial \Psi}{\partial \lambda} = YP_Y + Z - \overline{I} = 0 \tag{5.18}$$

The demand function (5.7) follows from equations (5.16) and (5.17). Alternatively, the inverse demand can be obtained

$$P_Y = AY^{\delta - 1} \tag{5.19}$$

3. Derivation of the expected profits for vertical FDI (equation (5.8))

From (5.2) and (5.3) we calculate L_Y and L_M^*

$$L_Y = \left(\frac{Y}{b}\right)^2 \tag{5.20}$$

$$L_M^* = \left(\frac{Y}{(1+\epsilon^*)b^*}\right)^2 \tag{5.21}$$

Insert L_Y and L_M^* and (5.19) into monopolist profit function

$$\Pi_v = 2Y^d P_Y - L_Y - w^* L_M^* - C_v \tag{5.22}$$

yields

$$\Pi_v = 2AY^\delta - 2Y^2 \left\{ b^{-2} + w^*[(1+\epsilon^*)b^*]^{-2} \right\} - C_v. \tag{5.23}$$

The monopolist optimal output can be calculated

$$\frac{\partial \Pi_v}{\partial Y} = 2\delta AY^{\delta-1} - 4Y \left\{ b^{-2} + w^*[(1+\epsilon^*)b^*]^{-2} \right\} \tag{5.24}$$

$$\Longrightarrow \widetilde{Y} = \left[\frac{0.5\delta A}{\{b^{-2} + w^*[(1+\epsilon^*)b^*]^{-2}\}} \right]^{\frac{1}{2-\delta}} \tag{5.25}$$

Thus, the monopolist profits are

$$\Pi_v = 2A\left[\frac{0.5\delta A}{\{b^{-2}+w^*[(1+\epsilon^*)b^*]^{-2}\}}\right]^{\frac{\delta}{2-\delta}} - 2\left[\frac{0.5\delta A}{\{b^{-2}+w^*[(1+\epsilon^*)b^*]^{-2}\}}\right]^{\frac{2}{2-\delta}}\left\{b^{-2}+w^*[(1+\epsilon^*)b^*]^{-2}\right\} - C_v. \tag{5.26}$$

Rearranging terms gives

$$\Pi_v = 2A\left[\frac{0.5\delta A}{\{b^{-2}+w^*[(1+\epsilon^*)b^*]^{-2}\}}\right]^{\frac{\delta}{2-\delta}} - \delta A\left[\frac{0.5\delta A}{\{b^{-2}+w^*[(1+\epsilon^*)b^*]^{-2}\}}\right]^{\frac{\delta}{2-\delta}} - C_v \tag{5.27}$$

$$\Pi_v = 2A\left[\frac{0.5\delta A}{\{b^{-2}+w^*[(1+\epsilon^*)b^*]^{-2}\}}\right]^{\frac{\delta}{2-\delta}}(1-0.5\delta) - C_v \tag{5.28}$$

$$\Pi_v = (1-0.5\delta)A^{\frac{2-\delta+\delta}{2-\delta}}0.5^{\frac{\delta}{2-\delta}}2\delta^{\frac{\delta}{2-\delta}}\left[\frac{1}{b^{-2}+w^*b^{*-2}}\right]^{\frac{\delta}{2-\delta}}\left[\frac{1}{b^{-2}+w^*b^{*-2}}\right]^{\frac{-\delta}{2-\delta}}\left\{b^{-2}+w^*[(1+\epsilon^*)b^*]^{-2}\right\}^{\frac{-\delta}{2-\delta}} - C_v \tag{5.29}$$

$$\Pi_v = (1-0.5\delta)A^{\frac{2}{2-\delta}}2^{\frac{2(1-\delta)}{2-\delta}}\left[\frac{\delta}{b^{-2}+w^*b^{*-2}}\right]^{\frac{\delta}{2-\delta}}\left[\frac{b^{-2}+w^*[(1+\epsilon^*)b^*]^{-2}}{b^{-2}+w^*b^{*-2}}\right]^{\frac{-\delta}{2-\delta}} - C_v \tag{5.30}$$

Using $\eta = \frac{1}{1-\delta}$ and rearranging gives

$$\Pi_v = \underbrace{(1-0.5\delta)A^{\frac{2\eta}{\eta+1}}2^{\frac{2}{\eta+1}}\left[\frac{\delta}{b^{-2}+w^*b^{*-2}}\right]^{\frac{\eta-1}{\eta+1}}}_{k_v}\left[\underbrace{\frac{b^{-2}}{b^{-2}+w^*b^{*-2}}}_{\theta_v}+\underbrace{\frac{w^*b^{*-2}}{b^{-2}+w^*b^{*-2}}}_{\theta_v^*}(1+\epsilon^*)^{-2}\right]^{-\frac{\eta-1}{\eta+1}} - C_v \tag{5.31}$$

Taking expectations yields equation (5.8).

4. Derivation of the expected profits for horizontal FDI (equation (5.9))

The monopolist profit function is

$$\Pi_h = 2\left[\frac{a\sqrt{L_Y} + (1+\epsilon^*)a^*\sqrt{L_Y^*}}{2}\right]^{\delta} - L_Y - w^* L_Y^* - C_h \tag{5.32}$$

After inserting $L_Y^* = L_Y \frac{[a^*(1+\epsilon^*)/w^*]^2}{a^2}$ from equation (5.6) we find

$$\Pi_h = 2^{1-\delta} A L_Y^{0.5\delta}\left[a + \frac{[(1+\epsilon^*)a^*]^2}{w^* a}\right]^{\delta} - L_Y\left[1 + \frac{[(1+\epsilon^*)a^*]^2}{w^* a^2}\right] - C_h \tag{5.33}$$

The optimal labor employed in the home country can be calculated

$$\frac{\partial \Pi_h}{\partial L_Y} = 2^{1-\delta} A 0.5\delta L_Y^{0.5\delta - 1}\left[a + \frac{[(1+\epsilon^*)a^*]^2}{w^* a}\right]^{\delta} - \left[1 + \frac{[(1+\epsilon^*)a^*]^2}{w^* a^2}\right] = 0 \tag{5.34}$$

$$\begin{aligned}\widetilde{L_Y} &= (2^{-\delta} A\delta)^{\frac{2}{2-\delta}}\left[\frac{\left[a + \frac{[(1+\epsilon^*)a^*]^2}{w^* a}\right]^{\delta}}{\left[1 + \frac{[(1+\epsilon^*)a^*]^2}{w^* a^2}\right]}\right]^{\frac{2}{2-\delta}} \\ &= (2^{-\delta} A\delta)^{\frac{2}{2-\delta}}\left[a^2 + \frac{[(1+\epsilon^*)a^*]^2}{w^*}\right]^{-\frac{2(1-\delta)}{2-\delta}} a^{\frac{2(2-\delta)}{2-\delta}}\end{aligned} \tag{5.35}$$

Substituting $\widetilde{L_Y}$ into equation (5.33) yields

$$\Pi_h = 2^{1-\delta} A \left[(2^{-\delta} A\delta)^{\frac{2}{2-\delta}} \left[a^2 + \frac{[(1+\epsilon^*)a^*]^2}{w^*} \right]^{-\frac{2(1-\delta)}{2-\delta}} a^2 \right]^{0.5\delta} \left[a + \frac{[(1+\epsilon^*)a^*]^2}{w^* a} \right]^{\delta}$$
$$- \left[(2^{-\delta} A\delta)^{\frac{2}{2-\delta}} \left[a^2 + \frac{[(1+\epsilon^*)a^*]^2}{w^*} \right]^{-\frac{2(1-\delta)}{2-\delta}} a^2 \right] \left[1 + \frac{[(1+\epsilon^*)a^*]^2}{w^* a^2} \right] - C_h \tag{5.36}$$

Collecting terms gives

$$\Pi_h = (1-0.5\delta) A^{\frac{2}{2-\delta}} 2^{\frac{2-2\delta}{2-\delta}} \delta^{\frac{\delta}{2-\delta}} \left[a^2 + \frac{[(1+\epsilon^*)a^*]^2}{w^*} \right]^{\frac{\delta}{2-\delta}} - C_h \tag{5.37}$$

which is equivalent to

$$\Pi_h = (1-0.5\delta) A^{\frac{2}{2-\delta}} 2^{\frac{2(1-\delta)}{2-\delta}} \left[\delta \left(a^2 + \frac{a^{*2}}{w^*} \right) \right]^{\frac{\delta}{2-\delta}} \left[\frac{a^2 w^*}{a^2 w^* + a^{*2}} + \frac{a^{*2}}{a^2 w^* + a^{*2}} (1+\epsilon^*)^2 \right]^{\frac{\delta}{2-\delta}} - C_h. \tag{5.38}$$

With $\eta = \frac{1}{1-\delta}$

$$\Pi_h = \underbrace{(1-0.5\delta) A^{\frac{2\eta}{\eta+1}} 2^{\frac{2}{\eta+1}} \left[\delta \left(a^2 + \frac{a^{*2}}{w^*} \right) \right]^{\frac{\eta-1}{\eta+1}}}_{k_h} \left[\underbrace{\frac{a^2 w^*}{a^2 w^* + a^{*2}}}_{\theta_h} + \underbrace{\frac{a^{*2}}{a^2 w^* + a^{*2}}}_{\theta_h^*} (1+\epsilon^*)^2 \right]^{\frac{\eta-1}{\eta+1}} - C_h \tag{5.39}$$

5. The 1. and 2. derivative of the profit function from vertical FDI with respect to ϵ^*

The profit function is

$\Pi_v = k_v[\theta_v + \theta_v^*(1+\epsilon^*)^{-2}]^{-\frac{\eta-1}{\eta+1}} - C_v$

The first derivative with respect to ϵ^* is

$$\frac{\partial \Pi_v}{\partial \epsilon^*} = (-2)\left(-\frac{\eta-1}{\eta+1}\right) k_v \left[\theta_v + \theta_v^*(1+\epsilon^*)^{-2}\right]^{-\frac{\eta-1}{\eta+1}-1} \theta_v^*(1+\epsilon^*)^{-3} > 0 \quad (5.40)$$

The second derivative than is

$$\frac{\partial^2 \Pi_v}{\partial \epsilon^{*2}} = (-2)\left(-\frac{\eta-1}{\eta+1}\right)\theta_v^*\left(-\frac{\eta-1}{\eta+1}-1\right) k_v \left[\theta_v + \theta_v^*(1+\epsilon^*)^{-2}\right]^{-\frac{\eta-1}{\eta+1}-2}$$
$$(-2)\theta_v^*(1+\epsilon^*)^{-3}(1+\epsilon^*)^{-3}$$
$$+ (-2)\left(-\frac{\eta-1}{\eta+1}\right)\theta_v^* k_v \left[\theta_v + \theta_v^*(1+\epsilon^*)^{-2}\right]^{-\frac{\eta-1}{\eta+1}-1}(-3)(1+\epsilon^*)^{-4} \quad (5.41)$$

At ϵ^*=0 and with $\theta_v + \theta_v^*$=1 we get

$$\frac{\partial^2 \Pi_v}{\partial \epsilon^{*2}}|_{\epsilon^*=0} =$$
$$(-2)\left(-\frac{\eta-1}{\eta+1}\right)\theta_v^*\left(-\frac{\eta-1}{\eta+1}-1\right) k_v(-2)\theta_v^* + (-2)\left(-\frac{\eta-1}{\eta+1}\right)\theta_v^* k_v(-3)$$
$$= k_v(-2)\left(-\frac{\eta-1}{\eta+1}\right)\theta_v^*\left[(-2)\left(-\frac{\eta-1}{\eta+1}-1\right)\theta_v^* - 3\right] \quad (5.42)$$

The profit function is concave with respect to ϵ^* at ϵ^*=0 if $\partial^2\Pi_v/\partial\epsilon^{*2} < 0$, hence if

$$(-2)\left(-\frac{\eta-1}{\eta+1}-1\right)\theta_v^* - 3 < 0 \iff \theta_v^* < \frac{3}{4}\frac{(\eta+1)}{\eta}. \quad (5.43)$$

Note that $\theta_v^* \in]0;1[$. As $\eta > 1$, the right hand side of the inequality ranges between 0.75 ($\eta \rightarrow \infty$) and 1.5 ($\eta \rightarrow 1$). Hence, only extremely high levels of η and θ_v^* could make it possible that Π_v would be convex. For instance, if $\eta = 10$ than θ_v^* has to be smaller than 0.825 to ensure concavity. Hence, for plausible values of η and θ_v^* Π_v is concave.

6. The 1. and 2. derivative of the profit function from horizontal FDI with respect to ϵ^*

The profit function is

$\Pi_h = k_h[\theta_h + \theta_h^*(1+\epsilon^*)^2]^{\frac{\eta-1}{\eta+1}} - C_h$

The first derivative with respect to ϵ^* is

$$\frac{\partial \Pi_h}{\partial \epsilon^*} = 2\left(\frac{\eta-1}{\eta+1}\right) k_h \left[\theta_h + \theta_h^*(1+\epsilon^*)^2\right]^{\frac{\eta-1}{\eta+1}-1} \theta_h^*(1+\epsilon^*) > 0 \qquad (5.44)$$

For the second derivative at ϵ^*=0 and with $\theta_v + \theta_v^*$=1 we get

$$\frac{\partial^2 \Pi_h}{\partial \epsilon^{*2}}|_{\epsilon^*=0} = k_h 2\left(\frac{\eta-1}{\eta+1}\right)\theta_h^*\left[2\left(\frac{\eta-1}{\eta+1}-1\right)\theta_h^*+1\right] \qquad (5.45)$$

The profit function is convex with respect to ϵ^* at ϵ^*=0 if $\partial^2\Pi_h/\partial\epsilon^{*2} > 0$, hence if

$$2\left(\frac{\eta-1}{\eta+1}-1\right)\theta_h^*+1 > 0 \iff \theta_v^* < \frac{1}{4}(\eta+1). \qquad (5.46)$$

For $\theta_h^* \in]0;1[$ and as the right hand side of the inequality ranges between 0.5 ($\eta \rightarrow 1$) and ∞ ($\eta \rightarrow \infty$), this is not necessarily true. Hence, for small values of η and high values of θ_v^* the profit function would be concave.

For instance, if η is marginal larger than 1, the critical value for θ_h^* to ensure the condition for convexity is 0.5. If $\eta = 3$ than Π_h would be always convex, as the critical value for θ_h^* would be 1. As it is possible for a wider range of combinations of η and θ_v^* to fail the convexity condition, we would expect no impact of uncertainty on the profits of a multinational enterprise engaging in horizontal FDI.

7. Comparative statics from the profit functions

Vertical profits

The impact of productivity in the parent firm is

$$
\begin{aligned}
\frac{\partial \Pi_v}{\partial b} &= 2(1-0.5\delta)A^{\frac{2\eta}{\eta+1}}2^{\frac{2}{\eta+1}}\left(\frac{\delta}{b^{-2}+w^*b^{*-2}}\right)^{\frac{\eta-1}{\eta+1}} \\
&\frac{\eta-1}{\eta+1}\left[\frac{b^{-2}}{b^{-2}+w^*b^{*-2}}+\frac{w^*b^{*-2}}{b^{-2}+w^*b^{*-2}}(1+\epsilon^*)^{-2}\right]^{-\frac{\eta-1}{\eta+1}} \\
&\left[b^{-2}+w^*b^{*-2}\right]^{-1}b^{-3}-(1-0.5\delta)A^{\frac{2\eta}{\eta+1}}2^{\frac{2}{\eta+1}}\left(\frac{\delta}{b^{-2}+w^*b^{*-2}}\right)^{\frac{\eta-1}{\eta+1}} \\
&\frac{\eta-1}{\eta+1}\left[\frac{b^{-2}}{b^{-2}+w^*b^{*-2}}+\frac{w^*b^{*-2}}{b^{-2}+w^*b^{*-2}}(1+\epsilon^*)^{-2}\right]^{-\frac{\eta-1}{\eta+1}} \\
&\left[-\frac{2b^{-3}}{(b^{-2}+w^*b^{*-2})}+\frac{2b^{-5}}{(b^{-2}+w^*b^{*-2})^2}+\frac{2w^*b^{-3}b^{*-2}}{(b^{-2}+w^*b^{*-2})^2}(1+\epsilon^*)^{-2}\right] \\
&\left[\frac{b^{-2}}{b^{-2}+w^*b^{*-2}}+\frac{w^*b^{*-2}}{b^{-2}+w^*b^{*-2}}(1+\epsilon^*)^{-2}\right]^{-1}
\end{aligned}
\tag{5.47}
$$

Rearranging terms gives

$$\frac{\partial \Pi_v}{\partial b} = 2(1-0.5\delta)(1+\epsilon^*)^2 A^{\frac{2\eta}{\eta+1}} 2^{\frac{2}{\eta+1}} \left(\frac{\delta}{b^{-2}+w^* b^{*-2}}\right)^{\frac{\eta-1}{\eta+1}}$$

$$\frac{\eta-1}{\eta+1} b^{*2} \left[\frac{b^{*2}(1+\epsilon^*)^2 + w^* b^2}{(b^{*2}+w^* b^2)(1+\epsilon^*)^2}\right]^{-\frac{\eta-1}{\eta+1}} \left[b^{*2}(1+\epsilon^*)^2 + w^* b^2\right]^{-1} b^{-1} > 0. \tag{5.48}$$

Similarly we yield the impact of productivity in the foreign affiliate

$$\frac{\partial \Pi_v}{\partial b^*} = 2(1-0.5\delta) A^{\frac{2\eta}{\eta+1}} 2^{\frac{2}{\eta+1}} \left(\frac{\delta}{b^{-2}+w^* b^{*-2}}\right)^{\frac{\eta-1}{\eta+1}}$$

$$\frac{\eta-1}{\eta+1} b^2 w^* \left[\frac{b^{*2}(1+\epsilon^*)^2 + w^* b^2}{(b^{*2}+w^* b^2)(1+\epsilon^*)^2}\right]^{-\frac{\eta-1}{\eta+1}} \left[b^{*2}(1+\epsilon^*)^2 + w^* b^2\right]^{-1} b^{*-1} > 0. \tag{5.49}$$

The impact of wages in the foreign affiliate is

$$\frac{\partial \Pi_v}{\partial w^*} = (-1)(1-0.5\delta) A^{\frac{2\eta}{\eta+1}} 2^{\frac{2}{\eta+1}} \left(\frac{\delta}{b^{-2}+w^* b^{*-2}}\right)^{\frac{\eta-1}{\eta+1}}$$

$$\frac{\eta-1}{\eta+1} b^2 \left[\frac{b^{*2}(1+\epsilon^*)^2 + w^* b^2}{(b^{*2}+w^* b^2)(1+\epsilon^*)^2}\right]^{-\frac{\eta-1}{\eta+1}} \left[b^{*2}(1+\epsilon^*)^2 + w^* b^2\right]^{-1} < 0. \tag{5.50}$$

Horizontal profits

$$\frac{\partial \Pi_h}{\partial a} = 2(1-0.5\delta)A^{\frac{2\eta}{\eta+1}}2^{\frac{2}{\eta+1}}\left[\delta\left(a^2+\frac{a^{*2}}{w^*}\right)\right]^{\frac{\eta-1}{\eta+1}}$$

$$\left(a^2+\frac{a^{*2}}{w^*}\right)^{-1}\frac{\eta-1}{\eta+1}a\left[\frac{a^2w^*}{a^2w^*+a^{*2}}+\frac{a^{*2}}{a^2w^*+a^{*2}}(1+\epsilon^*)^2\right]^{\frac{\eta-1}{\eta+1}}+$$

$$+(1-0.5\delta)A^{\frac{2\eta}{\eta+1}}2^{\frac{2}{\eta+1}}\left[\delta\left(a^2+\frac{a^{*2}}{w^*}\right)\right]^{\frac{\eta-1}{\eta+1}}\left[\frac{a^2w^*}{a^2w^*+a^{*2}}+\frac{a^{*2}}{a^2w^*+a^{*2}}(1+\epsilon^*)^2\right]^{\frac{\eta-1}{\eta+1}-1}$$

$$\frac{\eta-1}{\eta+1}\left[\frac{2aw^*}{(a^2w^*+a^{*2})}-\frac{2a^3w^{*2}}{(a^2w^*+a^{*2})^2}-\frac{2a^{*2}aw^*}{(a^2w^*+a^{*2})^2}(1+\epsilon^*)^2\right] \tag{5.51}$$

Collecting terms yields

$$\frac{\partial \Pi_h}{\partial a} = 2(1-0.5\delta)A^{\frac{2\eta}{\eta+1}}2^{\frac{2}{\eta+1}}\left[\delta\left(a^2+\frac{a^{*2}}{w^*}\right)\right]^{\frac{\eta-1}{\eta+1}}\frac{\eta-1}{\eta+1}aw^*$$

$$\left[\frac{a^2w^*}{a^2w^*+a^{*2}}+\frac{a^{*2}}{a^2w^*+a^{*2}}(1+\epsilon^*)^2\right]^{\frac{\eta-1}{\eta+1}}\left[a^2w^*+a^{*2}(1+\epsilon^*)^2\right]^{-1}>0. \tag{5.52}$$

The impact of the productivity in the foreign affiliate on the profits of the MNE is

$$\frac{\partial \Pi_h}{\partial a^*} = 2(1-0.5\delta)A^{\frac{2\eta}{\eta+1}}2^{\frac{2}{\eta+1}}\left[\delta\left(a^2+\frac{a^{*2}}{w^*}\right)\right]^{\frac{\eta-1}{\eta+1}}\frac{\eta-1}{\eta+1}a^*(1+\epsilon^*)^2$$

$$\left[\frac{a^2w^*}{a^2w^*+a^{*2}}+\frac{a^{*2}}{a^2w^*+a^{*2}}(1+\epsilon^*)^2\right]^{\frac{\eta-1}{\eta+1}}\left[a^2w^*+a^{*2}(1+\epsilon^*)^2\right]^{-1}>0. \tag{5.53}$$

The impact of the wage in the foreign affiliate on the profits of the MNE is

$$\frac{\partial \Pi_h}{\partial w^*} = (-1)(1-0.5\delta)A^{\frac{2\eta}{\eta+1}}2^{\frac{2}{\eta+1}}\left[\delta\left(a^2+\frac{a^{*2}}{w^*}\right)\right]^{\frac{\eta-1}{\eta+1}}\frac{\eta-1}{\eta+1}a^{*2}(1+\epsilon^*)^2$$

$$\left[\frac{a^2w^*}{a^2w^*+a^{*2}}+\frac{a^{*2}}{a^2w^*+a^{*2}}(1+\epsilon^*)^2\right]^{\frac{\eta-1}{\eta+1}}\left[a^2w^*+a^{*2}(1+\epsilon^*)^2\right]^{-1}w^{*-1}<0. \tag{5.54}$$

8. The impact of demand shocks on expected profits

In the case of demand shocks we assume a demand for each country

$$Y^d = [\frac{A}{P_Y}]^\eta; \quad \eta = \frac{1}{1-\delta} > 1$$

with

$$A = \begin{cases} A_0 & \text{for the home country} \\ (1+\nu^*)^{1/\eta}A_0 & \text{for the foreign country} \end{cases}$$

Thus, total demand is

$$2Y^d = Y_f^d + Y_h^d = \left[\frac{A_0}{P_Y}\right]^\eta + \left[\frac{(1+\nu^*)^{1/\eta}A_0}{P_Y}\right]^\eta$$

which is

$$2Y^d = 2\left[\frac{A}{P_Y}\right]^\eta = 2\left[\frac{A_0}{P_Y}\right]^\eta(1+0.5\nu^*)$$

thus

$$A = A_0(1 + 0.5\nu^*)^{1/\eta}$$

Hence, the profit functions (5.33) and (5.39) with ϵ^*=0 but with demand shocks are

$$\Pi_v = (1 - 0.5\delta)\left[A_0(1 + 0.5\nu^*)^{1/\eta}\right]^{\frac{2\eta}{\eta+1}} 2^{\frac{2}{\eta+1}} \left[\frac{\delta}{b^{-2} + w^* b^{*-2}}\right]^{\frac{\eta-1}{\eta+1}} - C_v$$

and

$$\Pi_h = (1 - 0.5\delta)\left[A_0(1 + 0.5\nu^*)^{1/\eta}\right]^{\frac{2\eta}{\eta+1}} 2^{\frac{2}{\eta+1}} \left[\delta\left(a^2 + \frac{a^{*2}}{w^*}\right)\right]^{\frac{\eta-1}{\eta+1}} - C_h$$

Simplifying yields

$$\Pi_v = X_v(1 + 0.5\nu^*)^{2/1+\eta} - C_v$$

and

$$\Pi_h = X_h(1 + 0.5\nu^*)^{2/1+\eta} - C_h$$

with

$$X_v = (1-0.5\delta)A_0^{\frac{2\eta}{\eta+1}} 2^{\frac{2}{\eta+1}} \left[\frac{\delta}{b^{-2} + w^* b^{*-2}}\right]^{\frac{\eta-1}{\eta+1}}, X_h = (1-0.5\delta)A_0^{\frac{2\eta}{\eta+1}} 2^{\frac{2}{\eta+1}} \left[\delta\left(a^2 + \frac{a^{*2}}{w^*}\right)\right]^{\frac{\eta-1}{\eta+1}}$$

The first and second derivative of Π_v is

$$\frac{\partial \Pi_v}{\partial \nu^*} = 0.5\frac{2}{\eta + 1} X_v(1 + 0.5\nu^*)^{\frac{2}{\eta+1}-1} > 0$$

$$\frac{\partial^2 \Pi_v}{\partial \nu^{*2}} = 0.25\frac{2}{\eta + 1}\left[\frac{2}{\eta + 1} - 1\right] X_v(1 + 0.5\nu^*)^{\frac{2}{\eta+1}-2} < 0 \texttt{ as } \eta > 1$$

Accordingly it holds that $\frac{\partial \Pi_h}{\partial \nu^*} > 0$ and $\frac{\partial^2 \Pi_h}{\partial \nu^{*2}} < 0$.

Chapter 6

Concluding Remarks

The world economy experienced a rapid increase in foreign direct investments during the last two decades, especially between developed countries. After the fall of the iron curtain, FDI inflows into Central and Eastern European Countries and the Commonwealth of Independent States have also grown dramatically during the 1990s. The transition of the former planned economies into market economies is accompanied by economic, political and social changes, which are responsible for different types of risks.

The aim of this thesis has been to analyze the impact of uncertainty and country risks on various decisions of a multinational enterprise, which undertakes a direct investment abroad. We examined different models and then tested them empirically. In the first step, in Chapter 2 we recalled different country risk measures and developed a measure for exchange rate risk. Data from a firm survey indicates that decision makers of multinational enterprises regarded this type of country risk to be most important.

In Chapter 3 we explored the investors decision about the mode of entry. Previous theoretical and empirical literature has shown that the choice between greenfield investment and acquisition is driven by the technological advantage of the investor. If it is large, buying and restructuring an existing firm in an developing country such as CEEC could be too expensive. On the other hand, an existing firm could have some valuable experience in business within a country. Hence, if country risks are high, these risks might be less costly in case of an acquisition than in case of a greenfield investment. The trade-off between the costs of restructuring and the costs of uncertainty implies that for high levels of both, the investor will never invest. For moderate levels he will prefer greenfield investment if country risk is low and if the technological advantage is high. To test this implications empirically, we used a probit application of the Heckman sample selection model which accounts for the possibility that a multinational enterprise decided not to invest at all. Contrary to the huge amount of empirical studies, for the case of investments in Eastern Europe, technological intensive investors less likely enter a foreign market via greenfield investment. As predicted, we find strong evidence that higher country risks reduce the probability for this entry mode.

Chapter 4 raises the question when to enter a foreign market. A real option approach suggests that, among other factors, investment will occur later if uncertainty is high. The reason is that in this case the option to invest becomes highly valuable and the investor desires a higher present value from the FDI project. Thus, the investor postpones the investment. The empirical investigation confirms this theoretical result. By applying a Cox Proportional Hazard Model we find, among other factors, that higher country risks decrease the likelihood for early investment.

Finally, Chapter 5 analyzes the impact of demand and supply uncertainty on the profits of a multinational enterprise in the case of horizontal and vertical FDI separately. Both production modes suffer from higher demand uncertainty. However, higher supply uncertainty reduces the expected income associated with vertical FDI but potentially increases those from horizontal FDI. The empirical analysis with firm level data supports both predictions. Furthermore, this result implies a clear statement about the decision of a multinational enterprise whether to undertake a vertical or a horizontal FDI: Higher supply uncertainty should make vertical FDI less likely, whereas demand uncertainty should show no impact. A bivariate estimation procedure empirically supports these predictions.

To sum up, the thesis shows that country risks play an important role for the FDI decisions of multinational enterprises. The question whether an investment abroad occurs if uncertainty is present already had been discussed in the previous literature. More attention should be paid to the impact of country risk on other decisions, for instance those examined in this thesis - the entry mode, the timing and the production mode decision.

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